

## 650V 0.52Ω Super Junction Power MOSFET

### Description

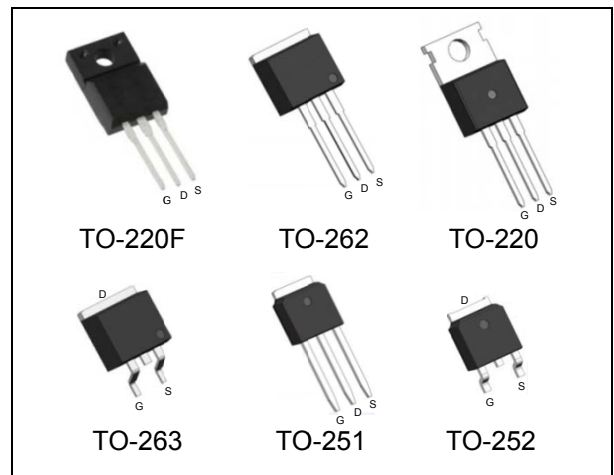
WMOS™ C4 is Wayon's 4<sup>th</sup> generation super junction MOSFET family that is utilizing charge balance technology for extremely low on-resistance and low gate charge performance. WMOS™ C4 is suitable for applications which require superior power density and outstanding efficiency.

### Features

- $V_{DS} = 700V @ T_{j,max}$
- Typ.  $R_{DS(on)} = 0.52\Omega$
- 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/WMP/WMO | WML  | Unit          |
|---|------------------|---------------------|------|---------------|
| Drain-source voltage  | $V_{DSS}$        | 650                 |      | V             |
| Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ C$ )           | $I_D$            | 8                   |      | A             |
|   |                  | 4.8                 |      | A             |
| Pulsed drain current <sup>2)</sup>                                      | $I_{DM}$         | 19                  |      | A             |
| Gate-source voltage   | $V_{GS}$         | $\pm 30$            |      | V             |
| Avalanche energy, single pulse <sup>3)</sup>                            | $E_{AS}$         | 45                  |      | mJ            |
| Avalanche energy, repetitive <sup>2)</sup>                              | $E_{AR}$         | 0.15                |      | mJ            |
| Avalanche current, repetitive <sup>2)</sup>                             | $I_{AR}$         | 1.0                 |      | A             |
| Power dissipation ( $T_C = 25^\circ C$ )<br>- Derate above $25^\circ C$ | $P_D$            | 57                  | 27   | W             |
|   |                  | 0.46                | 0.22 | W/ $^\circ C$ |
| Operating and storage temperature range                                 | $T_{j}, T_{stg}$ | -55 to +150         |      | $^\circ C$    |
| Continuous diode forward current  | $I_S$            | 8                   |      | A             |
| Diode pulse current   | $I_{S,pulse}$    | 19                  |      | A             |

### Thermal Characteristics

| Parameter                               | Symbol          | WMK/WMM/WMN/WMP/WMO | WML | Unit         |
|---|-----------------|---------------------|-----|--------------|
| Thermal resistance, junction-to-case    | $R_{\theta JC}$ | 2.2                 | 4.6 | $^\circ C/W$ |
| 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       | $BV_{DSS}$    | $V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$  | 650  | -    | -    | 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                | $I_{DSS}$     | $V_{DS}=650\text{ V}, V_{GS}=0\text{ V},$<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     | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=1.5\text{ A}$<br>$T_j = 25^\circ\text{C}$                                 | -    | 0.52 | 0.6  | $\Omega$      |
| <b>Dynamic characteristics</b>       |               |  |      |      |      |               |
| Input capacitance                    | $C_{iss}$     | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V},$<br>$f = 1\text{ MHz}$                                    | -    | 415  | -    | pF            |
| Output capacitance                   | $C_{oss}$     |  | -    | 19   | -    |               |
| Reverse transfer capacitance         | $C_{rss}$     |  | -    | 0.95 | -    |               |
| Turn-on delay time                   | $t_{d(on)}$   | $V_{DD} = 300\text{ V}, I_D = 2\text{ A}$<br>$R_G = 25\Omega, V_{GS}=10\text{ V}$                  | -    | 12   | -    | ns            |
| Rise time                            | $t_r$         |  | -    | 10   | -    |               |
| Turn-off delay time                  | $t_{d(off)}$  |  | -    | 62   | -    |               |
| Fall time                            | $t_f$         |  | -    | 13   | -    |               |
| <b>Gate charge characteristics</b>   |               |  |      |      |      |               |
| Gate to source charge                | $Q_{gs}$      | $V_{DD}=480\text{ V}, I_D=2\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$                         | -    | 1.7  | -    | nC            |
| Gate to drain charge                 | $Q_{gd}$      |  | -    | 3.5  | -    |               |
| Gate charge total                    | $Q_g$         |  | -    | 9.6  | -    |               |
| Gate plateau voltage                 | $V_{plateau}$ |  | -    | 5.2  | -    | V             |
| <b>Reverse diode characteristics</b> |               |  |      |      |      |               |
| Diode forward voltage                | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=1.5\text{ A}$  | -    | -    | 1.2  | V             |
| Reverse recovery time                | $t_{rr}$      | $V_R=50\text{ V}, I_F=2\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$                           | -    | 105  | -    | ns            |
| Reverse recovery charge              | $Q_{rr}$      |  | -    | 0.6  | -    | $\mu\text{C}$ |
| Peak reverse recovery current        | $I_{rrm}$     |  | -    | 11.3 | -    | A             |

## Notes:

- Limited by  $T_{j\text{max}}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature.
- $I_{AS} = 1.0\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\Omega$ , starting  $T_j = 25^\circ\text{C}$ .

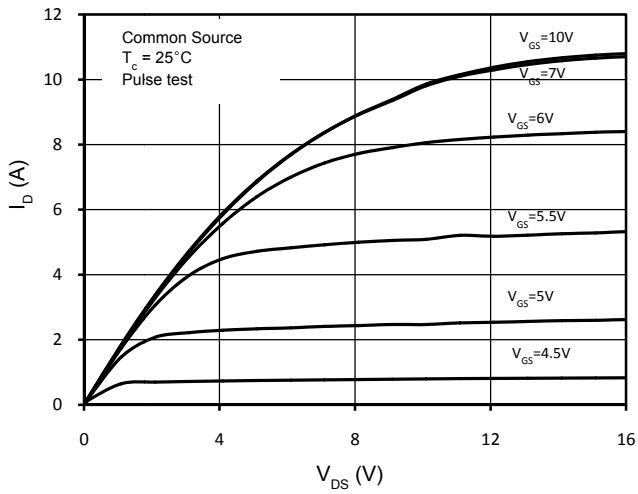


Figure 1. On-Region Characteristics

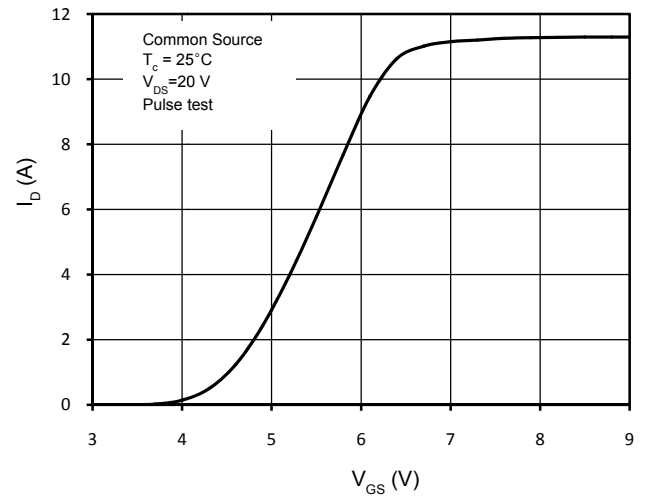


Figure 2. Transfer Characteristics

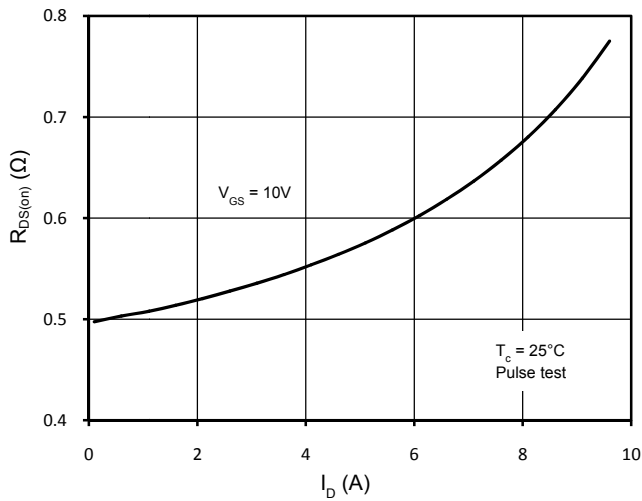


Figure 3. Static Drain-Source On Resistance

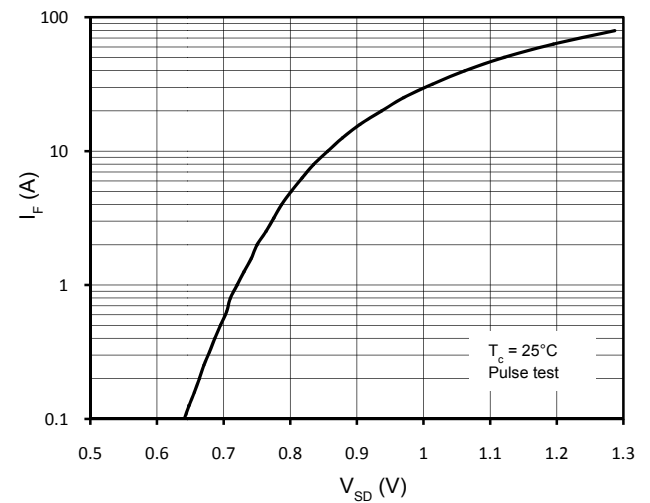


Figure 4. Body-Diode Forward Characteristics

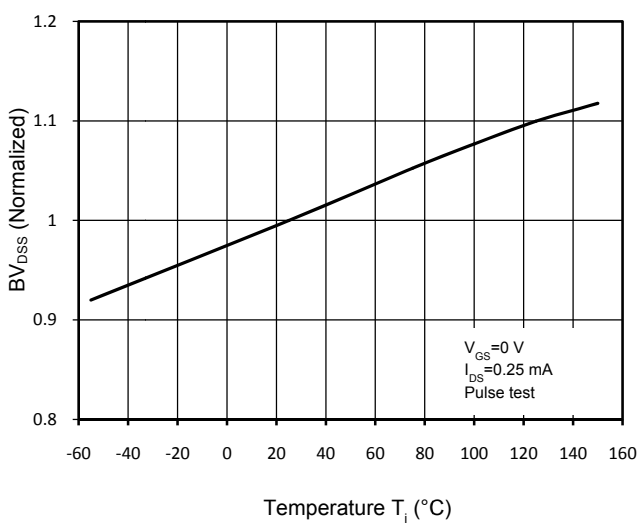


Figure 5. Normalized  $BV_{DS(s)}$  vs. Temperature

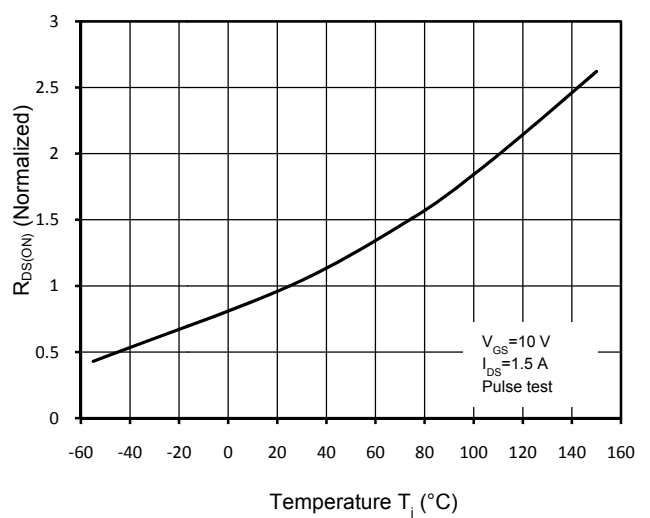


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

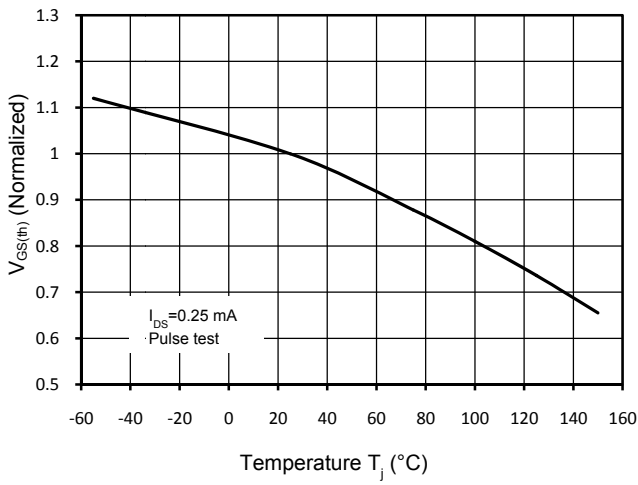


Figure 7. Threshold Voltage vs. Temperature

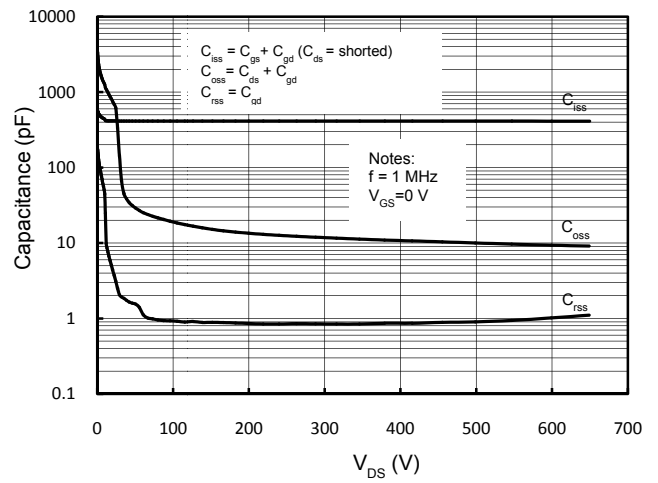


Figure 8. Capacitance Characteristics

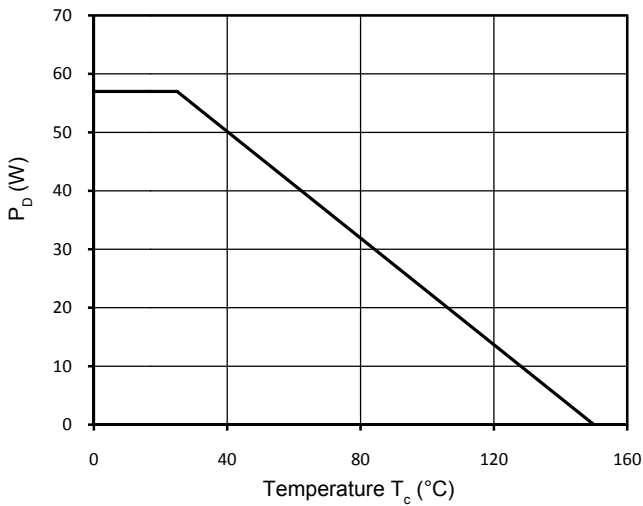


Figure 9. Power Dissipation

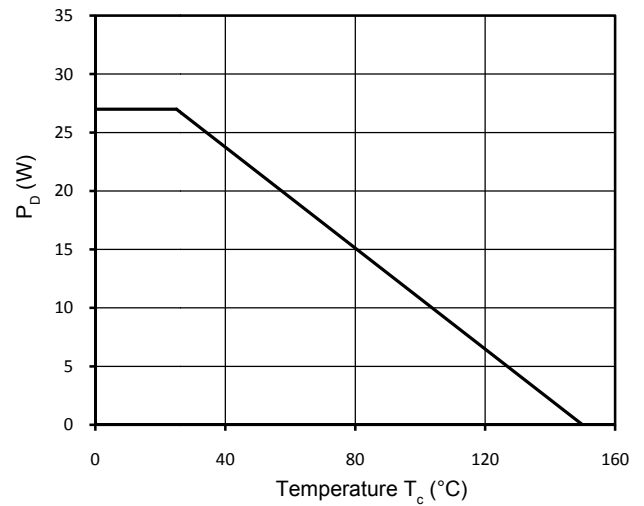


Figure 10. Power Dissipation (TO-220F)

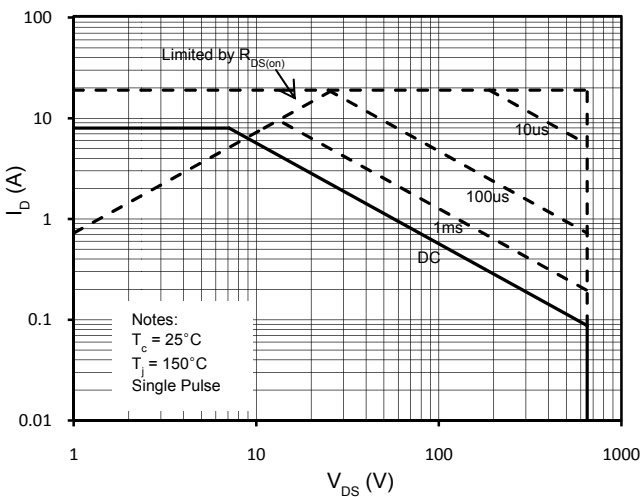


Figure 11. Maximum Safe Operating Area

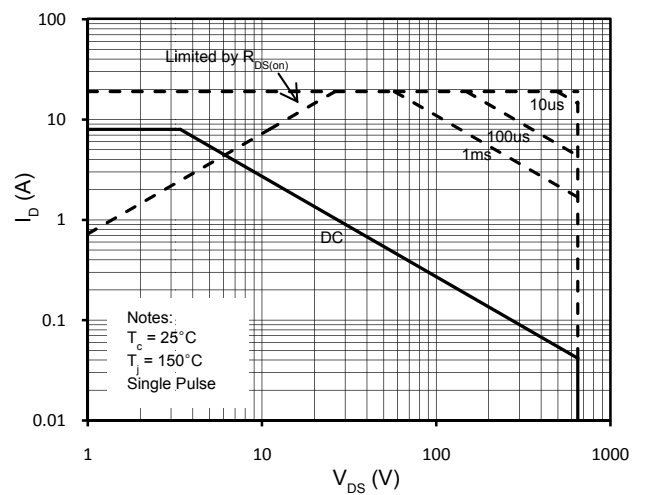


Figure 12. Maximum Safe Operating Area (TO-220F)

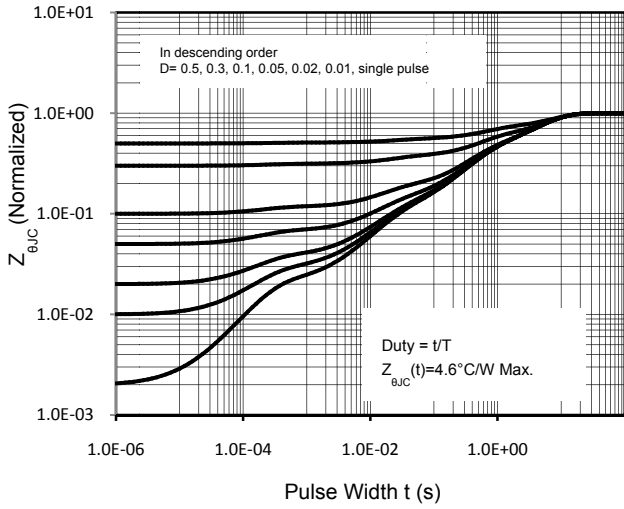


Figure 13. Transient Thermal Response Curve (TO-220F)

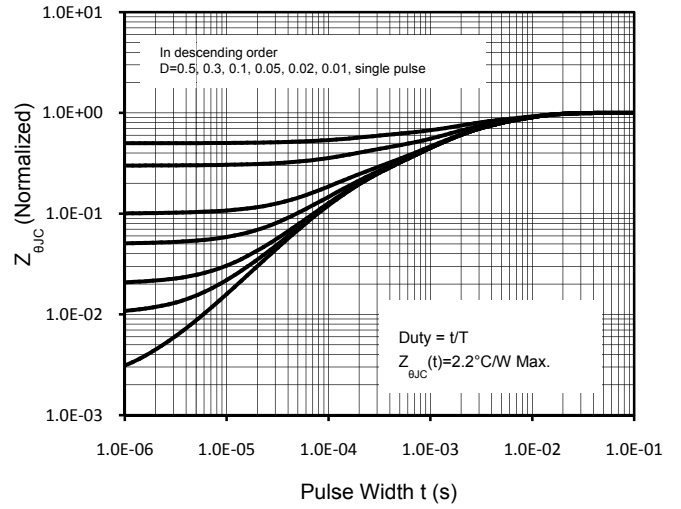


Figure 14. Transient Thermal Response Curve

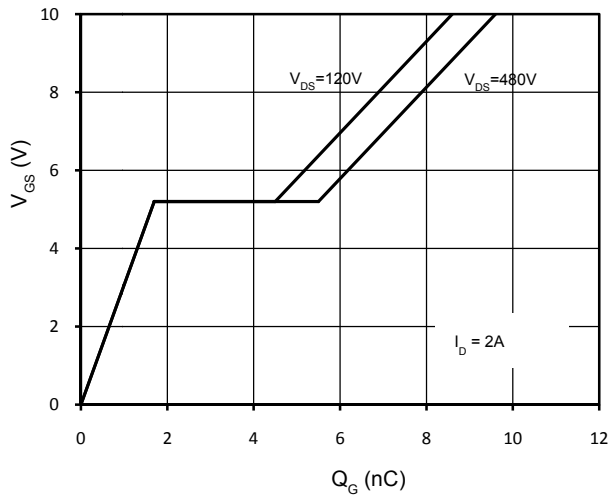
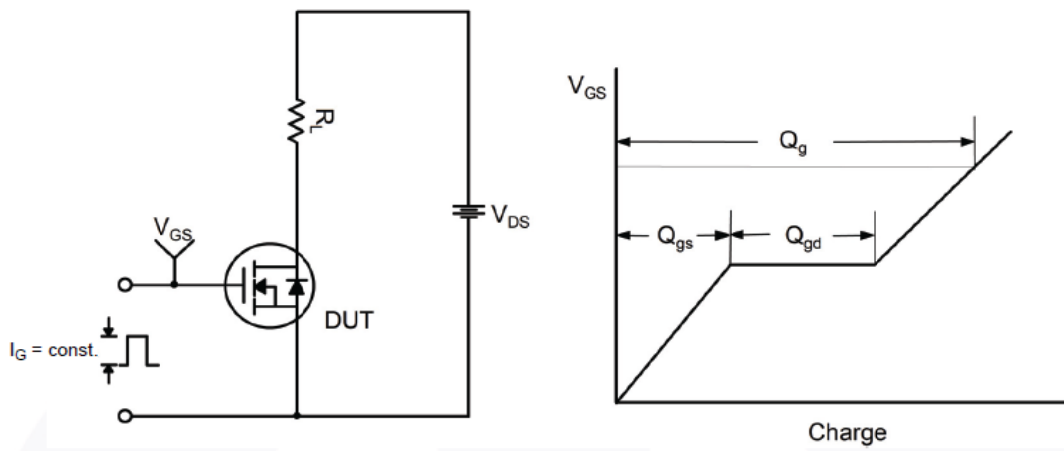


Figure 15. Gate Charge Characteristics

### Gate Charge Test Circuit & Waveform



### Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms



Mechanical Dimensions for TO-220F

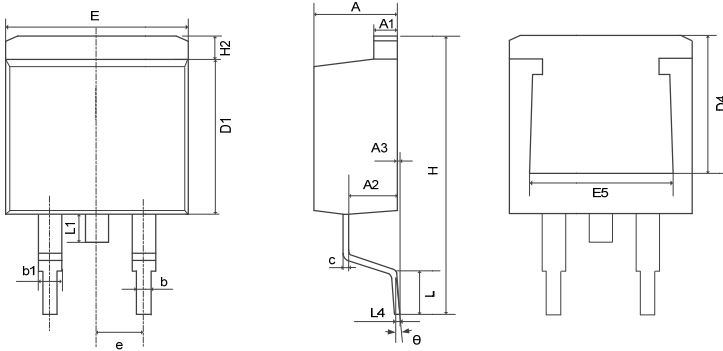


COMMON DIMENSIONS

| SYMBOL | MM      |       |
|--------|---------|-------|
|        | MIN     | 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

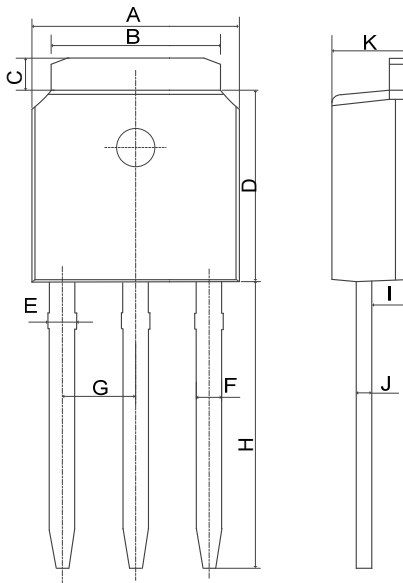
COMMON DIMENSIONS



| 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-251

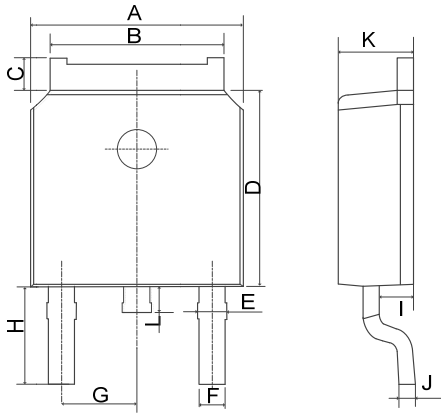
## COMMON DIMENSIONS



| 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      | 9.00    | 9.65 |
| I      | 0.85    | 1.17 |
| J      | 0.40    | 0.61 |
| K      | 2.10    | 2.50 |

Mechanical Dimensions for TO-252

COMMON DIMENSIONS

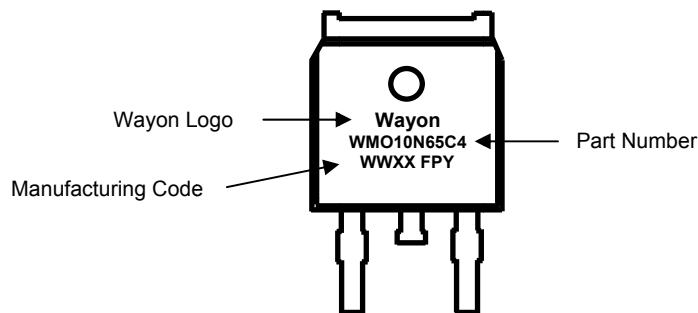


| SYMBOL | MM      |      |
|--------|---------|------|
|        | MIN     | MAX  |
| A      | 6.40    | 6.80 |
| B      | 5.13    | 5.50 |
| C      | 0.88    | 1.28 |
| D      | 5.90    | 6.22 |
| E      | 0.68    | 1.10 |
| F      | 0.68    | 0.91 |
| G      | 2.29REF |      |
| H      | 2.90REF |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

## Ordering Information

| Part       | Package | Marking    | Packing method |
|------------|---------|------------|----------------|
| WML10N65C4 | TO-220F | WML10N65C4 | Tube           |
| WMK10N65C4 | TO-220  | WMK10N65C4 | Tube           |
| WMN10N65C4 | TO-262  | WMN10N65C4 | Tube           |
| WMM10N65C4 | TO-263  | WMM10N65C4 | Tape and Reel  |
| WMO10N65C4 | TO-252  | WMO10N65C4 | Tape and Reel  |
| WMP10N65C4 | TO-251  | WMP10N65C4 | Tube           |

## Marking Information



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[BXP4N65F](#) [AOL1454G](#) [WMJ80N60C4](#) [BXP2N20L](#) [BXP2N65D](#) [BXT1150N10J](#) [BXT1700P06M](#) [TSM60NB380CP](#) [ROG](#) [RQ7L055BGTCR](#)  
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