650V, 380mΩ, 11.2 A Super Junction Power MOSFET

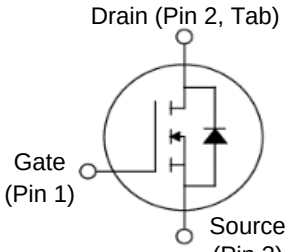
Ordering Information

Part Number	Package Option
D3S380N65B-U	TO-220
D3S380N65E-T	TO-263
D3S380N65F-U	TO-220 FullPak (FP)

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



LEAD-FREE RoHS

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
RDS(on),max	<380	mΩ
Q_g ,typ	16	nC
$I_{D\ @\ 25C}$	11.2	A
Coss	35	pf

Applications

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

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Table of contents

Description----------1

Maximum ratings----------3

Thermal characteristics----------3

Electrical characteristic----------4

Electrical characteristics diagrams----------6

Test Circuit & Waveform----------11

Revision----------16

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@ T_J = 25°C ,unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values				Unit	Note/Test Condition
		Min.	Typ.	Max. 220, 263 &247	Max. 220FP		
Continuous drain current(1)	I_D			11.2	7.0	A	T_C = 25°C
				7.1	4.4		T_C = 100°C
Pulsed drain current(2)	$I_{D,pulse}$			44.7	28.0	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			202	202	mJ	I_D=1.8A, V_{DD}=50V
Avalanche energy, repetitive	E_{AR}			0.5	0.5	mJ	I_D=1.8A, V_{DD}=50V
Avalanche current, repetitive	I_{AR}			1.8	1.8	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}			114	44	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			11.2	7.0	A	T_C = 25°C
Diode pulsed current	$I_{S,pulse}$			44.7	28.0	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	Max. 220FP		
Thermal resistance, Junction-case	R_{thJC}			1.3	3.1	°C/W	
Thermal resistance, Junction-ambient	R_{thJA}			55.8	60	°C/W	Leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}			260	260	°C	1.6mm form case for 10s

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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=52.6uA
Zero gate voltage drain current	I_{DSS}			1	uA	V_{DS}=650V, V_{GS}=0V, T_J = 25°C
				40		V_{DS}=650V, V_{GS}=0V, T_J = 150°C
Gate to source leakage current	I_{GSS}			100	nA	V_{GS}=±20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(On)}$		320	380	mΩ	V_{GS}=10V, I_D=5.6A, T_J = 25°C
			860		mΩ	V_{GS}=10V, I_D=5.6A, T_J = 150°C
Gate resistance	R_G		1.1		Ω	Scaf-F

Table 5 Dynamic characterristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		618		pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}		26.2		pF	
Reverse transfer capacitance	C_{rss}		4.8		pF	
Effective output capacitance, energy related 1	$C_{o(er)}$		63		pF	V_{DS}=0…480V, V_{GS}= 0V
Effective output capacitance, time related 2	$C_{o(tr)}$		137		pF	I_D=constant, V_{DS}=0…480V, V_{GS}= 0V
Turn on delay time	$t_{d(on)}$		5		ns	V_{DD}=400V, I_D=5.6A, R_G=1.0Ω, V_{GS}=10V
Rising time	t_r		21		ns	
Turn off delay time	$t_{d(off)}$		20		ns	
Fall time	t_f		24		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Total gate charge	Q_g		15.4		nC	V_{DD}=480V, V_{GS}=0 to10V I_D=5.6A
Gate-source charge	Q_{gs}		4.1		nC	
Gate-drain charge	Q_{gd}		6.2		nC	
Gate plateau voltage	$V_{plateau}$		5.0		V	

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Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}		0.84	0.96	V	I_F=11.2A, V_{GS}=0V, T_J = 25°C
Reverse recovery time	t_{rr}		232		ns	I_F=11.2A,dI_F/dt=100A/us
Reverse recovery charge	Q_{rr}		2.0		uC	
Peak reverse recovery current	I_{rrm}		16.6		A	

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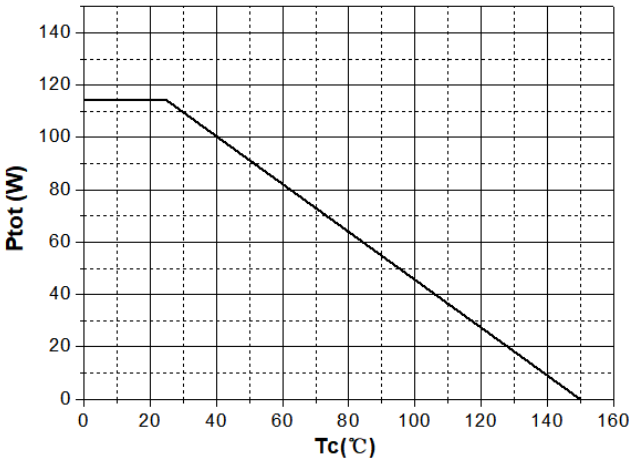
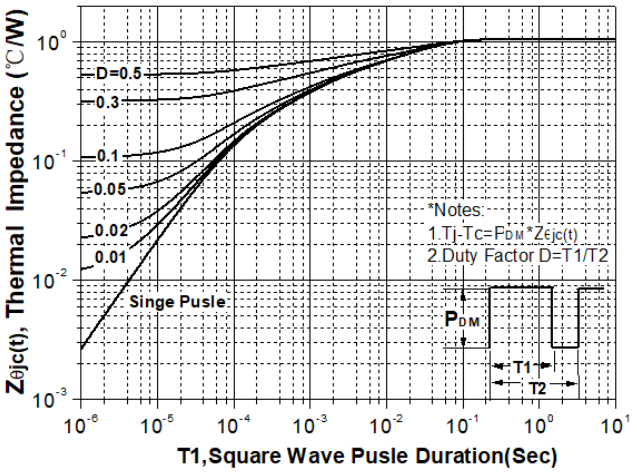
Table 8 Thermal Performance

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

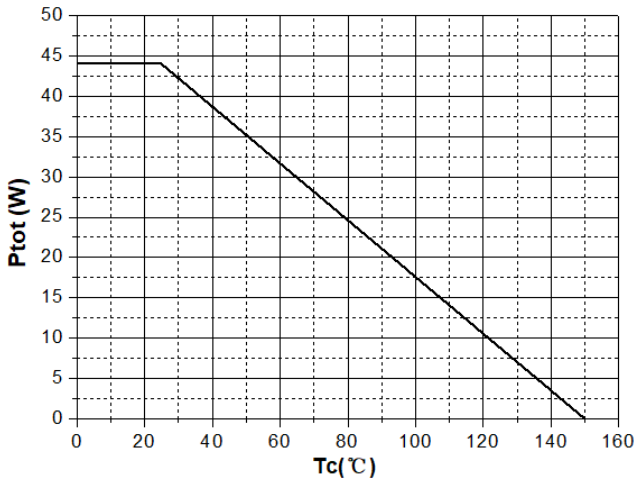
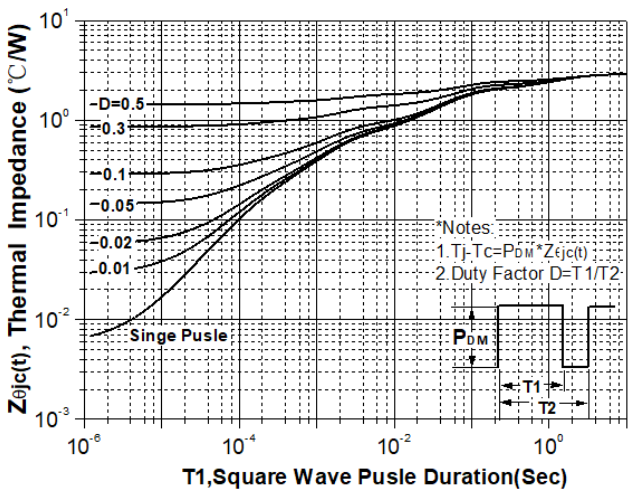
Power dissipation（TO220F）	Max. transient thermal impedance（TO220F）
	
$P_{tot}=f(T_C)$	$Z_{thJC}=f(t_P)$;parameter:$D=t_P/T$

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Table 9 Output Characteristics

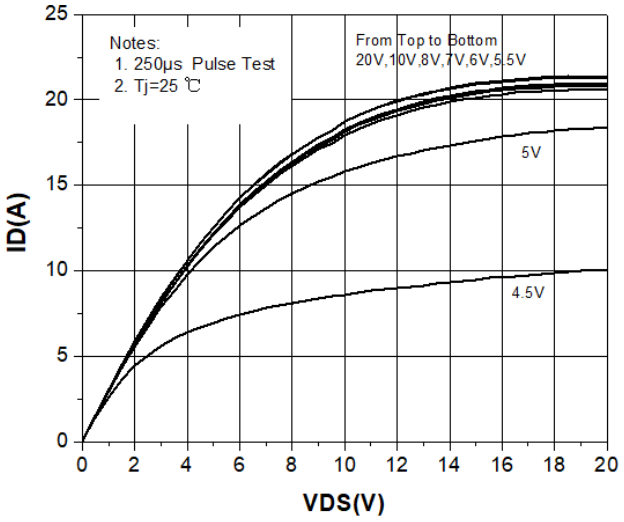
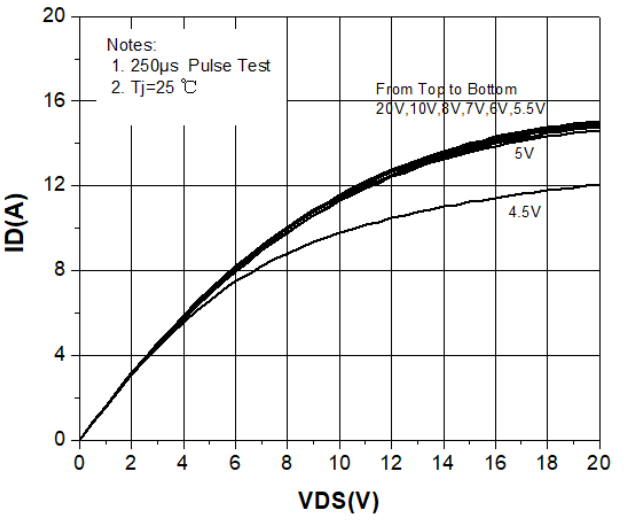
Typical output characteristics T_J= 25ºC	Typical output characteristics T_J= 125ºC
	
I_D=f(V_{DS}); T_j = 25ºC ;parameter:V_{GS}	I_D=f(V_{DS}); T_j = 125ºC ;parameter:V_{GS}

Table 10 Drain Source Resistance

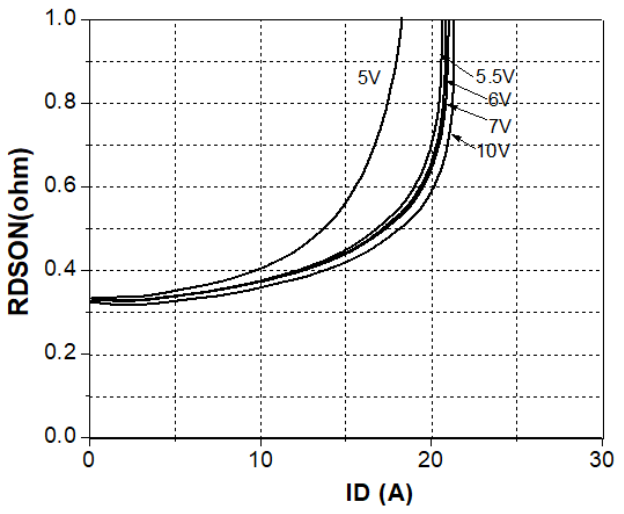
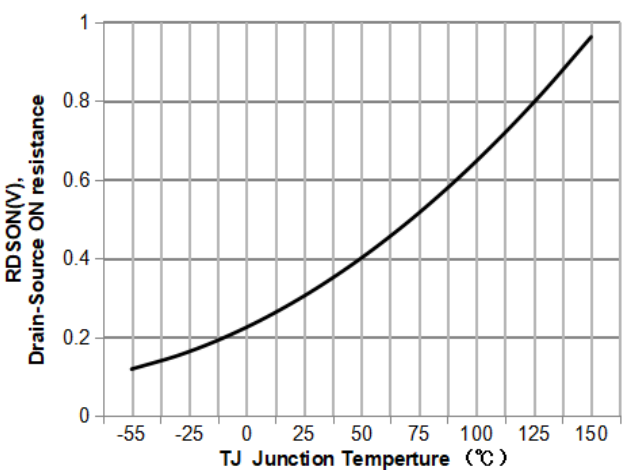
Typical drain-source on-state resistance	Drain-source on-state resistance
	
$R_{DS(On)}$=f(I_D); T_j = 25ºC parameter:V_{GS}	$R_{DS(On)}$=f(T_j); I_D = 5.6A :V_{GS}=10V

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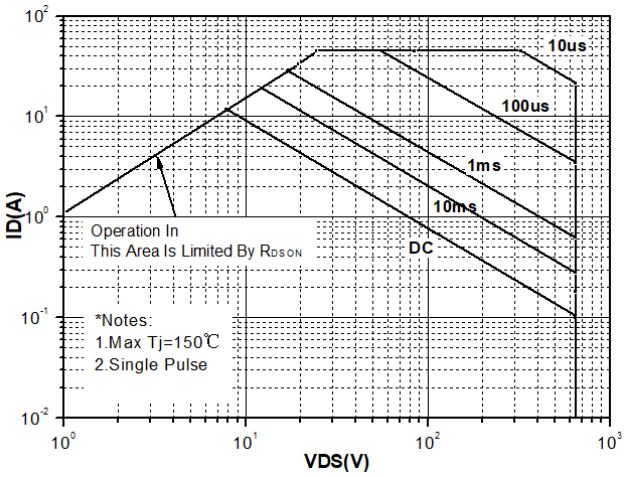
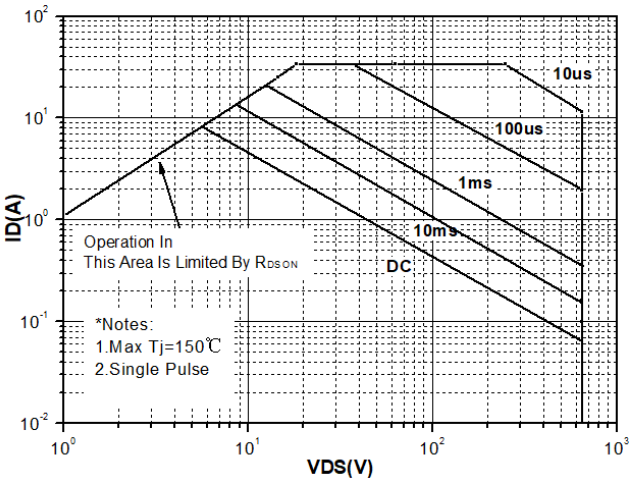
Table 12 Safe Operating Area

Safe operating area T_C= 25ºC（TO220, TO263 & TO247）	**Safe operating area T_C= 80ºC（TO220, TO263 & TO247）**
	
I_D=f(V_{DS}); T_C = 25ºC ;D=0;parameter:t_P	I_D=f(V_{DS}); T_C = 80ºC ;D=0;parameter:t_P

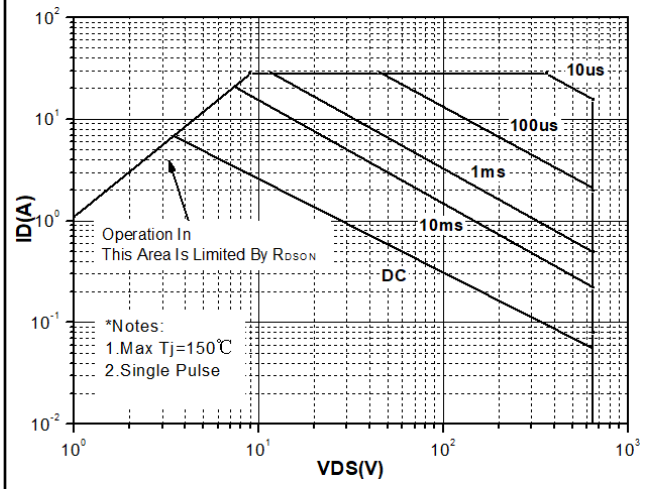
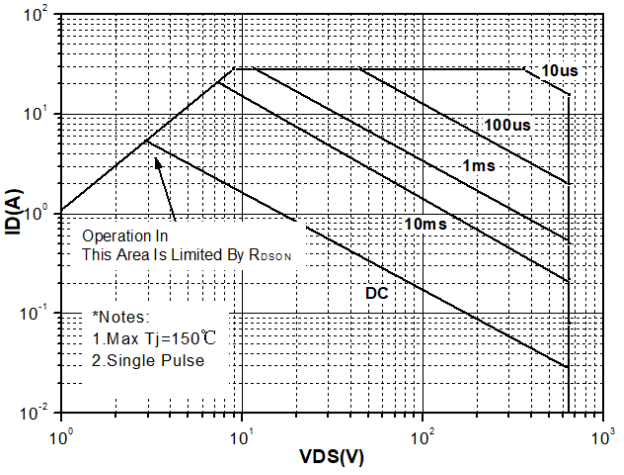
Safe operating area T_C= 25ºC（TO220F）	**Safe operating area T_C= 80ºC（TO220F）**
	
I_D=f(V_{DS}); T_C = 25ºC ;D=0;parameter:t_P	I_D=f(V_{DS}); T_C = 80ºC ;D=0;parameter:t_P

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Table 12 Capacitances and Gate Charge

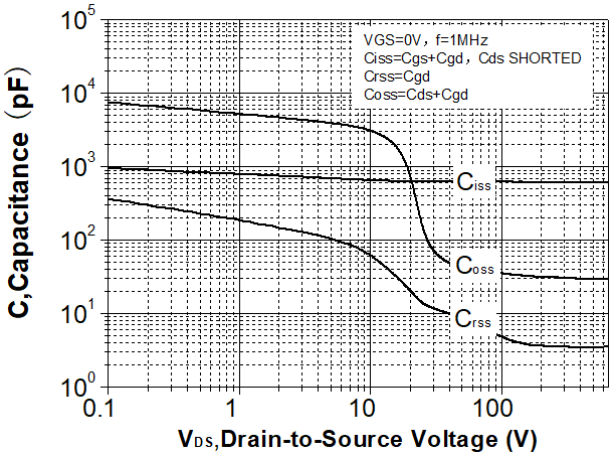
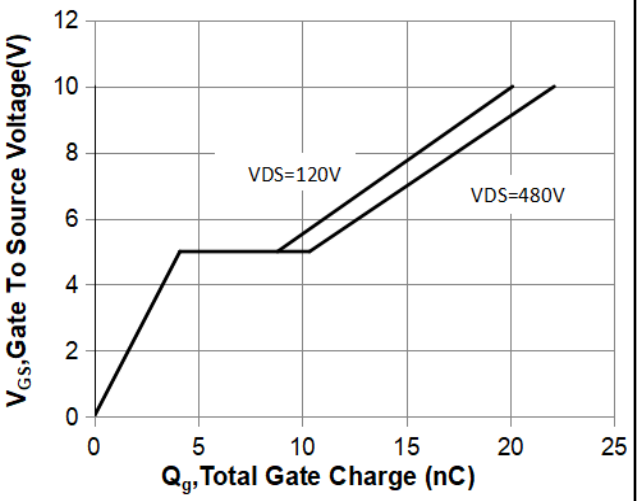
Typical Capacitances	Typical Gate charge
	
V_{gs}=0v, Freq.= 1MHz	I_D=f(Q_{gate}); I_D = 7.1A pulsed; parameter:V_{DD}

Table 13 Diode Characteristics and Avalanche Energy

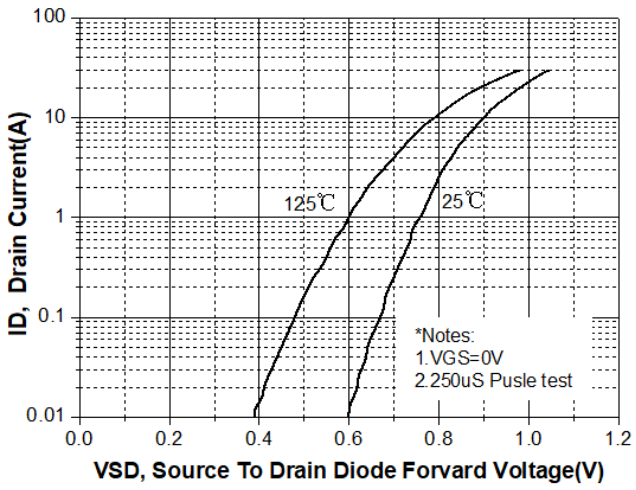
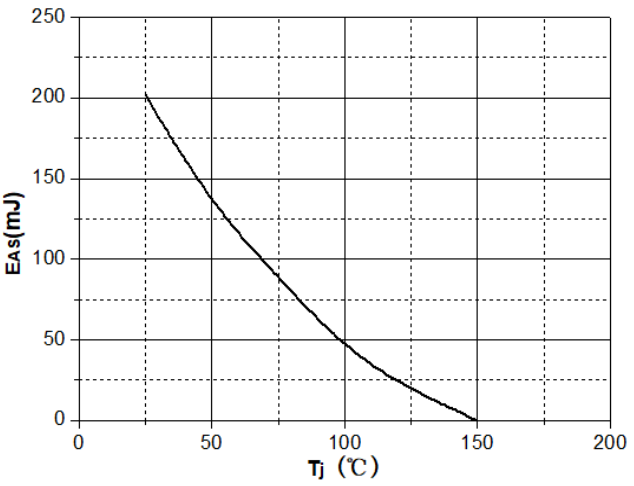
Forward characteristics of reverse diode	Avalanche energy
	
I_F=f(V_{SD}); parameter:T_j	E_{AS}=f(T_j); I_D = 1.8A ; V_{DD} = 50V

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Table 16 Breakdown Voltage and Transfer Characteristics

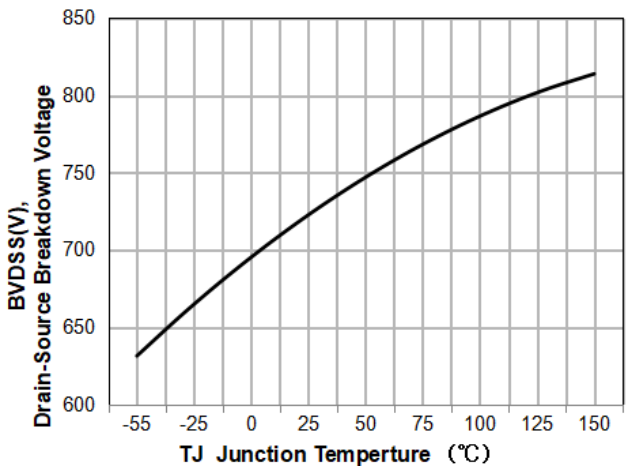
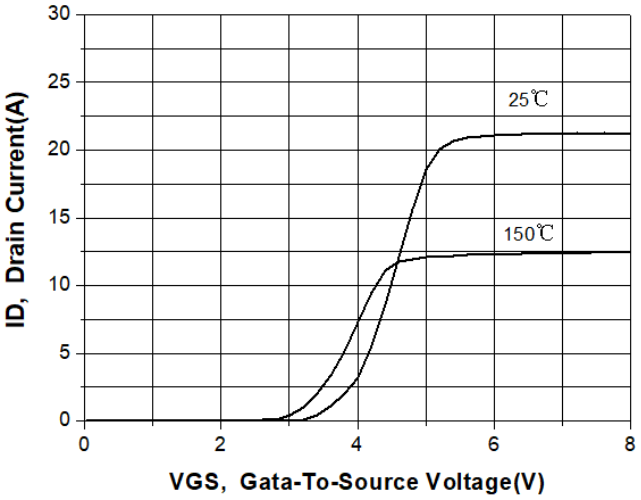
Drain-source breakdown voltage	Transfer Characteristics
	
$V_{BR(DSS)}$=f(T_j); I_D = 0.25mA	I_D=f(V_{GS}); |V_{DS} | >2|I_D|$R_{DS(On)max}$;parameter:T_j

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Table 15 Diode Recovery Characteristic

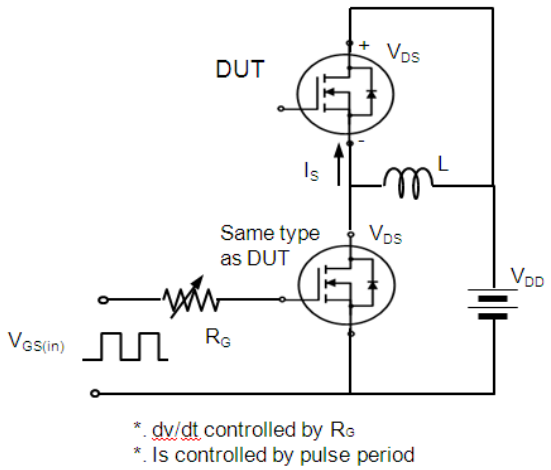
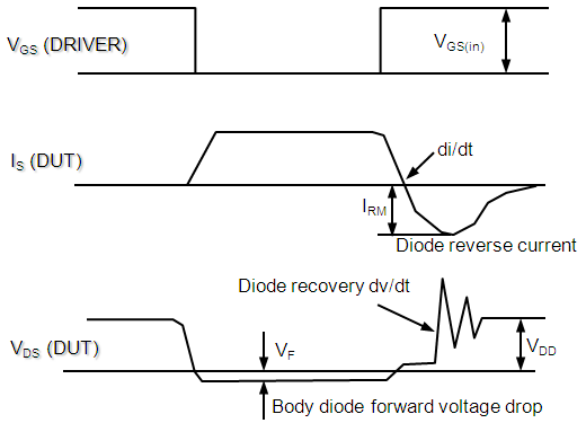
Test Ciruit For Diode Recovery	Test Waveform For Diode Recovery
	

Table 16 Switching Time Characteristic

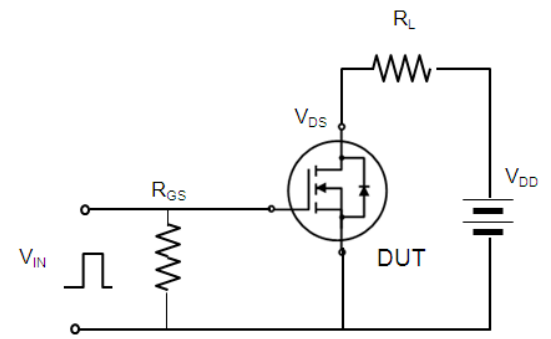
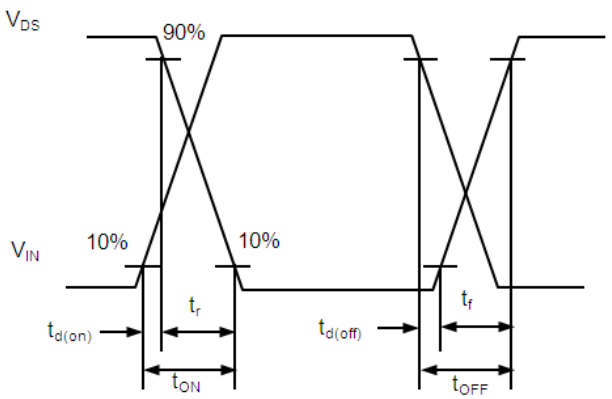
Test Ciruit for Switching Time	Test Waveform for Switching Time
	

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Table 17 Gate Charge Characteristic

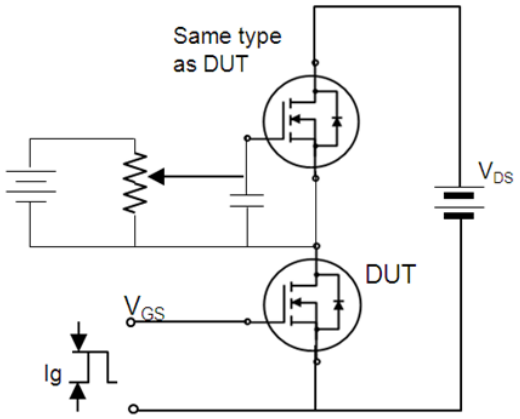
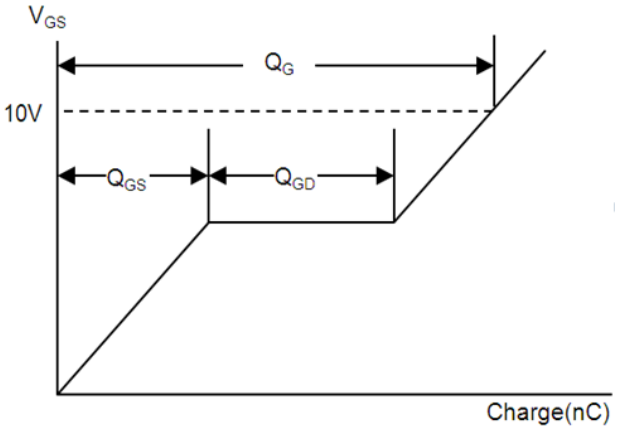
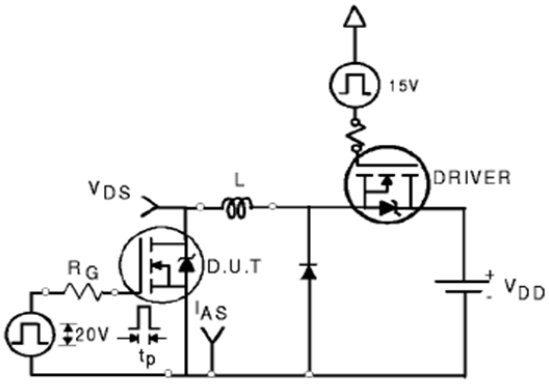
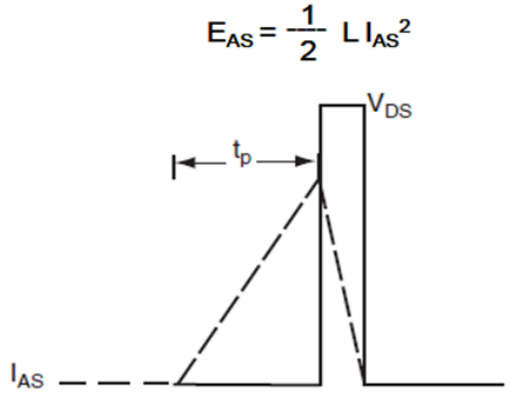
Test Ciruit For Gate Charge	Test Waveform For Gate Charge
	

Table 18 Unclamped Inductive Characteristic

Test Ciruit For Unclamped Inductive	Test Waveform For Unclamped Inductive
	

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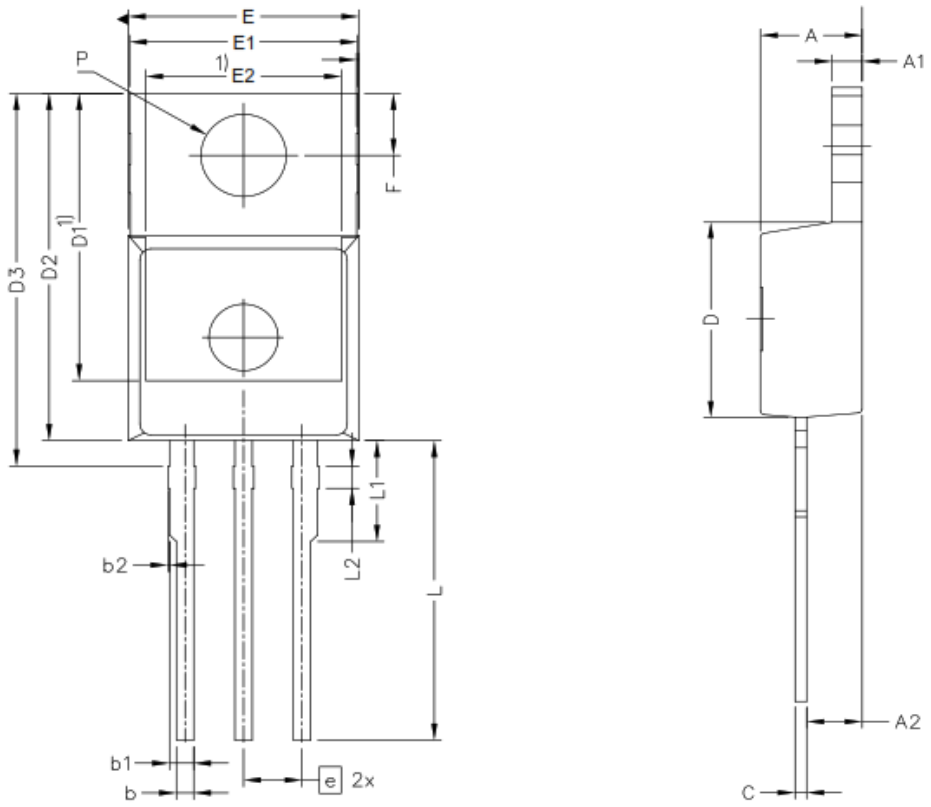
4a) TO-220



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

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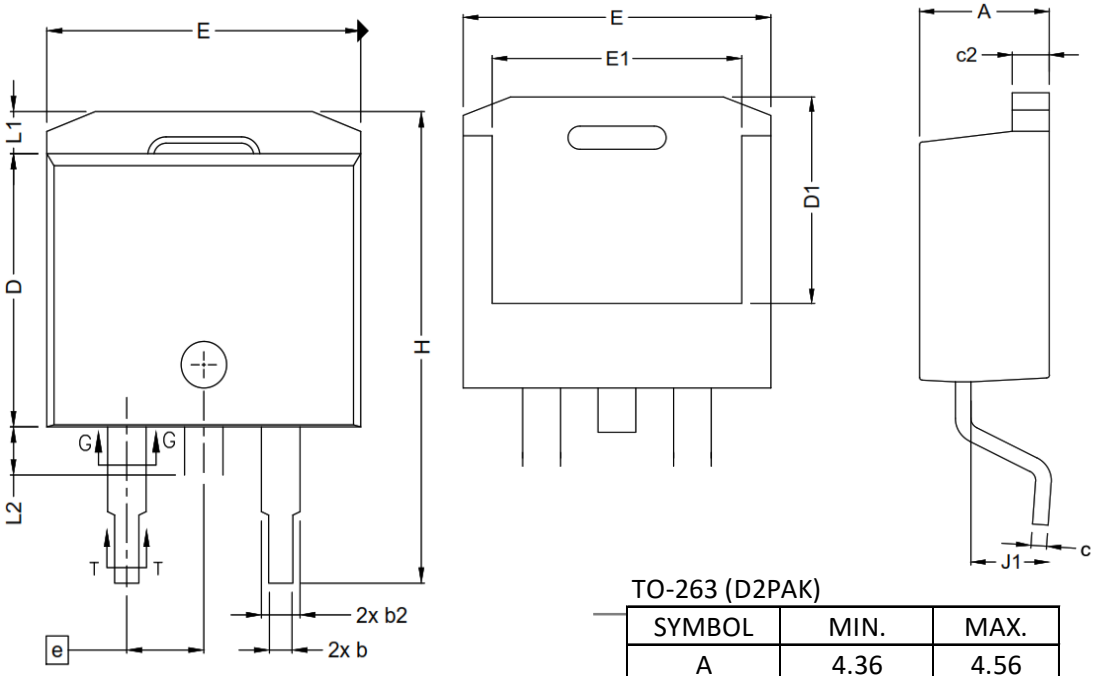
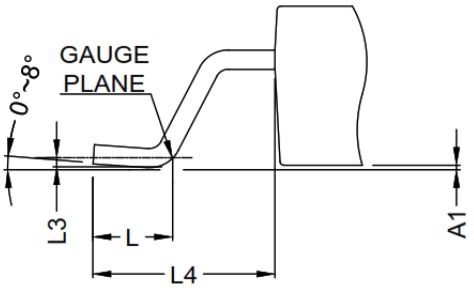
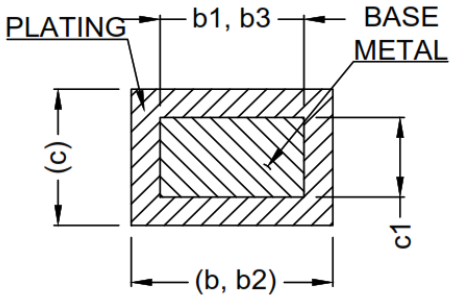
4b) TO-263







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

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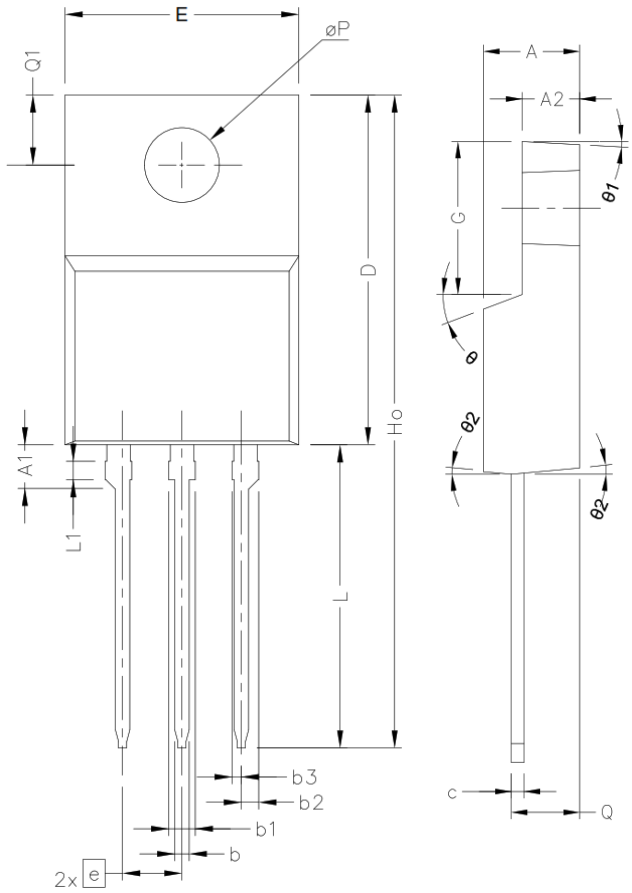
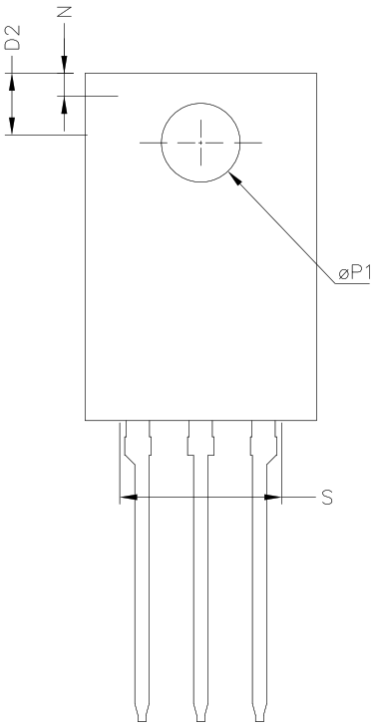
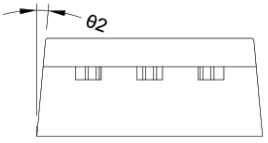
4C) TO-220 FullPak







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.	

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