

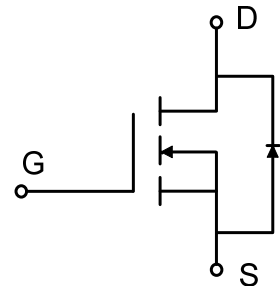
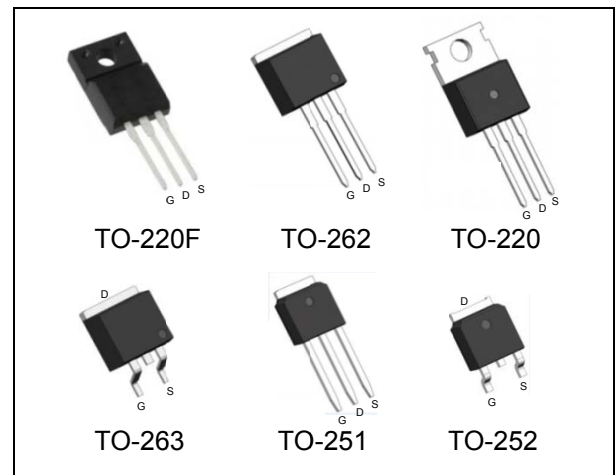
## 500V 0.24Ω Super Junction Power MOSFET

### Description

WMOS™ ES is Wayon's new generation super junction MOSFET family that is utilizing charge balance technology for extremely low on-resistance and low gate charge performance. WMOS™ ES is suitable for applications which require superior power density and outstanding efficiency.

### Features

- Fast body diode
- Typ.  $R_{DS(on)} = 0.24\Omega$
- 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  | $V_{DSS}$      | 500                 |      | V                   |
| Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ\text{C}$ )                 | $I_D$          | 25                  |      | A                   |
|   |                | 13                  |      | A                   |
| Pulsed drain current <sup>2)</sup>  | $I_{DM}$       | 60                  |      | A                   |
| Gate-source voltage   | $V_{GS}$       | $\pm 30$            |      | V                   |
| Avalanche energy, single pulse <sup>3)</sup>  | $E_{AS}$       | 140                 |      | mJ                  |
| Avalanche energy, repetitive <sup>2)</sup>  | $E_{AR}$       | 0.2                 |      | mJ                  |
| Avalanche current, repetitive <sup>2)</sup>   | $I_{AR}$       | 2                   |      | A                   |
| Power dissipation ( $T_C = 25^\circ\text{C}$ )<br>- Derate above $25^\circ\text{C}$ | $P_D$          | 85                  | 31   | W                   |
|   |                | 0.68                | 0.25 | W/ $^\circ\text{C}$ |
| Operating and storage temperature range   | $T_i, T_{stg}$ | -55 to +150         |      | $^\circ\text{C}$    |
| Continuous diode forward current  | $I_S$          | 25                  |      | A                   |
| Diode pulse current   | $I_{S,pulse}$  | 60                  |      | A                   |

## Thermal Characteristics

| Parameter                               | Symbol          | WMK/WMM/WMO/WMP/WMN | WML | Unit                 |
|---|-----------------|---------------------|-----|----------------------|
| Thermal resistance, junction-to-case    | $R_{\theta JC}$ | 1.3                 | 4   | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-to-ambient | $R_{\theta JA}$ | 62                  | 80  | $^{\circ}\text{C/W}$ |

## 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       | $BV_{DSS}$    | $V_{GS}=0\text{ V}$ , $I_D=0.25\text{ mA}$   | 500  | -    | -    | V             |
| Gate threshold voltage               | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=0.25\text{ mA}$   | 2.8  | 3.8  | 4.8  | V             |
| Drain cut-off current                | $I_{DSS}$     | $V_{DS}=500\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j = 25^{\circ}\text{C}$<br>$T_j = 125^{\circ}\text{C}$ | -    | -    | 10   | $\mu\text{A}$ |
| 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     | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=3\text{ A}$  | --   | 0.24 | 0.27 | $\Omega$      |
| <b>Dynamic characteristics</b>       |               |  |      |      |      |               |
| Input capacitance                    | $C_{iss}$     | $V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$f=1\text{ MHz}$  | -    | 708  | -    | pF            |
| Output capacitance                   | $C_{oss}$     |  | -    | 35   | -    |               |
| Reverse transfer capacitance         | $C_{rss}$     |  | -    | 1.8  | -    |               |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{DD}=300\text{ V}$ , $I_D=5\text{ A}$<br>$R_G=25\Omega$ , $V_{GS}=10\text{ V}$                          | -    | 18   | -    | ns            |
| Rise time                            | $t_r$         |  | -    | 18   | -    |               |
| Turn-off delay time                  | $t_{d(off)}$  |  | -    | 69   | -    |               |
| Fall time                            | $t_f$         |  | -    | 17   | -    |               |
| <b>Gate charge characteristics</b>   |               |  |      |      |      |               |
| Gate to source charge                | $Q_{gs}$      | $V_{DD}=480\text{ V}$ , $I_D=5\text{ A}$ ,<br>$V_{GS}=0\text{ to }10\text{ V}$                             | -    | 5.3  | -    | nC            |
| Gate to drain charge                 | $Q_{gd}$      |  | -    | 5.4  | -    |               |
| Gate charge total                    | $Q_g$         |  | -    | 18.4 | -    |               |
| Gate plateau voltage                 | $V_{plateau}$ |  | -    | 5.4  | -    | 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>$dI_F/dt=100\text{ A}/\mu\text{s}$                               | -    | 101  | -    | ns            |
| Reverse recovery charge              | $Q_{rr}$      |  | -    | 0.5  | -    | $\mu\text{C}$ |
| Peak reverse recovery current        | $I_{rrm}$     |  | -    | 8.7  | -    | A             |

### Notes:

- Limited by  $T_{j\text{max}}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature.
- $I_{AS}=2\text{ A}$ ,  $V_{DD}=50\text{ V}$ ,  $R_G=25\Omega$ , starting  $T_j=25^{\circ}\text{C}$ .

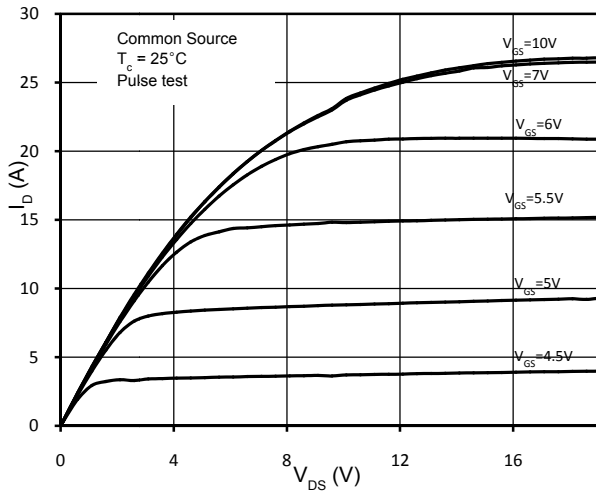


Figure 1. On-Region Characteristics

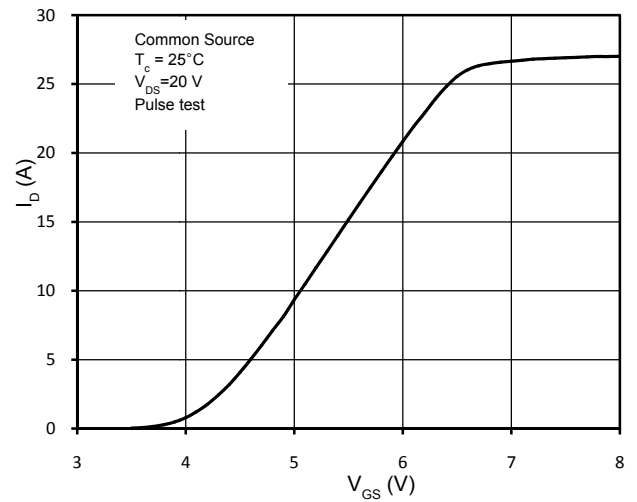


Figure 2. Transfer Characteristics

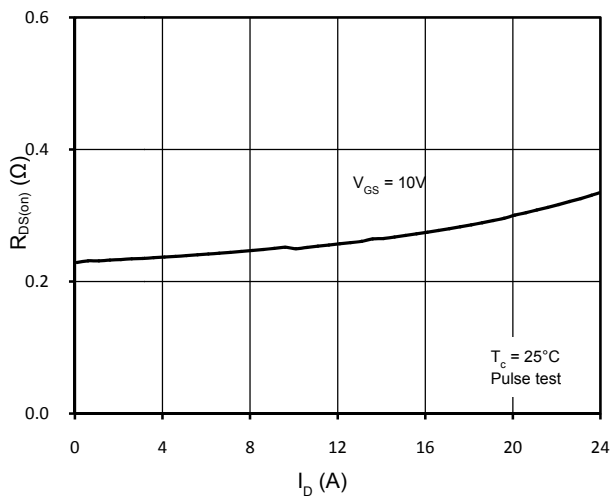


Figure 3. Static Drain-Source On Resistance

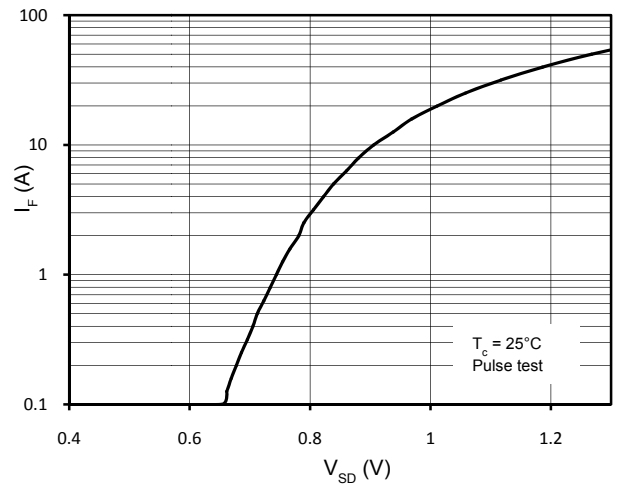


Figure 4. Body-Diode Forward Characteristics

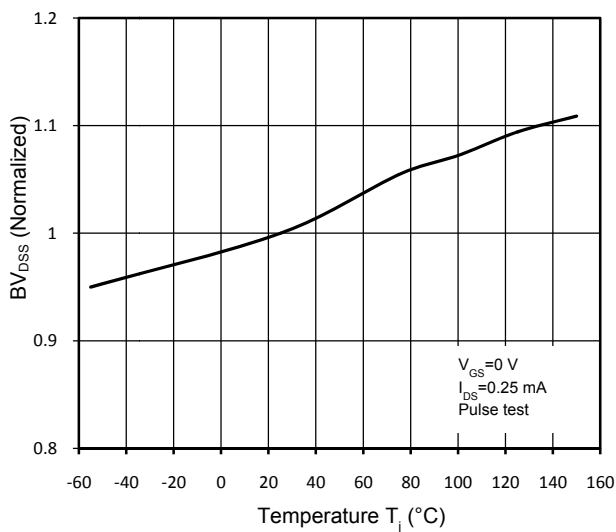


Figure 5. Normalized  $BV_{DS(s)}$  vs. Temperature

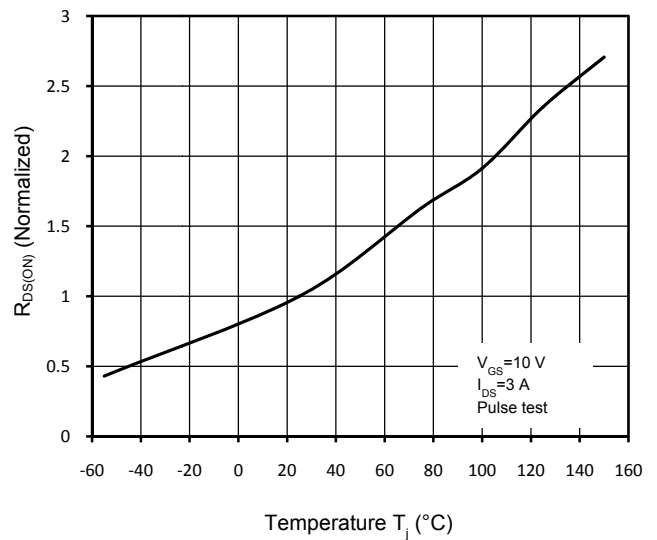


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

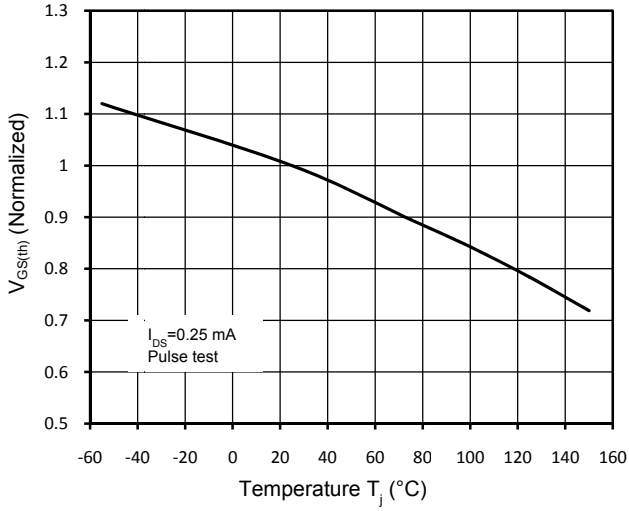


Figure 7. Threshold Voltage vs. Temperature

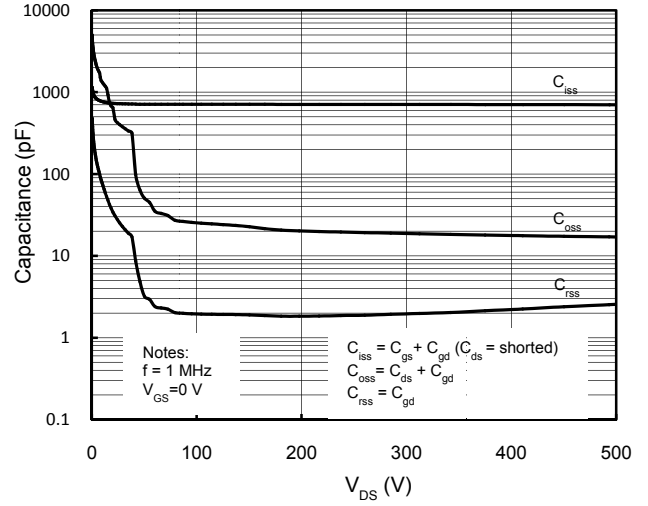


Figure 8. Capacitance Characteristics

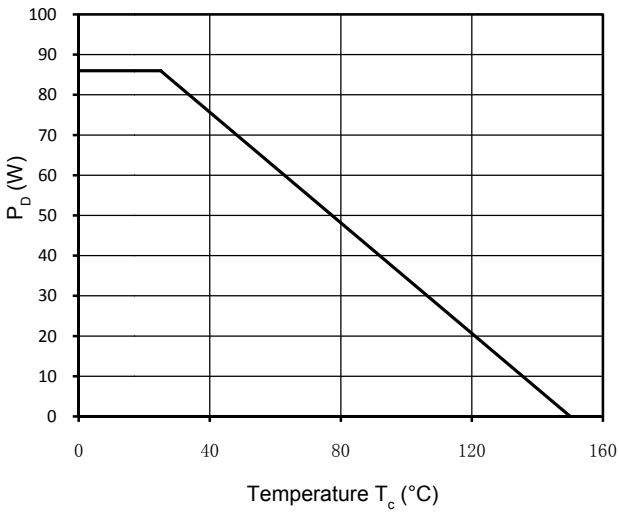


Figure 9. Power Dissipation

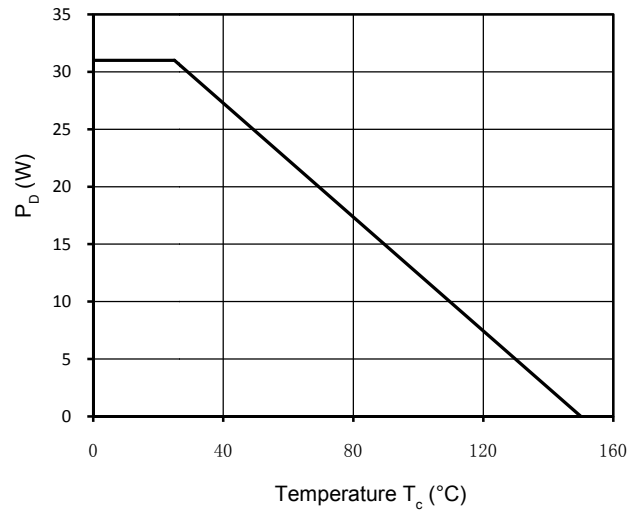


Figure 10. Power Dissipation (TO-220F)

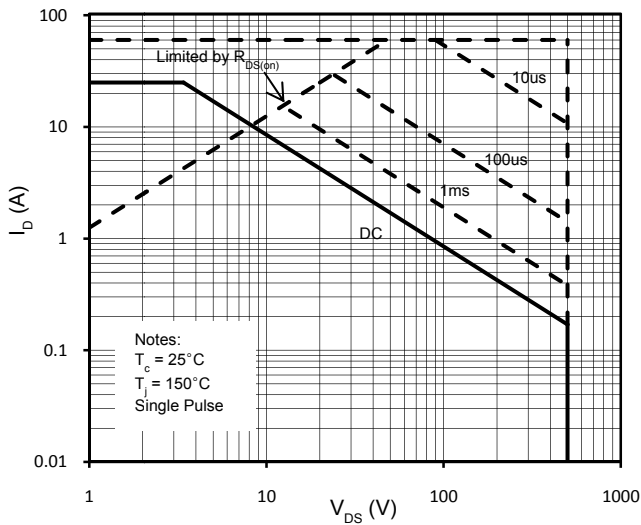


Figure 11. Maximum Safe Operating Area

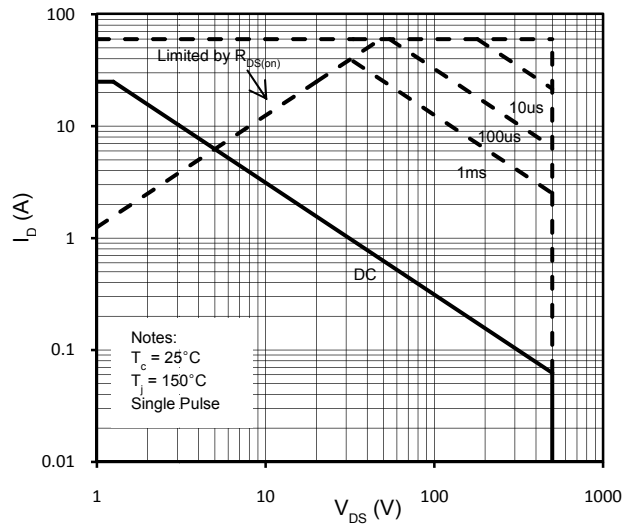


Figure 12. Maximum Safe Operating Area (TO-220F)

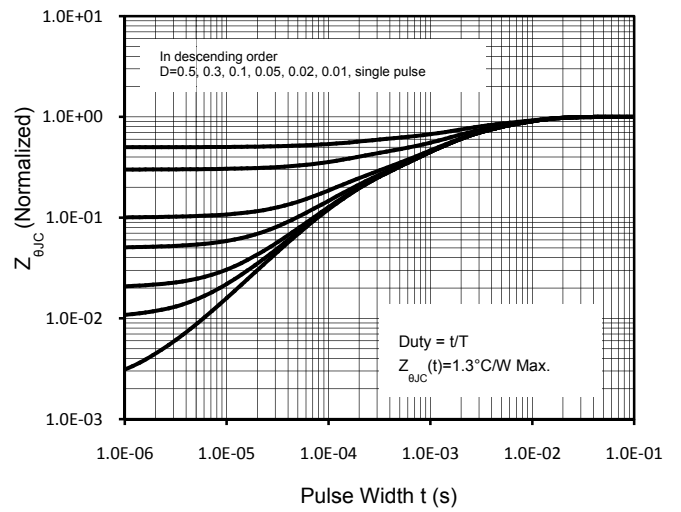
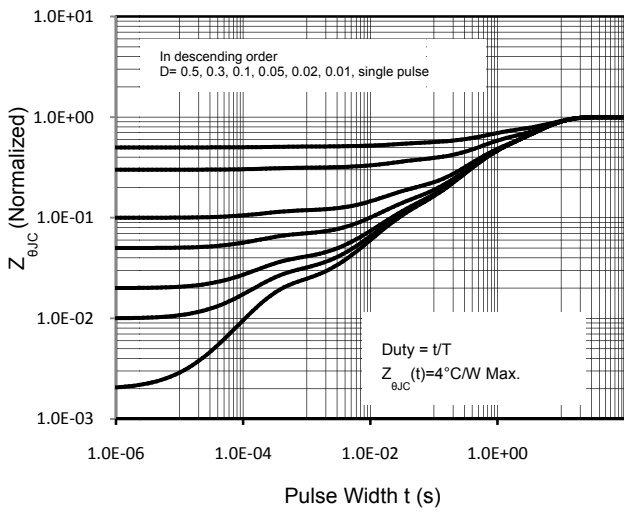


Figure 13. Transient Thermal Response Curve (TO-220F) Figure 14. Transient Thermal Response Curve

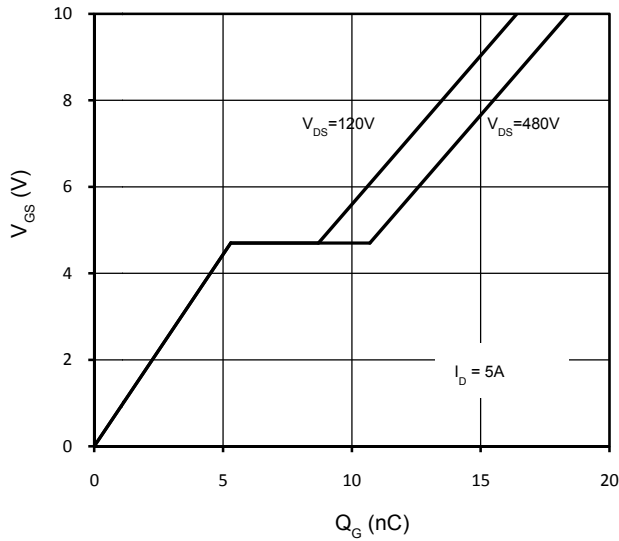
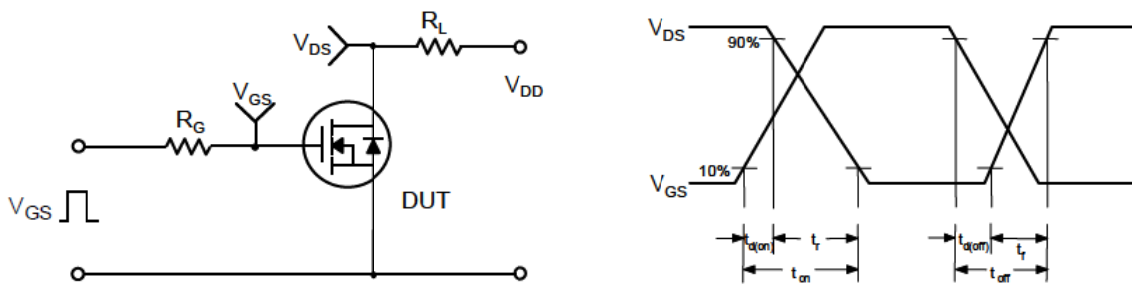


Figure 15. Gate Charge Characteristics

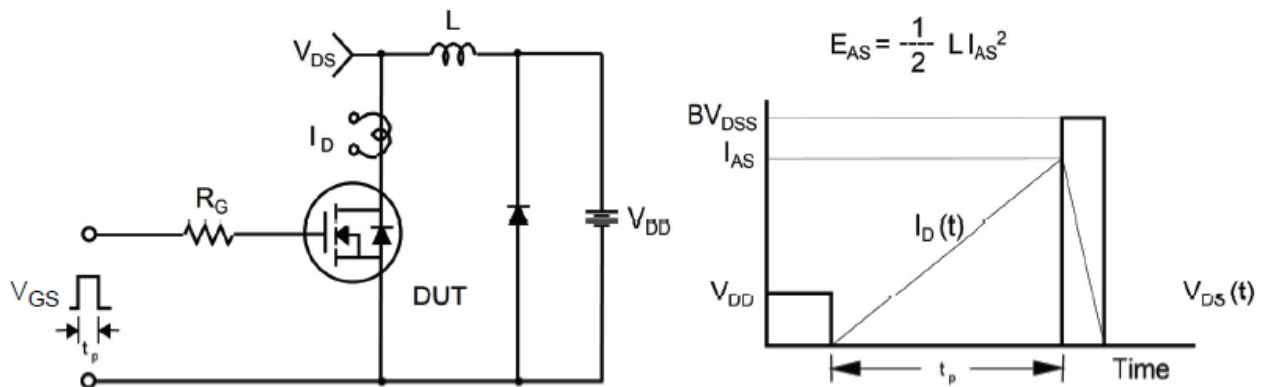
### Gate Charge Test Circuit & Waveform



### Switching Test Circuit & Waveforms

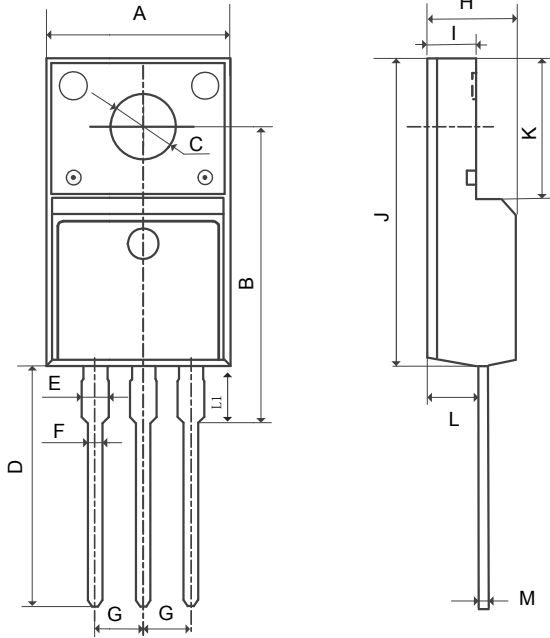


### Unclamped Inductive Switching Test Circuit & Waveforms



Mechanical Dimensions for TO-220F

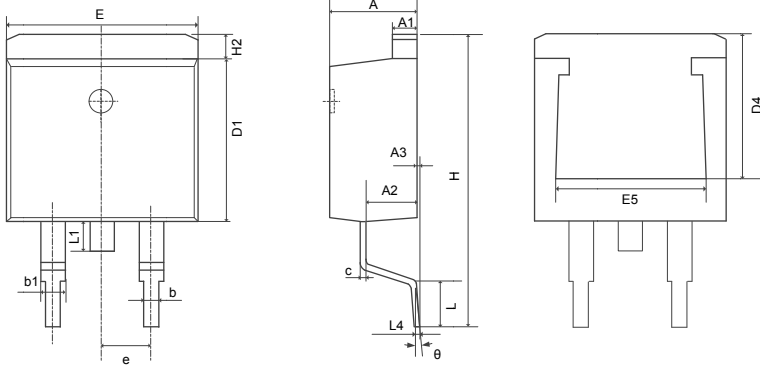
COMMON DIMENSIONS



| SYMBOL | MM      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A      | 9.96    | 10.16 | 10.36 |
| B      | 15.10   | 15.60 | 16.10 |
| C      | 3.03    | 3.20  | 3.38  |
| D      | 12.64   | 12.96 | 13.28 |
| E      | 1.18    | 1.38  | 1.58  |
| F      | 0.70    | 0.81  | 0.95  |
| G      | 2.54REF |       |       |
| H      | 4.50    | 4.70  | 4.90  |
| I      | 2.34    | 2.54  | 2.74  |
| J      | 15.57   | 15.87 | 16.17 |
| K      | 6.70REF |       |       |
| L      | 2.56    | 2.76  | 2.96  |
| M      | 0.40    | 0.52  | 0.65  |
| L1     | 2.85    | 3.10  | 3.45  |

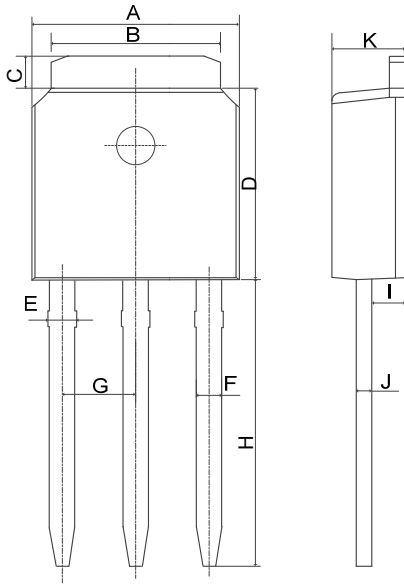
Mechanical Dimensions for TO-263

COMMON DIMENSIONS



| SYMBOL | MM      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A      | 4.37    | 4.57  | 4.77  |
| A1     | 1.22    | 1.27  | 1.42  |
| A2     | 2.49    | 2.69  | 2.89  |
| b      | 0.70    | 0.81  | 0.96  |
| b1     | 1.17    | 1.27  | 1.47  |
| c      | 0.30    | 0.38  | 0.53  |
| D1     | 8.50    | 8.70  | 8.90  |
| D4     | 6.60    | —     | —     |
| E      | 9.86    | 10.16 | 10.36 |
| E5     | 7.06    | —     | —     |
| e      | 2.54BSC |       |       |
| H      | 14.70   | 15.10 | 15.50 |
| H2     | 1.07    | 1.27  | 1.47  |
| L      | 2.00    | 2.3   | 2.60  |
| L1     | 1.40    | 1.55  | 1.70  |
| L4     | 0.25BSC |       |       |
| θ      | 0°      | 5°    | 9°    |

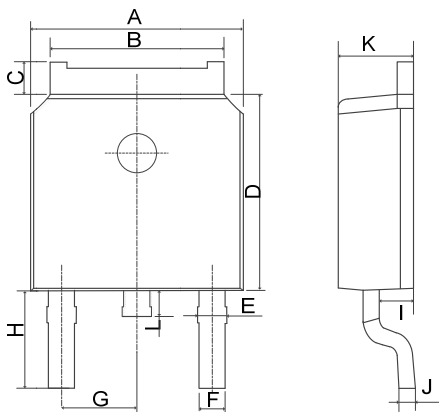
**Mechanical Dimensions for TO-251**



**COMMON DIMENSIONS**

| SYMBOL | MM      |      |      |
|--------|---------|------|------|
|        | MIN     | NOM  | MAX  |
| A      | 6.40    | 6.60 | 6.80 |
| B      | 5.13    | 5.30 | 5.46 |
| C      | 0.88    | 1.02 | 1.28 |
| D      | 5.90    | 6.06 | 6.22 |
| E      | 0.68    | 0.89 | 1.10 |
| F      | 0.68    | 0.78 | 0.91 |
| G      | 2.29REF |      |      |
| H      | 9.00    | 9.40 | 9.65 |
| I      | 0.90    | 1.04 | 1.17 |
| J      | 0.40    | 0.51 | 0.61 |
| K      | 2.10    | 2.30 | 2.50 |

**Mechanical Dimensions for TO-252**

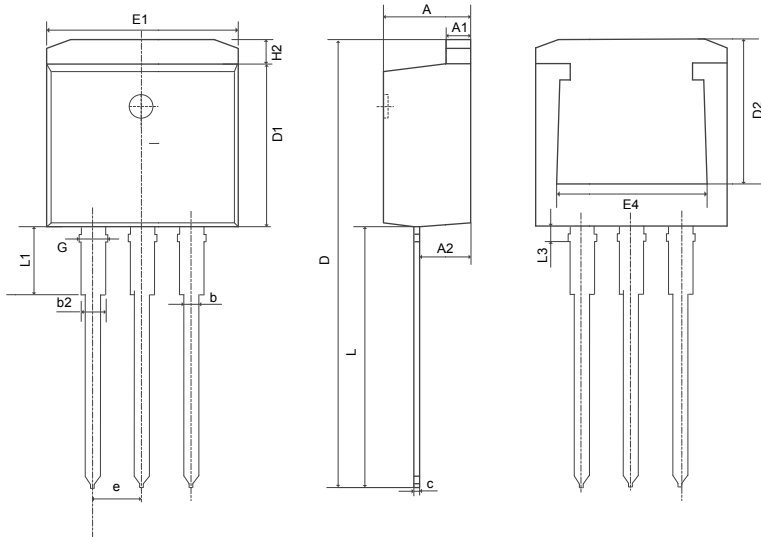


**COMMON DIMENSIONS**

| SYMBOL | MM      |      |      |
|--------|---------|------|------|
|        | MIN     | NOM  | MAX  |
| A      | 6.40    | 6.60 | 6.80 |
| B      | 5.13    | 5.33 | 5.50 |
| C      | 0.88    | —    | 1.28 |
| D      | 5.90    | 6.10 | 6.22 |
| E      | 0.68    | 0.89 | 1.10 |
| F      | 0.68    | 0.78 | 0.91 |
| G      | 2.29REF |      |      |
| H      | 2.90REF |      |      |
| I      | 0.85    | 1.07 | 1.17 |
| J      | 0.51REF |      |      |
| K      | 2.10    | 2.30 | 2.50 |
| L      | 0.40    | —    | 1.00 |

Mechanical Dimensions for TO-262

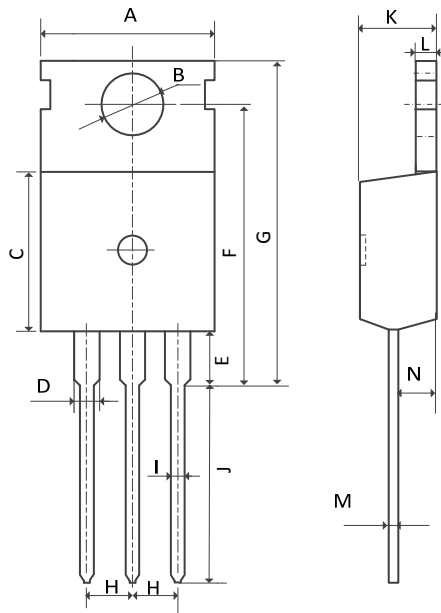
COMMON DIMENSIONS



| SYMBOL | MM      |       |       |
|--------|---------|-------|-------|
|        | MIN     | NOM   | MAX   |
| A      | 4.37    | 4.57  | 4.77  |
| A1     | 1.22    | 1.27  | 1.42  |
| A2     | 2.49    | 2.69  | 2.89  |
| b      | 0.71    | 0.81  | 0.96  |
| b2     | 1.17    | 1.27  | 1.42  |
| c      | 0.28    | 0.38  | 0.53  |
| D      | 23.20   | 23.70 | 24.02 |
| D1     | 8.50    | 8.7   | 8.90  |
| D2     | 6.00    | —     | —     |
| E1     | 9.86    | 10.16 | 10.36 |
| E4     | 7.06    | —     | —     |
| e      | 2.54BSC |       |       |
| G      | 1.25    | 1.35  | 1.50  |
| H2     | —       | —     | 1.50  |
| L      | 13.33   | 13.73 | 14.13 |
| L1     | 3.50    | 3.75  | 4.00  |
| L3     | 1.28    | 1.43  | 1.58  |

Mechanical Dimensions for TO-220

COMMON DIMENSIONS

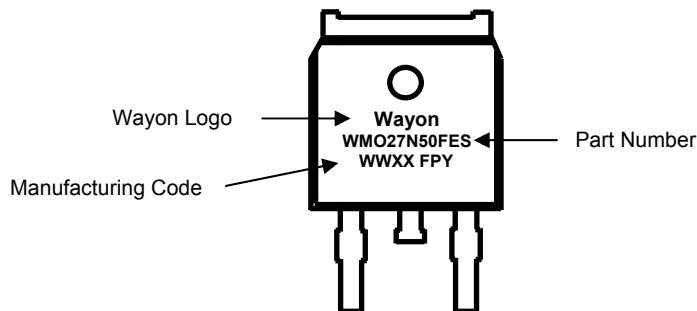


| SYMBOL | MM       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 9.70     | 10.00 | 10.20 |
| B      | 3.40     | 3.60  | 3.80  |
| C      | 8.90     | 9.10  | 9.40  |
| D      | 1.17     | 1.27  | 1.47  |
| E      | 2.60     | 3.10  | 3.40  |
| F      | 15.10    | 15.80 | 16.70 |
| G      | 19.55MAX |       |       |
| H      | 2.54REF  |       |       |
| I      | 0.70     | 0.80  | 0.95  |
| J      | 9.35     | 10.30 | 11.00 |
| K      | 4.30     | 4.57  | 4.77  |
| L      | 1.20     | 1.30  | 1.45  |
| M      | 0.40     | 0.50  | 0.65  |
| N      | 2.20     | 2.40  | 2.60  |

## Ordering Information

| Part        | Package | Marking     | Packing method |
|-------------|---------|-------------|----------------|
| WML27N50FES | TO-220F | WML27N50FES | Tube           |
| WMK27N50FES | TO-220  | WMK27N50FES | Tube           |
| WMN27N50FES | TO-262  | WMN27N50FES | Tube           |
| WMM27N50FES | TO-263  | WMM27N50FES | Tape and Reel  |
| WMO27N50FES | TO-252  | WMO27N50FES | Tape and Reel  |
| WMP27N50FES | TO-251  | WMP27N50FES | Tube           |

## Marking Information



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