

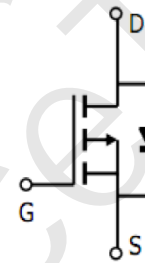
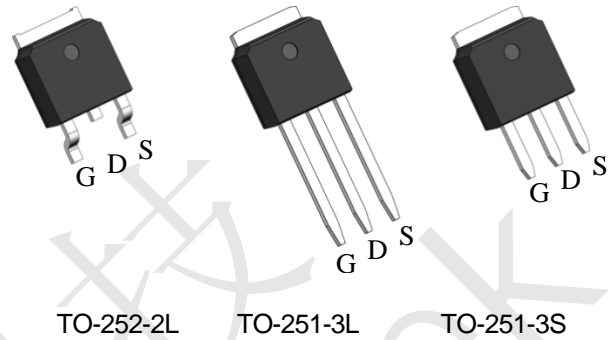


P-Channel Enhancement Mode MOSFET

Feature

- -60V/-40A
 $R_{DS(ON)} = 19m\Omega(\text{typ.}) @ V_{GS} = -10V$
 $R_{DS(ON)} = 25m\Omega(\text{typ.}) @ V_{GS} = -4.5V$
- 100% avalanche tested
- Reliable and Rugged
- Halogen Free and Green Devices Available
 (RoHS Compliant)

Pin Description



P-Channel MOSFET

Applications

- Power Management in DC/DC
- Load switching.
- Motor control.

Ordering and Marking Information

D	U	V	Package Code
G210P06	G210P06	G210P06	D: TO-252-2L U: TO-251-3L V: TO-251-3S
XYMXXXXXX	XYMXXXXXX	XYMXXXXXX	Date Code
			XYMXXXXXX

Note: The Company lead-free products contain molding compounds/die attach materials and 100% matte tin plate Termination finish; which are fully compliant with RoHS. The Company lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020 for MSL classification at lead-free peak reflow temperature. The Company 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).

The Company reserves the right to make changes to improve reliability or manufacturability without notice, and Advise customers to obtain the latest version of relevant information to verify before placing orders.



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit	
Common Ratings (Tc=25°C Unless Otherwise Noted)				
V _{DSS}	Drain-Source Voltage	-60	V	
V _{GSS}	Gate-Source Voltage	±20	V	
T _J	Junction Temperature Range	-55 to 175	°C	
T _{STG}	Storage Temperature Range	-55 to 175	°C	
I _S	Drain Current-Continuous	Tc=25°C	-40	A
Mounted on Large Heat Sink				
I _{DM}	Pulsed Drain Current *	Tc=25°C	-140	A
I _D	Continuous Drain Current	Tc=25°C	-40	A
		Tc=100°C	-28	A
P _D	Maximum Power Dissipation	Tc=25°C	60	W
		Tc=100°C	30	W
R _{θJC}	Thermal Resistance, Junction-to-Case		2.5	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient **		110	°C/W
E _{AS}	Single Pulsed-Avalanche Energy ***	L=0.3mH	289***	mJ

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

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

Symbol	Parameter	Test Conditions	HYG210P06LQ1			Unit
			Min	Typ	Max	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =-250uA	-60	-	-	V
I _{DSS}	Drain-to-Source Leakage Current	V _{DS} =-60V, V _{GS} =0V	-	-	-1	uA
		T _J =125°C	-	-	-50	uA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =-250uA	-1.0	-1.7	-3.0	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 _D = -20A	-	19	25	mΩ
		V _{GS} =-4.5V, I _D = -20A		25	32	mΩ
Diode Characteristics						
V _{SD*}	Diode Forward Voltage	I _{SD} = -20A, V _{GS} =0V	-	-0.9	-1.3	V
t _{rr}	Reverse Recovery Time	I _{SD} = -20A, dI/dt=100A/us	-	28	-	ns
Q _{rr}	Reverse Recovery Charge		-	25	-	nC



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

Symbol	Parameter	Test Conditions	HYG210P06LQ1			Unit
			Min	Typ	Max	
Dynamic Characteristics						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, F=1MHz	-	6.4	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V,	-	3679	-	pF
C _{oss}	Output Capacitance	V _{DS} =-25V,	-	123	-	
C _{rss}	Reverse Transfer Capacitance	Frequency=1.0MHz	-	60	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} = -25V, R _G =3Ω, I _{DS} = -20A, V _{GS} =-10V	-	11	-	ns
T _r	Turn-on Rise Time		-	17	-	
t _{d(OFF)}	Turn-off Delay Time		-	73	-	
T _f	Turn-off Fall Time		-	31	-	
Gate Charge Characteristics						
Q _g	Total Gate Charge	V _{DS} = -48V, V _{GS} = -10V, I _D = -20A,	-	90	-	nC
Q _{gs}	Gate-Source Charge		-	6	-	
Q _{gd}	Gate-Drain Charge		-	18	-	

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



Typical Operating Characteristics

Figure 1: Power Dissipation

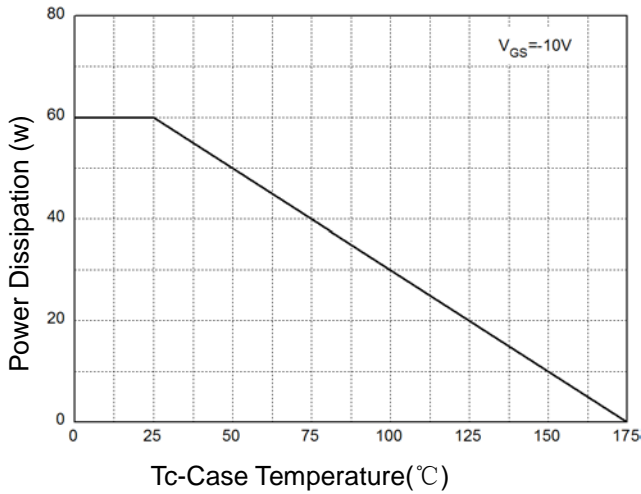


Figure 2: Drain Current

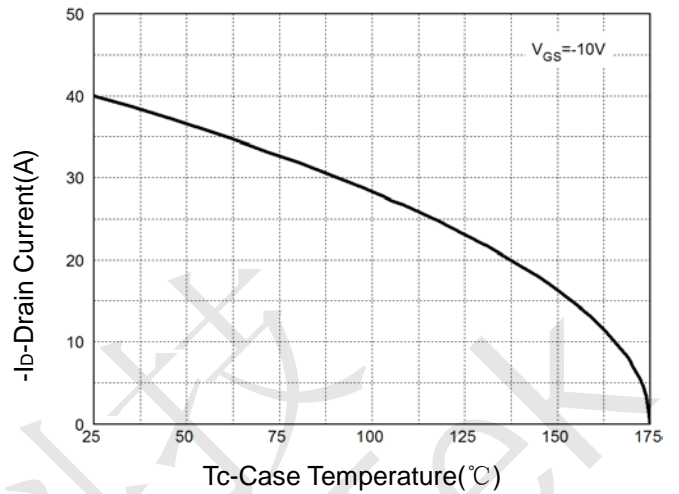


Figure 3: Safe Operation Area

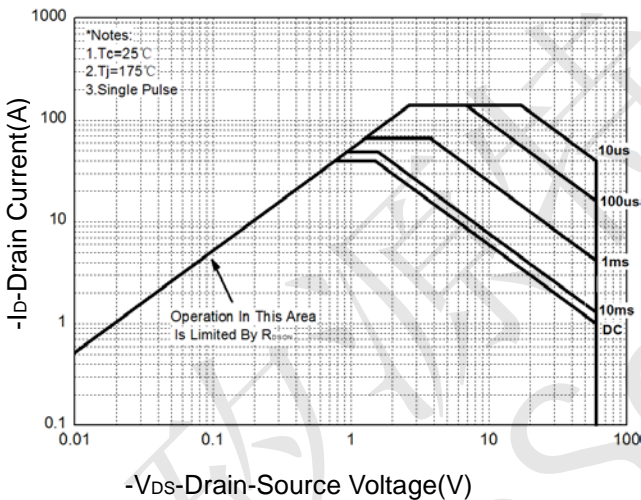


Figure 4: Thermal Transient Impedance

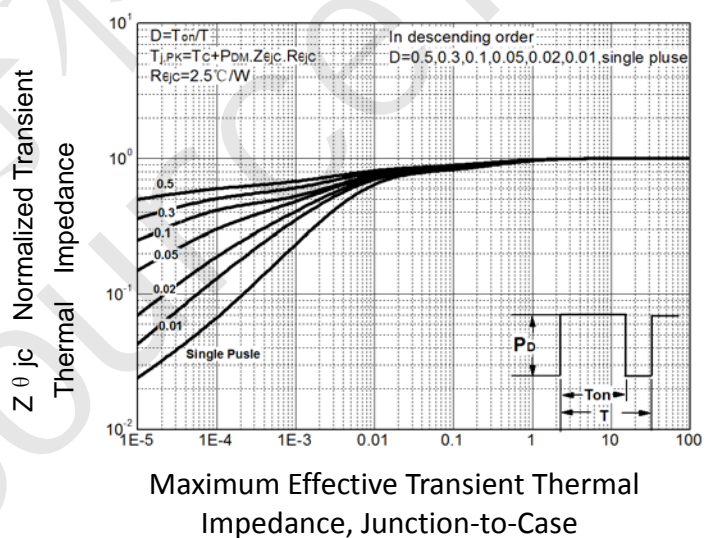


Figure 5: Output Characteristics

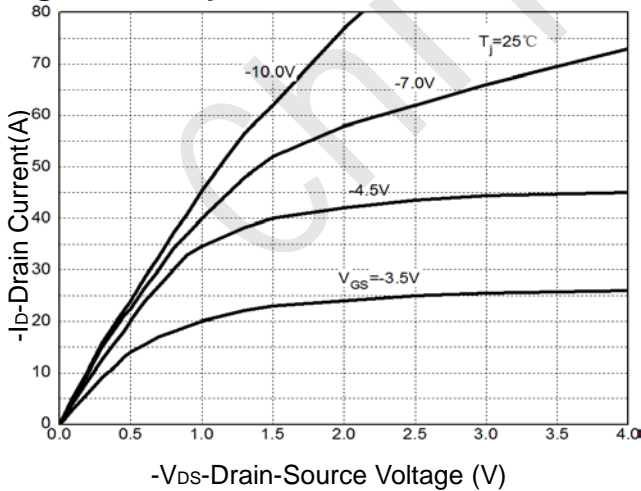
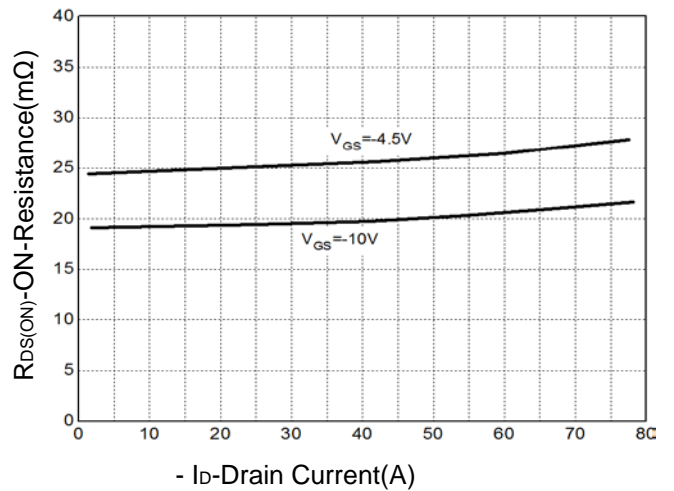


Figure 6: Drain-Source On Resistance





Typical Operating Characteristics(Cont.)

Figure 7: On-Resistance vs. Temperature

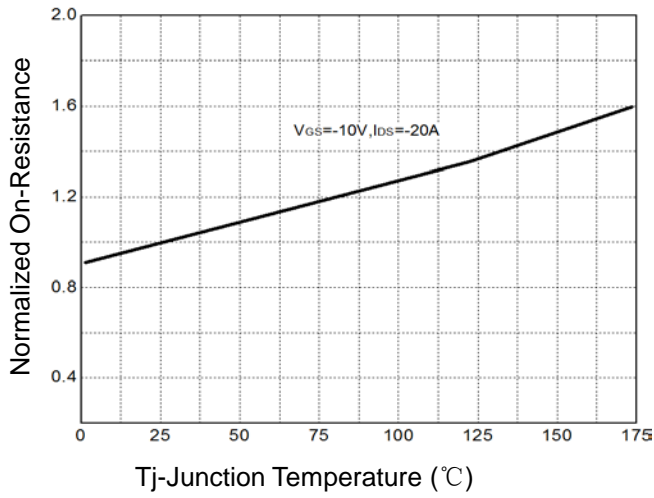


Figure 8: Source-Drain Diode Forward

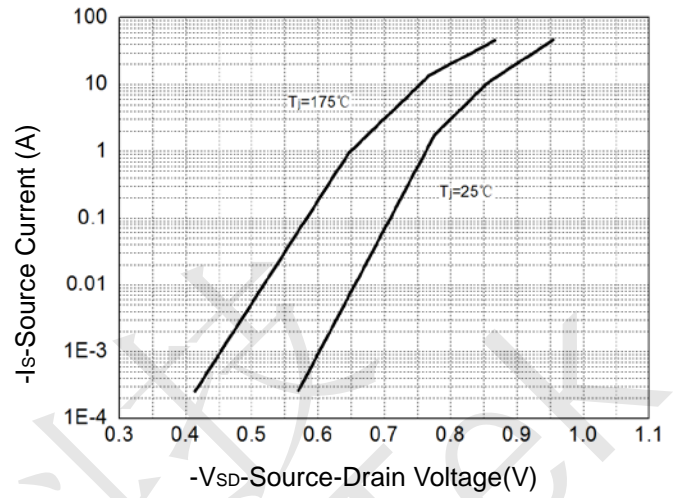


Figure 9: Capacitance Characteristics

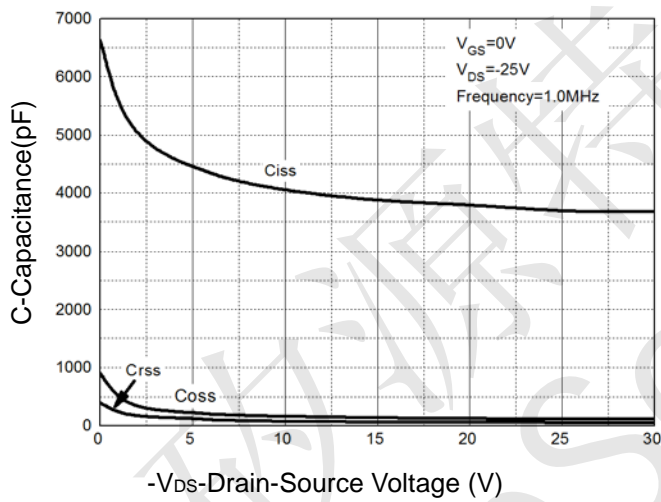
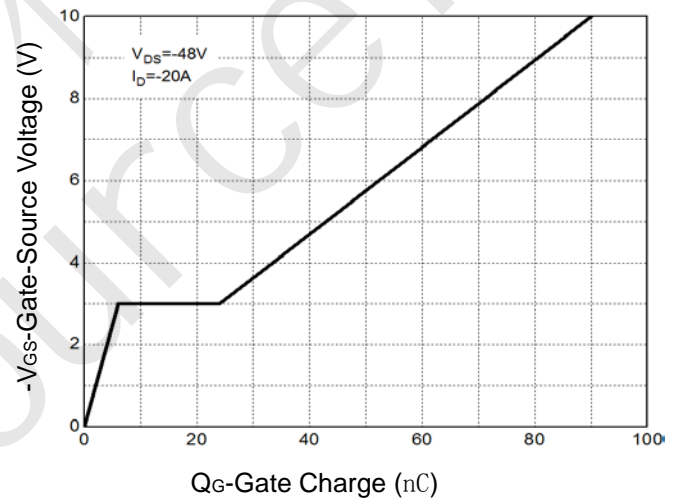
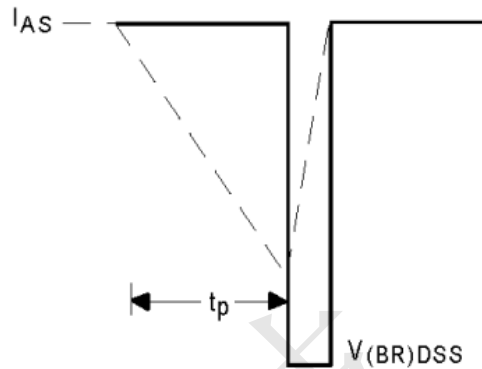
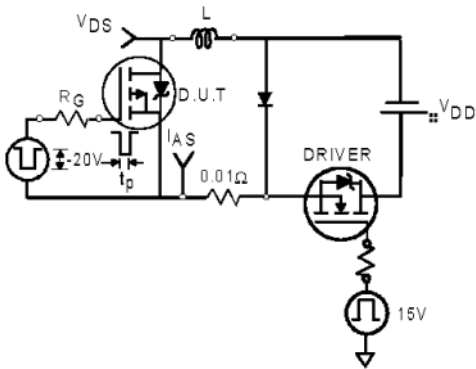


Figure 10: Gate Charge Characteristics

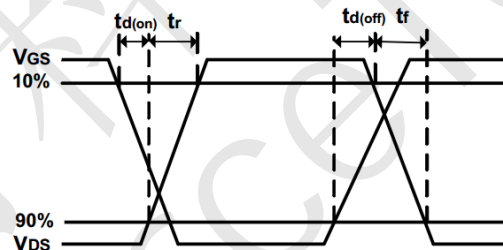
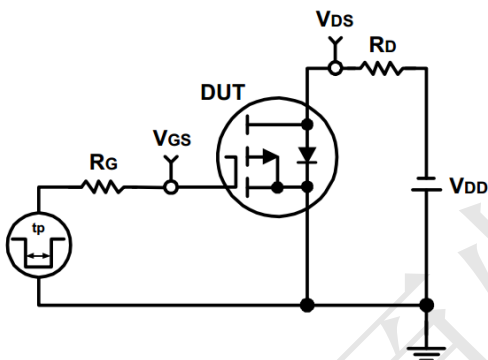




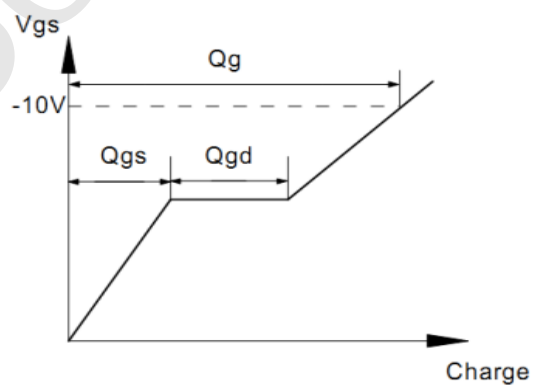
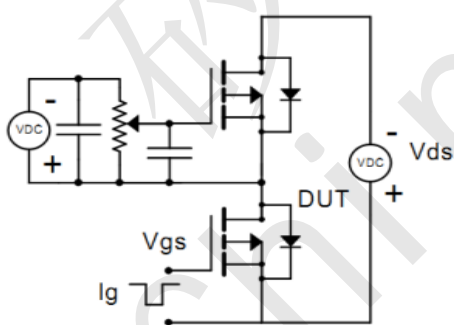
Avalanche Test Circuit



Switching Time Test Circuit



Gate Charge Test Circuit



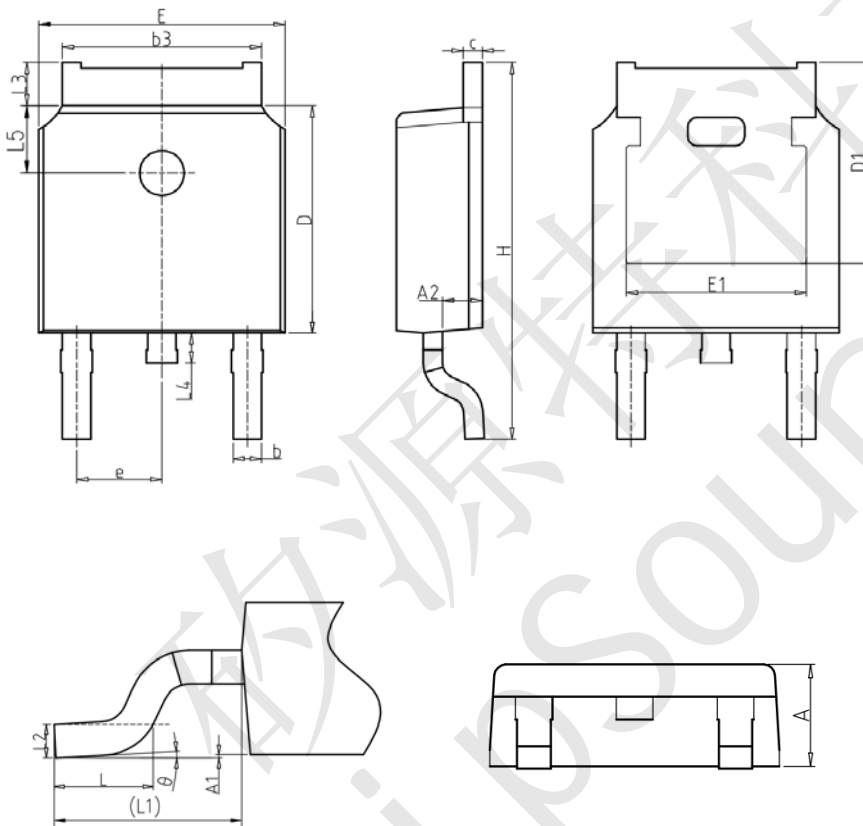


Device Per Unit

Package Type	Unit	Quantity
TO-252-2L	Tube	75
TO-252-2L	Reel	2500
TO-251-3L	Tube	75
TO-251-3S	Tube	75

Package Information

TO-252-2L

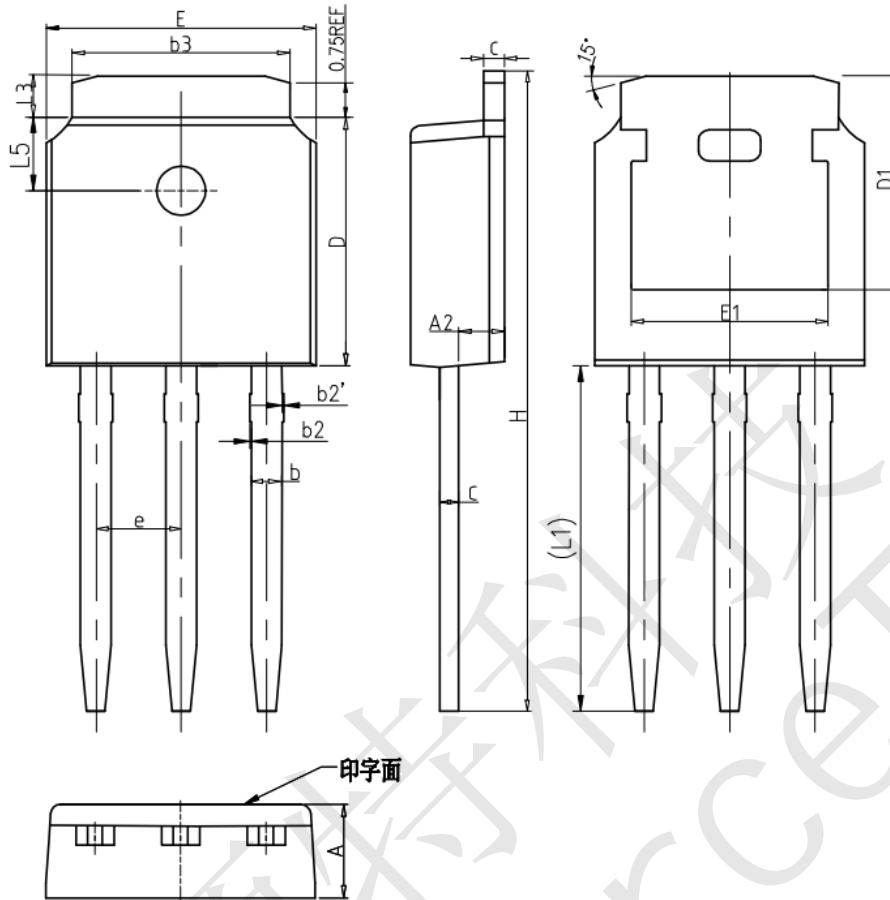


COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A1	0.00	-	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	-	-
e	2.286BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90REF		
L2	0.51BSC		
L3	0.88	-	1.28
L4	-	-	1.00
L5	1.65	1.80	1.95
θ	0°	-	8°



TO-251-3L

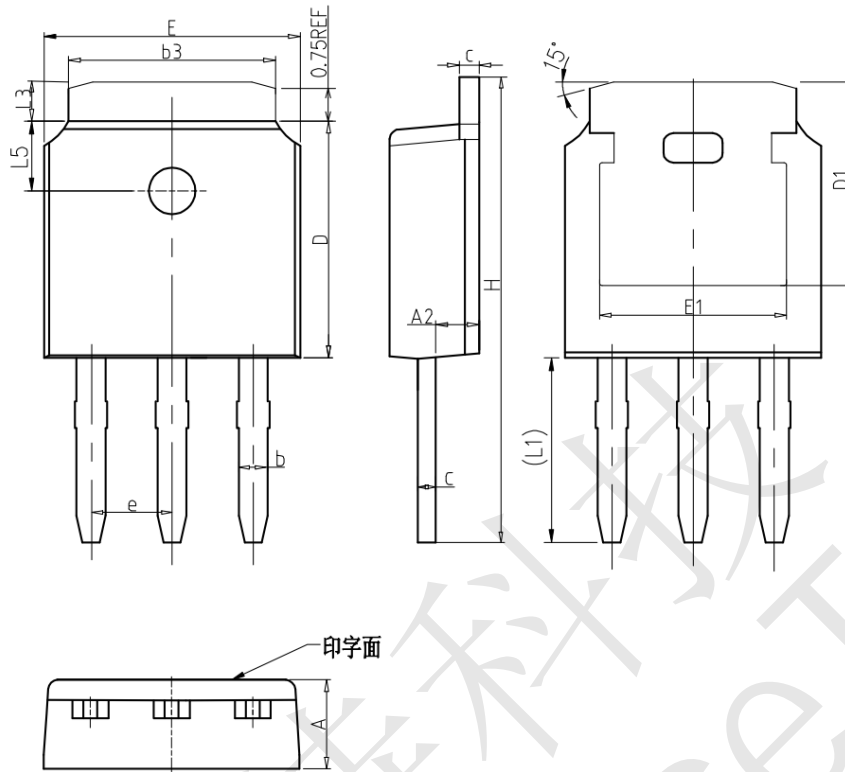


COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b2	0.00	0.04	0.10
b2'	0.00	0.04	0.10
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	-	-
e	2.286BSC		
H	16.22	16.52	16.82
L1	9.15	9.40	9.65
L3	0.88	1.02	1.28
L5	1.65	1.80	1.95



TO-251-3S

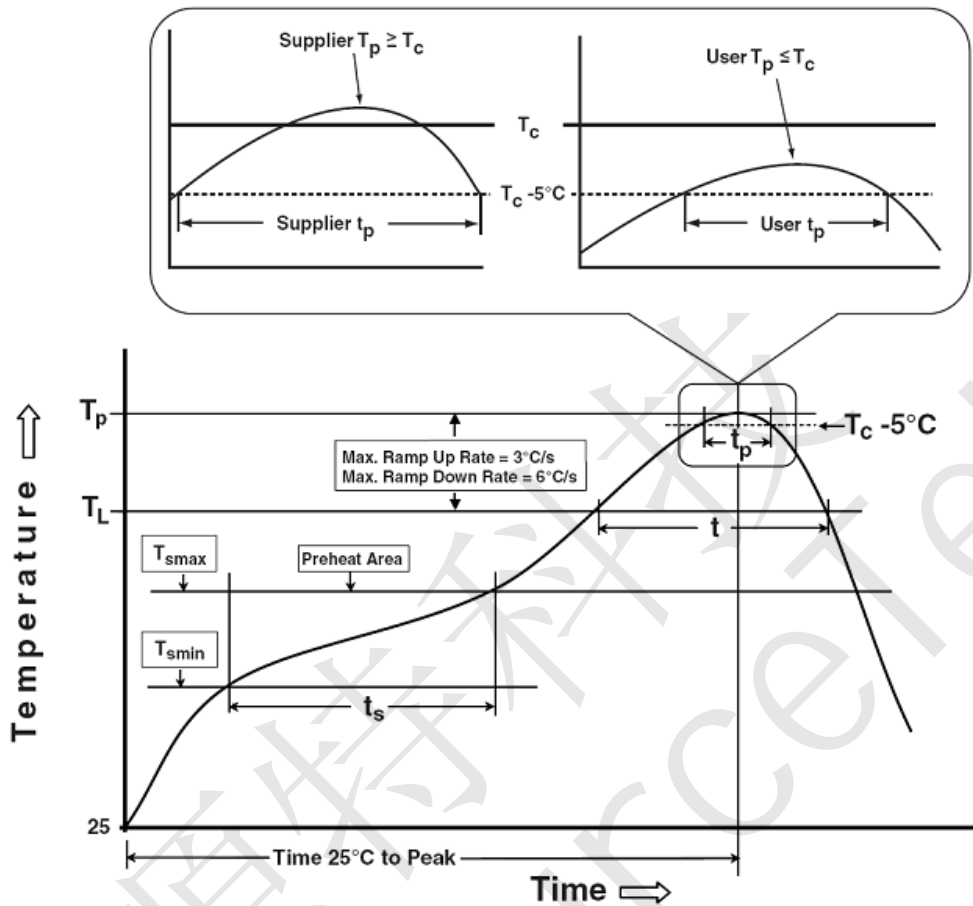


COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	-	-
e	2.286BSC		
H	10.00	11.22	11.44
L1	3.90	4.10	4.30
L3	0.88	1.02	1.28
L5	1.65	1.80	1.95



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
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 ³	
	<350	≥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 ³		
	<350	350-2000	≥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 Hrs/500 Hrs/1000Hrs, Bias @ 150°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -55°C~150°C