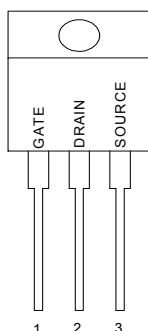


## GENERAL DESCRIPTION

This high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

## PIN CONFIGURATION

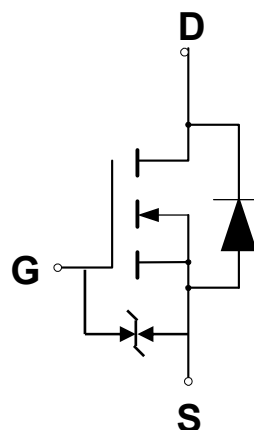
TO-220F/TO220  
Top View



## FEATURES

- ◆ Robust High Voltage Termination
- ◆ Avalanche Energy Specified
- ◆ Source-to-Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- ◆ Diode is Characterized for Use in Bridge Circuits
- ◆  $I_{DSS}$  and  $V_{DS(on)}$  Specified at Elevated Temperature

## SYMBOL



N-Channel MOSFET

## ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain to Current — Continuous	$I_D$	8.5	A
— Pulsed	$I_{DM}$	25.5	
Gate-to-Source Voltage — Continue	$V_{GS}$	$\pm 30$	V
Total Power Dissipation (TO220)	$P_D$	132	W
(TO220F)		38	W/°C
Derate above 25°C (TO220)		0.9	
(TO220F)		0.3	
Operating and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	°C
Single Pulse Drain-to-Source Avalanche Energy — $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100\text{V}$ , $V_{GS} = 10\text{V}$ , $I_L = 7\text{A}$ , $L = 10\text{mH}$ , $R_G = 25\Omega$ )	$E_{AS}$	245	mJ
Thermal Resistance — Junction to Case (TO220)	$\theta_{JC}$	1	°C/W
(TO220F)		4.4	
— Junction to Ambient		62.5	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	°C
ESD SENSITIVITY — HBM, C=100pF, R=1.5kΩ	$V_{esd}$	2000	V

## ORDERING INFORMATION

Part Number	Package
GPT09N45GN220FP*	TO-220F
GPT09N45GN220*	TO-220

\*Note: G : Suffix for PB Free Product

## ELECTRICAL CHARACTERISTICS

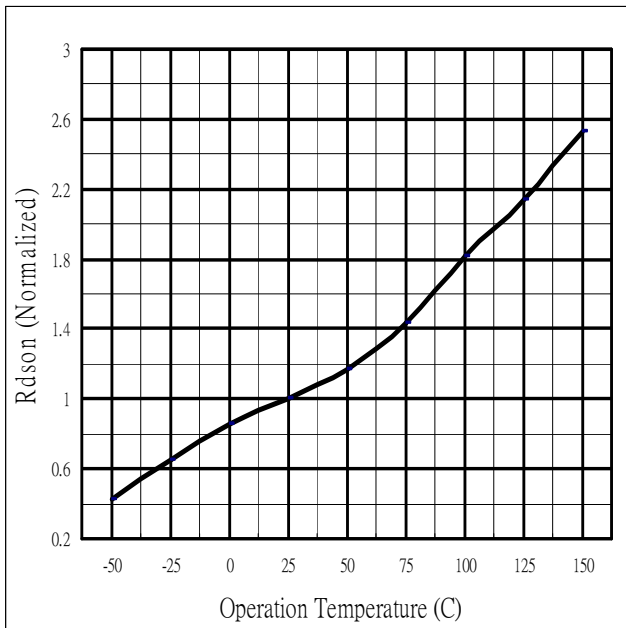
Unless otherwise specified,  $T_J = 25^\circ\text{C}$ .

		GPT09N45			
Characteristic	Symbol	Min	Typ	Max	Units
Drain-Source Breakdown Voltage (V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA)	V <sub>(BR)DSS</sub>	450			V
Drain-Source Leakage Current (V <sub>DS</sub> = 450 V, V <sub>GS</sub> = 0 V)	I <sub>DSS</sub>			1	μA
Gate-Source Leakage Current-Forward (V <sub>gsf</sub> = 30 V, V <sub>DS</sub> = 0 V)	I <sub>GSSF</sub>			100	nA
Gate-Source Leakage Current-Reverse (V <sub>gsr</sub> = -30 V, V <sub>DS</sub> = 0 V)	I <sub>GSSR</sub>			100	nA
Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA)	V <sub>GS(th)</sub>	2.5	3.5	4.5	V
Static Drain-Source On-Resistance (V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.5A) *		R <sub>DS(on)</sub>	0.59	0.7	Ω
Forward Transconductance (V <sub>DS</sub> = 50 V, I <sub>D</sub> = 4.5A) *		g <sub>FS</sub>	7		S
Input Capacitance	(V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>iss</sub>	1087		pF
Output Capacitance		C <sub>oss</sub>	119		pF
Reverse Transfer Capacitance		C <sub>rss</sub>	7.01		pF
Turn-On Delay Time	(V <sub>DD</sub> = 225 V, I <sub>D</sub> = 9 A, R <sub>D</sub> = 17Ω, R <sub>G</sub> = 6.2Ω) *	t <sub>d(on)</sub>	20.4		ns
Rise Time		t <sub>r</sub>	21.7		ns
Turn-Off Delay Time		t <sub>d(off)</sub>	37.33		ns
Fall Time		t <sub>f</sub>	14.13		ns
Total Gate Charge	(V <sub>DS</sub> = 360 V, I <sub>D</sub> = 9 A, V <sub>GS</sub> = 10 V)*	Q <sub>g</sub>	23.7		nC
Gate-Source Charge		Q <sub>gs</sub>	5.97		nC
Gate-Drain Charge		Q <sub>gd</sub>	8.91		nC
SOURCE-DRAIN DIODE CHARACTERISTICS					
Forward On-Voltage(1)	(I <sub>S</sub> =9 A, V <sub>GS</sub> = 0 V, dI <sub>S</sub> /d <sub>t</sub> = 100A/μs)	V <sub>SD</sub>		1.5	V
Forward Turn-On Time		t <sub>on</sub>	**		ns
Reverse Recovery Time		t <sub>rr</sub>	344		ns

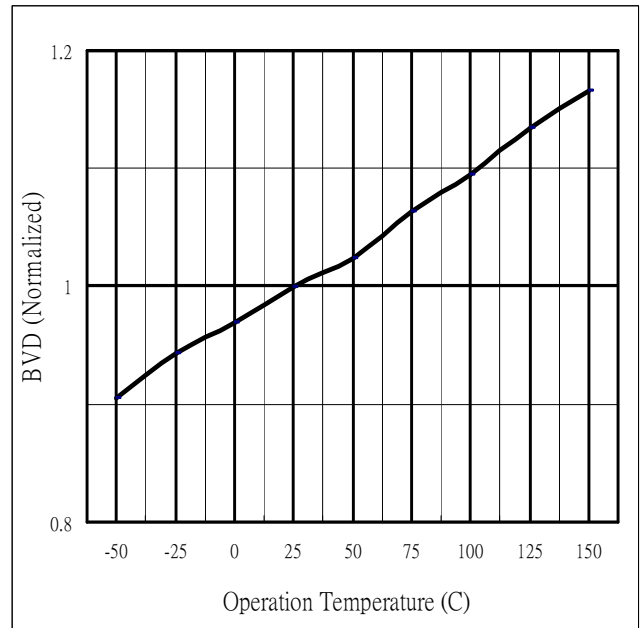
\* Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$

\*\* Negligible, Dominated by circuit inductance

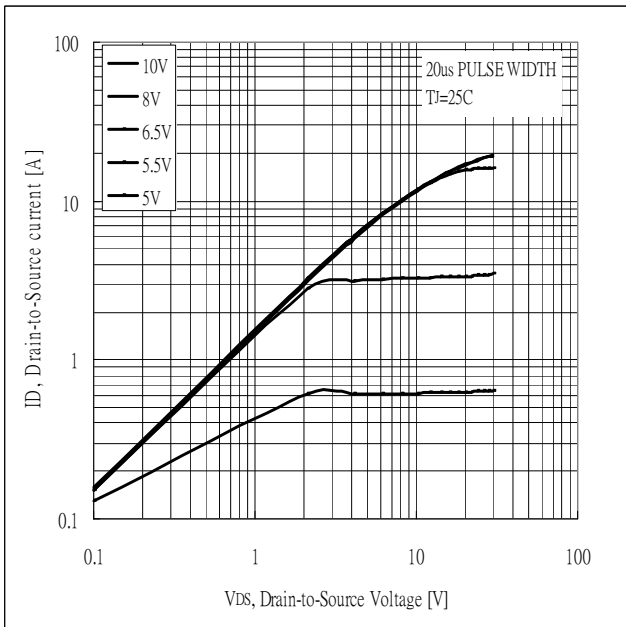
## TYPICAL ELECTRICAL CHARACTERISTICS



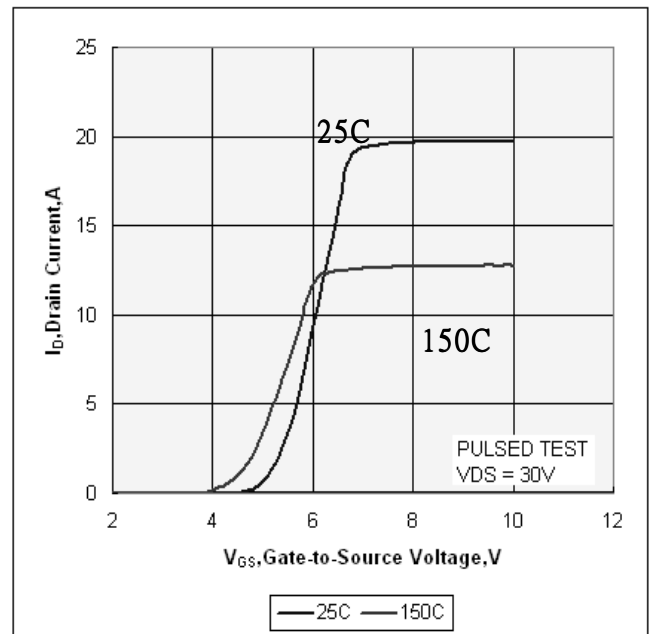
**Fig 1. On-Resistance Variation with vs. Temperature**



**Fig.2 Breakdown Voltage Variation vs. Temperature**



**Fig 3. Typical Output Characteristics**



**Fig 4. Typical Transfer Characteristics**

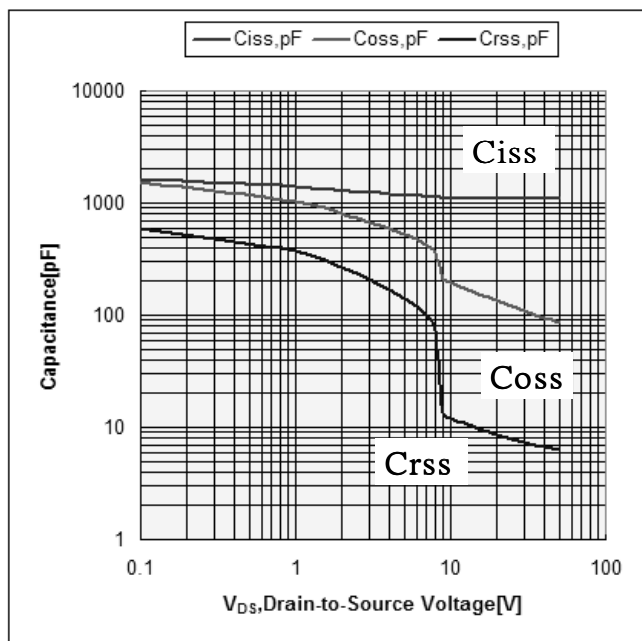


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

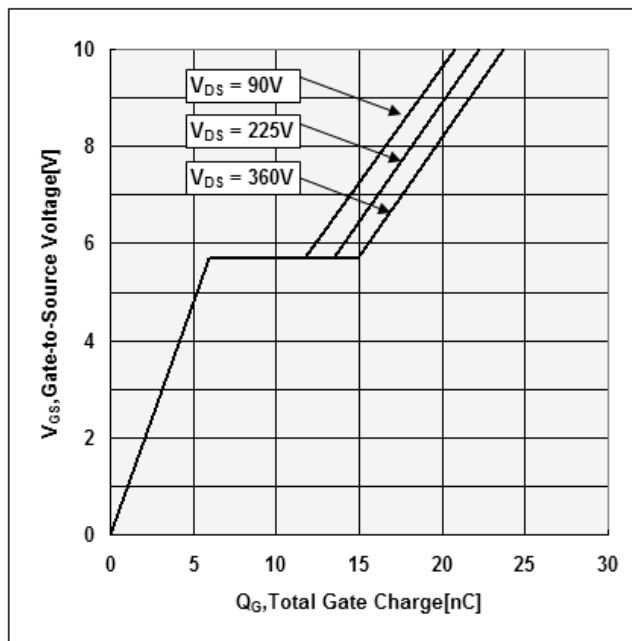
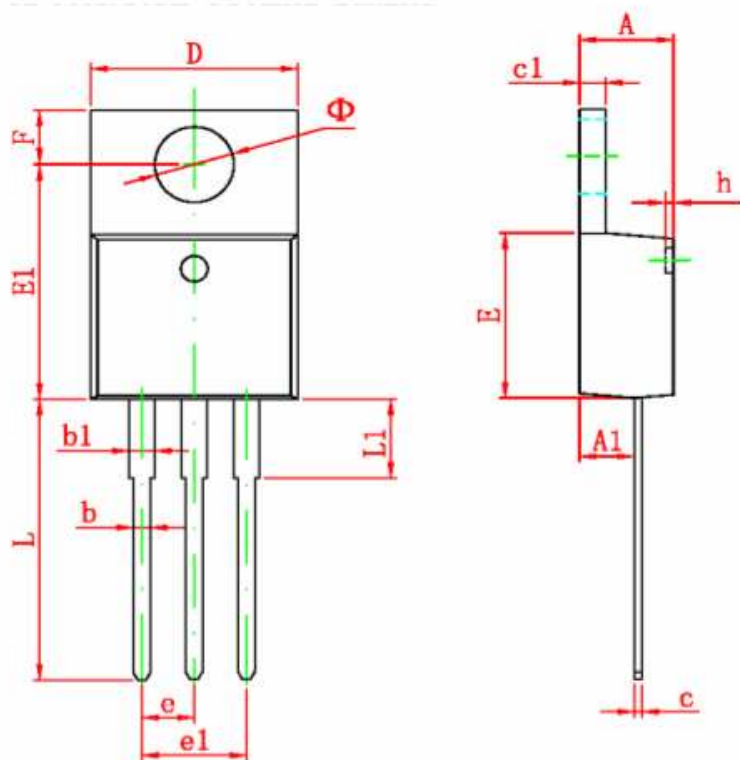


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

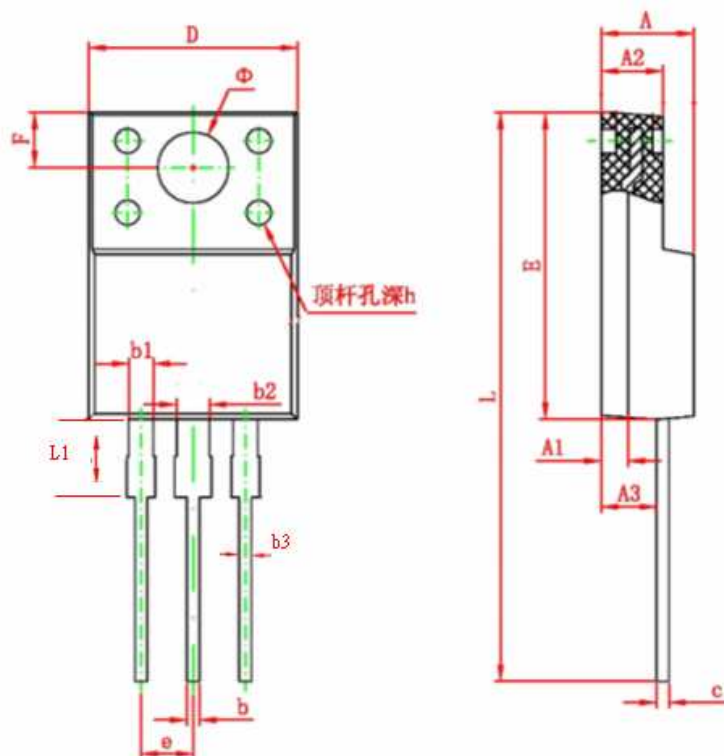
## PACKAGE DIMENSION

TO-220



Symbol	Dimensions In Millimeters	
	Min.	Max
A	4.40	4.80
A1	2.10	2.84
b	0.71	0.91
b1	1.17	1.37
c	0.30	0.60
c1	1.17	1.47
D	9.40	10.60
E	8.40	9.60
e	2.54 TYP.	
e1	4.90	5.60
F	3.00 REF.	
$\Phi$	3.50 REF.	
h	0.00	0.30
L	12.50	14.00
L1	3.50	4.00

TO-220F



Symbol	Dimensions In Millimeters	
	Min.	Max
A	3.80	4.70
A1	1.3 REF.	
A2	2.20	3.20
A3	2.10	3.20
b	0.30	0.95
b1	1.00	1.75
b2	1.00	1.75
b3	0.50	0.80
c	0.30	0.90
D	9.90	10.40
E	14.60	16.20
e	2.54 TYP.	
F	3.00 REF.	
$\Phi$	3.50 REF.	
h	0.00	0.30
L	28.00	30.00
L1	3.20	3.55

## IMPORTANT NOTICE

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