

## 600V 0.45Ω Super Junction Power MOSFET

### Description

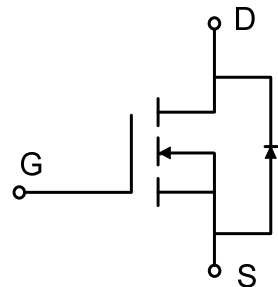
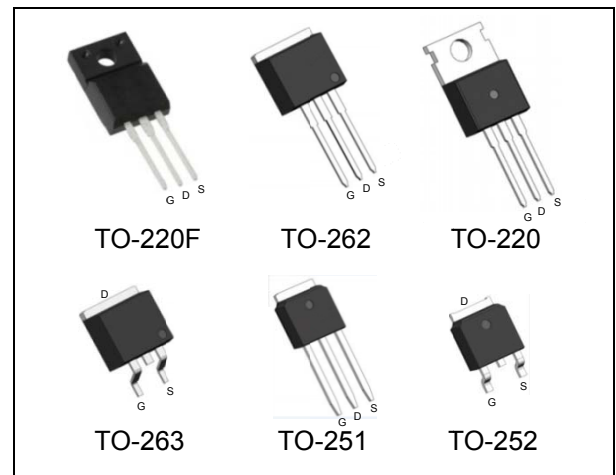
WMOS™ VD is Wayon's new high voltage power MOSFET family that is utilizing advanced technology for extremely low on-resistance and low gate charge performance. WMOS™ VD is suitable for applications which require superior power density and outstanding efficiency.

### Features

- $V_{DS} = 650V @ T_{j,max}$
- $I_{DM} = 21A$
- Typ.  $R_{DS(on)} = 0.45\Omega$
- 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                                          | $V_{DSS}$      | 600                 |     | V          |
| Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ C$ ) | $I_D$          | 10.5                |     | A          |
| ( $T_C = 100^\circ C$ )                                       |                | 6                   |     | A          |
| Pulsed drain current <sup>2)</sup>                            | $I_{DM}$       | 21                  |     | A          |
| Gate-source voltage                                           | $V_{GS}$       | $\pm 30$            |     | V          |
| Avalanche energy, single pulse <sup>3)</sup>                  | $E_{AS}$       | 55                  |     | mJ         |
| Avalanche energy, repetitive <sup>2)</sup>                    | $E_{AR}$       | 0.15                |     | mJ         |
| Avalanche current, repetitive <sup>2)</sup>                   | $I_{AR}$       | 1.2                 |     | A          |
| Power dissipation ( $T_C = 25^\circ C$ )                      | $P_D$          | 63                  | 28  | W          |
| Operating and storage temperature range                       | $T_j, T_{stg}$ | -55 to +150         |     | $^\circ C$ |
| Continuous diode forward current <sup>1)</sup>                | $I_S$          | 10.5                |     | A          |
| Diode pulse current <sup>2)</sup>                             | $I_{S,pulse}$  | 21                  |     | A          |

### Thermal Characteristics

| Parameter                               | Symbol          | WMK/WMM/WMO/WMP/WMN | WML | Unit         |
|-----------------------------------------|-----------------|---------------------|-----|--------------|
| Thermal resistance, junction-to-case    | $R_{\theta JC}$ | 2                   | 4.5 | $^\circ C/W$ |
| 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  |
|----------------------------------|----------------------|--------------------------------------------------------------------------------------------------|--------|----------|----------|-------|
| Static characteristics           |                      |                                                                                                  |        |          |          |       |
| Drain-source breakdown voltage   | BV <sub>DSS</sub>    | V <sub>GS</sub> =0 V, I <sub>D</sub> =0.25 mA                                                    | 600    | -        | -        | V     |
| Gate threshold voltage           | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =0.25mA                                        | 2.5    | 3.3      | 4.5      | V     |
| Drain cut-off current            | I <sub>DSS</sub>     | V <sub>DS</sub> =600 V, V <sub>GS</sub> =0 V,<br>T <sub>J</sub> = 25°C<br>T <sub>J</sub> = 125°C | -<br>- | -<br>10  | 1<br>-   | μA    |
| Gate leakage current, forward    | I <sub>GSSF</sub>    | V <sub>GS</sub> =30 V, V <sub>DS</sub> =0 V                                                      | -      | -        | 100      | nA    |
| Gate leakage current, reverse    | I <sub>GSSR</sub>    | V <sub>GS</sub> =-30 V, V <sub>DS</sub> =0 V                                                     | -      | -        | -100     | nA    |
| Drain-source on-state resistance | R <sub>DS(on)</sub>  | V <sub>GS</sub> =10 V, I <sub>D</sub> =3 A<br>T <sub>J</sub> = 25°C                              | -<br>- | <br>0.45 | <br>0.53 | <br>Ω |
| Dynamic characteristics          |                      |                                                                                                  |        |          |          |       |
| Input capacitance                | C <sub>iss</sub>     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V,                                                   | -      | 589      | -        | pF    |
| Output capacitance               | C <sub>OSS</sub>     | f = 1 MHz                                                                                        | -      | 400      | -        |       |
| Reverse transfer capacitance     | C <sub>rss</sub>     |                                                                                                  | -      | 5.1      | -        |       |
| Turn-on delay time               | t <sub>d(on)</sub>   | V <sub>DD</sub> = 300V, I <sub>D</sub> = 3.5A                                                    | -      | 21       | -        | ns    |
| Rise time                        | t <sub>r</sub>       | R <sub>G</sub> = 25Ω, V <sub>GS</sub> =10V                                                       | -      | 16       | -        |       |
| Turn-off delay time              | t <sub>d(off)</sub>  |                                                                                                  | -      | 56       | -        |       |
| Fall time                        | t <sub>f</sub>       |                                                                                                  | -      | 12       | -        |       |
| Gate charge characteristics      |                      |                                                                                                  |        |          |          |       |
| Gate to source charge            | Q <sub>gs</sub>      | V <sub>DD</sub> =480 V, I <sub>D</sub> =3.5A,                                                    | -      | 3.4      | -        | nC    |
| Gate to drain charge             | Q <sub>gd</sub>      | V <sub>GS</sub> =0 to 10 V                                                                       | -      | 5.7      | -        |       |
| Gate charge total                | Q <sub>g</sub>       |                                                                                                  | -      | 13.7     | -        |       |
| Gate plateau voltage             | V <sub>plateau</sub> |                                                                                                  | -      | 5.3      | -        | V     |
| Reverse diode characteristics    |                      |                                                                                                  |        |          |          |       |
| Diode forward voltage            | V <sub>SD</sub>      | V <sub>GS</sub> =0 V, I <sub>F</sub> =3.5A                                                       | -      | -        | 1.2      | V     |
| Reverse recovery time            | t <sub>rr</sub>      | V <sub>R</sub> =50 V, I <sub>F</sub> =3.5A,                                                      | -      | 240      | -        | ns    |
| Reverse recovery charge          | Q <sub>rr</sub>      | di <sub>F</sub> /dt=100 A/μs                                                                     | -      | 1.67     | -        | μC    |
| Peak reverse recovery current    | I <sub>rrm</sub>     |                                                                                                  | -      | 14       | -        | A     |

## Notes:

- Limited by  $T_{j\max}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature.
- $I_{AS} = 1.2\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\Omega$ , starting  $T_j = 25^\circ\text{C}$ .

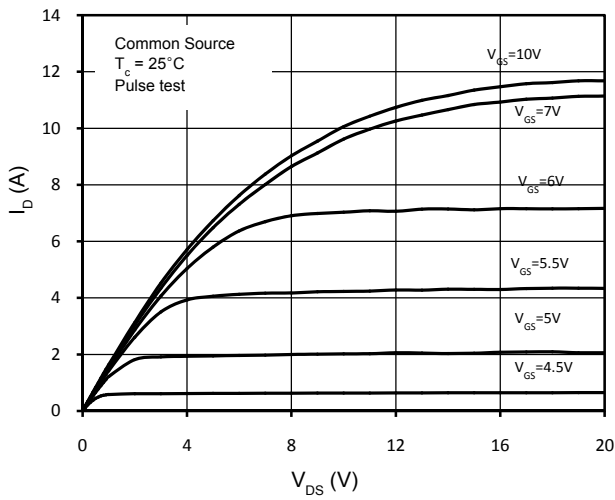


Figure 1. On-Region Characteristics

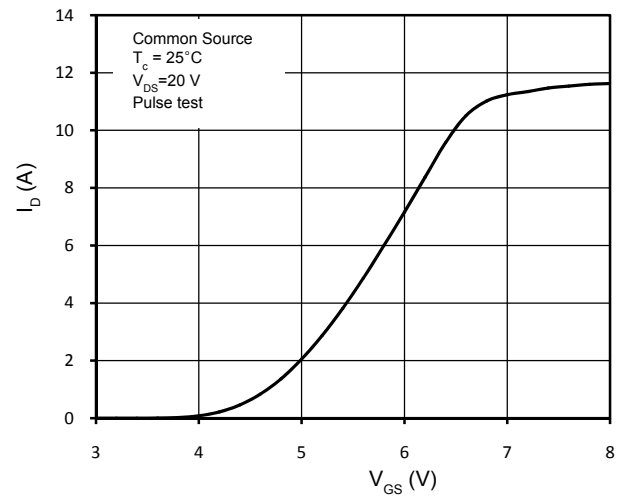


Figure 2. Transfer Characteristics

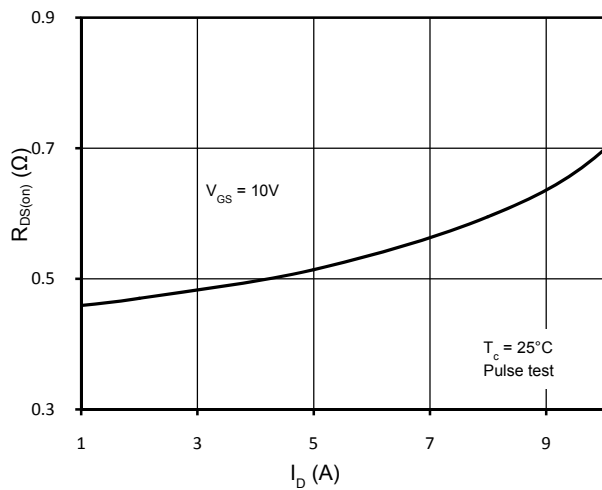


Figure 3. Static Drain-Source On Resistance

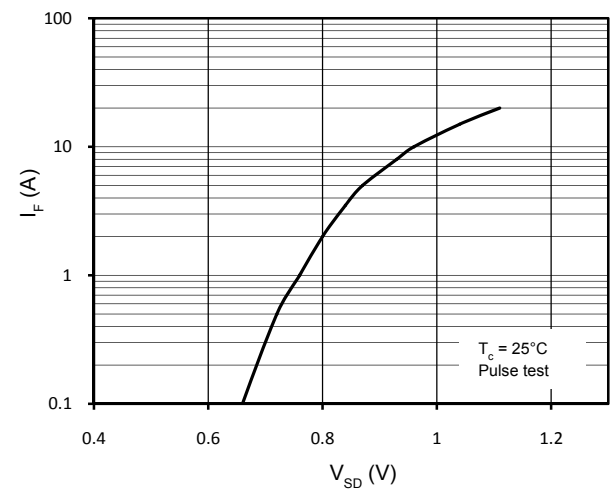
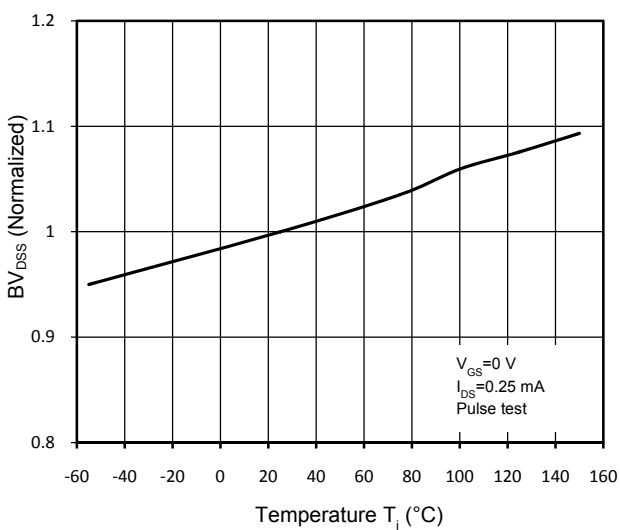
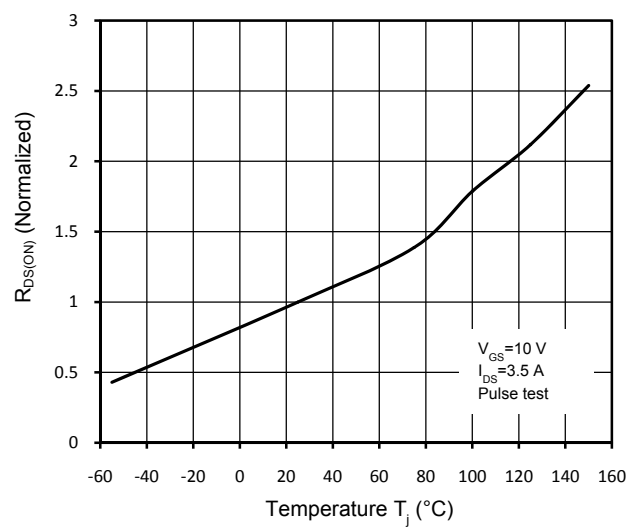


Figure 4. Body-Diode Forward Characteristics

Figure 5. Normalized  $BV_{DS}$  vs. TemperatureFigure 6. Normalized  $R_{DS(on)}$  vs. Temperature

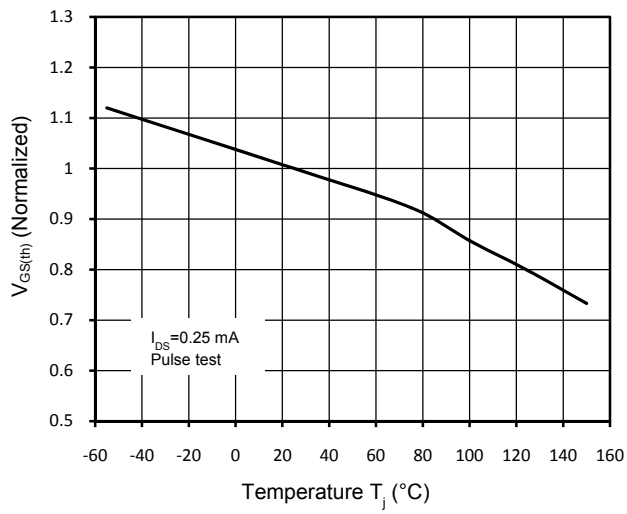


Figure 7. Threshold Voltage vs. Temperature

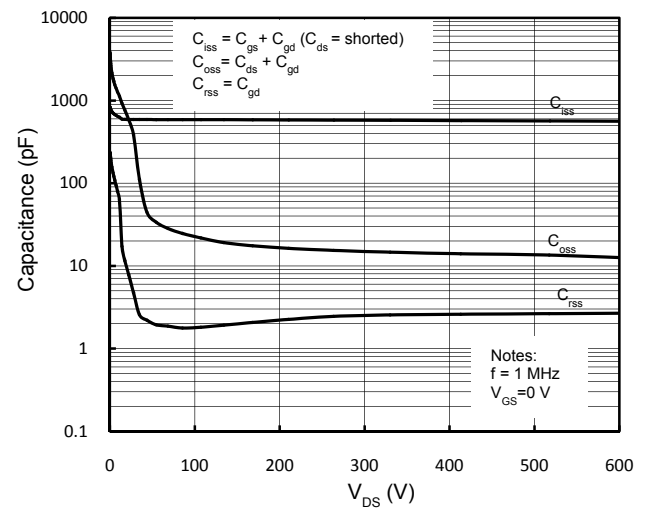


Figure 8. Capacitance Characteristics

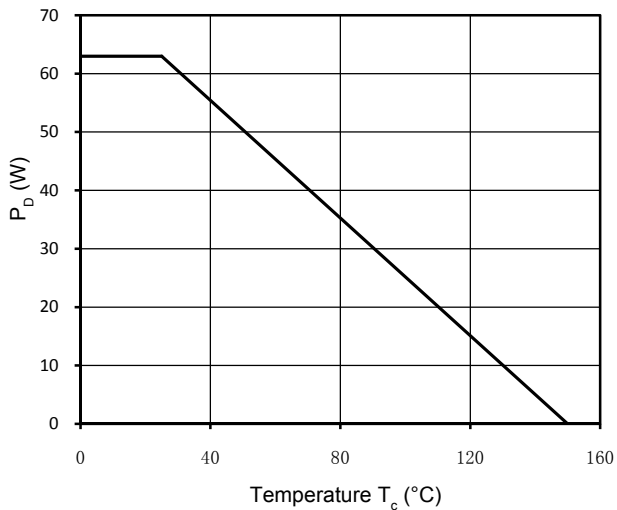


Figure 9. Power Dissipation

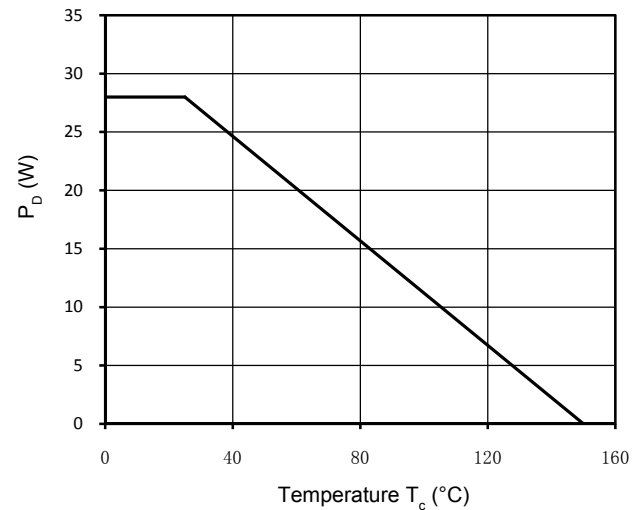


Figure 10. Power Dissipation (TO-220F)

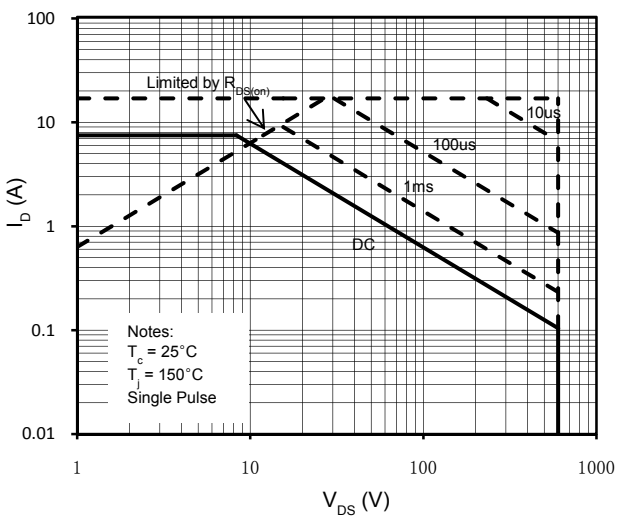


Figure 11. Maximum Safe Operating Area

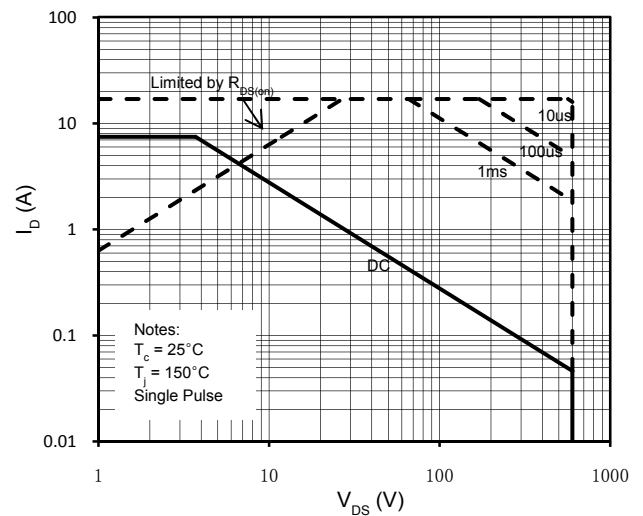


Figure 12. Maximum Safe Operating Area (TO-220F)

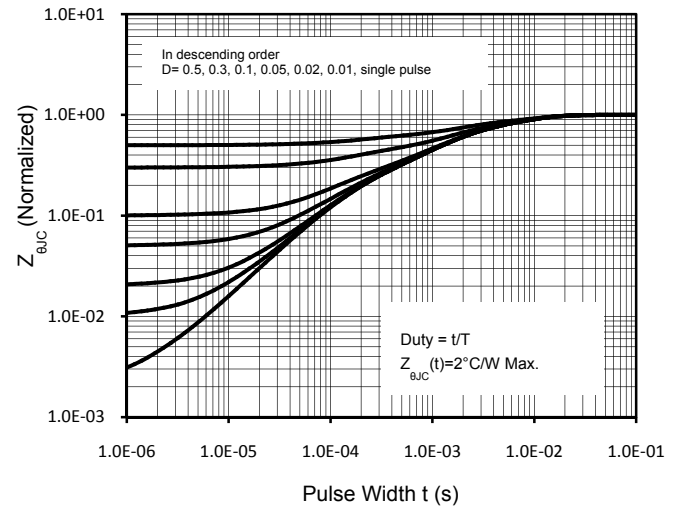
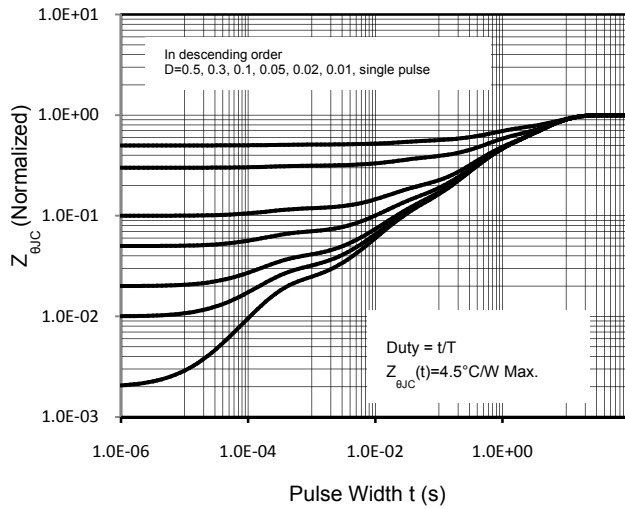


Figure 13. Transient Thermal Response Curve (TO-220F) Figure 14. Transient Thermal Response Curve

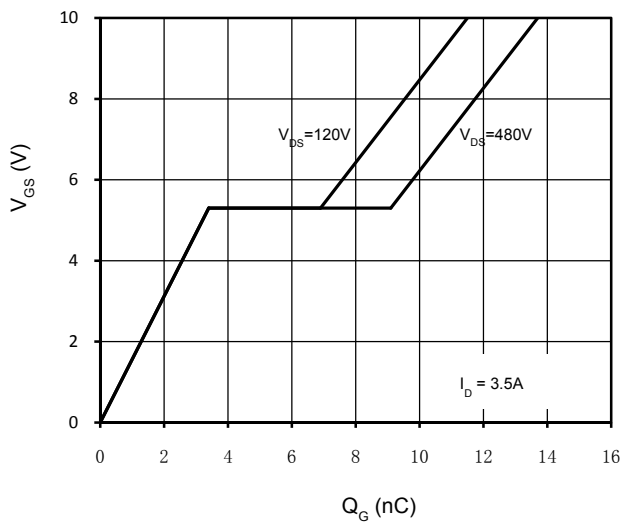
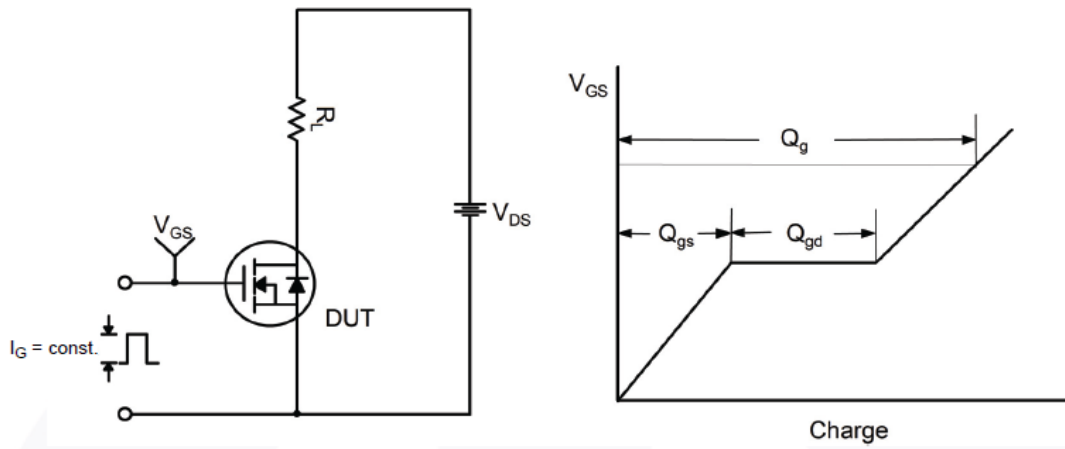
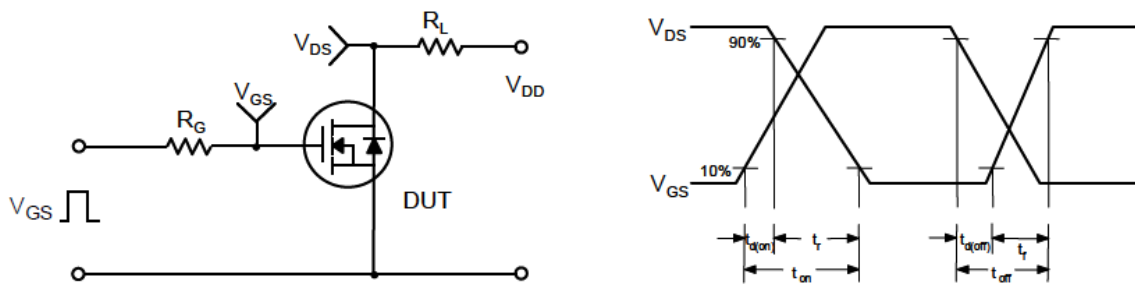


Figure 15. Gate Charge Characteristics

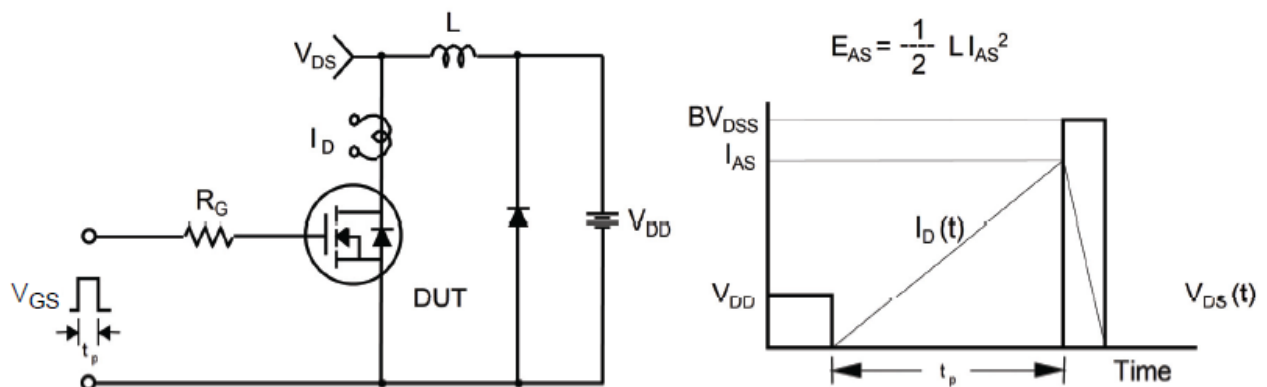
### Gate Charge Test Circuit & Waveform

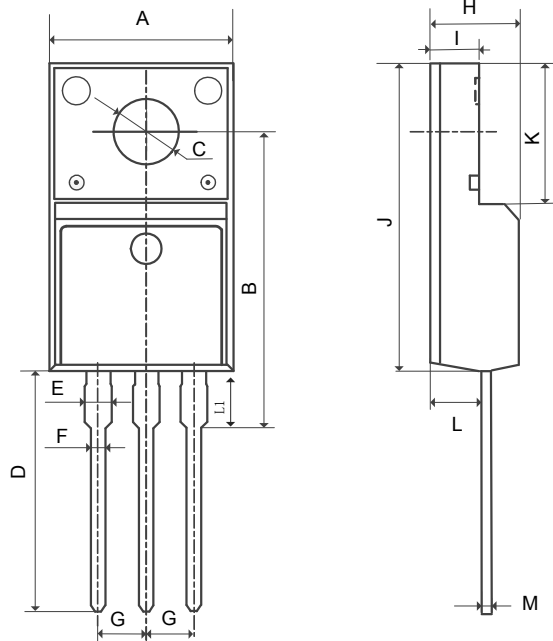


### Switching Test Circuit & Waveforms

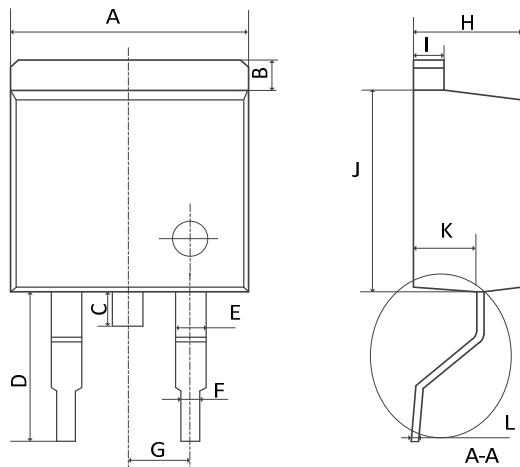


### Unclamped Inductive Switching Test Circuit & Waveforms

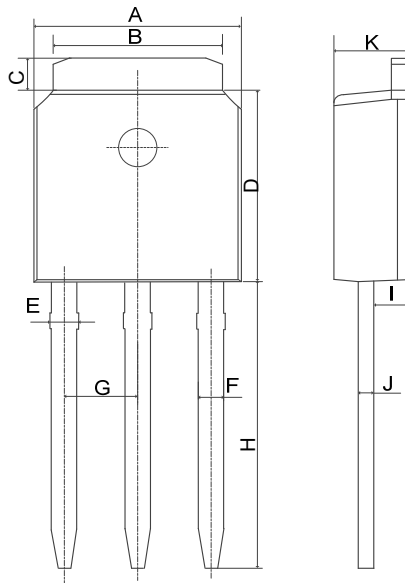


**Mechanical Dimensions for TO-220F**

**COMMON DIMENSIONS**

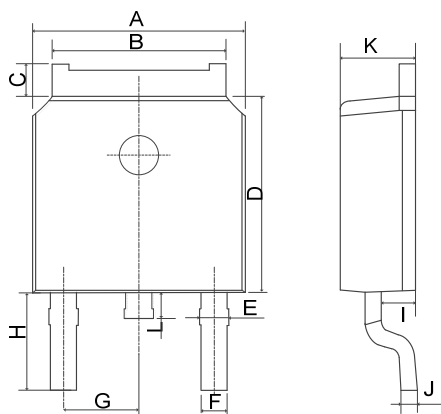
| SYMBOL | MM      |       |
|--------|---------|-------|
|        | MIN     | MAX   |
| A      | 9.96    | 10.36 |
| B      | 15.10   | 16.10 |
| C      | 3.03    | 3.38  |
| D      | 12.64   | 13.28 |
| E      | 1.18    | 1.58  |
| F      | 0.70    | 0.95  |
| G      | 2.54REF |       |
| H      | 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**

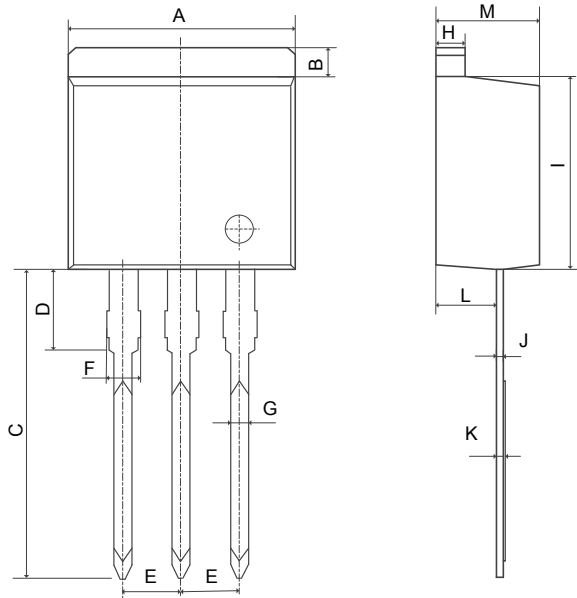
| SYMBOL | MM    |       |
|--------|-------|-------|
|        | MIN   | MAX   |
| A      | 10.00 | 10.40 |
| B      | 1.11  | 1.41  |
| C      | 1.25  | 1.55  |
| D      | 5.10  | 5.50  |
| E      | 1.12  | 1.42  |
| F      | 0.71  | 0.92  |
| G      | 2.39  | 2.69  |
| H      | 4.49  | 4.89  |
| I      | 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**

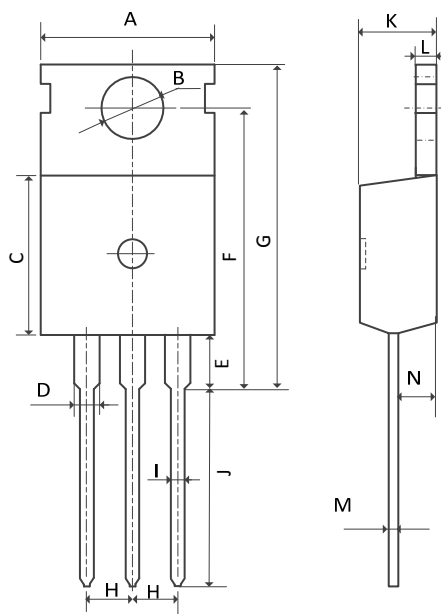
| SYMBOL | MM      |      |
|--------|---------|------|
|        | MIN     | MAX  |
| A      | 6.40    | 6.80 |
| B      | 5.13    | 5.46 |
| C      | 0.88    | 1.28 |
| D      | 5.90    | 6.22 |
| E      | 0.68    | 1.10 |
| F      | 0.68    | 0.91 |
| G      | 2.29REF |      |
| H      | 9.00    | 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  |

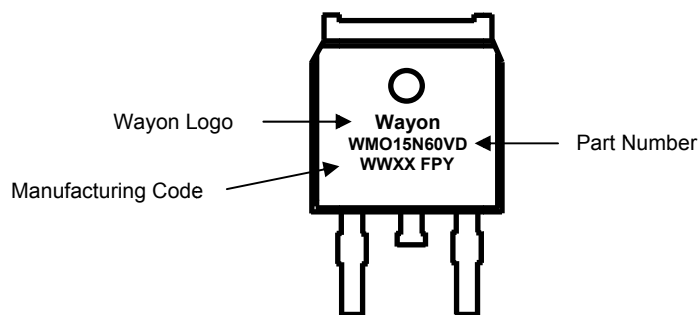
**Mechanical Dimensions for TO-220**

**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 |
|------------|---------|------------|----------------|
| WML15N60VD | TO-220F | WML15N60VD | Tube           |
| WMK15N60VD | TO-220  | WMK15N60VD | Tube           |
| WMN15N60VD | TO-262  | WMN15N60VD | Tube           |
| WMM15N60VD | TO-263  | WMM15N60VD | Tape and Reel  |
| WMO15N60VD | TO-252  | WMO15N60VD | Tape and Reel  |
| WMP15N60VD | TO-251  | WMP15N60VD | Tube           |

## Marking Information



## Contact Information

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WAYON website: <http://www.way-on.com>

For additional information, please contact your local Sales Representative.

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