650V, 70mΩ, 43.6 Amp Super Junction Power

Ordering Information

Part Number	Package Option
D3S070N65B-U	TO-220
D3S070N65D-U	TO-247
D3S070N65E-U	TO-263
D3S070N65F-U	TO-220 Fullpak

Package Options

TO-220   TO-263   TO-247   TO-220 FullPak

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.

Device Schematic

Drain (Pin 2, Tab)

Gate (Pin 1)

Source (Pin 3)

RoHS

Features

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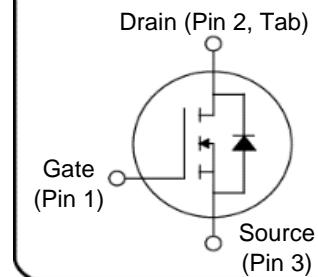
Benefits

- 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 ℃	43.6	A

Applications

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

Contents

Maximum Ratings

Parameter	Symbol	Min	Typ	Max 220 & 263	Max 220FP	Unit	Condition
Continuous drain current	I_D			43.6	20.3	A	$T_c = 25^oC$
				27.6	12.8	A	$T_c = 100^oC$
Pulsed drain current	$I_{D, pulse}$			175	81	A	$T_c = 25^oC$
Avalanche energy, single pulse	E_{AS}			650	650	mJ	$I_D = 7.2A$; $V_{DD} = 50V$, VGS = 10V, L=10mH, RG=25 Ohms
Avalanche energy, repetitive	E_{AR}			1	1	mJ	$I_D = 7.2$; $V_{DD} = 50V$
Avalanche current, repetitive	I_{AS}			8.7	8.7	A	
MOSFET dv/dt ruggedness	dv/dt			50	50	V/ns	$V_{DS} = 0....480V$
Gate source voltage (static)	V_{GS}	-30		30	30	V	Static
Gate source voltage (dynamic)	V_{GS}	-30		30	30	V	AC (F>1Hz)
Power dissipation	P_{tot}			305	60	W	$T_c = 25^oC$
Storage temperature	T_{stg}	-55		150	150	^oC	
Operating junction temperature	T_j	-55		150	150	^oC	
Mounting torque				60		N-cm	M3 and M3.5 screws
					50	N-cm	M3 screw
Isolation Voltage*	V_{ISO}	3.5				kV	TO-220 FullPak Only
Continuous diode forward current	I_{SD}			43.6	20.3	A	Tc = 25ºC
Diode pulse current	$I_{S, pulse}$			175	81	A	Tc = 25ºC
Reverse diode dv/dt	dv/dt			15	15	V/ns	$V_{DS}=0...480V$, $I_{SD}<=I_S$, $T_j = 25^oC$
Maximum diode commutation speed	di_f/dt			500	500	A/µs	$V_{DS}=0...480V$, $I_{SD}<=I_S$, $T_j = 25^oC$

Thermal Characteristics

Table 3 Thermal Characteristics

Symbol	Parameter	Packages				Unit
		TO-220	**TO-263**	**TO-247**	TO-220FP	
R_{thjC}	Thermal resistance, junction-case	0.41	0.41	0.41	1.89	ºC/W
R_{thjA}	Thermal resistance, junction-ambient	42	42	42	44	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	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}			43.6	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 TO220, TO247, TO263	Maximum Transient Thermal Impedance
Max power limited by case temperature	Variable is pulse time (t_p) TO220, TO247, TO263
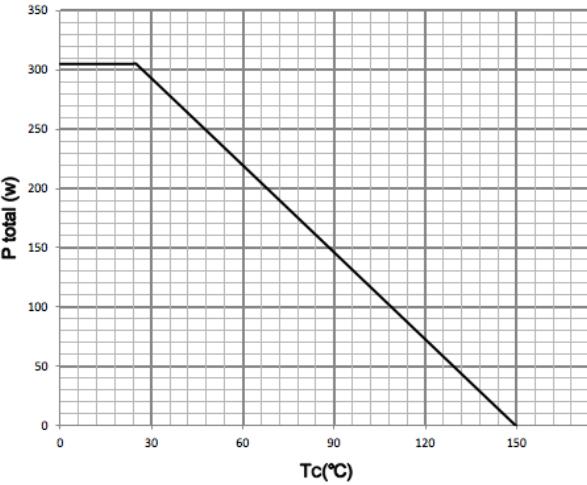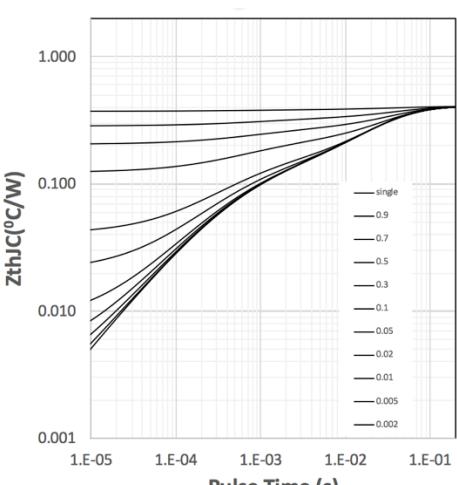
Power Dissipation TO220FP	Maximum Transient Thermal Impedance (TO220FP)
Max power limited by case temperature	Variable is pulse time (t_p) TO220FP
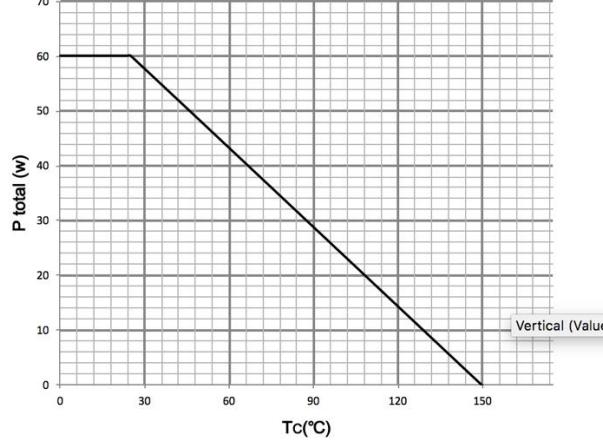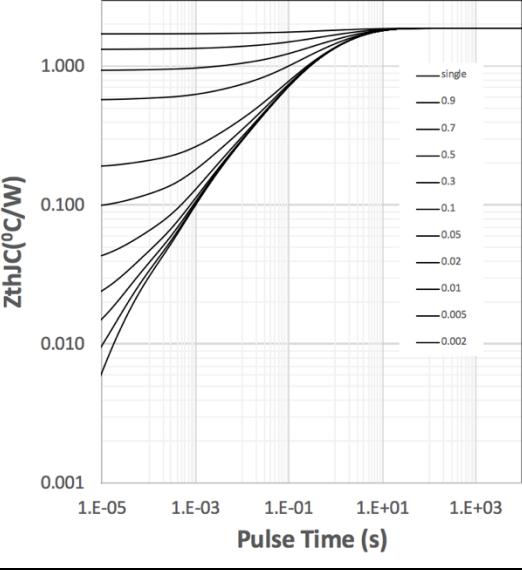
Table 9   Output Characteristics

Typical Output Characteristics	Typical Output Characteristics
T_C = 25°C; Variable is V_{GS}	T_C = 125°C; Variable is V_{GS}
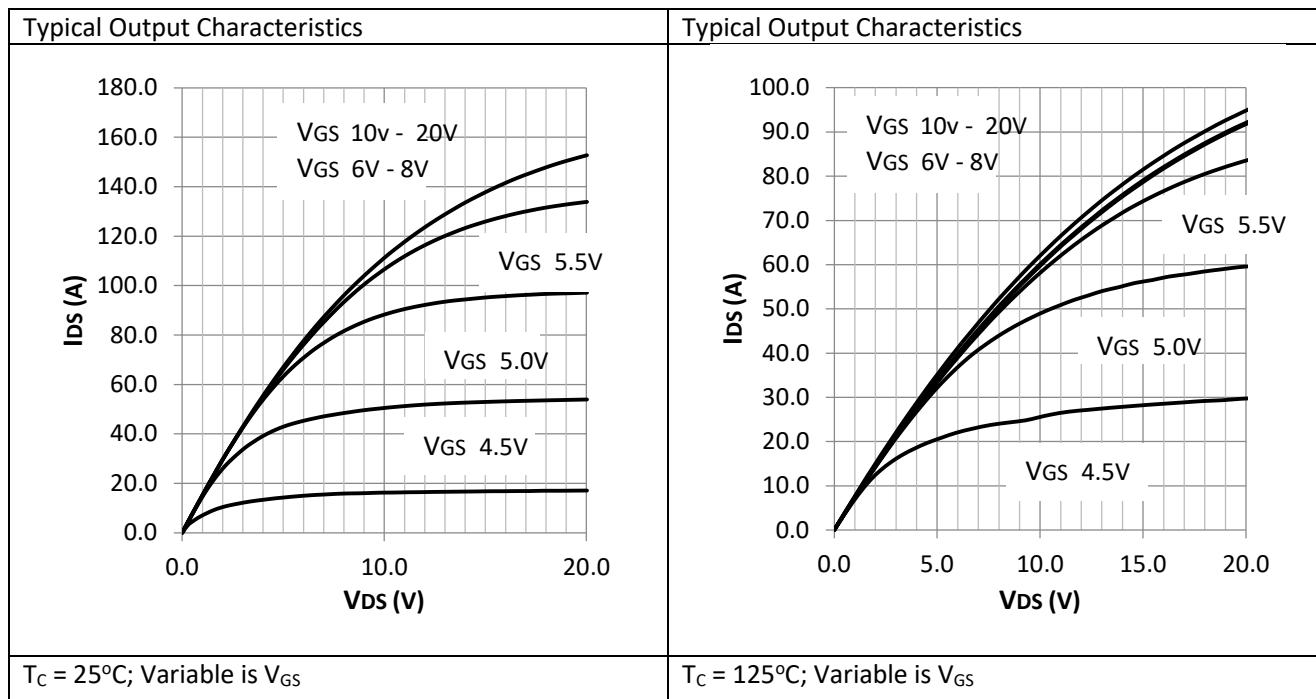
Table 10   Drain-Source Resistance

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
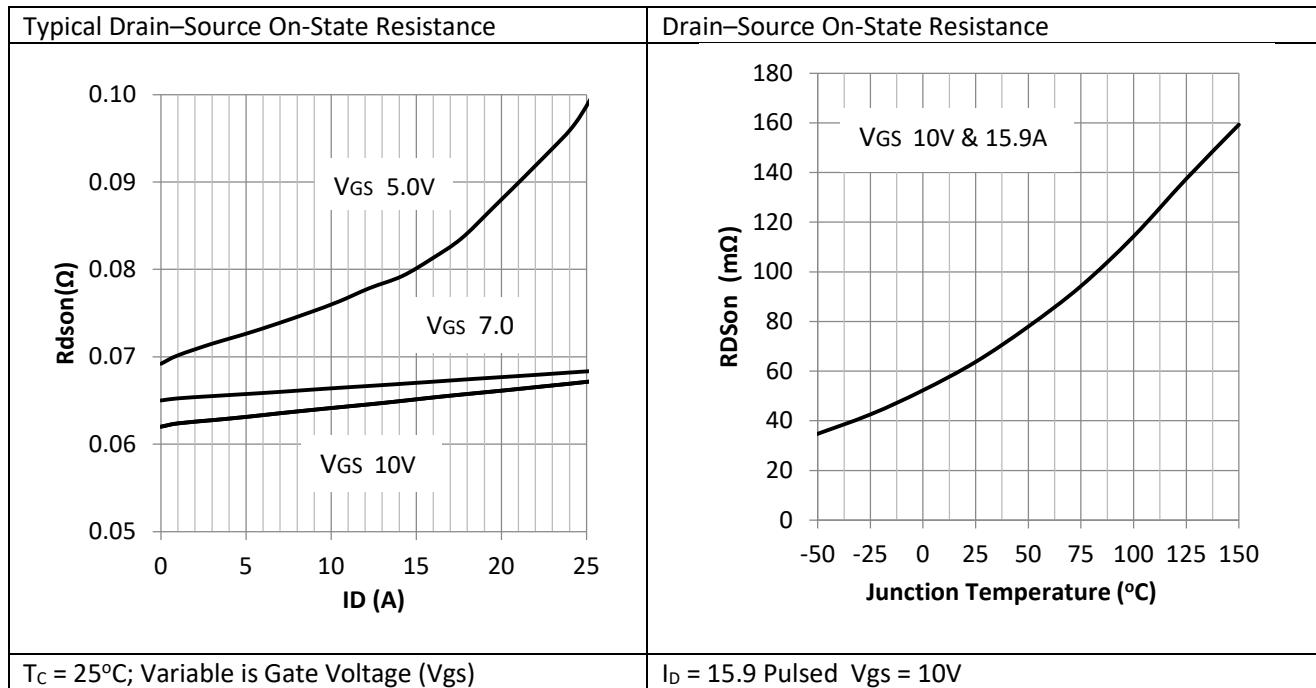
Table 11 Safe Operating Area

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)

Safe Operating Area (TO220FP)	Safe Operating Area (TO220P)
T_C = 25°C; Variable is pulse width (t_p)	T_C = 80°C; Variable is pulse width (t_p)
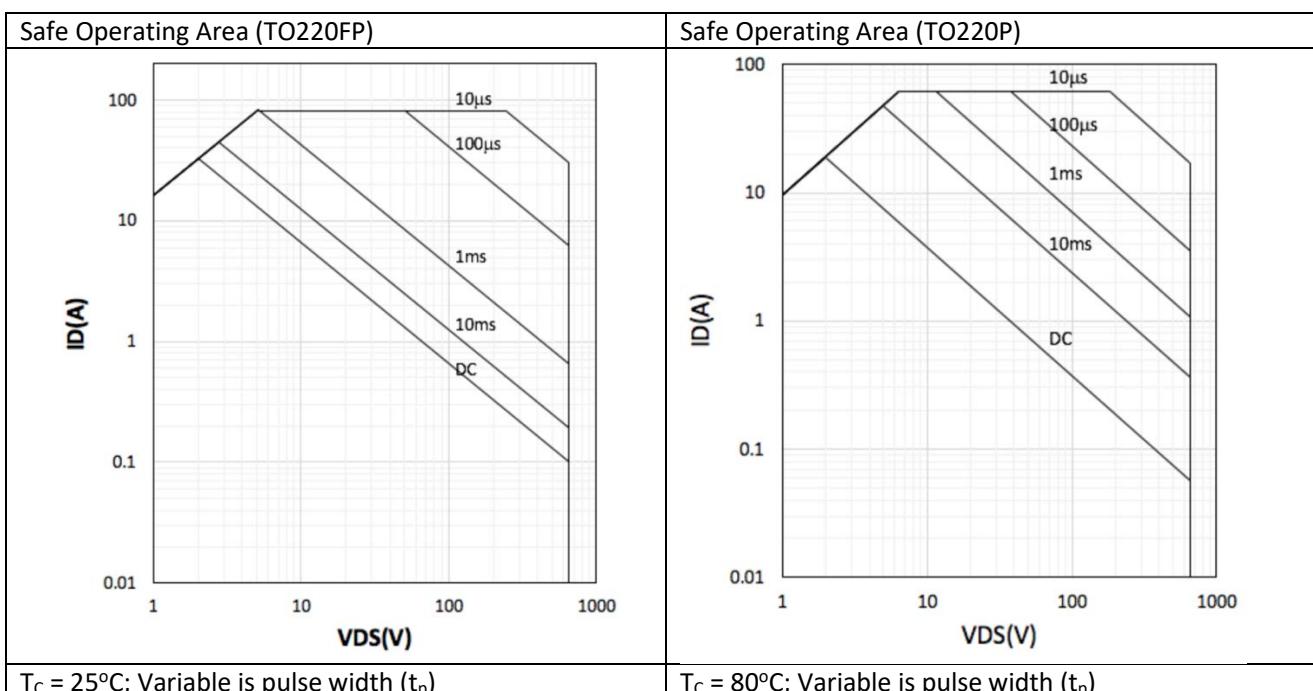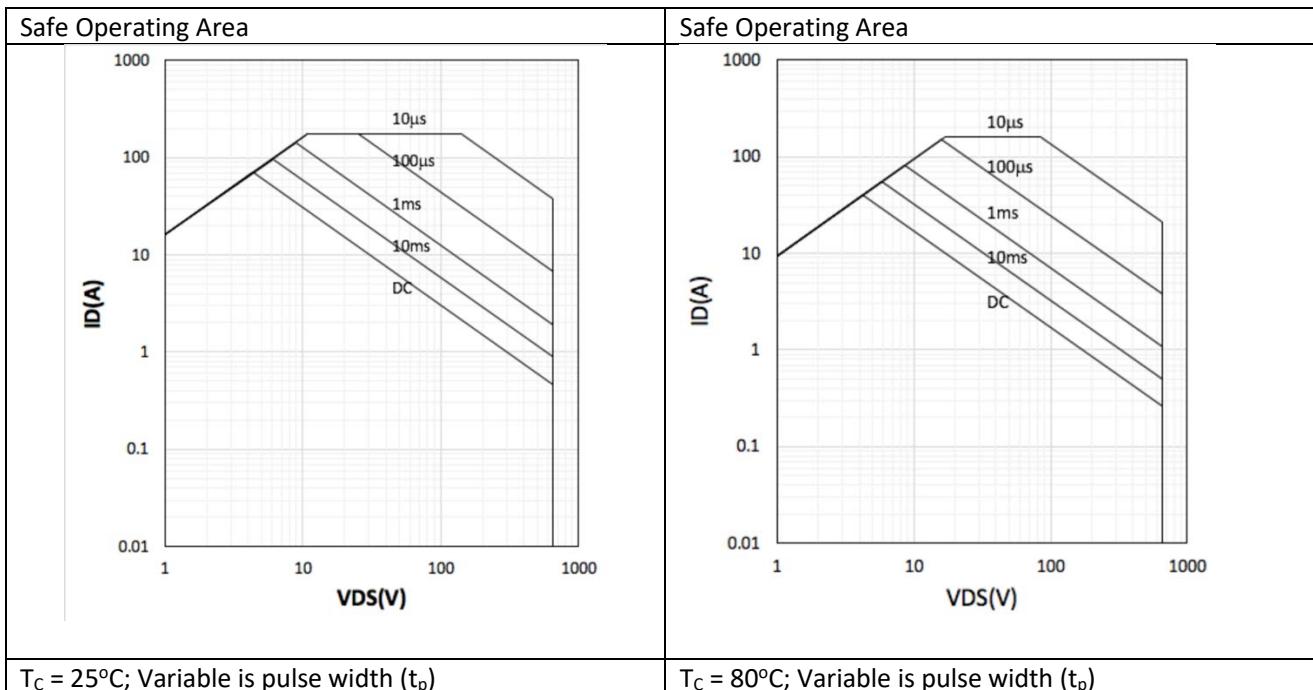
Table 12 Typical Capacitances and Gate Charge

Typical Capacitances	Typical Gate Charge
V_{GS} = 0V; Freq. = 1MHz	I_D = 15.9A Pulsed Vdd = 480V
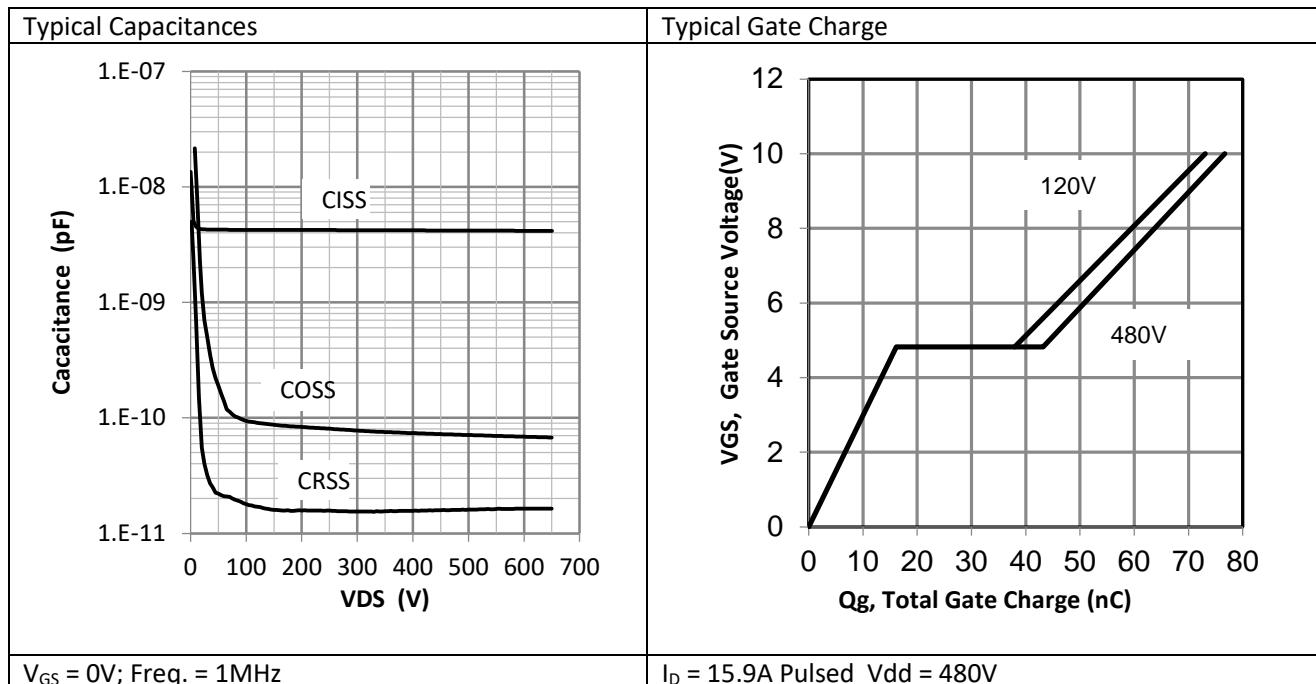
## Table 13 Diode Forward Characteristics and Avalanche Energy

| Forward Characteristics of Reverse Diode	Avalanche Energy
V_f of Body Diode	V_{DD} = 50V, VGS = 10V, L=10mH, RG=25 Ohms
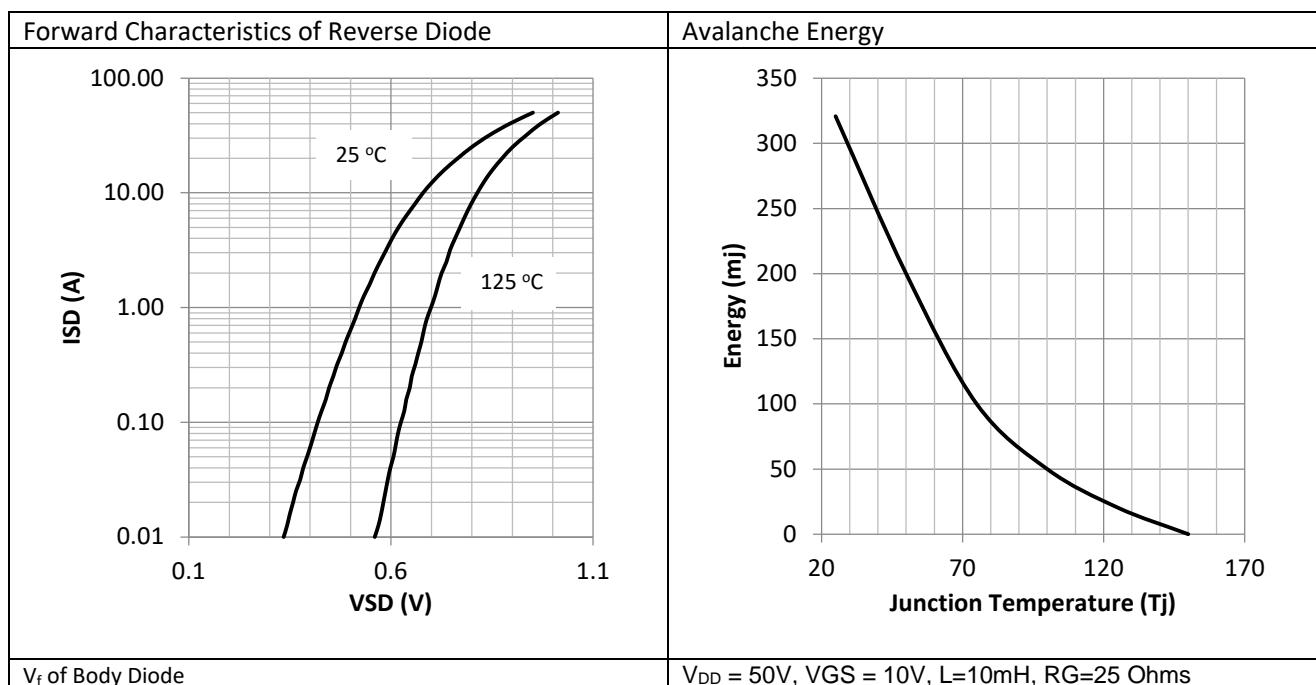
Table 14   Drain – Source Breakdown Voltage and Typical Transfer Characteristics

| I_D = 250uA | V_{DS} = 5V |

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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
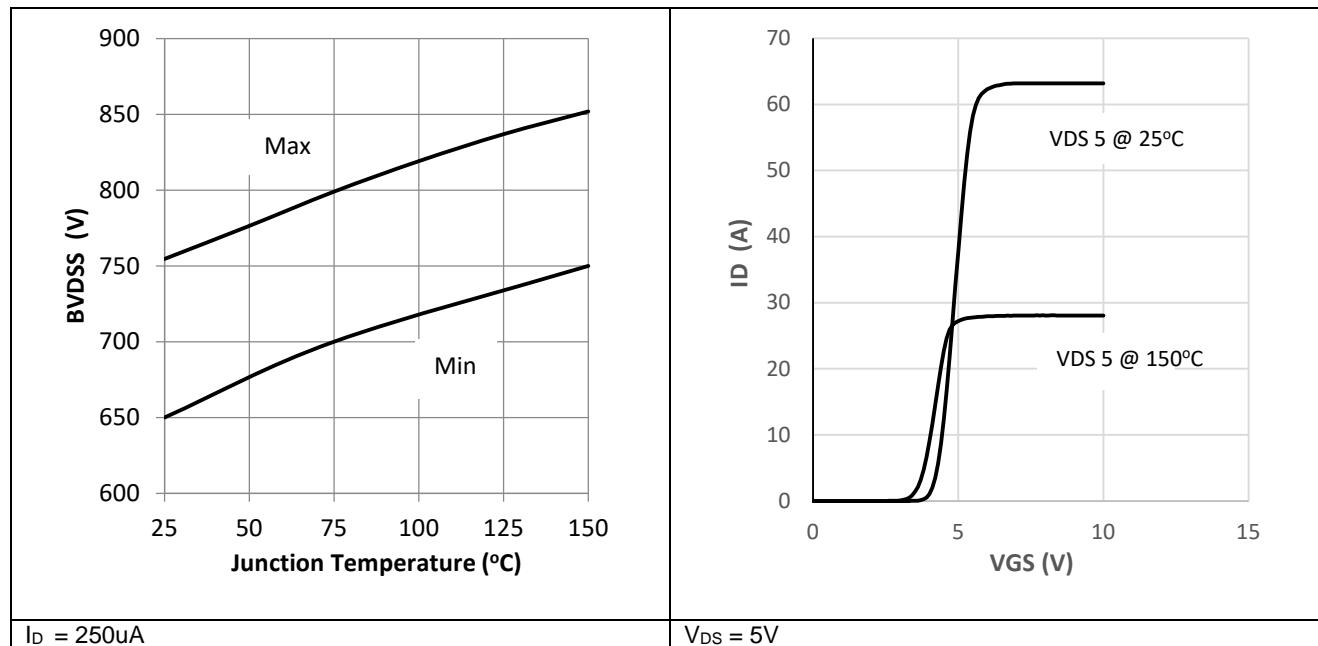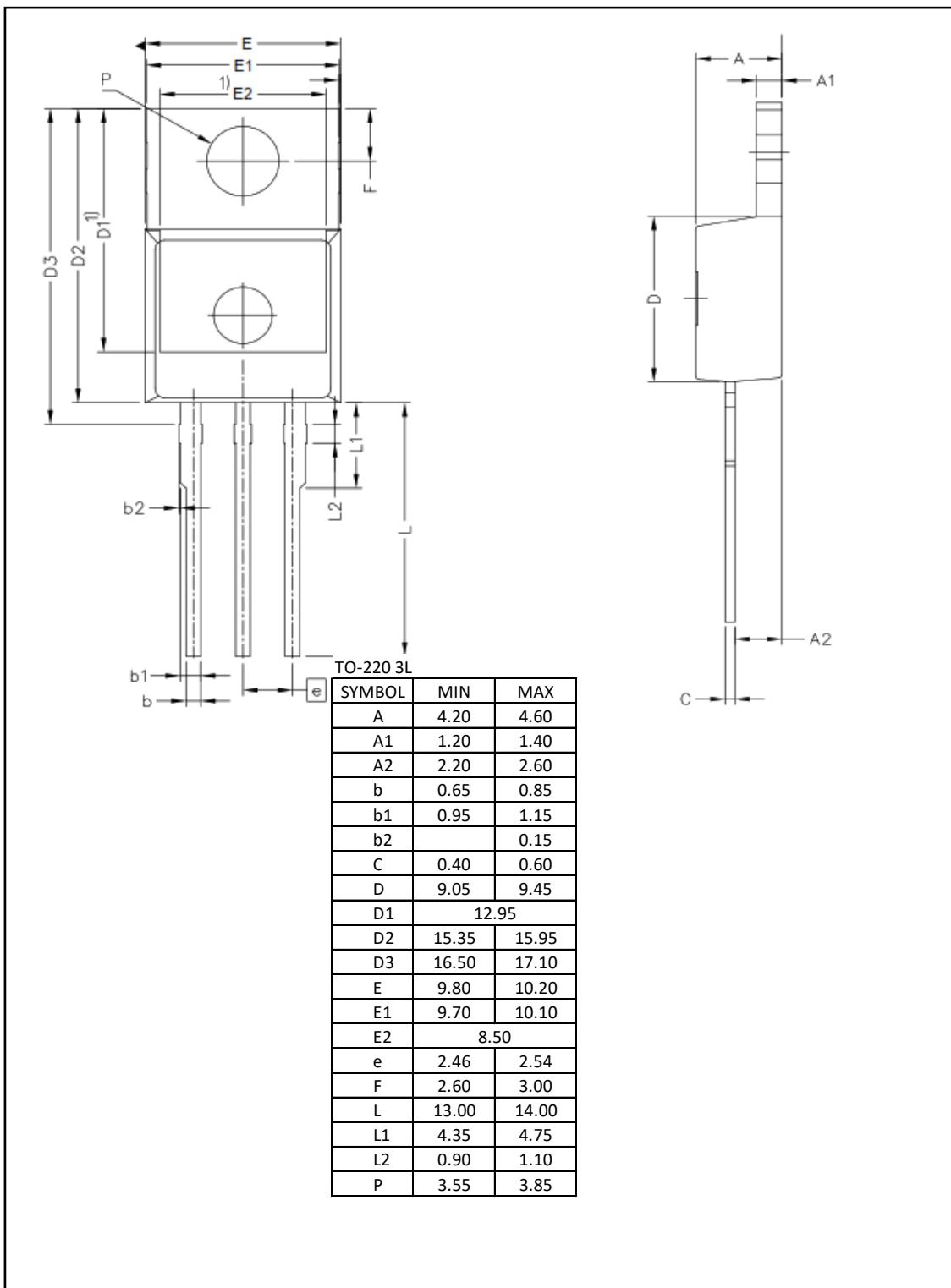
D3 Semiconductor TO-263 (D2PAK)

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
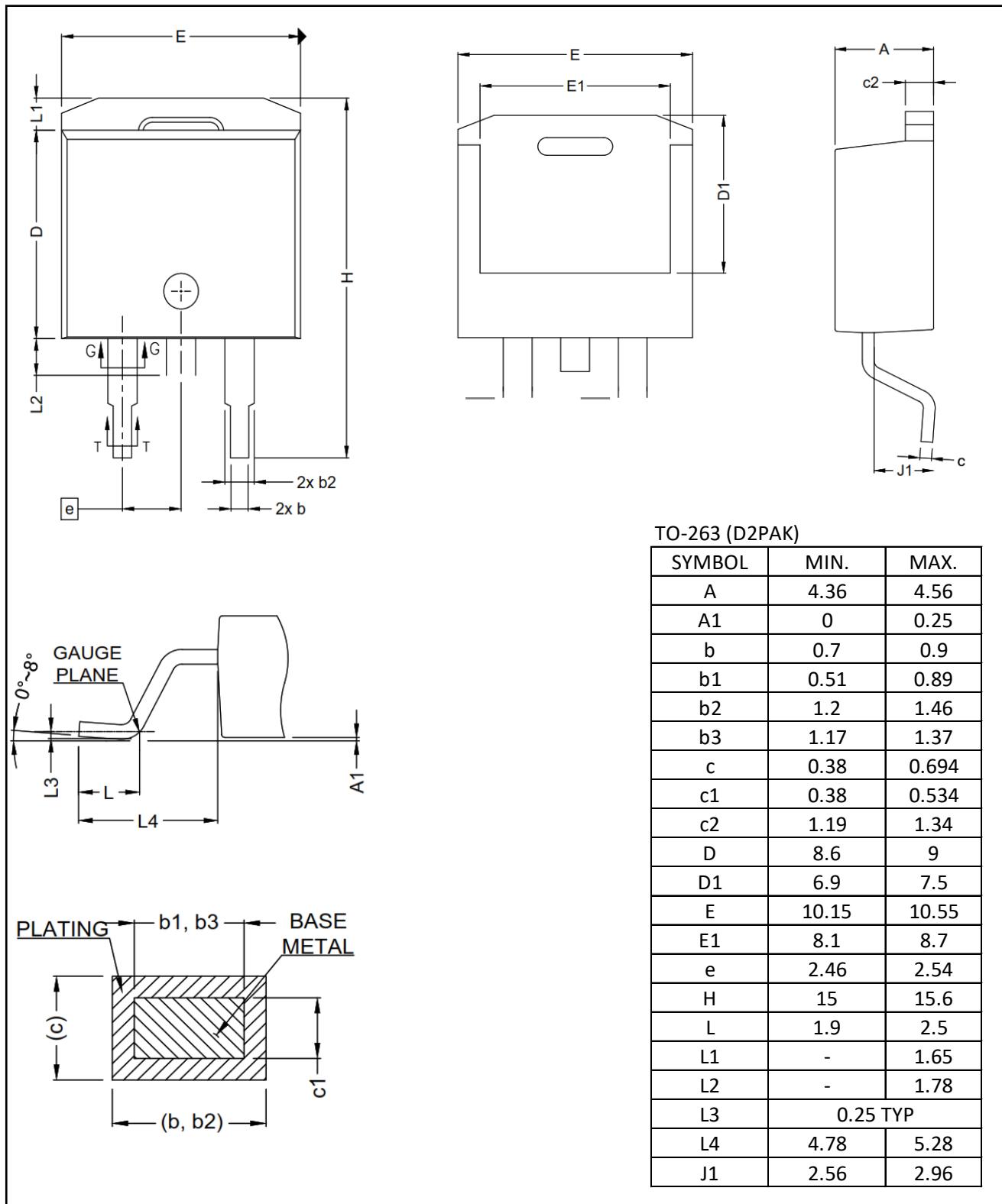
D3 Semiconductor TO-247-3L
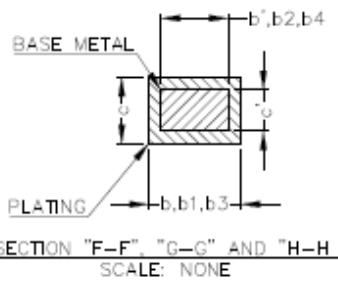
1. ALL METAL SURFACES: TIN PLATED,EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO
   ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS.
   ANGLES ARE IN DEGREES.
4. THIS DRAWING WILL MEET ALL DIMENSIONS REQUIREMENT
   OF JEDEC outlines TO-247 AD.

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

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	
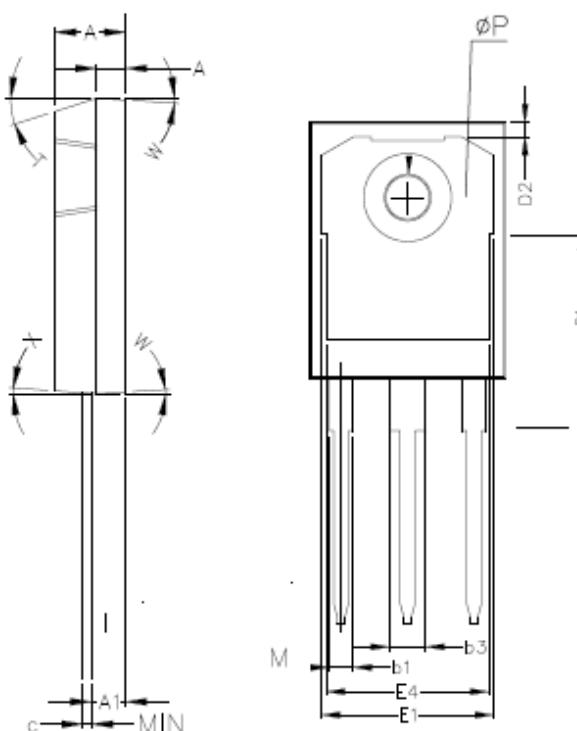
D3 Semiconductor TO-220 FullPak

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	
øP	3.05	3.40
øP1	3.40	
Q	3.10	3.30
Q1	2.70	3.30
S	7.00	
ϴ1	3 deg.	
ϴ2	5 deg.	
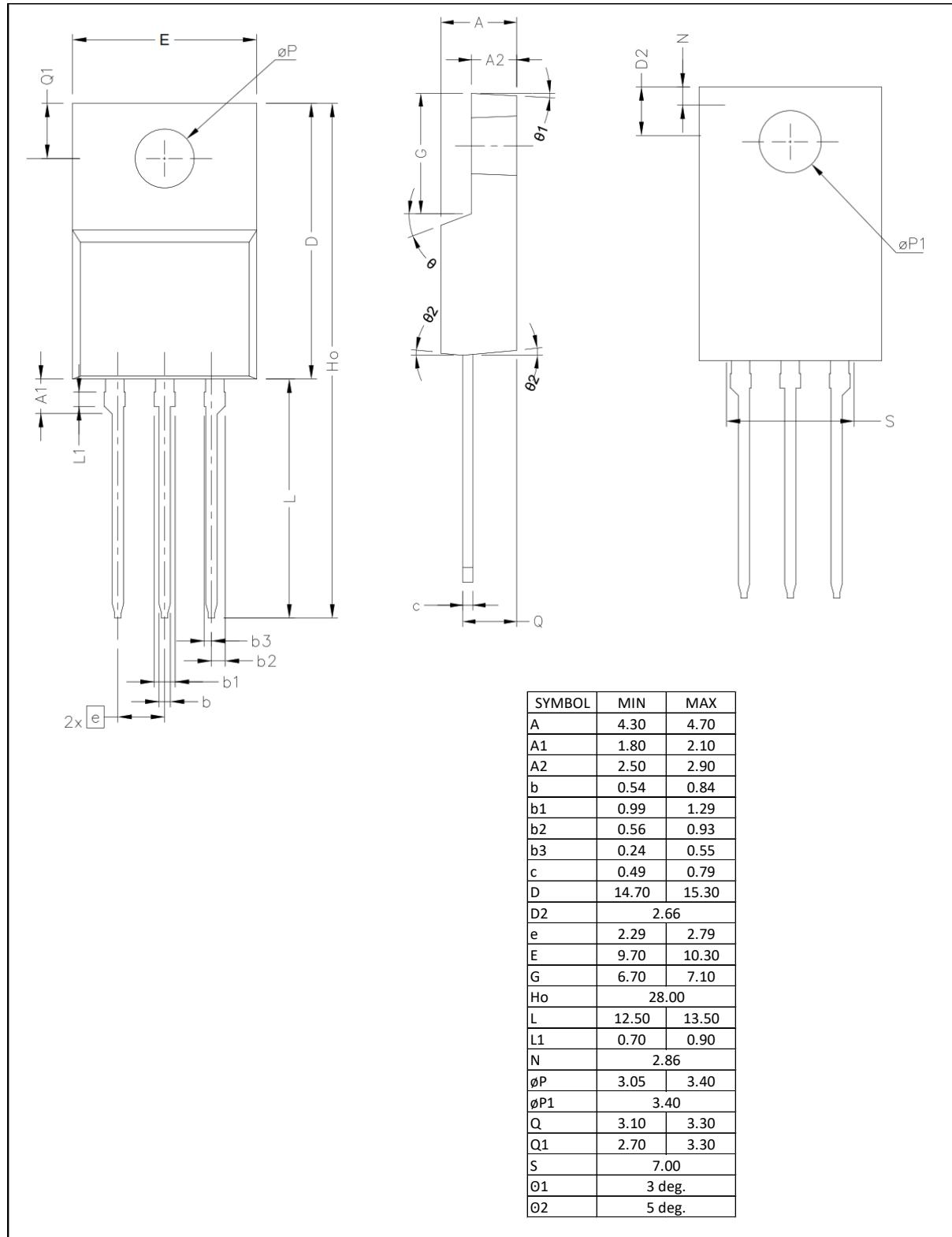
Revision History

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
3.0	04-Apr-2019	Added TO220FP Package

Resources

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