

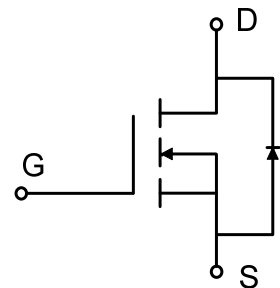
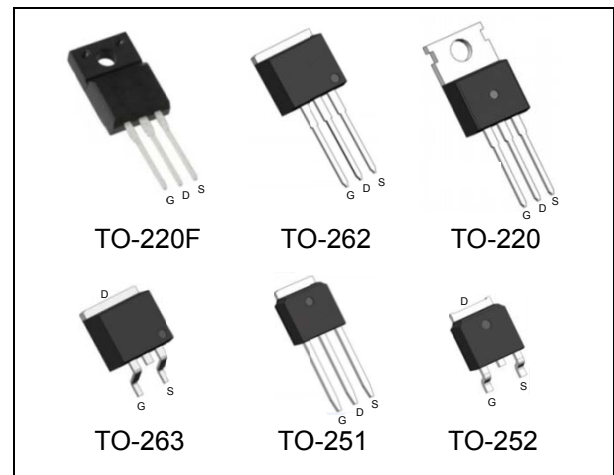
## 700V 0.21Ω Super Junction Power MOSFET

### Description

WMOS™ EM is Wayon's 3<sup>rd</sup> generation super junction MOSFET family that is utilizing charge balance technology for extremely low on-resistance and low gate charge performance. WMOS™ EM is suitable for applications which require superior power density and outstanding efficiency.

### Features

- $V_{DS} = 750V @ T_{j,max}$
- Typ.  $R_{DS(on)} = 0.21\Omega$
- 100% UIS tested
- Pb-free plating, Halogen free



### Applications

LED Lighting, Charger, Adapter, PC, LCD TV, Server

### Absolute Maximum Ratings

| Parameter   | Symbol         | WMK/WMM/WMO/WMP/WMN | WML  | Unit          |
|---|----------------|---------------------|------|---------------|
| Drain-source voltage  | $V_{DSS}$      | 700                 |      | V             |
| Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ C$ )           | $I_D$          | 17                  |      | A             |
|   |                | 10                  |      | A             |
| Pulsed drain current <sup>2)</sup>                                      | $I_{DM}$       | 50                  |      | A             |
| Gate-source voltage   | $V_{GS}$       | $\pm 30$            |      | V             |
| Avalanche energy, single pulse <sup>3)</sup>                            | $E_{AS}$       | 285                 |      | mJ            |
| Avalanche energy, repetitive <sup>2)</sup>                              | $E_{AR}$       | 0.25                |      | mJ            |
| Avalanche current, repetitive <sup>2)</sup>                             | $I_{AR}$       | 3                   |      | A             |
| Power dissipation ( $T_C = 25^\circ C$ )<br>- Derate above $25^\circ C$ | $P_D$          | 130                 | 34   | W             |
|   |                | 1.04                | 0.27 | W/ $^\circ C$ |
| Operating and storage temperature range                                 | $T_i, T_{stg}$ | -55 to +150         |      | $^\circ C$    |
| Continuous diode forward current  | $I_S$          | 17                  |      | A             |
| Diode pulse current   | $I_{S,pulse}$  | 50                  |      | A             |
| MOSFET dv/dt ruggedness   | dv/dt          | 50                  |      | V/ns          |
| Peak diode recovery voltage slope                                       | dv/dt          | 15                  |      | V/ns          |

## Thermal Characteristics

| Parameter                               | Symbol          | WMK/WMM/WMO/WMP/WMN | WML | Unit                        |
|---|-----------------|---------------------|-----|-----------------------------|
| Thermal resistance, junction-to-case    | $R_{\theta JC}$ | 1.0                 | 3.8 | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, junction-to-ambient | $R_{\theta JA}$ | 62                  | 80  | $^{\circ}\text{C}/\text{W}$ |

## Electrical Characteristics $T_c = 25^{\circ}\text{C}$ , unless otherwise noted

| Parameter                            | Symbol        | Test Condition   | Min. | Typ. | Max. | Unit          |
|--------------------------------------|---------------|--|------|------|------|---------------|
| <b>Static characteristics</b>        |               |  |      |      |      |               |
| Drain-source breakdown voltage       | $BV_{DSS}$    | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$   | 700  | -    | -    | V             |
| Gate threshold voltage               | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=0.25\text{ mA}$  | 2    | 3    | 4    | V             |
| Drain cut-off current                | $I_{DSS}$     | $V_{DS}=700\text{ V}, V_{GS}=0\text{ V},$<br>$T_j = 25^{\circ}\text{C}$<br>$T_j = 125^{\circ}\text{C}$ | -    | -    | 1    | $\mu\text{A}$ |
| Gate leakage current, forward        | $I_{GSSF}$    | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$  | -    | -    | 100  | nA            |
| Gate leakage current, reverse        | $I_{GSSR}$    | $V_{GS}=-20\text{ V}, V_{DS}=0\text{ V}$   | -    | -    | -100 | nA            |
| Drain-source on-state resistance     | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=4\text{ A}$   | --   | 0.21 | 0.25 | $\Omega$      |
| <b>Dynamic characteristics</b>       |               |  |      |      |      |               |
| Input capacitance                    | $C_{iss}$     | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V},$  | -    | 1210 | -    | pF            |
| Output capacitance                   | $C_{oss}$     | $f = 1\text{ MHz}$   | -    | 49   | -    |               |
| Reverse transfer capacitance         | $C_{rss}$     |  | -    | 1.3  | -    |               |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{DD} = 300\text{ V}, I_D = 5\text{ A}$<br>$R_G = 25\Omega, V_{GS}=10\text{ V}$                      | -    | 24   | -    | ns            |
| Rise time                            | $t_r$         |  | -    | 18   | -    |               |
| Turn-off delay time                  | $t_{d(off)}$  |  | -    | 78   | -    |               |
| Fall time                            | $t_f$         |  | -    | 21   | -    |               |
| <b>Gate charge characteristics</b>   |               |  |      |      |      |               |
| Gate to source charge                | $Q_{gs}$      | $V_{DD}=480\text{ V}, I_D=5\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$                             | -    | 7.2  | -    | nC            |
| Gate to drain charge                 | $Q_{gd}$      |  | -    | 12.5 | -    |               |
| Gate charge total                    | $Q_g$         |  | -    | 30.3 | -    |               |
| Gate plateau voltage                 | $V_{plateau}$ |  | -    | 4.7  | -    | V             |
| <b>Reverse diode characteristics</b> |               |  |      |      |      |               |
| Diode forward voltage                | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=2\text{ A}$  | -    | -    | 1.2  | V             |
| Reverse recovery time                | $t_{rr}$      | $V_R=50\text{ V}, I_F=5\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$                               | -    | 280  | -    | ns            |
| Reverse recovery charge              | $Q_{rr}$      |  | -    | 2.7  | -    | $\mu\text{C}$ |
| Peak reverse recovery current        | $I_{rrm}$     |  | -    | 19   | -    | A             |

### Notes:

- Limited by  $T_{j\text{max}}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature.
- $I_{AS} = 3\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\Omega$ , starting  $T_j = 25^{\circ}\text{C}$ .

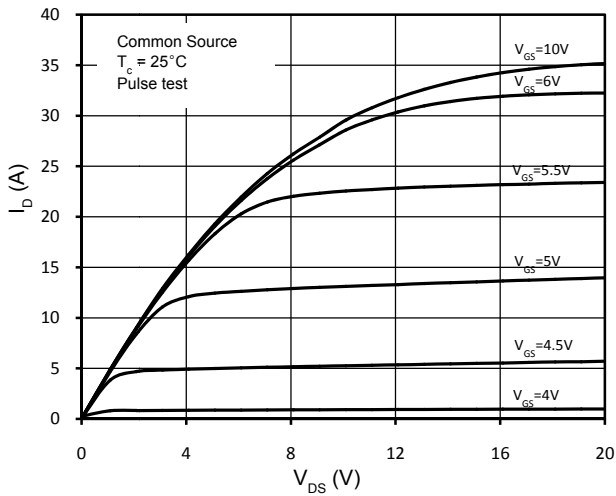


Figure 1. On-Region Characteristics

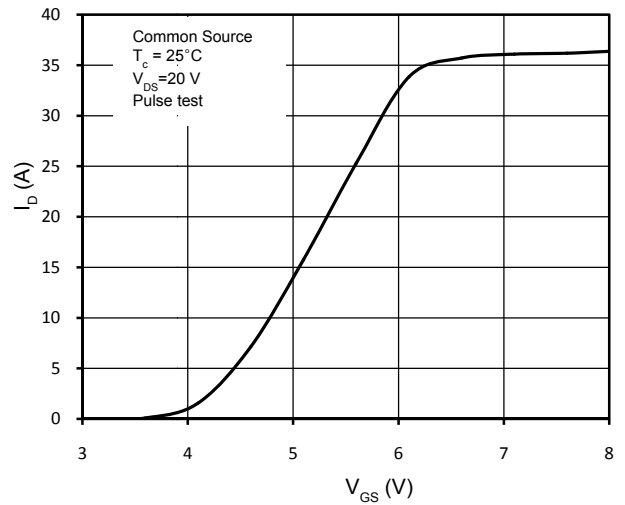


Figure 2. Transfer Characteristics

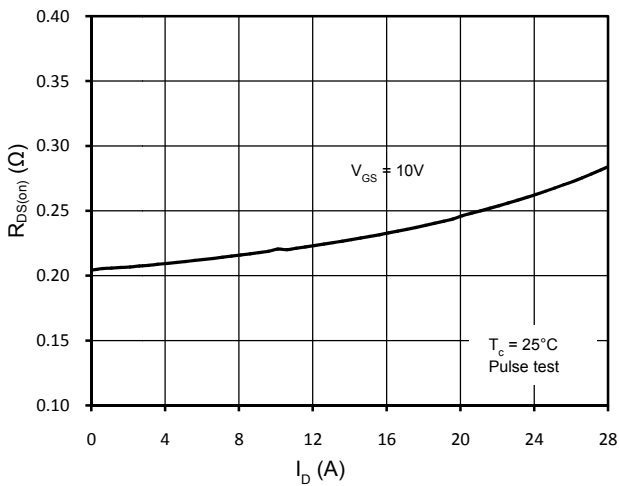


Figure 3. Static Drain-Source On Resistance

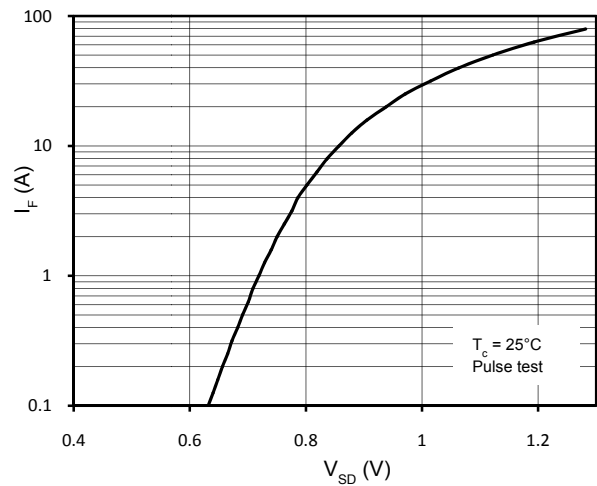


Figure 4. Body-Diode Forward Characteristics

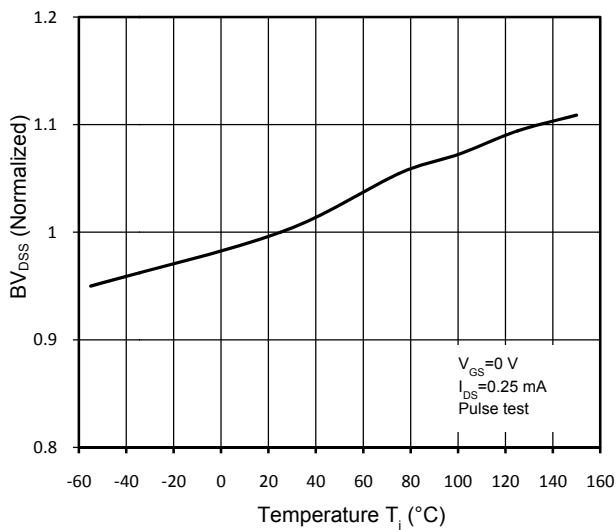


Figure 5. Normalized  $BV_{DSS}$  vs. Temperature

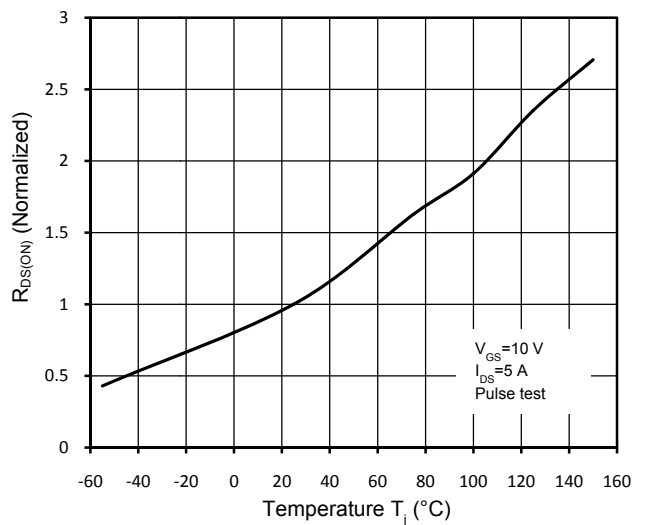


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

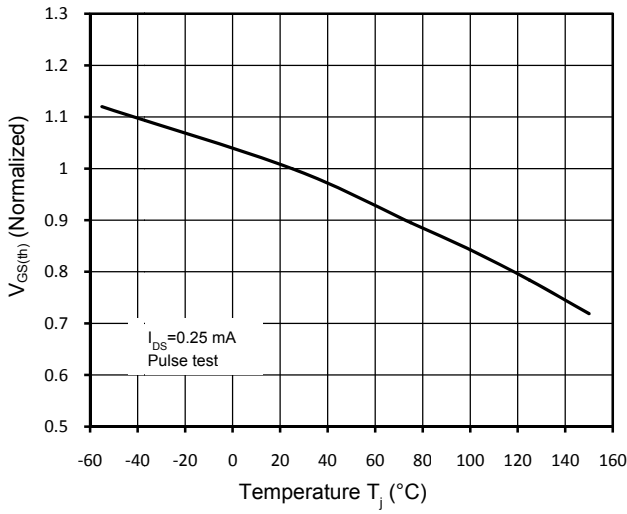


Figure 7. Threshold Voltage vs. Temperature

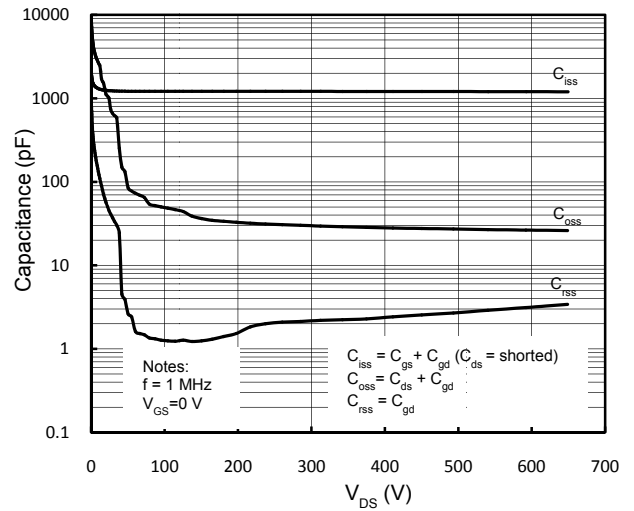


Figure 8. Capacitance Characteristics

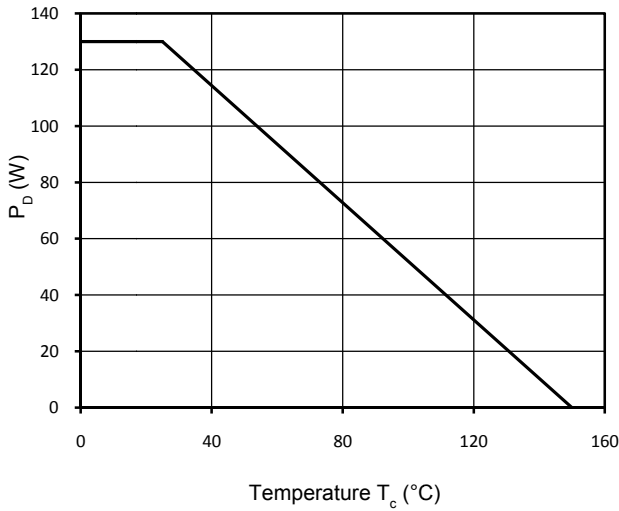


Figure 9. Power Dissipation

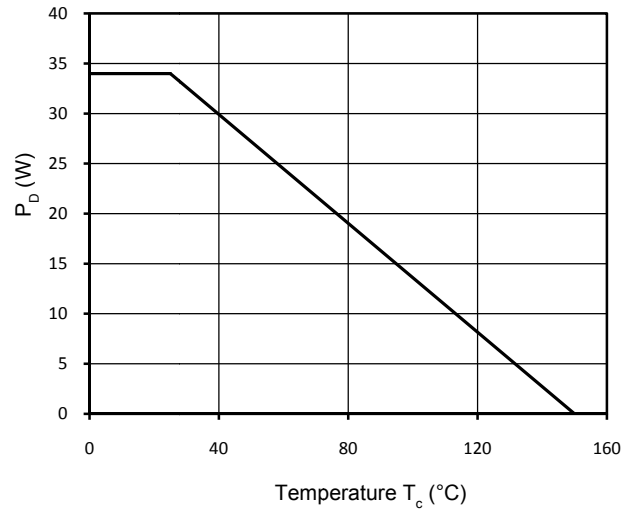


Figure 10. Power Dissipation (TO-220F)

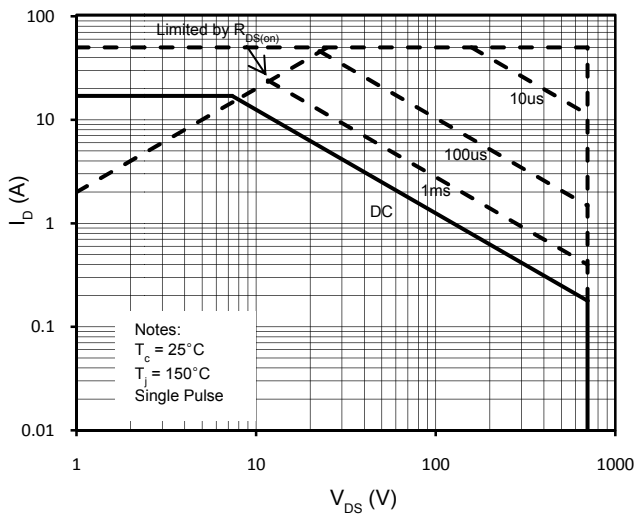


Figure 11. Maximum Safe Operating Area

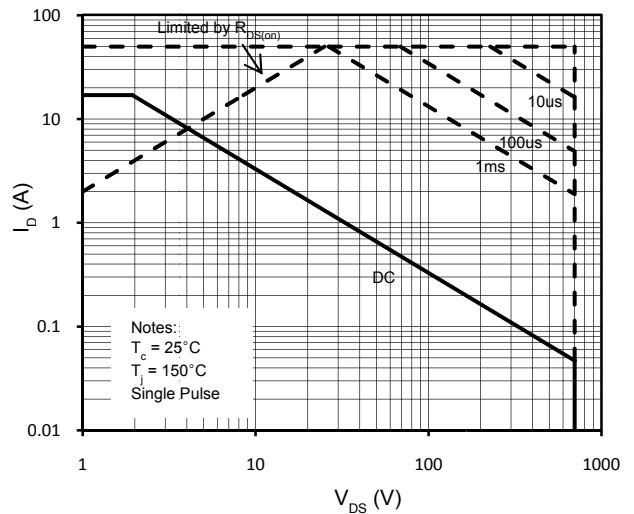


Figure 12. Maximum Safe Operating Area (TO-220F)

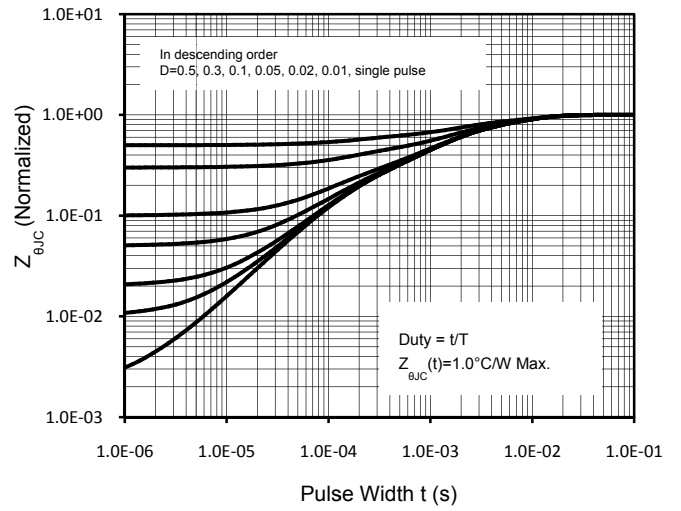
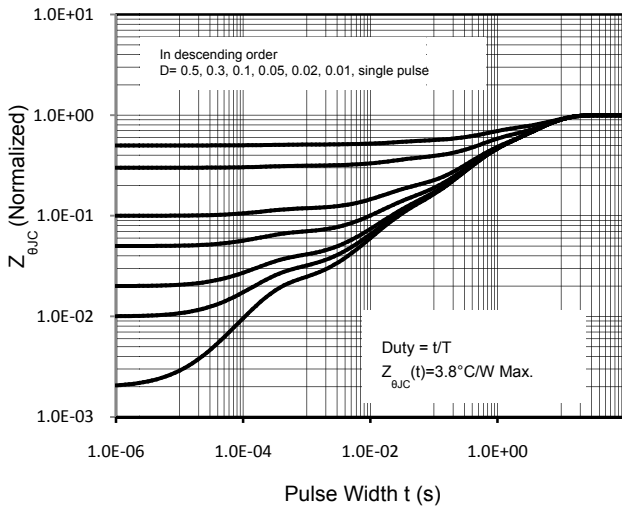


Figure 13. Transient Thermal Response Curve (TO-220F) Figure 14. Transient Thermal Response Curve

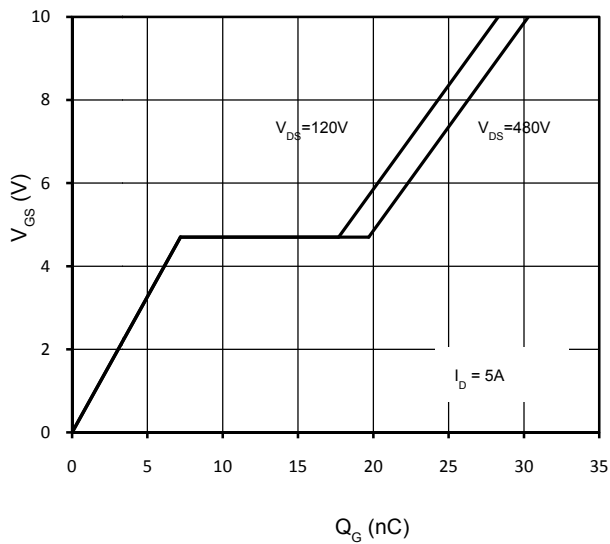


Figure 15. Gate Charge Characteristics

### Gate Charge Test Circuit & Waveform



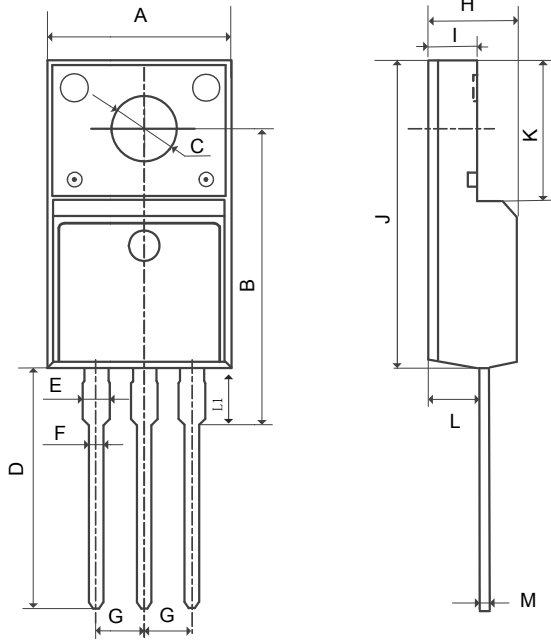
### Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms



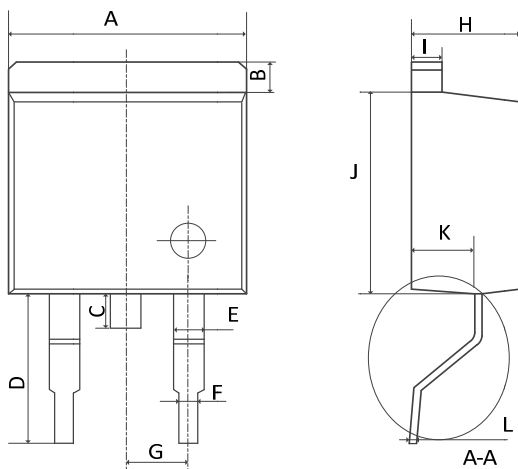
**Mechanical Dimensions for TO-220F**



**COMMON DIMENSIONS**

| SYMBOL | MM      |       |
|--------|---------|-------|
|        | MIN     | MAX   |
| A      | 9.96    | 10.36 |
| B      | 15.10   | 16.10 |
| C      | 3.03    | 3.38  |
| D      | 12.64   | 13.28 |
| E      | 1.18    | 1.58  |
| F      | 0.70    | 0.95  |
| G      | 2.54REF |       |
| H      | 4.50    | 4.90  |
| I      | 2.34    | 2.74  |
| J      | 15.57   | 16.17 |
| K      | 6.70REF |       |
| L      | 2.56    | 2.96  |
| M      | 0.40    | 0.65  |
| L1     | 2.85    | 3.45  |

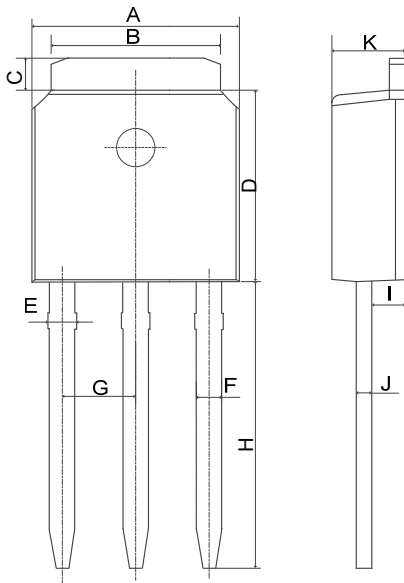
**Mechanical Dimensions for TO-263**



**COMMON DIMENSIONS**

| SYMBOL | MM    |       |
|--------|-------|-------|
|        | MIN   | MAX   |
| A      | 10.00 | 10.40 |
| B      | 1.11  | 1.41  |
| C      | 1.25  | 1.55  |
| D      | 5.10  | 5.50  |
| E      | 1.12  | 1.42  |
| F      | 0.71  | 0.92  |
| G      | 2.39  | 2.69  |
| H      | 4.49  | 4.89  |
| I      | 1.17  | 1.37  |
| J      | 8.45  | 8.85  |
| K      | 2.54  | 2.84  |
| L      | 0.28  | 0.49  |

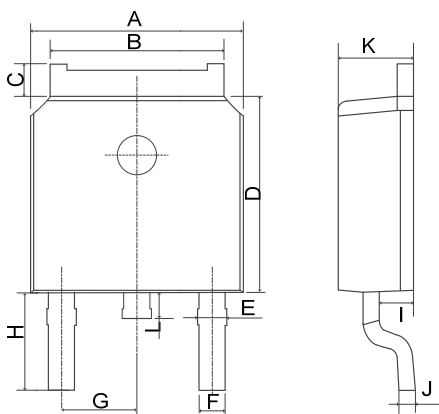
**Mechanical Dimensions for TO-251**



**COMMON DIMENSIONS**

| SYMBOL | MM      |      |
|--------|---------|------|
|        | MIN     | MAX  |
| A      | 6.40    | 6.80 |
| B      | 5.13    | 5.46 |
| C      | 0.88    | 1.28 |
| D      | 5.90    | 6.22 |
| E      | 0.68    | 1.10 |
| F      | 0.68    | 0.91 |
| G      | 2.29REF |      |
| H      | 9.00    | 9.65 |
| I      | 0.90    | 1.17 |
| J      | 0.40    | 0.61 |
| K      | 2.10    | 2.50 |

**Mechanical Dimensions for TO-252**

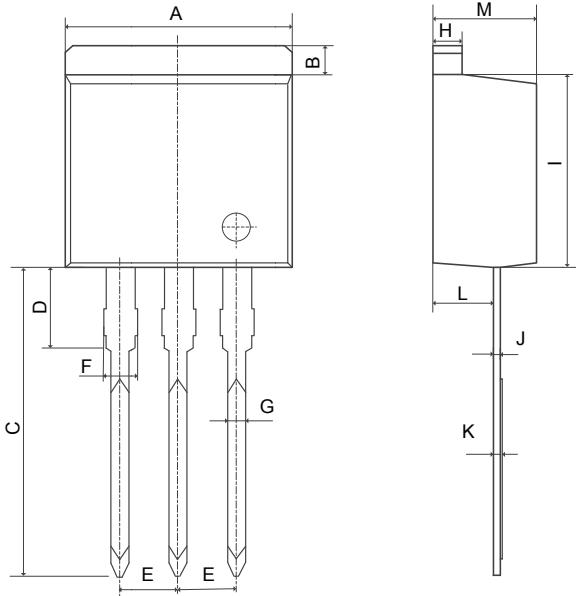


**COMMON DIMENSIONS**

| SYMBOL | MM      |      |
|--------|---------|------|
|        | MIN     | MAX  |
| A      | 6.40    | 6.80 |
| B      | 5.13    | 5.50 |
| C      | 0.88    | 1.28 |
| D      | 5.90    | 6.22 |
| E      | 0.68    | 1.10 |
| F      | 0.68    | 0.91 |
| G      | 2.29REF |      |
| H      | 2.90REF |      |
| I      | 0.85    | 1.17 |
| J      | 0.51REF |      |
| K      | 2.10    | 2.50 |
| L      | 0.40    | 1.00 |



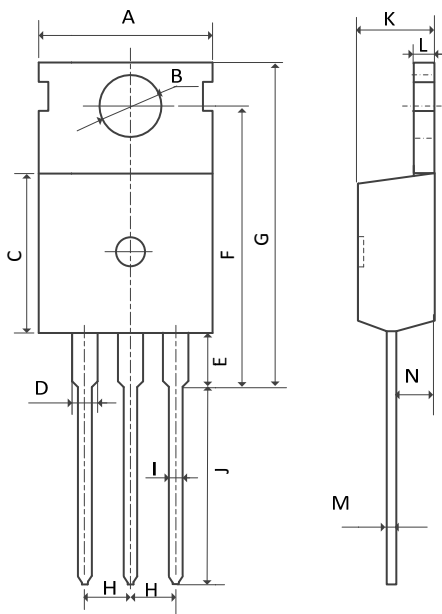
**Mechanical Dimensions for TO-262**



**COMMON DIMENSIONS**

| SYMBOL | MM    |       |
|--------|-------|-------|
|        | MIN   | MAX   |
| A      | 10.00 | 10.40 |
| B      | 1.11  | 1.41  |
| C      | 13.56 | 14.16 |
| D      | 3.58  | 3.98  |
| E      | 2.39  | 2.69  |
| F      | 1.07  | 1.47  |
| G      | 0.71  | 0.92  |
| H      | 1.17  | 1.37  |
| I      | 8.45  | 8.85  |
| J      | 0.28  | 0.49  |
| K      | 0.32  | 0.52  |
| L      | 2.54  | 2.85  |
| M      | 4.50  | 4.90  |

**Mechanical Dimensions for TO-220**



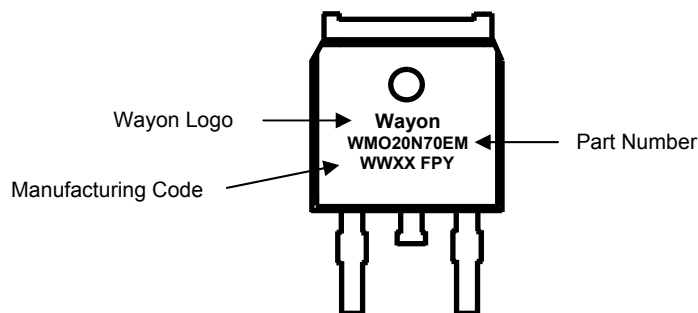
**COMMON DIMENSIONS**

| SYMBOL | MM       |       |
|--------|----------|-------|
|        | MIN      | MAX   |
| A      | 9.70     | 10.20 |
| B      | 3.40     | 3.80  |
| C      | 8.90     | 9.40  |
| D      | 1.17     | 1.47  |
| E      | 2.60     | 3.40  |
| F      | 15.10    | 16.70 |
| G      | 19.55MAX |       |
| H      | 2.54REF  |       |
| I      | 0.70     | 0.95  |
| J      | 9.35     | 11.00 |
| K      | 4.30     | 4.77  |
| L      | 1.20     | 1.45  |
| M      | 0.40     | 0.65  |
| N      | 2.20     | 2.60  |

## Ordering Information

| Part       | Package | Marking    | Packing method |
|------------|---------|------------|----------------|
| WML20N70EM | TO-220F | WML20N70EM | Tube           |
| WMK20N70EM | TO-220  | WMK20N70EM | Tube           |
| WMN20N70EM | TO-262  | WMN20N70EM | Tube           |
| WMM20N70EM | TO-263  | WMM20N70EM | Tape and Reel  |
| WMO20N70EM | TO-252  | WMO20N70EM | Tape and Reel  |
| WMP20N70EM | TO-251  | WMP20N70EM | Tube           |

## Marking Information



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