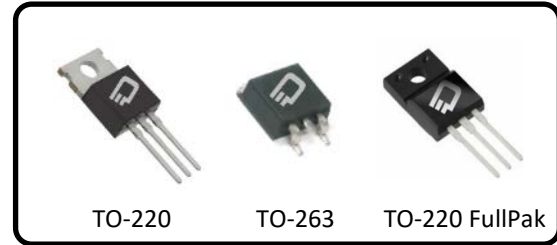
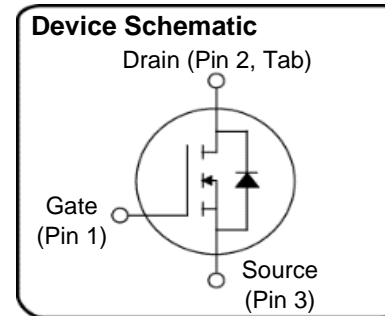


650V, 190mΩ, 15.2A N-Channel Enhancement Mode Super Junction Power MOSFET
Ordering Information

Part Number	Package Option
D3S190N65B-U	TO-220
D3S190N65E-U	TO-263
D3S190N65U-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
- HTRB, H3TRB TESTED >3000 HRS

Benefits

- LOW CONDUCTION LOSSES
- HIGH EFFICIENCY
- EXCELLENT AVALANCHE PERFORMANCE

Table 1 Key Maximum Parameters

Parameter	220/263	220FP	Unit
V_{DSS} @ T_{jmax}	710	710	V
$R_{DS(on)}$ max	< 190	<190	mΩ
Q_g typ	28	28	nC
I_{Dmax} @ 25 °C	25.8	13.5	A

Applications

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

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1. Maximum Ratings

Table 2 Maximum Ratings

 @ $T_j = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Values				Unit	Condition
		Min	Typ	Max			
				220 & 263	220FP		
Continuous drain current	I_D			15.2	8	A	$T_c = 25^\circ\text{C}$
				9.6	5.1	A	$T_c = 100^\circ\text{C}$
Pulsed drain current	$I_{D, \text{pulse}}$			67	51.6	A	$T_c = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			399	399	mJ	$I_D = 7.2\text{A}; V_{DD} = 50\text{V}, V_{GS} = 10\text{V}, L=10\text{mH}, R_G=25\text{ Ohms}$
Avalanche energy, repetitive	E_{AR}			0.60	0.4	mJ	$I_D = 7.2; V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AS}			7.2	7.2	A	
MOSFET dv/dt ruggedness	dv/dt			50	50	V/ns	$V_{DS} = 0 \dots 480\text{V}$
Gate source voltage (static)	V_{GS}	-30		30	30	V	Static
Gate source voltage (dynamic)	V_{GS}	-30		30	30	V	AC ($F > 1\text{Hz}$)
Power dissipation	P_{tot}			113	28	W	$T_c = 25^\circ\text{C}$
Storage temperature	T_{stg}	-55		150	150	$^\circ\text{C}$	
Operating junction temperature	T_j	-55		150	150	$^\circ\text{C}$	
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}			15.2	8	A	$T_c = 25^\circ\text{C}$
Diode pulse current	$I_{S, \text{pulse}}$			67	51.6	A	$T_c = 25^\circ\text{C}$
Reverse diode dv/dt	dv/dt			12	12	V/ns	$V_{DS}=0 \dots 480\text{V}, I_{SD} \leq I_S, T_j = 25^\circ\text{C}$
Maximum diode commutation speed	dI_i/dt			350	350	A/ μs	$V_{DS}=0 \dots 480\text{V}, I_{SD} \leq I_S, T_j = 25^\circ\text{C}$

*For TO-220 FullPak only

2. Thermal Characteristics

Table 3 Thermal Characteristics

Symbol	Parameter	Packages			Unit
		TO-220	TO-220FP	TO-263	
R_{th-jC}	Thermal resistance, junction-case	1.1	3.9	1.1	°C/W
R_{th-jA}	Thermal resistance, junction-ambient	65	80	65	°C/W
T_s	Soldering temperature, wave soldering only allowed at leads	260	260	260	°C

3. Electrical Characteristics

@ T_j = 25°C, unless otherwise specified

Table 4 Static Characteristics

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Drain-source breakdown voltage	V _{(BR)DSS}	650			V	I _D = 1mA, V _{GS} = 0V
Gate threshold voltage	V _{GS(TH)}	2.3	3	3.7	V	V _{DS} = V _{GS} , I _D = 105μA
Zero gate voltage drain current	I _{DSS}			1	μA	V _{DS} = 650V, T _C = 25°C, V _{GS} = 0V
				50		V _{DS} = 650V, T _C = 125°C, V _{GS} = 0V
Gate-source leakage current	I _{GSS}			100	nA	V _{GS} = ±30V, V _{DS} = 0V
Drain-source on-state resistance	R _{DS(on)}		0.16	0.19	Ω	V _{GS} = 10V, I _D = 8.71 A T _J = 25°C
			0.40		Ω	V _{GS} = 10V, I _D = 8.71 A, T _J = 150°C
Gate resistance***	R _G		1.1		Ω	

Table 5 Dynamic Characteristics

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Input capacitance	C _{iss}		1360		pF	V _{DS} = 100V, f = 1MHz, V _{GS} = 0V
Output capacitance	C _{oss}		47		pF	
Reverse transfer capacitance	C _{rss}		9.2		pF	
Turn-on delay time	t _{d(on)}		9		ns	V _{DD} = 400V, I _D = 6.7A R _G = 3.4Ω, V _{GS} = 13V, di/dt=100A/μs
Rise time	t _r		8		ns	
Turn-off delay time	t _{d(off)}		57		ns	
Fall time	t _f		21		ns	

Table 6 Gate Charge Characteristics

Parameter	Symbol	Values			Unit	Condition
		Min	Typ	Max		
Gate to source charge	Q _{gs}		1.2		nC	V _{DD} = 480V, I _D = 6.7A V _{GS} = 0 to 10V
Gate to drain charge	Q _{gd}		12.5		nC	
Gate charge total	Q _g		28.0		nC	
Gate plateau voltage	V _{plateau}		5		V	

Table 7 Reverse Diode Characteristics

Parameter	Symbol	Values				Unit	Condition
		Min	Typ	Max			
				220 & 263	220FP		
Diode source-drain current	I_{SD}			15.2	8	A	
Diode forward voltage	V_{fd}		0.9	1.2		V	$I_{SD} = 15.2, V_{GS} = 0V, T_J = 25^\circ C$
Reverse recovery time	t_{rr}		225			ns	$I_F = 6.7A, V_{GS} = 13V$ $L = 500\mu H$ $di/dt = 100A/\mu S$ $V_{DD} = 400V, T_J = 25^\circ C$
Reverse recovery charge	Q_{rr}		1.9			μC	
Peak reverse recovery current	I_{rrm}		16.6		8.3	A	

4. Electrical Characteristics Graphs

Table 8 Thermal Performance TO220 & TO247

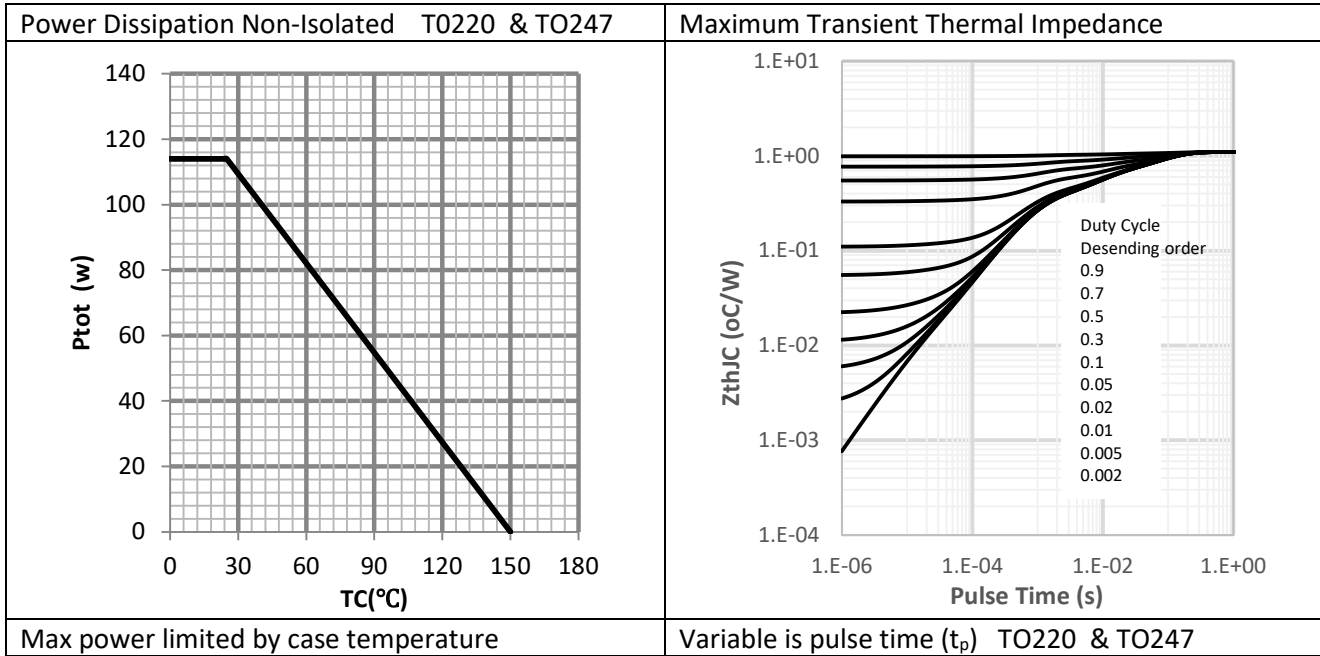


Table 8 Thermal Performance TO220 FULL PAK

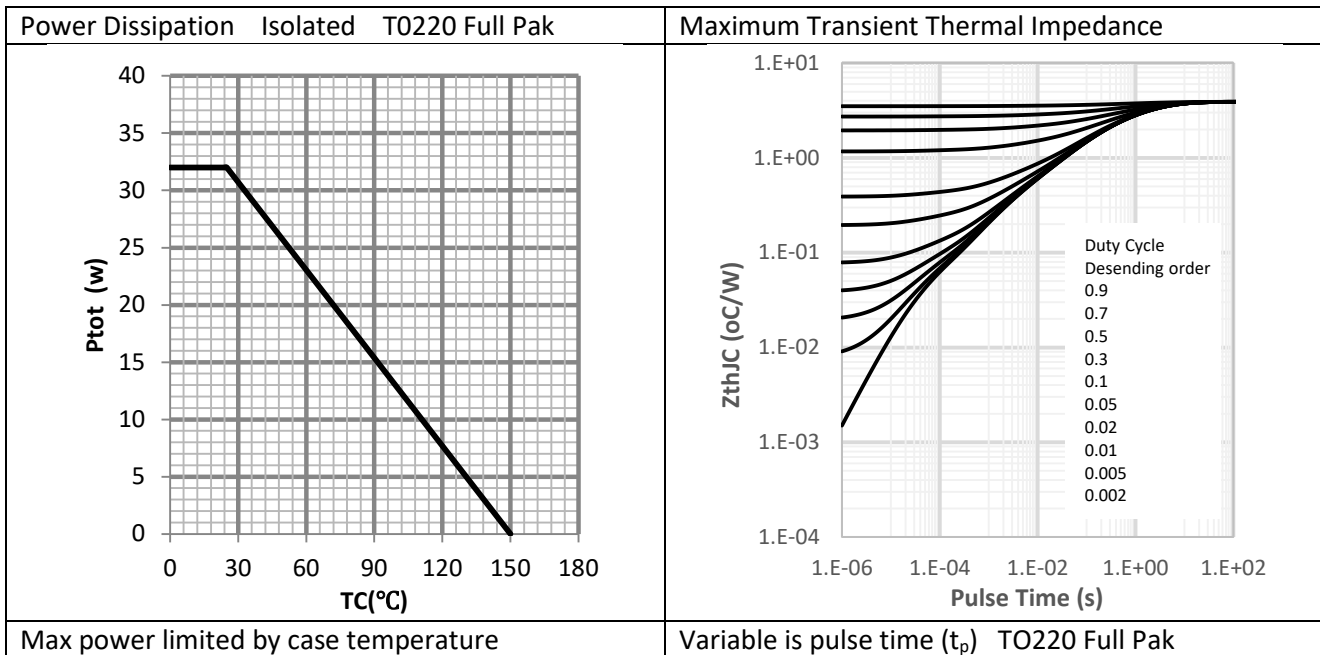


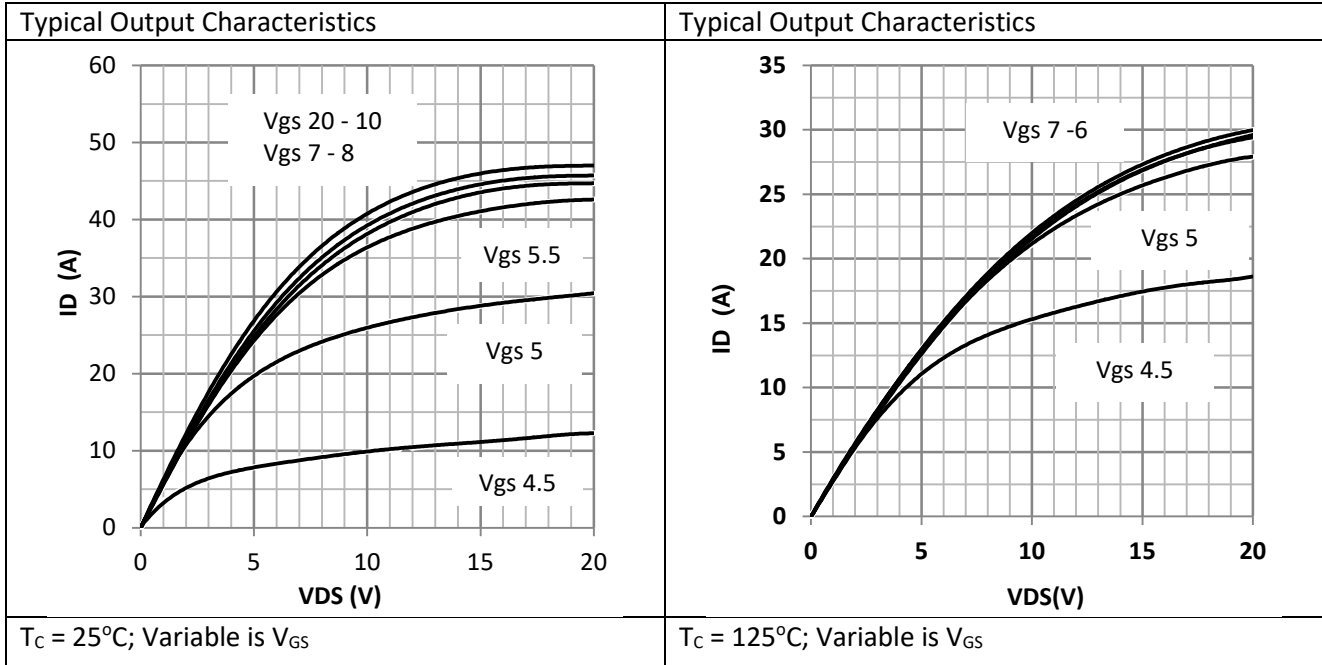
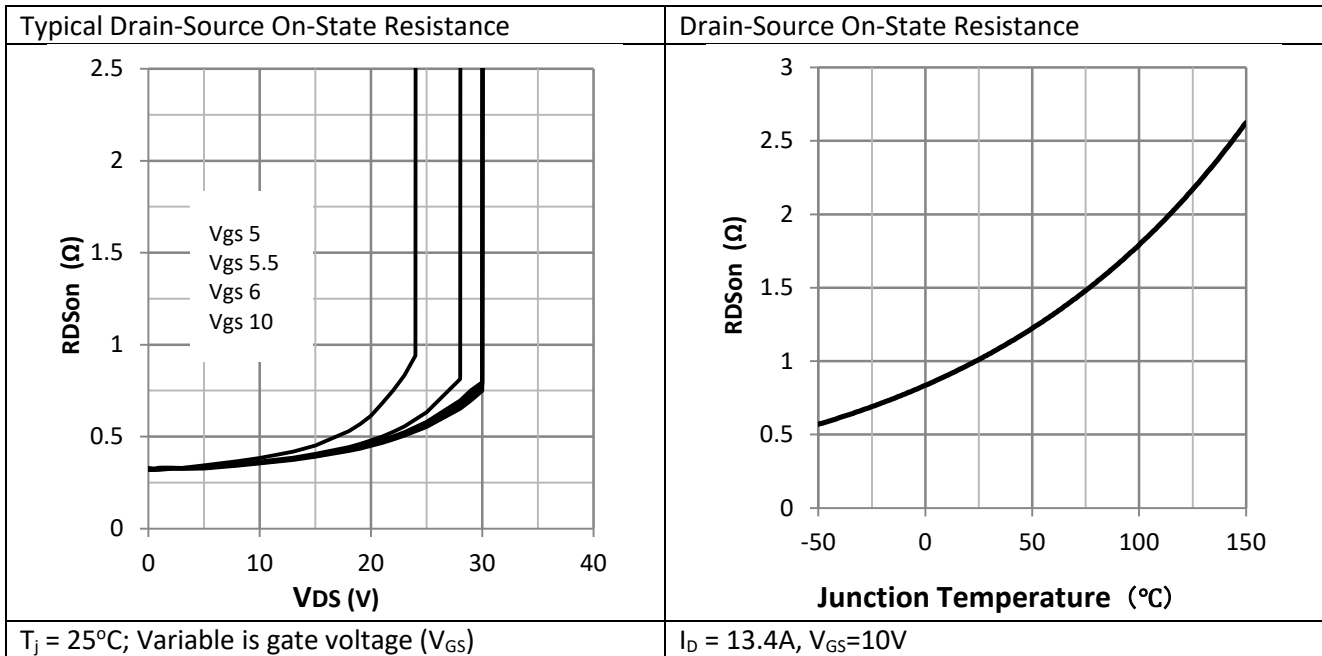
Table 9 Output Characteristics

Table 10 Drain-Source Resistance


Table 11 Safe Operating Area TO220 TO247

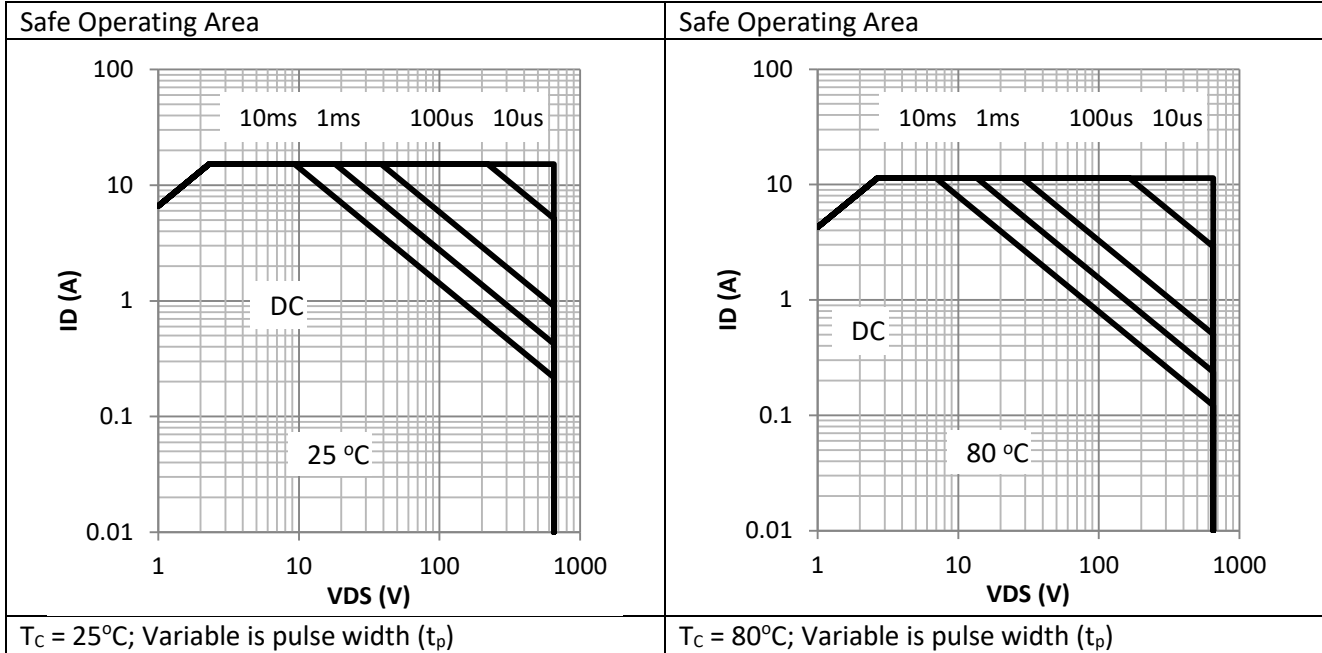


Table 11 Safe Operating Area TO220 FULL PAK

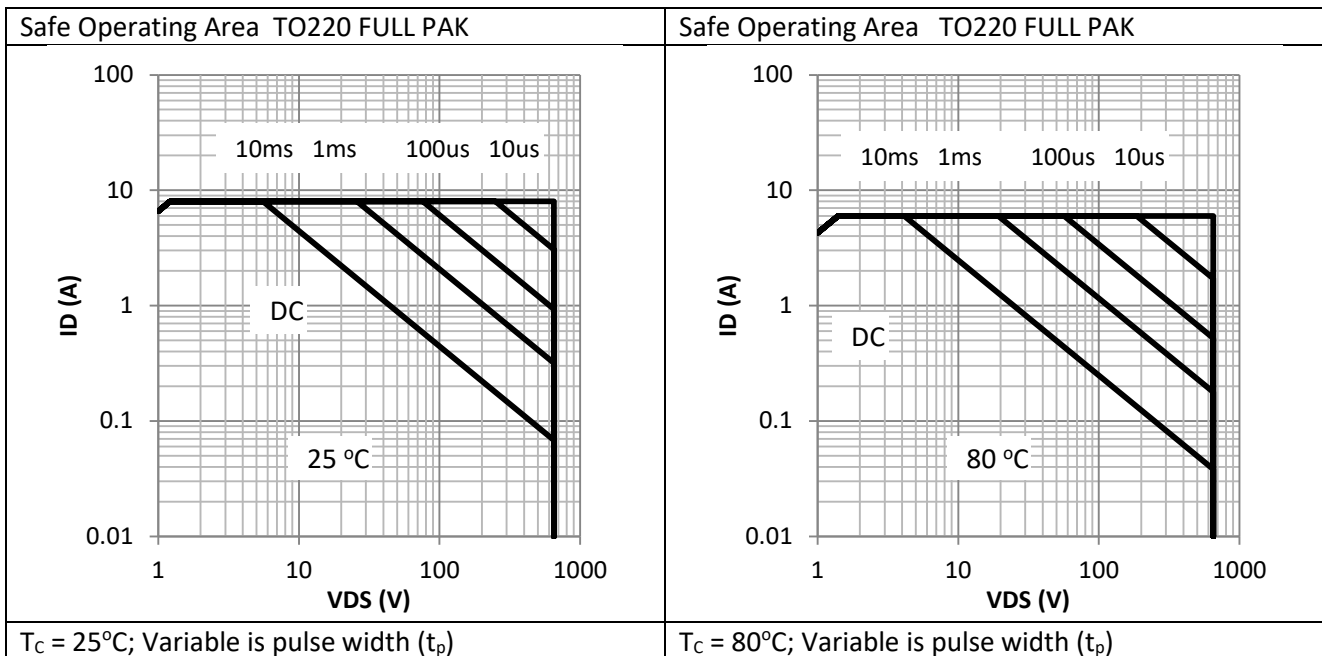


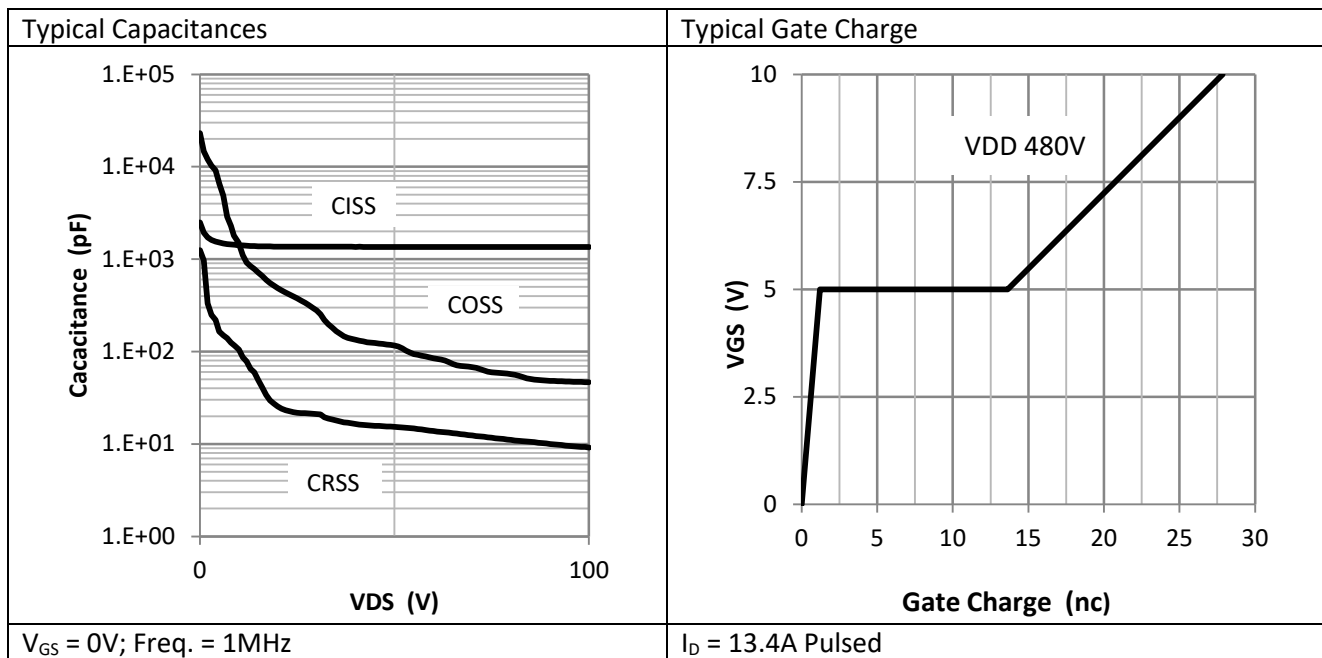
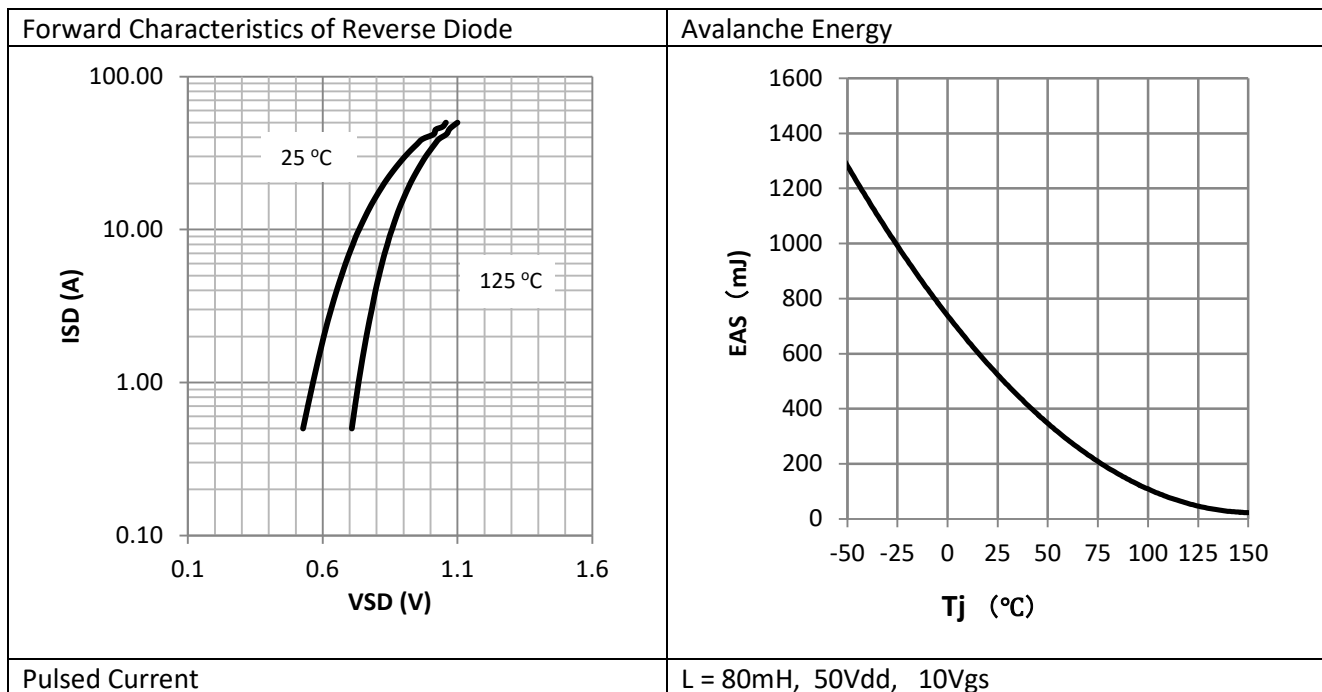
Table 12 Typical Capacitances and Gate Charge

Table 13 Diode Forward Characteristics and Avalanche Energy


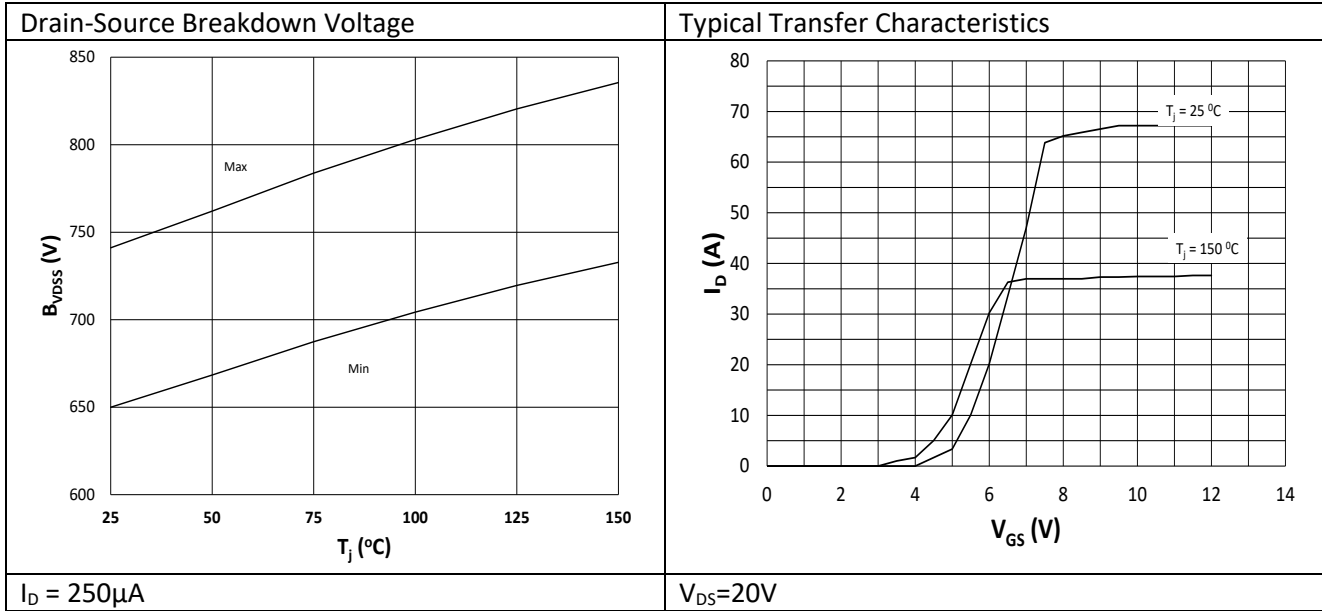
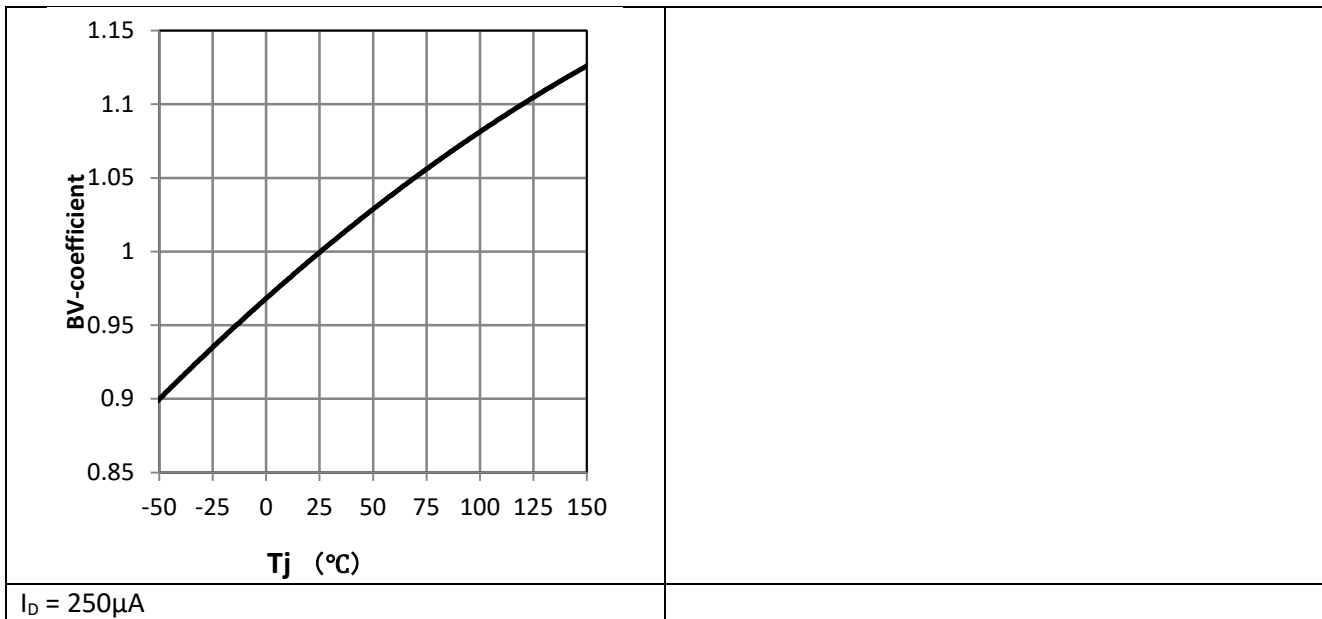
Table 14 Drain-Source Breakdown Voltage and Typical Transfer Characteristics

Table 15 Drain-Source Breakdown Voltage


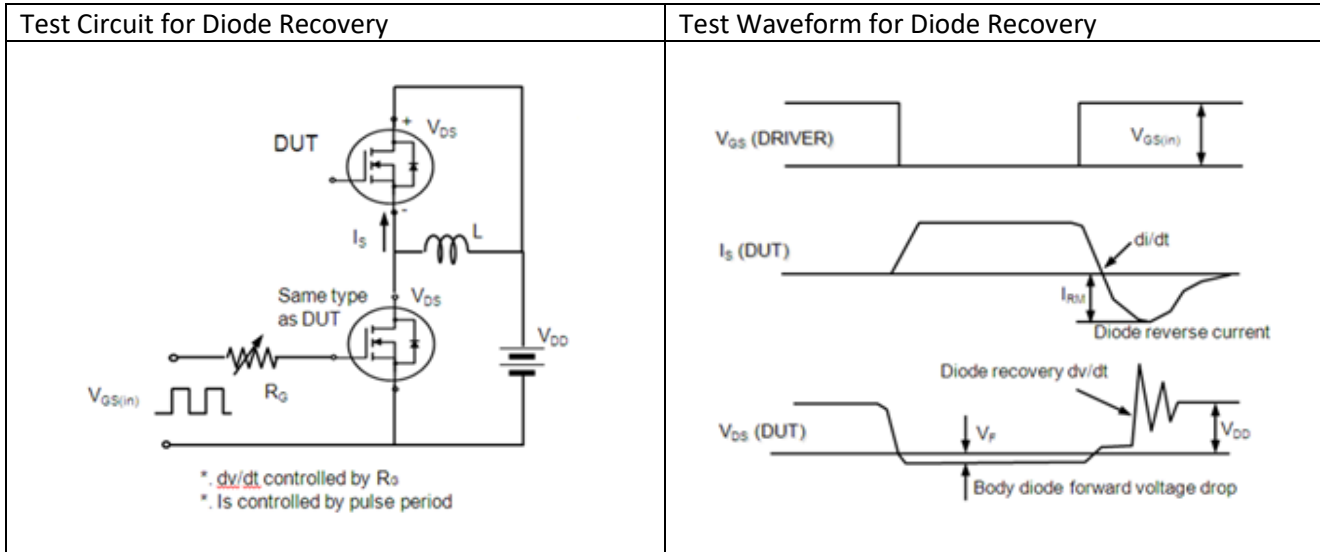
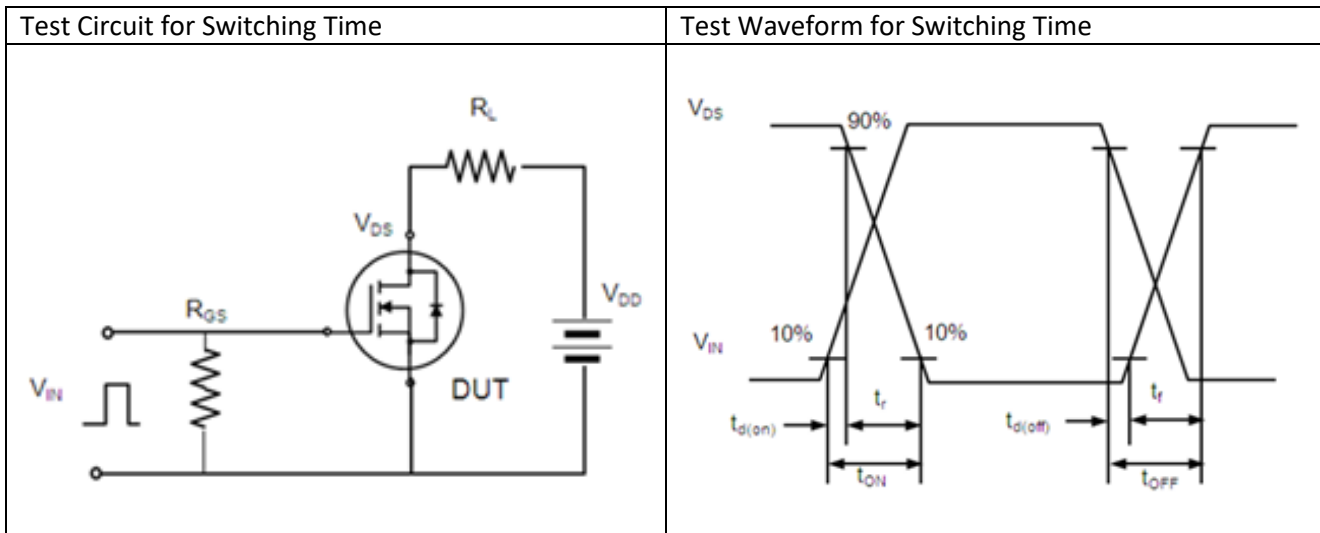
Table 15 Diode Recovery Characteristics

Table 16 Switching Time Characteristics


Table 17 Gate Charge Characteristics

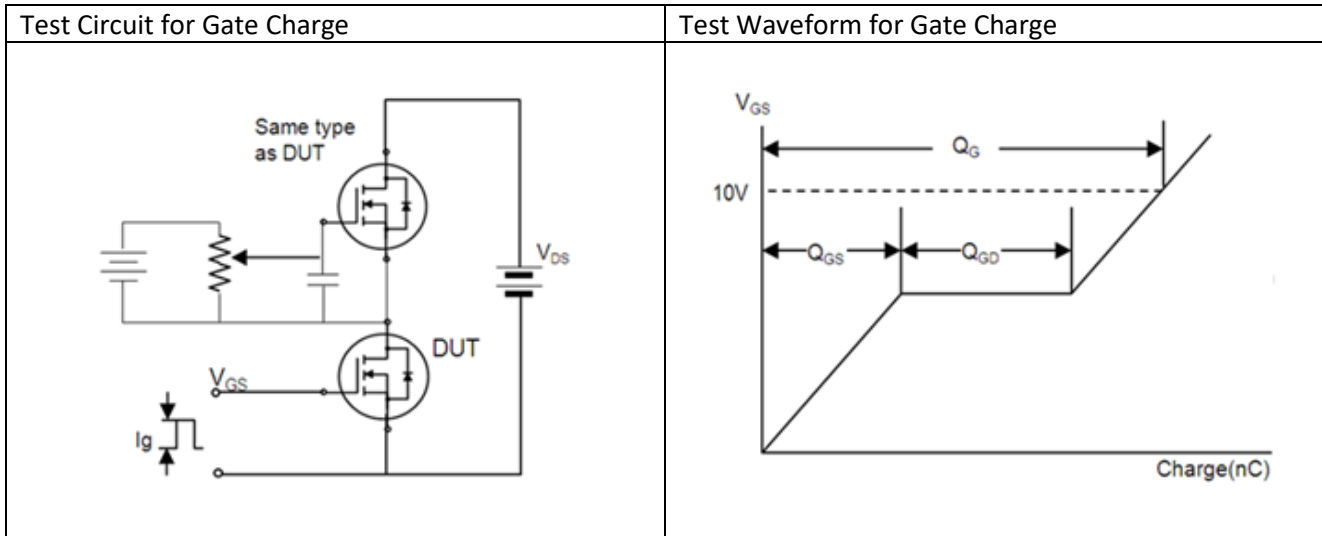
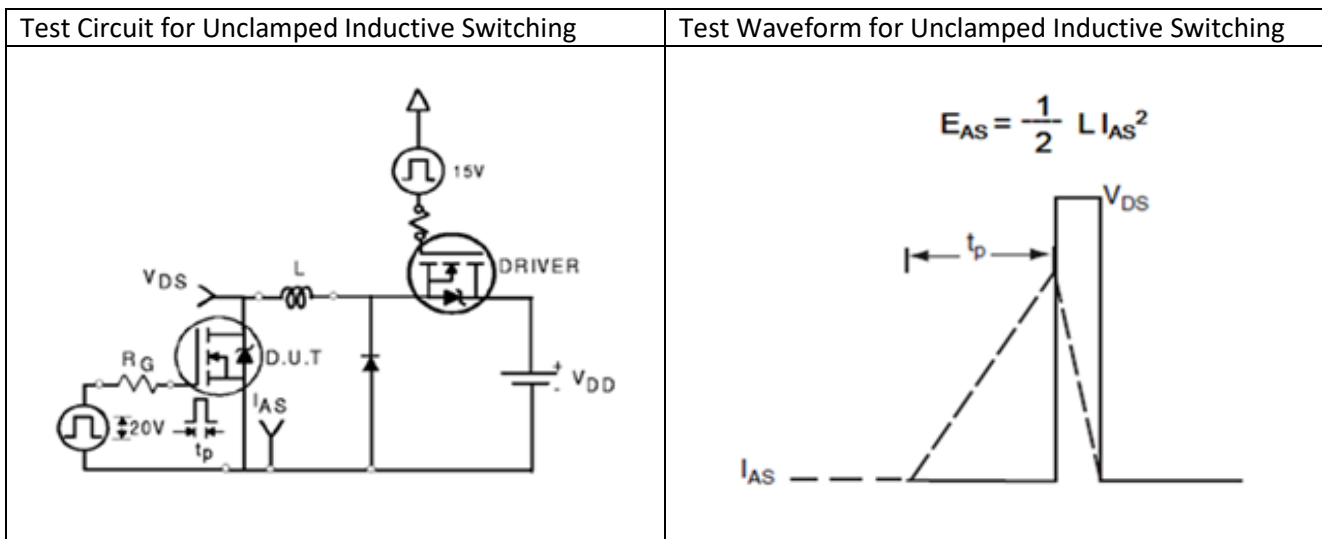


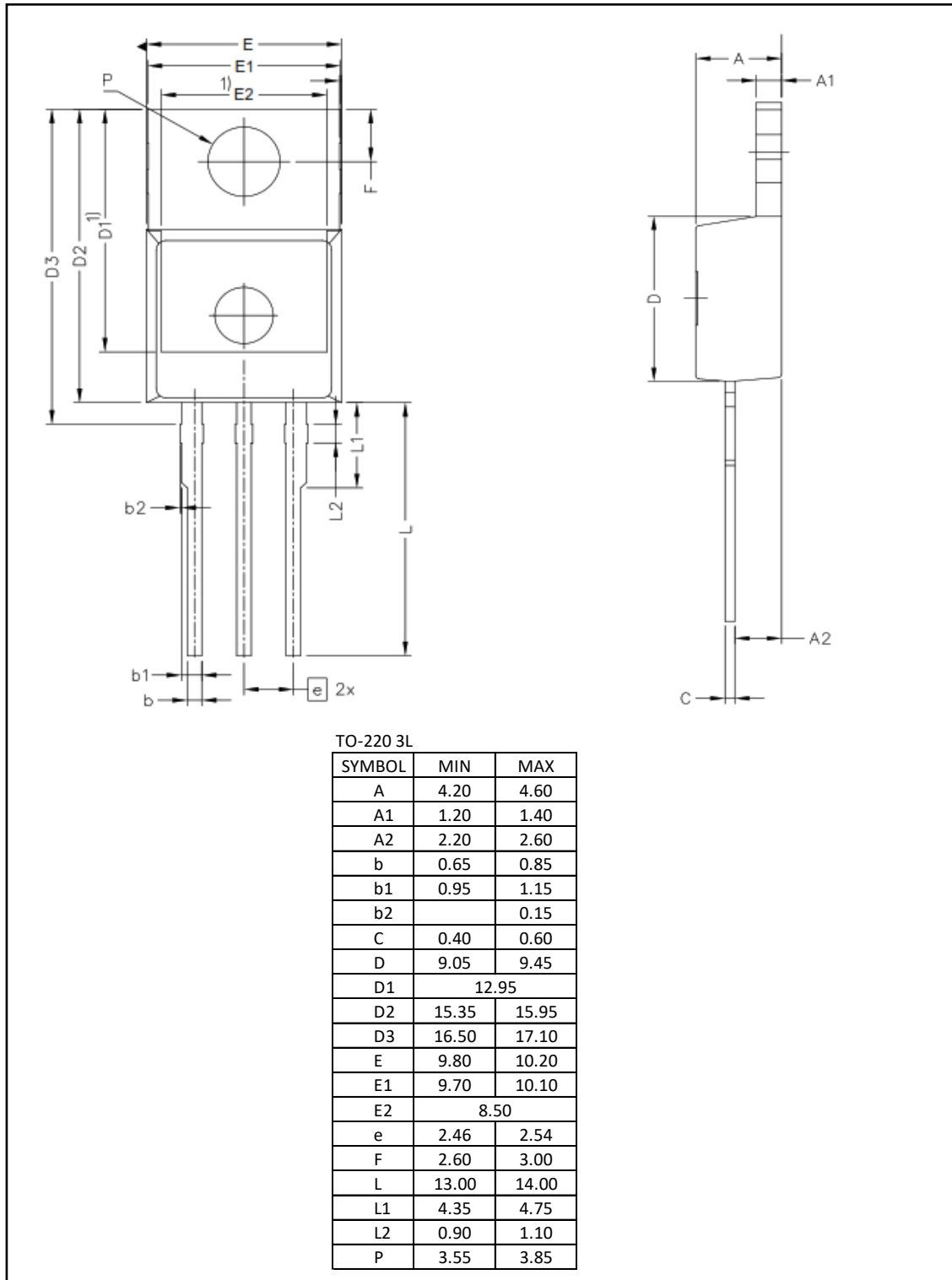
Table 18 Unclamped Inductive Switching Characteristic



5. Package Outlines

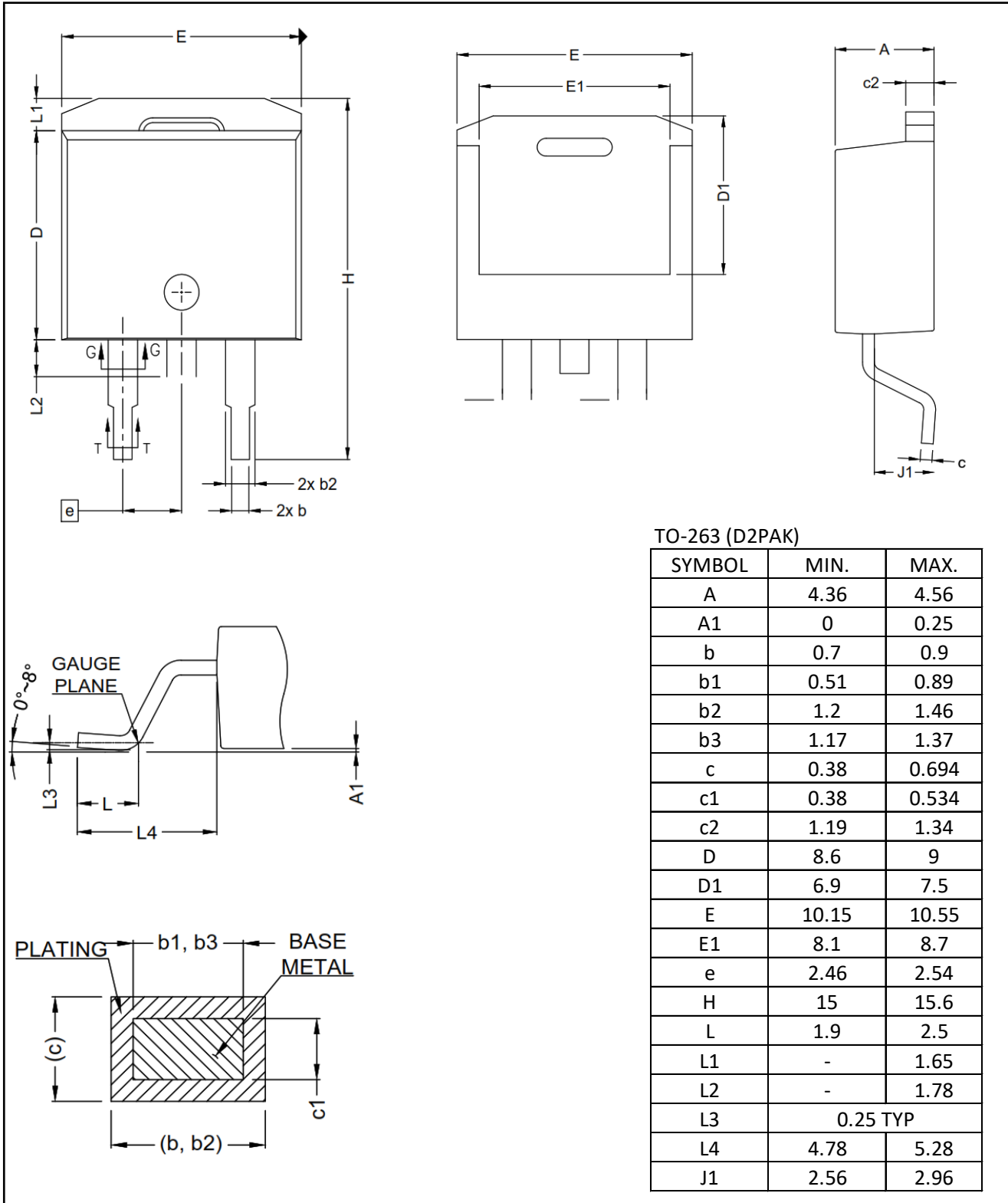
4a) TO-220

D3 Semiconductor TO-220-3L



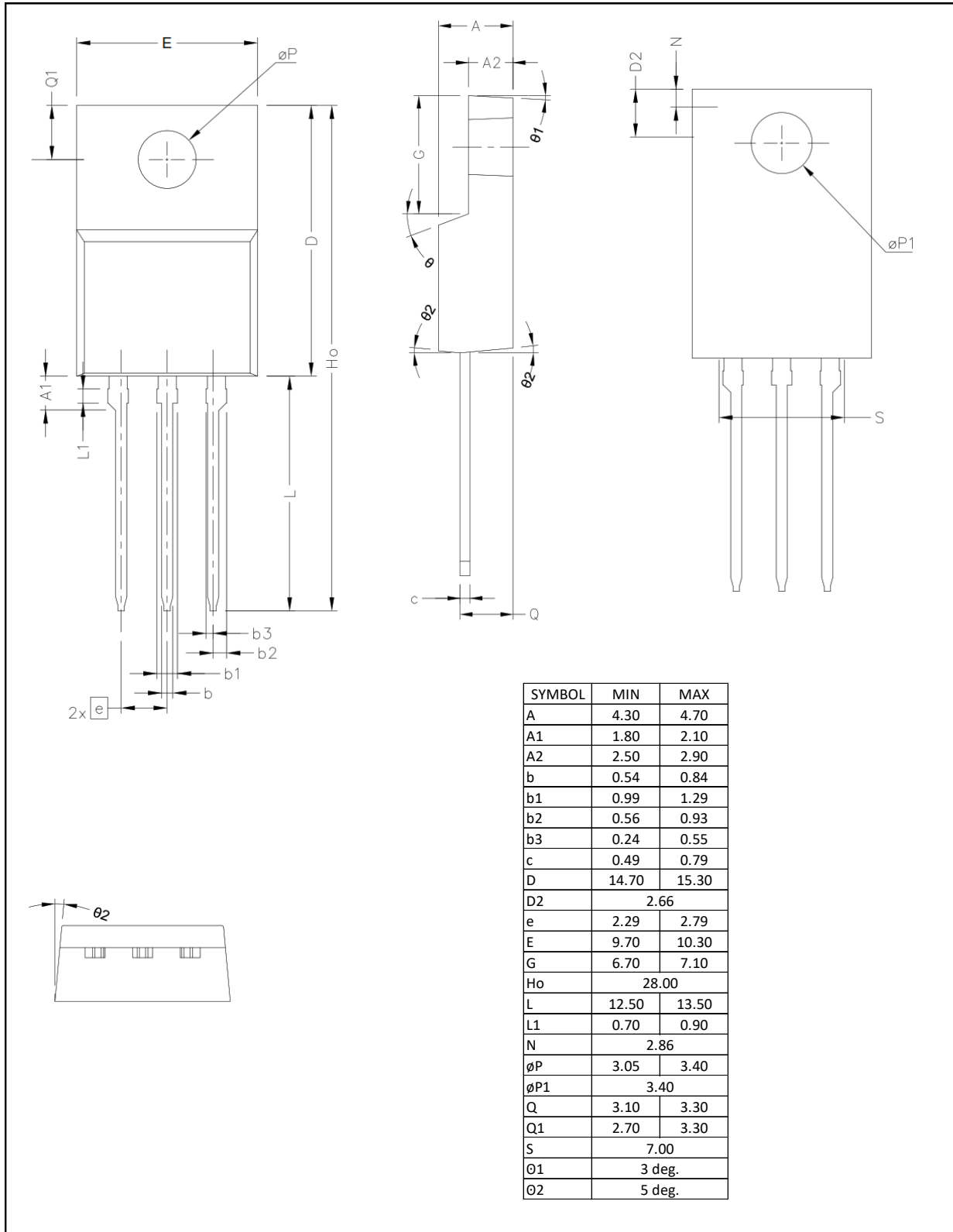
4b) TO-263

D3 Semiconductor TO-263 (D2PAK)



4c) TO-220 FullPak

D3 Semiconductor TO-220 FullPak



6. Revision History

Revision	Release Date	Comments
1.0	1-November-2016	Preliminary Datasheet Release
2.0	15-June-2017	Added graphs and finalized info
2.1	10-Oct-2017	Added FullPak information
2.5	17-Nov-2017	Designers Data Sheet
2.7	20-Nov-2017	Designers Data Sheet Update info

7. Resources

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