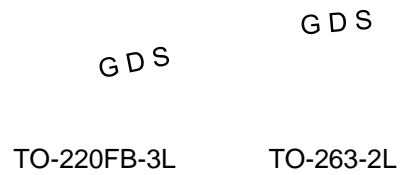
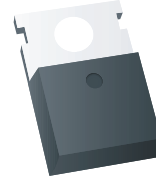


## N-Channel Enhancement Mode MOSFET

### Feature

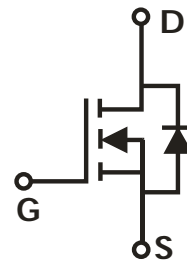
- 40V/320A
- $R_{DS(ON)} = 1.5\ m\ (\text{typ.}) @ V_{GS} = 10V$
- $R_{DS(ON)} = 1.7\ m\ (\text{typ.}) @ V_{GS} = 4.5V$
- 100% Avalanche Tested
- 100% DVDS
- Reliable and Rugged
- Halogen Free and Green Devices Available  
(RoHS Compliant)

### Pin Description



### Applications

- Switching application
- Li-battery protection



Single N-Channel MOSFET

### Ordering and Marking Information

<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">P</td> <td style="width: 50%; text-align: center;">B</td> </tr> <tr> <td style="text-align: center;">HYG013N04</td> <td style="text-align: center;">HYG013N04</td> </tr> <tr> <td style="text-align: center;">XYMXXXXXX</td> <td style="text-align: center;">XYMXXXXXX</td> </tr> </table>	P	B	HYG013N04	HYG013N04	XYMXXXXXX	XYMXXXXXX	<p>Package Code P:TO-220FB-3L      B:TO-263-2L</p> <p>Date Code XYMXXXXXX</p>
P	B						
HYG013N04	HYG013N04						
XYMXXXXXX	XYMXXXXXX						

Note: HUAYI halogen free products contain molding compounds/die attach materials and 100% matte tin plate Termination finish; which are fully compliant with RoHS. HUAYI halogen free products meet or exceed the halogen free requirements of IPC/JEDEC J-STD-020 for MSL classification at halogen free peak reflow temperature. HUAYI defines “Green” to mean halogen free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

HUAYI reserves the right to make changes, corrections, enhancements, modifications, and improvements to this product and/or to this document at any time without notice.

## Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit	
<b>Common Ratings</b> (Tc=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)	Tc=25°C	320	A
<b>Mounted on Large Heat Sink</b>				
I <sub>DM</sub>	Pulsed Drain Current *	Tc=25°C	1150	A
I <sub>D</sub>	Continuous Drain Current	Tc=25°C	320	A
		Tc=100°C	226	A
P <sub>D</sub>	Maximum Power Dissipation	Tc=25°C	333	W
		Tc=100°C	166	W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case		0.45	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient **		62.5	°C/W
E <sub>AS</sub>	Single Pulsed-Avalanche Energy ***	L=0.3mH	1365	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>C</sub>= 25 , V<sub>GS</sub>=10V.

## Electrical Characteristics(Tc =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	HYG013N04LR1			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	->T <sub>J</sub> -0.602	-0.5202	2.0	μA





## Typical Operating Characteristics(Cont.)

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

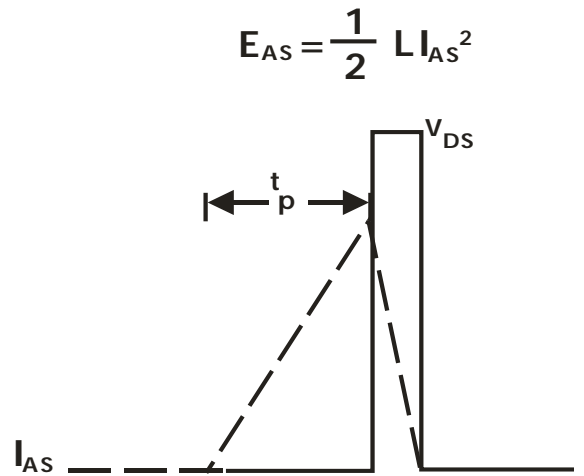
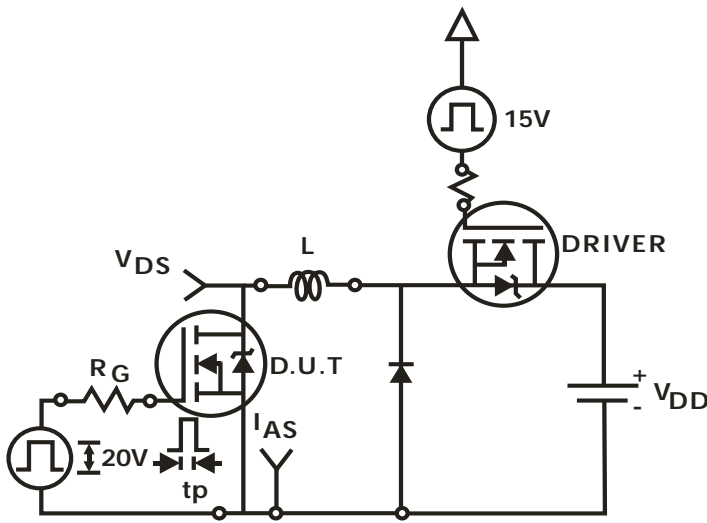
**Figure 8: Source-Drain Diode Forward**



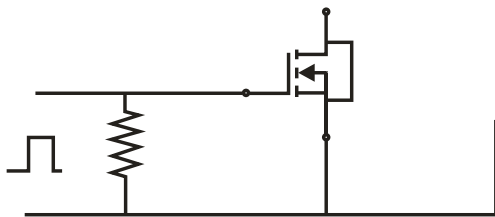
**Figure 9: Capacitance Characteristics**

**Figure 10: Gate Charge Characteristics**

**Avalanche Test Circuit**



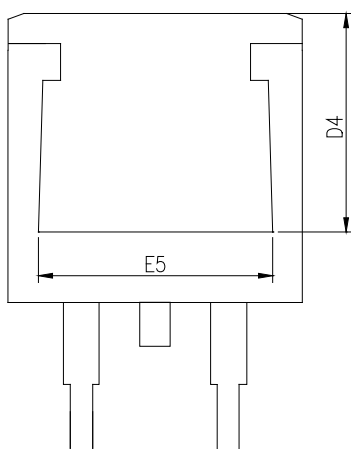
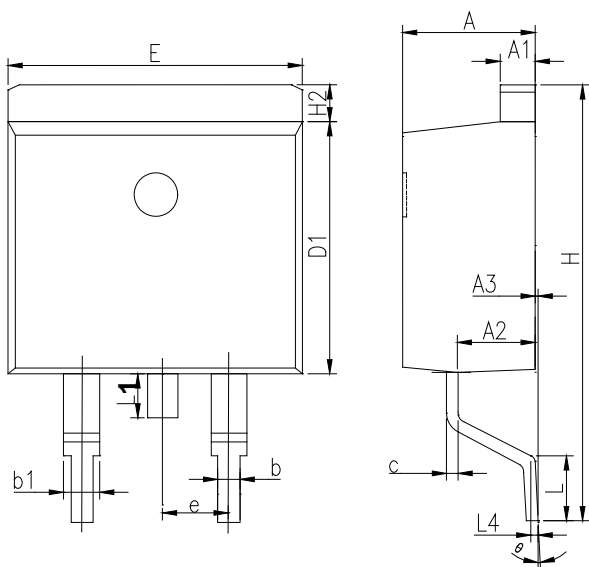
**Switching Time Test Circuit**



**Gate Charge Test Circuit**



TO-263-2L



COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MIN
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25 BSC		
	0°	5°	9°



## 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.

\*

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

<b>Package Thickness</b>	<b>Volume mm &lt;350</b>	<b>Volume mm 350</b>
2.5 mm	235 °C	220 °C
2.5 mm	220 °C	220 °C

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

<b>Package Thickness</b>	<b>Volume mm &lt;350</b>	<b>Volume mm 350-2000</b>	<b>Volume mm</b>
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