

N-Channel Super Junction Power MOSFET

Features

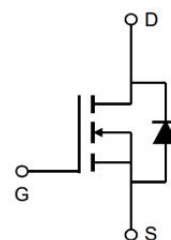
- 650V/20A
 $R_{DS(ON)} = 0.16\Omega(\text{typ.}) @ V_{GS} = 10V$
- 100% Avalanche Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
 (RoHS Compliant)

Pin Description



Applications

- PFC Power Supply Stages
- Switching Applications
- Motor Control
- AC/DC or DC/DC Converters



N-Channel MOSFET

Ordering and Marking Information

 P HY65R201 YYXXJWW G	 MF HY65R201 YYXXJWW G	Package Code P: TO-220FB-3L MF: TO-220MF-3L B: TO-263-2L W: TO-247-3L
 B HY65R201 YYXXJWW G	 W HY65R201 YYXXJWW G	Date Code YYXX WW Assembly Material G: Halogen Free

Note: HOOYI lead-free products contain molding compounds/die attach materials and 100% matte tin plate Termination finish; which are fully compliant with RoHS. HOOYI 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. HOOYI 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).

HOOYI 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
Common Ratings (Tc=25°C Unless Otherwise Noted)				
V _{DSS}	Drain-Source Voltage		650	V
V _{GSS}	Gate-Source Voltage		±30	V
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range		-55 to 150	°C
I _S	Source Current-Continuous(Body Diode)	Tc=25°C	20	A
Mounted on Large Heat Sink				
I _{DM}	Pulsed Drain Current *	Tc=25°C	78	A
I _D	Continuous Drain Current	Tc=25°C	20	A
		Tc=100°C	13	A
P _D	Maximum Power Dissipation TO-220/TO-263/TO-247	Tc=25°C	151	W
		Tc=100°C	60	W
P _D	Maximum Power Dissipation TO-220MF	Tc=25°C	34	W
		Tc=100°C	14	W
E _{AS}	Single Pulsed-Avalanche Energy **	L=10.8mH	390	mJ
Thermal Characteristics TO-220/TO-263/TO-247				
R _{θJC}	Thermal Resistance, Junction-to-Case		0.83	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient***		62	°C/W
Thermal Characteristics TO-220MF				
R _{θJC}	Thermal Resistance, Junction-to-Case		3.7	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient***		80	°C/W

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

Symbol	Parameter	Test Conditions	HY65R201			Unit
			Min	Typ.	Max	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250uA	650	-	-	V
I _{DSS}	Drain-to-Source Leakage Current	V _{DS} =650V, V _{GS} =0V	-	-	1	μA
		T _J =55°C	-	-	5	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	2.0	3.3	4.0	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =± 30V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ****	Drain-Source On-State Resistance	V _{GS} =10V, I _{DS} =10A	-	0.16	0.2	Ω

Diode Characteristics

V_{SD}^{****}	Diode Forward Voltage	$I_{SD}=10A, V_{GS}=0V$	-	0.8	1.3	V
t_{rr}	Reverse Recovery Time	$I_{SD}=10A, dI_{SD}/dt=100A/\mu s$	-	380	-	ns
Q_{rr}	Reverse Recovery Charge		-	5.3	-	μC

Electrical Characteristics (Cont.) ($T_c = 25^\circ C$ Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	HY65R201			Unit
			Min	Typ.	Max	
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =50V, Frequency=1.0MHz	-	1433	-	pF
C _{oss}	Output Capacitance		-	925	-	
C _{rss}	Reverse Transfer Capacitance		-	3.9	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =380V,R _G =4Ω, I _{DS} =11A,V _{GS} =10V	-	11	-	ns
T _r	Turn-on Rise Time		-	6	-	
t _{d(OFF)}	Turn-off Delay Time		-	61	-	
T _f	Turn-off Fall Time		-	4.5	-	
Gate Charge Characteristics						
Q _g	Total Gate Charge	V _{DS} =520V, V _{GS} =10V, I _D =10A,	-	24	-	nC
Q _{gs}	Gate-Source Charge		-	5.6	-	
Q _{gd}	Gate-Drain Charge		-	10.1	-	

Note: * Repetitive rating; pulse width limited by max. junction temperature.
 ** Limited by T_{Jmax} , starting $T_J=25^\circ C$, $L=10.8mH$, $R_G=25\Omega$, $V_{GS}=10V$
 *** Surface mounted on FR-4 board.
 **** Pulse test, pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$

Typical Operating Characteristics

Figure 1: Power Dissipation
TO-220, TO-263, TO-247

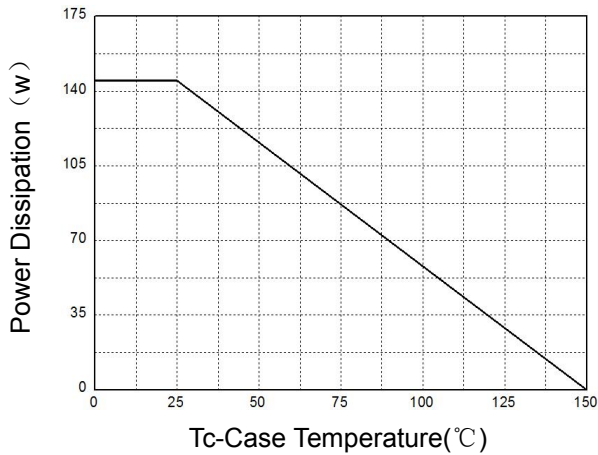


Figure 2: Power Dissipation
TO-220MF

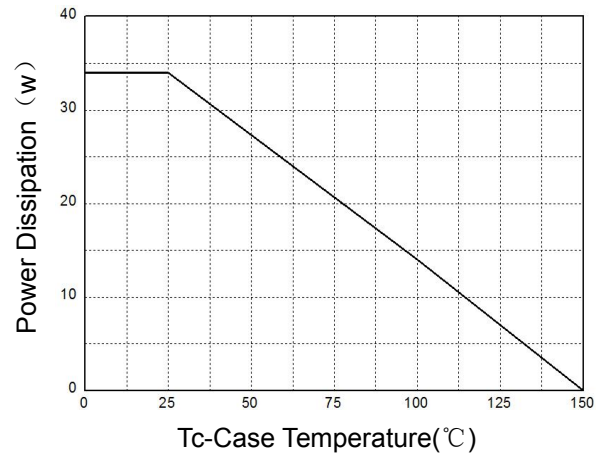


Figure 3: Safe Operation Area
TO-220, TO-263, TO-247

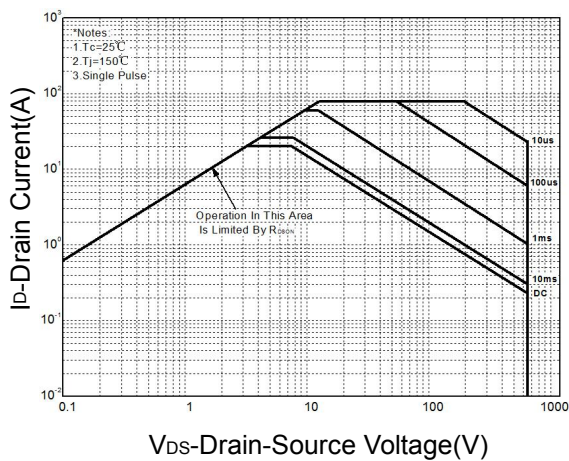


Figure 4: Safe Operation Area
TO-220MF

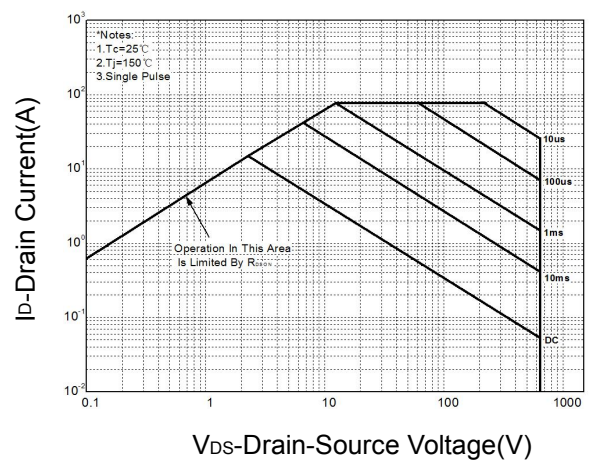


Figure 5: Drain-Source Breakdown Voltage
TO-220, TO-263, TO-247

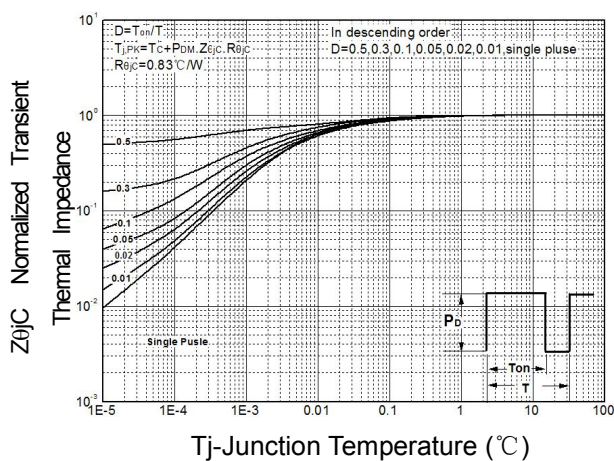


Figure 6: Drain-Source Breakdown Voltage
TO-220MF

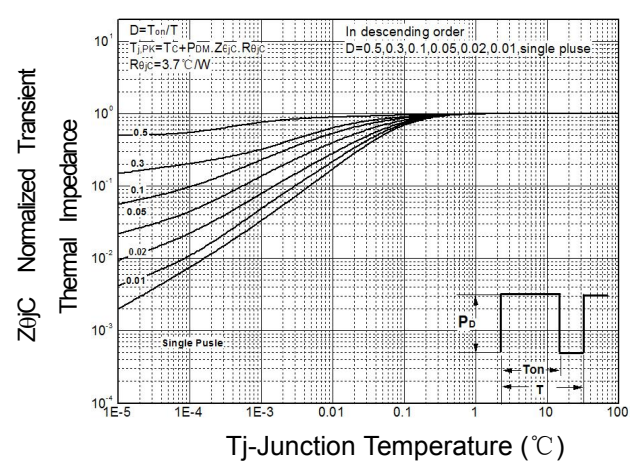
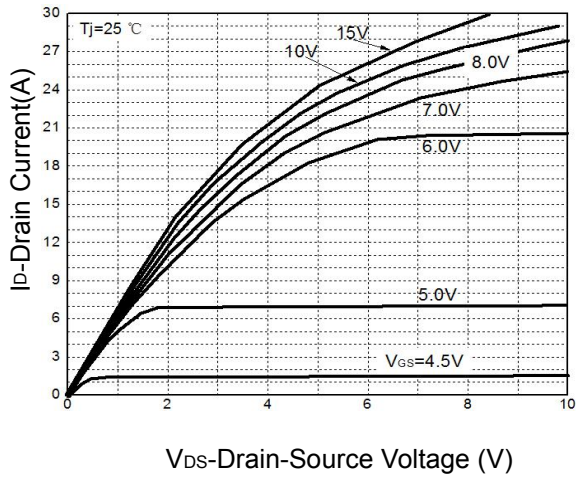
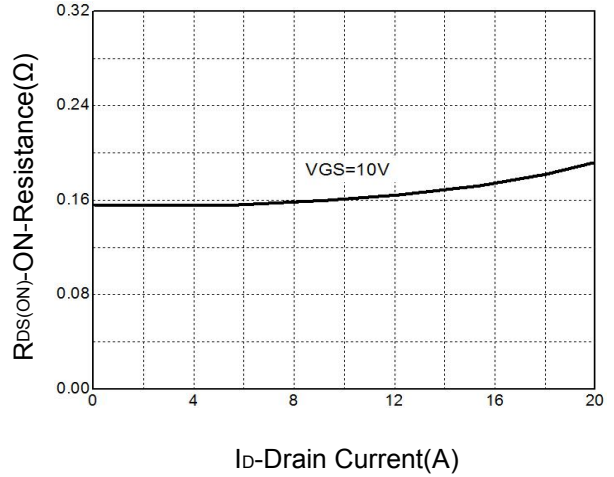
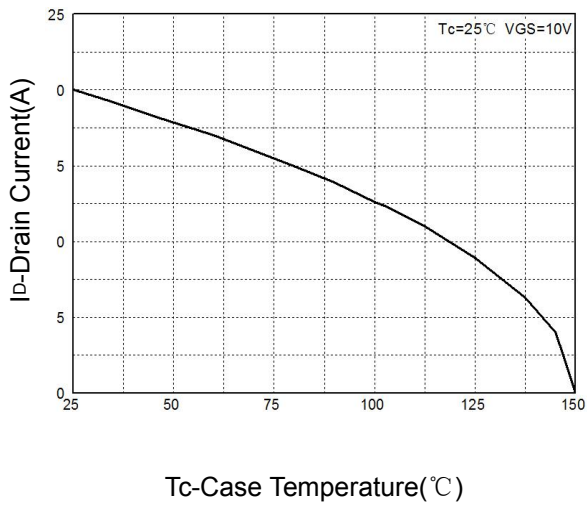


Figure 7: Output Characteristics**Figure 8: Drain-Source On Resistance****Figure 9: Drain Current**

Typical Operating Characteristics(Cont.)

Figure 10 : On-Resistance vs. Temperature

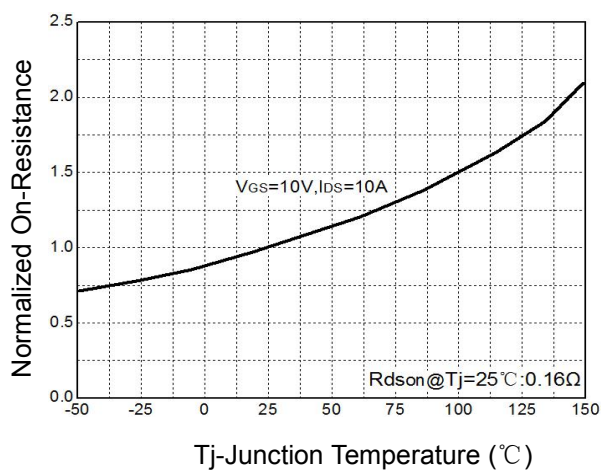


Figure 11 : Source-Drain Diode Forward

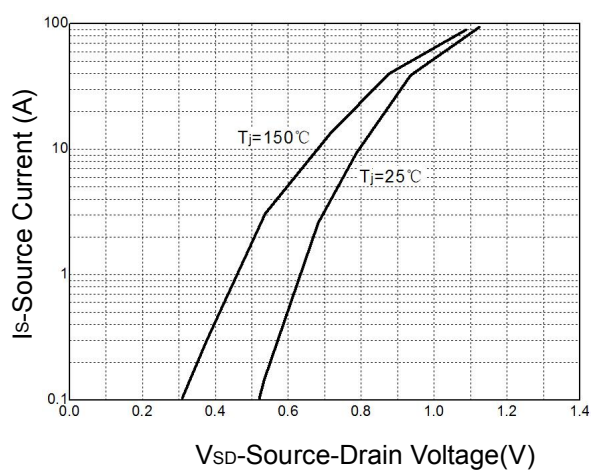


Figure 12 : Capacitance Characteristics

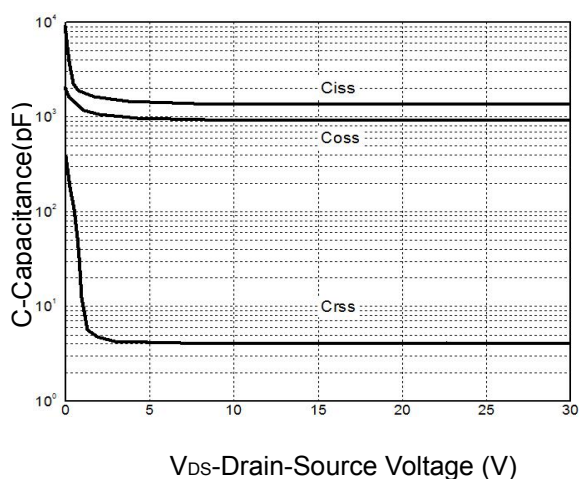
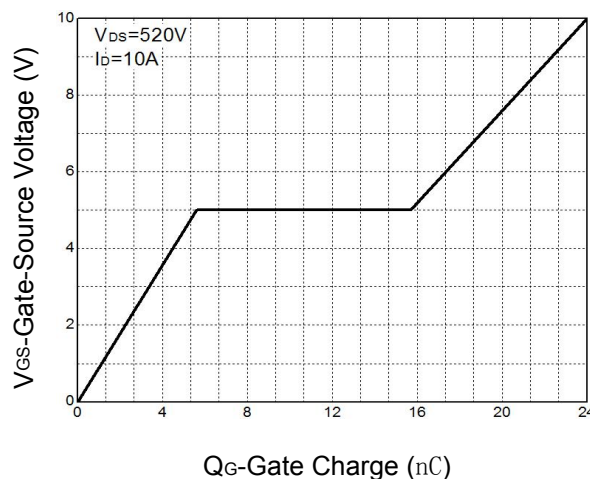
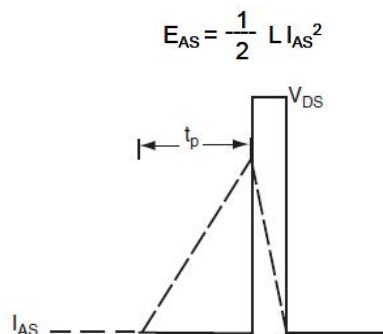
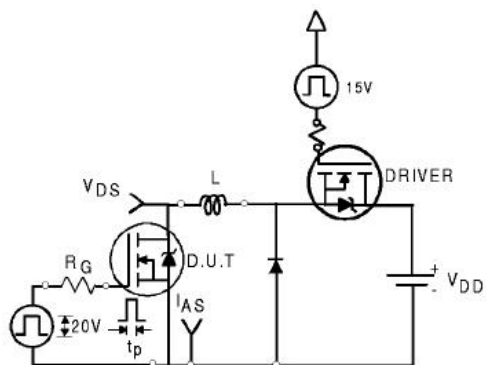


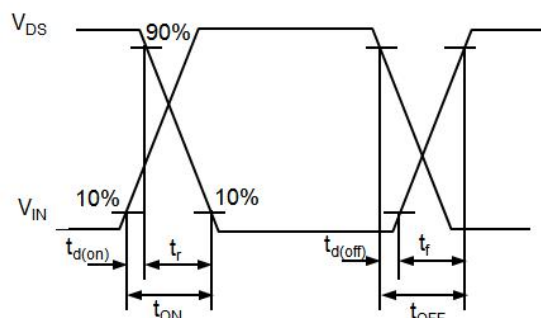
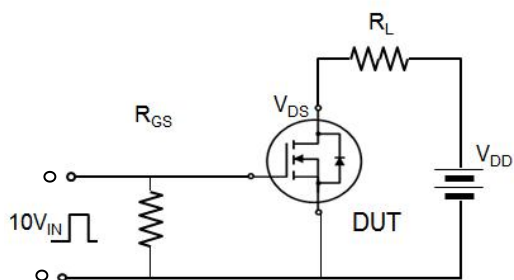
Figure 13 : Gate Charge Characteristics



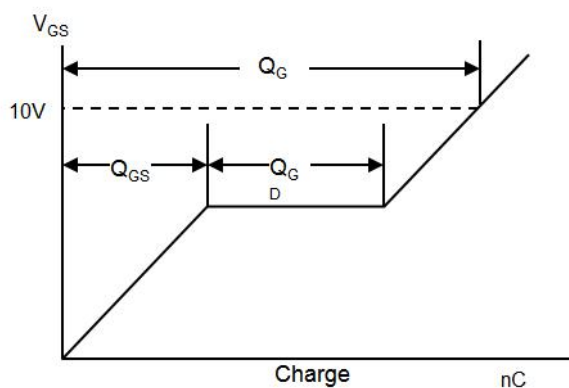
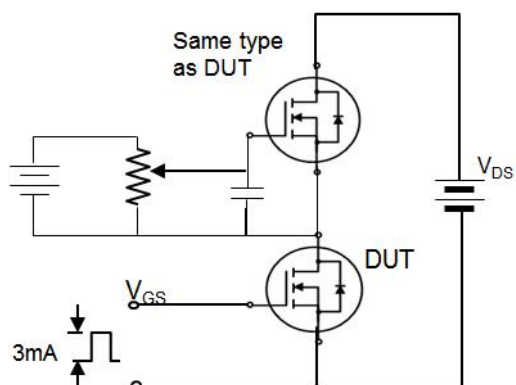
Avalanche Test Circuit



Switching Time Test Circuit

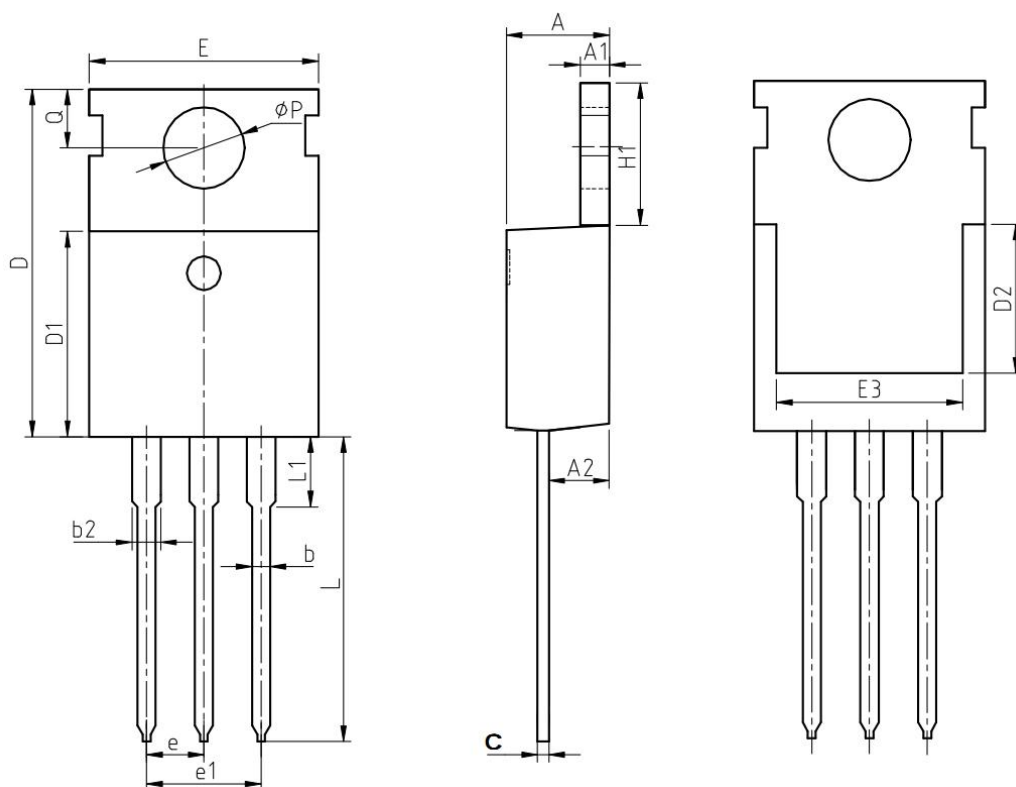


Gate Charge Test Circuit



Package Information

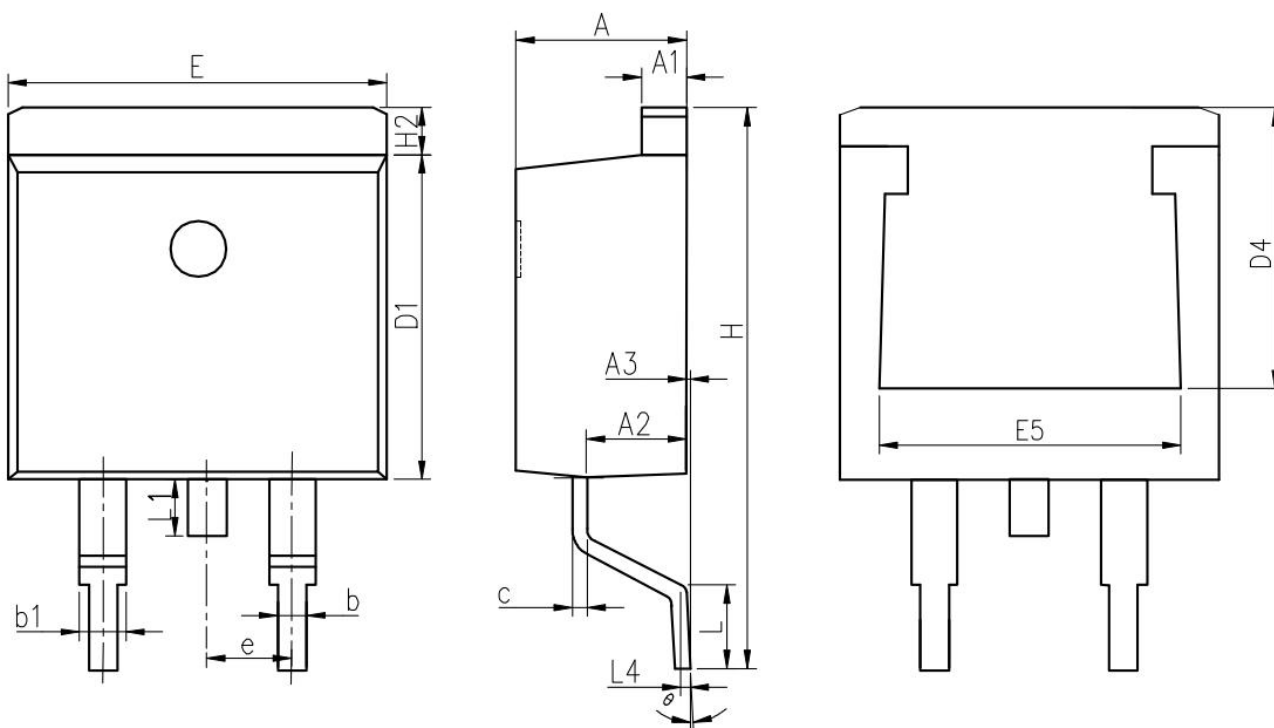
TO-220FB-3L



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.25	1.30	1.45
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.40	0.50	0.65
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ϕP	3.40	3.60	3.80
Q	2.60	2.80	3.00

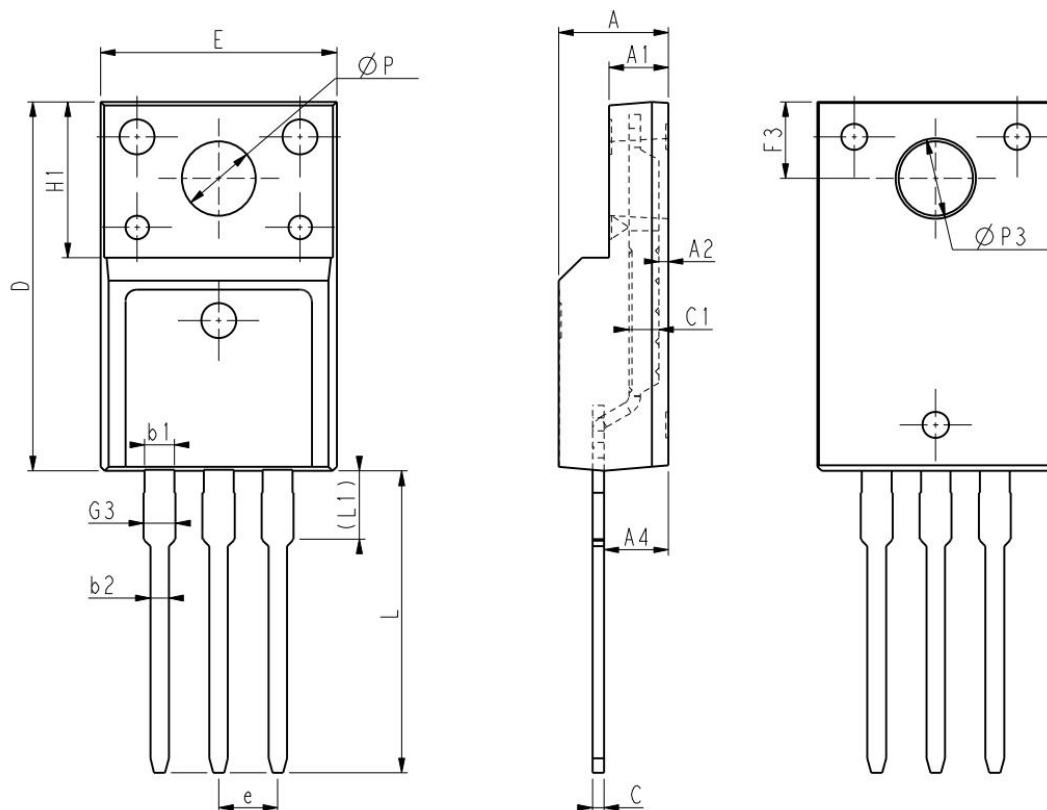
TO-263-2L



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
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	0.7	0.81	0.96
b1	1.17	1.27	1.47
c	0.3	0.38	0.53
D1	8.5	8.7	8.9
D4	6.6	-	-
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.7	15.1	15.5
H2	1.07	1.27	1.47
L	2	2.3	2.6
L1	1.4	1.55	1.7
L4	0.25 BSC		
θ	0°	5°	9°

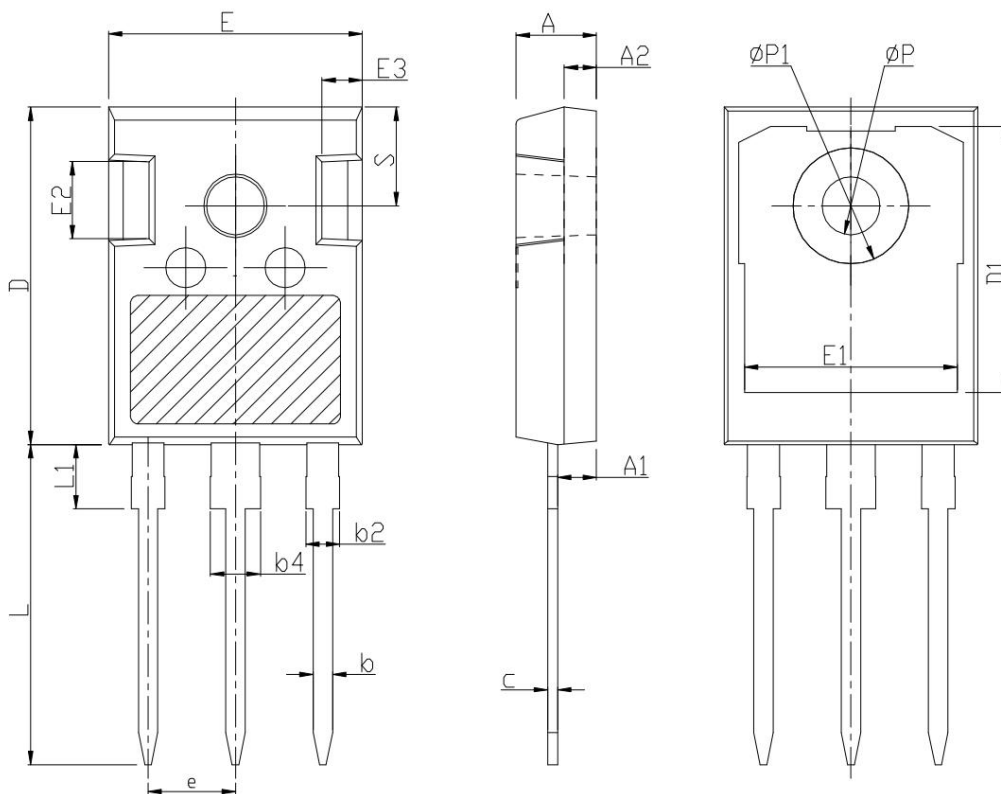
TO-220MF-3L



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.93	3.03	3.13
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95

TO-247-3L



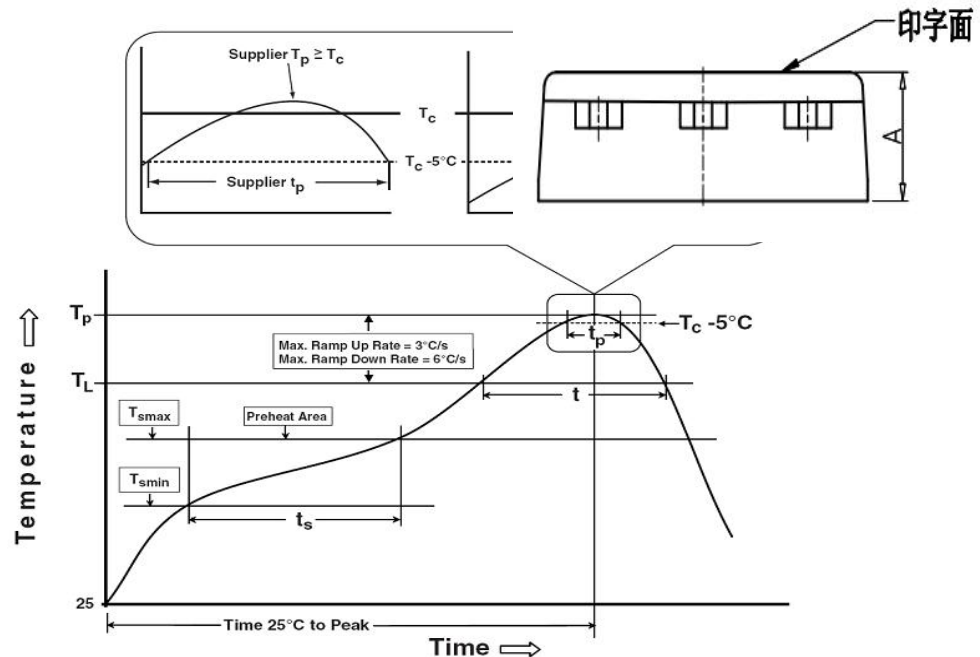
COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

Device Per Unit

Package Type	Unit	Quantity
TO-220FB-3L	Tube	50
TO-220MF-3L	Tube	50
TO-263-2L	Tube	50
TO-247-3L	Tube	30

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	Volume mm ³ ≥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	Volume mm ³ 350-2000	Volume mm ³ ≥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	1000 Hrs, Bias @ 125°C
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C

Customer Service

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