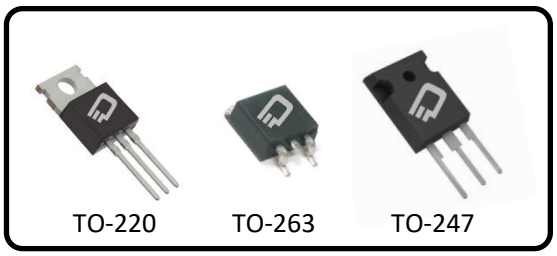
650V, 99mΩ, 31.8 A Super Junction Power MOSFET

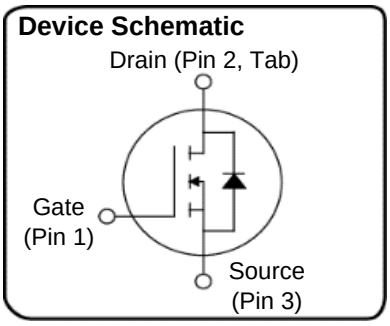
Ordering Information

Part Number	Package Option
D3S099N65B-U	TO-220
D3S099N65D-U	TO-247
D3S099N65E-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	< 99	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

Contents

Contents 2
1. Maximum Ratings 3
2. Thermal Characteristics 4
3. Electrical Characteristics 5
4. Package Outlines 12
5. Revision History 16
6. Resources 16
7. Patents, Copyrights and Trademarks 16
8. Legal Disclaimer 16

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, TO-247, T_c = 25ºC
Storage temperature	T_{stg}	-55		150	ºC	
Operating junction temperature	T_j	-55		150	ºC	
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	0.099	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

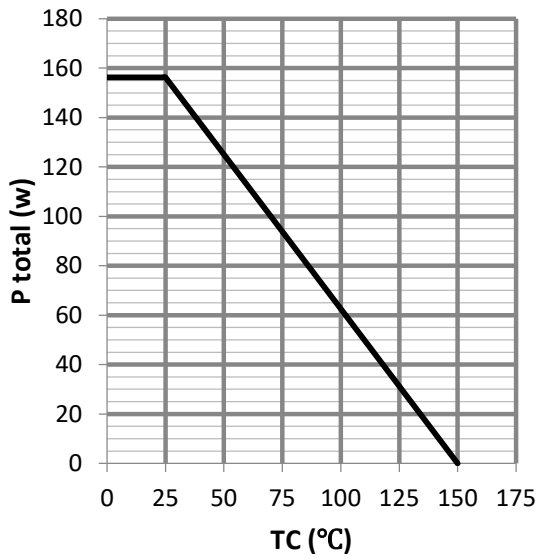
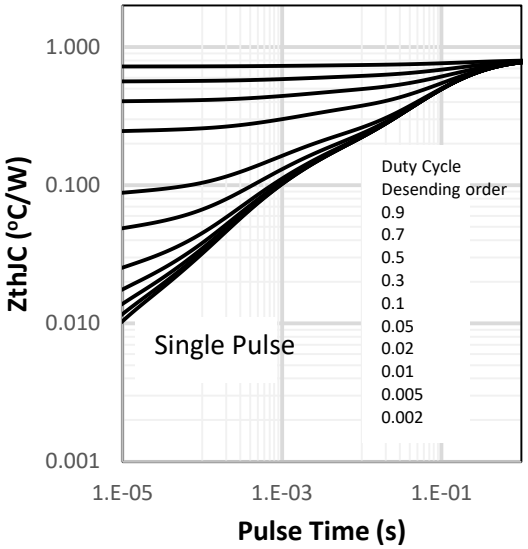
Power Dissipation	Maximum Transient Thermal Impedance
	
Max power limited by case temperature	Variable is pulse time (t_p)

Table 9 Output Characteristics

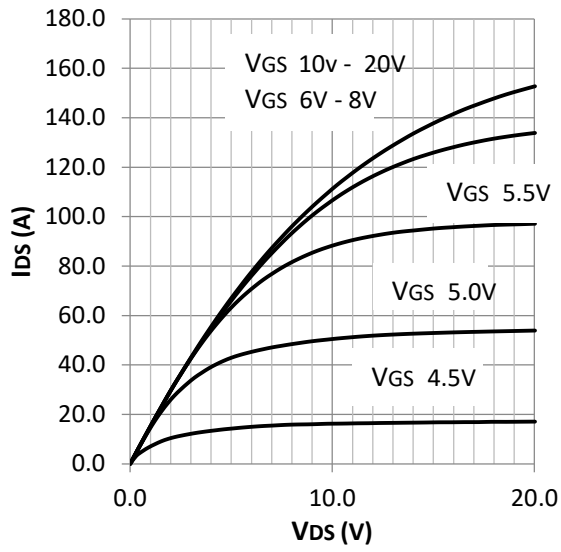
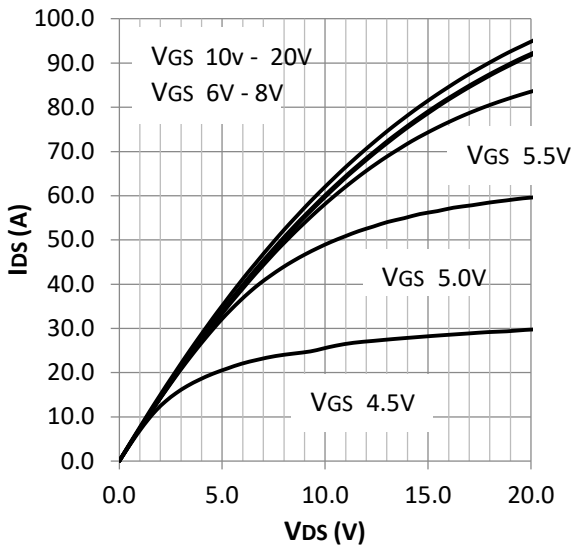
Typical Output Characteristics	Typical Output Characteristics
	
T_C = 25°C; Variable is V_{GS}	T_C = 125°C; Variable is V_{GS}

Table 10 Drain-Source Resistance

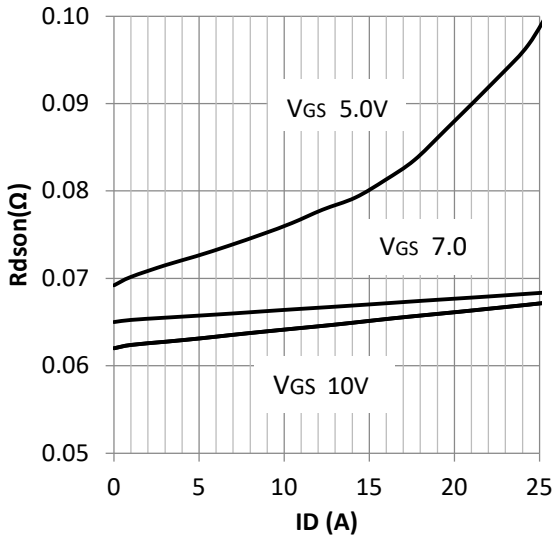
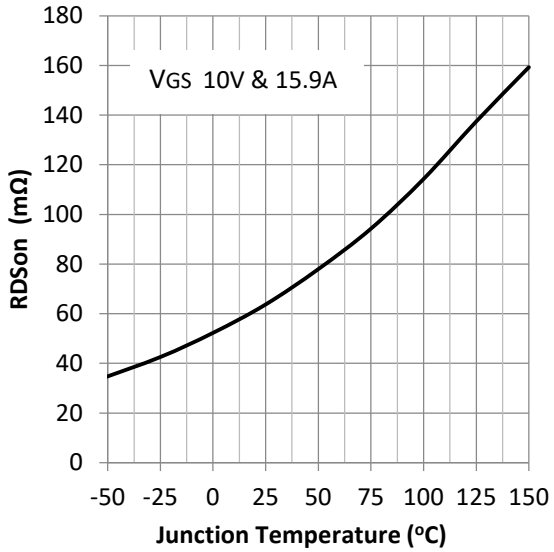
Typical Drain–Source On-State Resistance	Drain–Source On-State Resistance
	
T_C = 25°C; Variable is Gate Voltage (Vgs)	I_D = 15.9 Pulsed Vgs = 10V

Table 11 Safe Operating Area

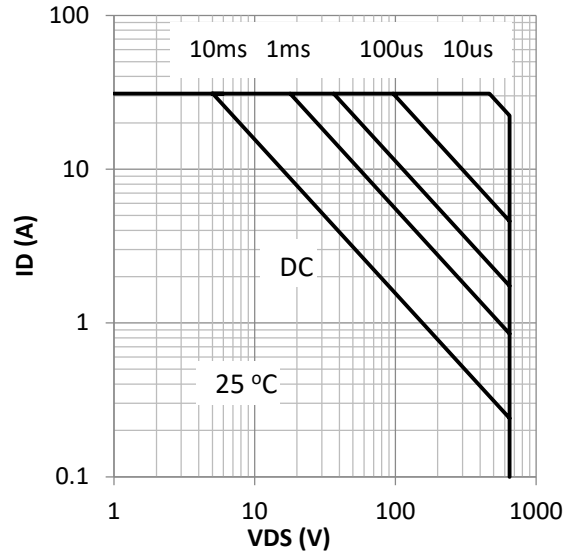
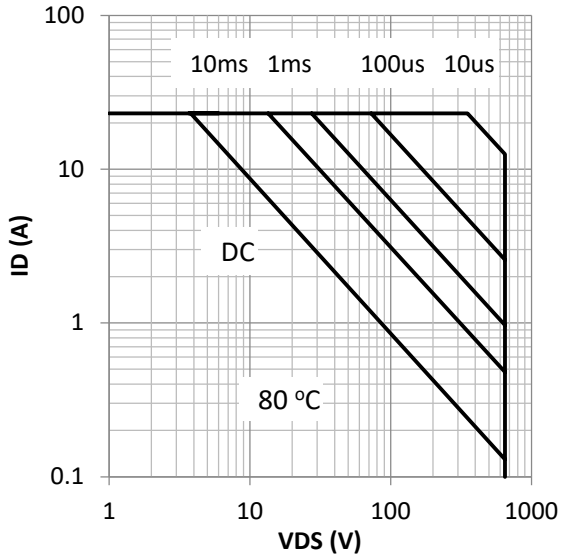
Safe Operating Area	Safe Operating Area
	
T_C = 25°C; Variable is pulse width (t_p)	T_C = 80°C; Variable is pulse width (t_p)

Table 12 Typical Capacitances and Gate Charge

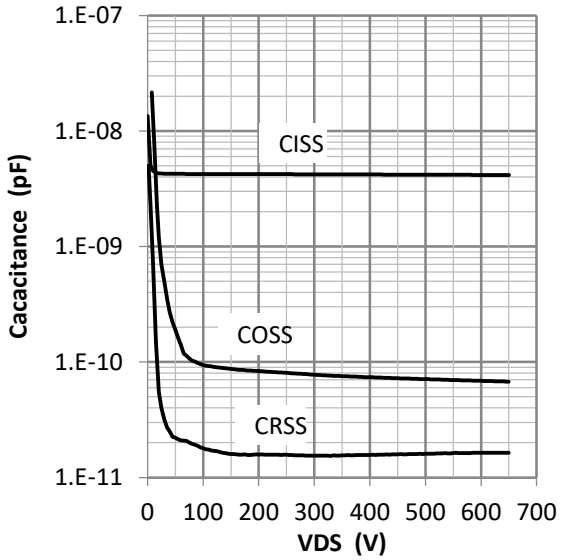
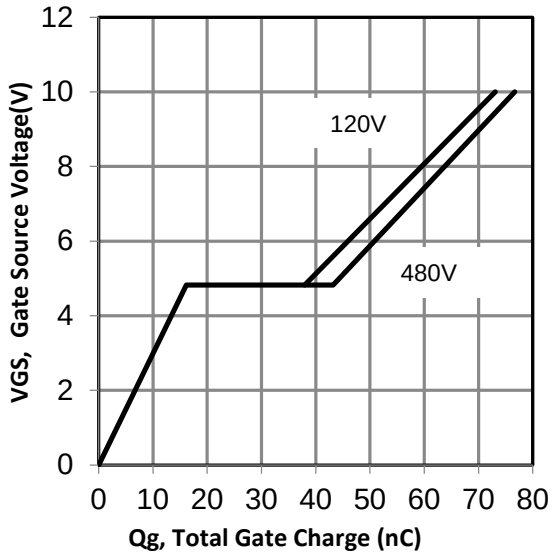
Typical Capacitances	Typical Gate Charge
	
V_{GS} = 0V; Freq. = 1MHz	I_D = 15.9A Pulsed Vdd = 480V

Table 13 Diode Forward Characteristics and Avalanche Energy

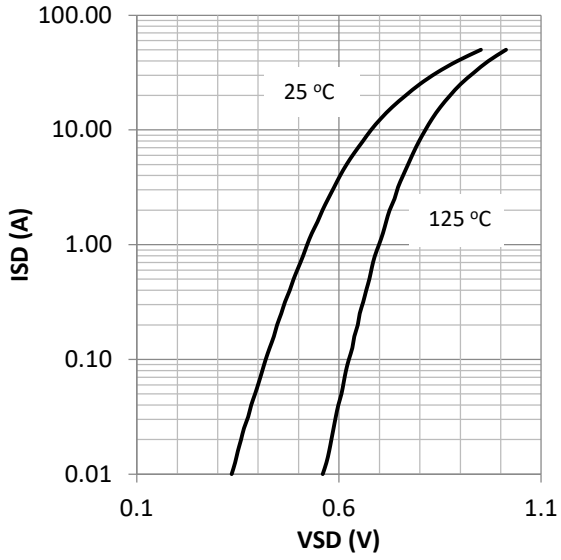
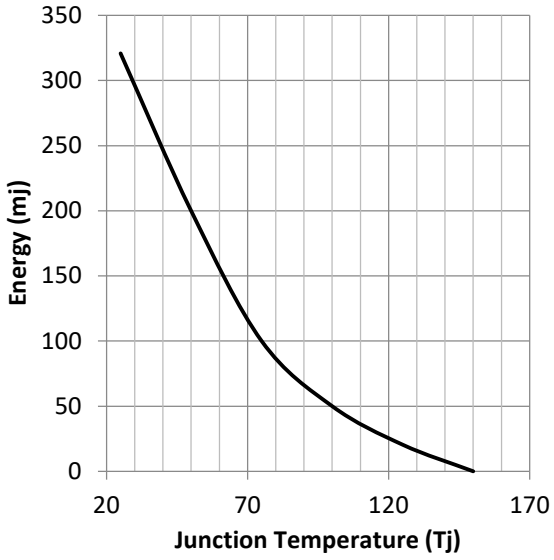
Forward Characteristics of Reverse Diode	Avalanche Energy
	
V_f of Body Diode	V_{DD} = 50V, VGS = 10V, L=10mH, RG=25 Ohms

Table 14 Drain – Source Breakdown Voltage and Typical Transfer Characteristics

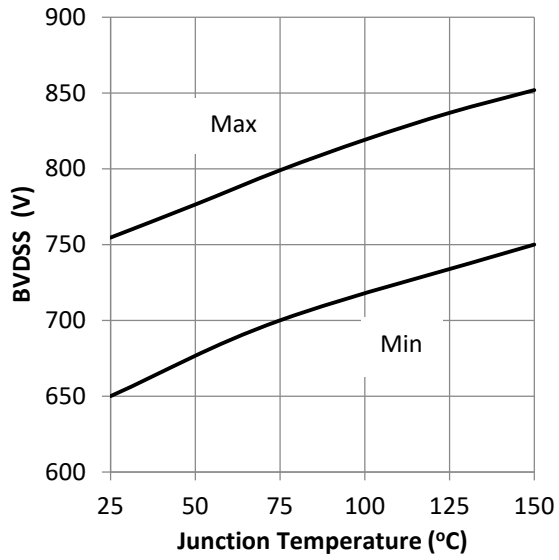
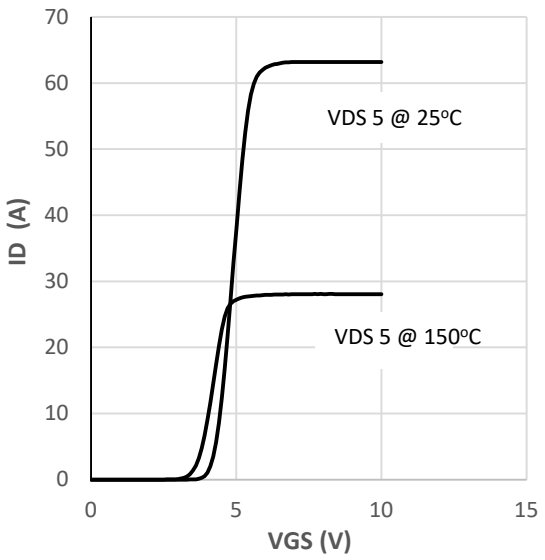
Breakdown Voltage	Transfer Characteristics
	
I_D = 250uA	V_{DS} = 5V

Table 15 Diode Recovery Characteristics

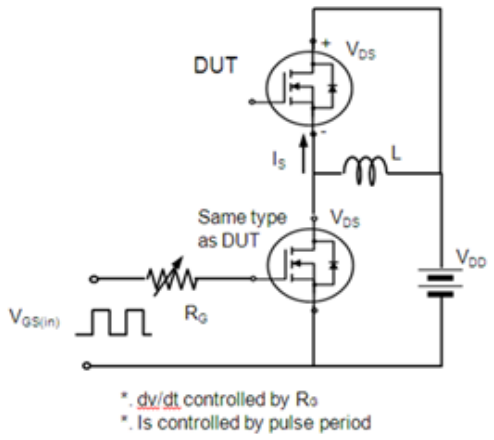
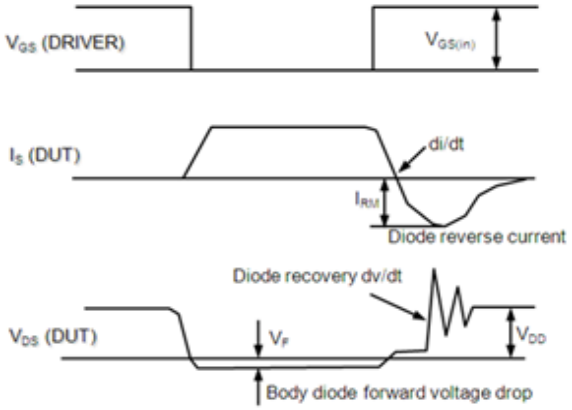
Test Circuit for Diode Recovery	Test Waveform for Diode Recovery
	

Table 16 Switching Time Characteristics

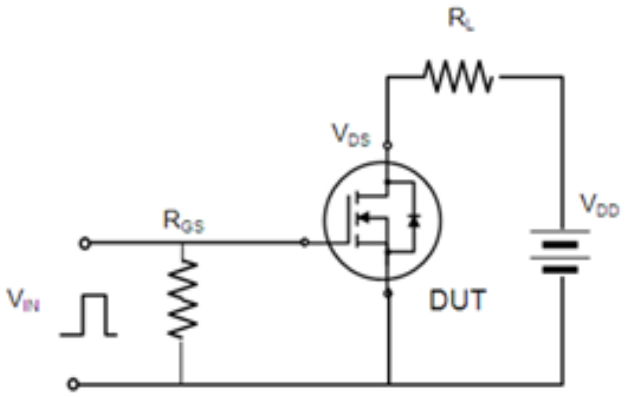
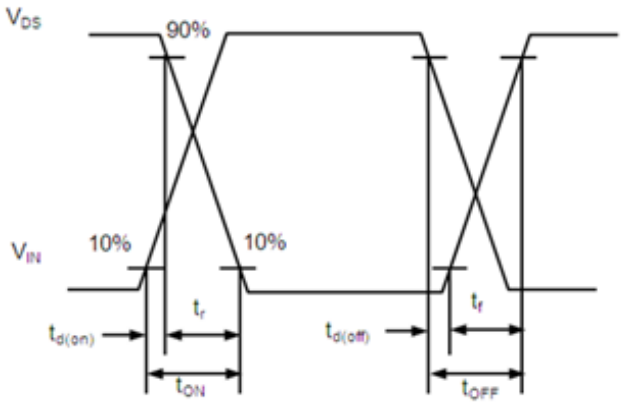
Test Circuit for Switching Time	Test Waveform for Switching Time
	

Table 17 Gate Charge Characteristics

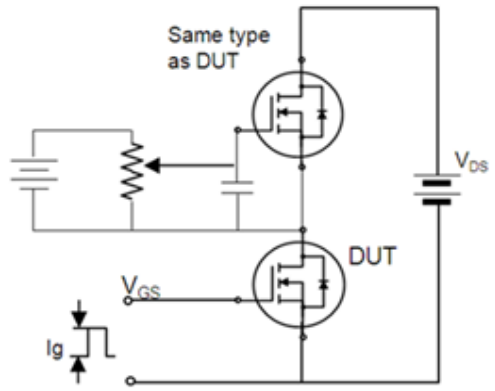
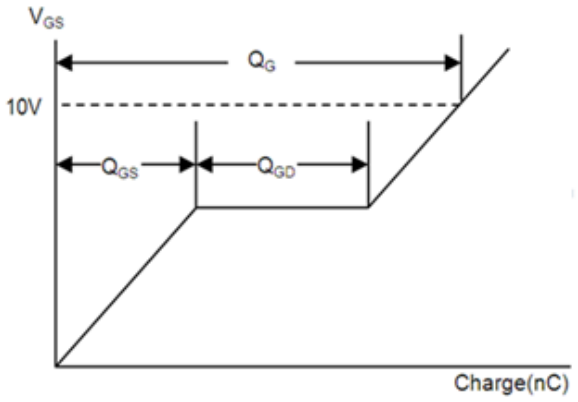
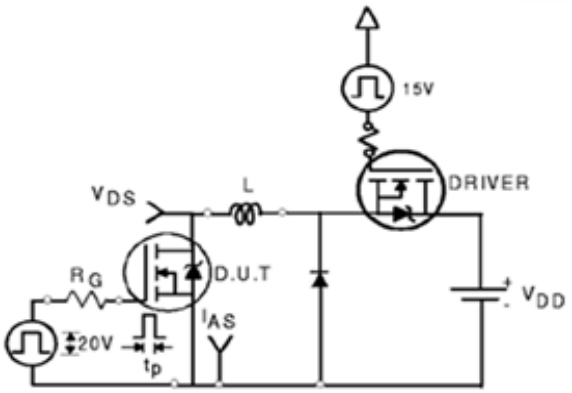
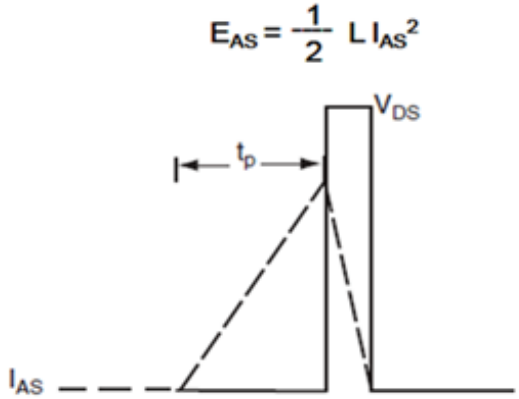
Test Circuit for Gate Charge	Test Waveform for Gate Charge
	

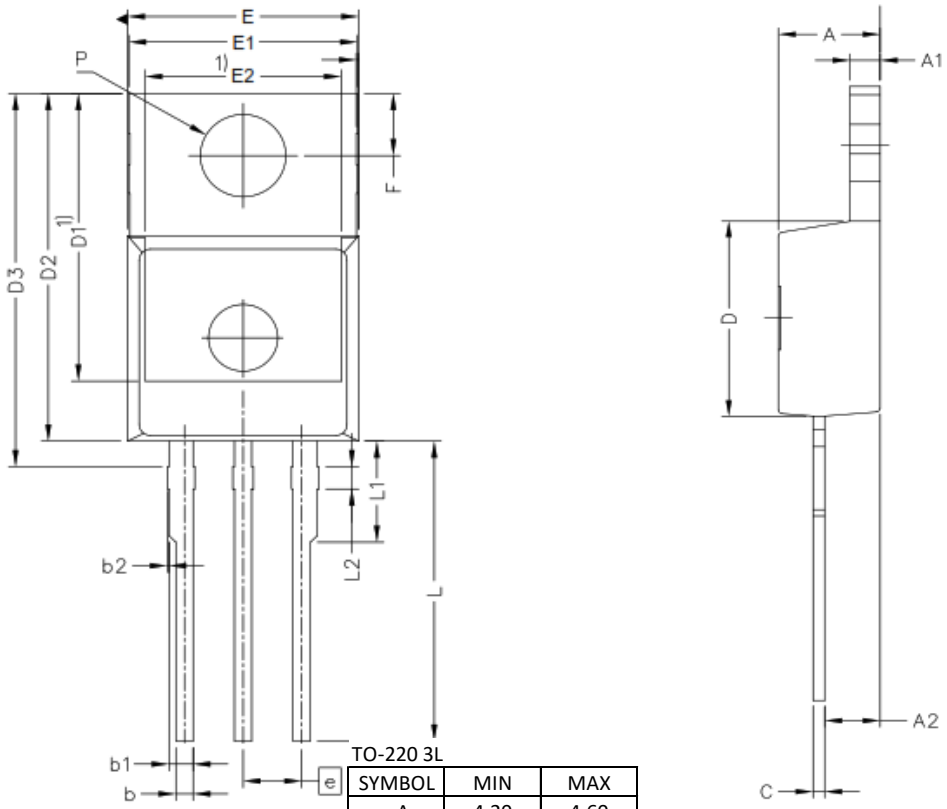
Table 18 Unclamped Inductive Switching Characteristic

Test Circuit for Unclamped Inductive Switching	Test Waveform for Unclamped Inductive Switching
	

Package Outlines

4a) TO-220

D3 Semiconductor TO-220-3L

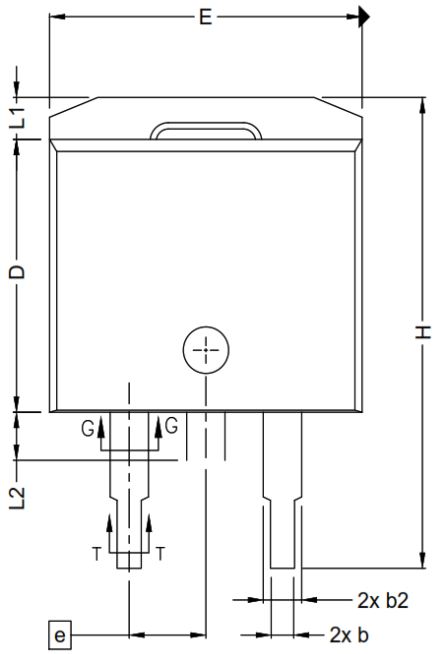


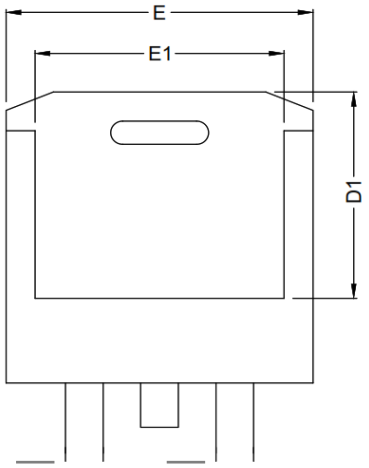
TO-220 3L

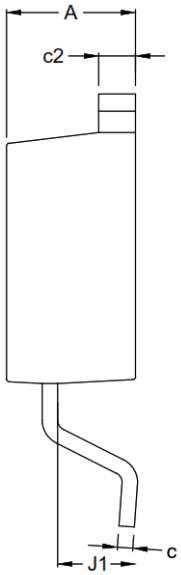
SYMBOL	MIN	MAX
A	4.20	4.60
A1	1.20	1.40
A2	2.20	2.60
b	0.65	0.85
b1	0.95	1.15
b2		0.15
C	0.40	0.60
D	9.05	9.45
D1	12.95	
D2	15.35	15.95
D3	16.50	17.10
E	9.80	10.20
E1	9.70	10.10
E2	8.50	
e	2.46	2.54
F	2.60	3.00
L	13.00	14.00
L1	4.35	4.75
L2	0.90	1.10
P	3.55	3.85

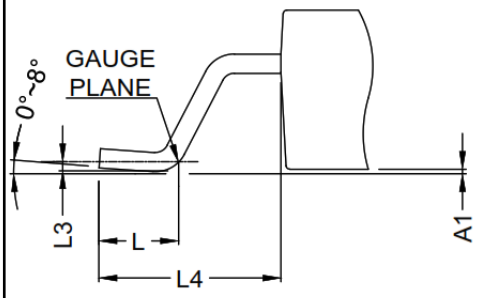
4b) TO-263

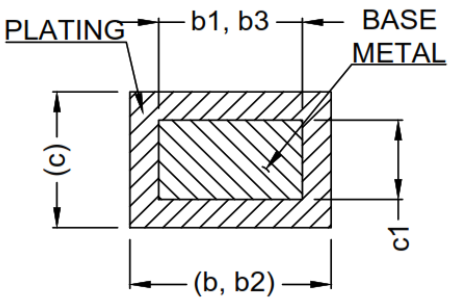
D3 Semiconductor TO-263 (D2PAK)









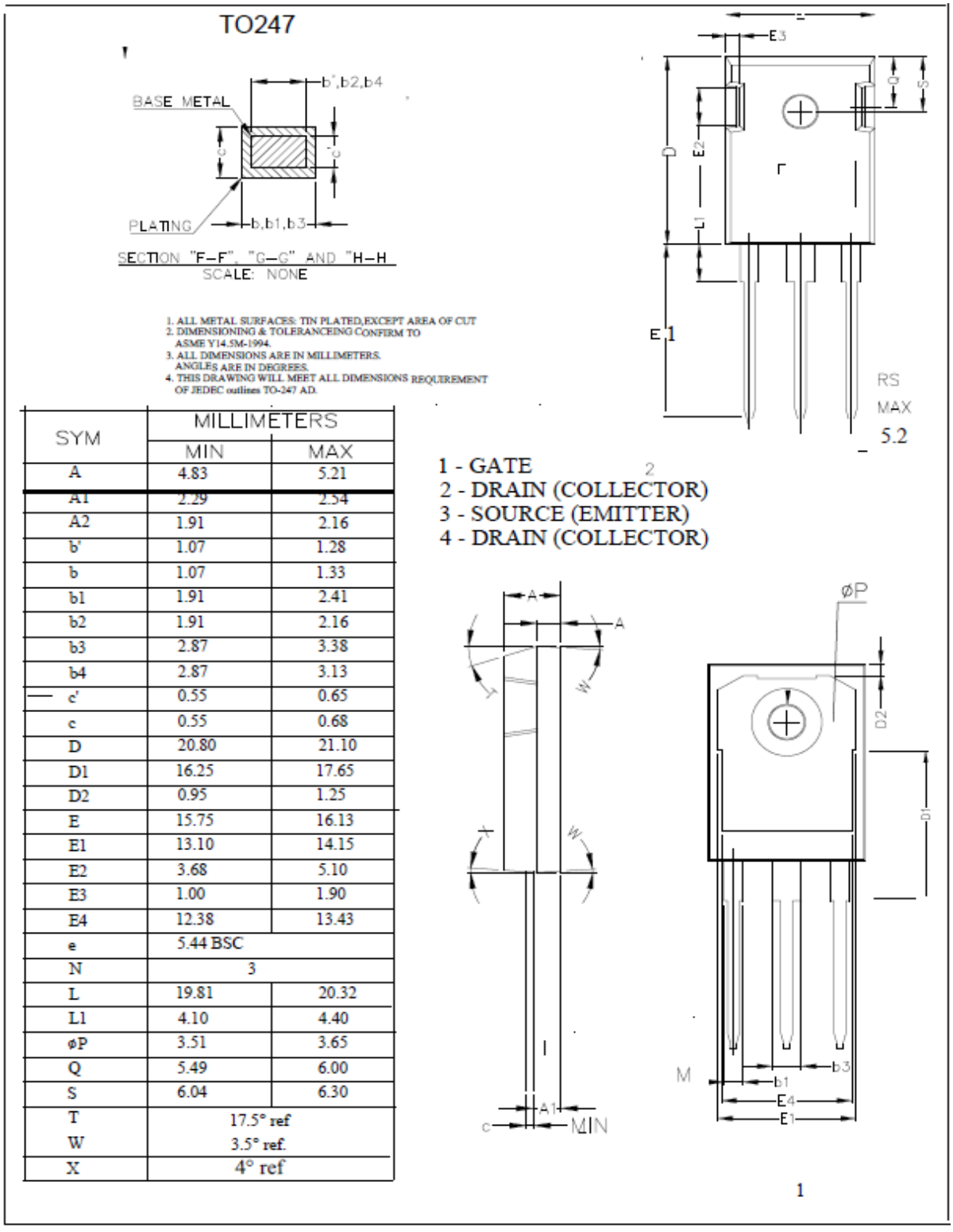


TO-263 (D2PAK)

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



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	

Revision History

Revision	Release Date	Comments
1.0	1-Nov-2016	Preliminary Datasheet
1.1	1-July-2017	Updated data tables and added packaging detail
2.3	20-Nov-2017	Added TO247 Package and Designers Datasheet
2.4	11-Dec-2017	Added Test Circuits

Resources

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