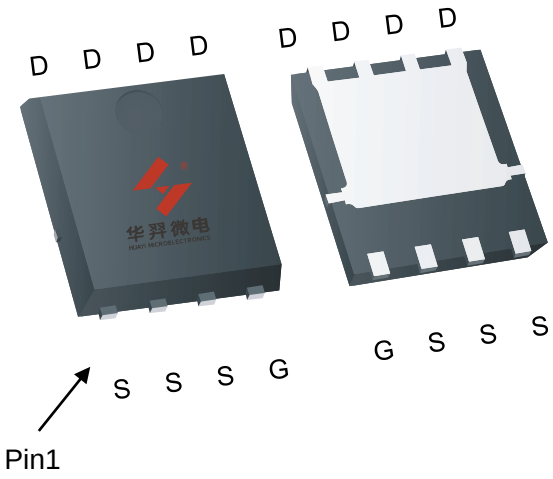
Single N-Channel Enhancement Mode MOSFET

Feature

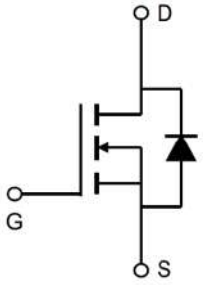
- 40V/78A
  $R_{DS(ON)}$= 5.3 mΩ (typ.) @ V_{GS} = 10V
- 100% Avalanche Tested
- 100% DVDS
- Reliable and Rugged
- MSL1 up to 260℃ Peak Reflow
- AEC-Q101 Qualified
- 175℃ operating temperature
- Halogen Free and Green Devices Available (RoHS Compliant)

Pin Description



Applications

- DC-DC converter for H.E.V.（hybrid electric vehicle）
- Battery Disconnect Switch
- Load Disconnect Power Stage
- Automotive Applications



Single N-Channel MOSFET

Ordering and Marking Information

C2 HYA060N04 XYMXXXXXX	Package Code C2: PDFN8L(5x6) Date Code XYMXXXXXX

Note: HUAYI lead-free products contain molding compounds/die attach materials and 100% matte tin plateTermi-Nation finish; which are fully compliant with RoHS. HUAYI lead-free products meet or exceed the lead-Free require-
ments of IPC/JEDEC J-STD-020 for MSL classification at lead-free peak reflow temperature. HUAYI defines “Green” to mean lead-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 pr

-oduct and/or to this document at any time without notice.

Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
Common Ratings (Tc=25°C Unless Otherwise Noted)				
V_{DSS}	Drain-Source Voltage		40	V
V_{GSS}	Gate-Source Voltage		+20 / -20	V
T_J	Maximum Junction Temperature		-55 to 175	°C
T_{STG}	Storage Temperature Range			°C
I_S	Source Current-Continuous(Body Diode)	Tc=25°C	78	A
Mounted on Large Heat Sink				
I_{DM}	Pulsed Drain Current *	Tc=25°C	312	A
I_D	Continuous Drain Current	Tc=25°C	78	A
		Tc=125°C	44	A
P_D	Maximum Power Dissipation	Tc=25°C	74	W
		Tc=100°C	37	W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case		2.03	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient **		80	°C/W
E_{AS}	SinglePulsed-Avalanche Energy ***	L=0.3mH	76	mJ

Note: * Repetitive rating；pulse width limited by max.junction temperature.
** Surface mounted on FR-4 board.
*** Limited by $T_J$max , starting T_J=25°C, L = 0.3mH, V_{DS} =32V., V_{GS} =10V.

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

Symbol	Parameter	Test Conditions	HYA060N04NS1			Unit
			Min	Typ.	Max	
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V,I_{DS}=250μA	40	-	-	V
I_{DSS}	Drain-to-Source Leakage Current	V_{DS}=40V,V_{GS}=0V	-	-	1	μA
		T_J=100°C	-	-	50	μA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250μA	2.0	3.0	4.0	V
I_{GSS}	Gate-Source Leakage Current	V_{GS}=±20V,V_{DS}=0V	-	-	±100	nA
$R_{DS(ON)}$*	Drain-Source On-State Resistance	V_{GS}=10V,I_{DS}=20A	-	5.3	6.5	mΩ
Diode Characteristics						
V_{SD}*	Diode Forward Voltage	I_{SD}=20A,V_{GS}=0V	-	0.86	1.2	V
t_{rr}	Reverse Recovery Time	I_{SD}=20A,dI_{SD}/dt=100A/μs	-	17.4	-	ns
Q_{rr}	Reverse Recovery Charge		-	9.5	-	nC

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

Symbol	Parameter	Test Conditions	HYA060N04NS1			Unit
			Min	Typ.	Max	
Dynamic Characteristics						
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V, F=500kHz	-	2.8	-	Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=25V, Frequency=500kHz	-	962	-	pF
C_{oss}	Output Capacitance		-	218	-	
C_{rss}	Reverse Transfer Capacitance		-	20	-	
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=20V,R_G=2.5Ω, I_{DS}=20A,V_{GS}=10V	-	11.2	-	ns
T_r	Turn-on Rise Time		-	42.8	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	20.8	-	
T_f	Turn-off Fall Time		-	28.3	-	
Gate Charge Characteristics						
Q_g	Total Gate Charge	V_{DS} =32V, V_{GS}=10V, I_D=20A	-	14.7	-	nC
Q_{gs}	Gate-Source Charge		-	5.6	-	nC
Q_{gd}	Gate-Drain Charge		-	2.1	-	
$V_{plateau}$	Gate plateau voltage		-	5.0	-	V

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

Typical Operating Characteristics

Figure 1: Power Dissipation

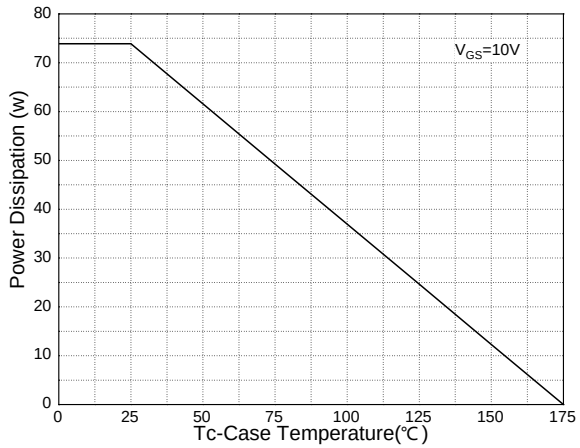


Figure 2: Drain Current

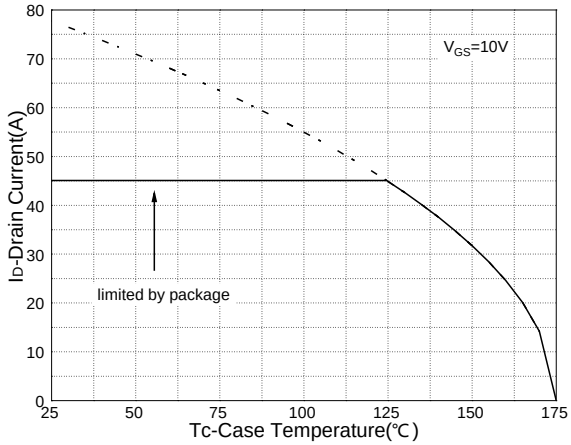


Figure 3: Safe Operation Area

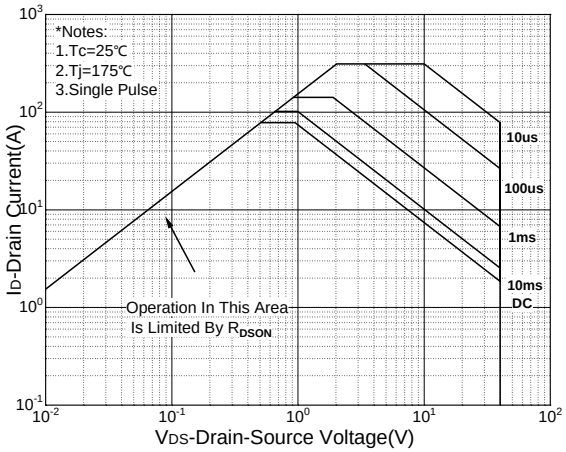


Figure 4: Thermal Transient Impedance

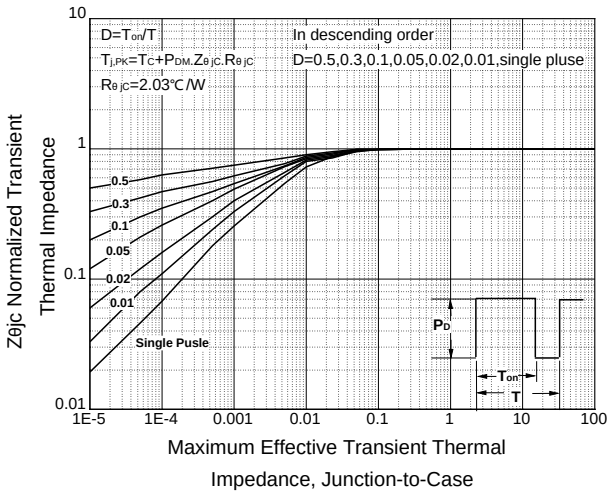


Figure 5: Output Characteristics

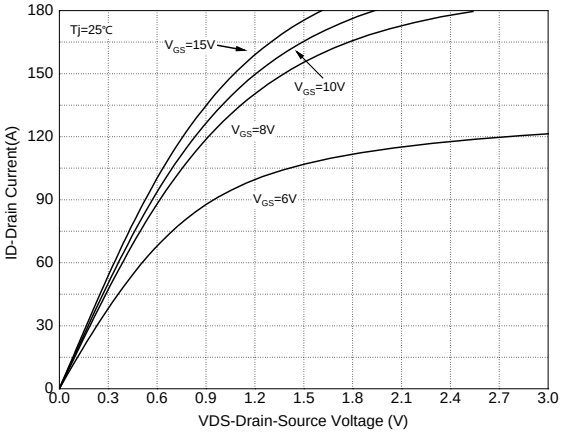
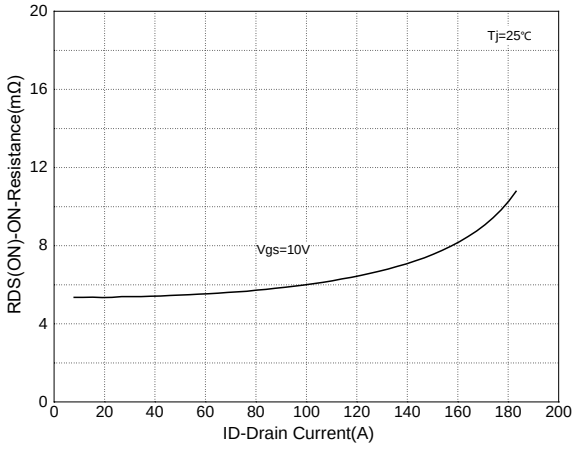


Figure 6: Drain-Source On Resistance



Typical Operating Characteristics(Cont.)

Figure 7: On-Resistance vs. Temperature

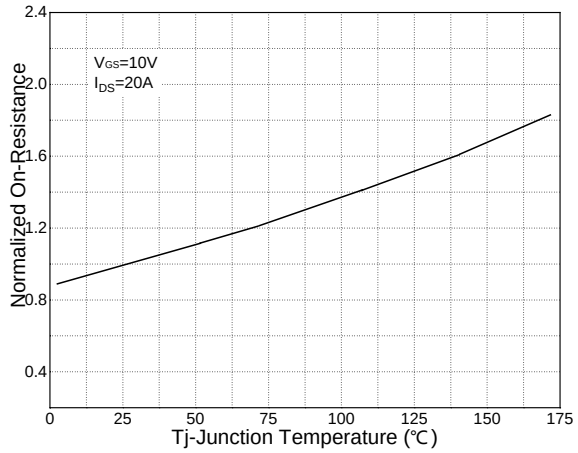


Figure 8: Source-Drain Diode Forward

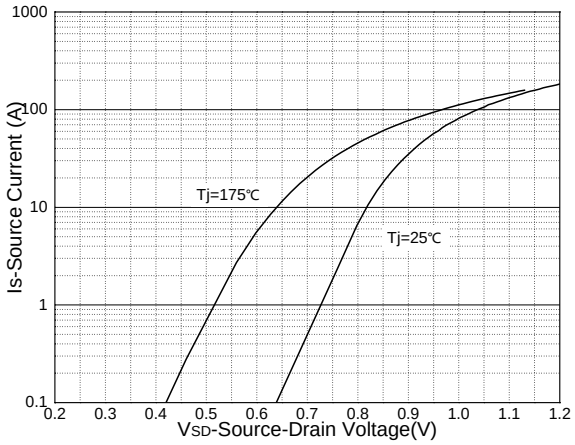


Figure 9: Capacitance Characteristics

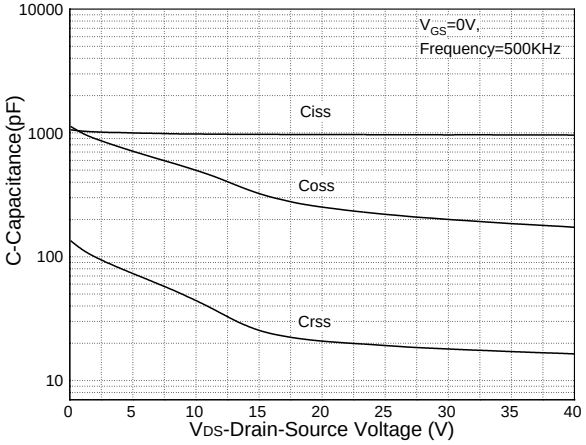


Figure 10: Gate Charge Characteristics

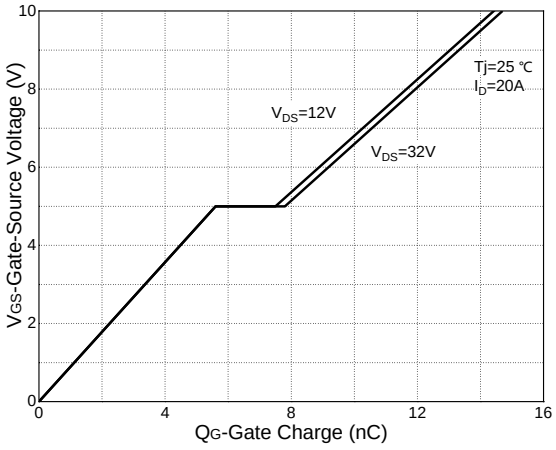


Figure 11: Transfer Characteristics

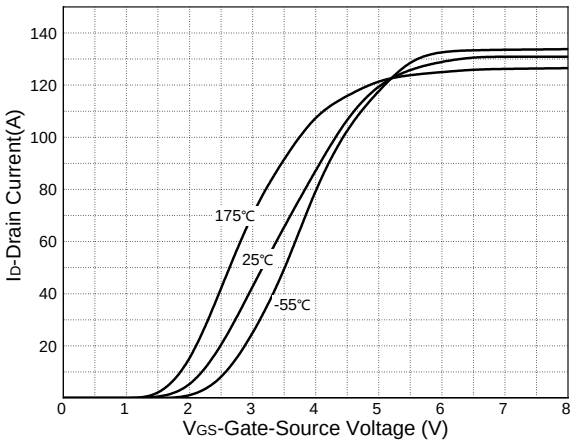
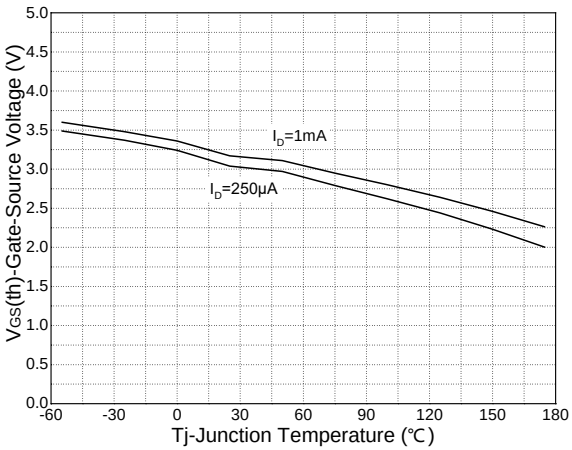


Figure 12: Gate Threshold Voltage



Typical Operating Characteristics(Cont.)

Figure 13: Drain-Source Breakdown

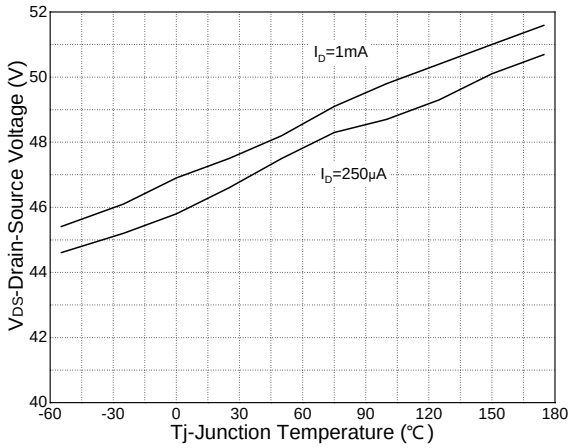


Figure 14: R_{dson} vs. Gate Voltage

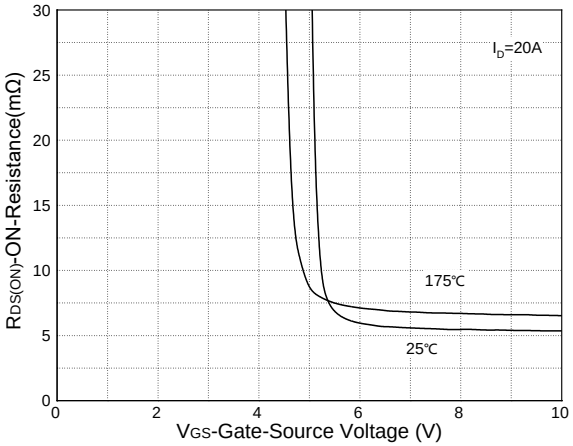
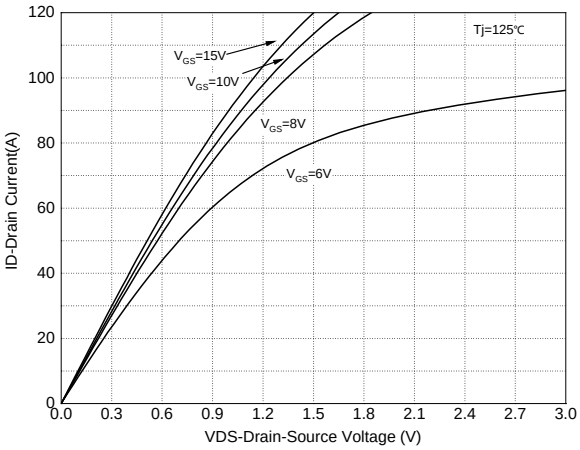
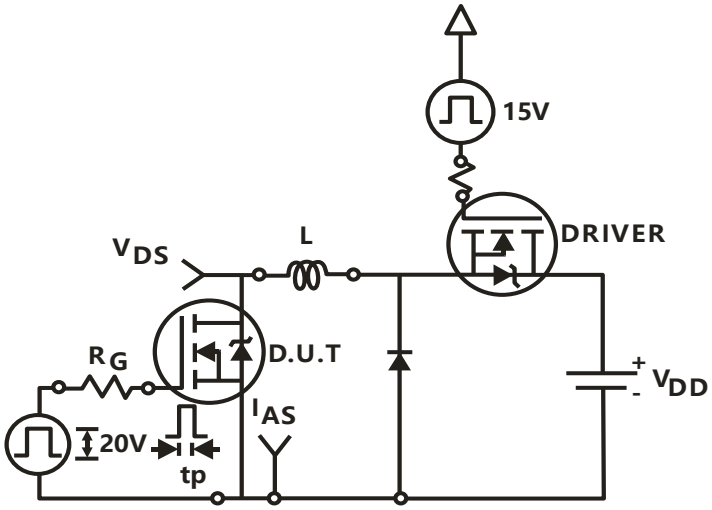


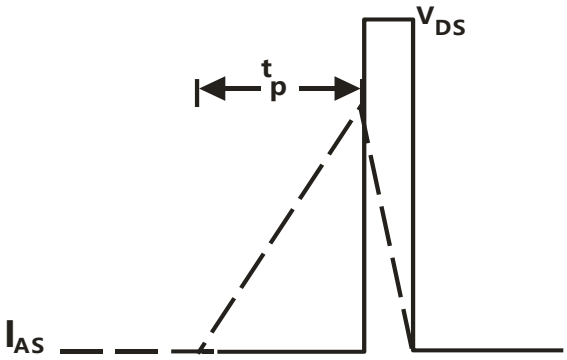
Figure 15: Output Characteristics（125℃）



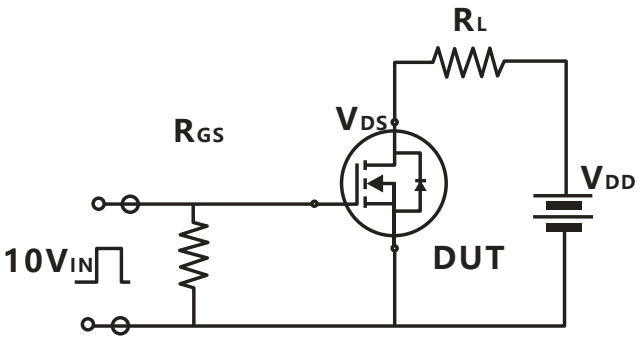
Avalanche Test Circuit and Waveforms

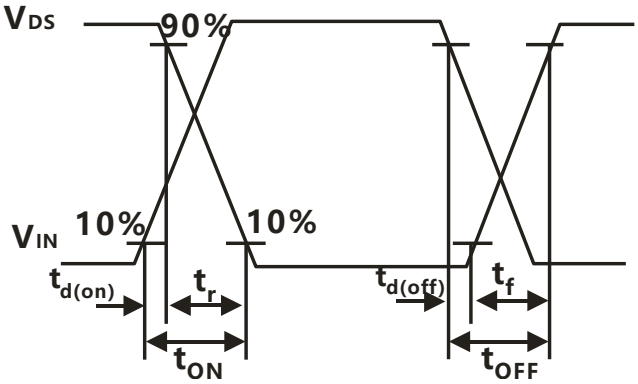


$$E_{AS} = \frac{1}{2} L I_{AS}^2$$

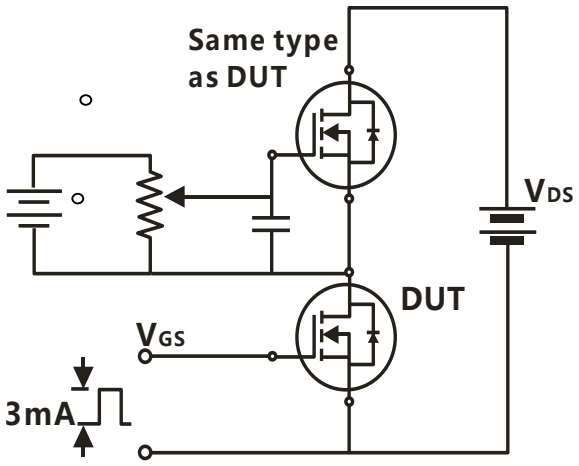


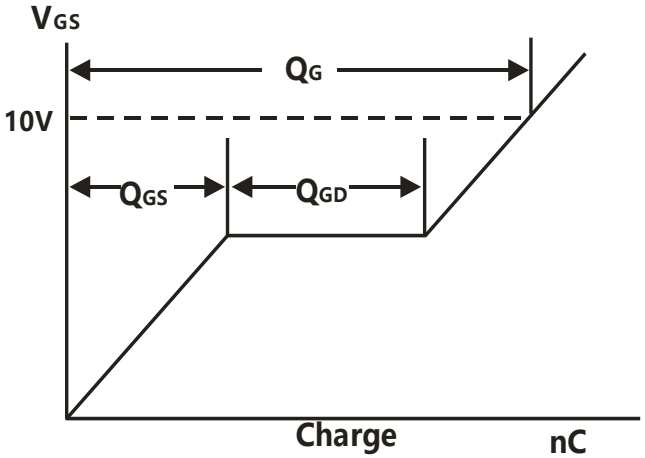
Switching Time Test Circuit and Waveforms





Gate Charge Test Circuit and Waveforms





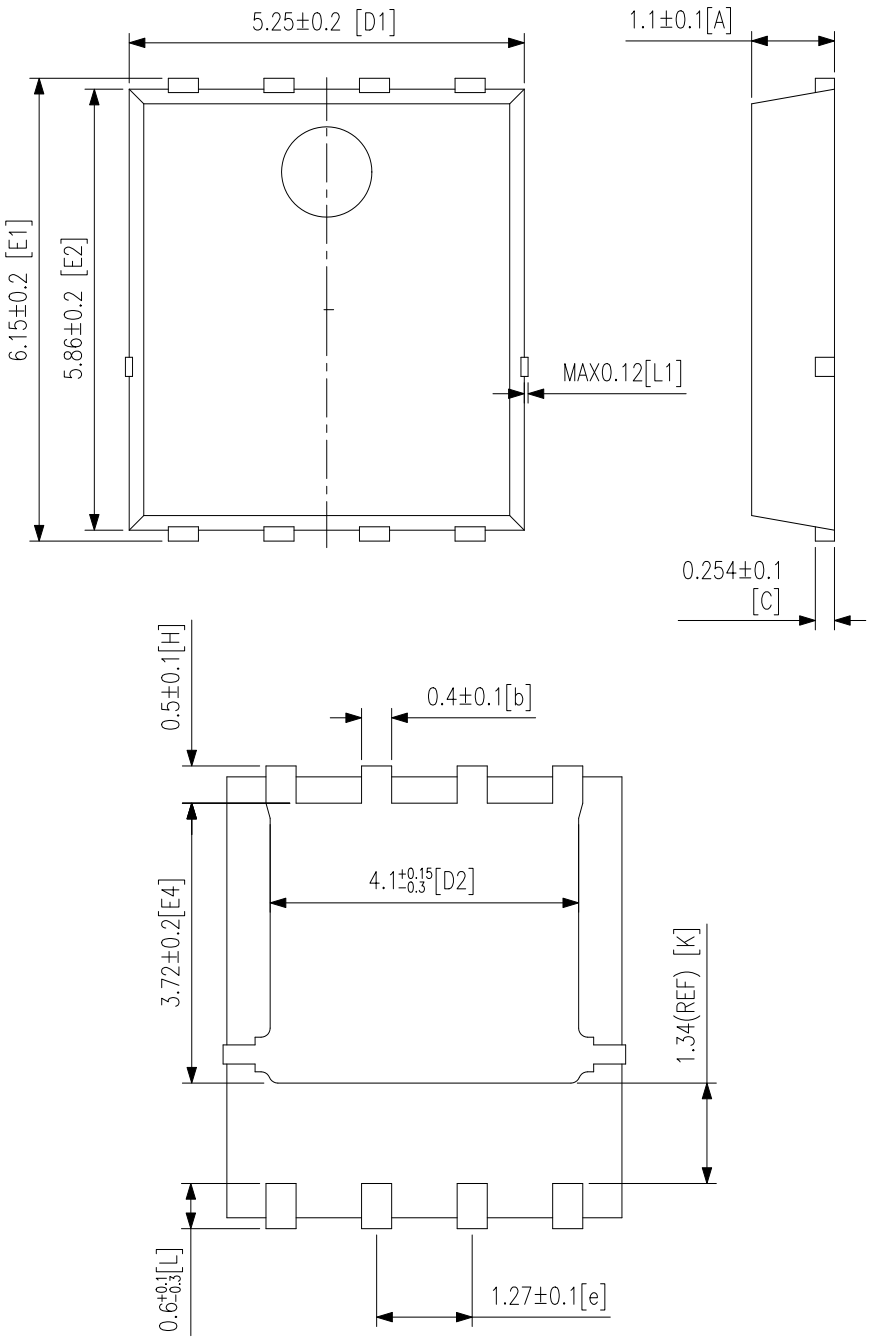
Device Per Unit

Package Type	Unit	Quantity
PDFN8L(5x6)	Reel	5000

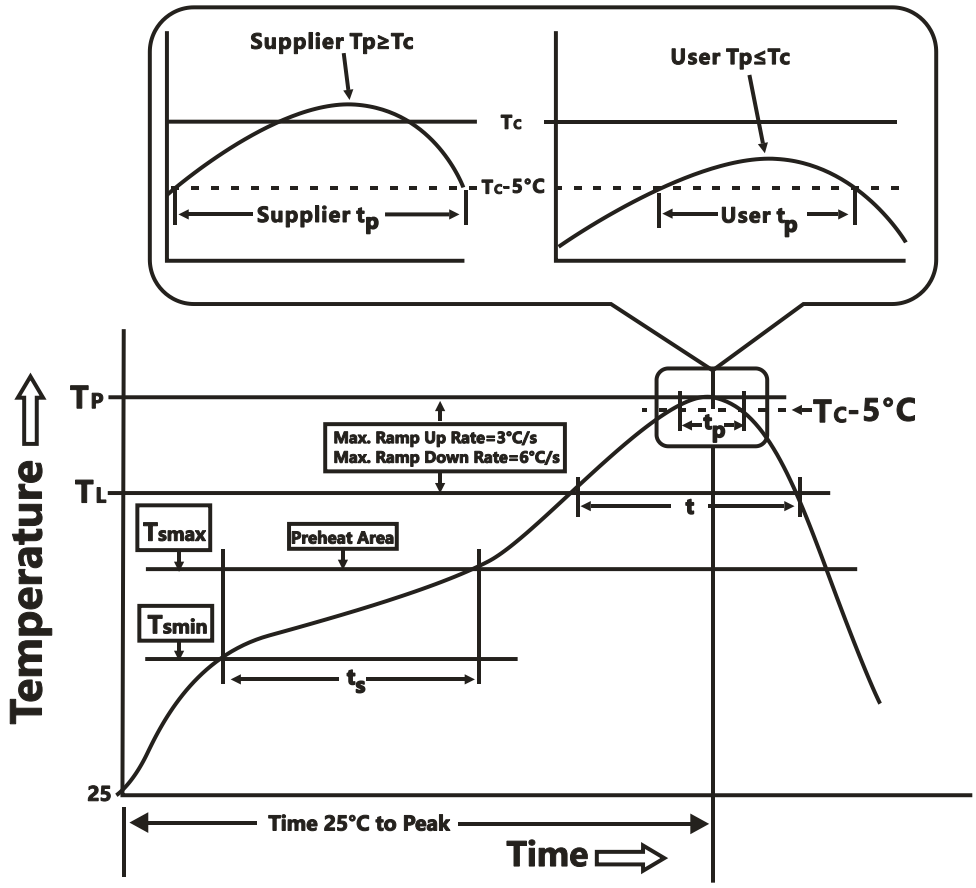
Package Information

PDFN8L(5x6)

(unit:mm)



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (Tsmin to Tsmax) (t_s)	 100 °C 150 °C 60-120 seconds	 150 °C 200 °C 60-120 seconds
Average ramp-up rate ($T_{smax}$to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	SeeClassification Tempin 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 mm³ <350	Volume mm³ ⩾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 mm³ <350	Volume mm³ 350-2000	Volume mm³ ⩾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
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_{DSS} @ 175℃
HTGB	JESD22-A108B	168/500/1000 Hrs, 100%V_{gs} @ 175℃
BHAST	JESD22-A110D	130℃，85%RH，230KPA;U=32V
IOL	MIL-STD-750	Ta=25℃,△Tj⩾100℃, Ton/Toff 2min ，15000cycles

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