

## 2N90L-TF3-T-VB Datasheet

### N-Channel 950 V (D-S) Power MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	950	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	3.5
$Q_g$ (Max.) (nC)	78	
$Q_{gs}$ (nC)	10	
$Q_{gd}$ (nC)	42	
Configuration	Single	

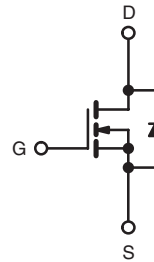
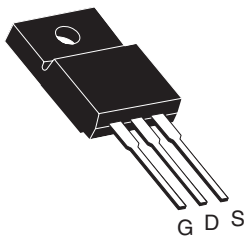
#### FEATURES

- Isolated Package
- High Voltage Isolation = 2.5 kV<sub>RMS</sub> (t = 60 s; f = 60 Hz)
- Sink to Lead Creepage Distance = 4.8 mm
- Dynamic dV/dt Rating
- Low Thermal Resistance
- Lead (Pb)-free Available



Available  
**RoHS\***  
 COMPLIANT

TO-220 FULLPAK



N-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			$V_{DS}$	950	V
Gate-Source Voltage			$V_{GS}$	$\pm 20$	
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^{\circ}\text{C}$	$I_D$	3.0	A
		$T_C = 100\text{ }^{\circ}\text{C}$		2.3	
Pulsed Drain Current <sup>a</sup>			$I_{DM}$	10	
Linear Derating Factor				0.28	W/ $^{\circ}\text{C}$
Single Pulse Avalanche Energy <sup>b</sup>			$E_{AS}$	220	mJ
Repetitive Avalanche Current <sup>a</sup>			$I_{AR}$	1.9	A
Repetitive Avalanche Energy <sup>a</sup>			$E_{AR}$	3.5	mJ
Maximum Power Dissipation		$T_C = 25\text{ }^{\circ}\text{C}$	$P_D$	35	W
Peak Diode Recovery $dV/dt^c$			$dV/dt$	1.5	V/ns
Operating Junction and Storage Temperature Range			$T_J, T_{stg}$	- 55 to + 150	$^{\circ}\text{C}$
Soldering Recommendations (Peak Temperature)		for 10 s		300 <sup>d</sup>	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

#### Notes

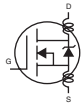

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 115\text{ mH}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 1.9\text{ A}$  (see fig. 12).
- $I_{SD} \leq 3.6\text{ A}$ ,  $dI/dt \leq 70\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 600$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.6	

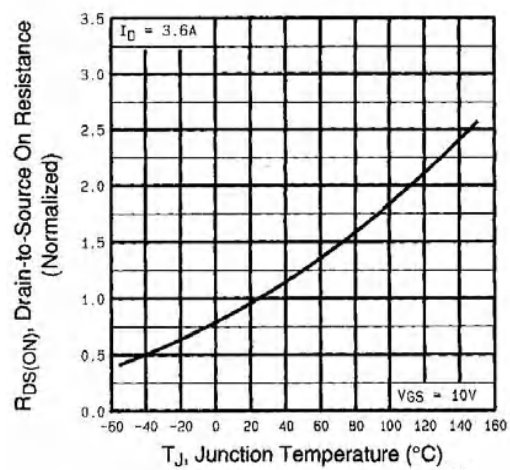
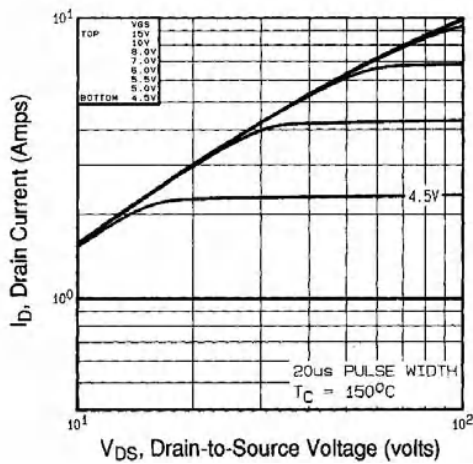
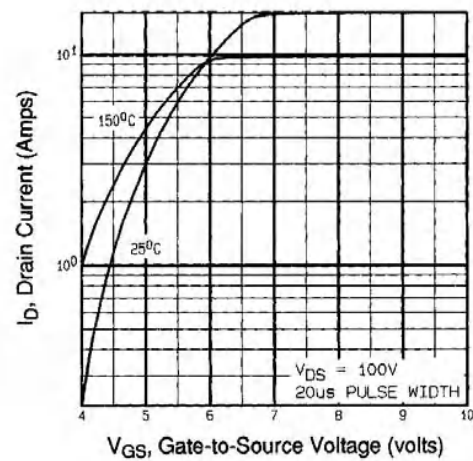
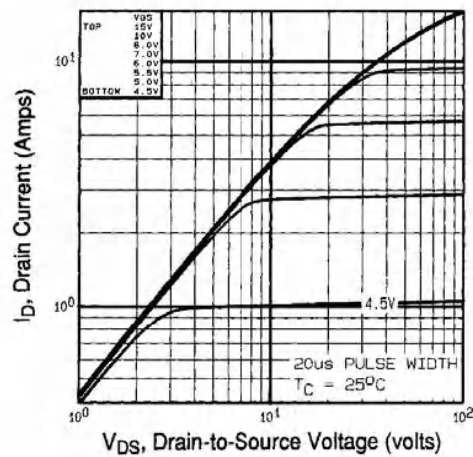
**SPECIFICATIONS**  $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$		950	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$		-	1.1	-	V/ $^{\circ}\text{C}$
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$		2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 900\text{ V}$ , $V_{GS} = 0\text{ V}$		-	-	100	$\mu\text{A}$
		$V_{DS} = 720\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$		-	-	500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 1.1\text{ A}^b$	-	3.5	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 1.1\text{ A}^b$		1.7	-	-	S
Dynamic							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5		-	1200	-	pF
Output Capacitance	$C_{oss}$			-	320	-	
Reverse Transfer Capacitance	$C_{rss}$			-	200	-	
Drain to Sink Capacitance	$C$	$f = 1.0\text{ MHz}$		-	12	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 3.6\text{ A}$ , $V_{DS} = 360\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	78	nC
Gate-Source Charge	$Q_{gs}$			-	-	10	
Gate-Drain Charge	$Q_{gd}$			-	-	42	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 450\text{ V}$ , $I_D = 3.6\text{ A}$ , $R_G = 12\text{ }\Omega$ , $R_D = 120\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	14	-	ns
Rise Time	$t_r$			-	25	-	
Turn-Off Delay Time	$t_{d(off)}$			-	90	-	
Fall Time	$t_f$			-	30	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact 		-	4.5	-	nH
Internal Source Inductance	$L_S$			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	1.9	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	7.6	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 1.9\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	-	1.8	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = 3.6\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	430	650	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	1.4	2.1	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



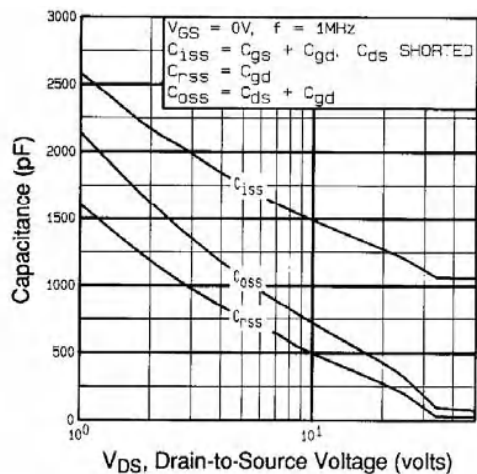


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

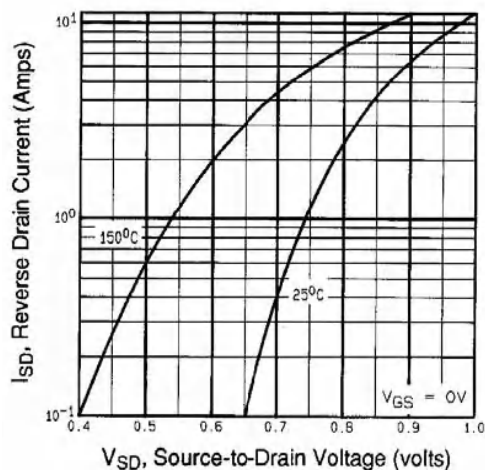


Fig. 7 - Typical Source-Drain Diode Forward Voltage

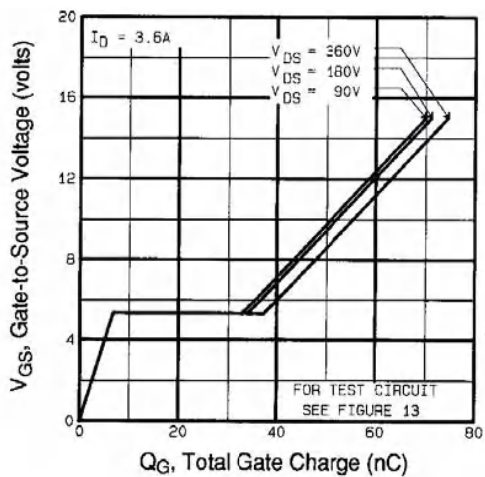


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

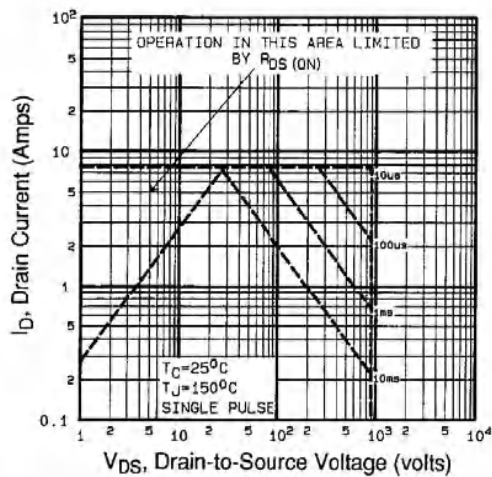


Fig. 8 - Maximum Safe Operating Area

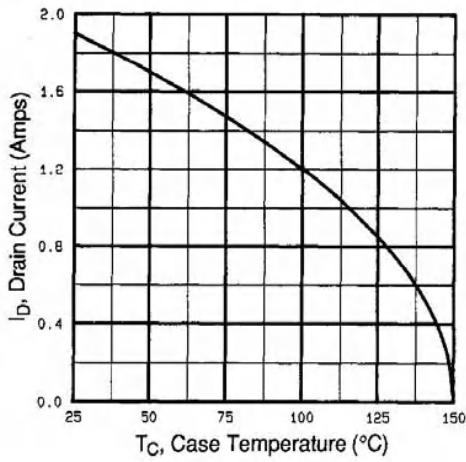


Fig. 9 - Maximum Drain Current vs. Case Temperature

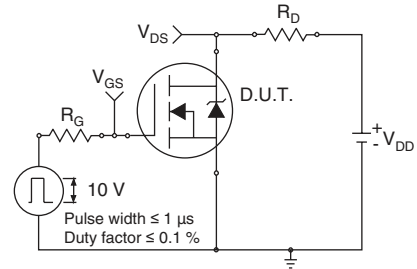


Fig. 10a - Switching Time Test Circuit

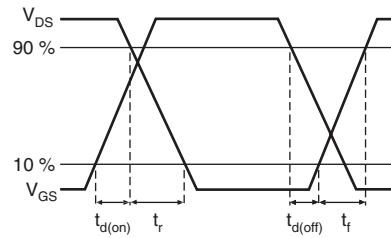


Fig. 10b - Switching Time Waveforms

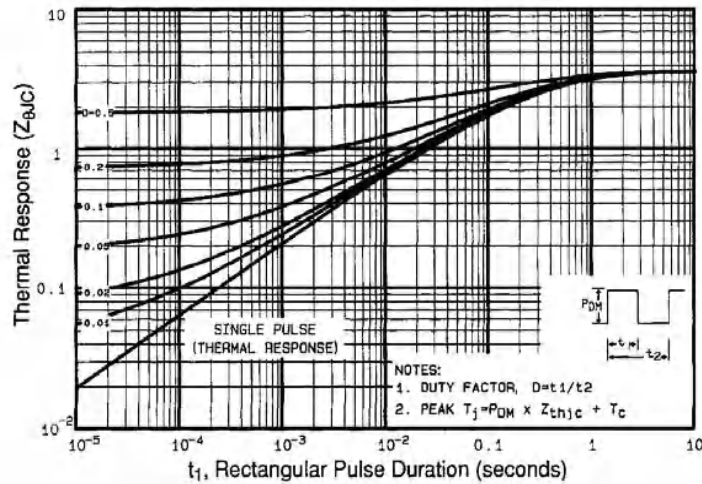


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

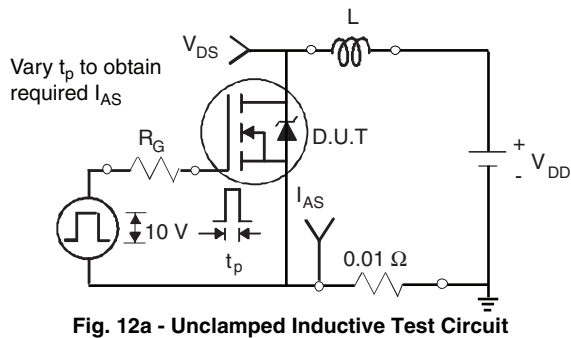


Fig. 12a - Unclamped Inductive Test Circuit

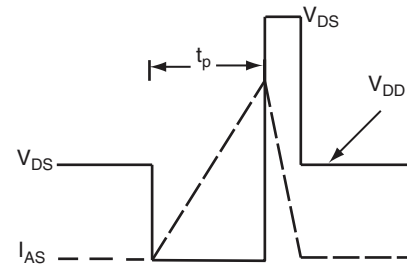


Fig. 12b - Unclamped Inductive Waveforms

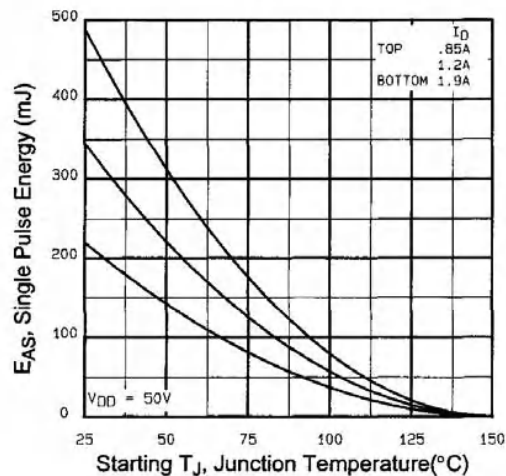


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

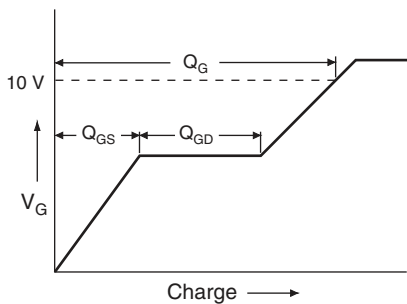


Fig. 13a - Basic Gate Charge Waveform

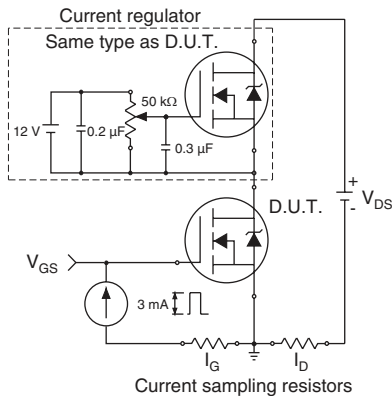


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery $dV/dt$ Test Circuit

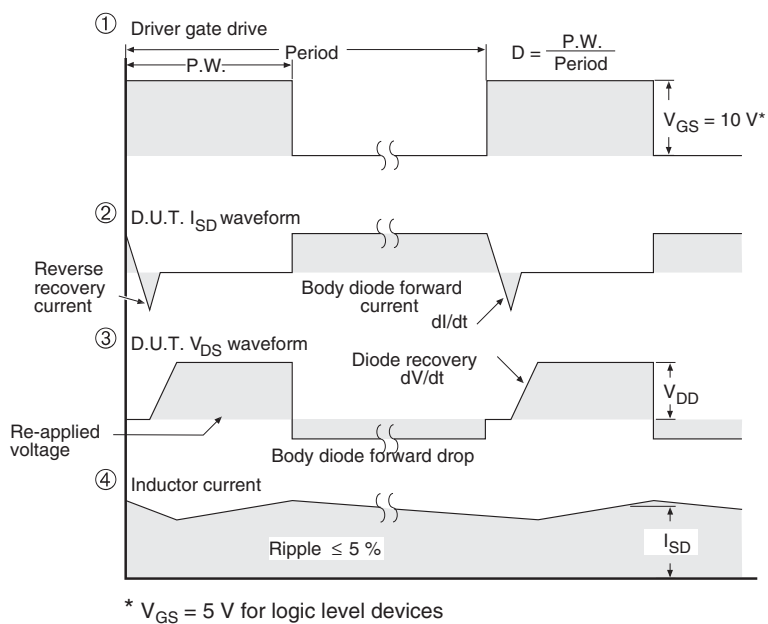
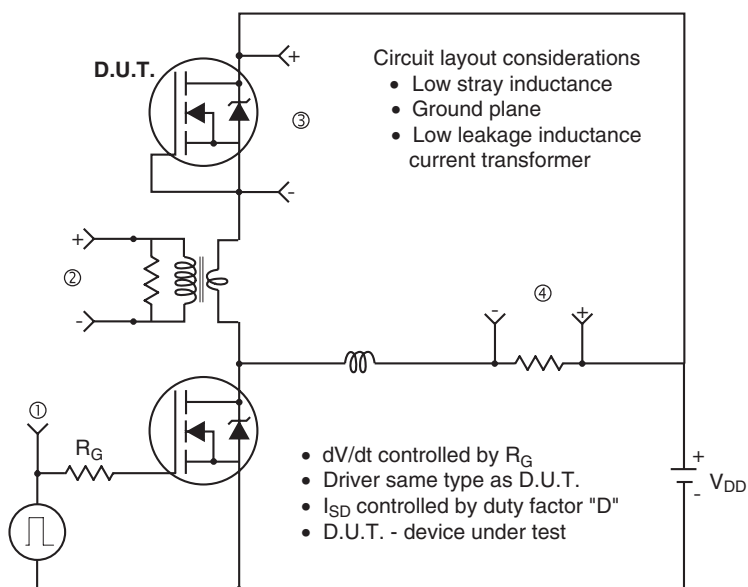
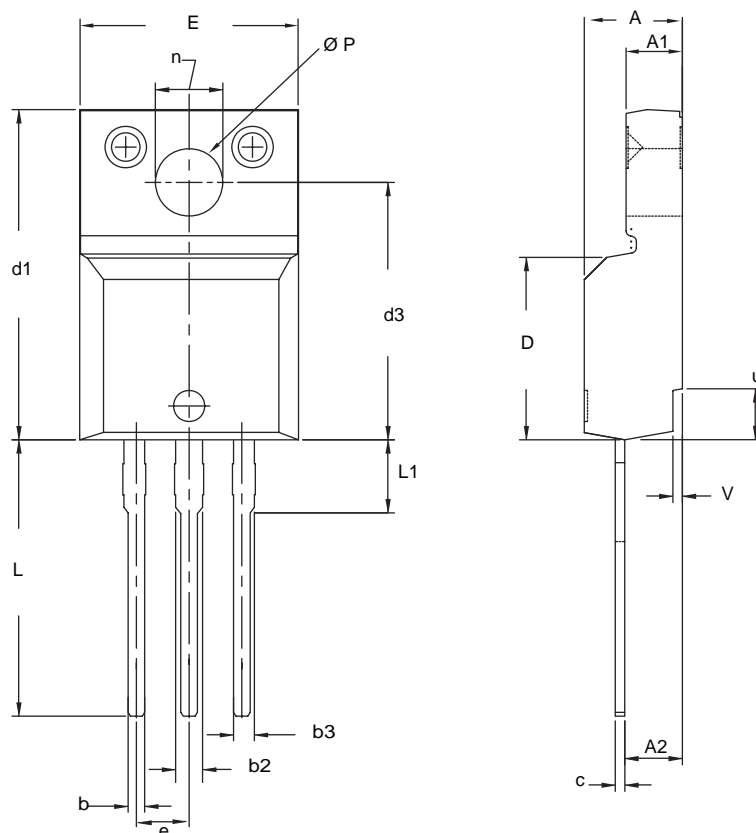


Fig.14 - For N-Channel

**TO-220 FULLPAK (HIGH VOLTAGE)**

DIM.	MILLIMETERS		INCHES	
	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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