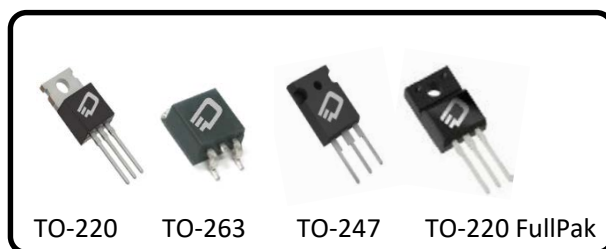


650V, 99mΩ, 33.6 A Super Junction Power MOSFET

Ordering Information

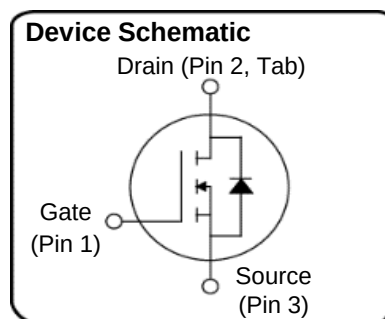
Part Number	Package Option
D3S099N65B-U	TO-220
D3S099N65D-U	TO-247
D3S099N65E-T	TO-263
D3S099N65F-U	TO-220 FullPak



Description

+FET™ is an advanced Super Junction Power MOSFET offering excellent efficiency through low $R_{DS(ON)}$ and low gate charge.

+FET™ is a rugged device with precision charge balance implementation designed for demanding uses such as enterprise power computing power supplies, motor control, lighting and other challenging power conversion applications.



Features

- LOW $R_{DS(ON)}$
- FAST SWITCHING
- HIGH E_{AS}
- REL TEST SPEC: JESD-22
- LOW OUTPUT CAPACITANCE

Benefits

- LOW CONDUCTION LOSSES
- HIGH EFFICIENCY
- EXCELLENT AVALANCHE PERFORMANCE

Table 1 Key Performance Parameters

Parameters	Value	Unit
$V_{DS} @ T_{J \max}$	710	V
$R_{DS(on), \max}$	<99	mΩ
Q_g, typ	56	nC
$I_D @ 25^\circ\text{C}$	33.6	A
C_{oss}	72	pf

Applications

- POWER FACTOR CORRECTION
- SERVER POWER SUPPLIES
- TELECOM POWER SUPPLIES
- INVERTERS
- MOTOR CONTROL

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Revision-----	17

@ $T_J = 25^\circ\text{C}$,unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values				Unit	Note/Test Condition
		Min.	Typ.	Max			
				220, 263 & 247	220FP		
Continuous drain current(1)	I _D			33.6	15.9	A	T _C = 25°C
				21.3	10.1		T _C = 100°C
Pulsed drain current(2)	I _{D,pulse}			135	63.8	A	T _C = 25°C
Avalanche energy,single pulse	E _{AS}			534	534	mJ	I _D =6.6A, V _{DD} =50V
Avalanche energy,repetitive	E _{AR}			1.34	1.34	mJ	I _D =6.6A, V _{DD} =50V
Avalanche current, repetitive	I _{AR}			6.6	6.6	A	
MOSFET dv/dt ruggedness	dv/dt			50	50	V/ns	V _{DS} =...480V
Gate source voltage	V _{GS}	-30		30	30	V	static
		-30		30	30		AC (f > 1HZ)
Power dissipation for TO-220	P _{tot}			272	61	W	T _C = 25°C
Operating and storage temperature	T _j , T _{stg}	-55		150	150	°C	
Mounting torque				60		Ncm	M3 and M3.5 screws
					50		M3 screws
Continuous diode forward current	I _S			33.6	15.9	A	T _C = 25°C
Diode pulsed current	I _{S,pulse}			135	63.8	A	T _C = 25°C
Reverse diode dv/dt(3)	dv/dt			15	15	V/ns	V _{DS} =...480V, I _{SD} <I _D T _J = 25°C
Maximum diode commutation speed	dif/dt			500	500	A/us	

Table 3 Thermal characteristics

Parameter	Symbol	Values				Unit	Note/Test Condition
		Min.	Typ.	Max			
				220, 263 & 247	220FP		
Thermal resistance, Junction-case	R _{thJC}			0.5	2.25	°C/W	
Thermal resistance, Junction-ambient	R _{thJA}			43.4	46	°C/W	Leaded
Soldering temperature, wavesoldering only allowed at leads	T _{sold}			260	260	°C	1.6mm form case for 10s

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Drain to source breakdown voltage	$V_{(BR)DSS}$	650			V	$V_{GS}=0V, I_D=1mA$
Gate threshold voltage	$V_{GS(TH)}$	2.3	3.2	4.5	V	$V_{DS}=V_{GS}, I_D=194\mu A$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS}=650V, V_{GS}=0V, T_J = 25^\circ C$
				40		$V_{DS}=650V, V_{GS}=0V, T_J = 150^\circ C$
Gate to source leakage current	I_{GSS}			100	nA	$V_{GS}=\pm 20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$		94	99	m Ω	$V_{GS}=10V, I_D=16.8A, T_J = 25^\circ C$
			190		m Ω	$V_{GS}=10V, I_D=16.8A, T_J = 150^\circ C$
Gate resistance	R_G		1		Ω	Scaf-F

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		2222		pF	$V_{GS}=0V, V_{DS}=100V, f=1MHz$
Output capacitance	C_{oss}		72		pF	
Reverse transfer capacitance	C_{rss}		13		pF	
Effective output capacitance, energy related 1	$C_{o(er)}$		105		pF	$V_{DS}=0...480V, V_{GS}=0V$
Effective output capacitance, time related 2	$C_{o(tr)}$		331		pF	$I_D=constant, V_{DS}=0...480V, V_{GS}=0V$
Turn on delay time	$t_{d(on)}$		18		ns	$V_{DD}=400V, I_D=16.8A, R_G=1.0\Omega, V_{GS}=10V$
Rising time	t_r		25		ns	
Turn off delay time	$t_{d(off)}$		41		ns	
Fall time	t_f		22		ns	

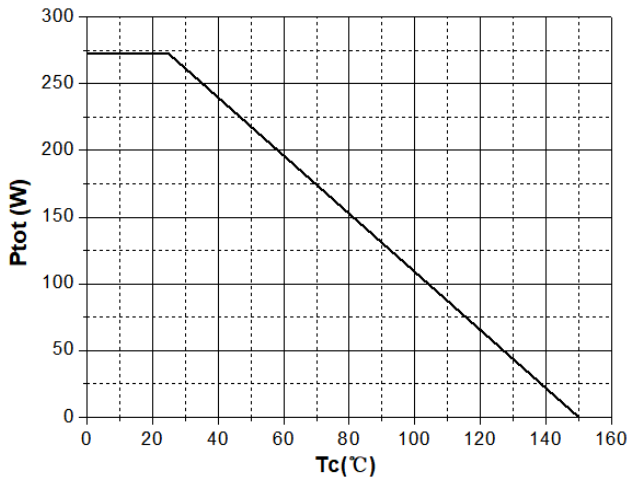
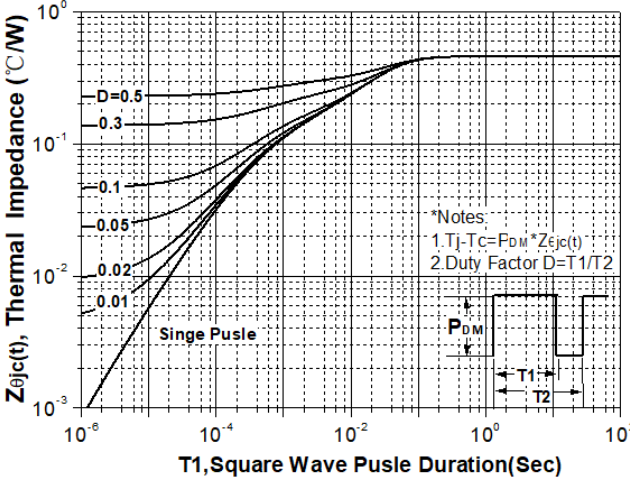
Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Total gate charge	Q_g		56		nC	$V_{DD}=480V, V_{GS}=0 \text{ to } 10V, I_D=16.8A$
Gate-source charge	Q_{gs}		14		nC	
Gate-drain charge	Q_{gd}		23		nC	
Gate plateau voltage	$V_{plateau}$		5.0		V	

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min	Typ	Max		
Diode forward voltage	V_{SD}		0.87	0.96	V	$I_F=33.6A, V_{GS}=0V, T_J = 25^{\circ}C$
Reverse recovery time	t_{rr}		452		ns	$I_F=33.6A, dI_F/dt=100A/us$
Reverse recovery charge	Q_{rr}		8.0		uC	
Peak reverse recovery current	I_{rrm}		36		A	

Table 8 Thermal Performance

Power dissipation (TO220, TO263 & TO247)	Max. transient thermal impedance (TO220, TO263 & TO247)
	
$P_{tot}=f(T_C)$	$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

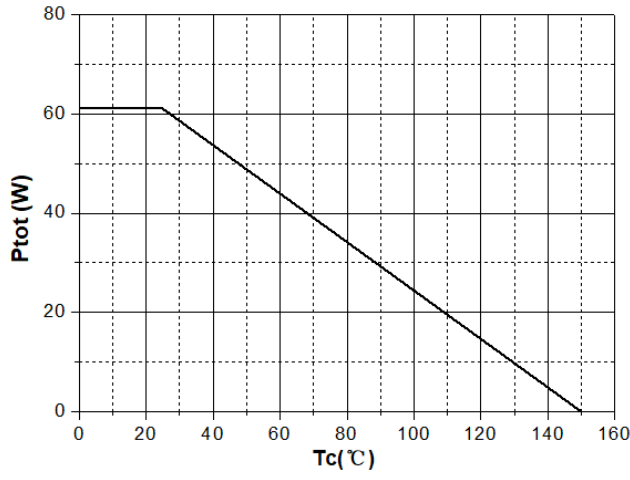
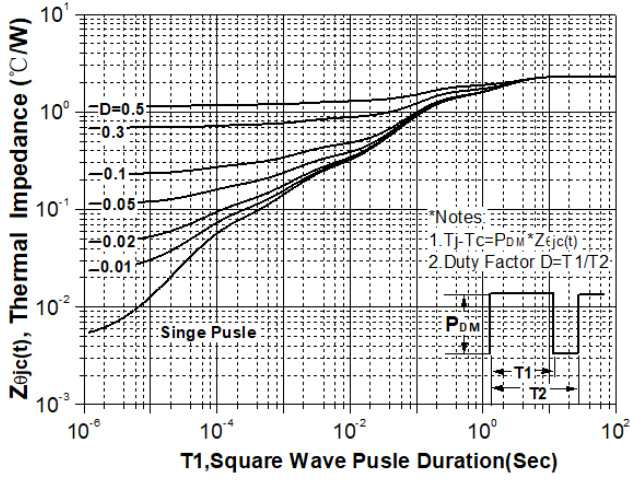
Power dissipation (TO220F)	Max. transient thermal impedance (TO220F)
	
$P_{tot}=f(T_C)$	$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

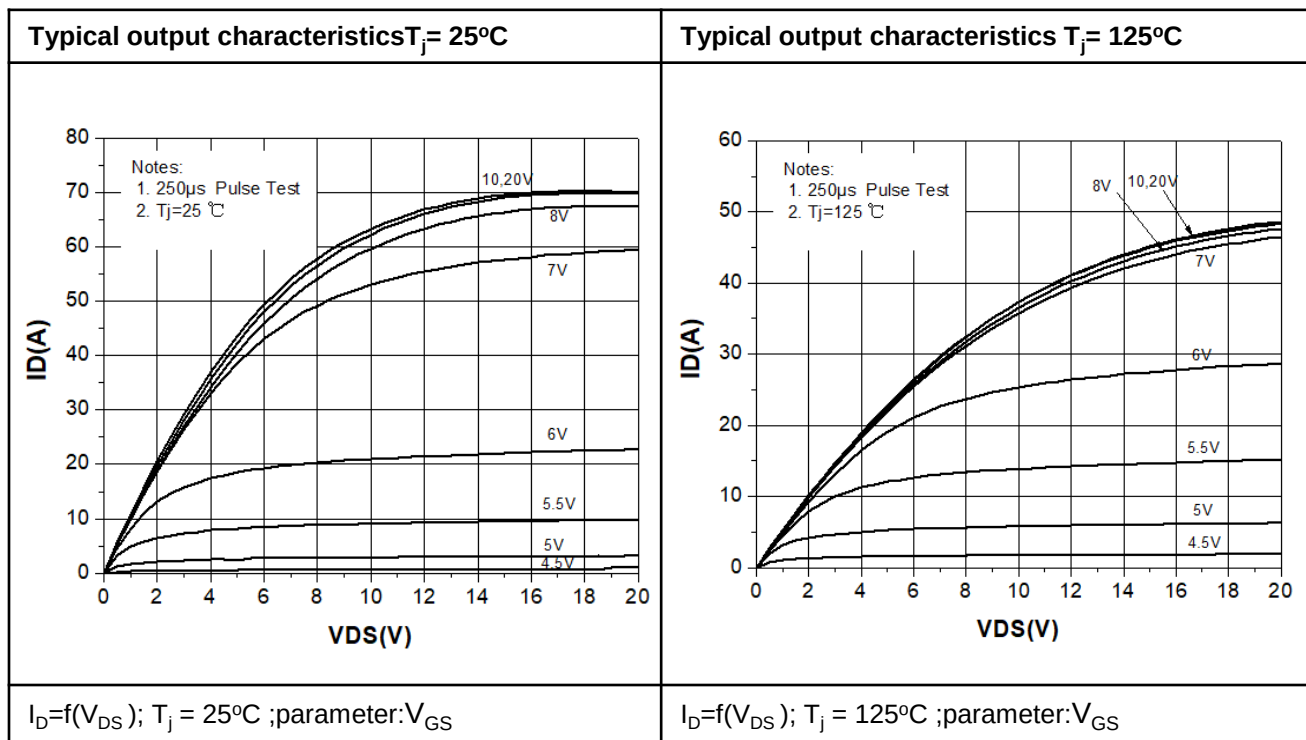
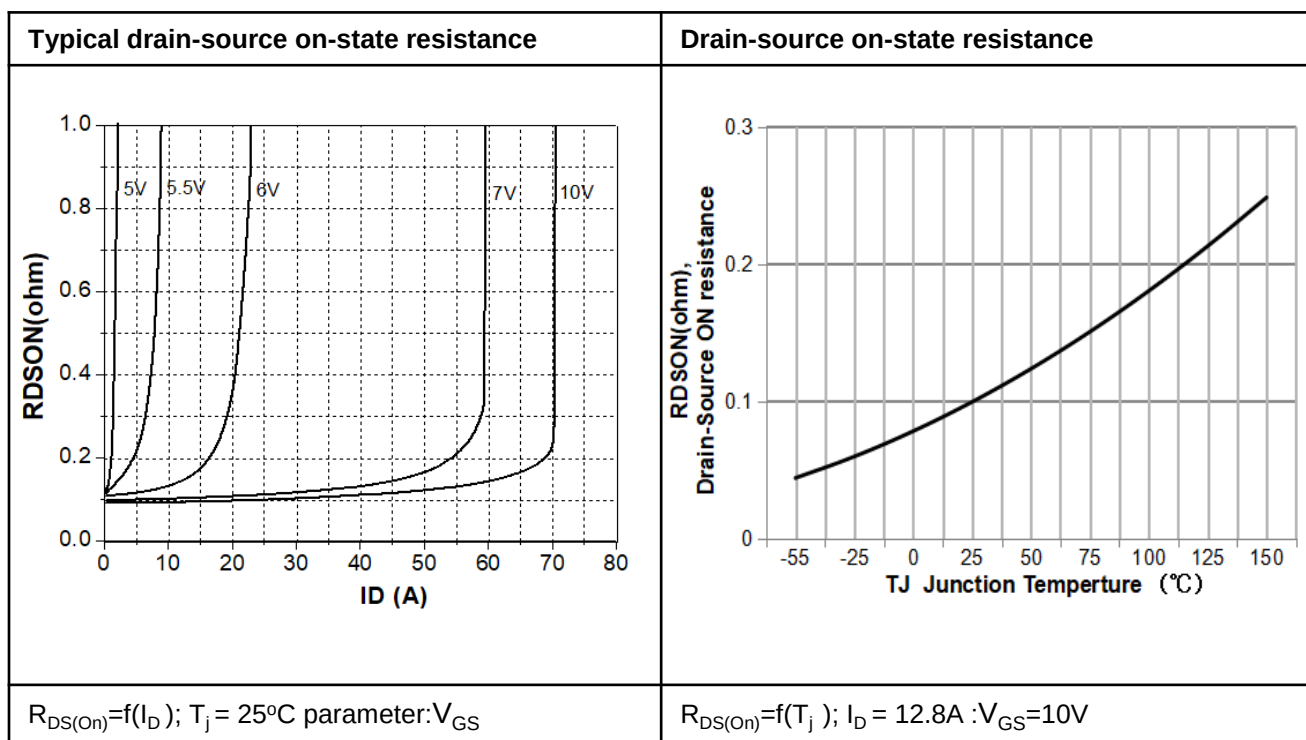
Table 9 Output Characteristics

Table 10 Drain Source Resistance


Table 11 Safe Operating Area

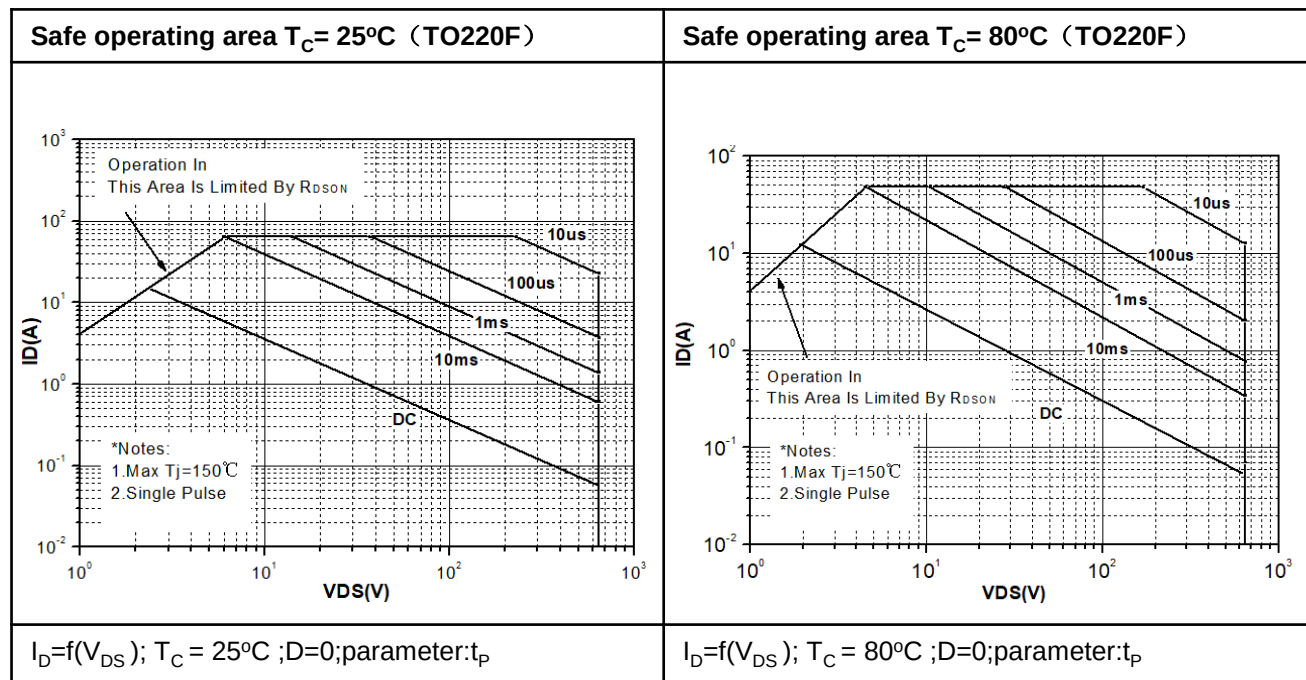
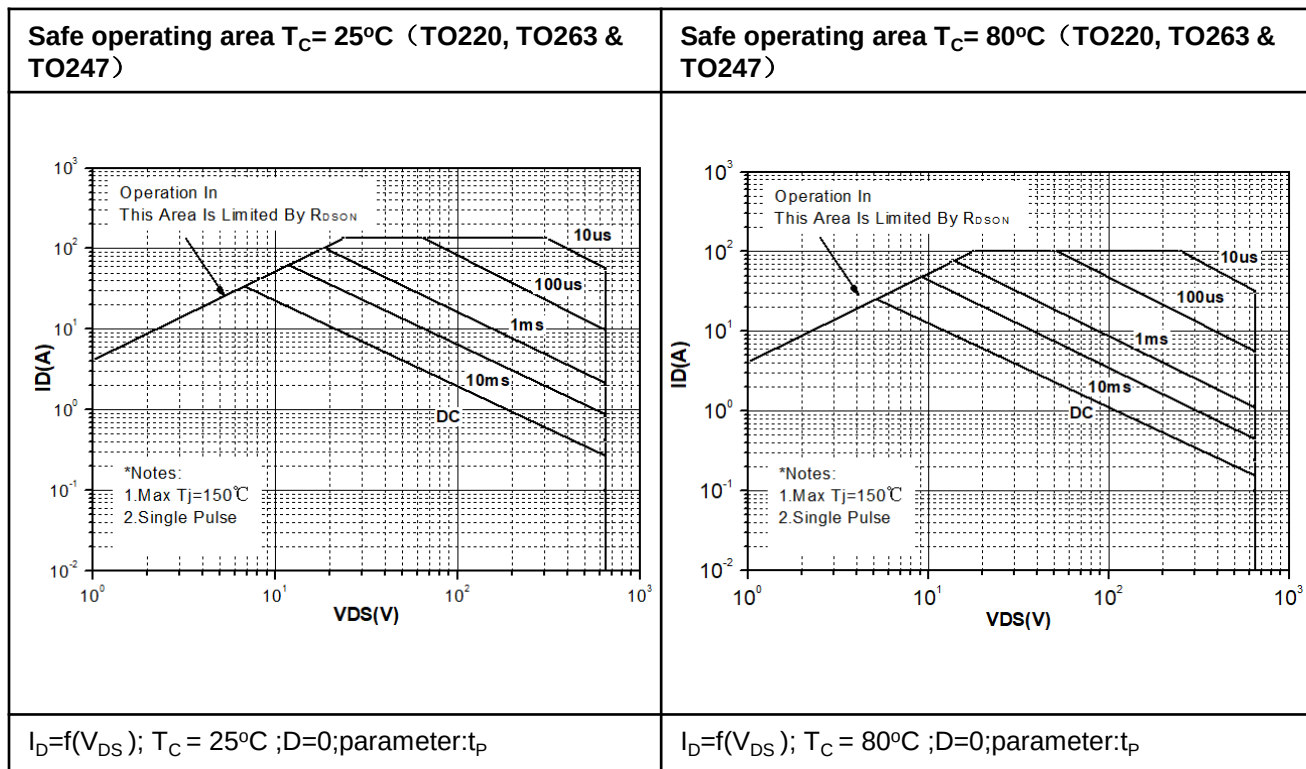


Table 12 Capacitances and Gate Charge

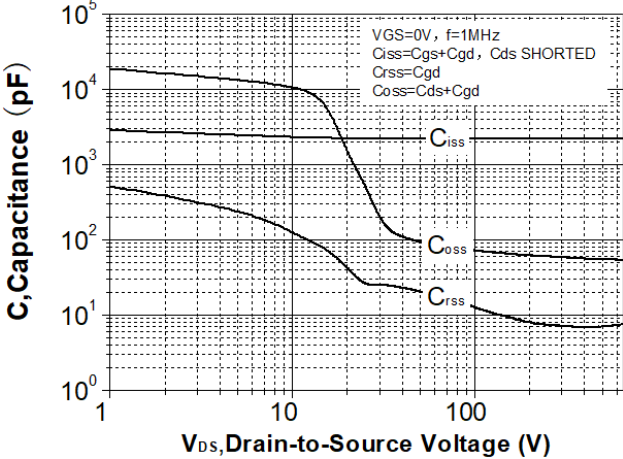
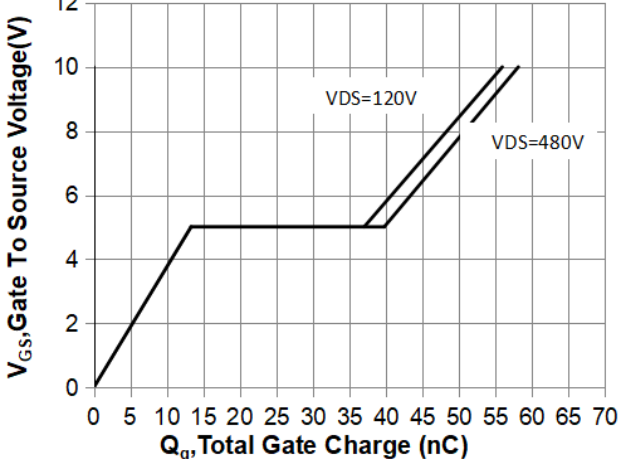
Typical Capacitances	Typical Gate charge
 $V_{GS}=0V$, $f=1MHz$ $C_{iss}=C_{gs}+C_{gd}$, C_{ds} SHORTED $C_{rss}=C_{gd}$ $C_{oss}=C_{ds}+C_{gd}$	
$V_{gs}=0v$, Freq.= 1MHz	$I_D=f(Q_{gate})$; $I_D = 16.8A$ pulsed; parameter: V_{DD}

Table 13 Diode Characteristics and Avalanche Energy

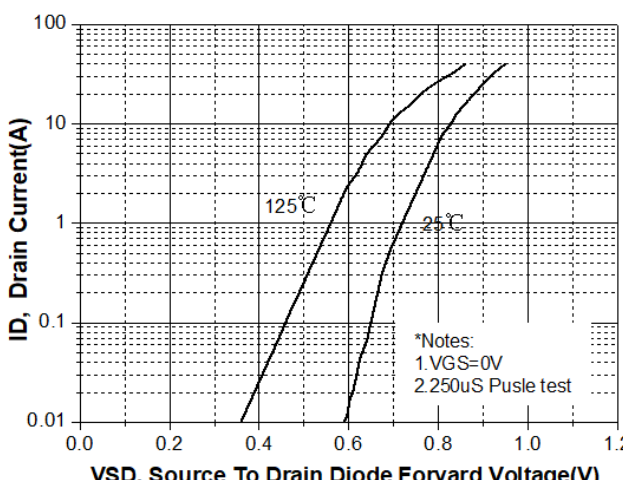
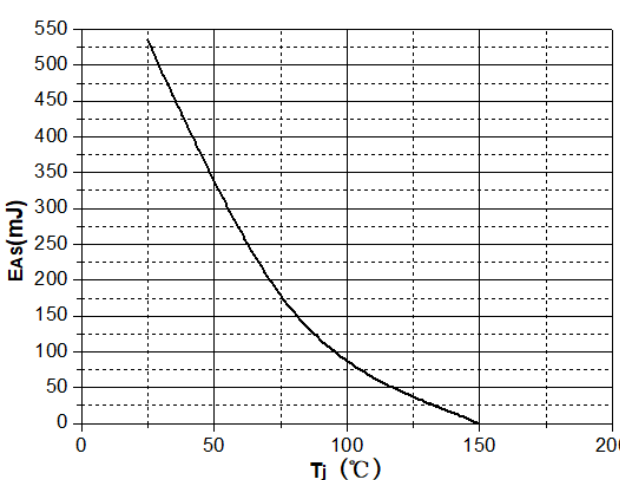
Forward characteristics of reverse diode	Avalanche energy
 I_D, Drain Current(A) V_{SD}, Source To Drain Diode Forward Voltage(V) 125°C 25°C *Notes: 1. $V_{GS}=0V$ 2. 250uS Pulse test	 E_{AS}(mJ) T_j (°C)
$I_F=f(V_{SD})$; parameter: T_j	$E_{AS}=f(T_j)$; $I_D = 6.6A$; $V_{DD} = 50V$

Table 14 Breakdown Voltage and Transfer Characteristics

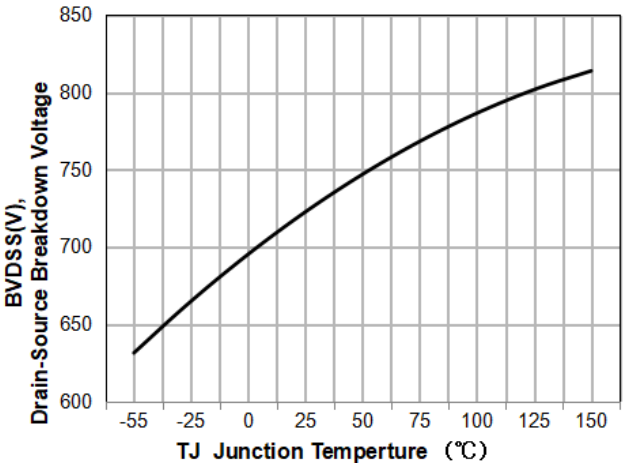
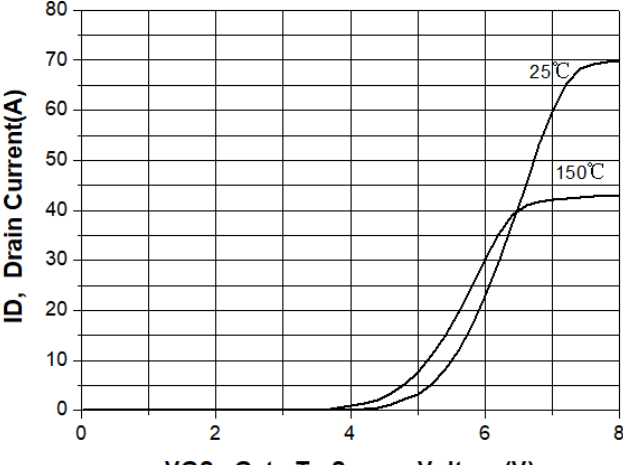
Drain-source breakdown voltage	Transfer Characteristics
 BVDS(V), Drain-Source Breakdown Voltage TJ Junction Temperture (°C)	 ID, Drain Current(A) VGS, Gata-To-Source Voltage(V)
$V_{BR(DSS)} = f(T_j); I_D = 1mA$	$I_D = f(V_{GS}); V_{DS} > 2 I_D R_{DS(On)max}; parameter: T_j$

Table 15 Diode Recovery Characteristic

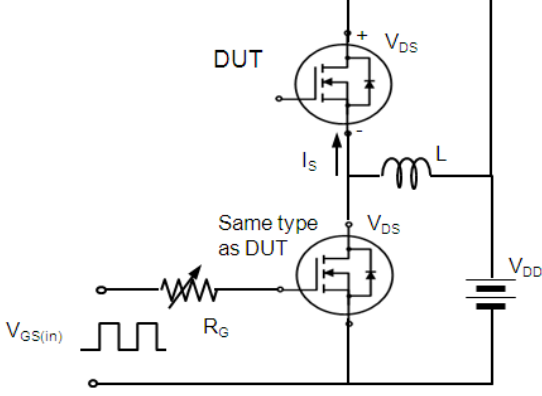
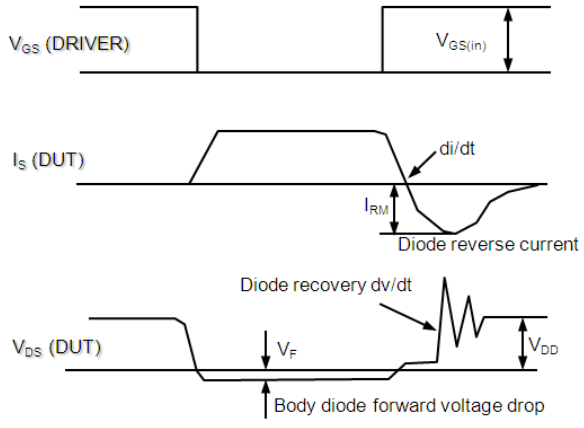
Test Circuit For Diode Recovery	Test Waveform For Diode Recovery
 *. dv/dt controlled by R_G *. I_S controlled by pulse period	

Table 16 Switching Time Characteristic

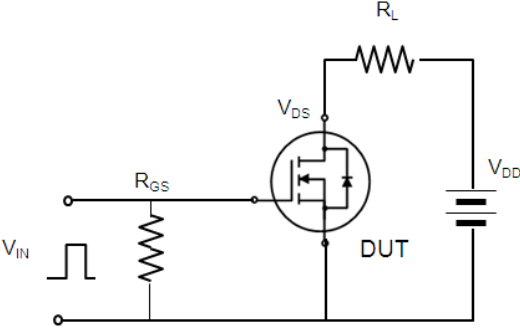
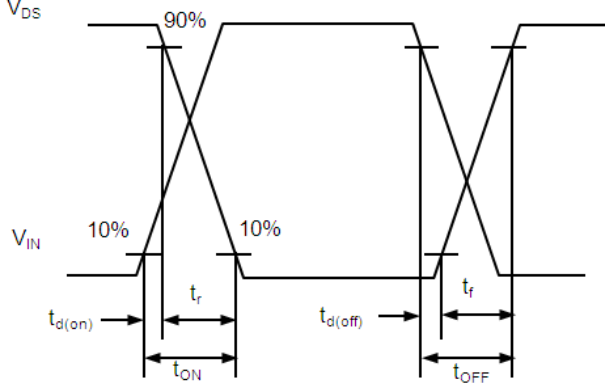
Test Circuit for Switching Time	Test Waveform for Switching Time
	

Table 17 Gate Charge Characteristic

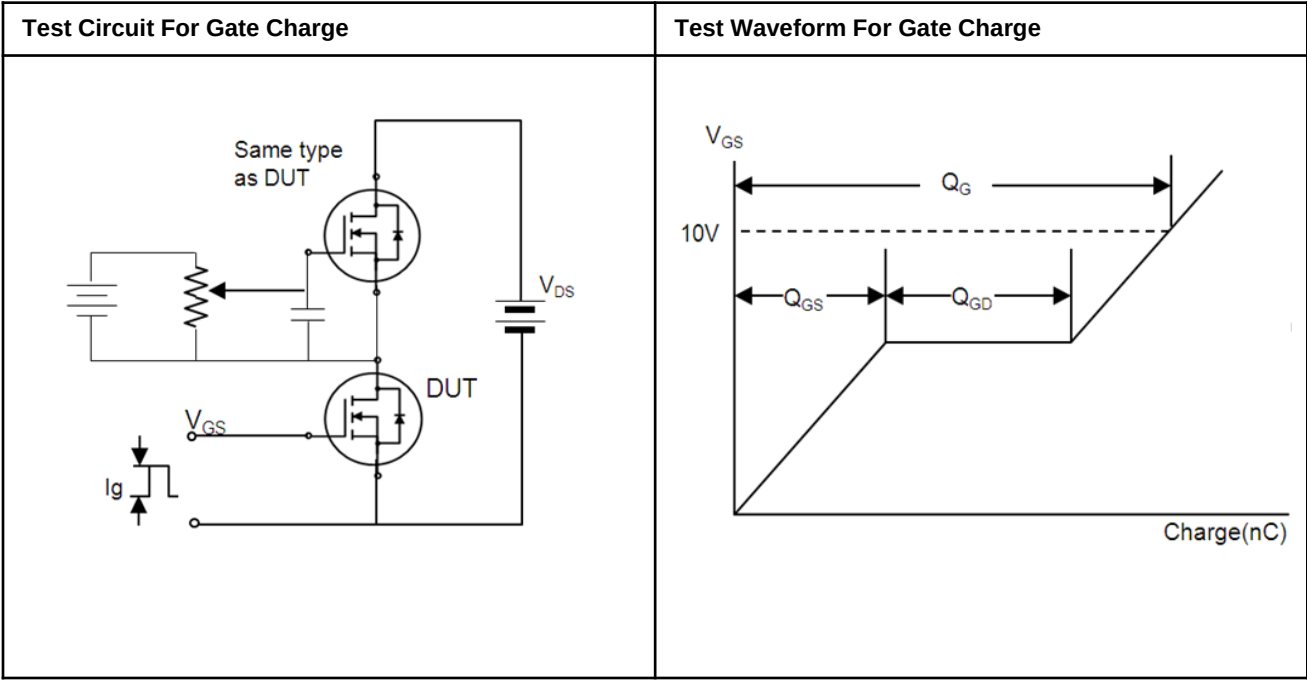
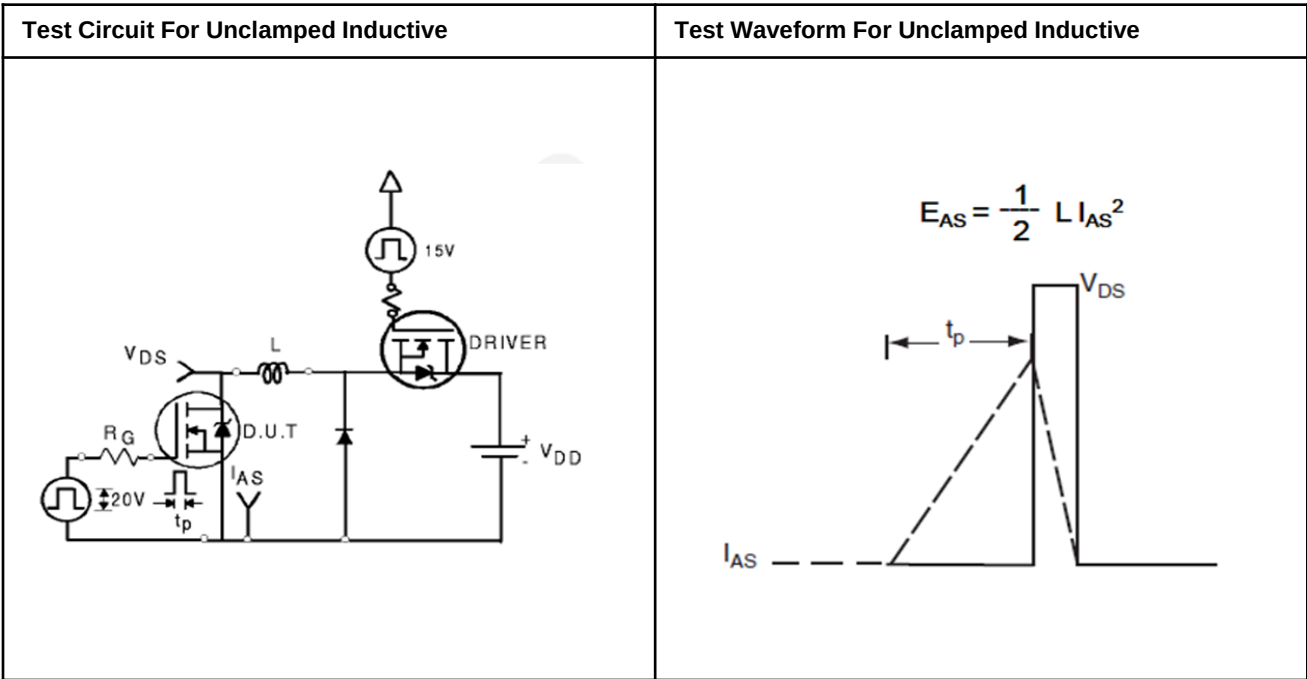
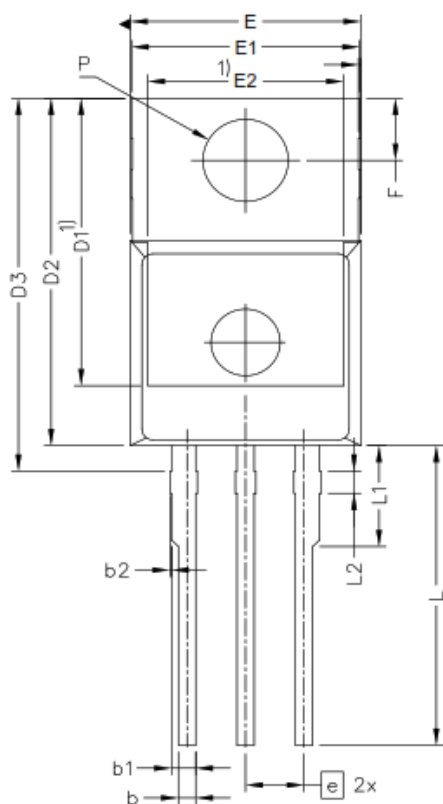


Table 18 Unclamped Inductive Characteristic



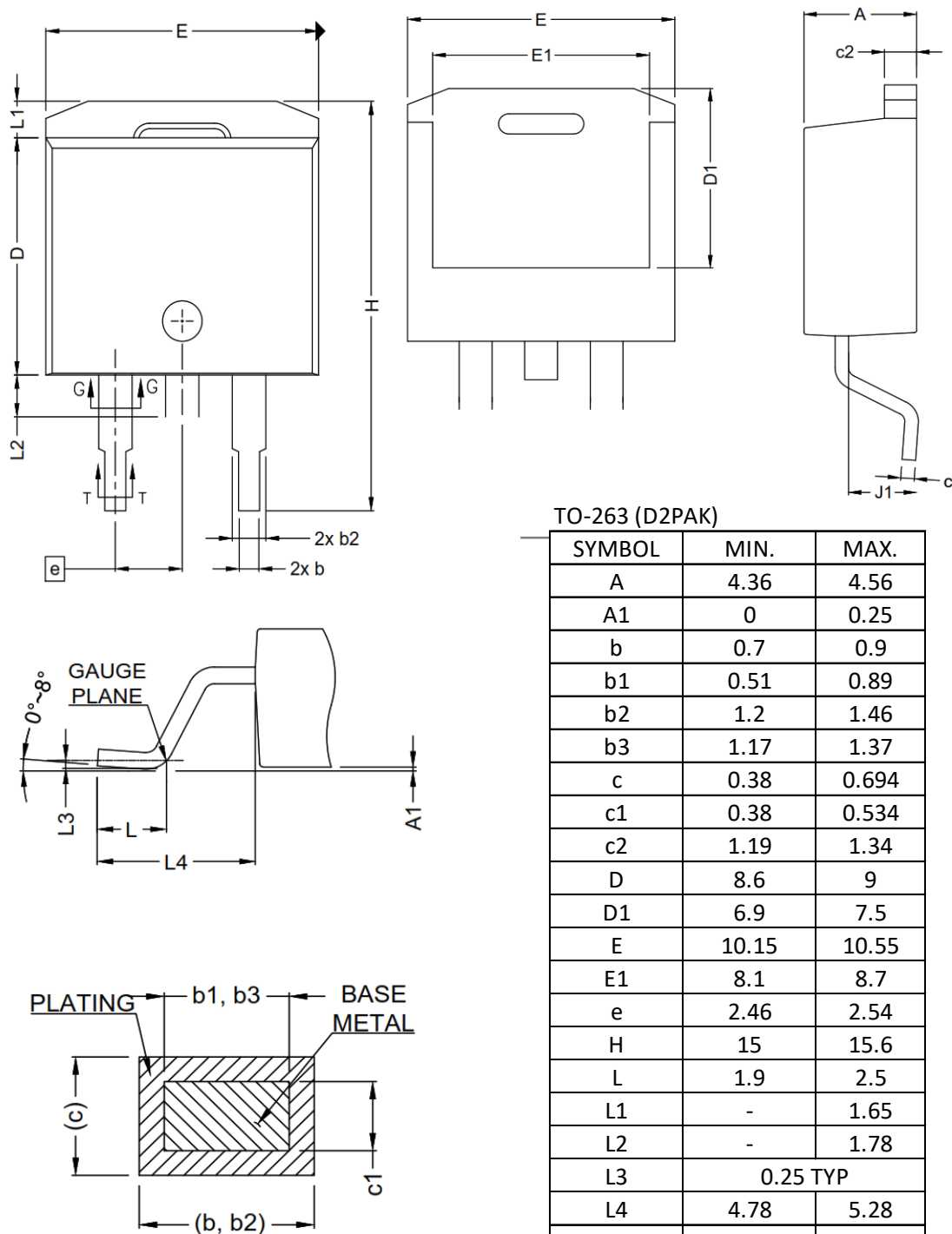
4a) TO-220

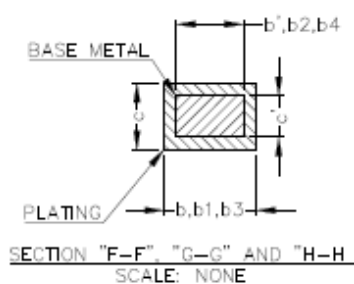


TO-220 3L

SYMBOL	MIN	MAX
A	4.20	4.60
A1	1.20	1.40
A2	2.20	2.60
b	0.65	0.85
b1	0.95	1.15
b2		0.15
C	0.40	0.60
D	9.05	9.45
D1	12.95	
D2	15.35	15.95
D3	16.50	17.10
E	9.80	10.20
E1	9.70	10.10
E2	8.50	
e	2.46	2.54
F	2.60	3.00
L	13.00	14.00
L1	4.35	4.75
L2	0.90	1.10
P	3.55	3.85

4b) TO-263

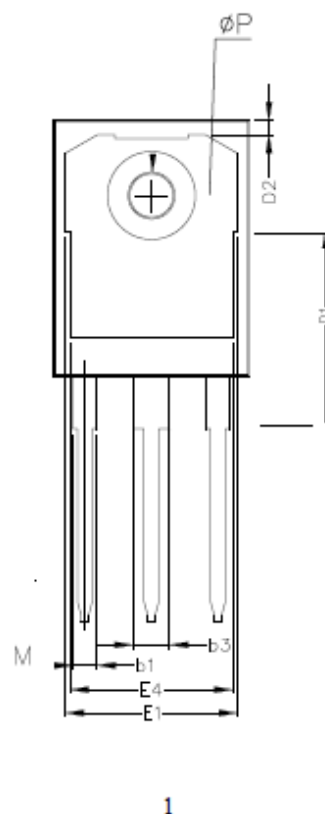
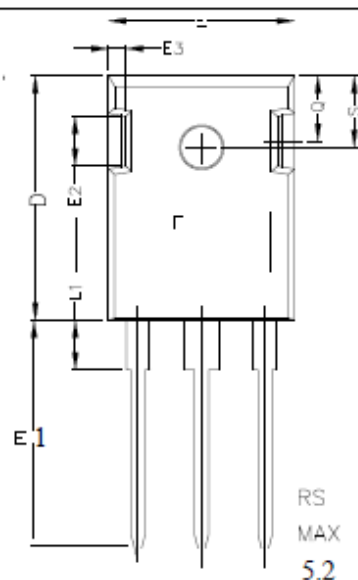
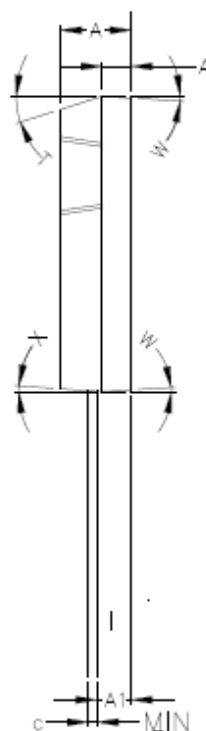


4c) TO-247


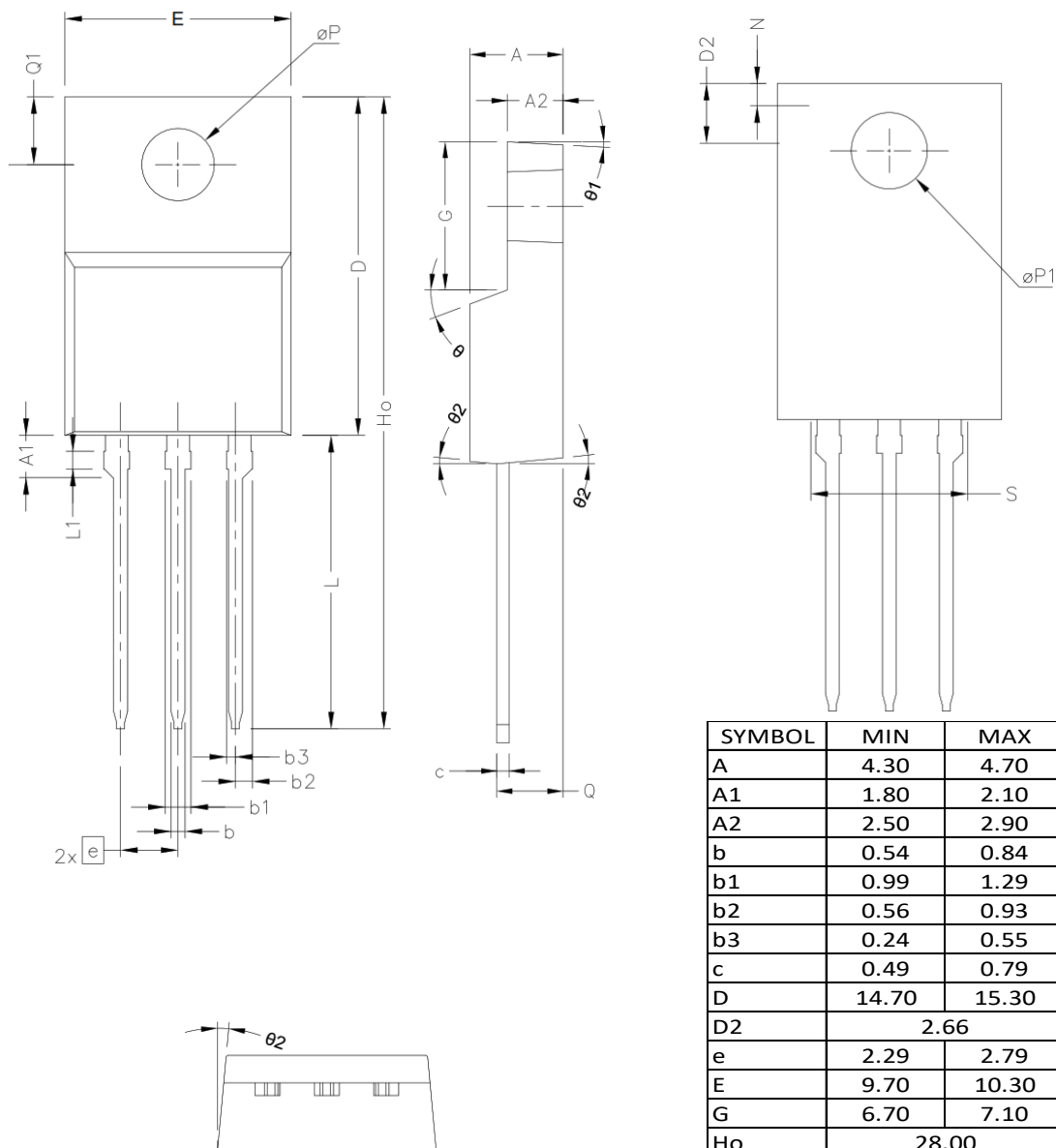
1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT OF JEDEC OUTLINE TO-247 AD.

SYM	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	1.91	2.41
b2	1.91	2.16
b3	2.87	3.38
b4	2.87	3.13
c'	0.55	0.65
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC	
N	3	
L	19.81	20.32
L1	4.10	4.40
øP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° ref	
W	3.5° ref	
X	4° ref	

- 1 - GATE
- 2 - DRAIN (COLLECTOR)
- 3 - SOURCE (EMITTER)
- 4 - DRAIN (COLLECTOR)



4d) TO-220 FullPak



SYMBOL	MIN	MAX
A	4.30	4.70
A1	1.80	2.10
A2	2.50	2.90
b	0.54	0.84
b1	0.99	1.29
b2	0.56	0.93
b3	0.24	0.55
c	0.49	0.79
D	14.70	15.30
D2	2.66	
e	2.29	2.79
E	9.70	10.30
G	6.70	7.10
Ho	28.00	
L	12.50	13.50
L1	0.70	0.90
N	2.86	
ϕP	3.05	3.40
$\phi P1$	3.40	
Q	3.10	3.30
Q1	2.70	3.30
S	7.00	
$\theta 1$	3 deg.	
$\theta 2$	5 deg.	

Revision History

Revision	Release Date	Comments
1.0	1-Nov-2016	Preliminary Datasheet Draft
2.0	1-July-2017	Update tables and package detail
2.5	20-Nov-2017	Added TO247 Package
2.6	11-Dec-2017	Added Test Circuits
3.0	2-Jan 2019	Updated/update tables and charts

Resources

www.d3semi.com

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Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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