

**HYA013N04**

## 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

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

Symbol	Parameter	Test Conditions	HYA013N04NR1			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	-	0.6	-	
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, Frequency=1MHz	-	8576	-	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> =4 Ω, I <sub>DS</sub> =40A, V <sub>GS</sub> =10V	-	37	-	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> =40A	-	167	-	nC
Q <sub>gs</sub>	Gate-Source Charge					
Q <sub>gd</sub>	Gate-Drain Charge					
V <sub>plateau</sub>	Gate plateau voltage		-	5.6	-	V

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

### Typical Operating Characteristics

Figure 1: Power Dissipation

Figure 2: Drain Current

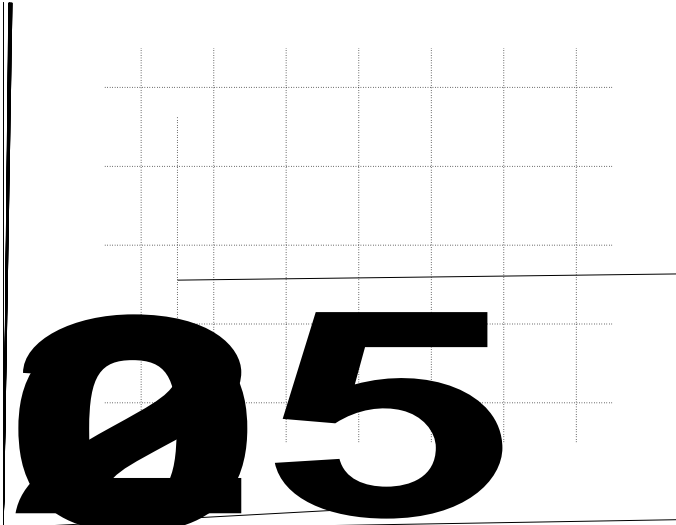


Figure 3: Safe Operation Area

Figure 4: Thermal Transient Impedance

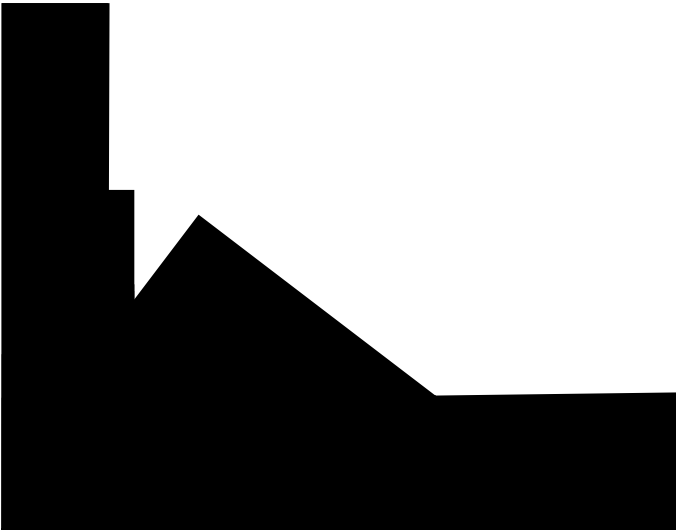
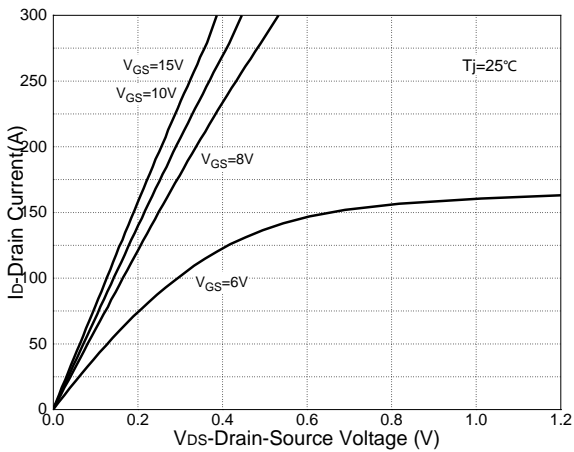


Figure 5: Output Characteristics

Figure 6: Drain-Source On Resistance



Typical Operating Characteristics(Cont.)

Figure 7: On-Resistance vs. Temperature

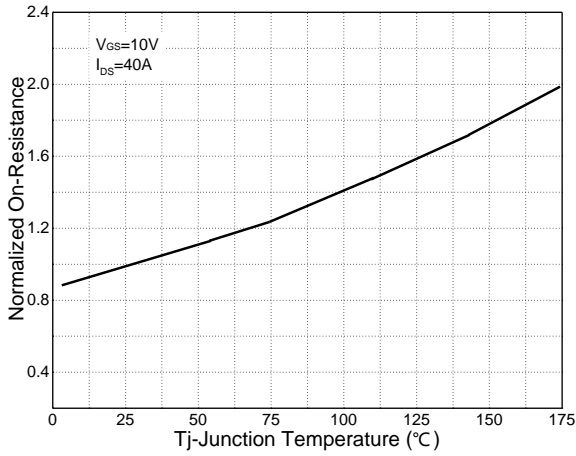


Figure 8: Source-Drain Diode Forward

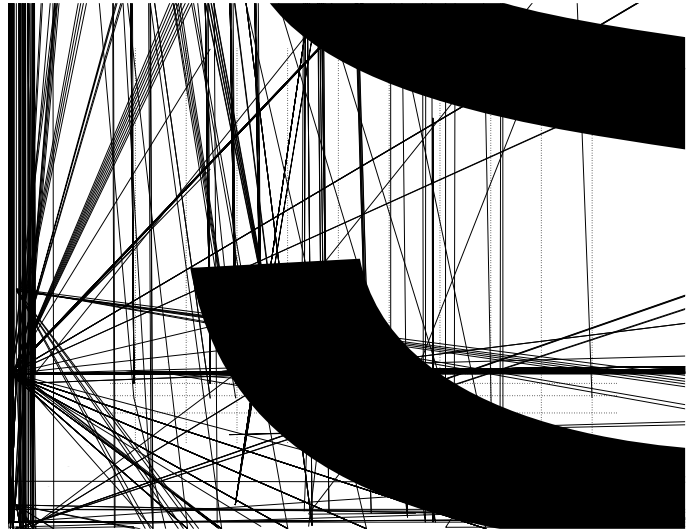


Figure 9: Capacitance Characteristics

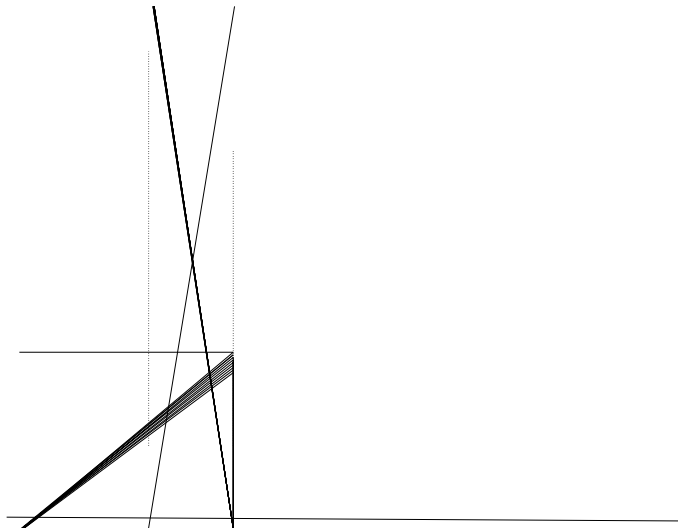


Figure 10: Gate Charge Characteristics



Figure 11: Transfer Characteristics

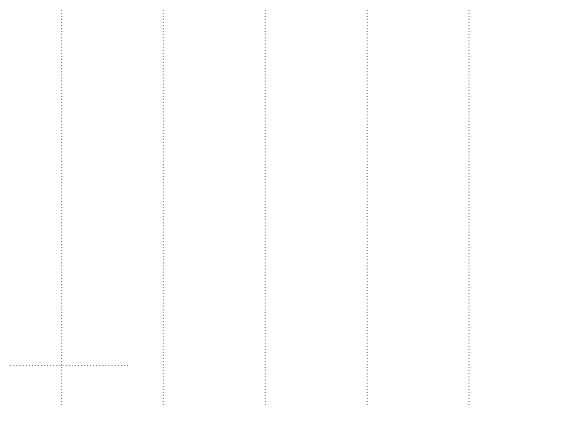
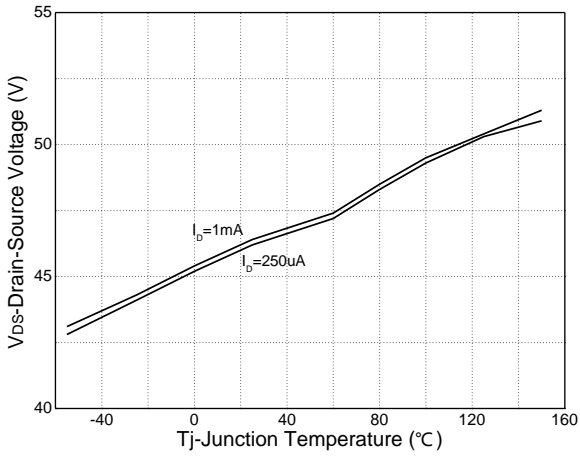


Figure 12: Gate Threshold Voltage

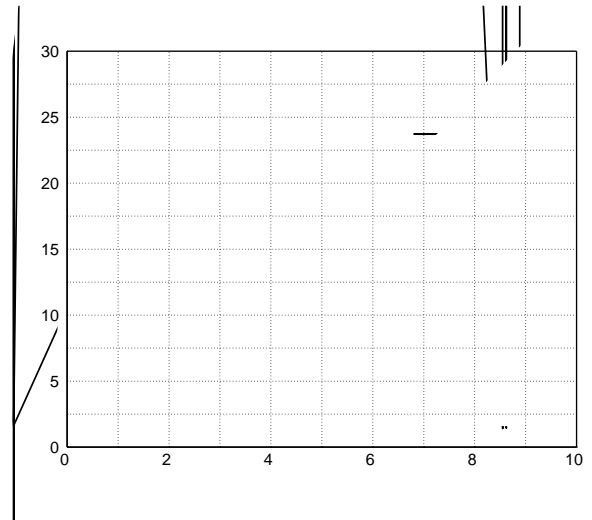


Typical Operating Characteristics(Cont.)

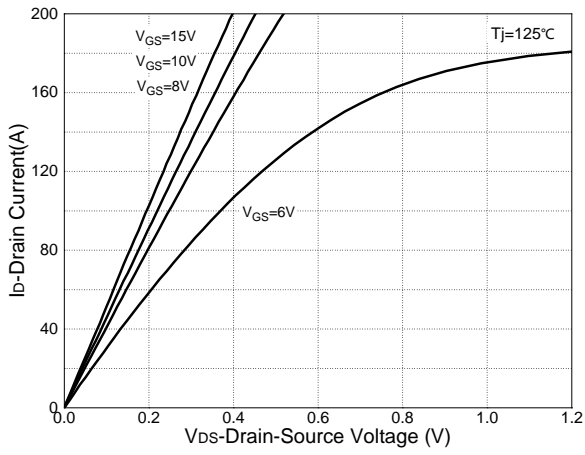
**Figure 13: Drain-Source Breakdown**



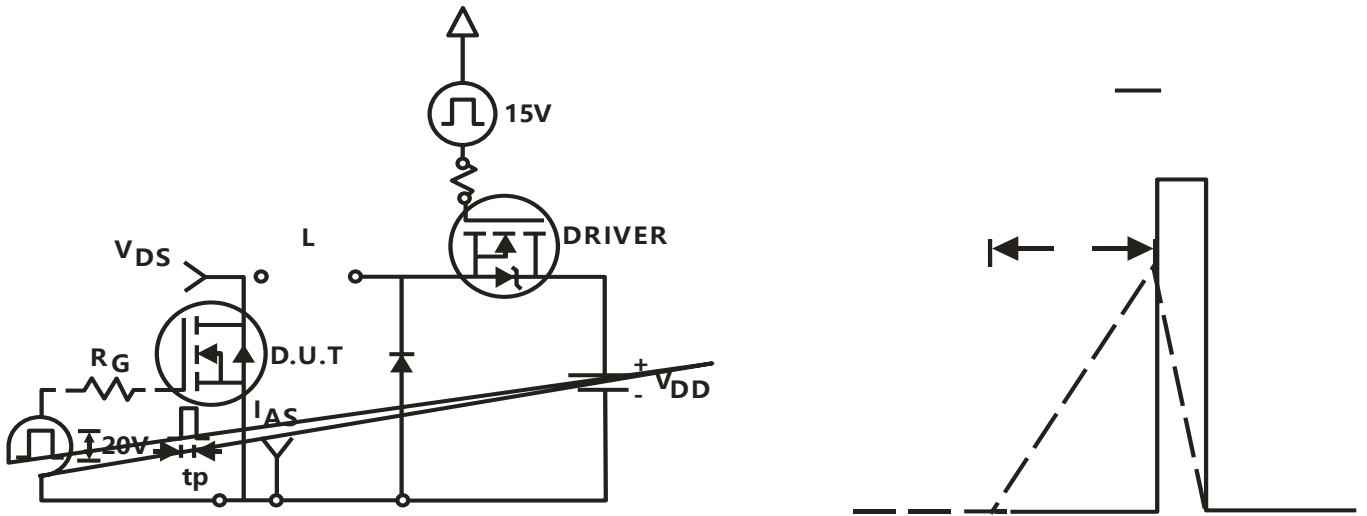
**Figure 14: R<sub>dson</sub> vs. Gate Voltage**



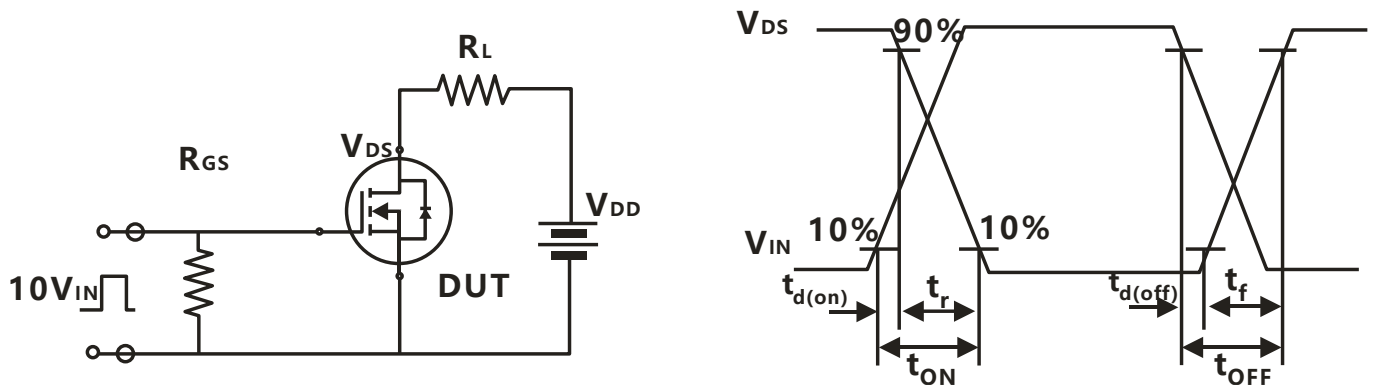
**Figure 15: Output Characteristics 125**



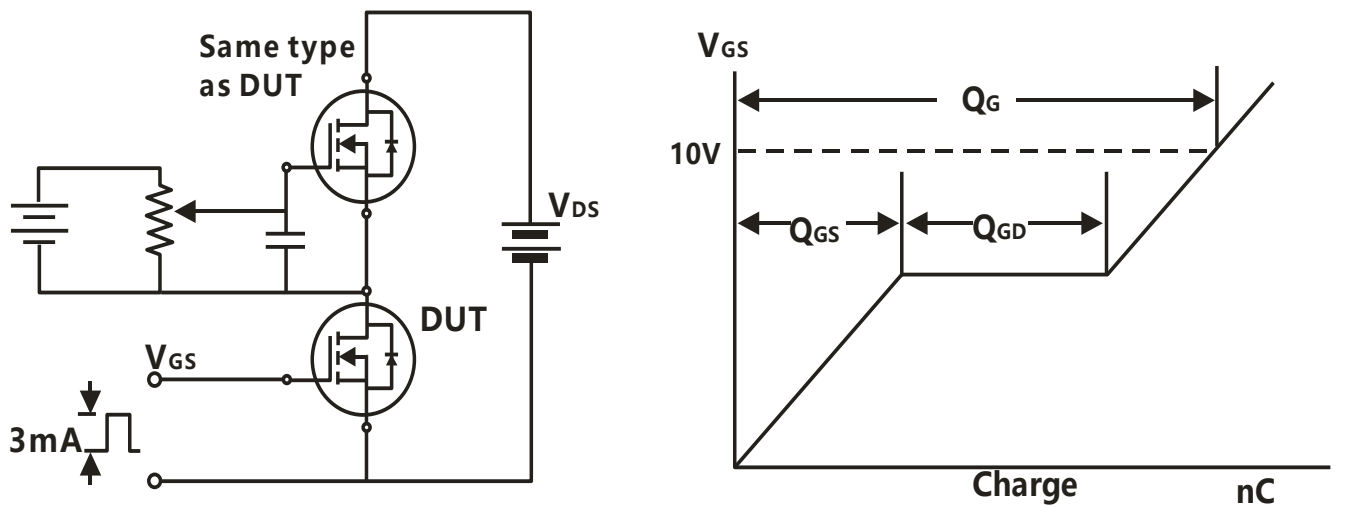
**Avalanche Test Circuit**



**Switching Time Test Circuit**



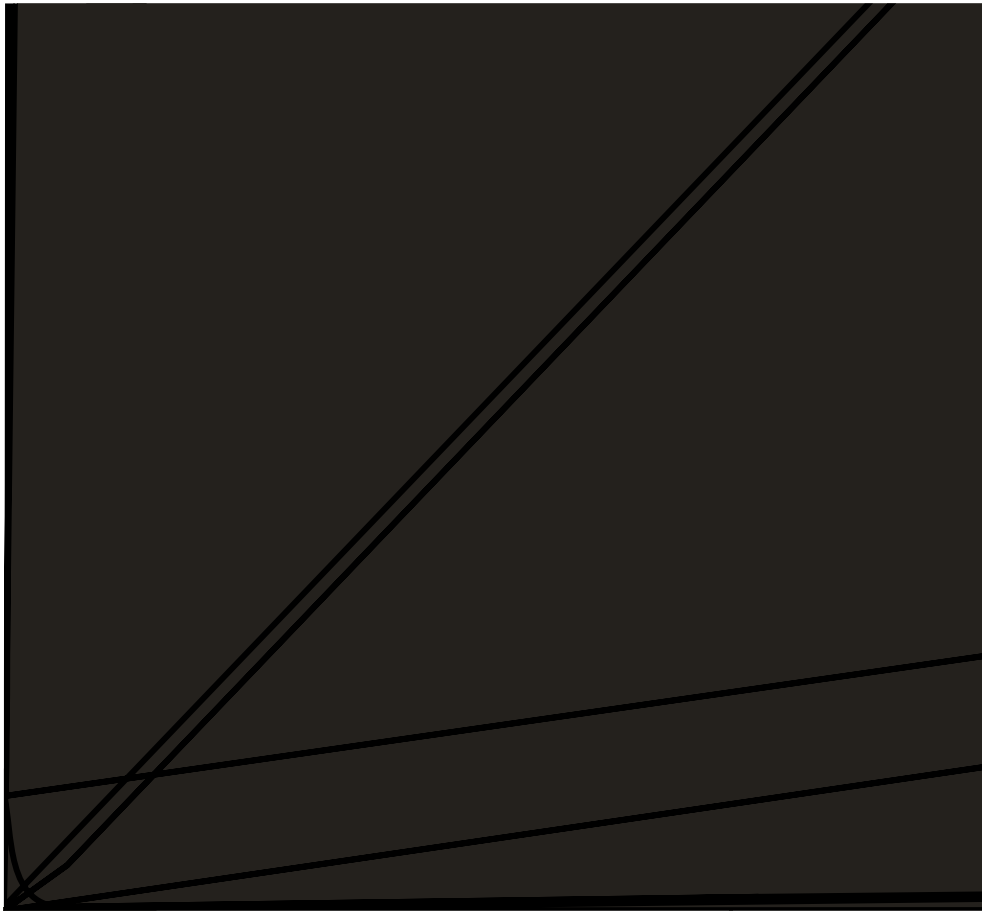
**Gate Charge Test Circuit**



Device Per Unit



**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 <350	Volume mm 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 <350	Volume mm 350-2000	Volume mm 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
MSL	JESD22-A113	85°C/85%/168Hrs
RSH	JESD22- B106(PTH)	260 5 10 1S
PCT	JESD22-A102	121 ,100%RH, 96hours, 205KPa
TCT	JESD22-A104	250/500/1000 Cycles, -55°C~150°C
HTRB	JESD22-A108B	168/500/1000 Hrs, 100% BV <sub>DSS</sub> @ 175
HTGB	JESD22-A108B	168/500/1000 Hrs, 100%V <sub>gs</sub> @ 175
BHAST	JESD22-A110D	130 85%RH 230KPA;U=32V
IOL	MIL-STD-750	Ta=25 , Tj 100 , Ton/Toff 3.5min, 8600cycles

## Customer Service

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