

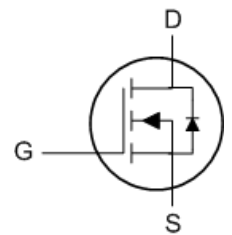
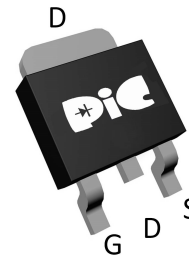
### ➤ General Description

This PAN60TX06X N-Channel enhancement mode power field effect transistor is the high density trench technology and this advanced technology can provide excellent  $R_{ds(On)}$  performance and efficiency for power switching and load switching application., this device also comply with the RoHS and Green Product requirement with full function reliability approved.

### ➤ Feature

- Super Low Gate Charge
- 100% EAS Guaranteed
- Green Device Available
- Excellent  $CdV/dt$  effect decline
- Advanced high cell density Trench technology

### ➤ TO-252



### ➤ Application

- Switch application
- DC/DC Converters Power
- Tools

### ➤ Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	$I_D@T_C=25^\circ C$	35	A
Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	$I_D@T_C=100^\circ C$	22	A
Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	$I_D@T_A=25^\circ C$	7.4	A
Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	$I_D@T_A=70^\circ C$	6	A
Pulsed Drain Current <sup>2</sup>	$I_{DM}$	80	A
Single Pulse Avalanche Energy <sup>3</sup>	EAS	39.2	mJ
Avalanche Current	$I_{AS}$	28	A
Total Power Dissipation <sup>4</sup>	$P_D@T_C=25^\circ C$	45	W
Total Power Dissipation <sup>4</sup>	$P_D@T_A=25^\circ C$	2	W
Storage Temperature Range	$T_{STG}$	-55 to 150	$^\circ C$
Operating Junction Temperature Range	$T_J$	-55 to 150	$^\circ C$
Thermal Resistance Junction-Ambient <sup>1</sup>	$R_{\theta JA}$	62	$^\circ C/W$
Thermal Resistance Junction-Case <sup>1</sup>	$R_{\theta JC}$	2.8	$^\circ C/W$

### ➤ Electrical Characteristics ( $T_J=25^\circ C$ Unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	60	---	---	V
$BV_{DSS}$ Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	Reference to $25^\circ C, I_D=1mA$	---	0.057	---	$V/^\circ C$
Static Drain-Source On-Resistance <sup>2</sup>	$R_{DS(ON)}$	$V_{GS}=10V, I_D=20A$	---	---	20	m $\Omega$
		$V_{GS}=4.5V, I_D=10A$	---	---	24	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.2	---	2.5	V
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}$		---	-5.68	---	mV/ $^\circ C$
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=48V, V_{GS}=0V, T_J=25^\circ C$	---	---	1	uA
		$V_{DS}=48V, V_{GS}=0V, T_J=55^\circ C$	---	---	5	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	---	---	$\pm 100$	nA
Forward Transconductance	gfs	$V_{DS}=5V, I_D=15A$	---	45	---	S
Gate Resistance	$R_g$	$V_{DS}=0V, V_{GS}=0V, f=1MHz$	---	1.7	---	$\Omega$
Total Gate Charge (4.5V)	$Q_g$	$V_{DS}=48V, V_{GS}=4.5V, I_D=15A$	---	19.3	---	nC
Gate-Source Charge	$Q_{gs}$		---	7.1	---	
Gate-Drain Charge	$Q_{gd}$		---	7.6	---	
Turn-On Delay Time	$T_{d(on)}$	$V_{DD}=30V, V_{GS}=10V, R_G=3.3\Omega, I_D=15A$	---	7.2	---	ns
Rise Time	$T_r$		---	50	---	
Turn-Off Delay Time	$T_{d(off)}$		---	36.4	---	
Fall Time	$T_f$		---	7.6	---	
Input Capacitance	$C_{iss}$	$V_{DS}=15V, V_{GS}=0V, f=1MHz$	---	2423	---	pF
Output Capacitance	$C_{oss}$		---	145	---	
Reverse Transfer Capacitance	$C_{rss}$		---	97	---	

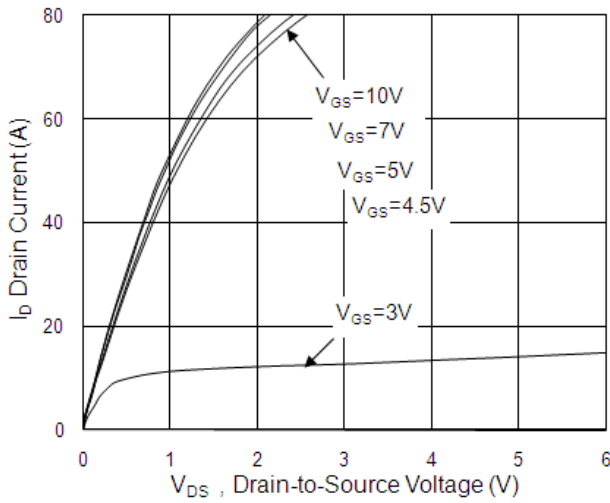
### ➤ Diode Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Continuous Source Current <sup>1,5</sup>	$I_S$	$V_G=V_D=0V, \text{Force Current}$	---	---	35	A
Pulsed Source Current <sup>2,5</sup>	$I_{SM}$		---	---	80	A
Diode Forward Voltage <sup>2</sup>	$V_{SD}$	$V_{GS}=0V, I_S=A, T_J=25^\circ C$	---	---	1	V
Reverse Recovery Time	$t_{rr}$	$I_F=15A, di/dt=100A/\mu s, T_J=25^\circ C$	---	16.3	---	nS
Reverse Recovery Charge	$Q_{rr}$		---	11	---	nC

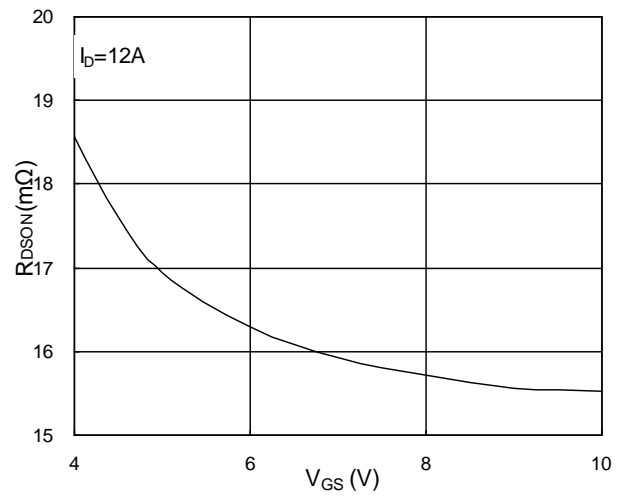
Note :

1. Pulse width limited by maximum junction temperature.
2. The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
3. The EAS data shows Max. rating . The test condition is  $V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=28A$
4. Ensure that the channel temperature does not exceed  $150^\circ C$ .
5. The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.

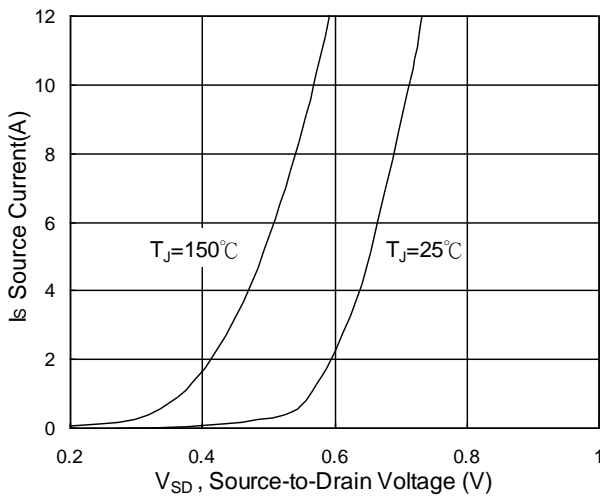
### ➤ Typical Characteristics



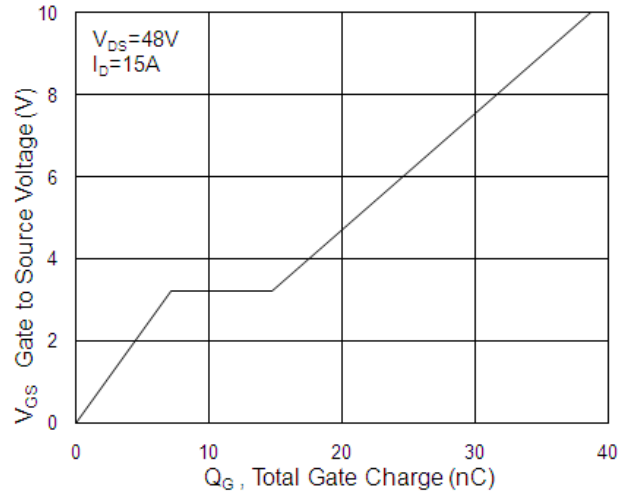
**Fig.1 Typical Output Characteristics**



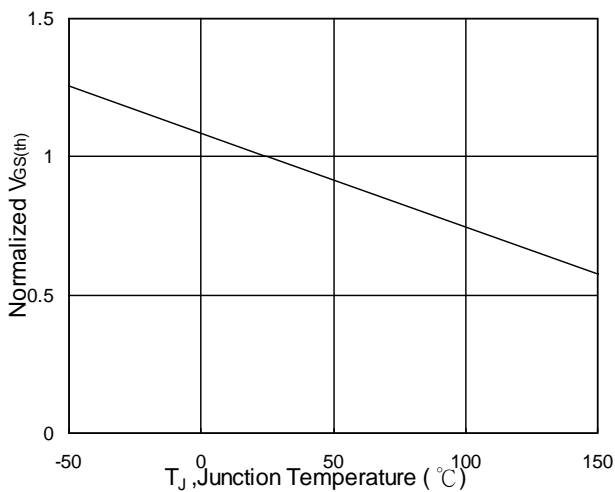
**Fig.2 On-Resistance v.s Gate-Source**



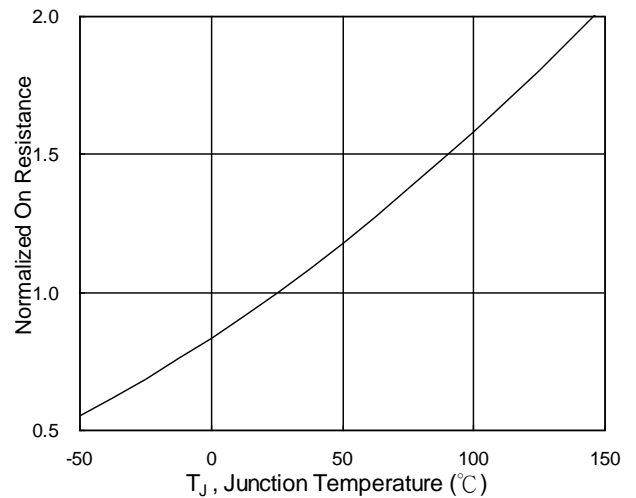
**Fig.3 Forward Characteristics of Reverse**



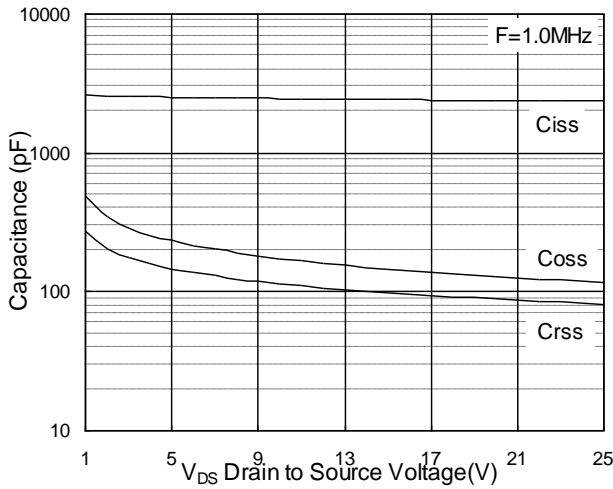
**Fig.4 Gate-Charge Characteristics**



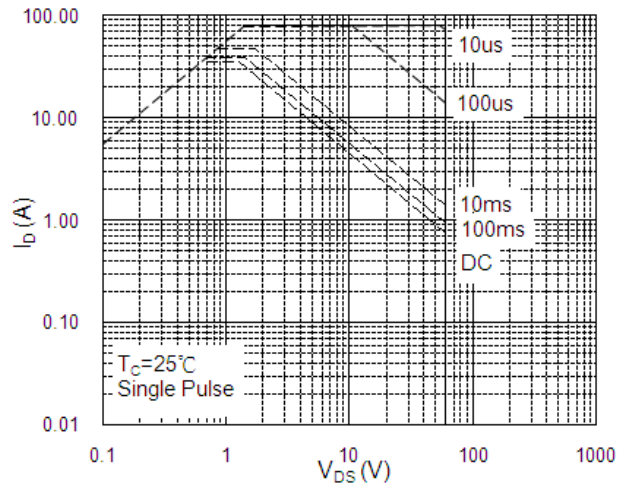
**Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$**



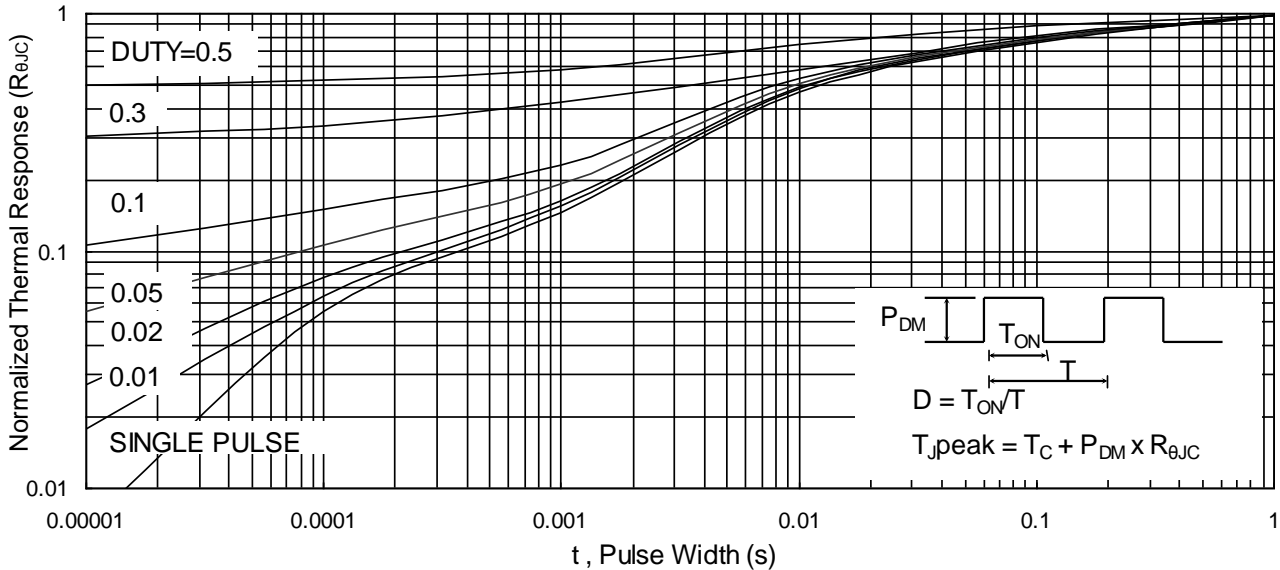
**Fig.6 Normalized  $R_{DS(ON)}$  v.s  $T_J$**



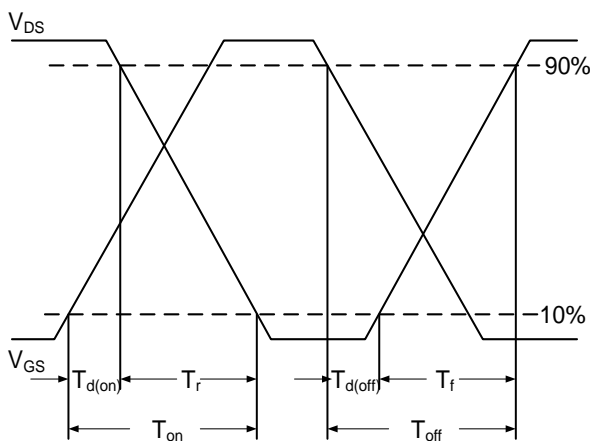
**Fig.7 Capacitance**



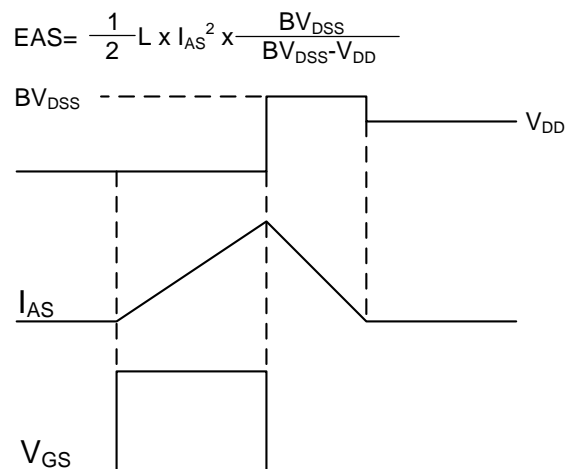
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**

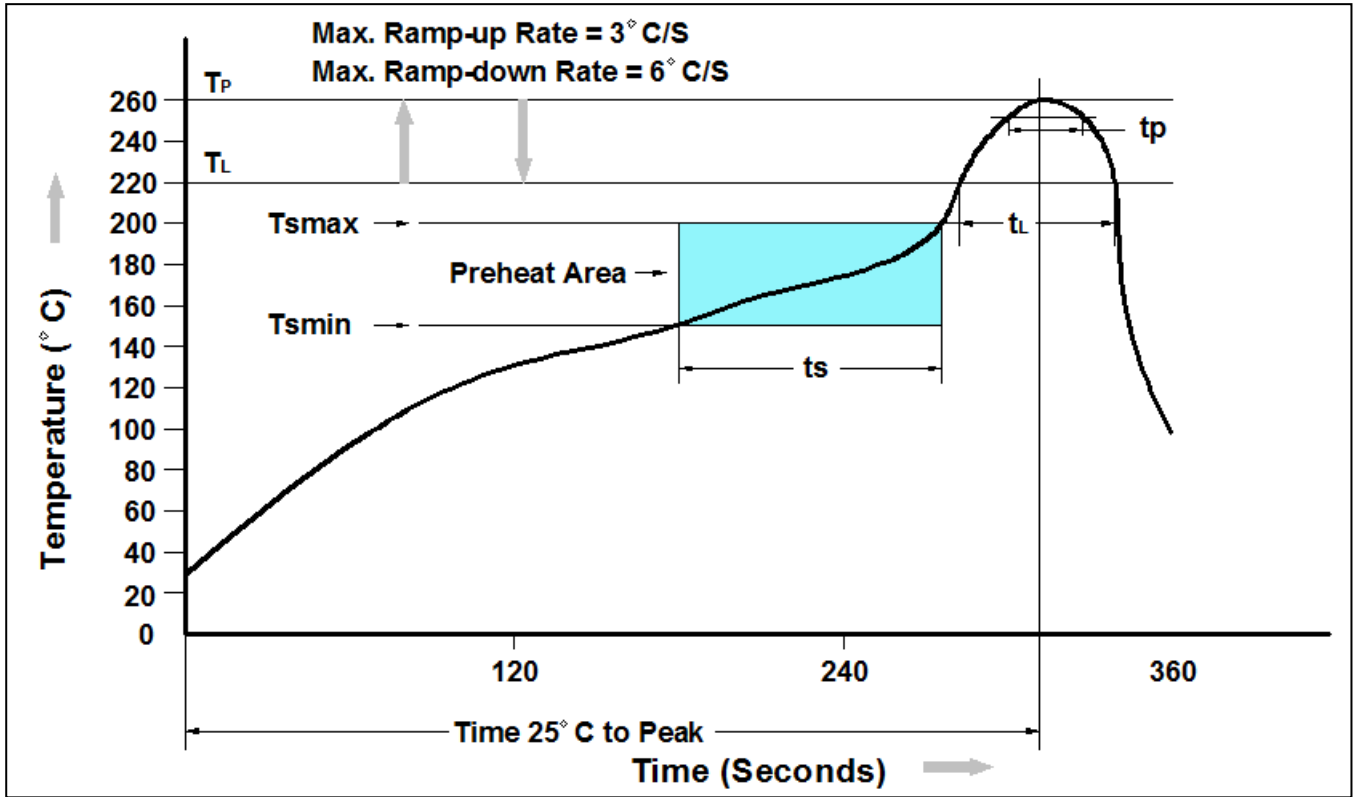


**Fig.10 Switching Time Waveform**



**Fig.11 Unclamped Inductive Switching Waveform**

## ➤ Recommend IR Reflow Soldering Thermal Profile

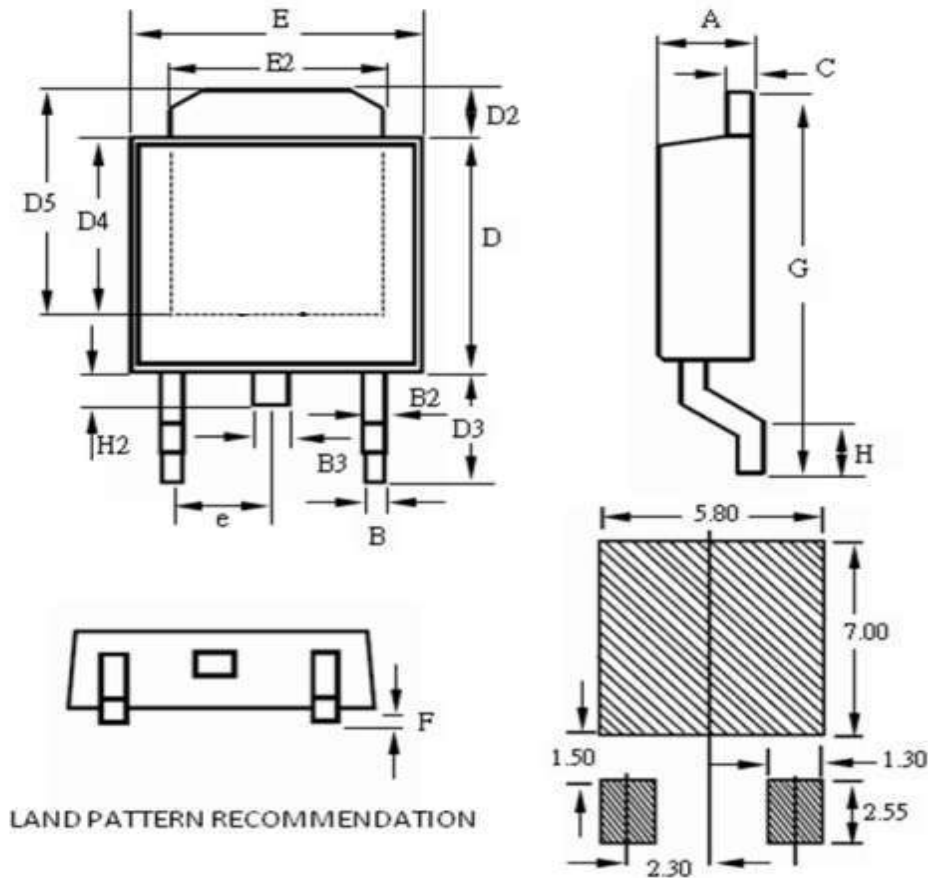


Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>smin</sub> )	150°C
Temperature Max. (T <sub>smax</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	60-120 seconds
Average Ramp-up Rate (t <sub>L</sub> to t <sub>P</sub> )	3°C/second max.
Liquidous Temperature (T <sub>L</sub> )	217°C
Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )	60 – 150 seconds
Peak Temperature	260°C +0°C / -5°C
Time (t <sub>P</sub> ) within 5°C of actual Peak Temperature	30 seconds
Ramp-down Rate (T <sub>P</sub> to T <sub>L</sub> )	6°C/second max
Time 25°C to Peak Temperature	8 minutes max.

## ➤ Ordering Information

Part Number	Description	Quantity
PAN60TX06X	TO-252 Reel	2500 pcs

### ➤ Package Information ( TO-252 )



SYMBOLS	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.10	--	2.50	0.083	--	0.098
B	0.30	--	0.89	0.012	--	0.035
B2	0.40	--	1.14	0.016	--	0.045
B3	0.60	--	1.00	0.024	--	0.039
C	0.40	--	0.89	0.016	--	0.035
D	5.30	--	6.25	0.209	--	0.246
D2	0.50	--	1.70	0.020	--	0.067
D3	2.20	--	3.40	0.087	--	0.134
D4	4.32	--	--	0.170	--	--
D5	5.21	--	--	0.205	--	--
E	6.30	--	6.73	0.248	--	0.265
E2	4.80	--	5.46	0.189	--	0.215
F	0.00	--	0.30	0.000	--	0.012
G	9.20	--	10.41	0.362	--	0.410
H	0.90	--	1.95	0.035	--	0.077
H2	0.50	--	1.10	0.020	--	0.043
e	--	2.30	--	--	0.091	--

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