

## 650V 1.0Ω Super Junction Power MOSFET

### Description

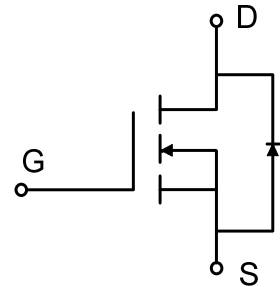
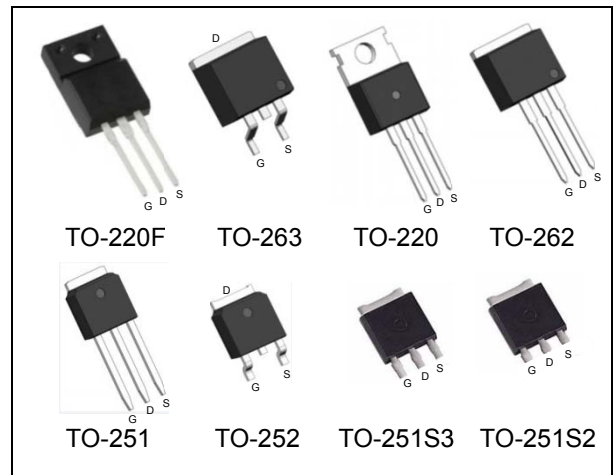
WMOS™ VD is Wayon's new high voltage power MOSFET family that is utilizing advanced technology for extremely low on-resistance and low gate charge performance. WMOS™ VD is suitable for applications which require superior power density and outstanding efficiency.

### Features

- $V_{DS} = 700V @ T_{j,max}$
- $I_{DM} = 10.5A$
- Typ.  $R_{DS(on)} = 1.0\Omega$
- 100% UIS tested
- Pb-free plating, Halogen free

### Applications

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



### Absolute Maximum Ratings

Parameter	Symbol	WMH_M_O_P_G_N_K	WML	Unit
Drain-source voltage	$V_{DSS}$	650		V
Continuous drain current <sup>1)</sup> ( $T_C = 25^\circ C$ )	$I_D$	6.5		A
		3		A
Pulsed drain current <sup>2)</sup>	$I_{DM}$	10.5		A
Gate-source voltage	$V_{GS}$	$\pm 30$		V
Avalanche energy, single pulse <sup>3)</sup>	$E_{AS}$	15		mJ
Avalanche energy, repetitive <sup>2)</sup>	$E_{AR}$	0.1		mJ
Avalanche current, repetitive <sup>2)</sup>	$I_{AR}$	0.7		A
Power dissipation ( $T_C = 25^\circ C$ )	$P_D$	42	23	W
Operating and storage temperature range	$T_i, T_{stg}$	-55 to +150		$^\circ C$
Continuous diode forward current <sup>1)</sup>	$I_S$	6.5		A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$	10.5		A

### Thermal Characteristics

Parameter	Symbol	WMH_M_O_P_G_N_K	WML	Unit
Thermal resistance, junction-to-case	$R_{\theta JC}$	3	5.4	$^\circ C/W$
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	$BV_{DSS}$	$V_{GS}=0\text{ V}, I_D=0.25\text{ mA}$	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.25\text{ mA}$	2.5	3.3	4.5	V
Drain cut-off current	$I_{DSS}$	$V_{DS}=650\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$	-	-	1	$\mu\text{A}$
Gate leakage current, forward	$I_{GSSF}$	$V_{GS}=30\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Gate leakage current, reverse	$I_{GSSR}$	$V_{GS}=-30\text{ V}, V_{DS}=0\text{ V}$	-	-	-100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=1\text{ A}$ $T_j = 25^\circ\text{C}$	-	1.0	1.13	$\Omega$
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS}=25\text{ V}, V_{GS}=0\text{ V},$	-	299	-	pF
Output capacitance	$C_{oss}$	$f = 1\text{ MHz}$	-	265	-	
Reverse transfer capacitance	$C_{rss}$		-	3	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{ V}, I_D = 2\text{ A}$	-	5	-	ns
Rise time	$t_r$	$R_G = 25\Omega, V_{GS}=10\text{ V}$	-	16	-	
Turn-off delay time	$t_{d(off)}$		-	24	-	
Fall time	$t_f$		-	12	-	
<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=480\text{ V}, I_D=2\text{ A},$	-	1.6	-	nC
Gate to drain charge	$Q_{gd}$	$V_{GS}=0\text{ to }10\text{ V}$	-	1.7	-	
Gate charge total	$Q_g$		-	5.8	-	
Gate plateau voltage	$V_{plateau}$		-	5	-	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	$t_{rr}$	$V_R=50\text{ V}, I_F=2\text{ A},$	-	163	-	ns
Reverse recovery charge	$Q_{rr}$	$dI_F/dt=100\text{ A}/\mu\text{s}$	-	0.84	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	10.3	-	A

## Notes:

- Limited by  $T_{j\max}$ . Maximum duty cycle  $D=0.5$ .
- Repetitive rating: pulse width limited by maximum junction temperature
- $I_{AS} = 0.7\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\Omega$ , starting  $T_j = 25^\circ\text{C}$

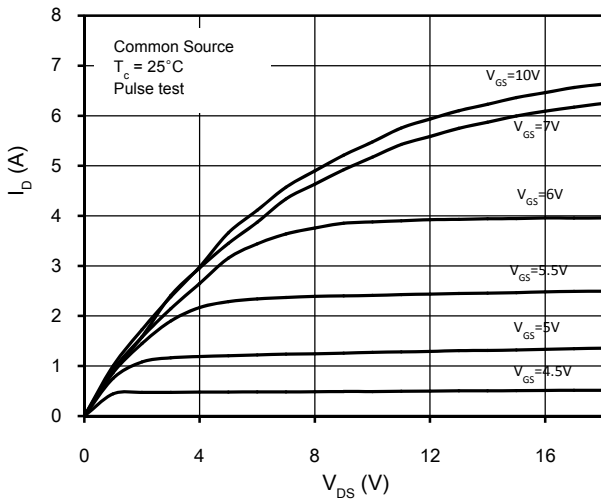


Figure 1. On-Region Characteristics

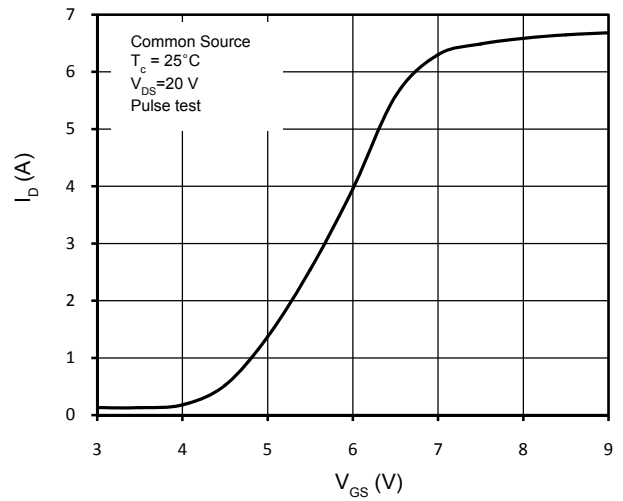


Figure 2. Transfer Characteristics

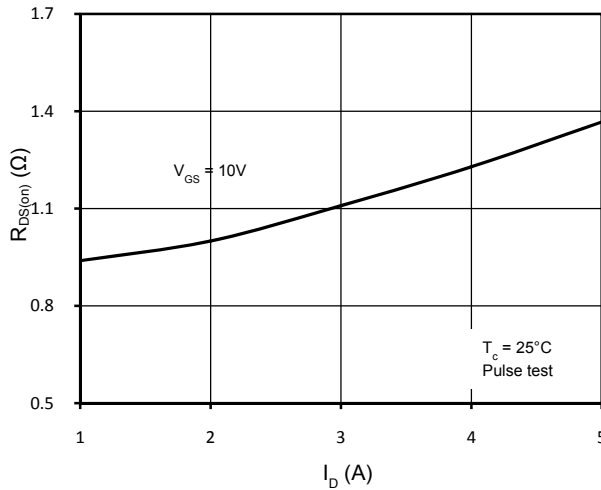


Figure 3. Static Drain-Source On Resistance

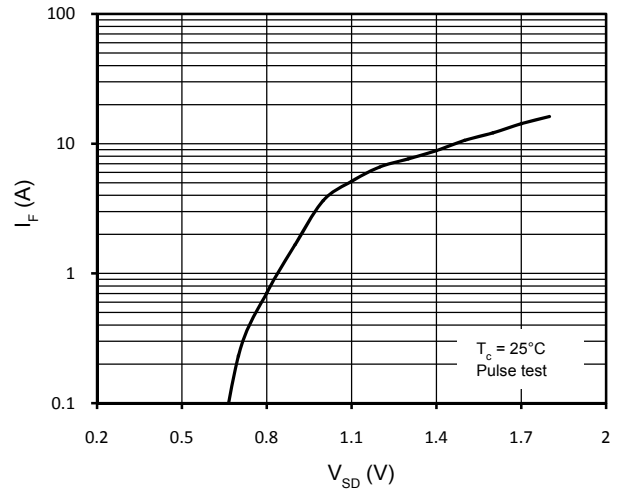


Figure 4. Body-Diode Forward Characteristics

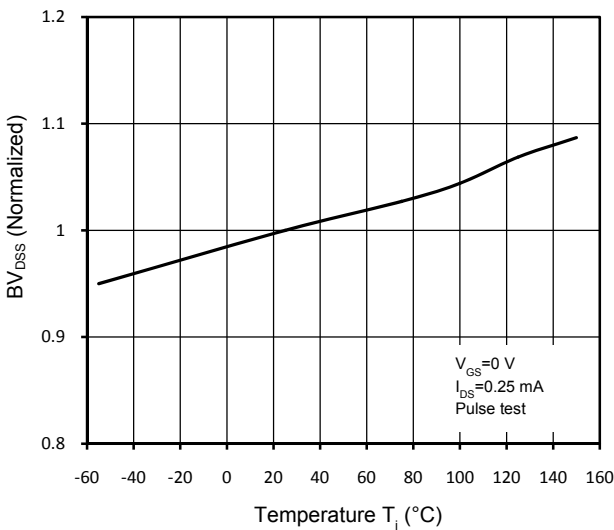


Figure 5. Normalized  $BV_{DS}$  vs. Temperature

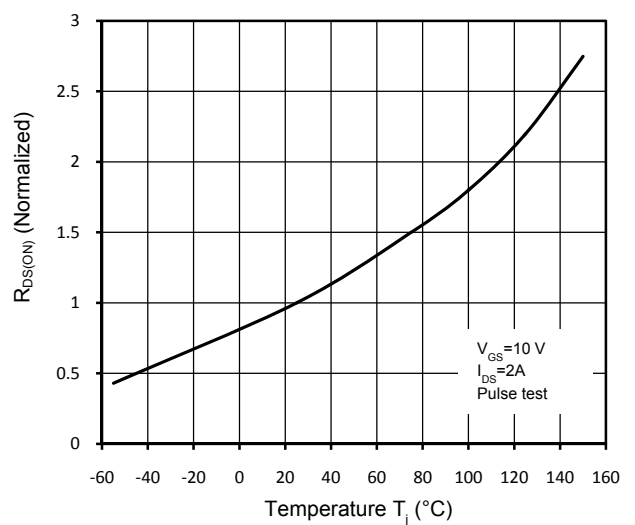


Figure 6. Normalized  $R_{DS(on)}$  vs. Temperature

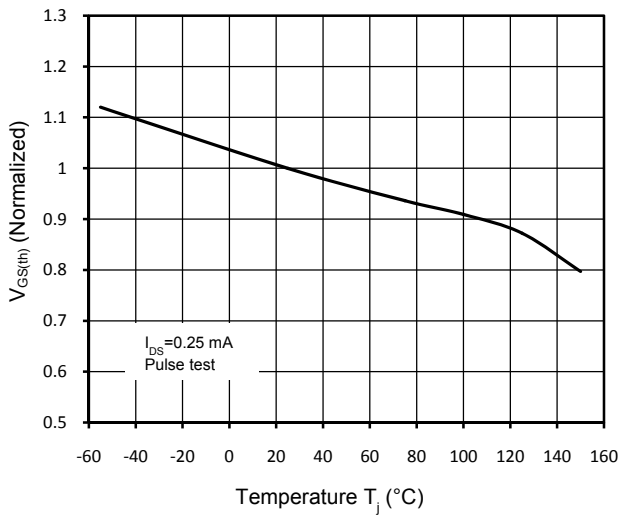


Figure 7. Threshold Voltage vs. Temperature

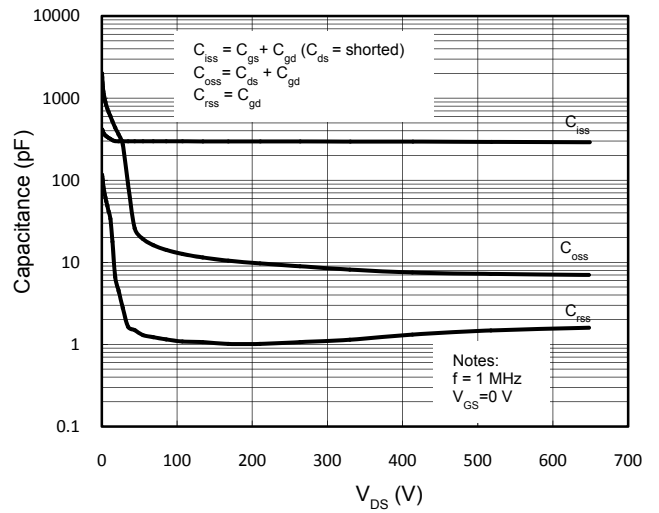


Figure 8. Capacitance Characteristics

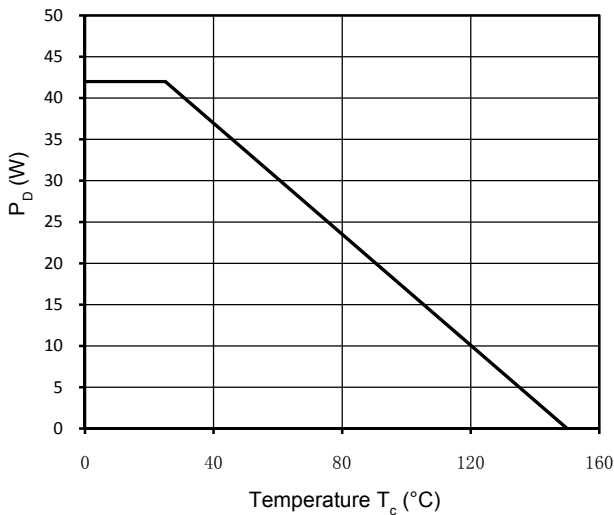


Figure 9. Power Dissipation

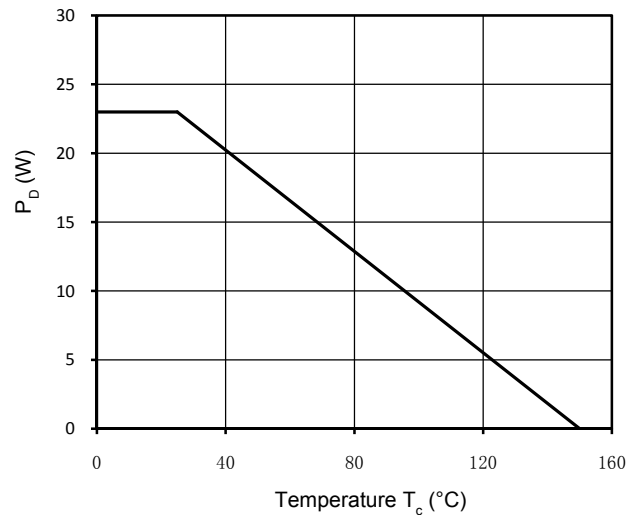


Figure 10. Power Dissipation (TO-220F)

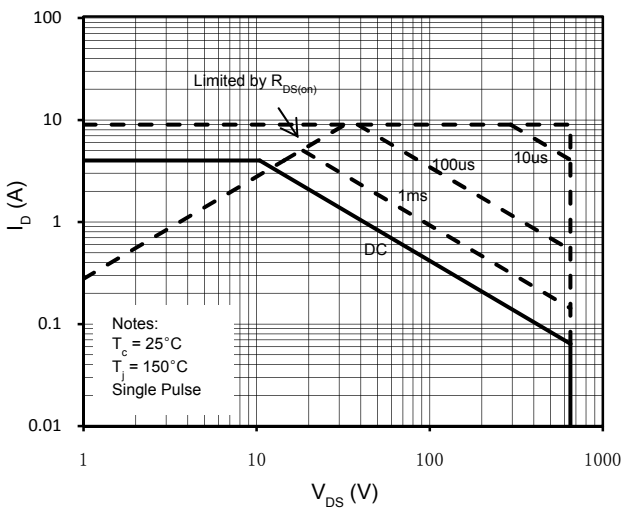


Figure 11. Maximum Safe Operating Area

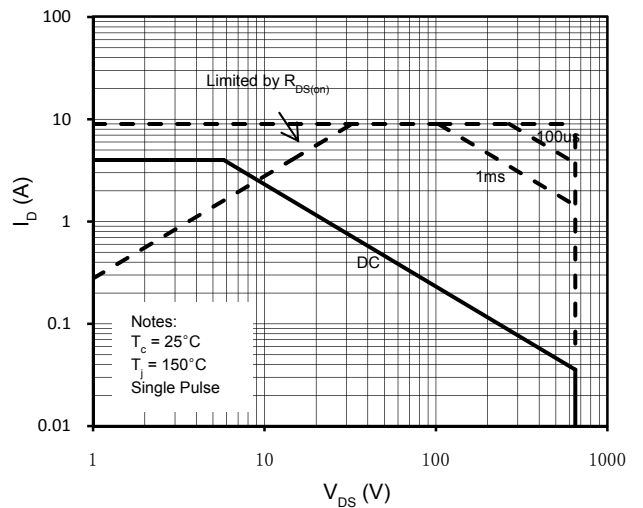


Figure 12. Maximum Safe Operating Area (TO-220F)

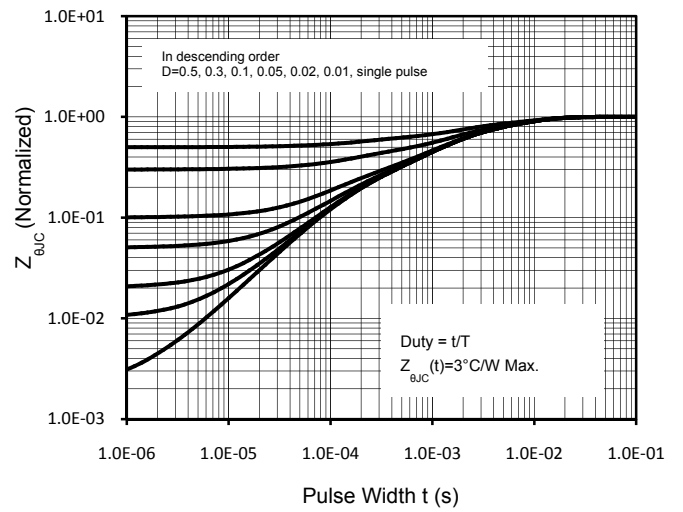
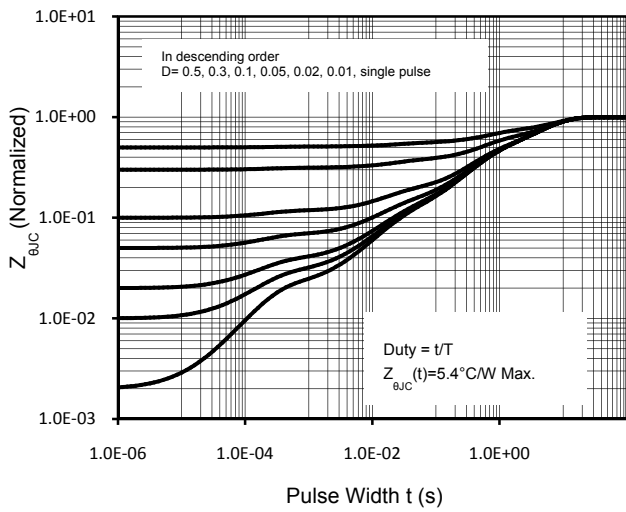


Figure 13. Transient Thermal Response Curve (TO-220F) Figure 14. Transient Thermal Response Curve

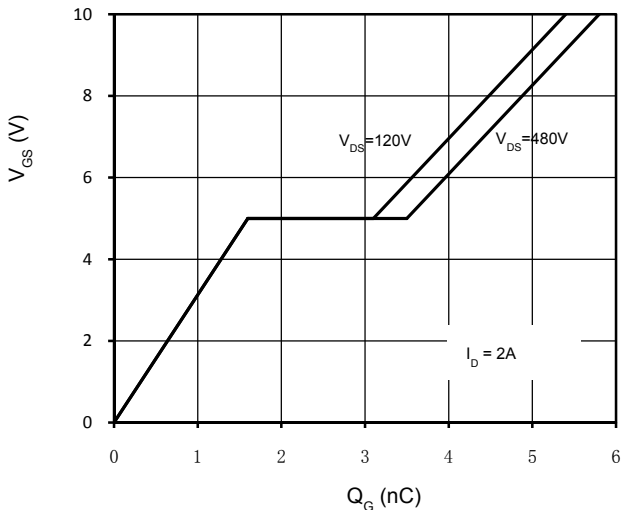


Figure 15. Gate Charge Characteristics

**Gate Charge Test Circuit & Waveform**



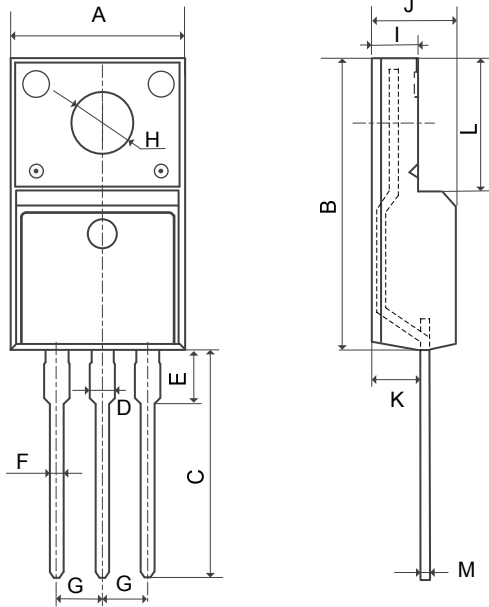
**Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



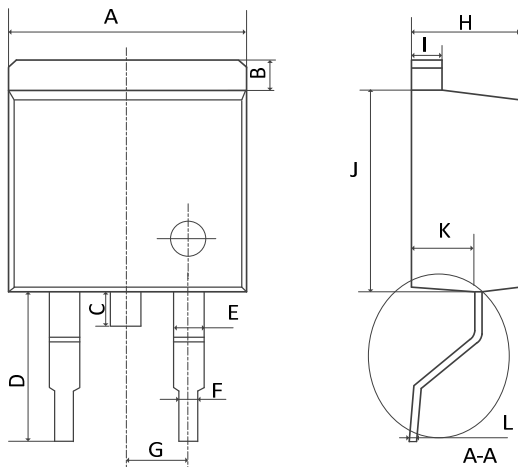
**Mechanical Dimensions for TO-220F**



**COMMON DIMENSIONS**

SYMBOL	MM	
	MIN	MAX
A	9.96	10.36
B	15.67	16.07
C	12.70	13.30
D	1.12	1.32
E	1.85	2.15
F	0.59	0.79
G	2.39	2.69
H	3.08	3.29
I	2.34	2.74
J	4.50	4.90
K	2.61	2.91
L	6.50	6.90
M	0.40	0.60

**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**

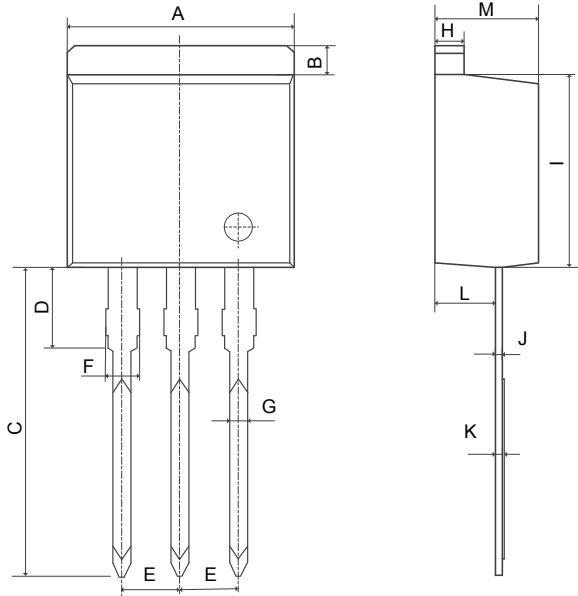


**COMMON DIMENSIONS**

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



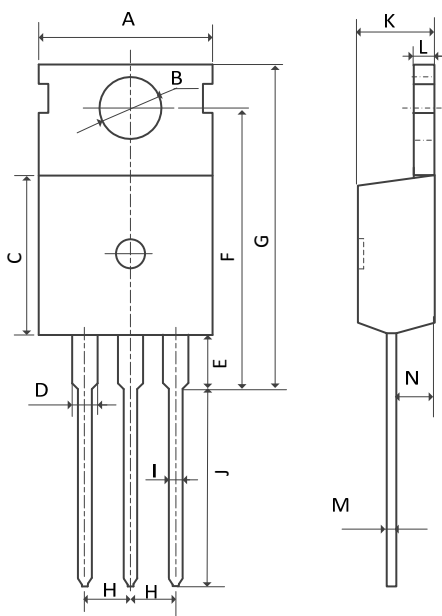
**Mechanical Dimensions for TO-262**



**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

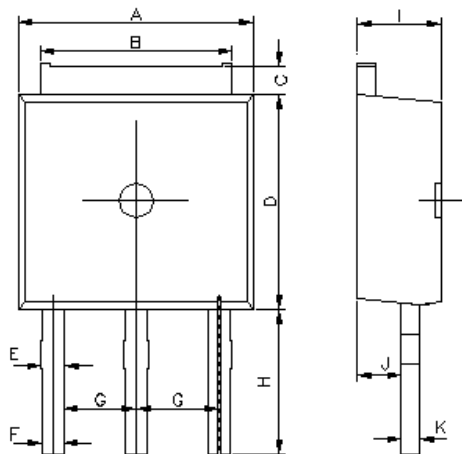
**Mechanical Dimensions for TO-220**



**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

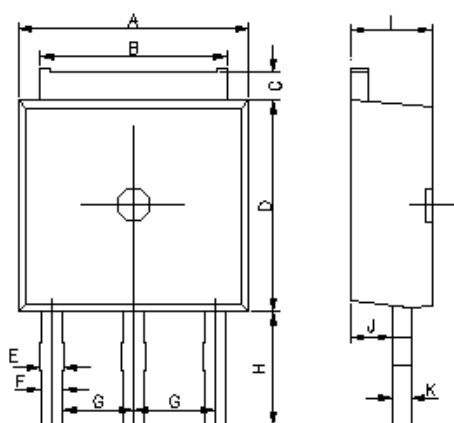
**Mechanical Dimensions for TO-251S3**



**COMMON DIMENSIONS**

SYMBOL	MM	
	MIN	MAX
A	6.40	6.80
B	5.15	5.48
C	0.71	1.02
D	5.95	6.35
E	0.70	1.00
F	0.70	0.90
G	2.13	2.44
H	3.20	3.80
I	2.10	2.50
J	0.85	1.15
K	0.40	0.61

**Mechanical Dimensions for TO-251S2**



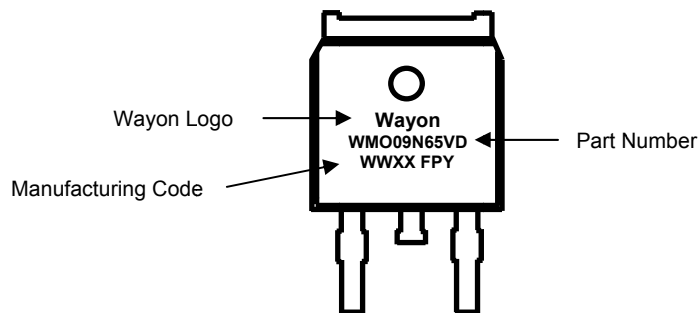
**COMMON DIMENSIONS**

SYMBOL	MM	
	MIN	MAX
A	6.40	6.80
B	5.15	5.48
C	0.71	1.02
D	5.95	6.35
E	0.70	1.00
F	0.70	0.90
G	2.13	2.44
H	2.20	2.80
I	2.10	2.50
J	0.85	1.15
K	0.40	0.61

## Ordering Information

Part	Package	Marking	Packing method
WML09N65VD	TO-220F	WML09N65VD	Tube
WMM09N65VD	TO-263	WMM09N65VD	Tape and Reel
WMK09N65VD	TO-220	WMK09N65VD	Tube
WMN09N65VD	TO-262	WMN09N65VD	Tube
WMO09N65VD	TO-252	WMO09N65VD	Tape and Reel
WMP09N65VD	TO-251	WMP09N65VD	Tube
WMG09N65VD	TO-251S3	WMG09N65VD	Tube
WMH09N65VD	TO-251S2	WMH09N65VD	Tube

## Marking Information



## Contact Information

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

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