



# SPN166T04

## N-Channel Enhancement Mode MOSFET

### DESCRIPTION

The SPN166T04 is the N-Channel logic enhancement mode power field effect transistor which is produced using super high cell density DMOS trench technology. This high density process is especially tailored to minimize on-state resistance. These devices are particularly suitable for synchronous rectifier application, Motor control power management and other Power Tool circuits. It has been optimized for low gate charge, low  $R_{DS(ON)}$  and fast switching speed.

### APPLICATIONS

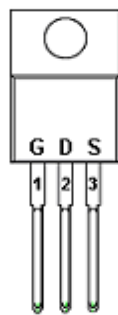
- DC/DC Converter
- Load Switch
- SMPS Secondary Side Synchronous Rectifier
- Motor Control
- Power Tool

### FEATURES

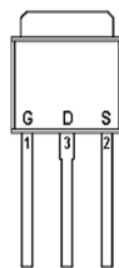
- ◆ 45V/166A,  $R_{DS(ON)}=2.9m\Omega@V_{GS}=10V$   
 $R_{DS(ON)}=4.5m\Omega@V_{GS}=4.5V$
- ◆ Super high density cell design for extremely low  $R_{DS(ON)}$
- ◆ Exceptional on-resistance and maximum DC current capability
- ◆ TO-220-3L/TO-251/TO-252/PPAK5x6 package design

### PIN CONFIGURATION

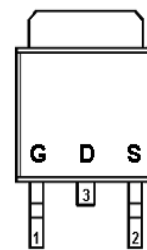
TO-220



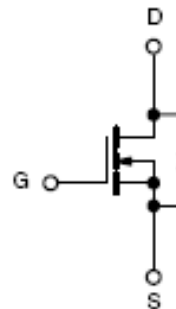
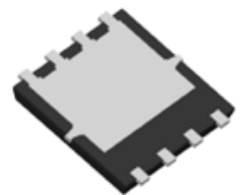
TO-251



TO-252



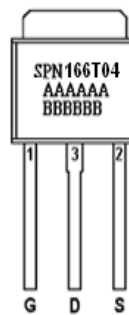
PPAK 5x6



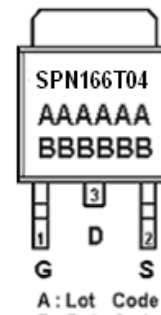
### PART MARKING



A : Lot Code  
B : Date Code  
(YY/MM/DD)



A : Lot Code  
B : Date Code



A : Lot Code  
B : Date Code



A : Lot Code  
B : Date Code  
(YY/MM/DD)



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## N-Channel Enhancement Mode MOSFET

### TO-220/TO-251/TO-252 PIN DESCRIPTION

Pin	Symbol	Description
1	G	Gate
2	D	Drain
3	S	Source

### PPAK5x6 PIN DESCRIPTION

Pin	Symbol	Description
1	S	Source
2	S	Source
3	S	Source
4	G	Gate
5	D	Drain
6	D	Drain
7	D	Drain
8	D	Drain

### ORDERING INFORMATION

Part Number	Package	Part Marking
SPN166T04T220TGB	TO-220-3L	SPN166T04
SPN166T04ST251TGB	TO-251	SPN166T04
SPN166T04ST252RGB	TO-252	SPN166T04
SPN166T04DN8RGB	PPAK5x6	SPN166T04

- ※ SPN166T04T220TGB : Tube ; Pb – Free ; Halogen – Free
- ※ SPN166T04ST251TGB : Tube ; Pb – Free ; Halogen – Free
- ※ SPN166T04T252RGB : Tape& Reel ; Pb – Free ; Halogen – Free
- ※ SPN166T04DN82RGB : Tape&Reel ; Pb – Free ; Halogen - Free



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## N-Channel Enhancement Mode MOSFET

### ABSOLUTE MAXIMUM RATINGS

(TA=25°C Unless otherwise noted)

Parameter	Symbol	Typical	Unit	
Drain-Source Voltage	V <sub>DSS</sub>	45	V	
Gate –Source Voltage	V <sub>GSS</sub>	±20	V	
Continuous Drain Current(TJ=150°C) (TO-220/TO-251)	I <sub>D</sub>	Tc=25°C	166	A
		Tc=70°C	118	
Continuous Drain Current(TJ=150°C) (PPAK5x6)	I <sub>D</sub>	Tc=25°C	125	A
		Tc=100°C	88	
Pulsed Drain Current (TO-220/TO-251)	I <sub>DM</sub>	450	A	
Pulsed Drain Current (PPAK5x6)	I <sub>DM</sub>	410	A	
Power Dissipation @ Tc=25°C	P <sub>D</sub>	TO-220	166	W
		TO251/PPAK5x6	83	
		TO-252	40	
Avalanche Energy with Single Pulse ( Tc=25°C, L = 0.1mH. ) (TO-220/TO-251)	EAS	180	mJ	
Avalanche Energy with Single Pulse ( Tc=25°C, L = 0.1mH. ) (PPAK5x6)		211		
Operating Junction Temperature	T <sub>J</sub>	-55/150	°C	
Storage Temperature Range	T <sub>STG</sub>	-55/150	°C	
Thermal Resistance-Junction to Case (TO-220)	R <sub>θJC</sub>	1.2	°C/W	
Thermal Resistance-Junction to Case (TO-251/TO-252)	R <sub>θJC</sub>	1.35	°C/W	
Thermal Resistance-Junction to Case (PPAK5x6)	R <sub>θJC</sub>	1.5	°C/W	



# SPN166T04

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### ELECTRICAL CHARACTERISTICS

(TA=25°C Unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=250\mu A$	45			V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	1.0		2.5	
Gate Leakage Current	$I_{GSS}$	$V_{DS}=0V, V_{GS}=\pm 20V$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=45V, V_{GS}=0V$ $T_J = 25^\circ C$			1	uA
		$V_{DS}=45V, V_{GS}=0V$ $T_J = 100^\circ C$			100	
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS}= 10V, I_D=20A$		2.5	2.9	mΩ
		$V_{GS}= 4.5V, I_D=20A$		3.7	4.5	
Forward Transconductance	$g_{fs}$	$V_{DS}=5V, I_D=20A$		65		S
Diode Forward Voltage	$V_{SD}$	$I_S=20A, V_{GS}=0V$		0.9	1.2	V
<b>Dynamic</b>						
Total Gate Charge (10V)	$Q_g$	$V_{DS}=20V, V_{GS}=10V$ $I_D = 20A$		50		nC
Total Gate Charge (4.5V)	$Q_g$			25		
Gate-Source Charge	$Q_{gs}$			8		
Gate-Drain Charge	$Q_{gd}$			10		
Input Capacitance	$C_{iss}$	$V_{DS}=20V, V_{GS}=0V$ $f=1MHz$		3322		pF
Output Capacitance	$C_{oss}$			1367		
Reverse Transfer Capacitance	$C_{rss}$			96		
Turn-On Time	$t_d(on)$	$V_{DD}=20V, I_D=20A$ $V_{GEN}=10V, R_G=10\Omega$		14		nS
	$t_r$			12		
Turn-Off Time	$t_d(off)$			57		
	$t_f$			18		



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### TYPICAL CHARACTERISTICS

Fig 1. Typical Output Characteristics

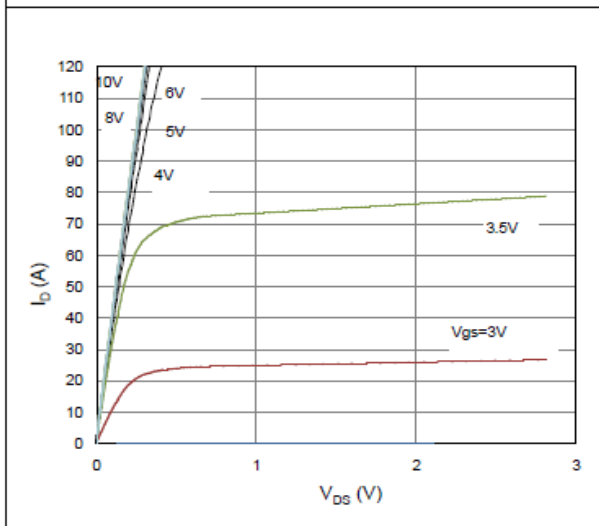


Figure 2. On-Resistance vs. Gate-Source Voltage

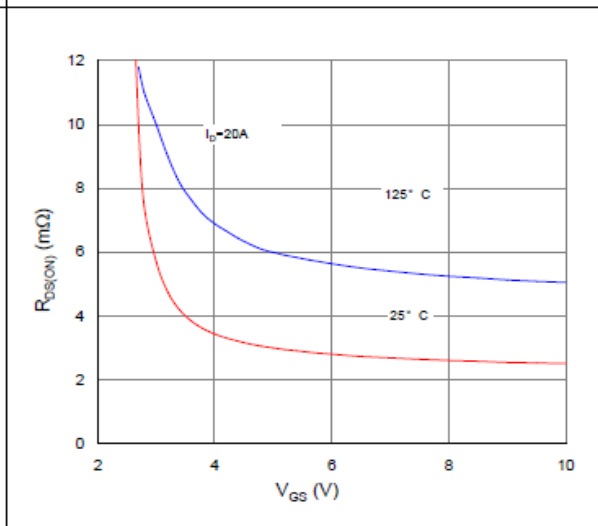


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

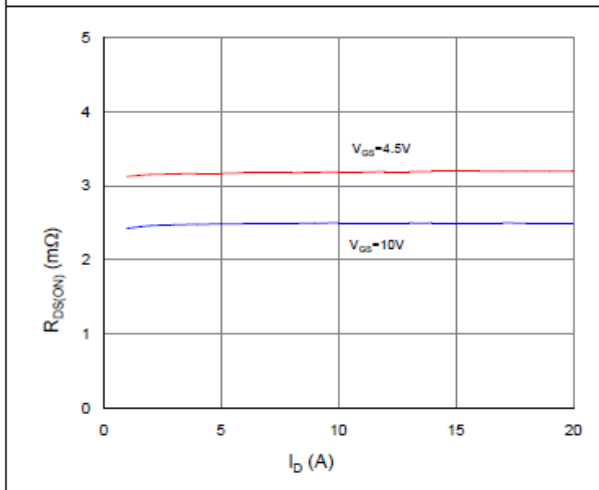


Figure 4. Normalized On-Resistance vs. Junction Temperature

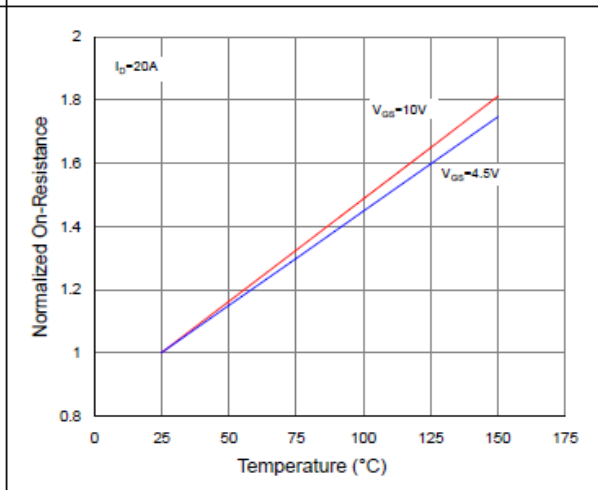


Figure 5. Typical Transfer Characteristics

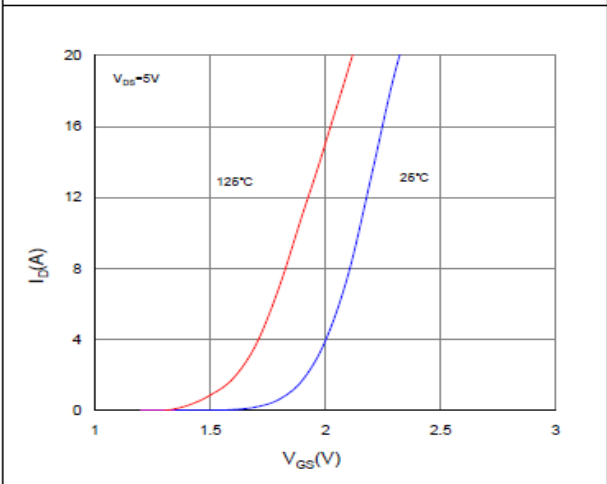
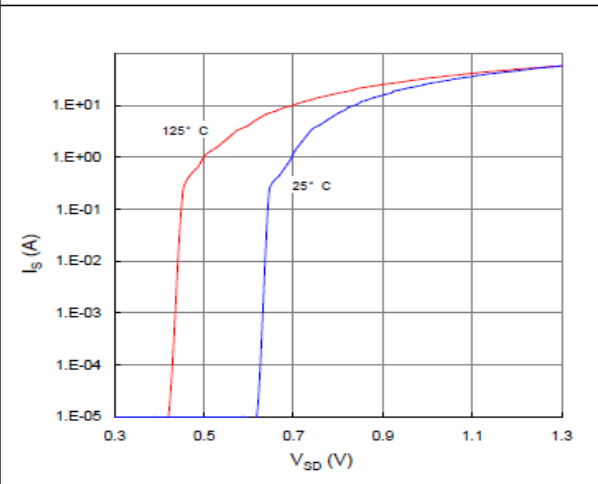


Figure 6. Typical Source-Drain Diode Forward Voltage





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### TYPICAL CHARACTERISTICS

Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage

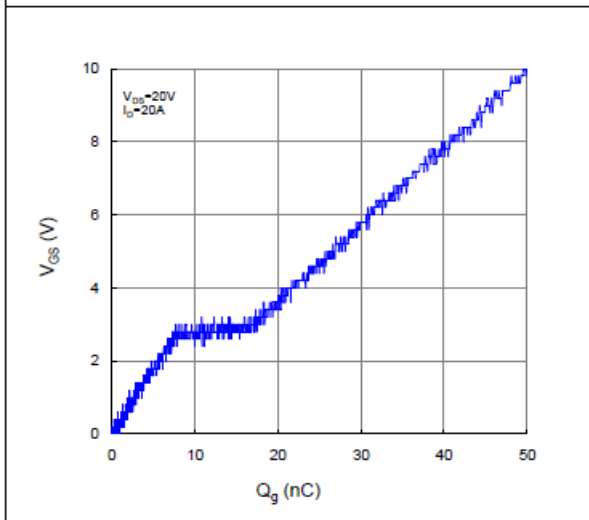


Figure 8. Typical Capacitance vs. Drain-to-Source Voltage

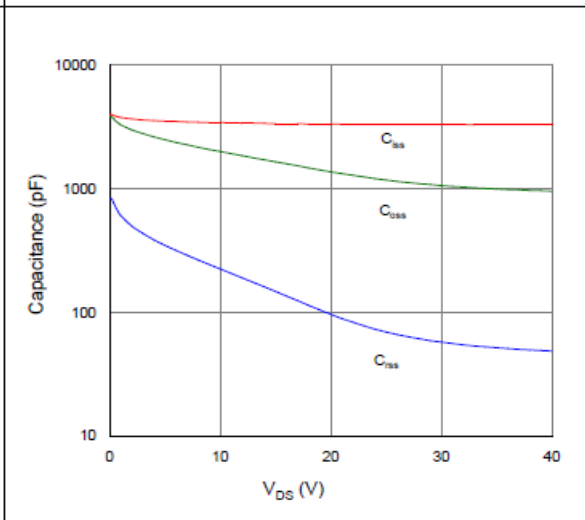


Figure 9. Maximum Safe Operating Area

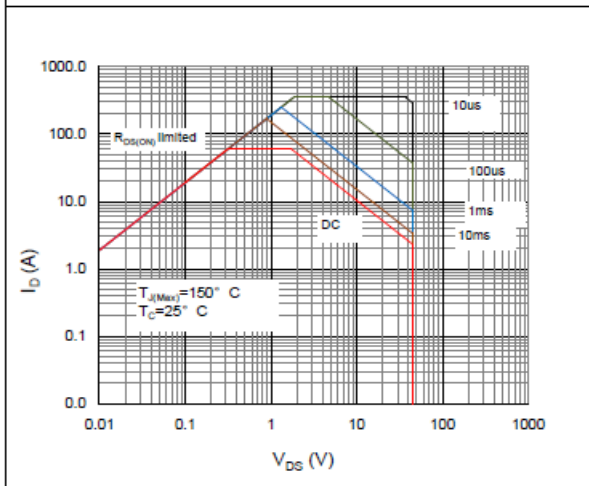


Figure 10. Maximum Drain Current vs. Case Temperature

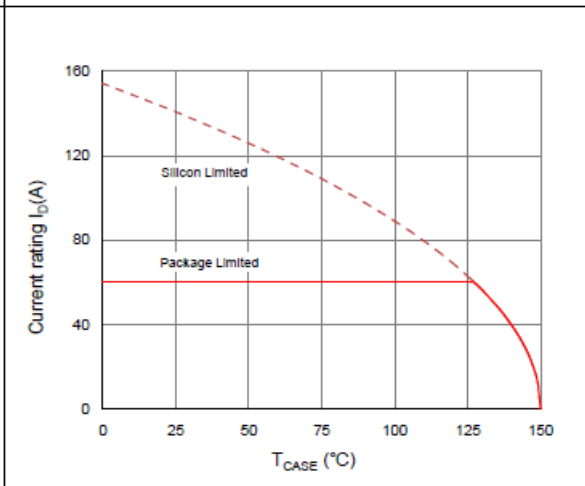
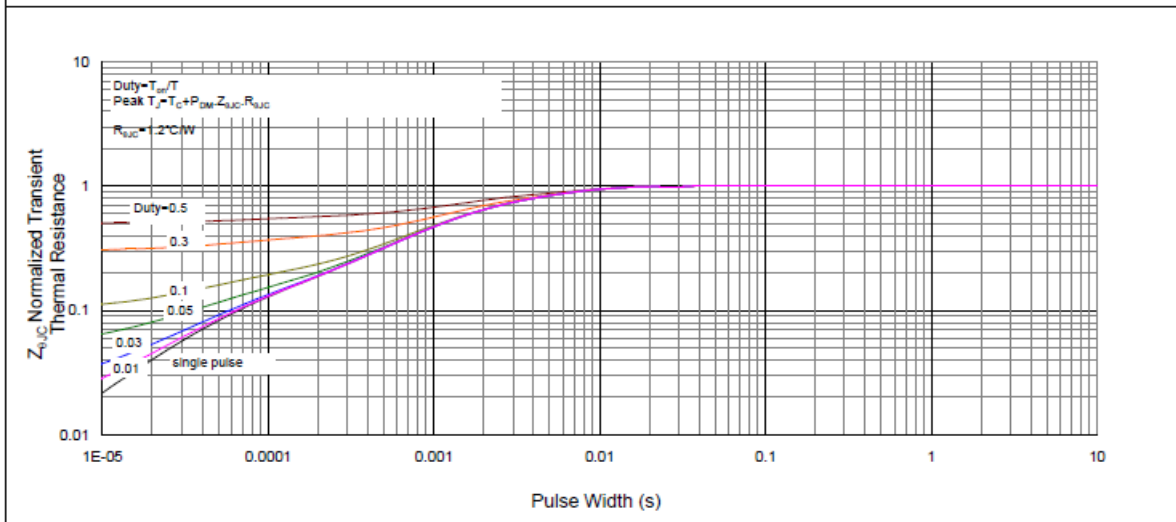


Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Case

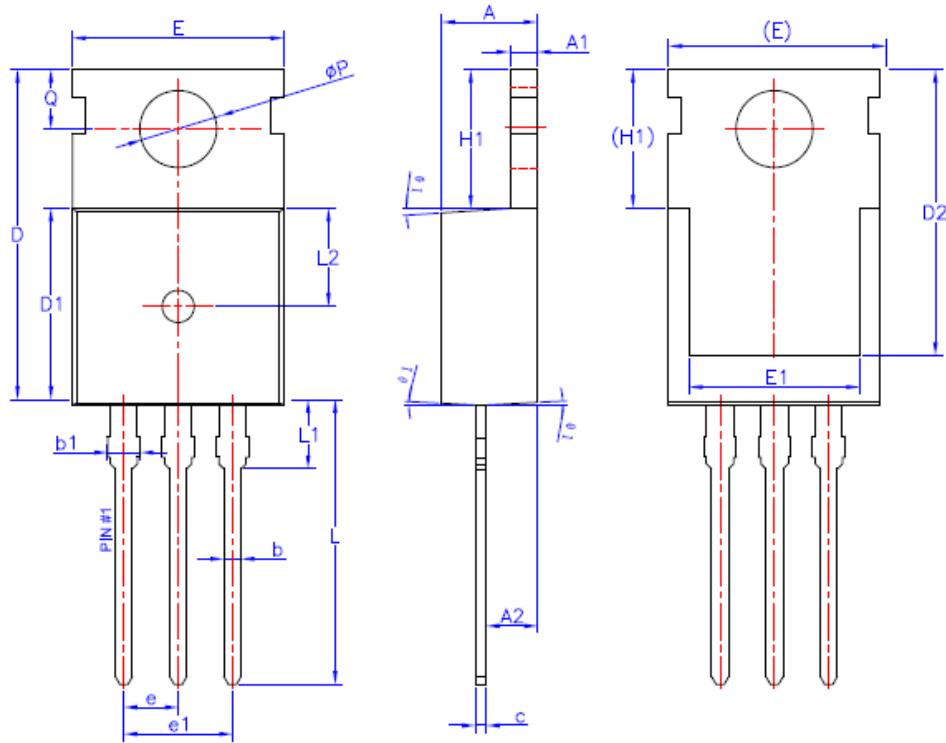




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## N-Channel Enhancement Mode MOSFET

### TO-220 PACKAGE OUTLINE



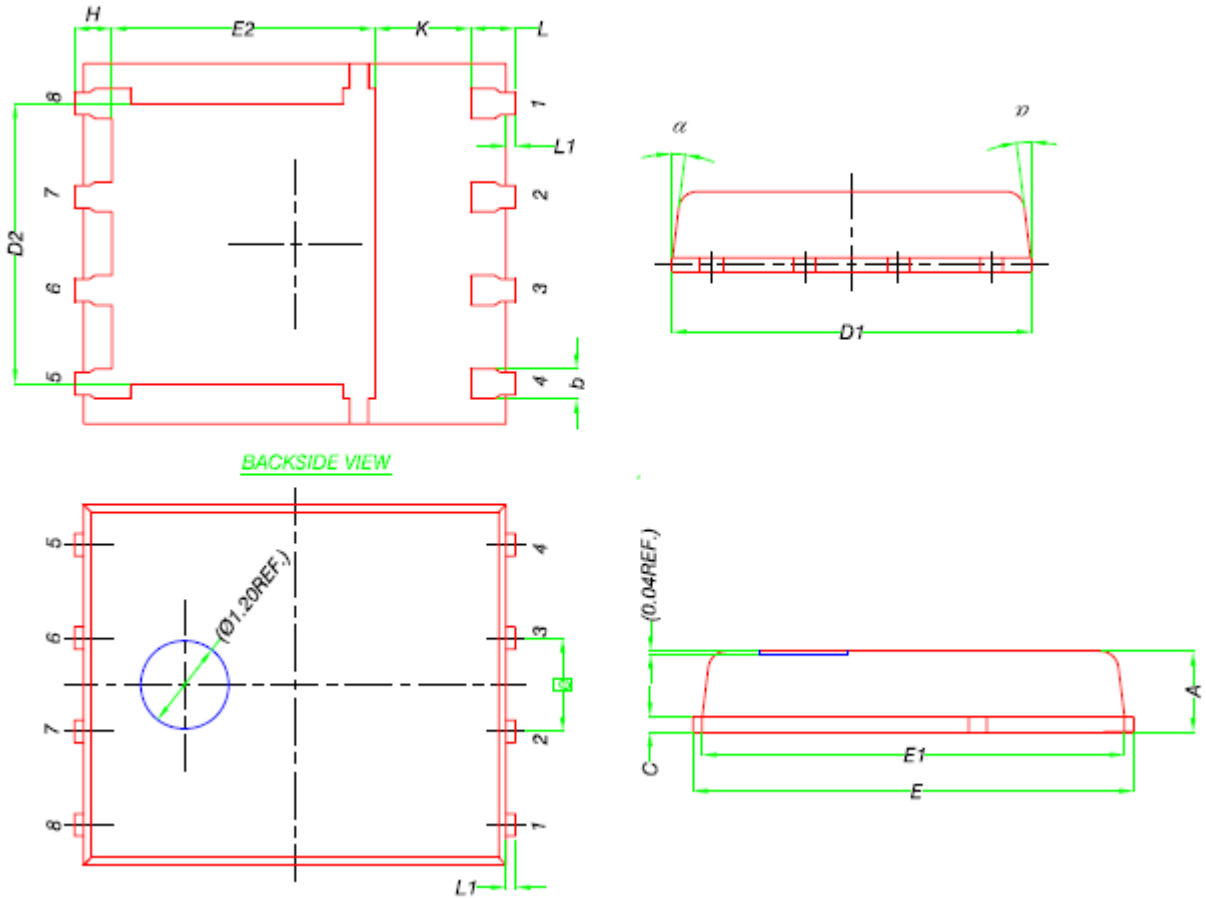
SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	—	0.90
b1	1.42	—	1.57
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	—	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.54BSC		
e1	5.08BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	—	—	3.50
L2	4.60REF		
$\phi P$	3.55	3.60	3.65
Q	2.73	—	2.87
$\theta 1$	1°	3°	5°



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### PPAK5x6 PACKAGE OUTLINE



DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
b	0.33	0.41	0.51
C	0.20	0.25	0.30
D1	4.80	4.90	5.00
D2	3.61	3.81	3.96
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.38	3.58	3.78
<span style="border: 1px solid black; padding: 2px;">e</span>	1.27 BSC		
H	0.41	0.51	0.61
K	1.10	-	-
L	0.51	0.61	0.71
L1	0.06	0.13	0.20
α	0°	-	12°

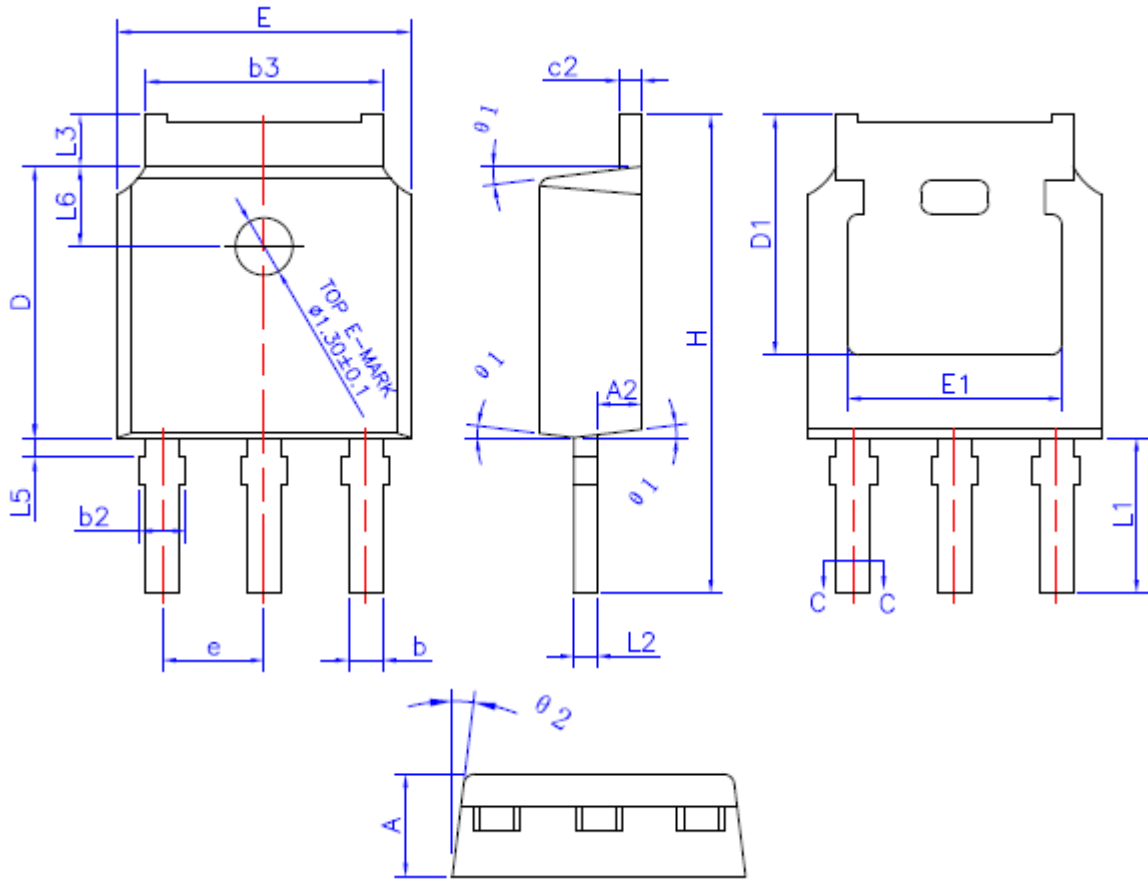




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## N-Channel Enhancement Mode MOSFET

### TO-251 PACKAGE OUTLINE



COMMON DIMENSIONS  
(UNITS OF MEASURE =MILLIMETER)

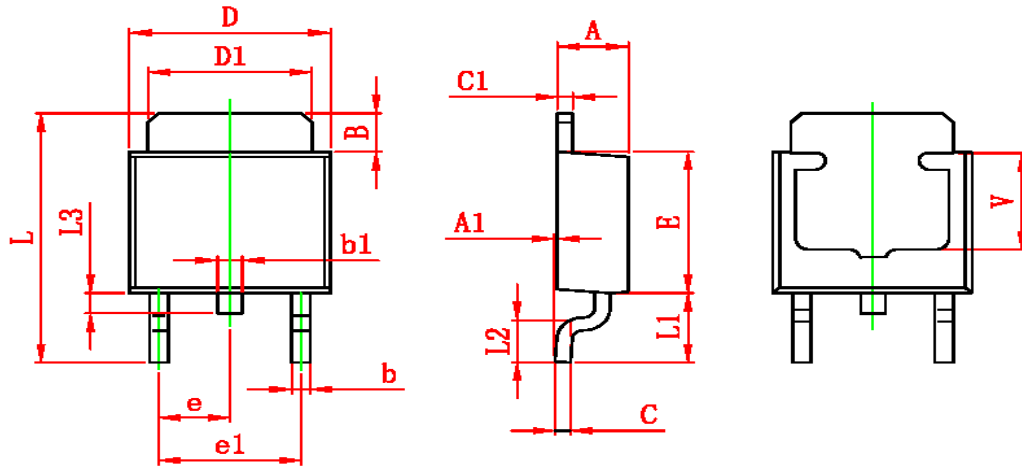
SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A2	0.90	1.01	1.10
b	0.72	—	0.85
b1	0.71	0.76	0.81
b2	0.72	—	0.90
b3	5.13	5.33	5.46
c	0.47	—	0.60
c1	0.46	0.51	0.56
c2	0.47	—	0.60
D	6.00	6.10	6.20
D1	5.25	—	—
E	6.50	6.60	6.70
E1	4.70	—	—
e	2.186	2.286	2.386
H	10.40	10.70	11.00
L1	3.50 REF		
L2	0.508 BSC		
L3	0.90	—	1.25
L5	0.15	—	0.75
L6	1.80 REF		
$\theta_1$	5°	7°	9°
$\theta_2$	5°	7°	9°



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### TO-252 PACKAGE OUTLINE



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP		0.091 TYP	
e1	4.500	4.700	0.177	0.185
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.350	0.650	0.014	0.026
V	3.80 REF		0.150 REF	



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