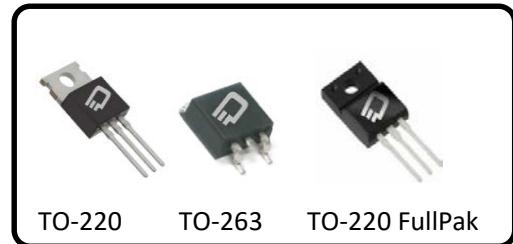


650V, 380mΩ, 11.2 A Super Junction Power MOSFET

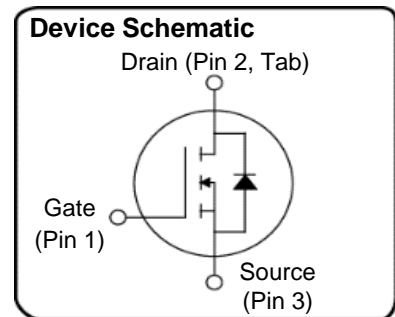
Ordering Information

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 $R_{DS(ON)}$ 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
$V_{DS} @ T_J \text{ max}$	710	V
$R_{DS(on), \text{max}}$	<380	mΩ
Q_g, typ	16	nC
$I_D @ 25^\circ\text{C}$	11.2	A
C_{oss}	35	pf

Applications

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

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@ $T_J = 25^\circ\text{C}$, 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			11.2	7.0	A	$T_C = 25^\circ\text{C}$
				7.1	4.4		$T_C = 100^\circ\text{C}$
Pulsed drain current(2)	$I_{D,pulse}$			44.7	28.0	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			202	202	mJ	$I_D=1.8\text{A}, V_{DD}=50\text{V}$
Avalanche energy, repetitive	E_{AR}			0.5	0.5	mJ	$I_D=1.8\text{A}, V_{DD}=50\text{V}$
Avalanche current, repetitive	I_{AR}			1.8	1.8	A	
MOSFET dv/dt ruggedness	dv/dt			50	50	V/ns	$V_{DS}=\dots480\text{V}$
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	$T_C = 25^\circ\text{C}$
Operating and storage temperature	T_J, T_{stg}	-55		150	150	$^\circ\text{C}$	
Mounting torque				60		Ncm	M3 and M3.5 screws
					50		M3 screws
Continuous diode forward current	I_S			11.2	7.0	A	$T_C = 25^\circ\text{C}$
Diode pulsed current	$I_{S,pulse}$			44.7	28.0	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt(3)	dv/dt			15	15	V/ns	$V_{DS}=\dots480\text{V}, I_{SD}<I_D$
Maximum diode commutation speed	dif/dt			500	500	A/us	$T_J = 25^\circ\text{C}$

Table 3 Thermal characteristics

Parameter	Symbol	Values				Unit	Note/Test Condition
		Min.	Typ.	Max.			
				220, 263 & 247	220FP		
Thermal resistance, Junction-case	R_{thJC}			1.3	3.1	$^\circ\text{C}/\text{W}$	
Thermal resistance, Junction-ambient	R_{thJA}			55.8	60	$^\circ\text{C}/\text{W}$	Leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}			260	260	$^\circ\text{C}$	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	$V_{DS}=V_{GS}, I_D=52.6\mu A$
Zero gate voltage drain current	I_{DSS}			1	uA	$V_{DS}=650V, V_{GS}=0V, T_J = 25^\circ C$
				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	$R_{DS(on)}$		320	380	mΩ	$V_{GS}=10V, I_D=5.6A, T_J = 25^\circ C$
			860		mΩ	$V_{GS}=10V, I_D=5.6A, T_J = 150^\circ C$
Gate resistance	R_G		1.1		Ω	Scaf-F

Table 5 Dynamic characteristics

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	$V_{DS}=0\dots 480V, V_{GS}= 0V$
Effective output capacitance, time related 2	$C_{o(tr)}$		137		pF	$I_D=constant, V_{DS}=0\dots 480V, V_{GS}= 0V$
Turn on delay time	$t_{d(on)}$		5		ns	$V_{DD}=400V, I_D=5.6A, R_G=1.0\Omega, V_{GS}=10V$
Rising time	t_r		21		ns	
Turn off delay time	$t_{d(off)}$		20		ns	
Fall time	t_f		24		ns	

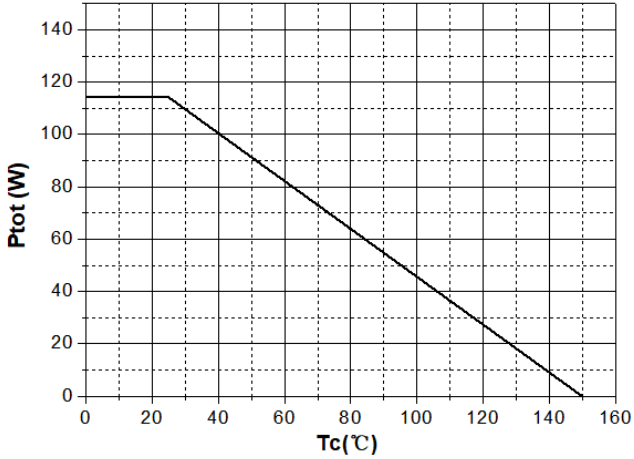
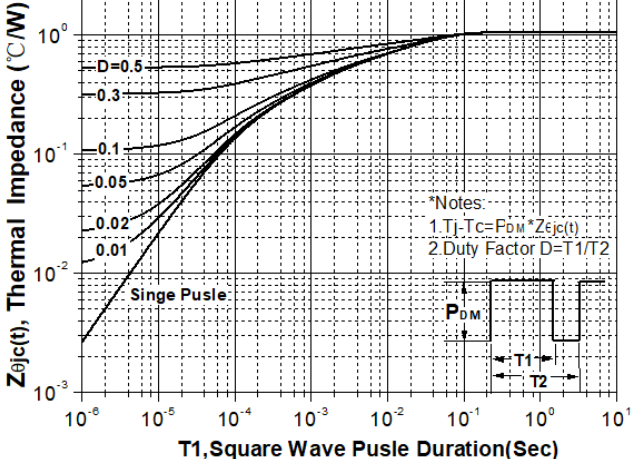
Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Total gate charge	Q_g		15.4		nC	$V_{DD}=480V, V_{GS}=0 \text{ to } 10V, I_D=5.6A$
Gate-source charge	Q_{gs}		4.1		nC	
Gate-drain charge	Q_{gd}		6.2		nC	
Gate plateau voltage	$V_{plateau}$		5.0		V	

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	$I_F=11.2A, V_{GS}=0V, T_J = 25^\circ C$
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	

Table 8 Thermal Performance

Power dissipation (TO220, TO263 & TO247)	Max. transient thermal impedance (TO220, TO263 & TO247)
	 <p>*Notes: 1. $T_J - T_C = P_{DM} * Z_{thJC}(t)$ 2. Duty Factor $D = T_1 / T_2$</p>
$P_{tot} = f(T_C)$	$Z_{thJC} = f(t_p)$; parameter: $D = t_p / T$

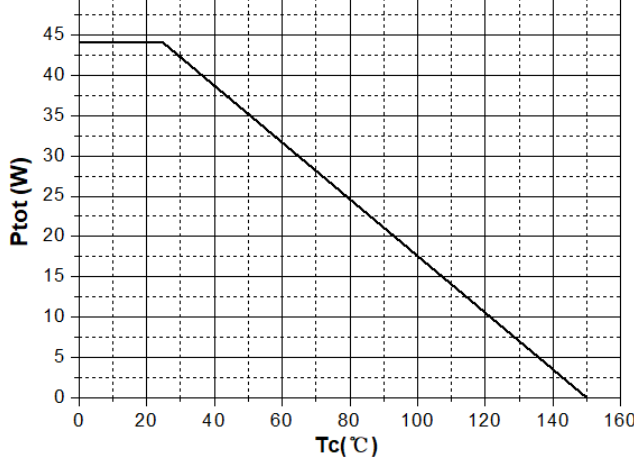
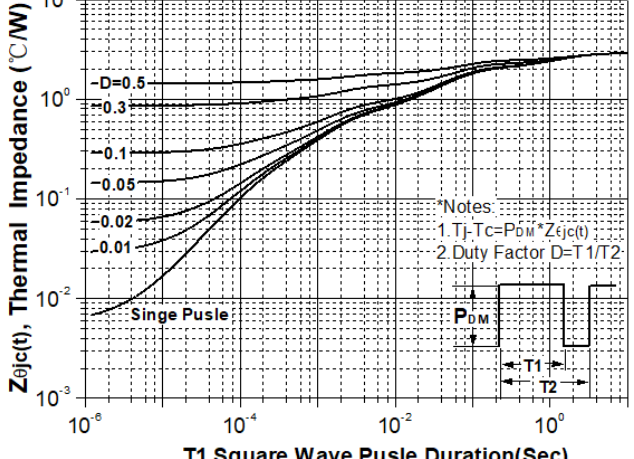
Power dissipation (TO220F)	Max. transient thermal impedance (TO220F)
	 <p>*Notes: 1. $T_J - T_C = P_{DM} * Z_{thJC}(t)$ 2. Duty Factor $D = T_1 / T_2$</p>
$P_{tot} = f(T_C)$	$Z_{thJC} = f(t_p)$; parameter: $D = t_p / T$

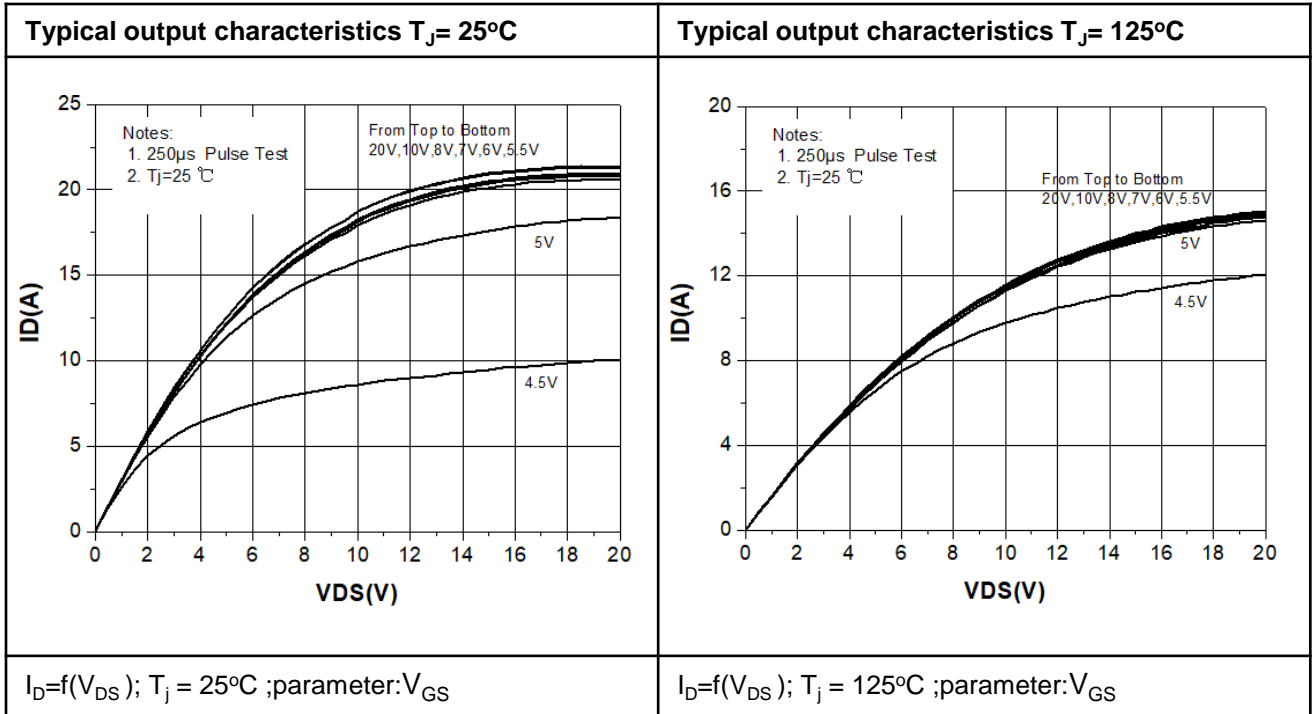
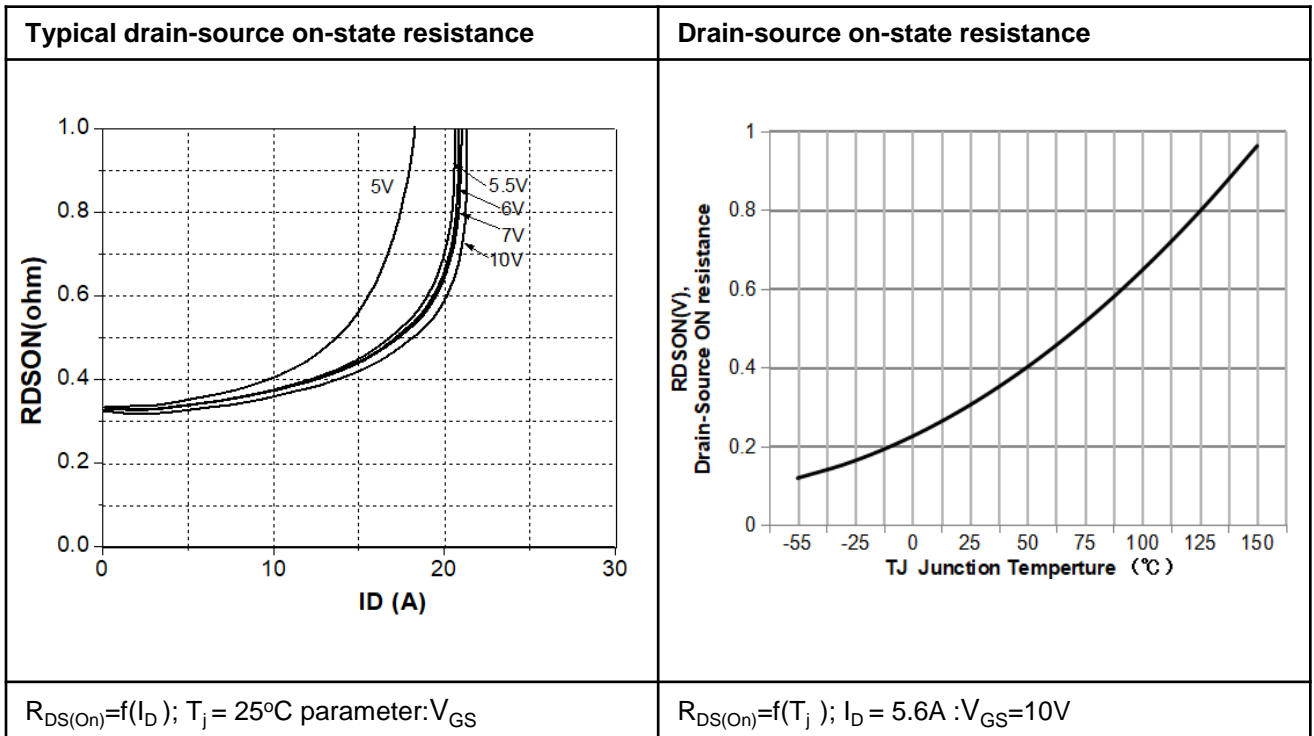
Table 9 Output Characteristics

Table 10 Drain Source Resistance


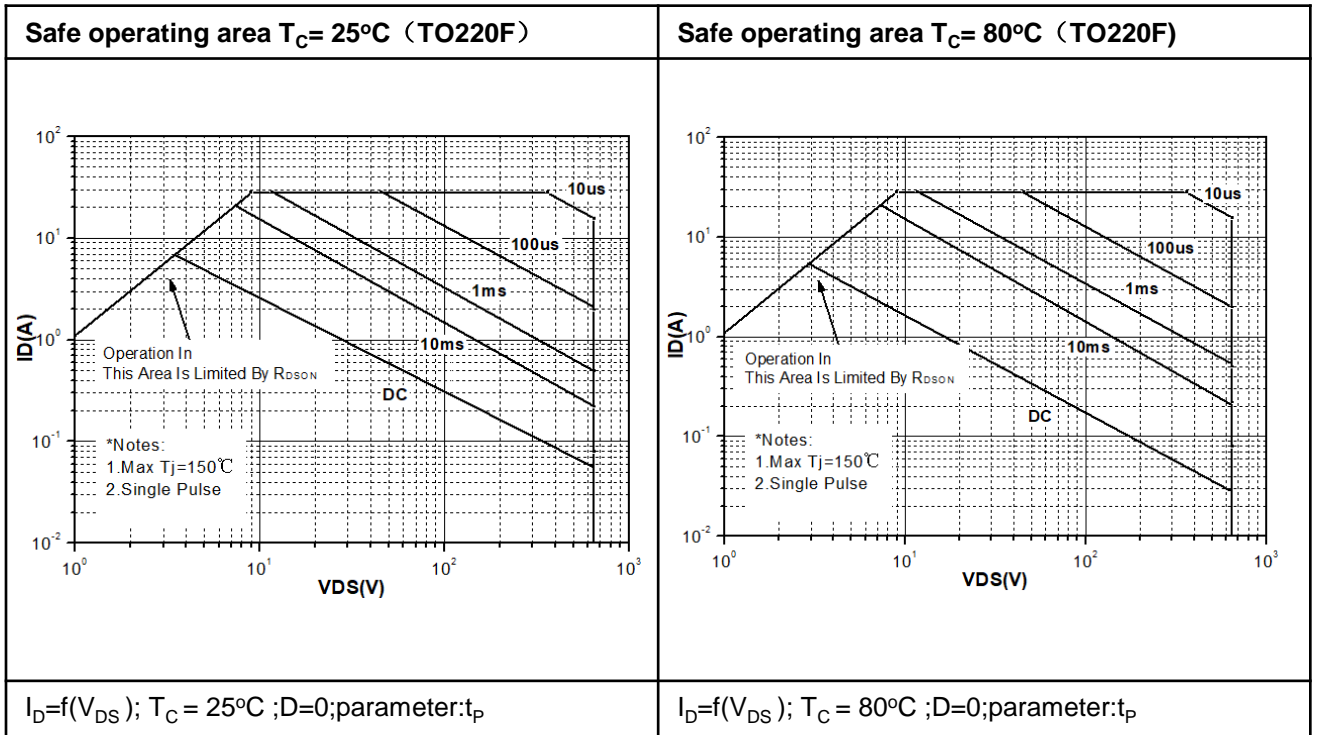
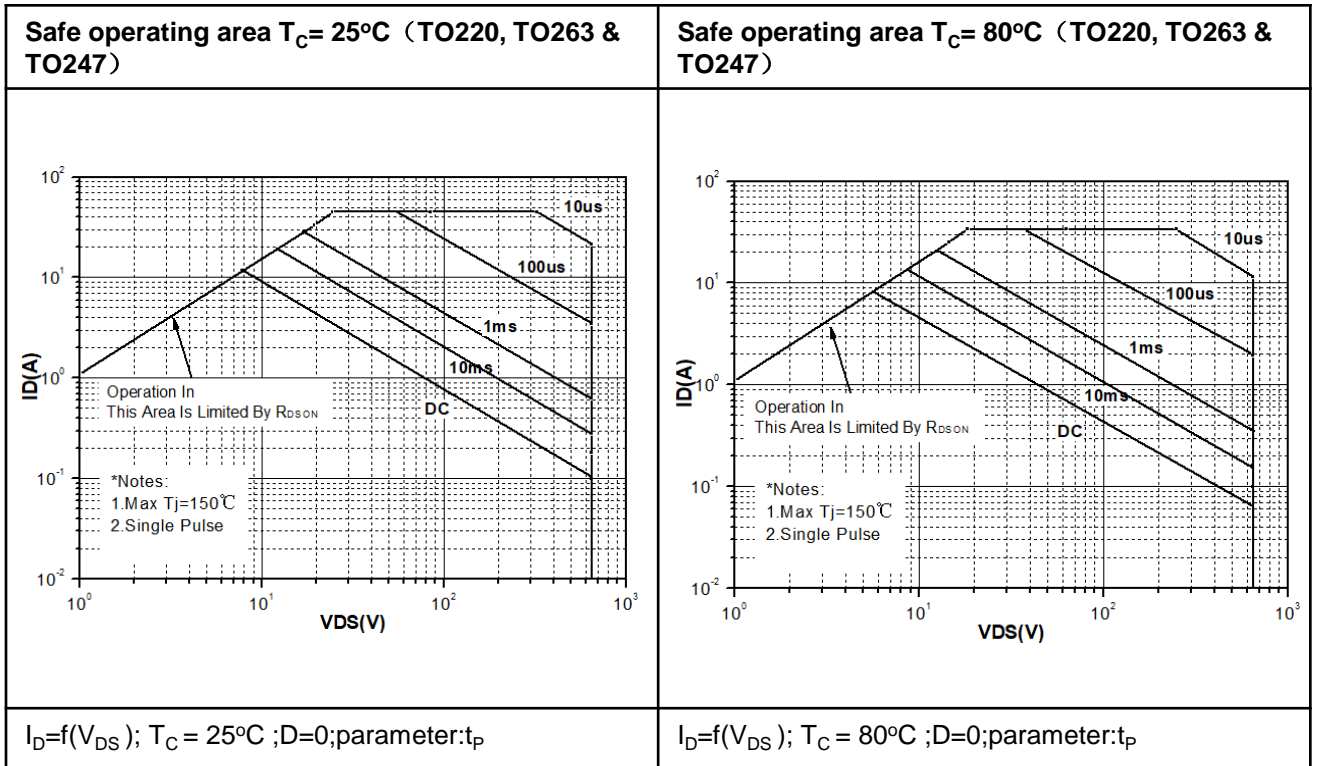
Table 12 Safe Operating Area


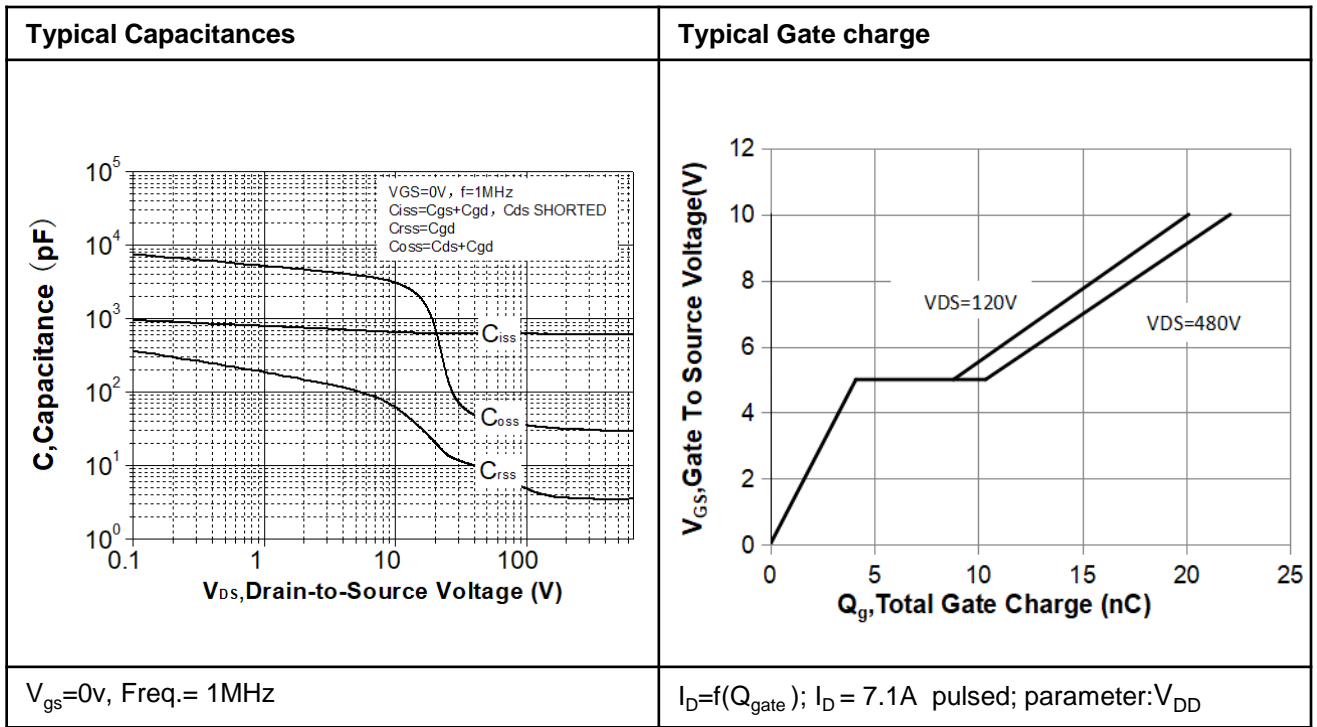
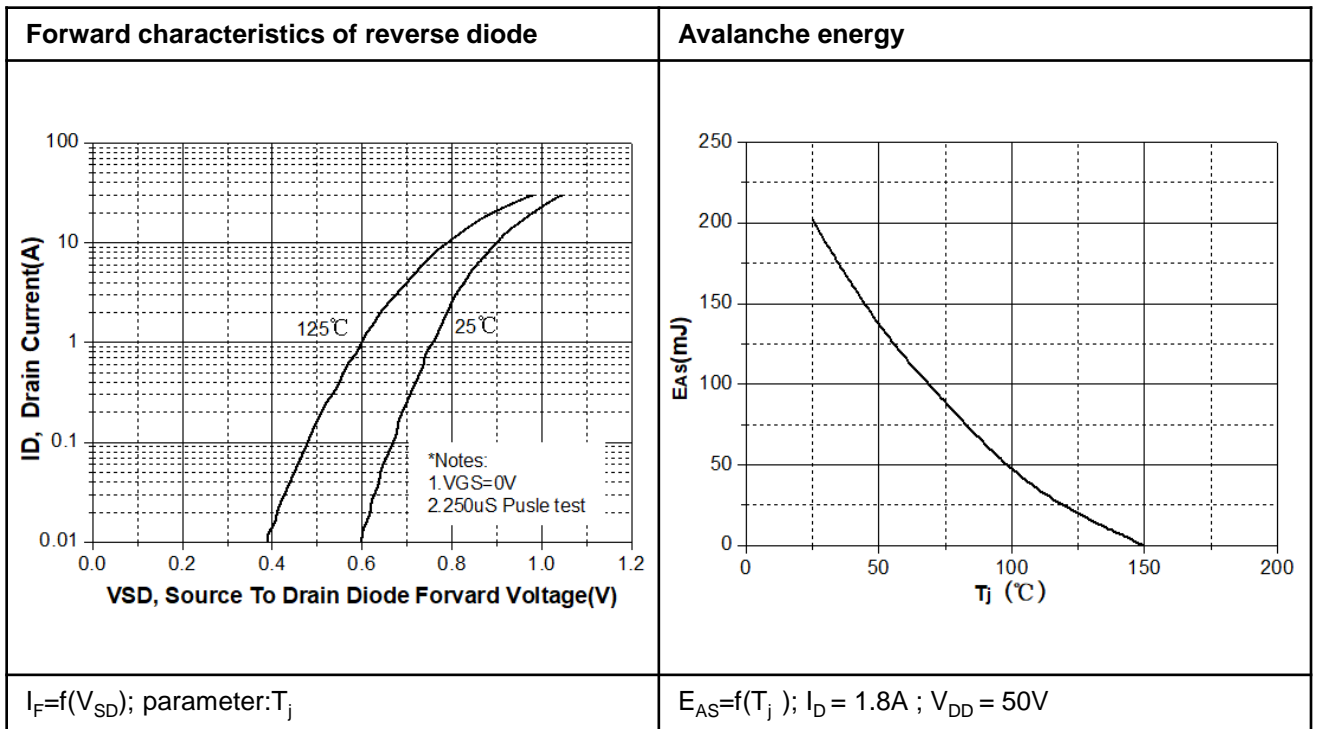
Table 12 Capacitances and Gate Charge

Table 13 Diode Characteristics and Avalanche Energy


Table 16 Breakdown Voltage and Transfer Characteristics

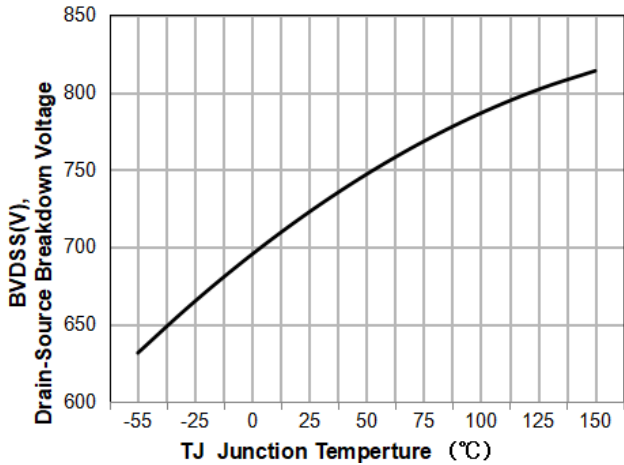
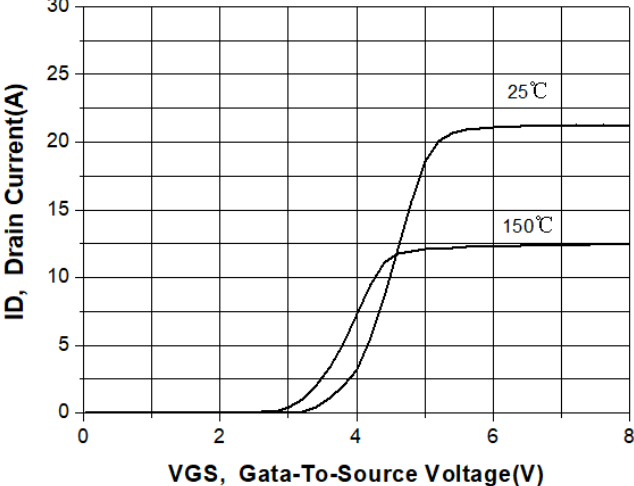
Drain-source breakdown voltage	Transfer Characteristics
 <p>The graph shows the Drain-Source Breakdown Voltage (BVDSS) in Volts (V) on the y-axis (ranging from 600 to 850) versus the TJ Junction Temperature in degrees Celsius (°C) on the x-axis (ranging from -55 to 150). The curve shows a positive correlation, starting at approximately 630V at -55°C and rising to about 815V at 150°C.</p>	 <p>The graph shows the Drain Current (ID) in Amperes (A) on the y-axis (ranging from 0 to 30) versus the Gate-To-Source Voltage (VGS) in Volts (V) on the x-axis (ranging from 0 to 8). Two curves are shown for different temperatures: 25°C and 150°C. The 25°C curve shows a higher drain current, reaching a saturation point of approximately 21A at 6V VGS. The 150°C curve shows a lower drain current, reaching a saturation point of approximately 12.5A at 6V VGS.</p>
$V_{BR(DSS)} = f(T_j); I_D = 0.25mA$	$I_D = f(V_{GS}); V_{DS} > 2 I_D R_{DS(On)max}; parameter: T_j$

Table 15 Diode Recovery Characteristic

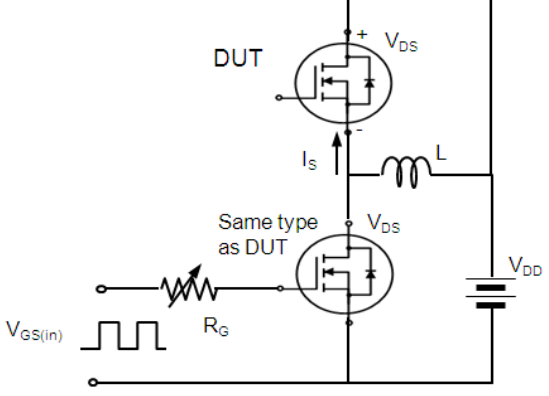
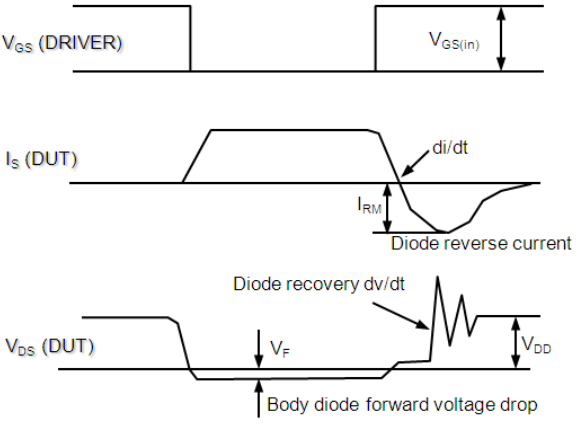
Test Circuit For Diode Recovery	Test Waveform For Diode Recovery
 <p>*. dv/dt controlled by R_G *. I_S controlled by pulse period</p>	

Table 16 Switching Time Characteristic

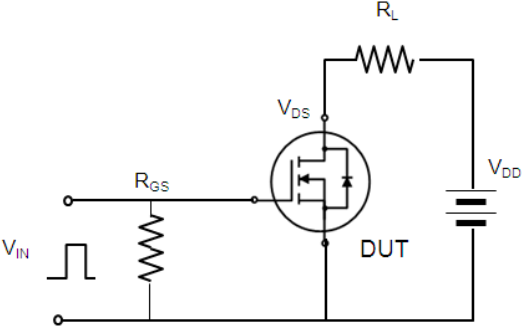
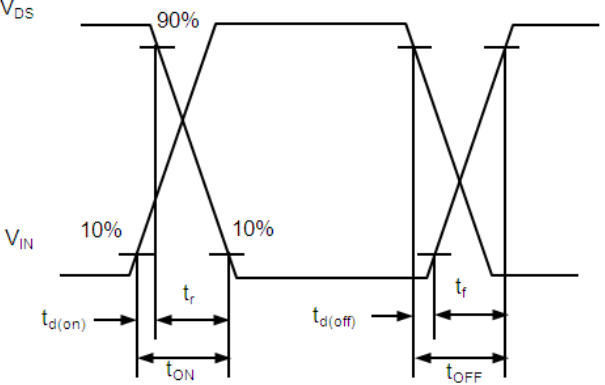
Test Circuit for Switching Time	Test Waveform for Switching Time
	

Table 17 Gate Charge Characteristic

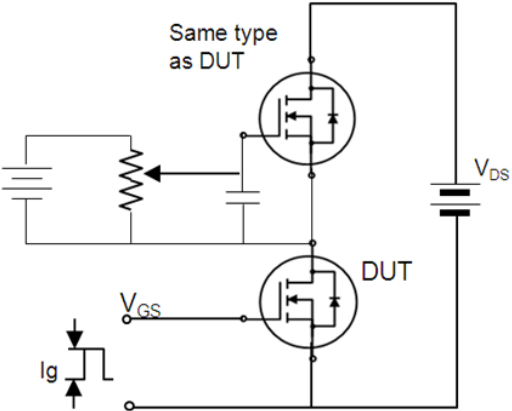
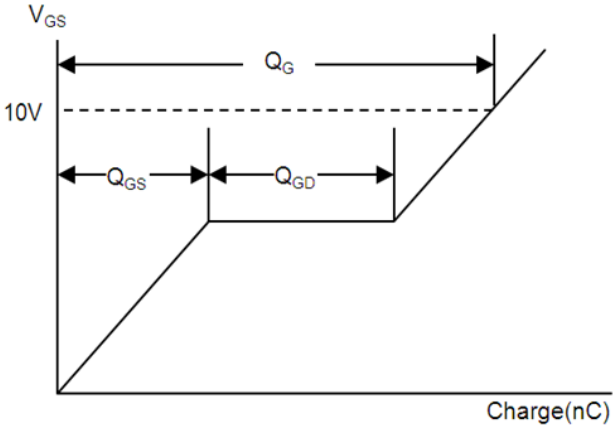
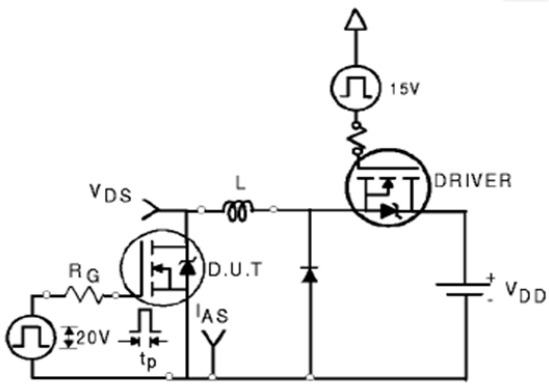
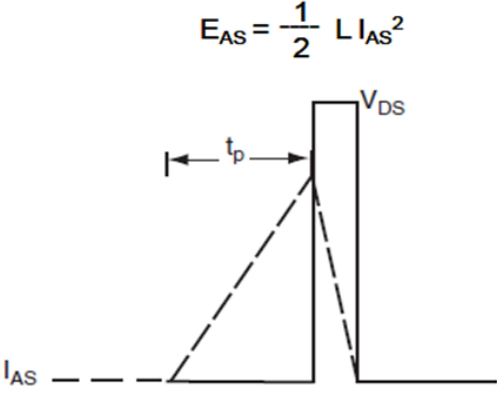
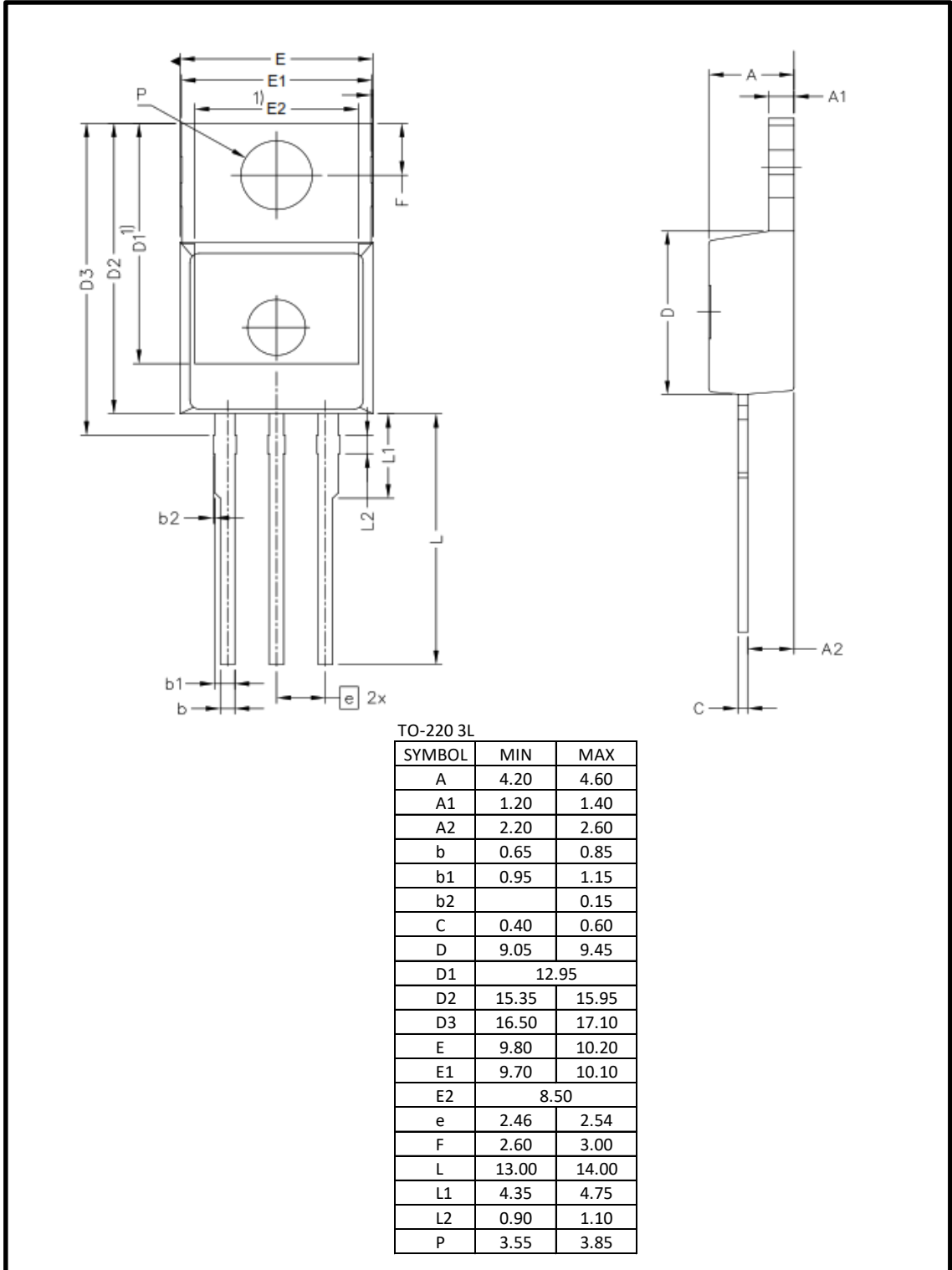
Test Circuit For Gate Charge	Test Waveform For Gate Charge
	

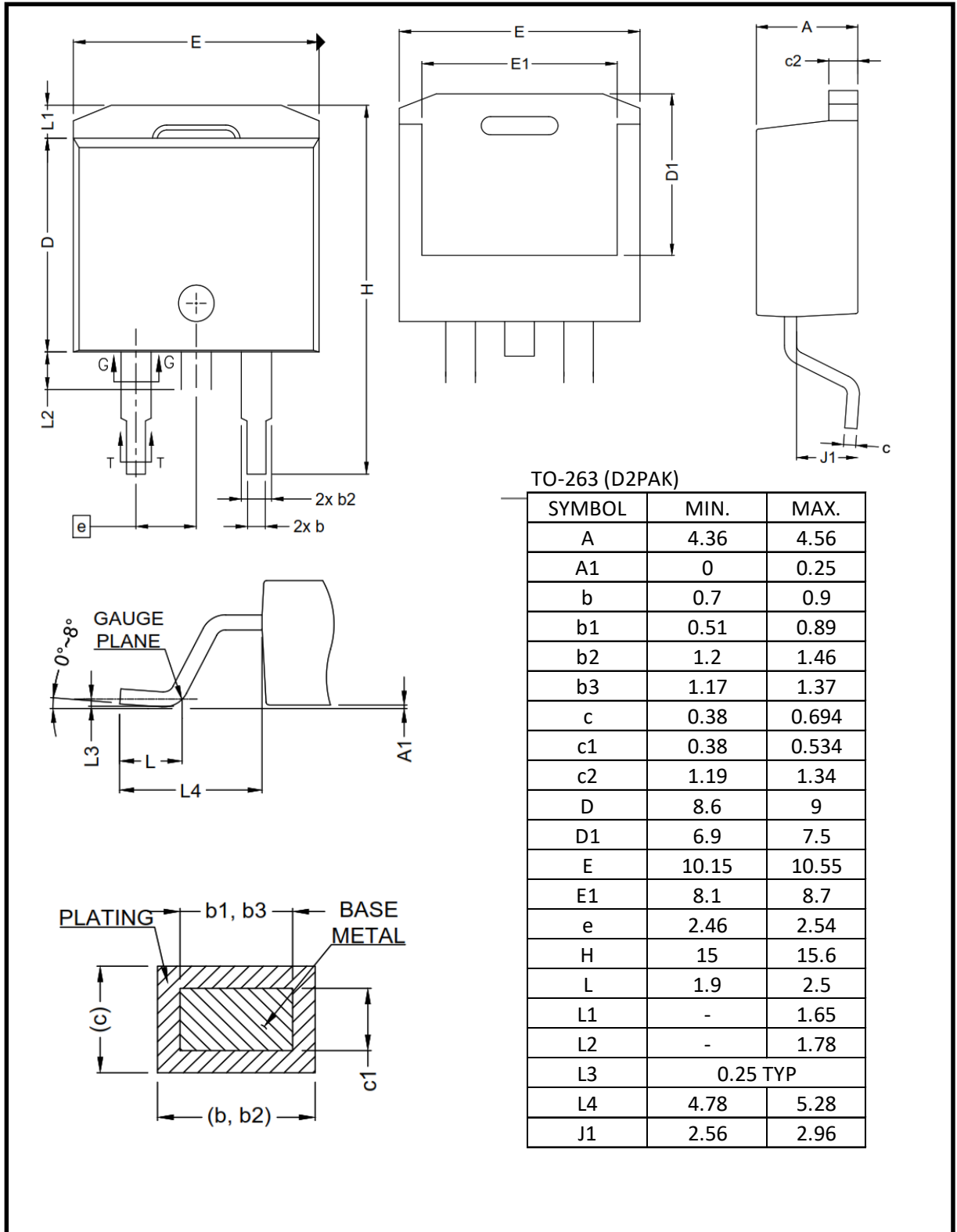
Table 18 Unclamped Inductive Characteristic

Test Circuit For Unclamped Inductive	Test Waveform For Unclamped Inductive
	 $E_{AS} = \frac{1}{2} L I_{AS}^2$

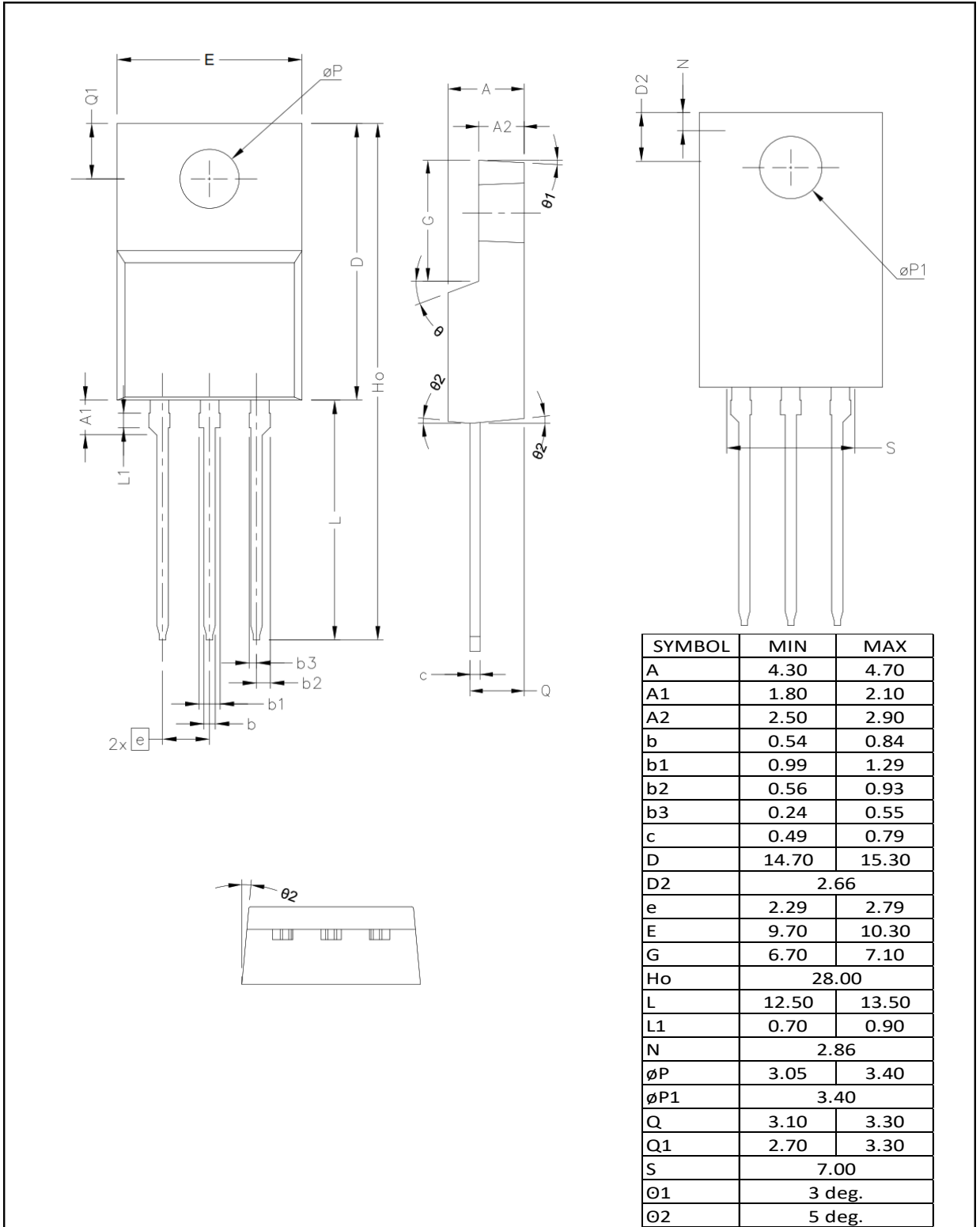
4a) TO-220



4b) TO-263



4C) TO-220 FullPak



Revision History

Revision	Release Date	Comments
1.0	1-Dec 2017	Preliminary Datasheet Draft
2.0	2-Jan 2019	Characterization and enhancements


Resources

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