

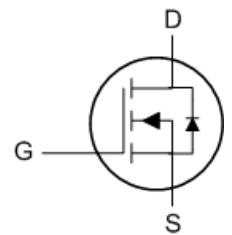
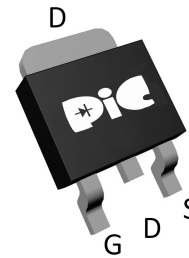
### ➤ General Description

This PAN60TX14X 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, $V_{GS} @ 10V^1$	$I_D@T_C=25^\circ C$	20	A
Continuous Drain Current, $V_{GS} @ 10V^1$	$I_D@T_C=100^\circ C$	13	A
Continuous Drain Current, $V_{GS} @ 10V^1$	$I_D@T_A=25^\circ C$	5	A
Continuous Drain Current, $V_{GS} @ 10V^1$	$I_D@T_A=70^\circ C$	4	A
Pulsed Drain Current <sup>2</sup>	$I_{DM}$	40	A
Single Pulse Avalanche Energy <sup>3</sup>	EAS	22	mJ
Avalanche Current	$I_{AS}$	21	A
Total Power Dissipation <sup>4</sup>	$P_D@T_C=25^\circ C$	31.3	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>	$R_{\theta JC}$	4	$^\circ C/W$

### ➤ 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
BVDSS Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	Reference to $25^\circ C$ , $I_D=1mA$	---	0.044	---	$V/^\circ C$
Static Drain-Source On-Resistance <sup>2</sup>	$R_{DS(ON)}$	$V_{GS}=10V$ , $I_D=15A$	---	33	40	m $\Omega$
		$V_{GS}=4.5V$ , $I_D=7A$	---	40	50	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}$ , $I_D=250\mu A$	1.0	---	2.5	V
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}$		---	-4.8	---	$mV/^\circ C$
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=48V$ , $V_{GS}=0V$ , $T_J=25^\circ C$	---	---	1	$\mu A$
		$V_{DS}=48V$ , $V_{GS}=0V$ , $T_J=55^\circ C$	---	---	5	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V$ , $V_{DS}=0V$	---	---	$\pm 100$	nA
Forward Transconductance	$g_{fs}$	$V_{DS}=5V$ , $I_D=15A$	---	25.3	---	S
Gate Resistance	$R_g$	$V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$	---	2.5	---	$\Omega$
Total Gate Charge (10V)	$Q_g$	$V_{DS}=48V$ , $V_{GS}=10V$ , $I_D=15A$	---	19	---	nC
Gate-Source Charge	$Q_{gs}$		---	2.5	---	
Gate-Drain Charge	$Q_{gd}$		---	5	---	
Turn-On Delay Time	$T_{d(on)}$	$V_{DD}=30V$ , $V_{GS}=10V$ , $R_G=3.3\Omega$ $I_D=15A$	---	2.8	---	ns
Rise Time	$T_r$		---	16.6	---	
Turn-Off Delay Time	$T_{d(off)}$		---	21.2	---	
Fall Time	$T_f$		---	5.6	---	
Input Capacitance	$C_{iss}$	$V_{DS}=15V$ , $V_{GS}=0V$ , $f=1MHz$	---	1027	---	pF
Output Capacitance	$C_{oss}$		---	65	---	
Reverse Transfer Capacitance	$C_{rss}$		---	46	---	

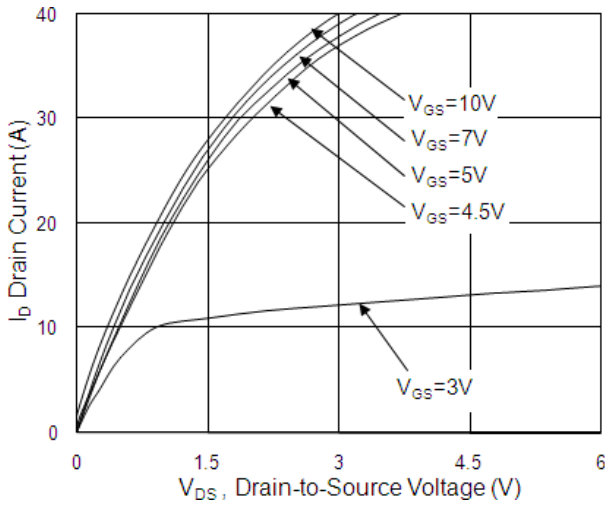
### ➤ Diode Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Continuous Source Current <sup>1,6</sup>	$I_S$	$V_G=V_D=0V$ , Force Current	---	---	20	A
Pulsed Source Current <sup>2,6</sup>	$I_{SM}$		---	---	40	A
Diode Forward Voltage <sup>2</sup>	$V_{SD}$	$V_{GS}=0V$ , $I_S=1A$ , $T_J=25^\circ C$	---	---	1.2	V
Reverse Recovery Time	$t_{rr}$	$I_F=15A$ , $dI/dt=100A/\mu s$ , $T_J=25^\circ C$	---	12.2	---	nS
Reverse Recovery Charge	$Q_{rr}$		---	7.3	---	nC

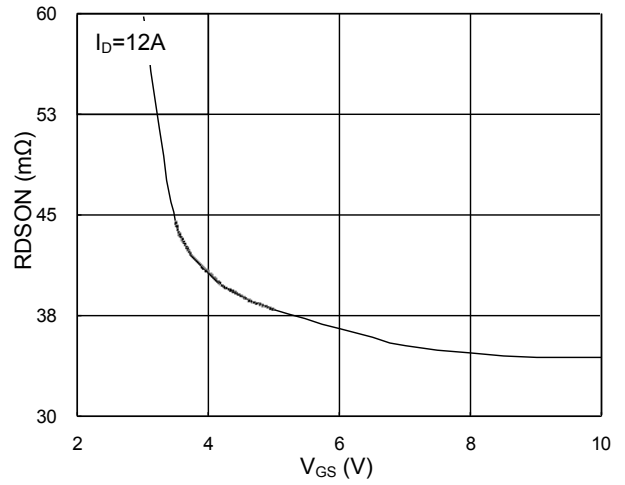
Note :

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  $V_{DD}=25V$ ,  $V_{GS}=10V$ ,  $L=0.1mH$ ,  $I_{AS}=21A$
4. Ensure that the channel temperature does not exceed  $150^\circ C$ .
5. The data is theoretically the same as ID and IDM, in real applications, should be limited by total power dissipation.

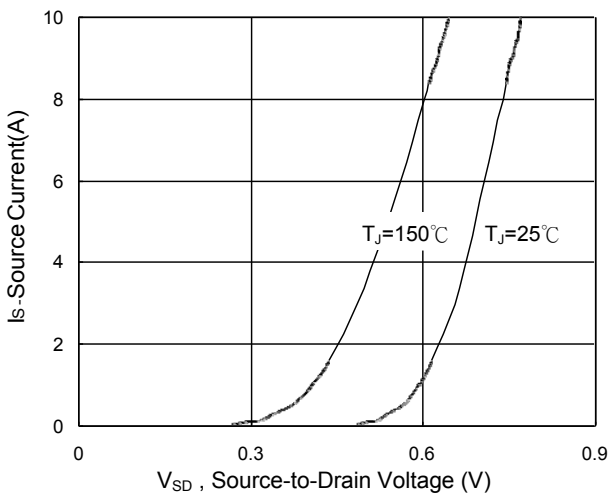
### ➤ Typical Characteristics



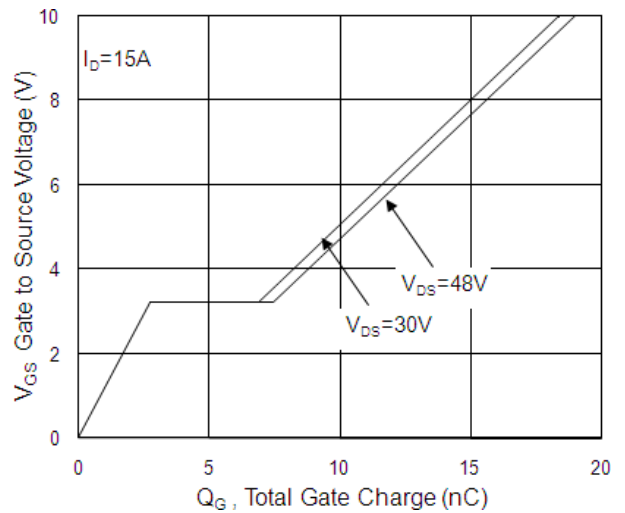
**Fig.1 Typical Output Characteristics**



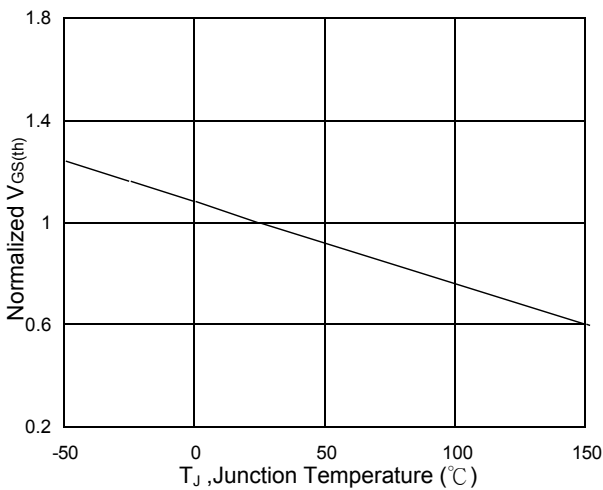
**Fig.2 On-Resistance vs. Gate-Source**



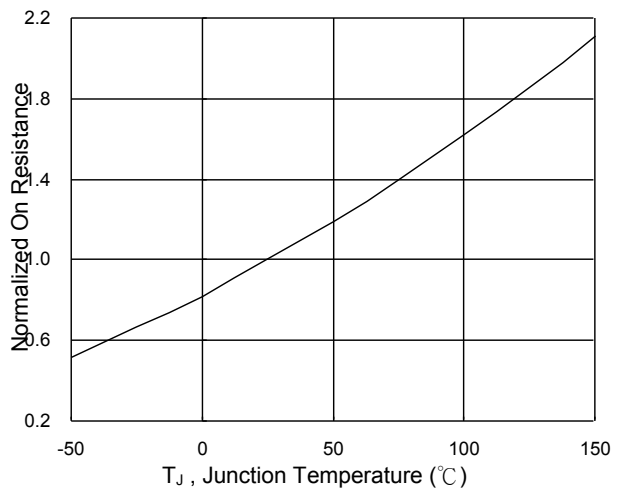
**Fig.3 Forward Characteristics Of Reverse**



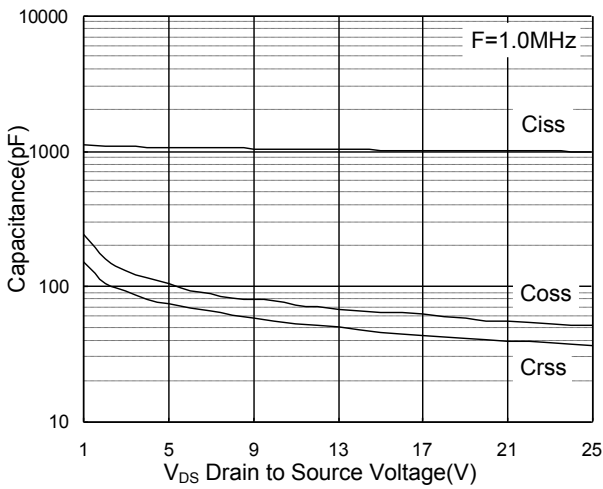
**Fig.4 Gate-Charge Characteristics**



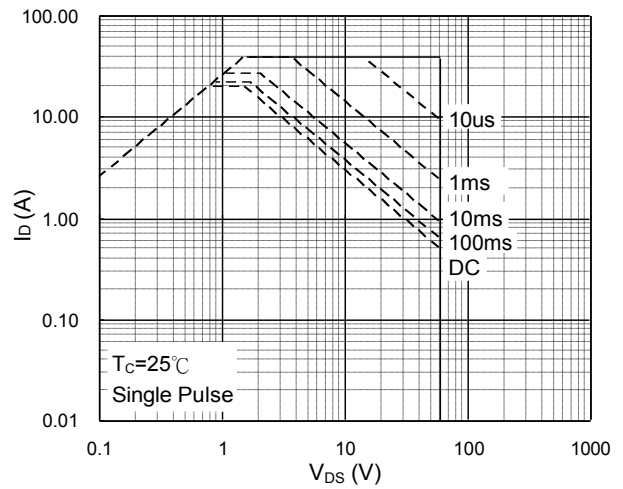
**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**



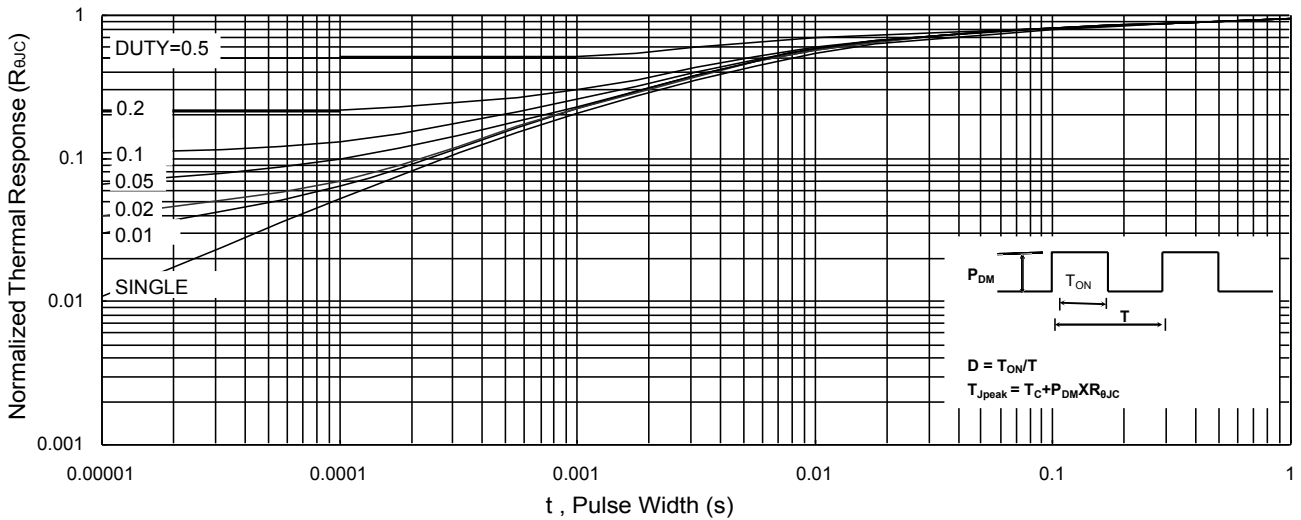
**Fig.6 Normalized  $R_{DS(ON)}$  vs.  $T_J$**



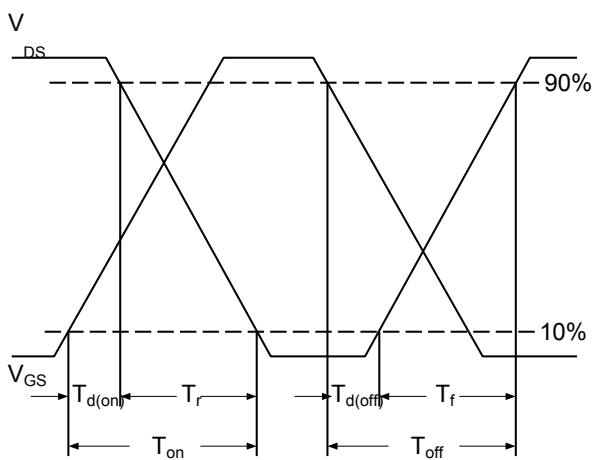
**Fig.7 Capacitance**



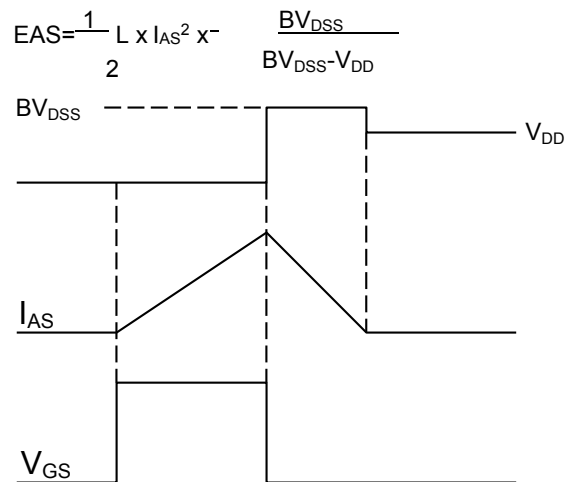
**Fig.8 Safe Operating Area**



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



**Fig.10 Switching Time Waveform**



**Fig.11 Unclamped Inductive Switching Waveform**

➤ Recommend IR Reflow Soldering Thermal Profile

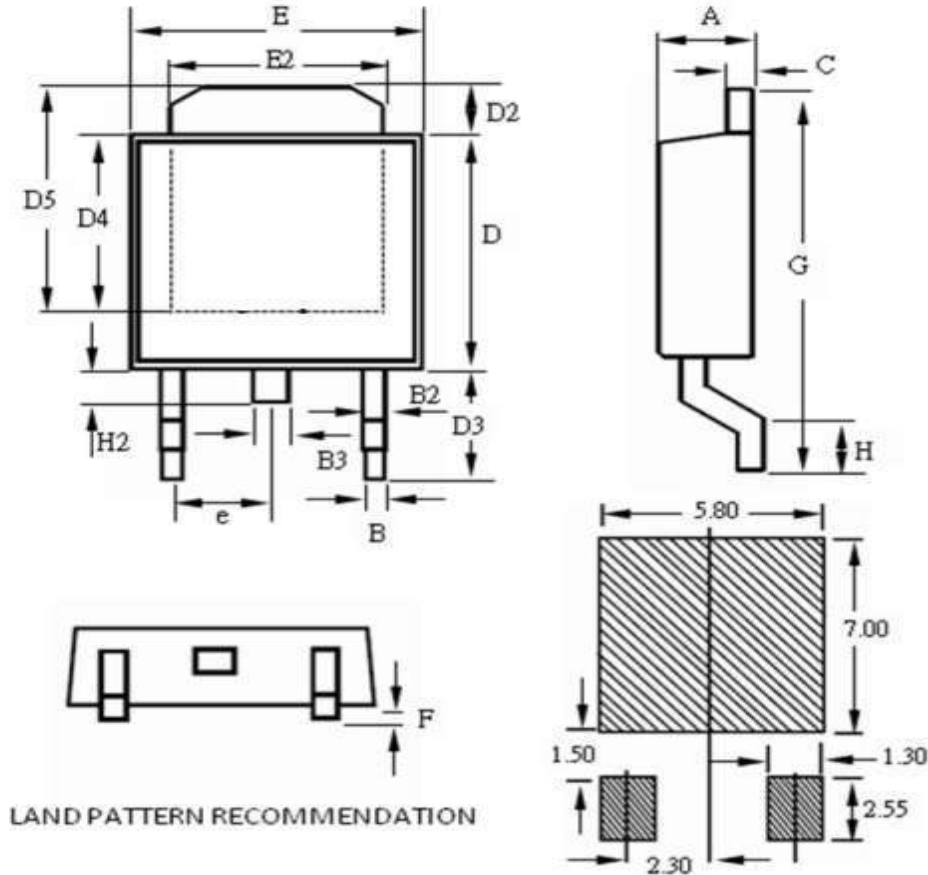


Profile Feature	Pb-Free Assembly Profile
Temperature Min. ( $T_{smin}$ )	150°C
Temperature Max. ( $T_{smax}$ )	200°C
Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	60-120 seconds
Average Ramp-up Rate ( $t_L$ to $t_P$ )	3°C/second max.
Liquidous Temperature ( $T_L$ )	217°C
Time ( $t_L$ ) Maintained Above ( $T_L$ )	60 – 150 seconds
Peak Temperature	260°C +0°C / -5°C
Time ( $t_P$ ) within 5°C of actual Peak Temperature	30 seconds
Ramp-down Rate ( $T_P$ to $T_L$ )	6°C/second max
Time 25°C to Peak Temperature	8 minutes max.

➤ Ordering Information

Part Number	Description	Quantity
PAN60TX14X	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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