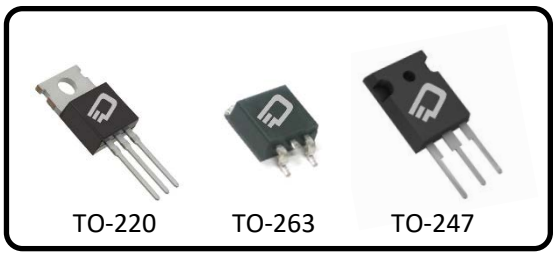
650V, 70mΩ, 31.8 Super Junction Power MOSFET

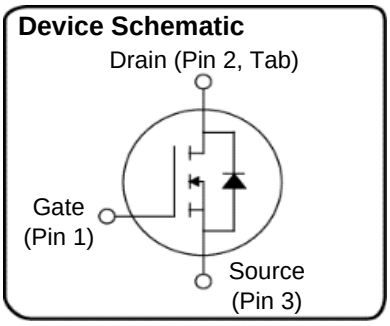
Ordering Information

Part Number	Package Option
D3S070N65B-U	TO-220
D3S070N65D-U	TO-247
D3S070N65E-U	TO-263



Description

+FET™ is an advanced Super Junction Power MOSFET offering excellent efficiency through low Rds-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.



RoHS

Features

- LOW $R_{DS(ON)}$
- FAST SWITCHING
- HIGH E_{AS}
- REL TEST SPEC: JESD-22
- HTRB >3000 HRS

Benefits

- LOW CONDUCTION LOSSES
- HIGH EFFICIENCY
- EXCELLENT AVALANCHE PERFORMANCE

Table 1 Key Parameters

Parameter	Value	Unit
V_{DSS} @ T_{jmax}	710	V
RDS(on) max	< 70	mΩ
Qg typ	77	nC
I_D @ 25 ºC	44.9	A

Applications

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

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Maximum Ratings

Table 2 Maximum Ratings

@ T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Continuous drain current	I_D			31.8	A	T_c = 25ºC
				23.7	A	T_c = 100ºC
Pulsed drain current	$I_{D, pulse}$			127	A	T_c = 25ºC
Avalanche energy, single pulse	E_{AS}			650	mJ	I_D = 8.7A; V_{DD} = 50V, VGS = 10V, L=17mH, RG=25 Ohms
Avalanche energy, repetitive	E_{AR}			1.0	mJ	I_D = 8.7A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			8.7	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	V_{DS} = 0….400V
Gate source voltage (static)	V_{GS}	-30		30	V	Static
Gate source voltage (dynamic)	V_{GS}	-30		30	V	AC (F>1Hz)
Power dissipation	P_{tot}			154	W	TO-220, TO-263, T_c = 25ºC
Storage temperature	T_{stg}	-55		150	ºC	TO-220FP, T_c = 25ºC
Operating junction temperature	T_j	-55		150	ºC	TO-247, T_c = 25ºC
Mounting torque				60	N-cm	
Continuous diode forward current	I_{SD}			31.8	A	Tc = 25ºC
Diode pulse current	$I_{S, pulse}$			127	A	Tc = 25ºC
Reverse diode dv/dt	dv/dt			15	V/ns	V_{DS}=0…400V, I_{SD}<=I_S, T_j = 25ºC
Maximum diode commutation speed	di_f/dt			500	A/µs	V_{DS}=0…400V, I_{SD}<=I_S, T_j = 25ºC

Thermal Characteristics

Table 3 Thermal Characteristics

Symbol	Parameter	Values			Unit
		TO-220	TO-263	TO-247	
R_{thjC}	Thermal resistance, junction-case	0.81	0.81	0.81	ºC/W
R_{thjA}	Thermal resistance, junction-ambient	62	62	50	ºC/W
R_{thjT}	Thermal resistance, junction-ambient for SMD version		30		ºC/W
T_S	Soldering temperature, wavesoldering only allowed at leads	260	260	260	ºC

Electrical Characteristics

@ T_j = 25ºC, unless otherwise specified

Table 4

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Drain-source breakdown voltage	V_{DSS}	650			V	I_D = 1mA, V_{GS} = 0V
Gate threshold voltage	$V_{(GS)th}$	2.3	3	3.7	V	
Zero gate voltage drain current	I_{DSS}			1	µA	V_{DS} = 650V, T_c = 25ºC
				50		V_{DS} = 650V, T_c = 125ºC
Gate-source leakage current	I_{GSS}			100	nA	
Drain-source on-state resistance	$R_{DS(on)}$		0.062	0.070	Ω	V_{GS} = 10V, I_D = 15.9A, T_c = 25ºC
	$R_{DS(on)}$		0.160			V_{GS} = 10V, I_D = 15.9A, T_c = 150ºC
Gate resistance	R_G		1		Ω	

Table 5

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Input capacitance	C_{iss}		4240		pF	V_{DS} = 100V, f = 1MHz, V_{GS} = 0V
Output capacitance	C_{oss}		97.5		pF	
Reverse transfer capacitance	C_{rss}		16.5		pF	
Turn-on delay time	$t_{d(on)}$		17		ns	V_{DD} = 400V, I_D = 15.9A, R_G = 1Ω, V_{GS} = 10V
Rise time	t_r		24		ns	
Turn-off delay time	$t_{d(off)}$		90		ns	
Fall time	t_f		23		ns	

Table 6 Gate Charge Characteristics

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Gate to source charge	Q_{gs}		16		nC	V_{DD} = 480V, I_D = 15.5A, V_{GS} = 10V
Gate to drain charge	Q_{gd}		27		nC	
Gate charge total	Q_g		77		nC	
Gate plateau voltage	$V_{plateau}$		5		V	

Table 7 Body Diode

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Diode source-drain current	I_{SD}			38.3	A	
Diode forward voltage	V_{fd}		0.95	1.5	V	I_{SD} = 31.8A, V_{GS} = 0V
Reverse recovery time	t_{rr}		468		ns	I_{SD} = 31.8A, di/dt = 100A/µS V_{DD} = 60V, T_c = 25ºC
Reverse recovery charge	Q_{rr}		9.5		µC	
Peak reverse recovery current	I_{rrm}		50.0		A	

Electrical Characteristics Graphs

Table 8 Thermal Performance

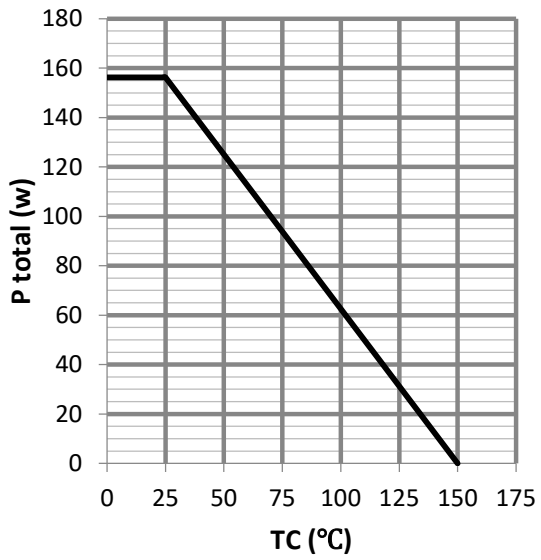
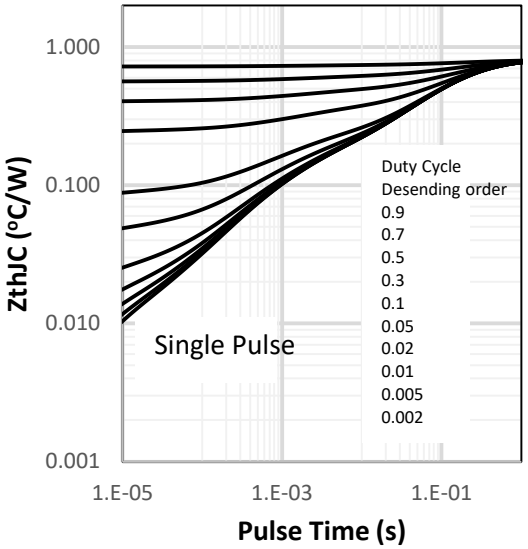
Power Dissipation	Maximum Transient Thermal Impedance
	
Max power limited by case temperature	Variable is pulse time (t_p)

Table 9 Output Characteristics

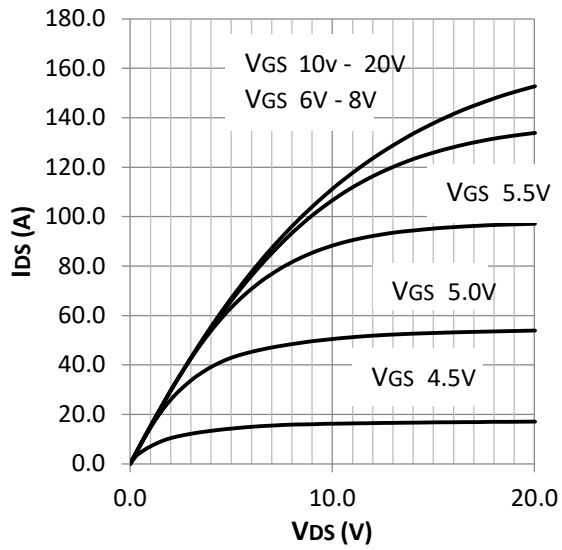
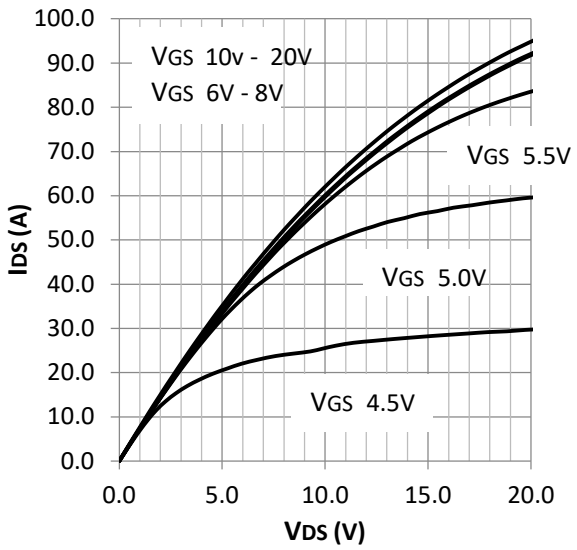
Typical Output Characteristics	Typical Output Characteristics
	
T_C = 25°C; Variable is V_{GS}	T_C = 125°C; Variable is V_{GS}

Table 10 Drain-Source Resistance

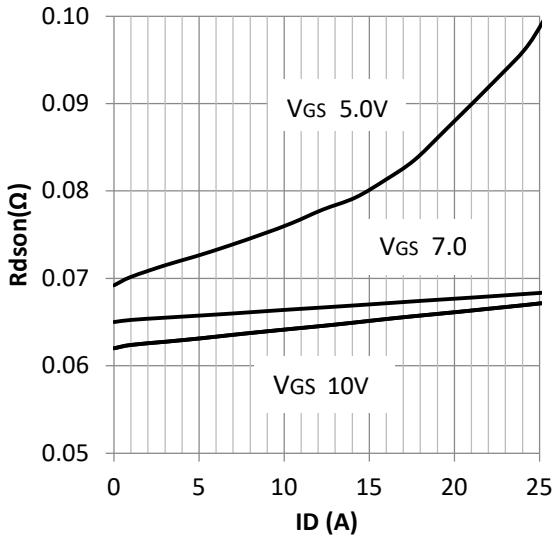
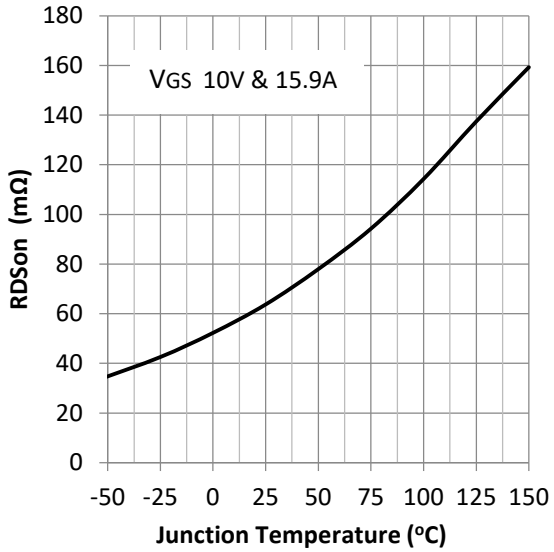
Typical Drain–Source On-State Resistance	Drain–Source On-State Resistance
	
T_C = 25°C; Variable is Gate Voltage (Vgs)	I_D = 15.9 Pulsed Vgs = 10V

Table 11 Safe Operating Area

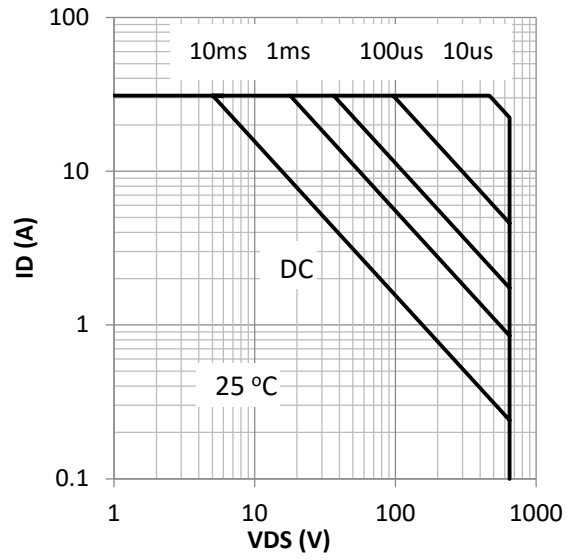
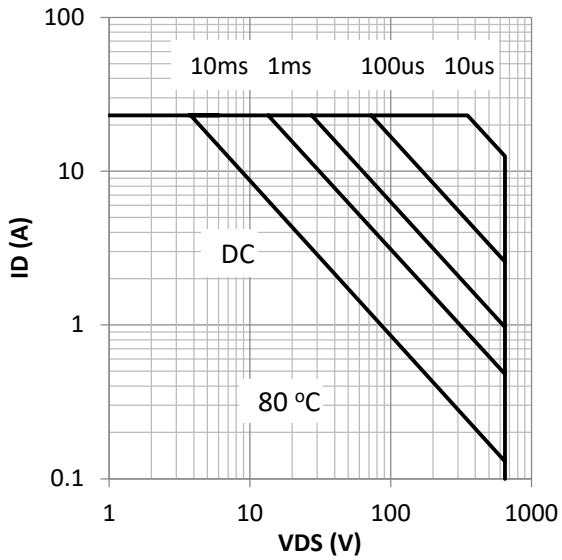
Safe Operating Area	Safe Operating Area
	
T_C = 25°C; Variable is pulse width (t_p)	T_C = 80°C; Variable is pulse width (t_p)

Table 12 Typical Capacitances and Gate Charge

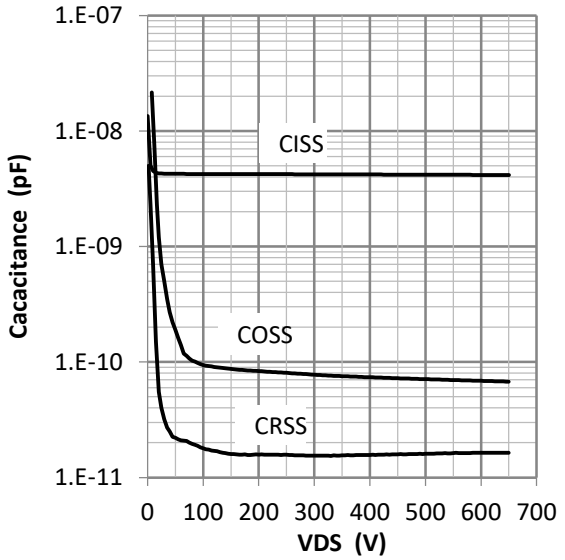
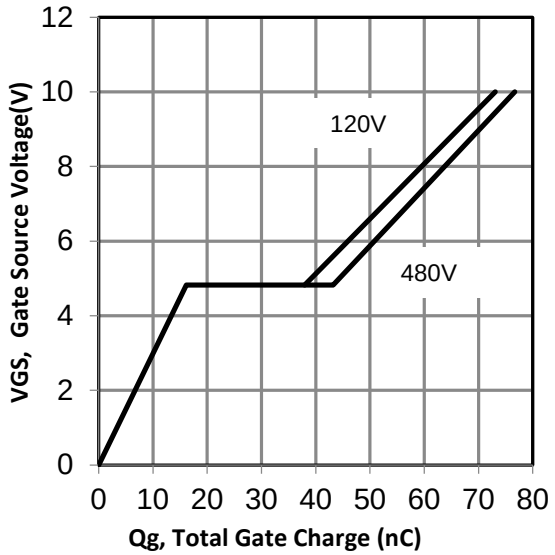
Typical Capacitances	Typical Gate Charge
	
V_{GS} = 0V; Freq. = 1MHz	I_D = 15.9A Pulsed Vdd = 480V

Table 13 Diode Forward Characteristics and Avalanche Energy

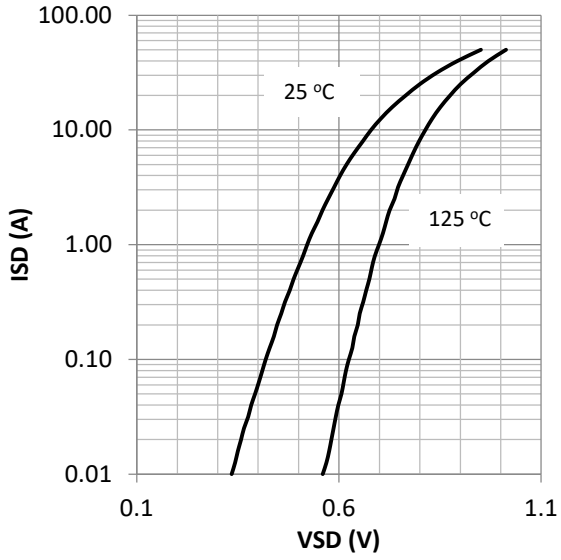
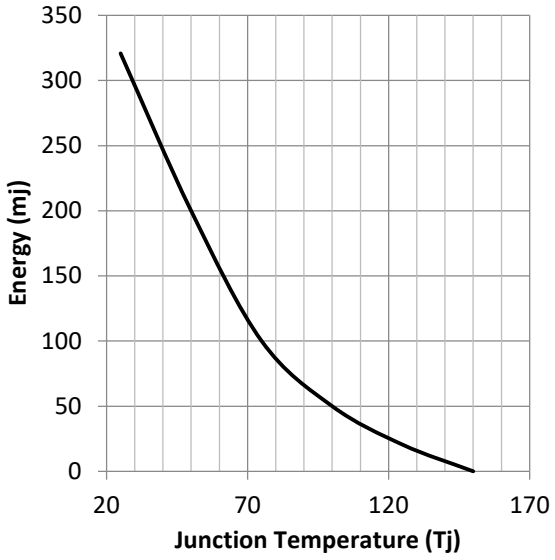
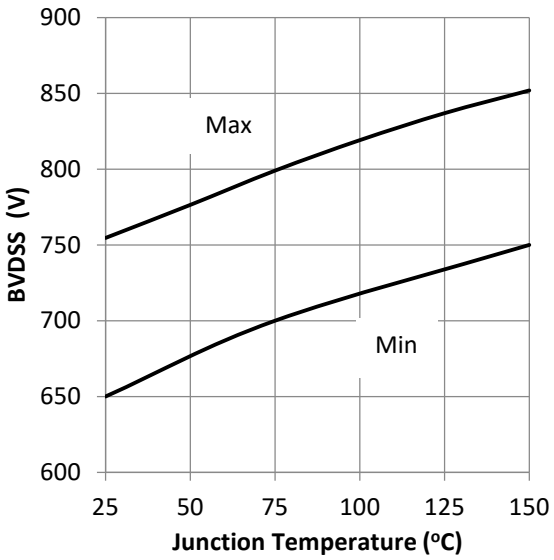
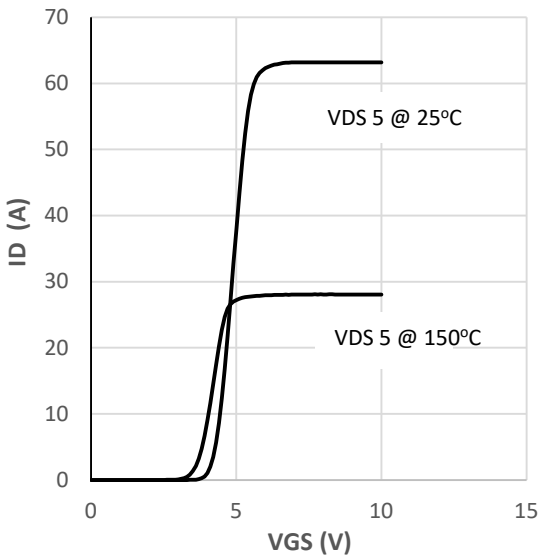
Forward Characteristics of Reverse Diode	Avalanche Energy
	
V_f of Body Diode	V_{DD} = 50V, VGS = 10V, L=10mH, RG=25 Ohms

Table 14 Drain – Source Breakdown Voltage and Typical Transfer Characteristics



I_D = 250uA

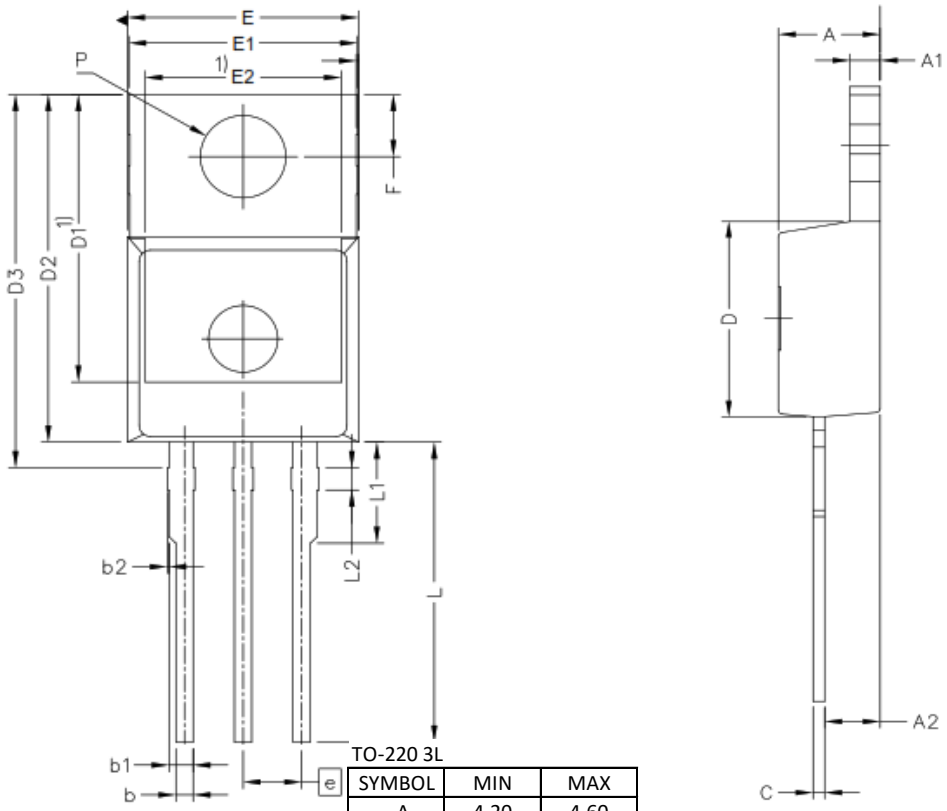


V_{DS} = 5V

Package Outlines

4a) TO-220

D3 Semiconductor TO-220-3L

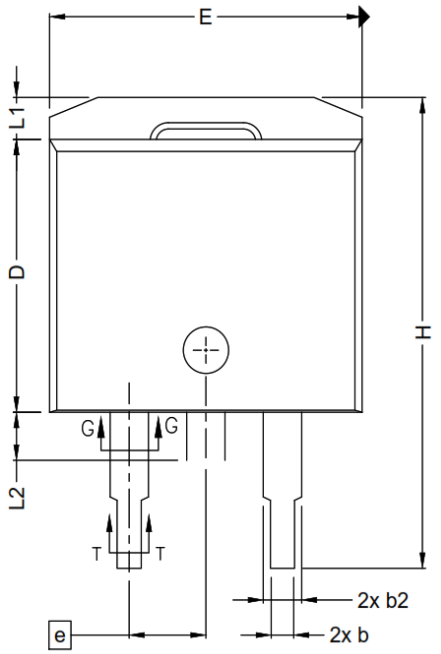


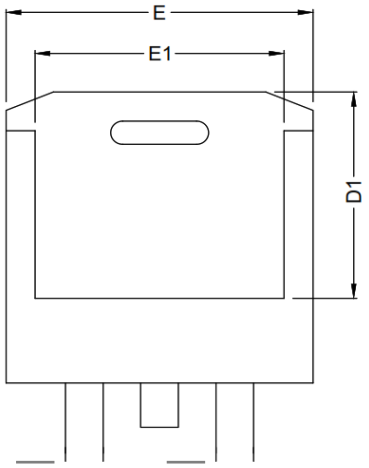
TO-220 3L

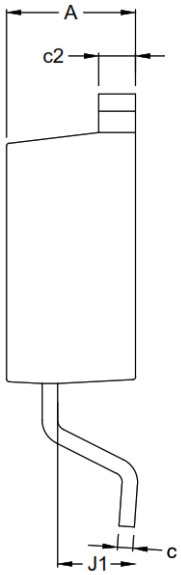
SYMBOL	MIN	MAX
A	4.20	4.60
A1	1.20	1.40
A2	2.20	2.60
b	0.65	0.85
b1	0.95	1.15
b2		0.15
C	0.40	0.60
D	9.05	9.45
D1	12.95	
D2	15.35	15.95
D3	16.50	17.10
E	9.80	10.20
E1	9.70	10.10
E2	8.50	
e	2.46	2.54
F	2.60	3.00
L	13.00	14.00
L1	4.35	4.75
L2	0.90	1.10
P	3.55	3.85

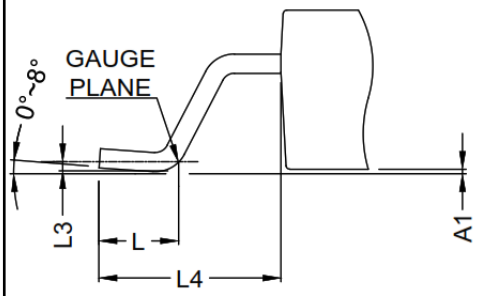
4b) TO-263

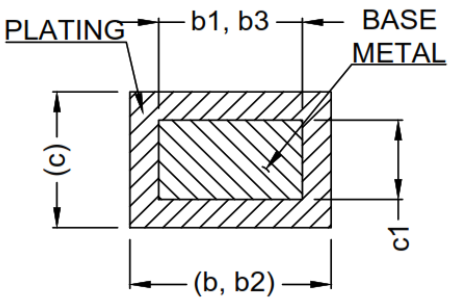
D3 Semiconductor TO-263 (D2PAK)







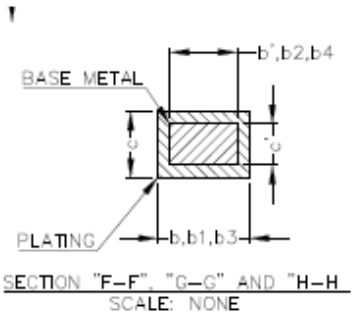


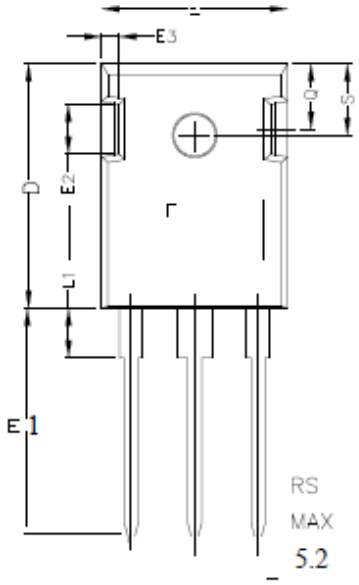


TO-263 (D2PAK)

SYMBOL	MIN.	MAX.
A	4.36	4.56
A1	0	0.25
b	0.7	0.9
b1	0.51	0.89
b2	1.2	1.46
b3	1.17	1.37
c	0.38	0.694
c1	0.38	0.534
c2	1.19	1.34
D	8.6	9
D1	6.9	7.5
E	10.15	10.55
E1	8.1	8.7
e	2.46	2.54
H	15	15.6
L	1.9	2.5
L1	-	1.65
L2	-	1.78
L3	0.25 TYP	
L4	4.78	5.28
J1	2.56	2.96

4c) TO-247 D3 Semiconductor TO-247-3L

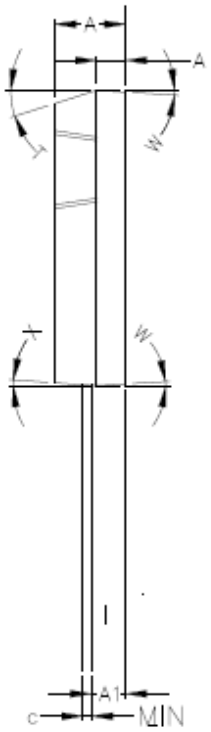


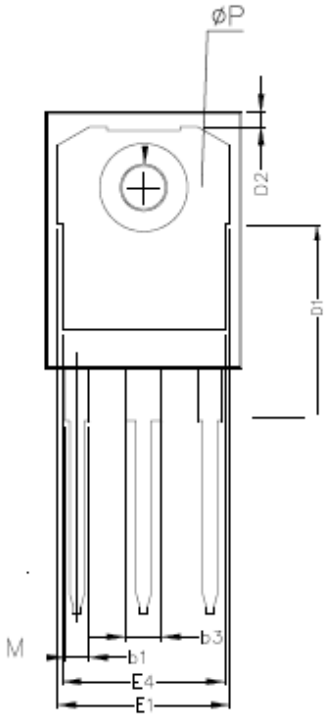


1. ALL METAL SURFACES: TIN PLATED,EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT OF JEDEC outlines TO-247 AD.

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)





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Revision History

Revision	Release Date	Comments
1.0	1-June-2016	Preliminary Datasheet Draft
2.0	14-Nov-2017	Designers Datasheet
2.5	20-Nov-2017	Added TO247 Package

Resources

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