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## **650V N-Channel MOSFET**

#### **General Features**

- $\triangleright$ Proprietary New Planar Technology
- $R_{\text{DS(ON),typ.}} = 0.36 \ \Omega @V_{\text{GS}} = 10V$  $\triangleright$
- Low Gate Charge Minimize Switching Loss  $\triangleright$
- Fast Recovery Body Diode

## **Applications**

- Adaptor
- TV Main Power  $\triangleright$
- SMPS Power Supply  $\triangleright$
- LCD Panel Power  $\triangleright$

## **Ordering Information**

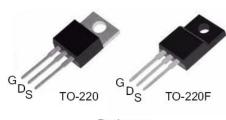
Part Number	Package	Brand
PTP20N65	TO-220	ï
PTA20N65	TO-220F	ï

## **Absolute Maximum Ratings**

(Pb)	Lead	Free	Package	and	Finish
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BV <sub>DSS</sub>	R <sub>DS(ON),typ.</sub>	I <sub>D</sub>
650V	0.36Ω	20A









Symbol	Parameter	PTP20N65	PTA20N65	Unit
V <sub>DSS</sub>	Drain-to-Source Voltage <sup>[1]</sup>	65	50	V
V <sub>GSS</sub>	Gate-to-Source Voltage	±3	30	v
I <sub>D</sub>	Continuous Drain Current	2	0	
I <sub>D @ Tc =100</sub> ℃	Continuous Drain Current @ Tc=100°C	Figure 3		А
I <sub>DM</sub>	Pulsed Drain Current at V <sub>GS</sub> =10V <sup>[2]</sup>	Figure 6		
E <sub>AS</sub>	Single Pulse Avalanche Energy	550		mJ
dv/dt	Peak Diode Recovery dv/dt <sup>[3]</sup>	5.0		V/ns
D	Power Dissipation	160	65	W
P <sub>D</sub>	Derating Factor above 25℃	1.28	0.52	W/°C
T <sub>L</sub> T <sub>PAK</sub>	Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds	300 260		°C
T <sub>J</sub> & T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to	o 150	

Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

## **Thermal Characteristics**

Symbol	Parameter	PTP20N65	PTA20N65	Unit
$R_{ extsf{ heta}JC}$	Thermal Resistance, Junction-to-Case	0.78	1.92	
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62	100	°CAW

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## **Electrical Characteristics**

### **OFF Characteristics** $T_J = 25^{\circ}C$ unless otherwise specified

Symbol	Parameter	Min.	Тур.	Max.	Unit	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	650			V	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA
	Desire to Oscarso Las la se Oscarso t			1		V <sub>DS</sub> =650V, V <sub>GS</sub> =0V
IDSS	Drain-to-Source Leakage Current			100	uA	V <sub>DS</sub> =520V, V <sub>GS</sub> =0V, T <sub>J</sub> =125℃
	Cata ta Sauraa Laakaga Currant			+100	m (	V <sub>GS</sub> =+30V, V <sub>DS</sub> =0V
I <sub>GSS</sub>	Gate-to-Source Leakage Current			-100	nA	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V

#### **ON** Characteristics

ON Chara	N Characteristics				$T_J = 25^{\circ}C$ unless otherwise specified			
Symbol	Parameter	Min.	Тур.	Max.	Unit	<b>Test Conditions</b>		
R <sub>DS(ON)</sub>	Static Drain-to-Source On-Resistance <sup>[4]</sup>		0.36	0.50	Ω	V <sub>GS</sub> =10V, I <sub>D</sub> =10A		
$V_{GS(TH)}$	Gate Threshold Voltage	2.0		4.0	V	$V_{DS}=V_{GS}, I_{D}=250uA$		
gfs	Forward Transconductance <sup>[4]</sup>		15		S	VDS=15V,ID=10A		

#### **Dynamic Characteristics**

Essentially independent of operating temperature

Symbol	Parameter	Min.	Тур.	Max.	Unit	Test Conditions
C <sub>iss</sub>	Input Capacitance		2400			<u> </u>
C <sub>rss</sub>	Reverse Transfer Capacitance		105		pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0MH <sub>Z</sub>
C <sub>oss</sub>	Output Capacitance		225			
Qg	Total Gate Charge		65			
Q <sub>gs</sub>	Gate-to-Source Charge		11		nC	$V_{DD}$ =325V, $I_{D}$ =20A, $V_{GS}$ =0 to 10V
Q <sub>gd</sub>	Gate-to-Drain (Miller) Charge		26			

## **Resistive Switching Characteristics**

Essentially independent of operating temperature

Symbol	Parameter	Min.	Тур.	Max.	Unit	Test Conditions
td(ON)	Turn-on Delay Time		35			
trise	Rise Time		82		~ 6	V <sub>DD</sub> =325V, I <sub>D</sub> =20A,
td(OFF)	Turn-Off Delay Time		180		nS	V <sub>GS</sub> = 10V Rg=25 Ω
tfall	Fall Time		90			

#### **Source-Drain Body Diode Characteristics**

 $T_J=25^{\circ}C$  unless otherwise specified

Symbol	Parameter	Min	Тур.	Max.	Unit	Test Conditions
I <sub>SD</sub>	Continuous Source Current <sup>[4]</sup>			20	۸	Integral PN-diode in
I <sub>SM</sub>	Pulsed Source Current <sup>[4]</sup>			80	A	MOSFET
V <sub>SD</sub>	Diode Forward Voltage			1.5	V	I <sub>S</sub> =20A, V <sub>GS</sub> =0V
trr	Reverse recovery time		390		ns	V <sub>GS</sub> =0V ,I⊧=20A,
Qrr	Reverse recovery charge		3.4		uC	di⊧/dt=100A/µs

Note:

[1] T<sub>J</sub>=+25℃ to +150℃

[2] Repetitive rating; pulse width limited by maximum junction temperature.

[3] ISD= 20A di/dt < 100 A/µs, VDD < BVDSS, TJ=+150 °C.

[4] Pulse width≤380µs; duty cycle≤2%.



# **Typical Characteristics**

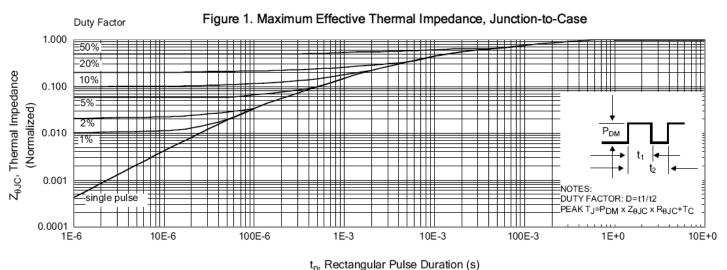
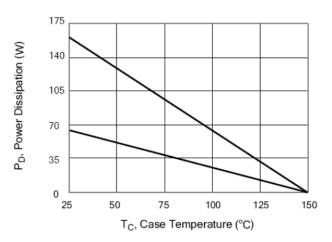


Figure 2. Maximum Power Dissipation vs Case Temperature



20

15

10

5

0

0

I<sub>D</sub>, Drain Current (A)

PULSE DURATION = 250 µS DUTY FACTOR = 0.5%

MAX, T<sub>C</sub> = 25 °C

3

6

9

V<sub>DS</sub>, Drain-to-Source Voltage (V)

12

Figure 4. Typical Output Characteristics

Figure 3. Maximum Continuous Drain Current vs Case Temperature

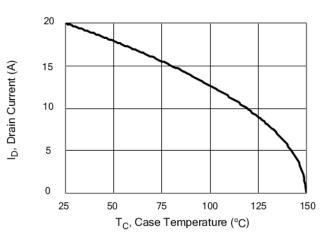
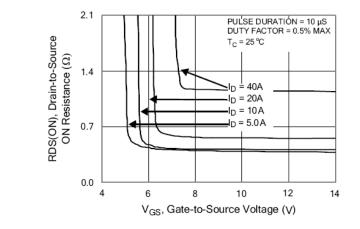


Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current



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GS = 15V

GS = 7.0V

GS = 6.5V

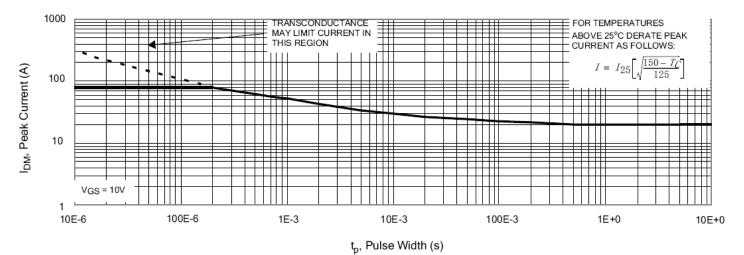
GS = 6.0V

VGS = 5.5V

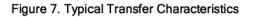
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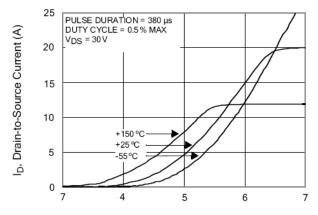
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# **Typical Characteristics(Cont.)**



#### Figure 6. Maximum Peak Current Capability





V<sub>GS</sub>, Gate-to-Source Voltage (V)

Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

Figure 8. Unclamped Inductive Switching Capability

PTP20N65 PTA20N65

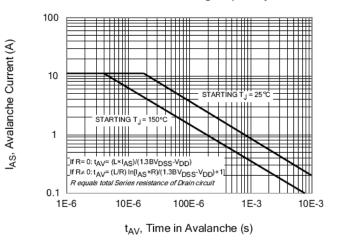
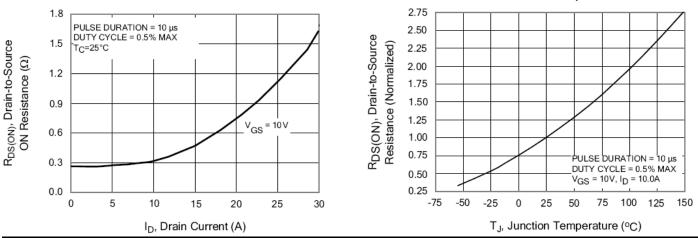


Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature

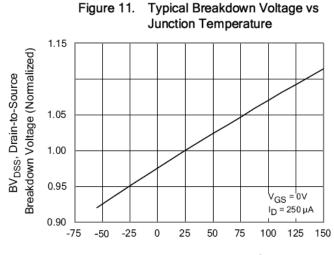


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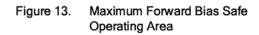
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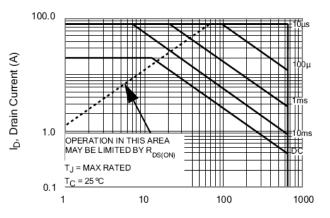
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## **Typical Characteristics**(Cont.)

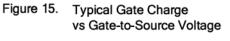


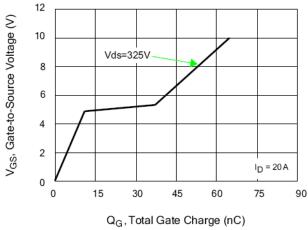
T<sub>J</sub>, Junction Temperature (°C)

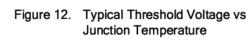


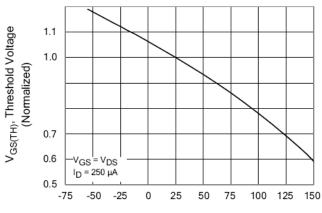


V<sub>DS</sub>, Drain-to-Source Voltage (V)



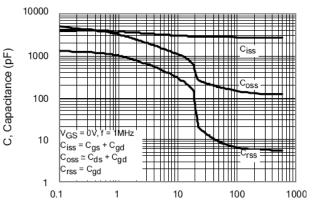






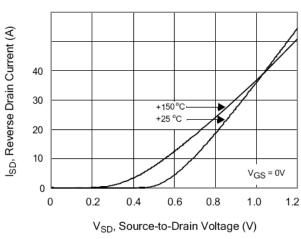
T<sub>J</sub>, Junction Temperature (°C)

Figure 14. Typical Capacitance vs Drain-to-Source Voltage



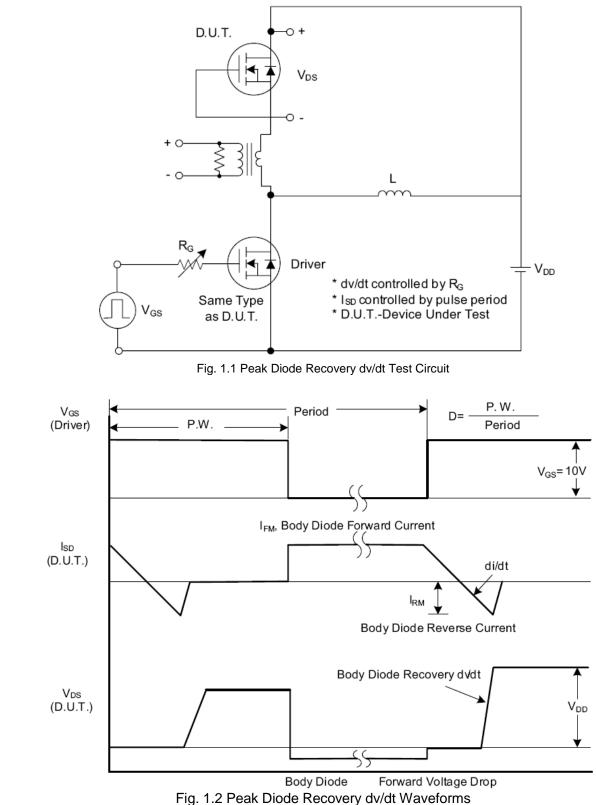
V<sub>DS</sub>, Drain Voltage (V)

Figure 16. Typical Body Diode Transfer Characteristics



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# PTP20N65 PTA20N65

# Test Circuits and Waveforms (Cont.)

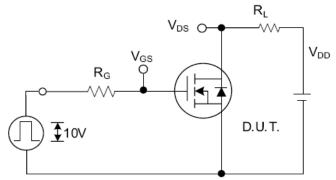


Fig. 2.1 Switching Test Circuit

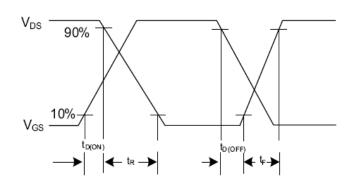


Fig. 2.2 Switching Waveforms

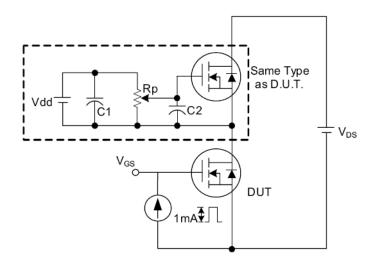


Fig. 3 . 1 Gate Charge Test Circuit

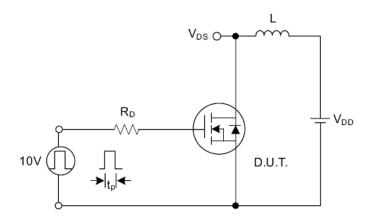


Fig. 4.1 Unclamped Inductive Switching Test Circuit

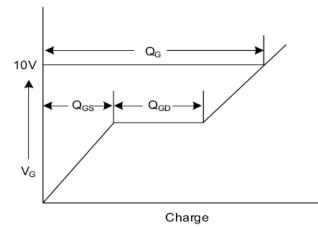
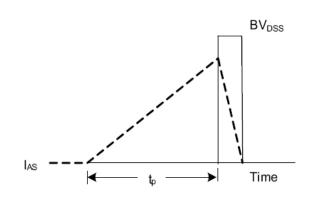
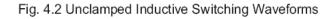


Fig. 3.2 Gate Charge Waveform





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