

## 500V 0.125Ω Super Junction Power MOSFET

### Description

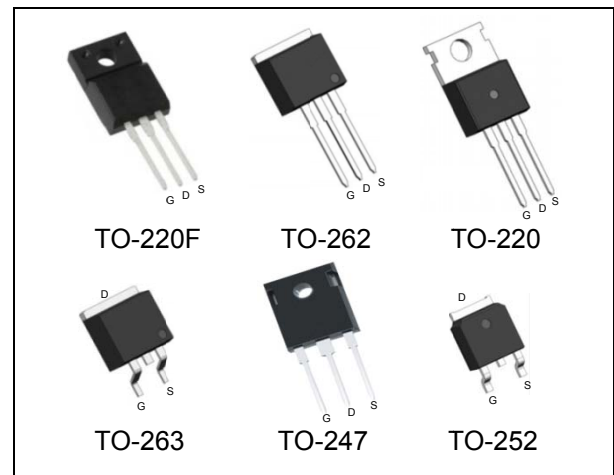
WMOS™ C4 is Wayon's 4<sup>th</sup> generation super junction MOSFET family that is utilizing charge balance technology for extremely low on-resistance and low gate charge performance. WMOS™ C4 is suitable for applications which require superior power density and outstanding efficiency.

### Features

- $V_{DS} = 550V @ T_{j,max}$
- Typ.  $R_{DS(on)} = 0.125\Omega$
- 100% UIS tested
- Pb-free plating, Halogen free

### Applications

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



### Absolute Maximum Ratings

| Parameter   | Symbol           | WMK/WMM/WMN/WMJ/WMO | WML  | Unit          |
|---|------------------|---------------------|------|---------------|
| Drain-source voltage  | $V_{DSS}$        | 500                 |      | V             |
| Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ C$ )           | $I_D$            | 23                  |      | A             |
|   |                  | 13                  |      | A             |
| Pulsed drain current <sup>2)</sup>                                      | $I_{DM}$         | 65                  |      | A             |
| Gate-source voltage   | $V_{GS}$         | $\pm 30$            |      | V             |
| Avalanche energy, single pulse <sup>3)</sup>                            | $E_{AS}$         | 210                 |      | mJ            |
| Avalanche energy, repetitive <sup>2)</sup>                              | $E_{AR}$         | 0.3                 |      | mJ            |
| Avalanche current, repetitive <sup>2)</sup>                             | $I_{AR}$         | 2.5                 |      | A             |
| Power dissipation ( $T_C = 25^\circ C$ )<br>- Derate above $25^\circ C$ | $P_D$            | 135                 | 31   | W             |
|   |                  | 1.08                | 0.25 | W/ $^\circ C$ |
| Operating and storage temperature range                                 | $T_{j}, T_{stg}$ | -55 to +150         |      | $^\circ C$    |
| Continuous diode forward current  | $I_S$            | 23                  |      | A             |
| Diode pulse current   | $I_{S,pulse}$    | 65                  |      | A             |

### Thermal Characteristics

| Parameter                               | Symbol          | WMK/WMM/WMN/WMJ/WMO | WML | Unit         |
|---|-----------------|---------------------|-----|--------------|
| Thermal resistance, junction-to-case    | $R_{\theta JC}$ | 0.9                 | 4   | $^\circ C/W$ |
| Thermal resistance, junction-to-ambient | $R_{\theta JA}$ | 62                  | 80  | $^\circ C/W$ |

**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    | 3     | 4    | 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>$T_j = 125^\circ\text{C}$ | -    | -     | 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     | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=6\text{ A}$<br>$T_j = 25^\circ\text{C}$                                   | -    | 0.125 | 0.16 | $\Omega$      |
| <b>Dynamic characteristics</b>       |               |  |      |       |      |               |
| Input capacitance                    | $C_{iss}$     | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V},$  | -    | 1310  | -    | pF            |
| Output capacitance                   | $C_{oss}$     | $f = 1\text{ MHz}$   | -    | 48    | -    |               |
| Reverse transfer capacitance         | $C_{rss}$     |  | -    | 1.5   | -    |               |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{DD} = 300\text{ V}, I_D = 15\text{ A}$   | -    | 31    | -    | ns            |
| Rise time                            | $t_r$         | $R_G = 25\Omega, V_{GS}=10\text{ V}$   | -    | 37    | -    |               |
| Turn-off delay time                  | $t_{d(off)}$  |  | -    | 97    | -    |               |
| Fall time                            | $t_f$         |  | -    | 31    | -    |               |
| <b>Gate charge characteristics</b>   |               |  |      |       |      |               |
| Gate to source charge                | $Q_{gs}$      | $V_{DD}=480\text{ V}, I_D=15\text{ A},$  | -    | 6.8   | -    | nC            |
| Gate to drain charge                 | $Q_{gd}$      | $V_{GS}=0\text{ to }10\text{ V}$   | -    | 6.8   | -    |               |
| Gate charge total                    | $Q_g$         |  | -    | 22.1  | -    |               |
| Gate plateau voltage                 | $V_{plateau}$ |  | -    | 5.6   | -    | V             |
| <b>Reverse diode characteristics</b> |               |  |      |       |      |               |
| Diode forward voltage                | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=6\text{ A}$  | -    | -     | 1.2  | V             |
| Reverse recovery time                | $t_{rr}$      | $V_R=50\text{ V}, I_F=15\text{ A},$  | -    | 241   | -    | ns            |
| Reverse recovery charge              | $Q_{rr}$      | $di/dt=100\text{ A}/\mu\text{s}$   | -    | 3.3   | -    | $\mu\text{C}$ |
| Peak reverse recovery current        | $I_{rrm}$     |  | -    | 25.5  | -    | A             |

## Notes:

- Limited by  $T_{j\text{max}}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature.
- $I_{AS} = 2.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\Omega$ , starting  $T_j = 25^\circ\text{C}$ .

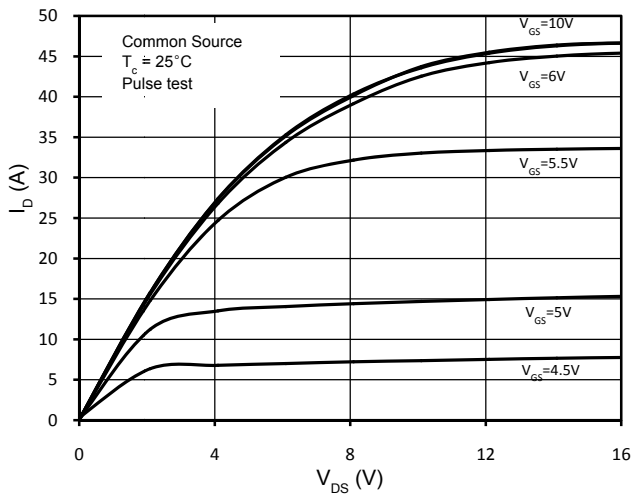


Figure 1. On-Region Characteristics

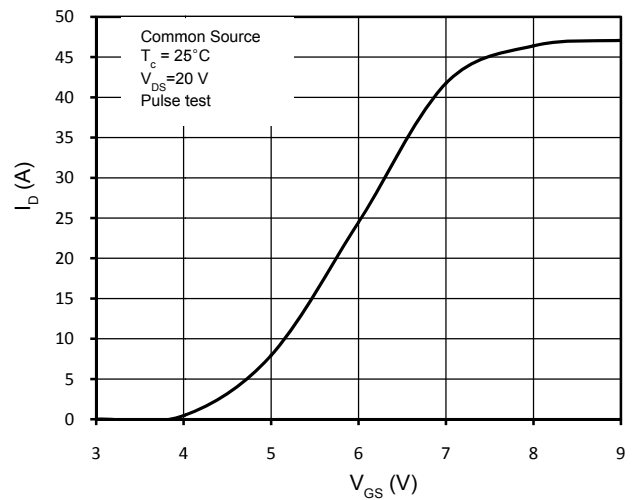


Figure 2. Transfer Characteristics

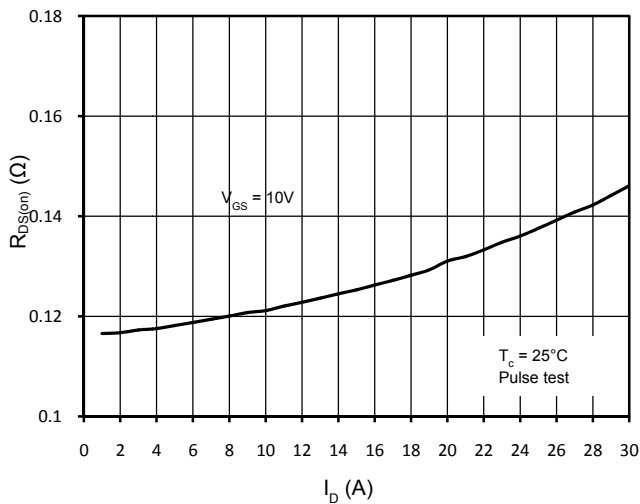


Figure 3. Static Drain-Source On Resistance

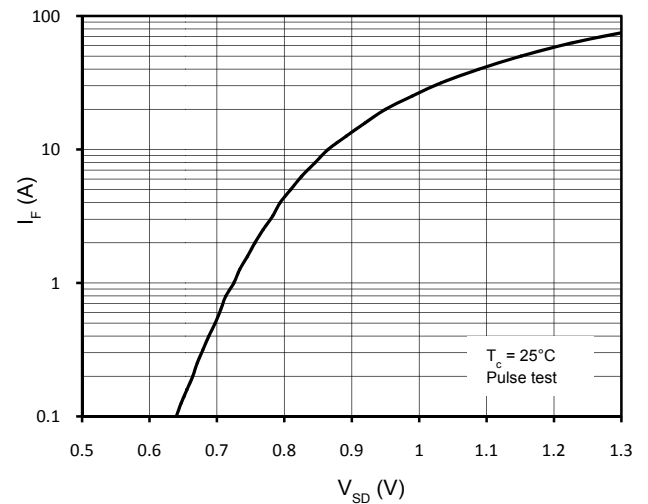


Figure 4. Body-Diode Forward Characteristics

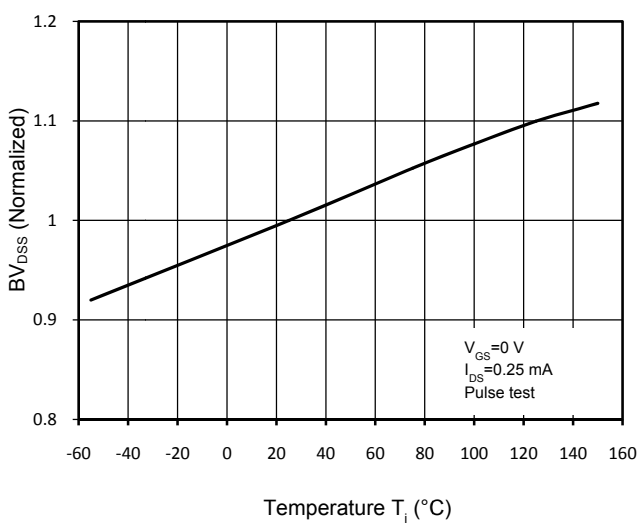


Figure 5. Normalized  $BV_{DS}$  vs. Temperature

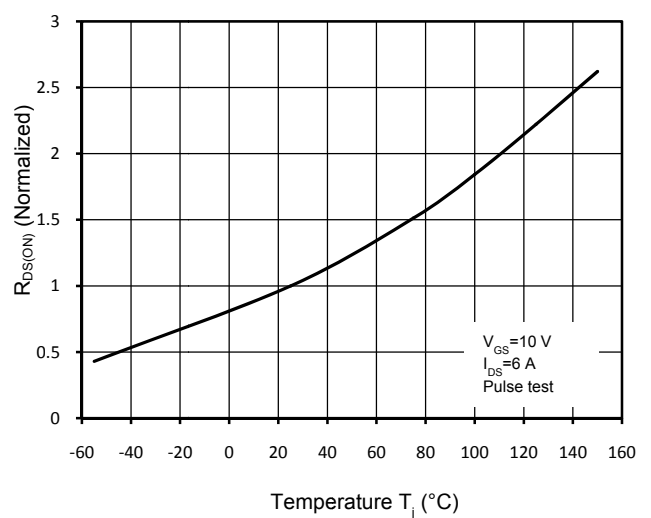


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

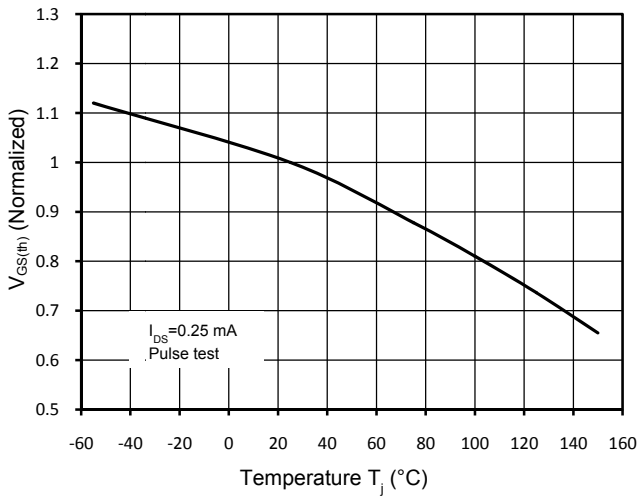


Figure 7. Threshold Voltage vs. Temperature

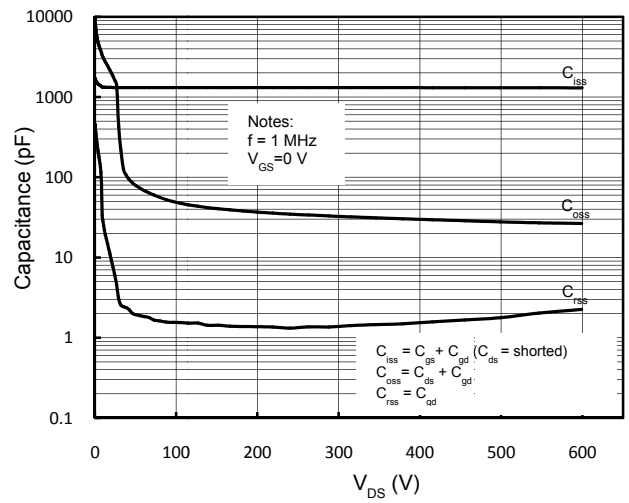


Figure 8. Capacitance Characteristics

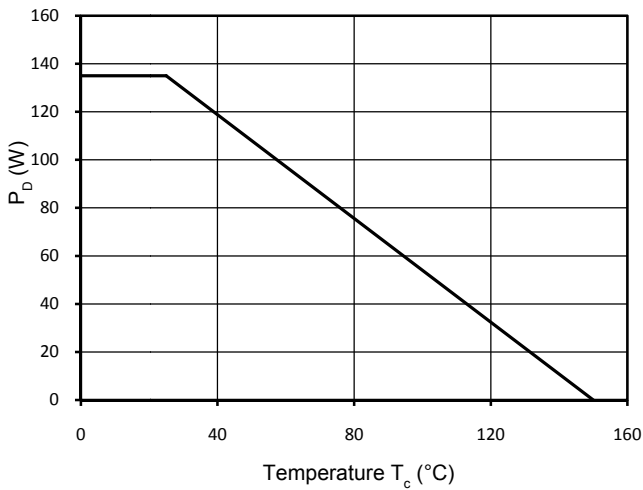


Figure 9. Power Dissipation

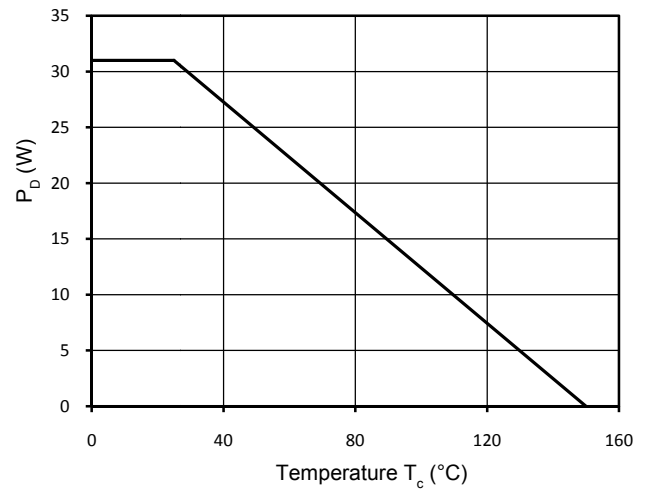


Figure 10. Power Dissipation (TO-220F)

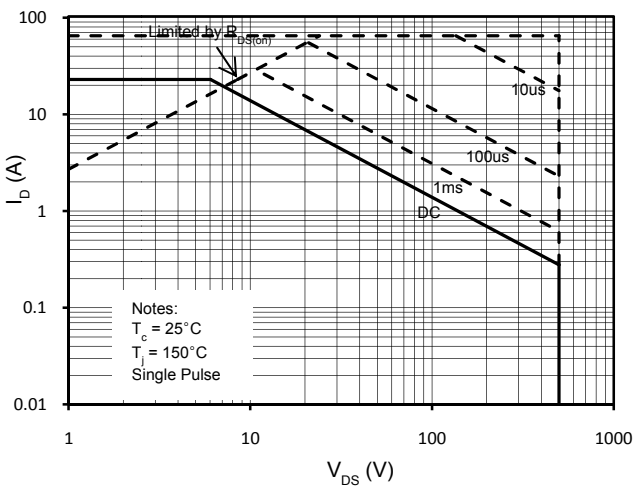


Figure 11. Maximum Safe Operating Area

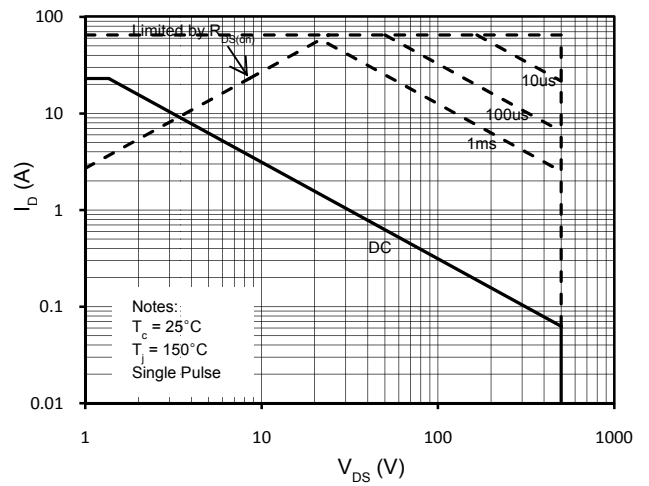


Figure 12. Maximum Safe Operating Area (TO-220F)

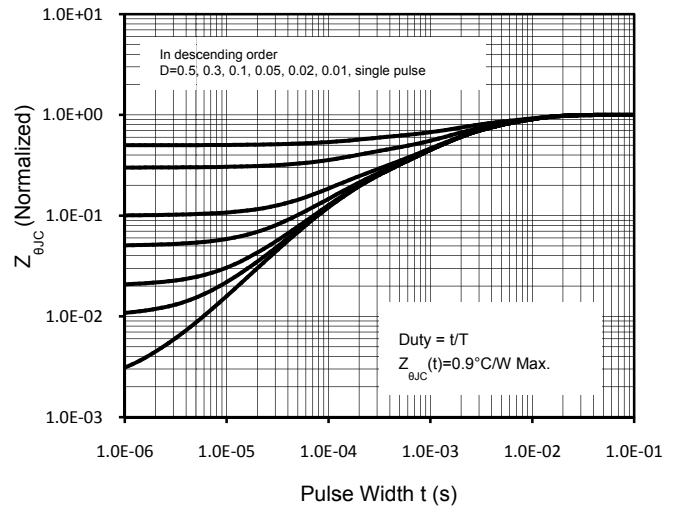
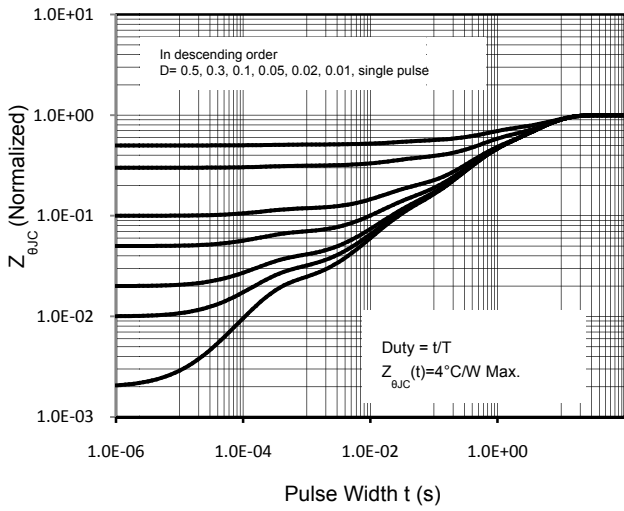


Figure 13. Transient Thermal Response Curve (TO-220F) Figure 14. Transient Thermal Response Curve

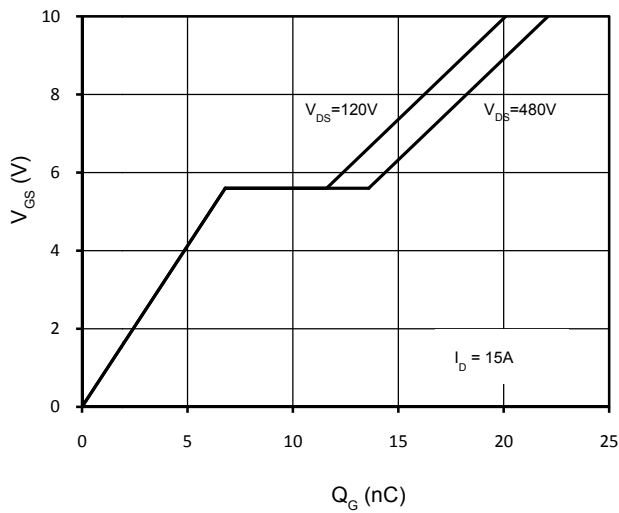
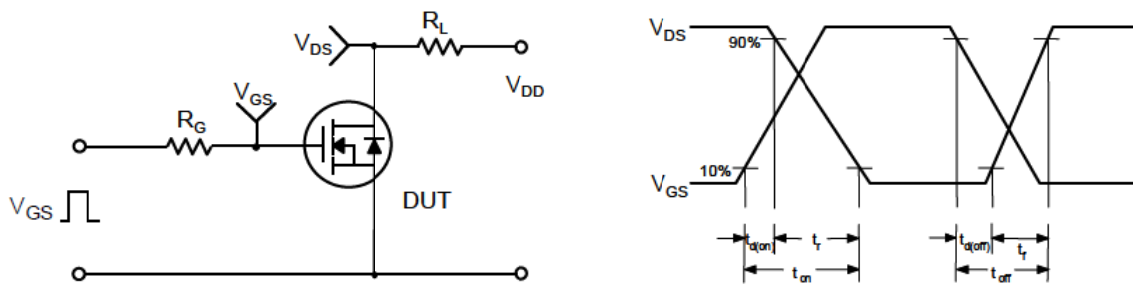


Figure 15. Gate Charge Characteristics

**Gate Charge Test Circuit & Waveform**



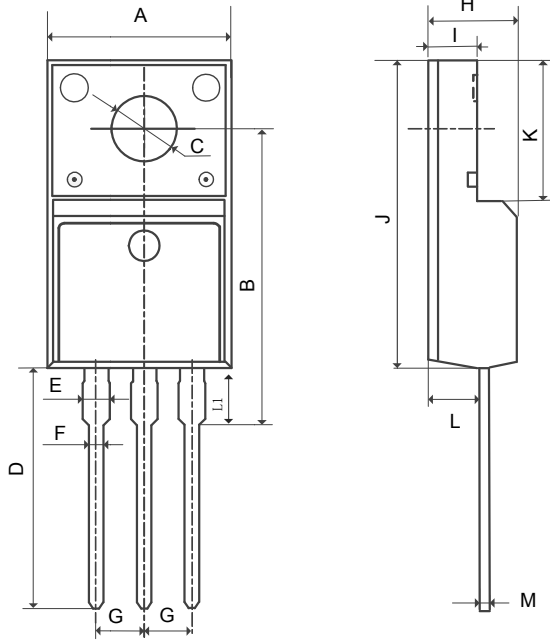
**Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



## Mechanical Dimensions for TO-220F

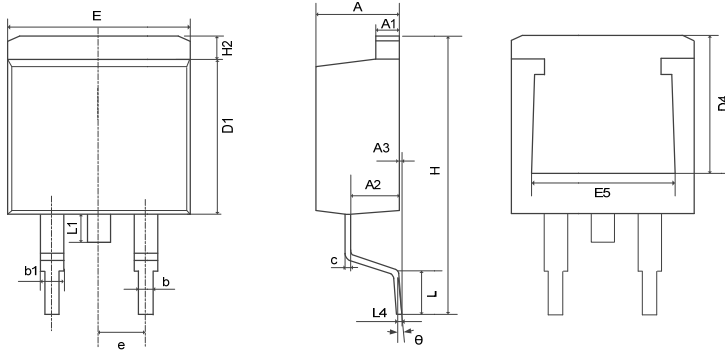


## COMMON DIMENSIONS

| 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      | 4.37    | 4.89  |
| A1     | 1.17    | 1.42  |
| A2     | 2.49    | 2.89  |
| b      | 0.70    | 0.96  |
| b1     | 1.17    | 1.47  |
| c      | 0.30    | 0.53  |
| D1     | 8.45    | 8.90  |
| D4     | 6.60    | —     |
| E      | 9.86    | 10.40 |
| E5     | 7.06    | —     |
| e      | 2.54BSC |       |
| H      | 14.70   | 15.50 |
| H2     | 1.07    | 1.47  |
| L      | 2.00    | 2.70  |
| L1     | 1.40    | 1.70  |
| L4     | 0.25BSC |       |
| θ      | 0°      | 9°    |



## Mechanical Dimensions for TO-262

## COMMON DIMENSIONS



| SYMBOL | MM      |       |
|--------|---------|-------|
|        | MIN     | MAX   |
| A      | 4.37    | 4.90  |
| A1     | 1.17    | 1.42  |
| A2     | 2.49    | 2.89  |
| b      | 0.71    | 0.96  |
| b2     | 1.07    | 1.47  |
| c      | 0.28    | 0.53  |
| D      | 23.20   | 24.02 |
| D1     | 8.45    | 8.90  |
| D2     | 6.00    | —     |
| E1     | 9.86    | 10.40 |
| E4     | 7.06    | —     |
| e      | 2.54BSC |       |
| G      | 1.25    | 1.50  |
| H2     | —       | 1.50  |
| L      | 13.33   | 14.16 |
| L1     | 3.50    | 4.00  |
| L3     | 1.28    | 1.58  |

Mechanical Dimensions for TO-220

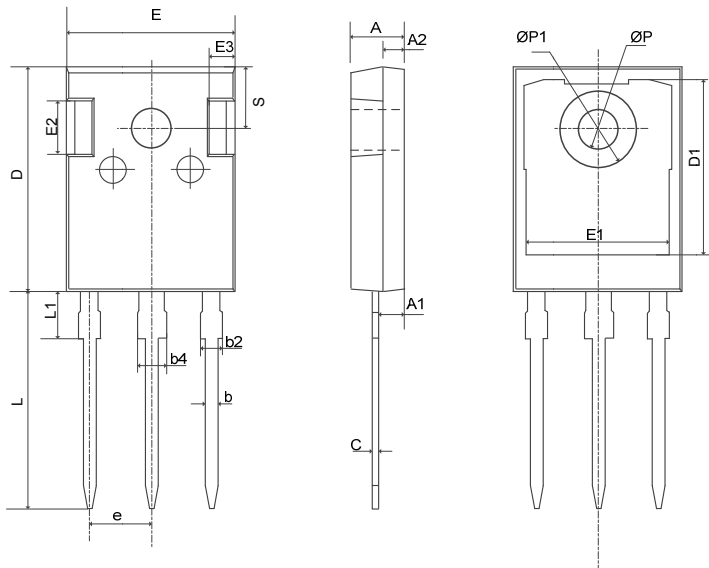
COMMON DIMENSIONS



| 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  |

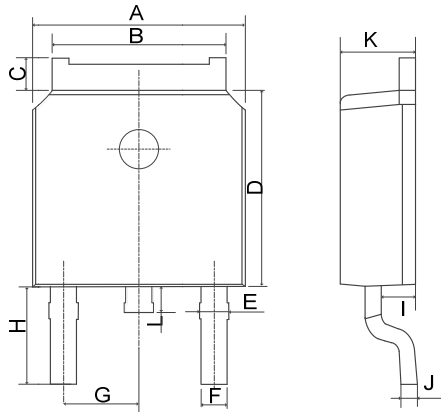
Mechanical Dimensions for TO-247

COMMON DIMENSIONS



| SYMBOL | MM      |       |
|--------|---------|-------|
|        | MIN     | MAX   |
| A      | 4.80    | 5.20  |
| A1     | 2.21    | 2.61  |
| A2     | 1.85    | 2.15  |
| b      | 1.11    | 1.36  |
| b2     | 1.91    | 2.21  |
| b4     | 2.91    | 3.21  |
| c      | 0.51    | 0.75  |
| D      | 20.70   | 21.30 |
| D1     | 16.25   | 16.85 |
| E      | 15.50   | 16.10 |
| E1     | 13.00   | 13.60 |
| E2     | 4.80    | 5.20  |
| E3     | 2.30    | 2.70  |
| e      | 5.44BSC |       |
| L      | 19.62   | 20.22 |
| L1     | —       | 4.30  |
| ØP     | 3.40    | 3.80  |
| ØP1    | —       | 7.30  |
| S      | 6.15BSC |       |

## Mechanical Dimensions for TO-252



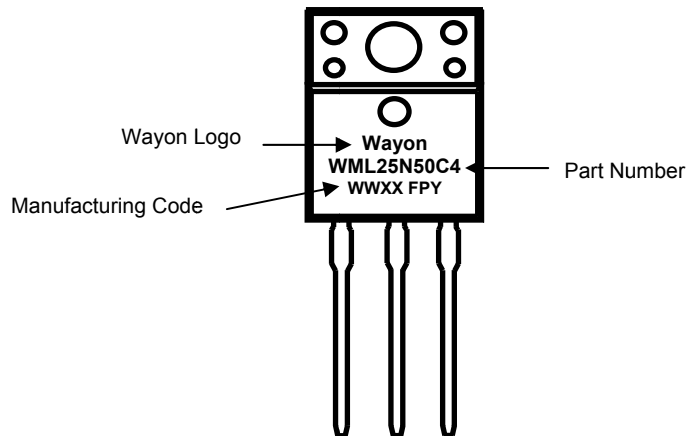
## COMMON DIMENSIONS

| 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 |

## Ordering Information

| Part       | Package | Marking    | Packing method |
|------------|---------|------------|----------------|
| WML25N50C4 | TO-220F | WML25N50C4 | Tube           |
| WMK25N50C4 | TO-220  | WMK25N50C4 | Tube           |
| WMN25N50C4 | TO-262  | WMN25N50C4 | Tube           |
| WMM25N50C4 | TO-263  | WMM25N50C4 | Tape and Reel  |
| WMO25N50C4 | TO-252  | WMO25N50C4 | Tape and Reel  |
| WMJ25N50C4 | TO-247  | WMJ25N50C4 | Tube           |

## Marking Information



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