



## Description

The IPD50N04S410ATMA1 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection in other Switching application.

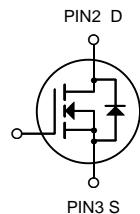


TO252-2L

## General Features

$V_{DS} = 40V$   $I_D = 60A$

$R_{DS(ON)} < 10m\Omega$  @  $V_{GS}=10V$



N-Channel MOSFET

## Application

Battery protection

Load switch

Uninterruptible power supply

## Package Marking and Ordering Information

Product ID	Pack	Brand	Qty(PCS)
IPD50N04S410ATMA1	TO252-2L	HXY MOSFET	2500

## Absolute Maximum Ratings ( $T_c=25^\circ C$ unless otherwise noted)

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	40	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D @ T_c=25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	60	A
$I_D @ T_c=100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	40	A
$I_{DM}$	Pulsed Drain Current <sup>2</sup>	160	A
EAS	Single Pulse Avalanche Energy <sup>3</sup>	46.1	mJ
$I_{AS}$	Avalanche Current	28	A
$P_D @ T_c=25^\circ C$	Total Power Dissipation <sup>4</sup>	34.6	W
$T_{STG}$	Storage Temperature Range	-55 to 150	°C
$T_J$	Operating Junction Temperature Range	-55 to 150	°C
$R_{\theta JA}$	Thermal Resistance Junction-ambient (Steady State) <sup>1</sup>	62	°C/W
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>1</sup>	3.8	°C/W



**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise specified)**

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	40	-	-	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V,	-	-	1.0	μA
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V	-	-	±100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1.0	1.5	2.5	V
R <sub>DS(on)</sub> note3	Static Drain-Source on-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =30A	-	7.7	10	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A	-	10	14	
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, f=1.0MHz	-	1639	-	pF
C <sub>oss</sub>	Output Capacitance		-	148	-	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		-	122	-	pF
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =20V, I <sub>D</sub> =15A, V <sub>GS</sub> =4.5V	-	16	-	nC
Q <sub>gs</sub>	Gate-Source Charge		-	5	-	nC
Q <sub>gd</sub>	Gate-Drain("Miller") Charge		-	7	-	nC
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-on Delay Time	V <sub>DS</sub> =20V, I <sub>D</sub> =1A, R <sub>GEN</sub> =6.2Ω, V <sub>GS</sub> =10V	-	10	-	ns
t <sub>r</sub>	Turn-on Rise Time		-	6	-	ns
t <sub>d(off)</sub>	Turn-off Delay Time		-	50	-	ns
t <sub>f</sub>	Turn-off Fall Time		-	26	-	ns
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	60	-	A
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	160	-	A
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> =0V, I <sub>S</sub> =30A	-	-	1.2	V
trr	Body Diode Reverse Recovery Time	I <sub>F</sub> =5A, dI/dt=100A/μs	-	13	-	ns
Qrr	Body Diode Reverse Recovery Charge		-	7	-	nC

Notes:1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

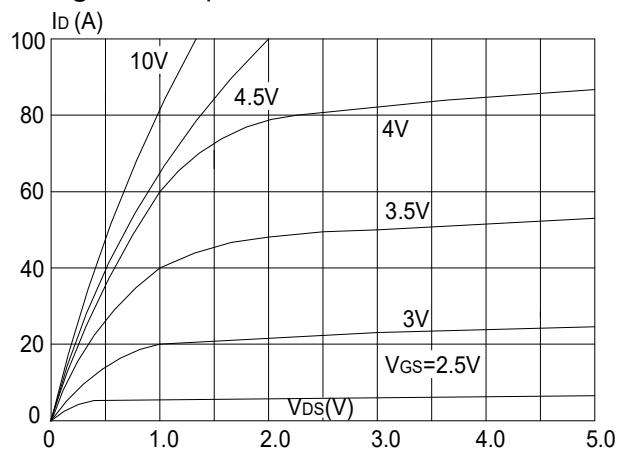
2. EAS condition: T<sub>J</sub>=25°C, V<sub>GS</sub>=20V, R<sub>G</sub>=25Ω, L=0.5mH, I<sub>AS</sub>=13A

3. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%

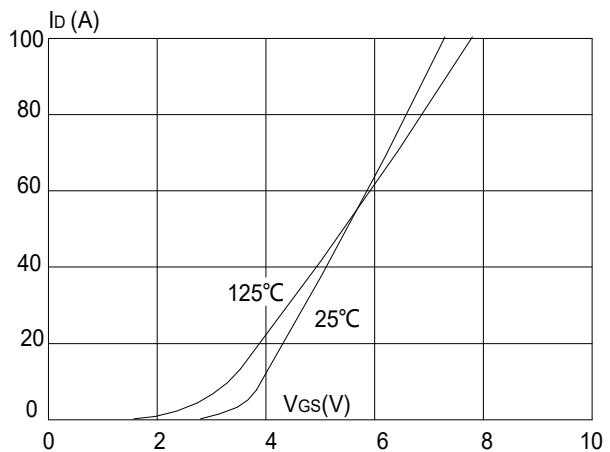


## Typical Performance Characteristics

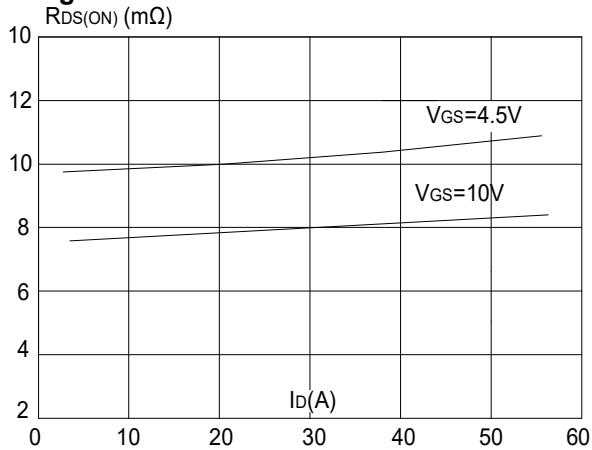
**Figure 1:** Output Characteristics



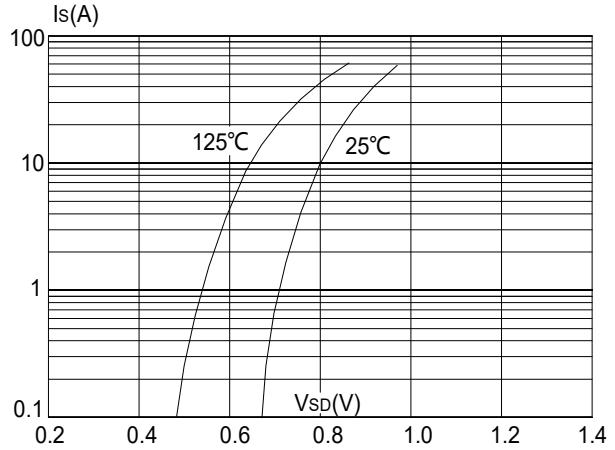
**Figure 2:** Typical Transfer Characteristics



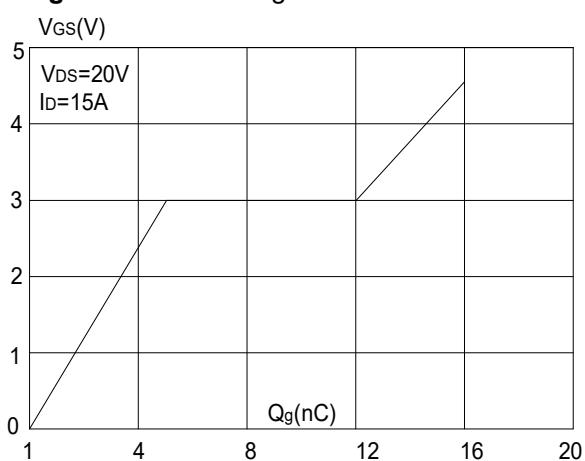
**Figure 3:** On-resistance vs. Drain Current



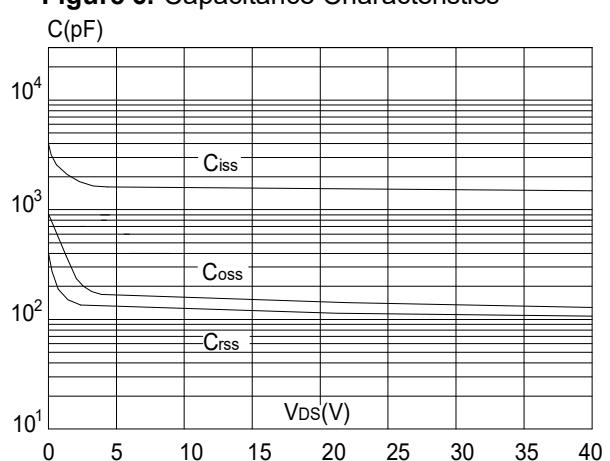
**Figure 4:** Body Diode Characteristics



**Figure 5:** Gate Charge Characteristics

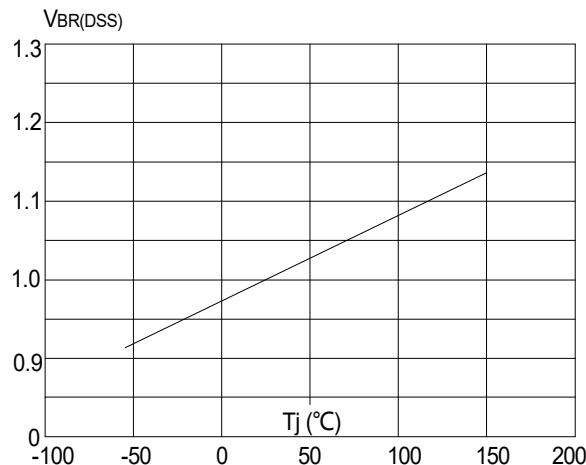


**Figure 6:** Capacitance Characteristics

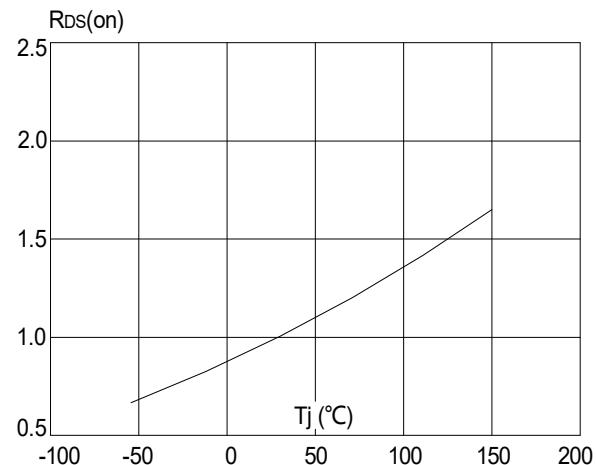




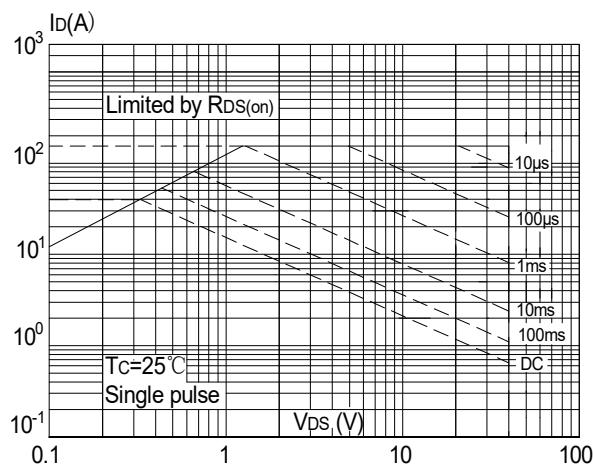
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



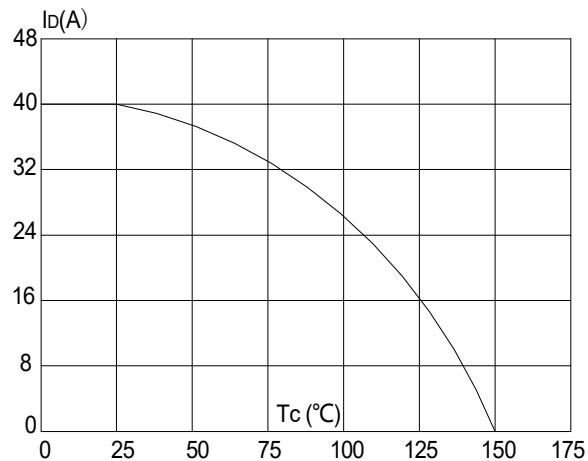
**Figure 8:** Normalized on Resistance vs. Junction Temperature



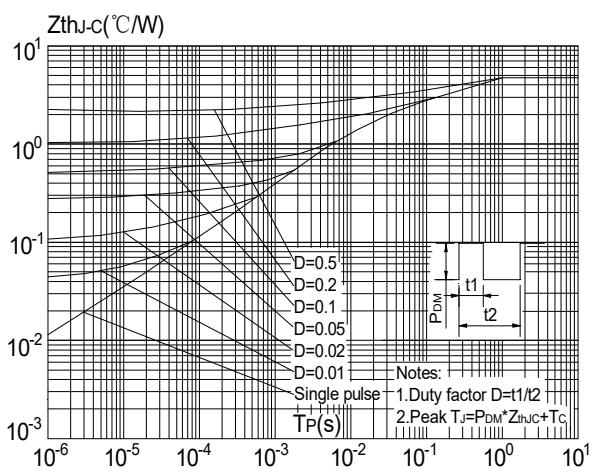
**Figure 9:** Maximum Safe Operating Area



**Figure 10:** Maximum Continuous Drain Current vs. Case Temperature



**Figure 11:** Maximum Effective Transient Thermal Impedance, Junction-to-Case





## Test Circuit

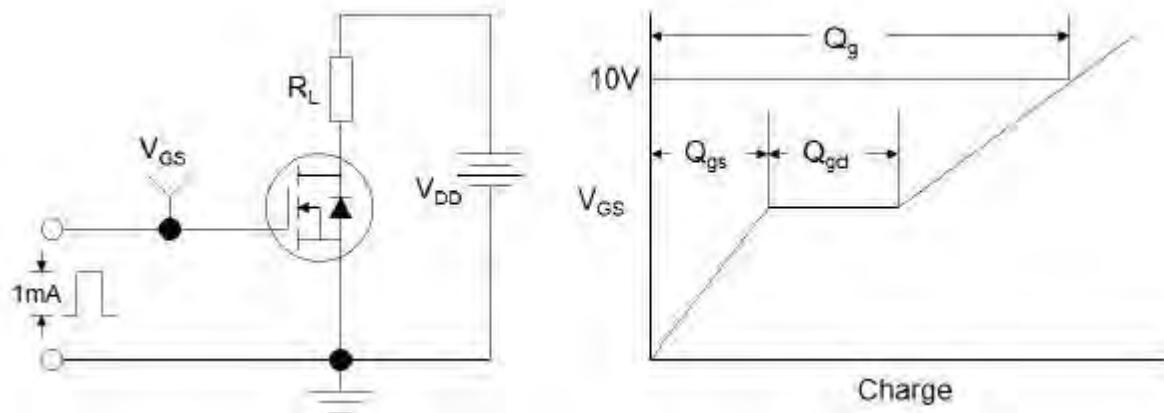


Figure 1: Gate Charge Test Circuit & Waveform

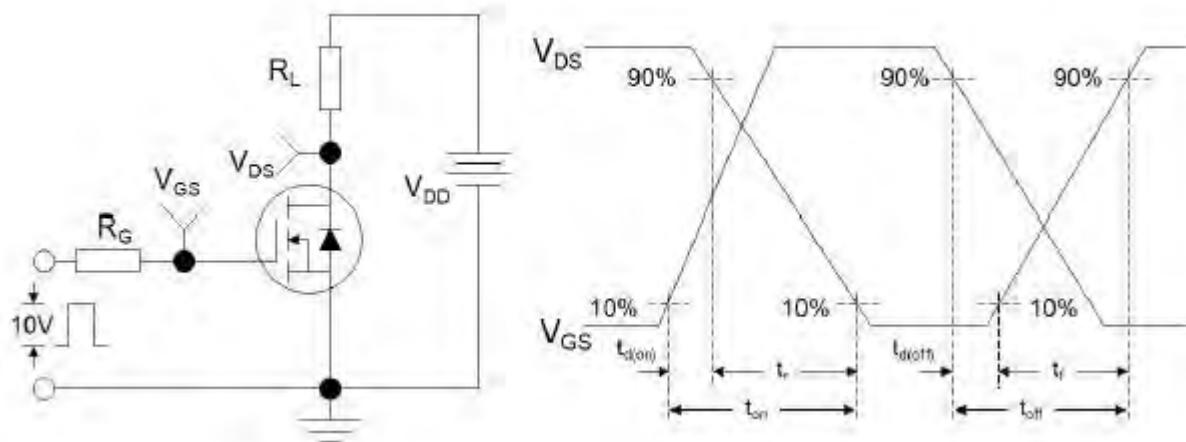


Figure 2: Resistive Switching Test Circuit & Waveforms

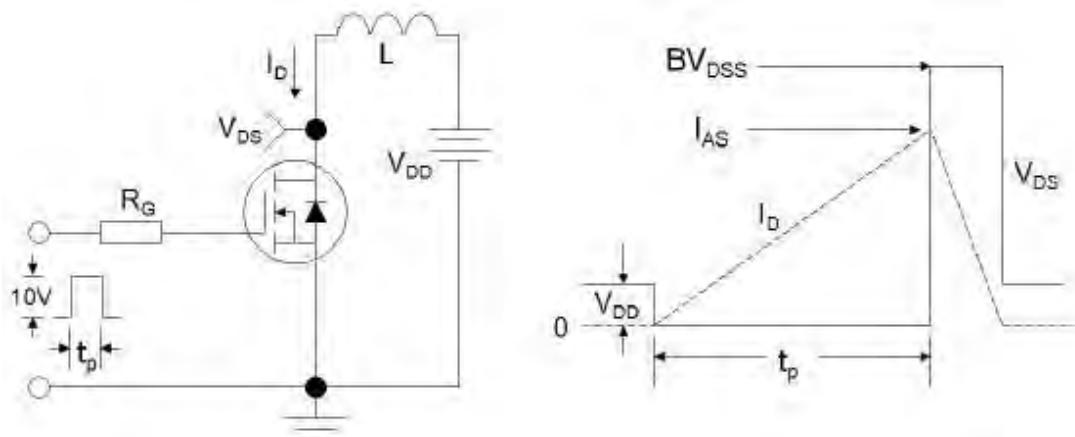
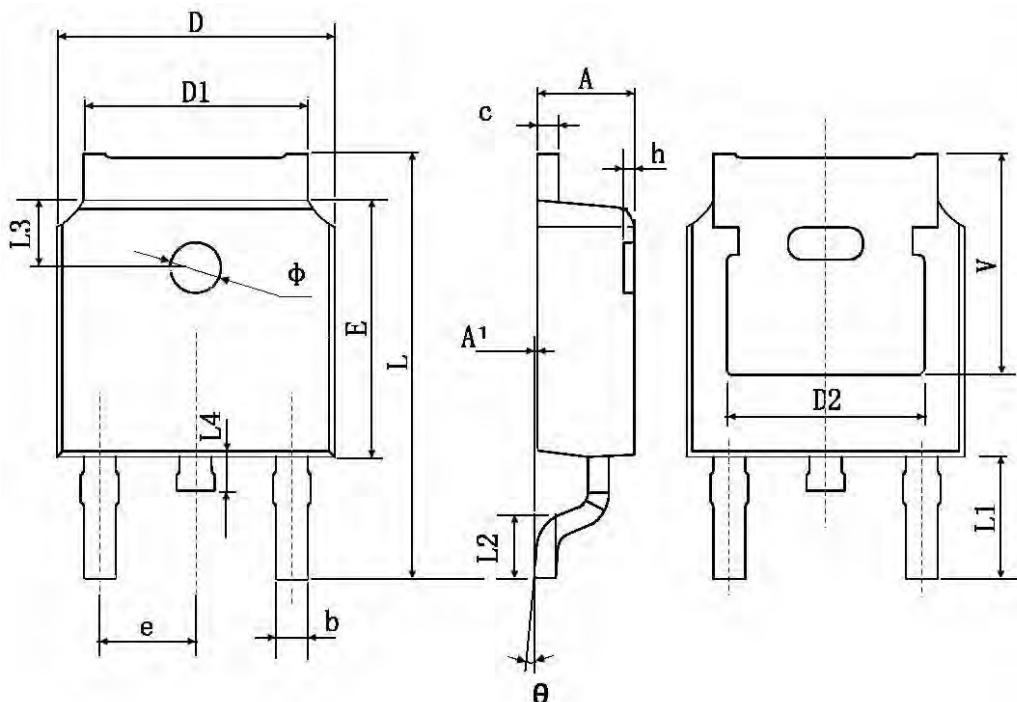


Figure 3: Unclamped Inductive Switching Test Circuit & Waveforms



## TO-252 Package Information



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	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	0.483 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
L4	0.600	1.000	0.024	0.039
Φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 TYP.		0.211 TYP.	



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