

### Features

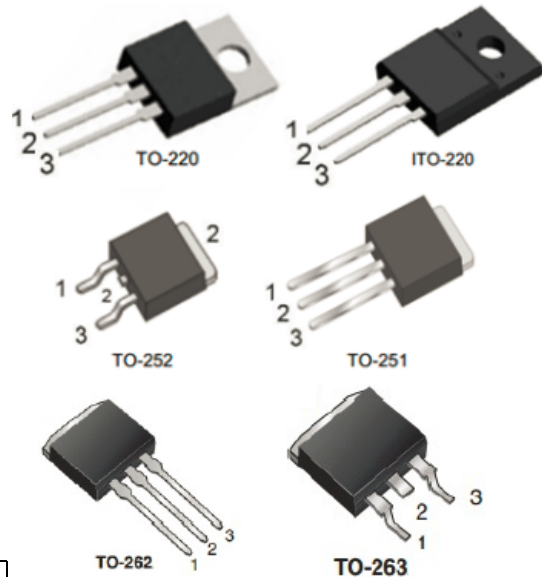
- $R_{DS(ON)} < 3.6\Omega @ V_{GS} = 10V, I_D = 1.5A$
- Fast switching capability
- Lead free in compliance with EU RoHS directive.
- Improved dv/dt capability, high ruggedness

### Mechanical Data

- Case: TO-251, TO-252, TO-220, ITO-220  
TO-262, TO-263 Package

### Ordering Information

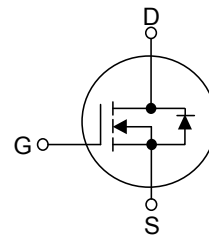
Part No.	Package	Packing
3N60P	TO-251	75pcs / Tube
3N60D	TO-252	75pcs / Tube
3N60T	TO-220	50pcs / Tube
3N60F	ITO-220	50pcs / Tube
3N60K	TO-262	50pcs / Tube
3N60G	TO-263	50pcs / Tube



Pin Definition:

1. Gate
2. Drain
3. Source

### Block Diagram



### Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise specified

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	600	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	3.0	A
Continuous Drain Current		$I_D$	3.0	A
Pulsed Drain Current (Note 2)		$I_{DM}$	12	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	200	mJ
Power Dissipation	TO-220/TO-262/TO-263	$P_D$	75	W
	ITO-220		34	W
	TO-251/TO-252		50	W
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Operating Temperature		$T_{OPR}$	-55 ~ +150	$^\circ\text{C}$
Storage Temperature		$T_{STG}$	-55 ~ +150	$^\circ\text{C}$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating : Pulse width limited by  $T_J$ .

3.  $L = 44.4\text{mH}$ ,  $I_{AS}=3\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$



## THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/ITO-220 TO-262/TO-263	$\theta_{JA}$	62.5	°C/W
	TO-251/ TO-252		110	
	TO-220/TO-262/TO-263		1.70	
Junction to Case	ITO-220	$\theta_{JC}$	3.70	°C/W
	TO-251/ TO-252		2.6	

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified)

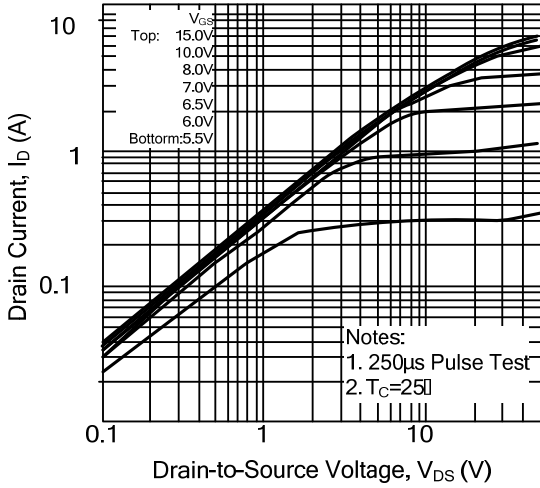
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>							
Drain-Source Breakdown Voltage		BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600			V
Drain-Source Leakage Current		I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V			100	nA
	Reverse		V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V			-100	nA
<b>ON CHARACTERISTICS</b>							
Gate Threshold Voltage		V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		R <sub>DS(ON)</sub>	V <sub>GS</sub> =10 V, I <sub>D</sub> =1.5A			3.6	Ω
<b>DYNAMIC CHARACTERISTICS</b>							
Input Capacitance		C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1MHz		350	450	pF
Output Capacitance		C <sub>OSS</sub>			50	65	pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			5.5	7.5	pF
<b>SWITCHING CHARACTERISTICS</b>							
Turn-On Delay Time		t <sub>D(ON)</sub>	V <sub>DD</sub> = 30V, I <sub>D</sub> = 0.5A, R <sub>G</sub> = 25Ω (Note 1, 2)		35	50	ns
Turn-On Rise Time		t <sub>R</sub>			60	70	ns
Turn-Off Delay Time		t <sub>D(OFF)</sub>			100	150	ns
Turn-Off Fall Time		t <sub>F</sub>			65	75	ns
Total Gate Charge		Q <sub>G</sub>	V <sub>DS</sub> =50V, I <sub>D</sub> =1.3 A, I <sub>G</sub> =100μA V <sub>GS</sub> =10V (Note 1, 2)		18.5	23	nC
Gate-Source Charge		Q <sub>GS</sub>			5.2	-	nC
Gate-Drain Charge		Q <sub>GD</sub>			4.9	-	nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>							
Drain-Source Diode Forward Voltage		V <sub>SD</sub>	V <sub>GS</sub> =0 V, I <sub>S</sub> =3.0A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current		I <sub>S</sub>				3.0	A
Maximum Pulsed Drain-Source Diode Forward Current		I <sub>SM</sub>				12	A
Reverse Recovery Time		t <sub>rr</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3A,		210		ns
Reverse Recovery Charge		Q <sub>RR</sub>	di <sub>F</sub> /dt = 100 A/μs (Note 1)		1.2		μC

- Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%  
2. Essentially independent of operating temperature

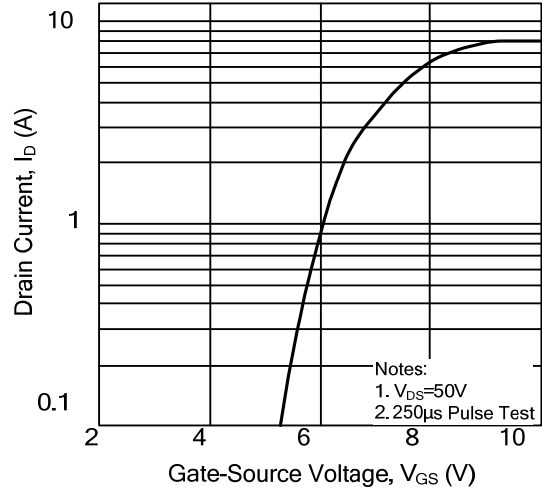


## TYPICAL CHARACTERISTICS

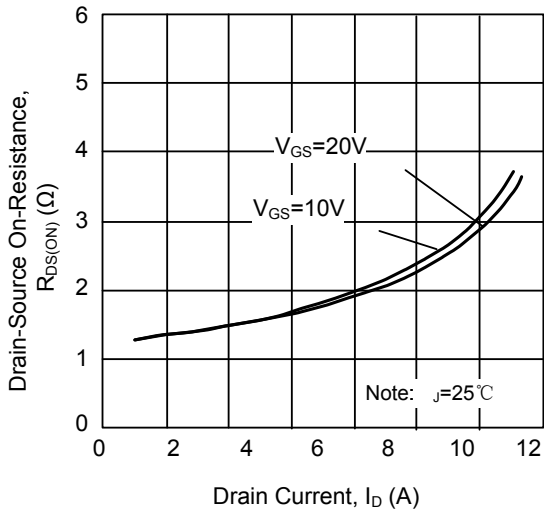
On-State Characteristics



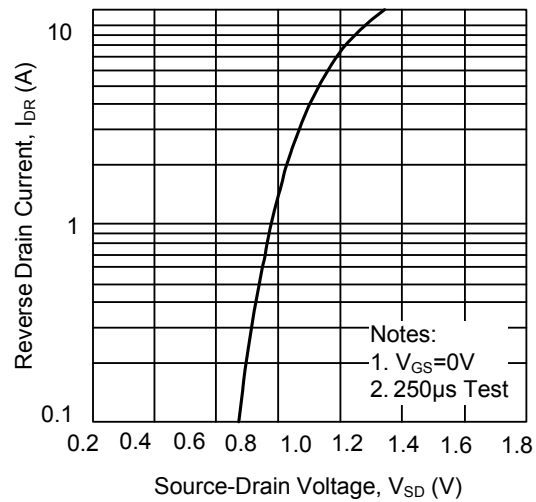
Transfer Characteristics



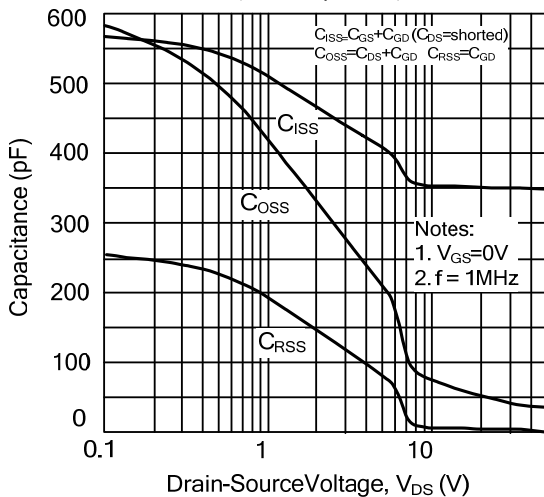
On-Resistance Variation vs. Drain Current and Gate Voltage



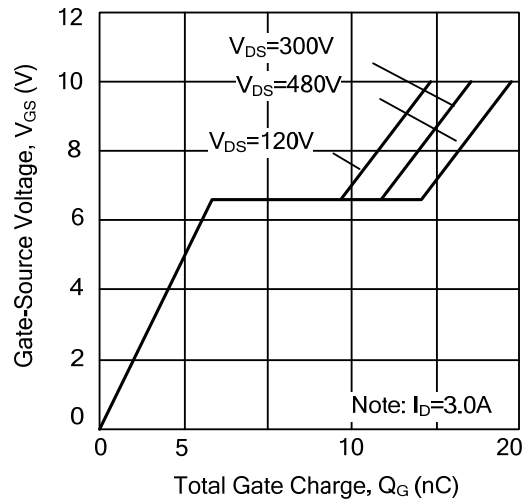
On State Current vs. Allowable Case Temperature



Capacitance Characteristics (Non-Repetitive)

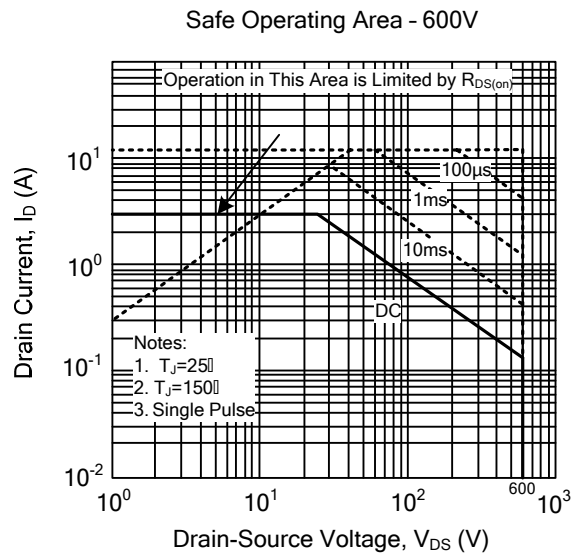
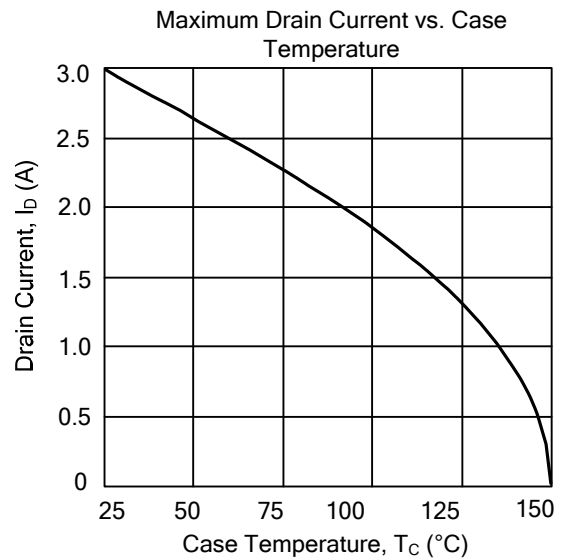
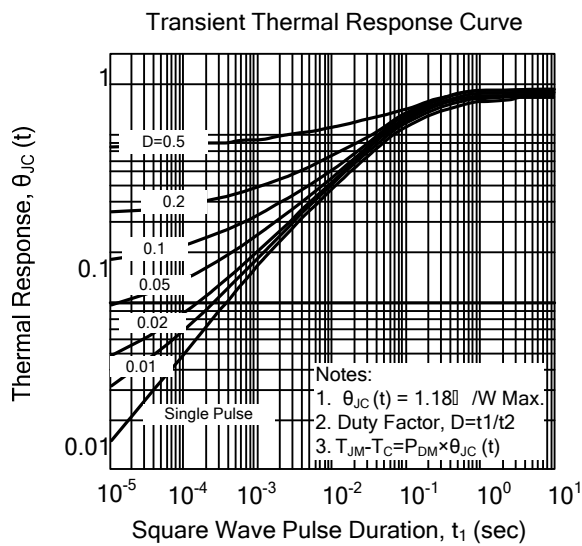
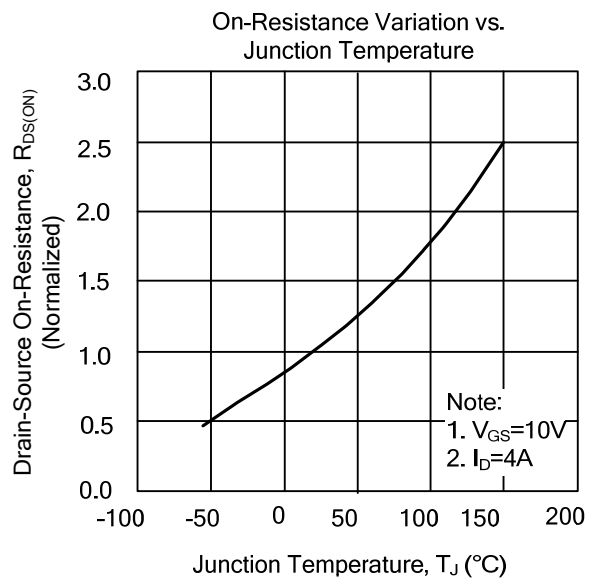
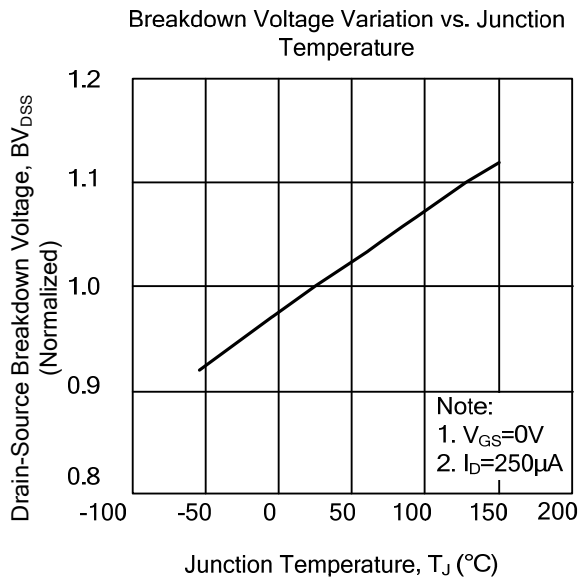


Gate Charge Characteristics

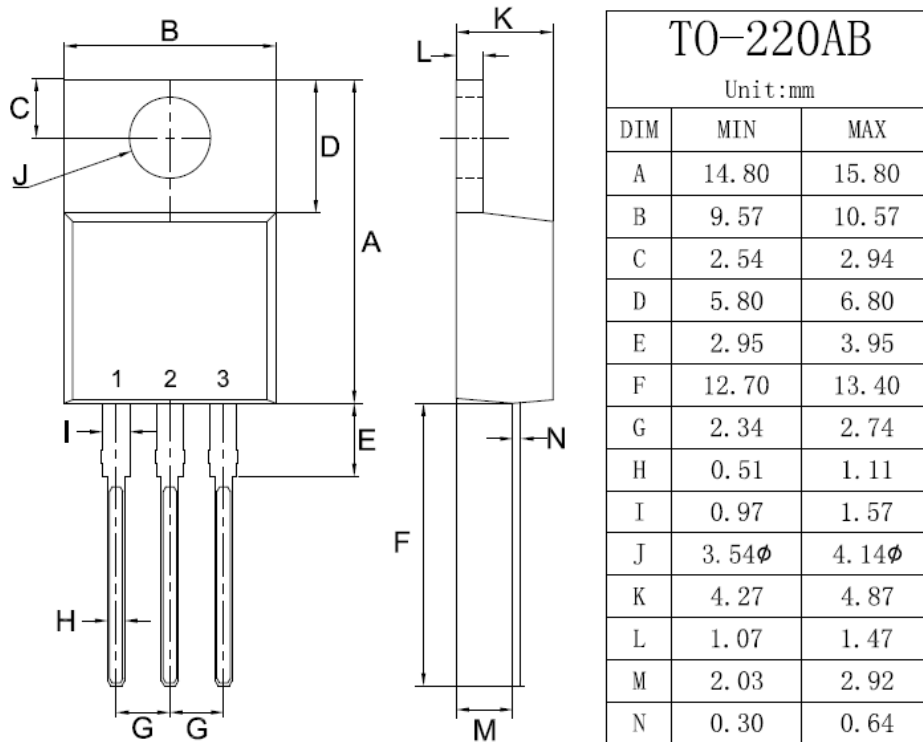




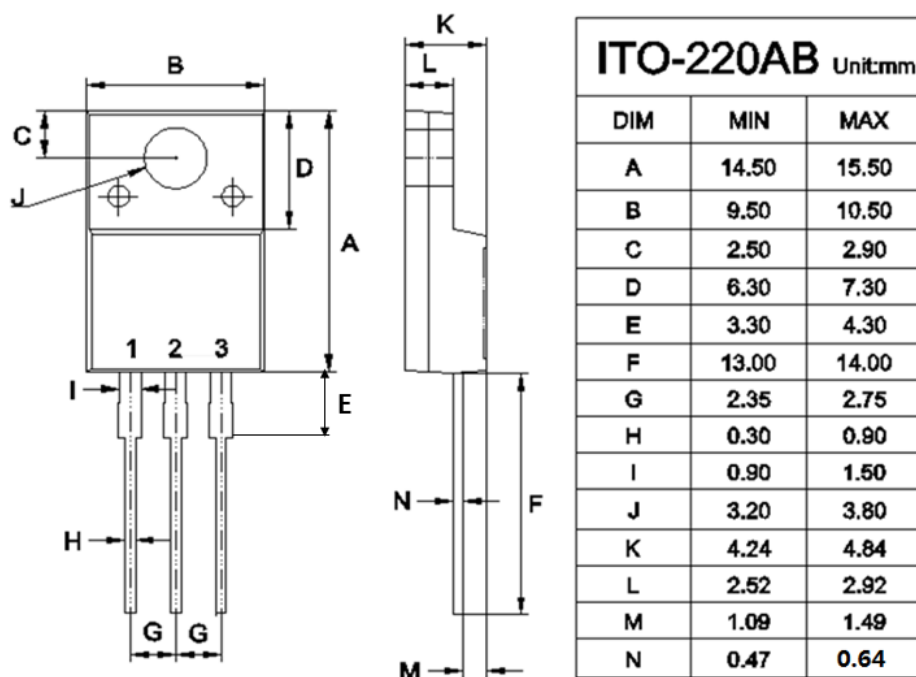
## TYPICAL CHARACTERISTICS



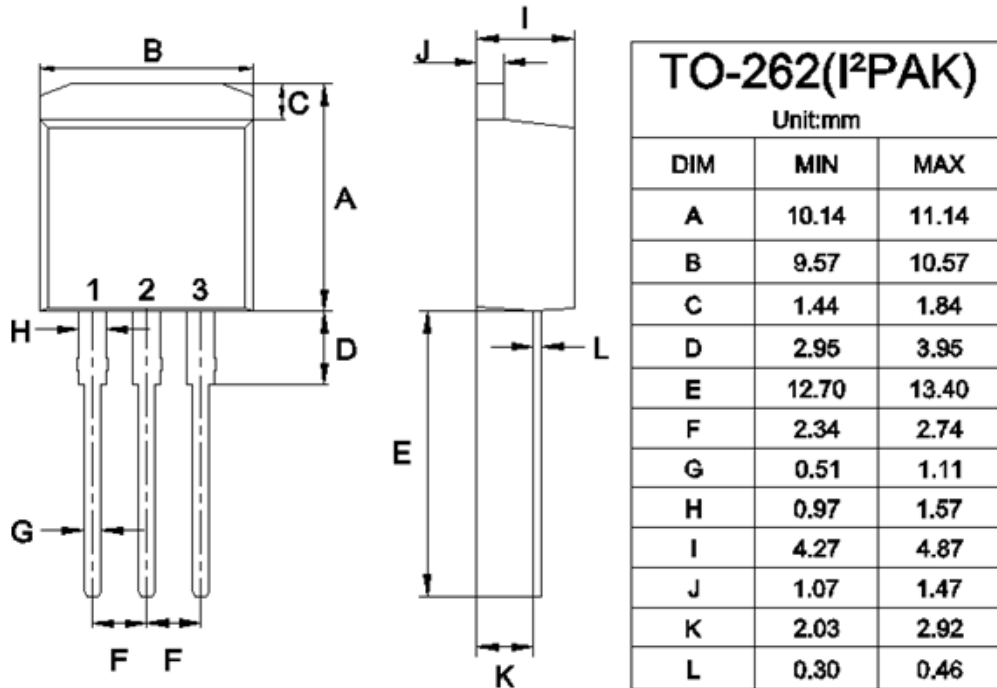
## TO-220 Mechanical Drawing



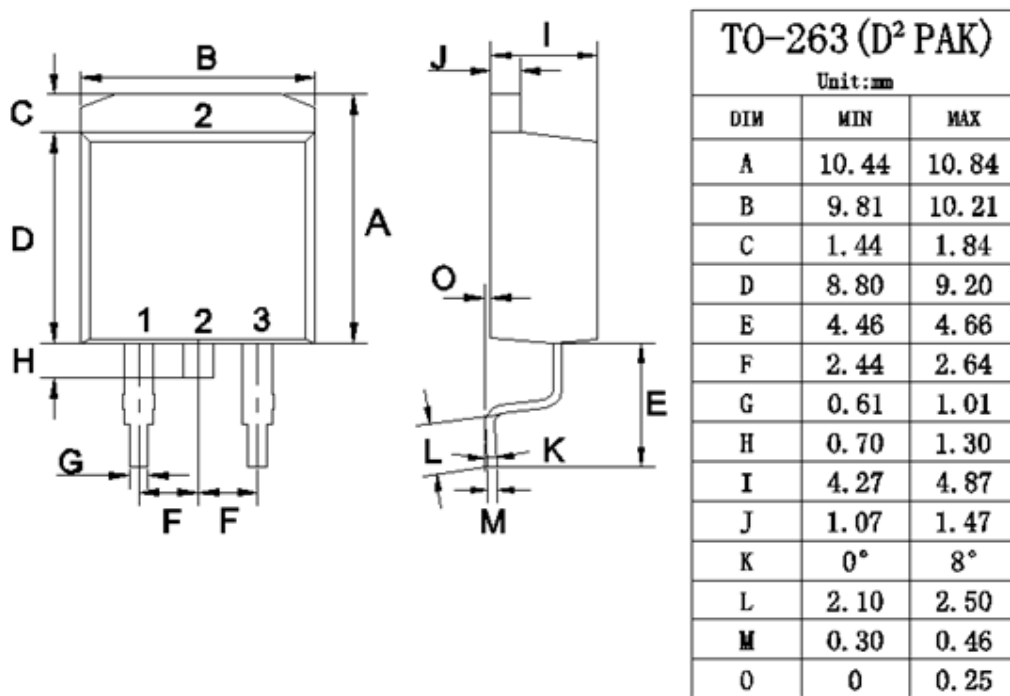
## ITO-220 Mechanical Drawing



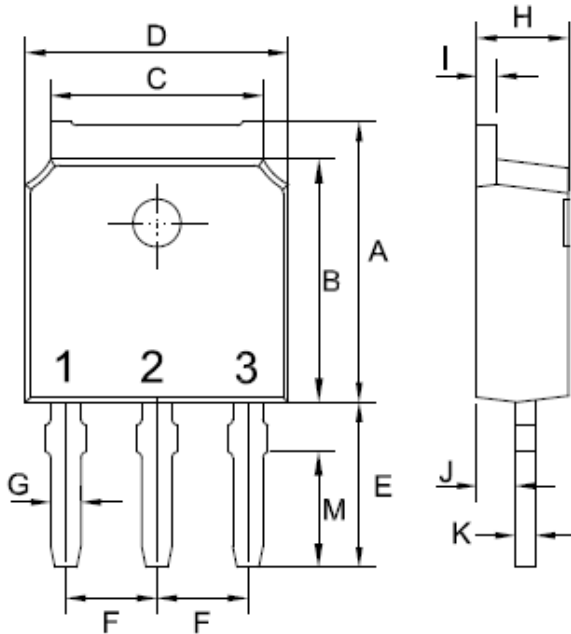
### TO-262 Mechanical Drawing



### TO-263 Mechanical Drawing

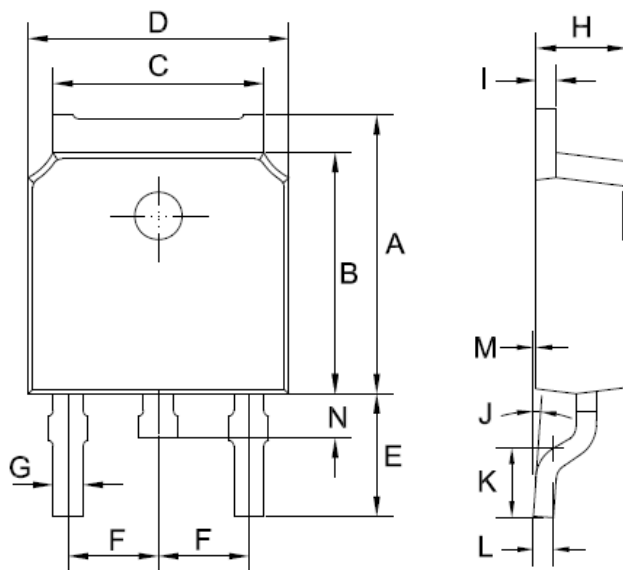


## TO-251 Mechanical Drawing



TO-251(IPAK)		
Unit:mm		
DIM	MIN	MAX
A	6.85	7.25
B	5.90	6.30
C	5.13	5.53
D	6.40	6.80
E	3.95	4.35
F	2.19	2.39
G	0.45	0.85
H	2.20	2.40
I	0.41	0.61
J	0.71	1.31
K	0.41	0.61
M	2.96	3.16

## TO-252 Mechanical Drawing



TO-252 (DPAK)		
Unit:mm		
DIM	MIN	MAX
A	6.85	7.25
B	5.90	6.30
C	5.13	5.53
D	6.40	6.80
E	2.90	3.30
F	2.19	2.39
G	0.45	0.85
H	2.20	2.40
I	0.41	0.61
J	0°	8°
K	1.45	1.85
L	0.41	0.61
M	0.00	0.12
N	0.60	1.00