N-Channel 650V (D-S) Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. at 25 °C (Ω)	V_{GS} = 10 V	1.1
Q_g max. (nC)	25	
Q_{gs} (nC)	2.0	
Q_{gd} (nC)	2.7	
Configuration	Single	

FEATURES

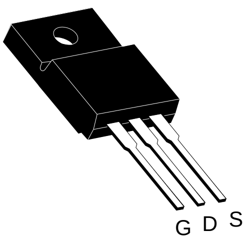
- Low figure-of-merit (FOM) R_{on} x Q_g
- Low input capacitance (C_{iss})
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)

RoHS

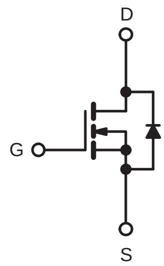
APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial

TO-220 FULLPAK



Top View



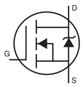
N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)					
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V_{DS}	650	V
Gate-Source Voltage			V_{GS}	± 30	
Continuous Drain Current (T_J = 150 °C)	V_{GS} at 10 V	T_C = 25 °C	I_D	7.0	A
		T_C = 100 °C		5.6	
Pulsed Drain Current [a]			I_{DM}	28	
Linear Derating Factor				1.67/1.5/0.3	W/°C
Single Pulse Avalanche Energy [b]			E_{AS}	86	mJ
Maximum Power Dissipation			P_D	83/83/31	W
Operating Junction and Storage Temperature Range			T_J, T_{stg}	-55 to +150	°C
Drain-Source Voltage Slope	T_J = 125 °C		dV/dt	50	V/ns
Reverse Diode dV/dt [d]				4.5	
Soldering Recommendations (Peak Temperature) [c]	for 10 s			300	°C

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature.
b. V_{DD} = 50 V, starting T_J = 25 °C, L = 28.2 mH, R_g = 25 Ω, I_{AS} = 3.5 A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/μs, starting T_J = 25 °C.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	63	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.6	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 μA	650	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA	-	0.65	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	2.5	-	5	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 20 V	-	-	± 100	nA
		V_{GS} = ± 30 V	-	-	± 1	μA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650 V, V_{GS} = 0 V	-	-	1	μA
		V_{DS} = 520 V, V_{GS} = 0 V, T_J = 125 °C	-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 4 A	-	1.1	-	Ω
Forward Transconductance	g_{fs}	V_{DS} = 30 V, I_D = 4 A	-	16	-	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	-	860	-	pF
Output Capacitance	C_{oss}		-	120	-	
Reverse Transfer Capacitance	C_{rss}		-	15	-	
Effective Output Capacitance, Energy Related [a]	$C_{o(er)}$	V_{DS} = 0 V to 520 V, V_{GS} = 0 V	-	45	-	
Effective Output Capacitance, Time Related [b]	$C_{o(tr)}$		-	62	-	
Total Gate Charge	Q_g	V_{GS} = 10 V, I_D = 4 A, V_{DS} = 520 V	-	25		nC
Gate-Source Charge	Q_{gs}		-	2.0	-	
Gate-Drain Charge	Q_{gd}		-	2.7	-	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 520 V, I_D = 4 A, V_{GS} = 10 V, R_g = 9.1 Ω	-	25	-	ns
Rise Time	t_r		-	55	-	
Turn-Off Delay Time	$t_{d(off)}$		-	70	-	
Fall Time	t_f		-	40	-	
Gate Input Resistance	R_g	f = 1 MHz, open drain	-	3.5	-	Ω
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	7	A
Pulsed Diode Forward Current	I_{SM}		-	-	18	
Diode Forward Voltage	V_{SD}	T_J = 25 °C, I_S = 4 A, V_{GS} = 0 V	-	-	1.5	V
Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = I_S = 4 A, dI/dt = 100 A/μs, V_R = 400 V	-	190	-	ns
Reverse Recovery Charge	Q_{rr}		-	2.3	-	μC
Reverse Recovery Current	I_{RRM}		-	10	-	A

Notes

a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS}.
b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS}.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

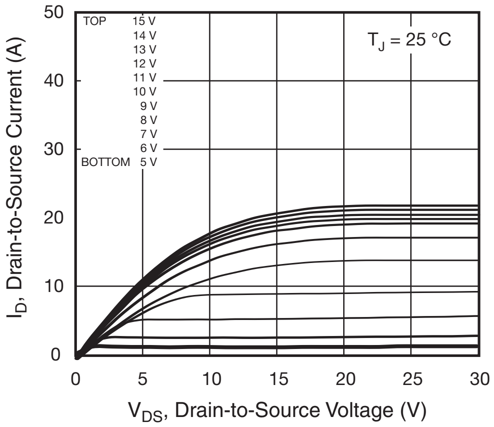


Fig. 1 - Typical Output Characteristics

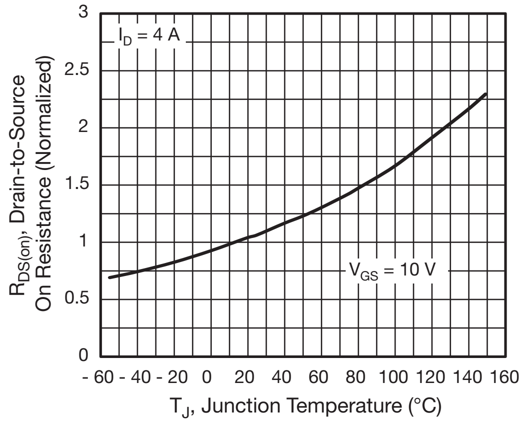


Fig. 4 - Normalized On-Resistance vs. Temperature

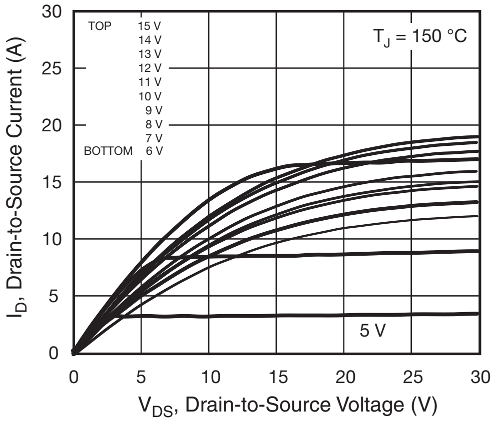


Fig. 2 - Typical Output Characteristics

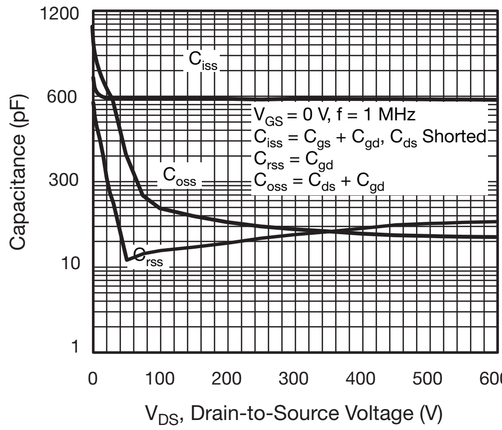


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

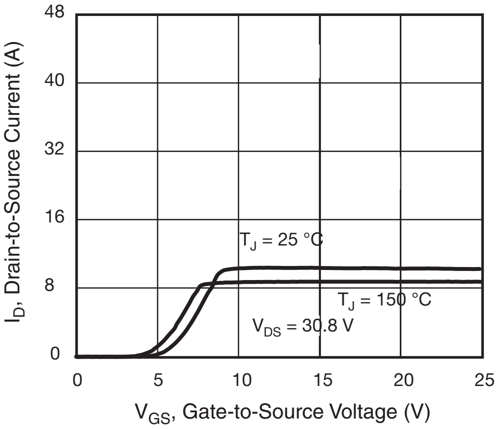


Fig. 3 - Typical Transfer Characteristics

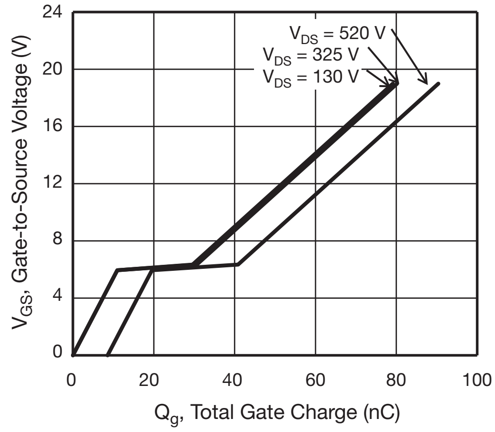


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

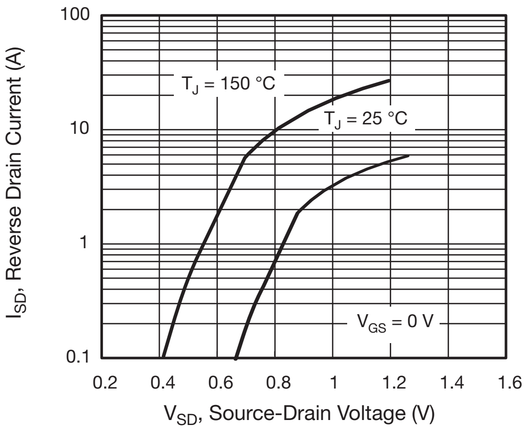


Fig. 7 - Typical Source-Drain Diode Forward Voltage

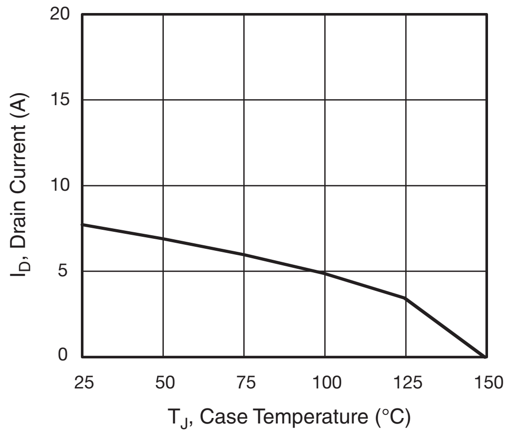


Fig. 9 - Maximum Drain Current vs. Case Temperature

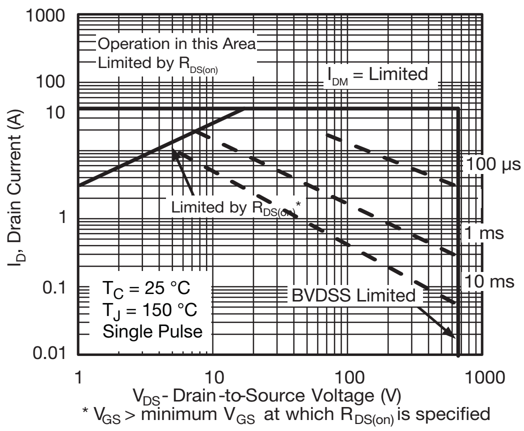


Fig. 8 - Maximum Safe Operating Area

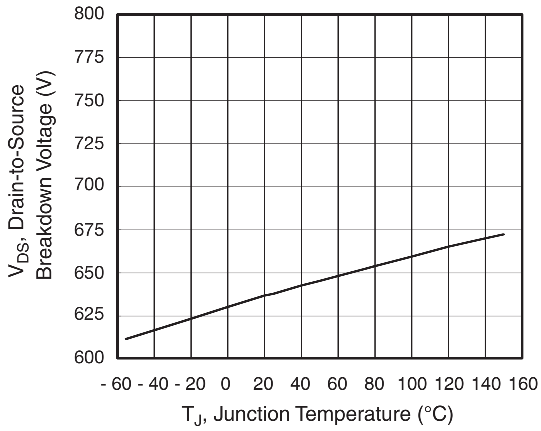


Fig. 10 - Temperature vs. Drain-to-Source Voltage

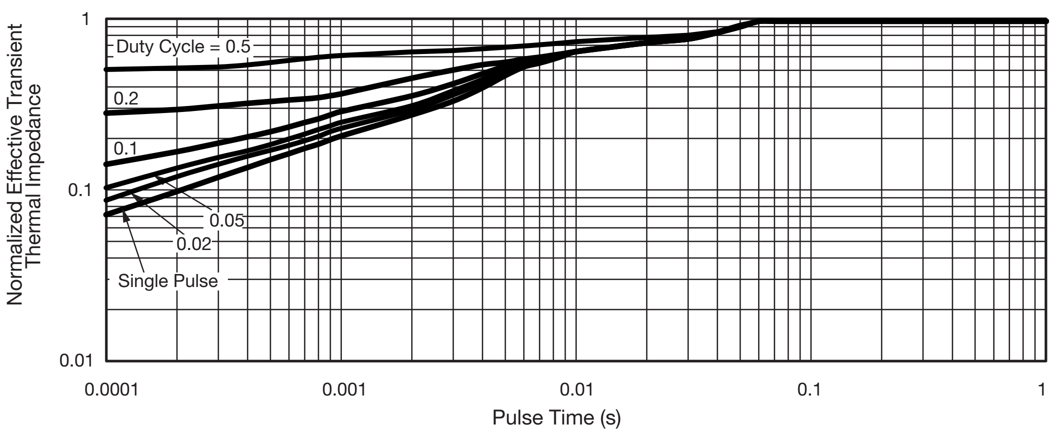


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

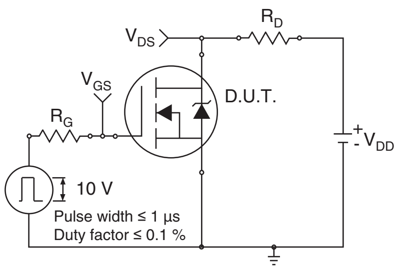


Fig. 12 - Switching Time Test Circuit

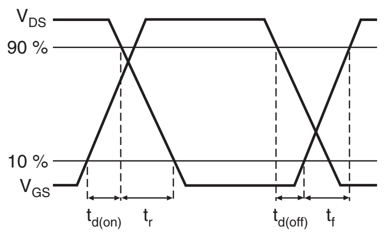


Fig. 13 - Switching Time Waveforms

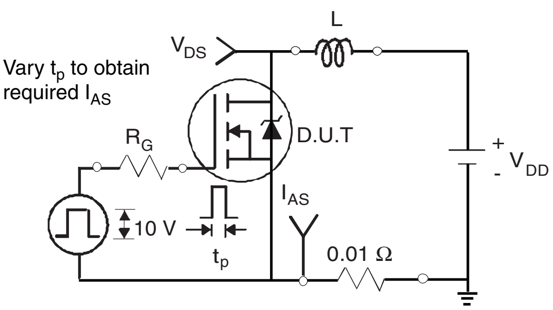


Fig. 14 - Unclamped Inductive Test Circuit

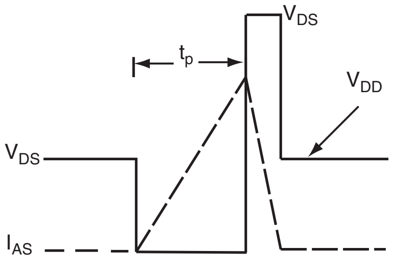


Fig. 15 - Unclamped Inductive Waveforms

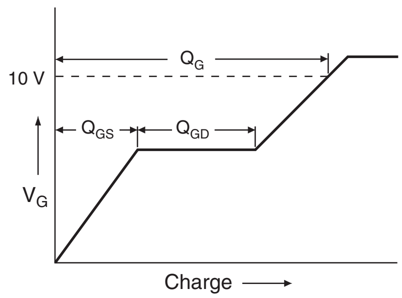


Fig. 16 - Basic Gate Charge Waveform

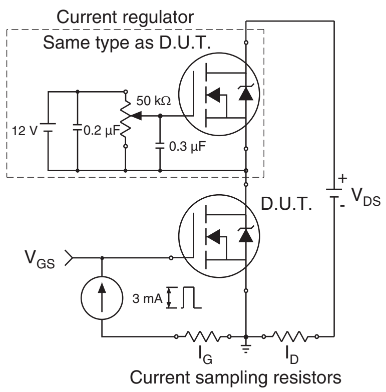
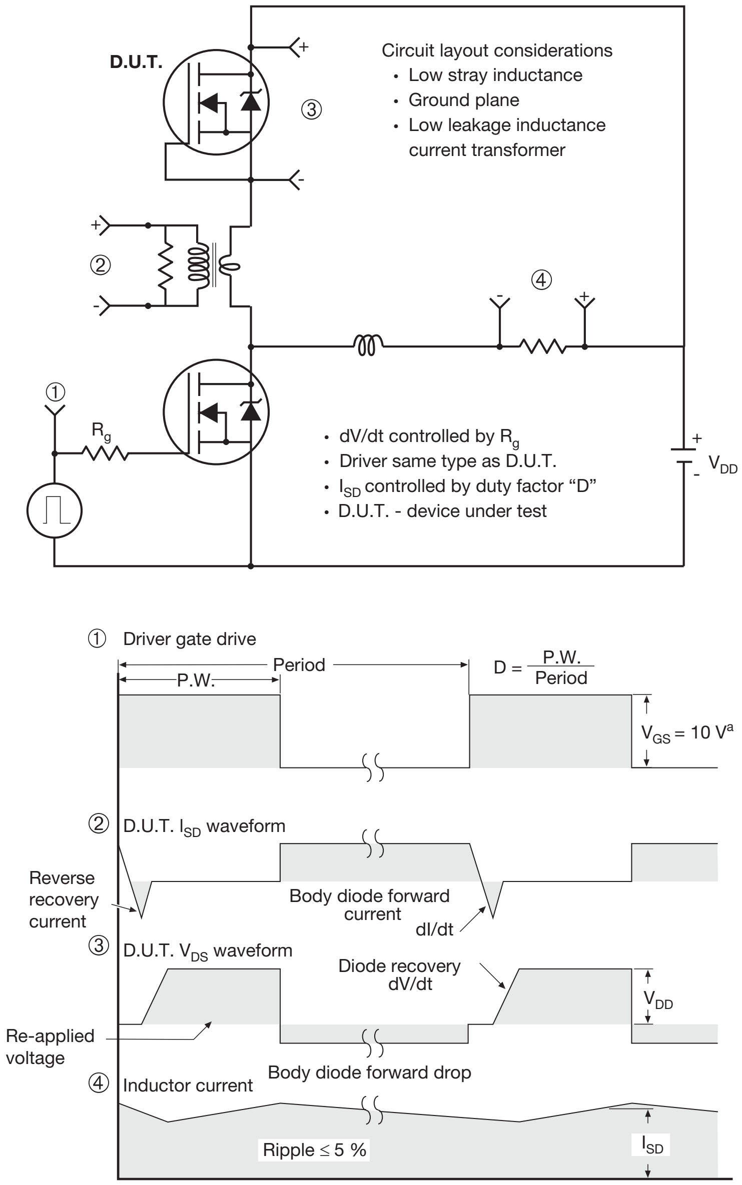


Fig. 17 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

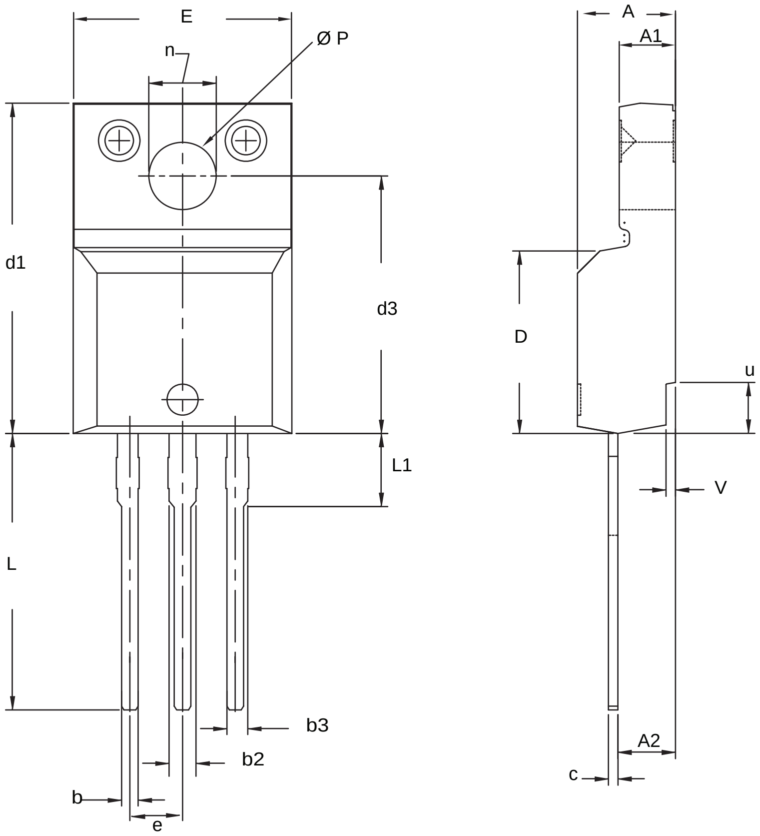


Note

a. V_{GS} = 5 V for logic level devices

Fig. 18 - For N-Channel

TO-220 FULLPAK (HIGH VOLTAGE)



	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
A	4.570	4.830	0.180	0.190
A1	2.570	2.830	0.101	0.111
A2	2.510	2.850	0.099	0.112
b	0.622	0.890	0.024	0.035
b2	1.229	1.400	0.048	0.055
b3	1.229	1.400	0.048	0.055
c	0.440	0.629	0.017	0.025
D	8.650	9.800	0.341	0.386
d1	15.88	16.120	0.622	0.635
d3	12.300	12.920	0.484	0.509
E	10.360	10.630	0.408	0.419
e	2.54 BSC		0.100 BSC	
L	13.200	13.730	0.520	0.541
L1	3.100	3.500	0.122	0.138
n	6.050	6.150	0.238	0.242
Ø P	3.050	3.450	0.120	0.136
u	2.400	2.500	0.094	0.098
v	0.400	0.500	0.016	0.020
ECN: X09-0126-Rev. B, 26-Oct-09 DWG: 5972				

Notes

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk} > 1.33$.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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