

## Dual N-Channel Enhancement Mode MOSFET

### Feature

### Pin Description

- 40V/75A  
R<sub>DS(ON)</sub> = 5.7 mΩ (typ.) @ V<sub>GS</sub> = 10V  
R<sub>DS(ON)</sub> = 8.0 mΩ (typ.) @ V<sub>GS</sub> = 4.5V
- 100% Avalanche Tested
- 100% DVDS
- Reliable and Rugged
- Halogen Free and Green Devices Available  
(RoHS Compliant)

### Applications

- Switching application
- Li-battery protection
- Power Management for DC/DC

## Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit	
<b>Common Ratings</b> (T <sub>c</sub> =25°C Unless Otherwise Noted)				
V <sub>DSS</sub>	Drain-Source Voltage	40	V	
V <sub>GSS</sub>	Gate-Source Voltage	±20	V	
T <sub>J</sub>	Junction Temperature Range	-55 to 175	°C	
T <sub>STG</sub>	Storage Temperature Range		°C	
I <sub>S</sub>	Source Current-Continuous(Body Diode)	T <sub>c</sub> =25°C	75	A
<b>Mounted on Large Heat Sink</b>				
I <sub>DM</sub>	Pulsed Drain Current *	T <sub>c</sub> =25°C	268	A
I <sub>D</sub>	Continuous Drain Current	T <sub>c</sub> =25°C	75	A
		T <sub>c</sub> =100°C	53	A
P <sub>D</sub>	Maximum Power Dissipation	T <sub>c</sub> =25°C	77	W
		T <sub>c</sub> =100°C	38	W
R <sub>JC</sub>	Thermal Resistance, Junction-to-Case		1.94	°C/W
R <sub>JA</sub>	Thermal Resistance, Junction-to-Ambient **		80	°C/W
E <sub>AS</sub>	Single Pulsed-Avalanche Energy ***	L=0.3mH	100	mJ

Note: \* Repetitive rating; pulse width limited by max.junction temperature.

\*\* Surface mounted on 1in2 FR-4 board.

\*\*\* Limited by T<sub>Jmax</sub>, starting T<sub>J</sub>=25°C, L = 0.3mH, R<sub>G</sub>= 25 Ω, V<sub>GS</sub>=10V.

## Electrical Characteristics(T<sub>c</sub> =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	HYG040ND04LS1			Unit
			Min	Typ.	Max	
<b>Static Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA	40	-	-	V
I <sub>DSS</sub>	Drain-to-Source Leakage Current	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	-	-	1	μA
		T <sub>J</sub> =125°C	-	-	50	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA	1.0	2.0	3.0	V
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance	V <sub>GS</sub> =10V, I <sub>DS</sub> =20A	-	5.7	7.0	m
		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =20A	-	8.0	10.0	m
<b>Diode Characteristics</b>						
V <sub>SD</sub>	Diode Forward Voltage	I <sub>SD</sub> =20A, V <sub>GS</sub> =0V	-	0.85	1.3	V
t <sub>rr</sub>	Reverse Recovery Time	I <sub>SD</sub> =20A, dI <sub>SD</sub> /dt=100A/μs	-	18	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	6	-	nC

## Electrical Characteristics (Cont.) (T<sub>c</sub> =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	HYG040ND04LS1			Unit
			Min	Typ.	Max	
<b>Dynamic Characteristics</b>						
R <sub>G</sub>	Gate Resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz	-	3.5	-	
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, Frequency=1MHz	-	1188	-	pF
C <sub>oss</sub>	Output Capacitance					
C <sub>rss</sub>	Reverse Transfer Capacitance					
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>DD</sub> =20V, R <sub>G</sub> =5Ω, I <sub>DS</sub> =20A, V <sub>GS</sub> =10V	-	10	-	ns
T <sub>r</sub>	Turn-on Rise Time					
t <sub>d(OFF)</sub>	Turn-off Delay Time					
T <sub>f</sub>	Turn-off Fall Time					
<b>Gate Charge Characteristics</b>						
Q <sub>g</sub>	Total Gate Charge(V <sub>GS</sub> =10V)	V <sub>DS</sub> =32V, I <sub>DS</sub> =20A	-	18	-	nC
	Total Gate Charge(V <sub>GS</sub> =4.5V)		-	8	-	
Q <sub>gs</sub>	Gate-Source Charge		-	5	-	
Q <sub>gd</sub>	Gate-Drain Charge		-	2	-	
V <sub>plateau</sub>	Gate plateau voltage		-	3.7	-	V

Note: \*Pulse test, pulse width ≤ 300us, duty cycle ≤ 2%

### Typical Operating Characteristics

Figure 1: Power Dissipation

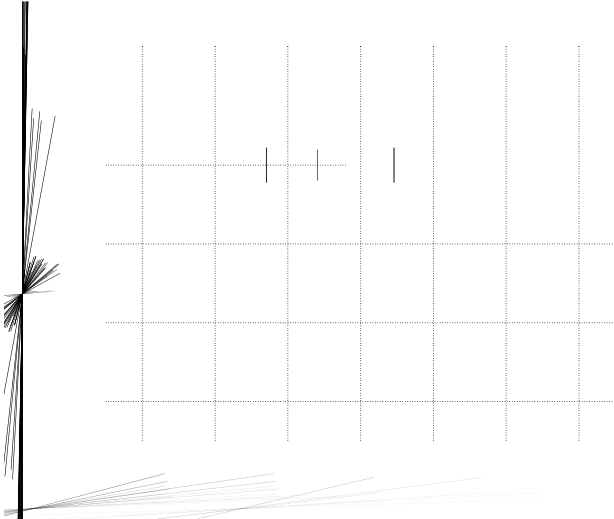


Figure 2: Drain Current

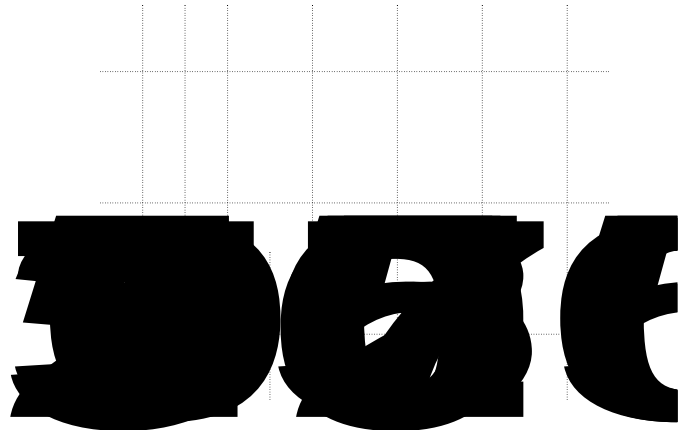


Figure 3: Safe Operation Area

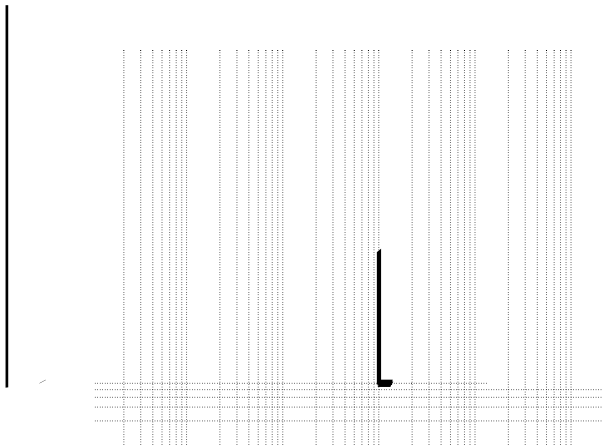


Figure 4: Thermal Transient Impedance

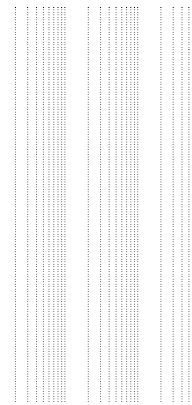


Figure 5: Output Characteristics

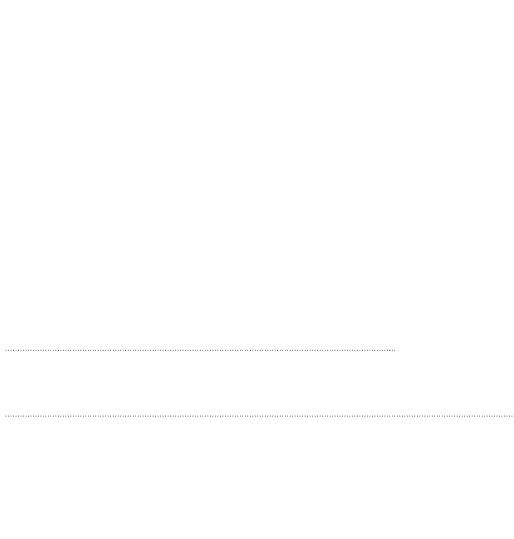


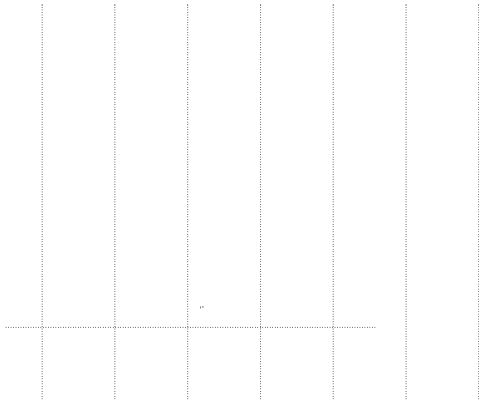
Figure 6: Drain-Source On Resistance



**Typical Operating Characteristics(Cont.)**

**Figure 7: On-Resistance vs. Temperature**

**Figure 8: Source-Drain Diode Forward**

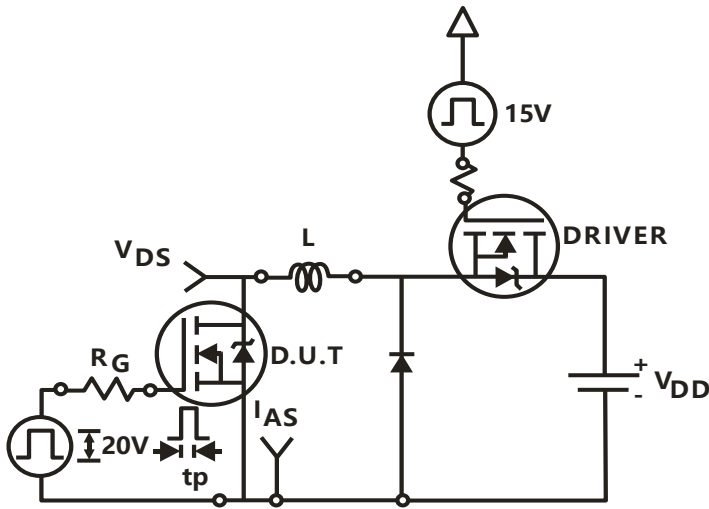


**Figure 9: Capacitance Characteristics**

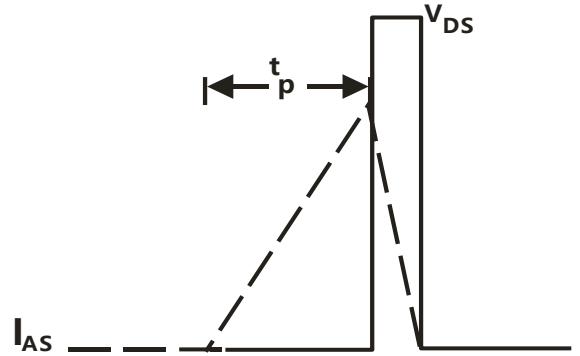
**Figure 10: Gate Charge Characteristics**



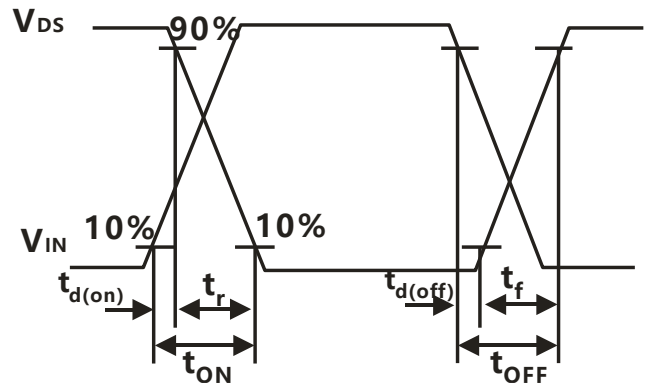
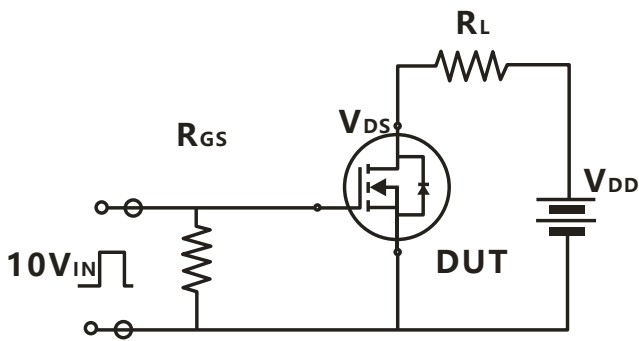
**Avalanche Test Circuit**



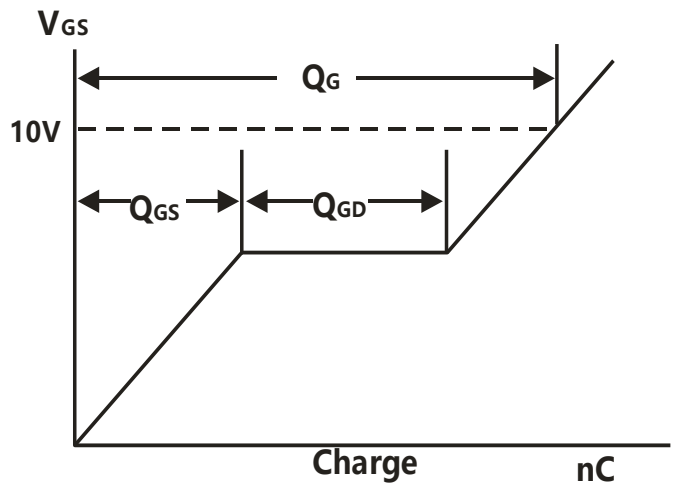
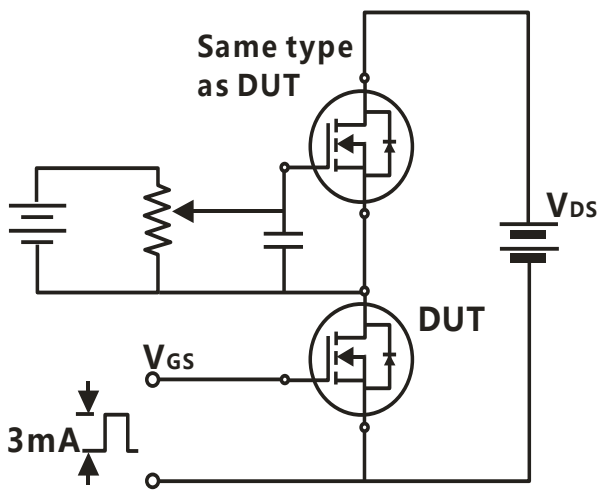
$$E_{AS} = \frac{1}{2} L I_{AS}^2$$



**Switching Time Test Circuit**



**Gate Charge Test Circuit**

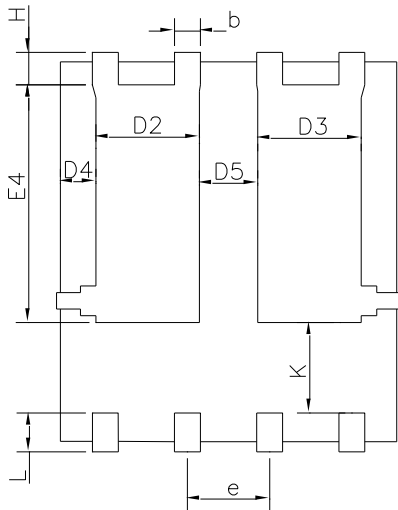
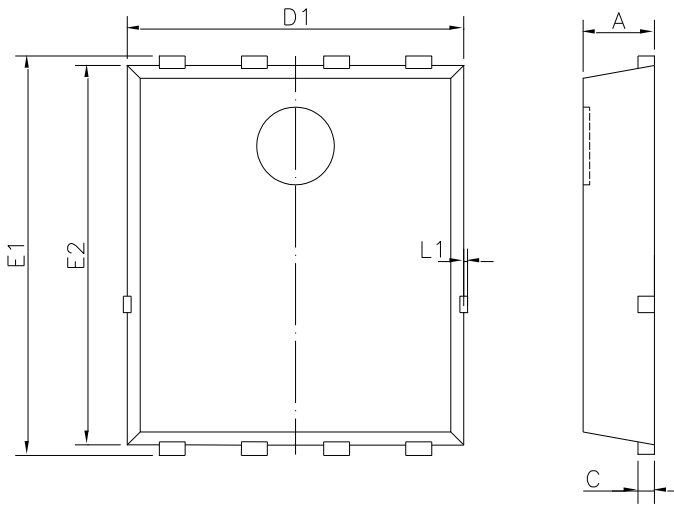


## Device Per Unit

Package Type	Unit	Quantity
PDFN8L(5x6)	Reel	5000

## Package Information

PDFN8L(5x6)



COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MAX
A	1.00	1.10	1.20
b	0.30	0.40	0.50
c	0.154	0.254	0.354
D1	5.00	5.20	5.40
D2	1.40	1.60	1.80
D3	1.40	1.60	1.80
D4	0.45	0.55	0.65
D5	0.70	0.90	1.10
e	1.27BSC		
E1	5.95	6.15	6.35
E2	5.66	5.86	6.06
E4	3.47	3.67	3.87
H	0.40	0.50	0.60
K	1.23	1.38	1.53
L	0.30	0.60	0.70
L1	\	\	0.12
*Not specified			

**Classification Profile**



**Classification Reflow Profiles**

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min ( $T_{smin}$ )	100 °C	150 °C
Temperature max ( $T_{smax}$ )	150 °C	200 °C
Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Average ramp-up rate ( $T_{smax}$ to $T_P$ )	3 °C/second max.	3°C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time at liquidous ( $t_L$ )	60-150 seconds	60-150 seconds
Peak package body Temperature ( $T_P$ )*	See Classification Temp in table 1	See Classification Temp in table 2
Time ( $t_P$ )** within 5°C of the specified classification temperature ( $T_c$ )	20** seconds	30** seconds
Average ramp-down rate ( $T_P$ to $T_{smax}$ )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
*Tolerance for peak profile Temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature ( $t_P$ ) is defined as a supplier minimum and a user maximum.		



Table 1.SnPb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2.Pb-free Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> ≥2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	168/500 Hrs, Bias @ 150°C
HTGB	JESD-22, A108	168/500 Hrs, V <sub>gs</sub> 100% @ 150°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	250/500 Cycles, -55°C~150°C

## Customer Service

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