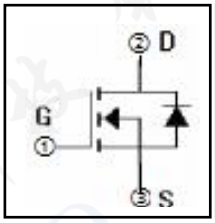
20A 650V N-channel Enhancement Mode Power MOSFET

1 Description

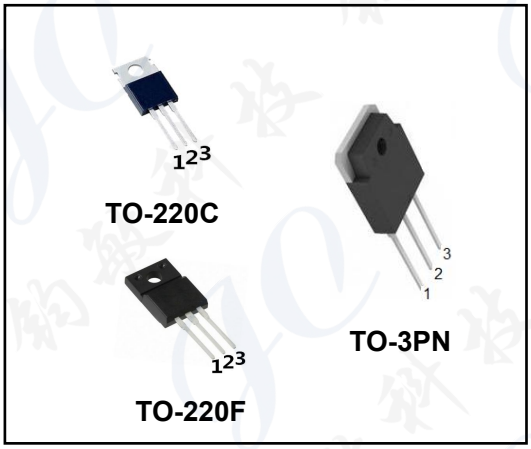
These silicon N-channel enhanced vdmosfets are obtained by the self-aligned planar technology which reduce the conduction loss,improve switching performance and enhance the avalanche energy.The package form is TO-220F. Which accords with the RoHS standard.



V_{DSS} = 650V

$R_{DS(on)\ (TYP)}$= 0.35Ω

I_D = 20A



2 Features

- Fast switching
- Low on resistance(Rdson≤0.5Ω)
- Low gate charge(Typ: 57.7nC)
- Low reverse transfer capacitances(Typ: 167pF)
- 100% single pulse avalanche energy test
- 100% ΔV_{DS} test

3 Application

- Used in various power switching circuit for system miniaturization and higher efficiency.
- Power switch circuit of adaptor and charger.

4 Electrical Characteristics

4.1 Absolute Maximum Rating (Tc=25℃,unless otherwise noted)

Parameter		Symbol	Value			Units
			20N65AQ1	F20N65AQ1	20N65DAQ1	
Maximum Drian-Source DC Voltage		V_{DSS}	650			V
Maximum Gate-Drain Voltage		V_{GSS}	±30			V
Drain Current(continuous)	T_C=25℃	I_D	20			A
	T_C=100℃		14			A
Drain Current(Pulsed)		I_{DM}	80			A
Single Pulse Avalanche Energy		E_{AS}	810			mJ
Peak Diode Recovery dv/dt		dv/dt	5			V/ns
Total Dissipation	T_a=25℃	P_{tot}	2	2	3	W
	T_C=25℃	P_{tot}	250	85	250	W
Junction Temperature		T_j	150			℃
storage Temperature		T_{stg}	-55～150			℃
High Temperature(tin solder)		T_L	300			℃

4.2 Thermal Characteristics

Parameter	Symbol	Value			Unit
		20N65AQ1	F20N65AQ1	20N65DAQ1	
Thermal Resistance Junction to Case-sink	R_{thJC}	0.5	1.47	0.5	℃/W
Thermal Resistance Junction to Ambient	R_{thJA}	62.5	62.5	41.7	℃/W

4.3 Electrical Characteristics（Tc=25℃,unless otherwise noted）

Parameter	Symbol	Test Condition	Value			Units
			Min	Typ	Max	
Off Characteristics						
Drain-source Breakdown Voltage	BV_{DSS}	I_D=250μA,V_{GS}=0V	650	680	--	V
Drain-to-Source Leakage Current	I_{DSS}	V_{DS}=650V,V_{GS}=0V,T_C=25℃	--	--	1	μA
		V_{DS}=520V,V_{GS}=0V,T_C=125℃	--	--	100	μA
Gate-to-Source Forward Leakage	I_{GSSF}	V_{GS}=+30V	--	--	100	nA
Gate-to-Source Reverse Leakage	I_{GSSR}	V_{GS}=-30V	--	--	-100	nA
On Characteristics						
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS},I_D=250μA	2.0	--	4.0	V
Drain-source on Resistance	$R_{DS(on)}$	V_{GS}=10V,I_D=10A	--	0.35	0.5	Ω
Forword Transconductance	g_{fs}	V_{DS}=15V,I_D=10A	--	15.5	--	S
Dynamic Characteristics(						
Input Capacitance	C_{iss}	V_{GS}=0V,V_{DS}=25V,f=1.0MHz	--	3021	--	pF
Output Capacitance	C_{oss}		--	199	--	
Reverse Transfer Capacitance	C_{rss}		--	167	--	
Gate Resisitance	R_G	V_{DS}=0V,V_{GS}=0V,F=1MHz	--	2.5	--	Ω
Switching Characteristics						
Turn-on Delay Time	$t_{d(on)}$	I_D=20A, V_{DD}=325V, R_G=25Ω	--	24.4	--	nS
Turn-on Rise Time	t_r		--	29.4	--	
Turn-off Delay Time	$t_{d(off)}$		--	76.8	--	
Turn-off Fall Time	t_f		--	36.8	--	
Total Gate Charge	Q_g	I_D=20A,V_{DD}=325V,V_{GS}=10V	--	57.7	--	nC
Gate-to-Source Charge	Q_{gs}		--	19.5	--	
Gate-to-Drain(“Miller”)Charge	Q_{gd}		--	15.3	--	
Drain-Source Diode Characteristics						
Diode Forward Voltage	V_{FSD}	V_{GS}=0V,I_S=20A	--	--	1.5	V
Diode Forward Current	I_S		--	--	20	A
Reverse Recovery Time	t_{rr}	T_J=25℃,I_F=20A, dI_F/dt=100A/μS,V_{GS}=0V	--	574	--	nS
Reverse Recovery Charge	Q_{rr}		--	7244	--	nC

Notes：

1: Repetitive rating, pulse width limited by maximum junction temperature.

2: Surface mounted on FR4 Board, t≤10sec.

3: Pulse width ≤ 300μs, duty cycle ≤ 2%.

4: Guaranteed by design, not subject to production.

5: L=10mH,I_D=18A,V_{DD}=50V,V_{GATE}=650V,Start T_J=25℃.

6. I_{SD}=20A,di/dt≤200A/μs,V_{DD}≤BV_{DSS}, Start T_J=25℃.

5 Typical characteristics diagrams

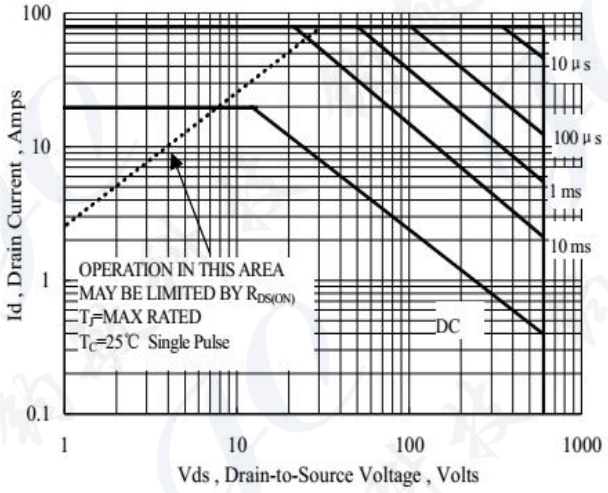


Figure 1 Maximum Forward Bias Safe Operating Area

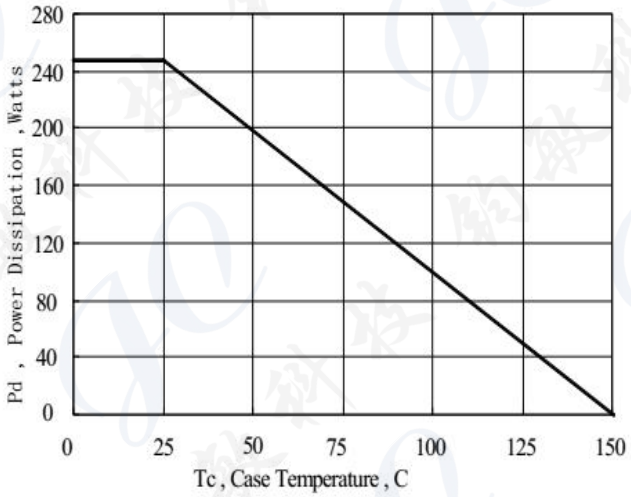


Figure 2 Maximum Power Dissipation vs Case Temperature

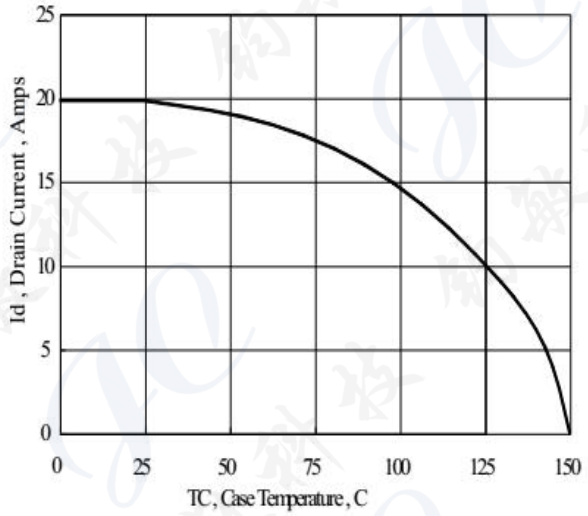


Figure 3 Maximum Continuous Drain Current vs Case Temperature

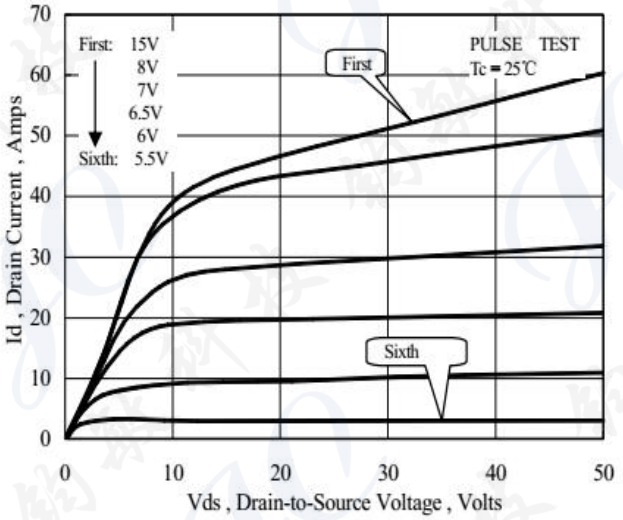


Figure 4 Typical Output Characteristics

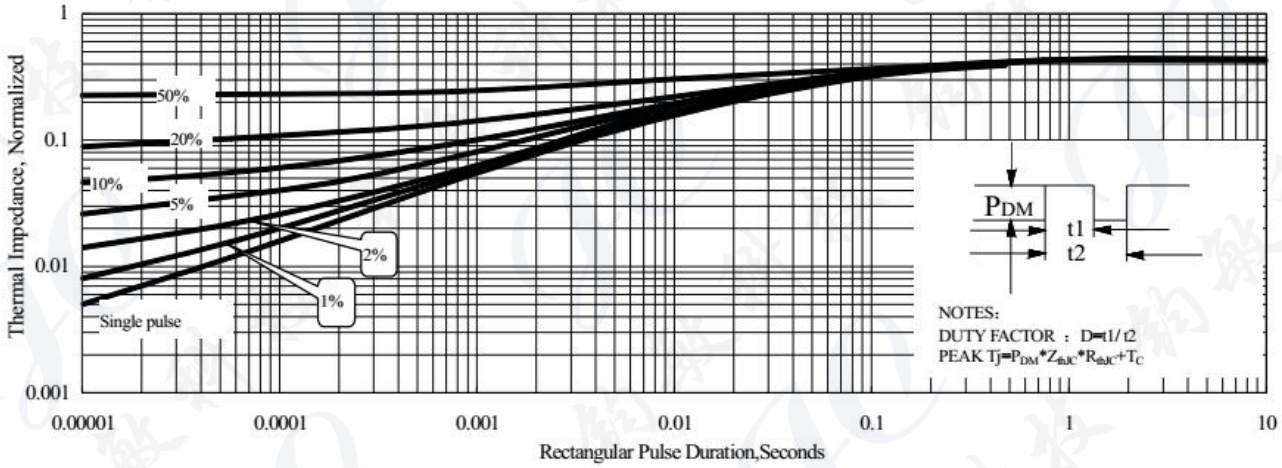


Figure 5 Maximum Effective Thermal Impendance , Junction to Case

5 Typical characteristics diagrams(continues)

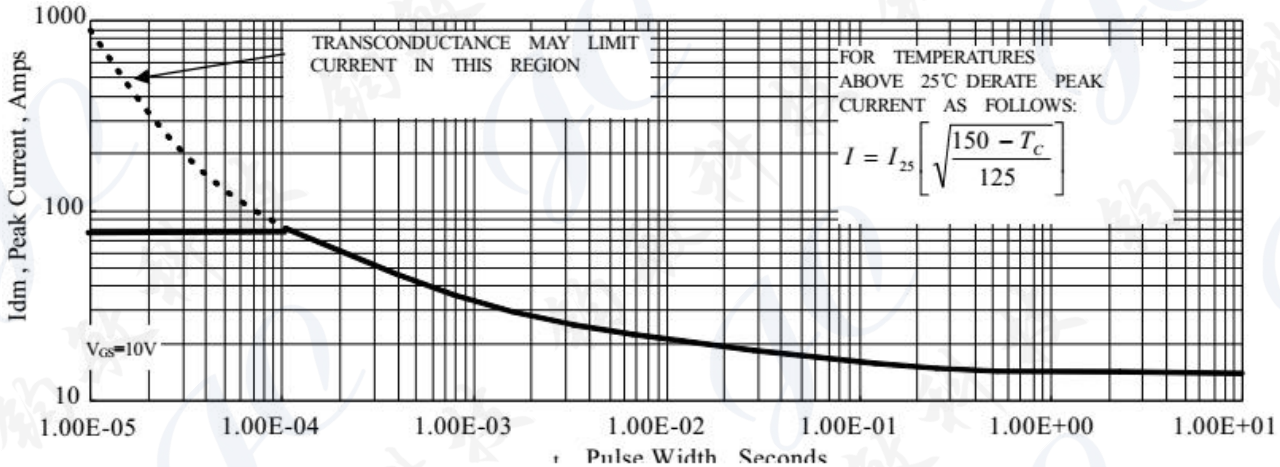


Figure 6 Maximun Peak Current Capability

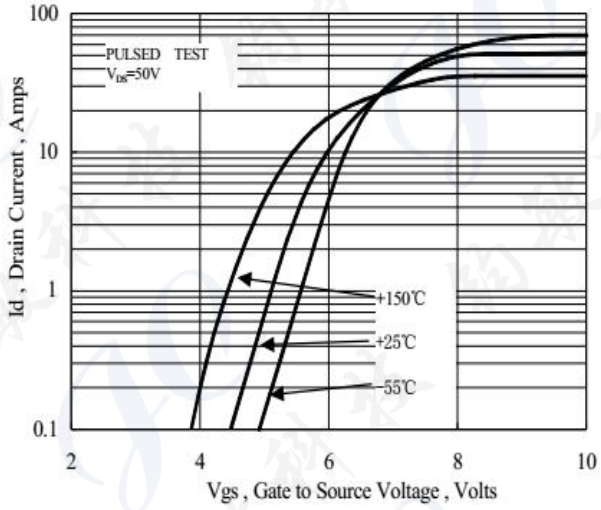


Figure 7 Typical Transfer Characteristics

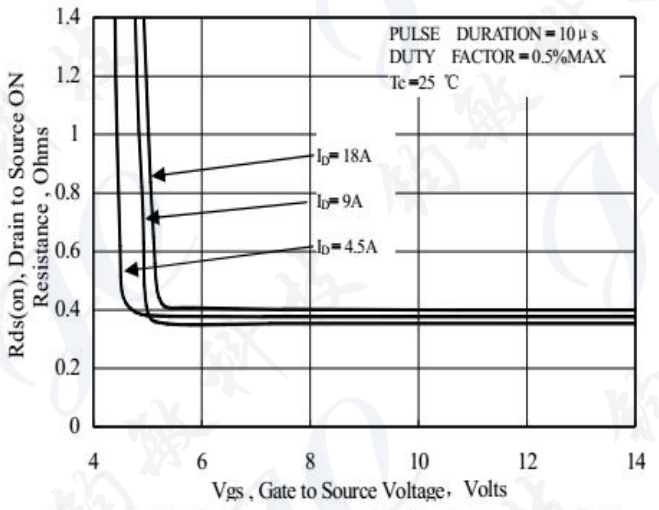


Figure 8 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

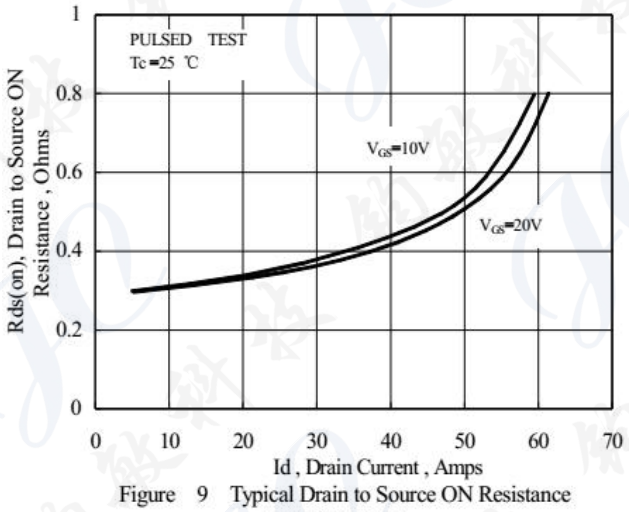


Figure 9 Typical Drain to Source ON Resistance vs Drain Current

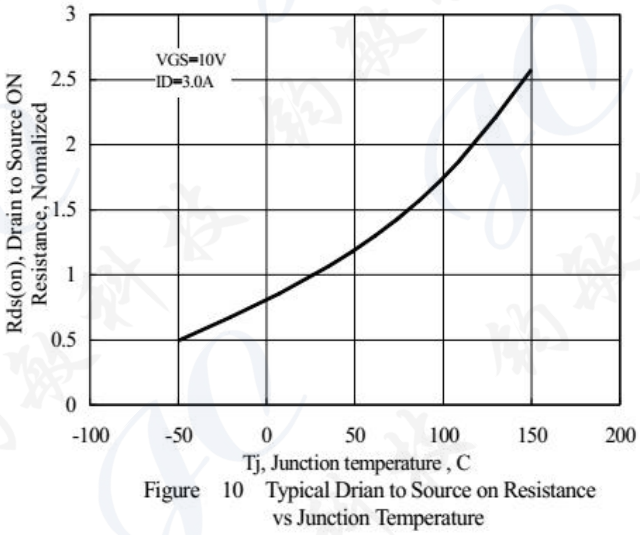


Figure 10 Typical Drian to Source on Resistance vs Junction Temperature

5 Typical characteristics diagrams(continues)

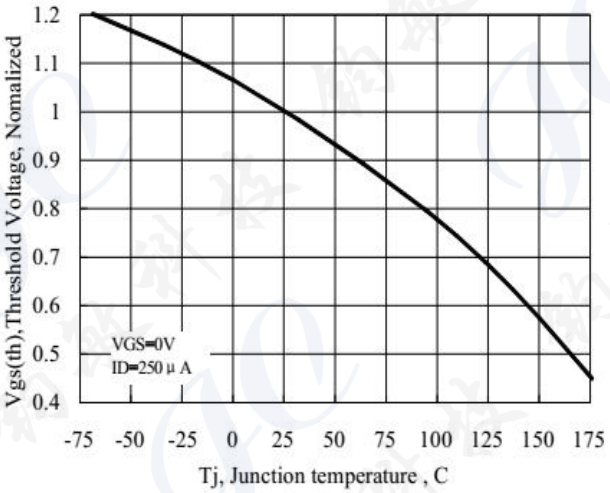


Figure 11 Typical Theshold Voltage vs Junction Temperature

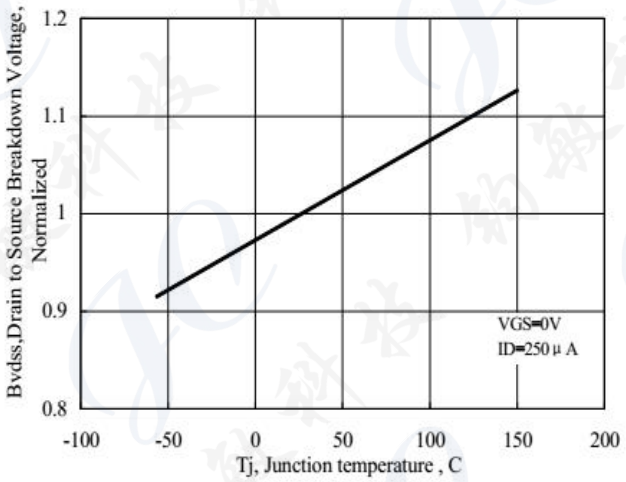


Figure 12 Typical Breakdown Voltage vs Junction Temperature

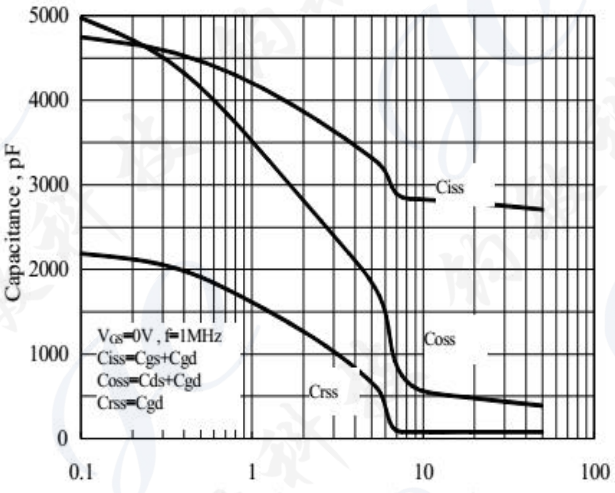


Figure 13 Typical Capacitance vs Drain to Source Voltage

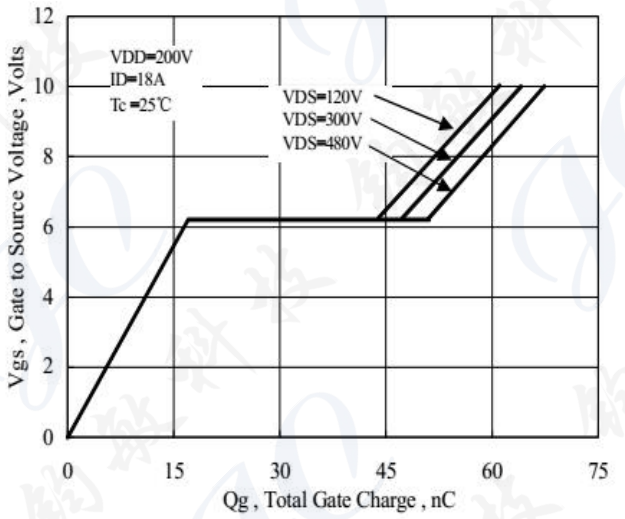


Figure 14 Typical Gate Charge vs Gate to Source Voltage

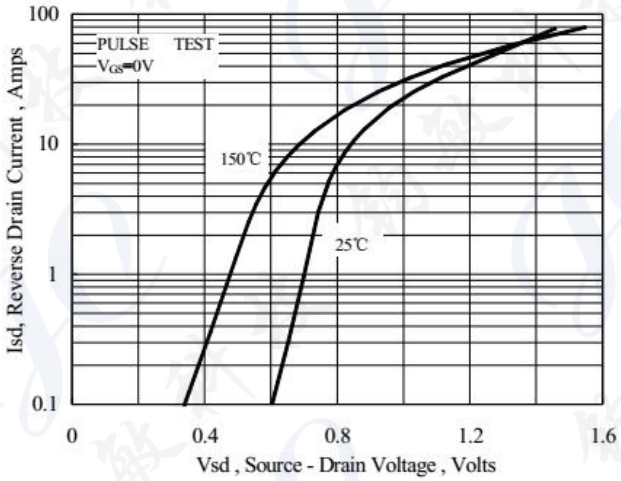


Figure 15 Typical Body Diode Transfer Characteristics

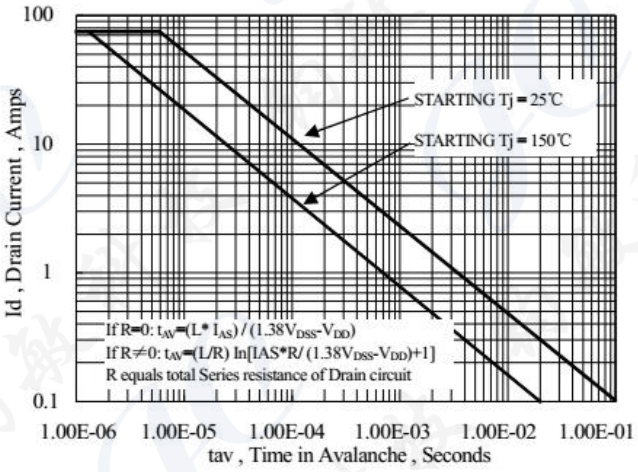


Figure 16 Unclamped Inductive Switching Capability

5 Typical characteristics diagrams(continues)

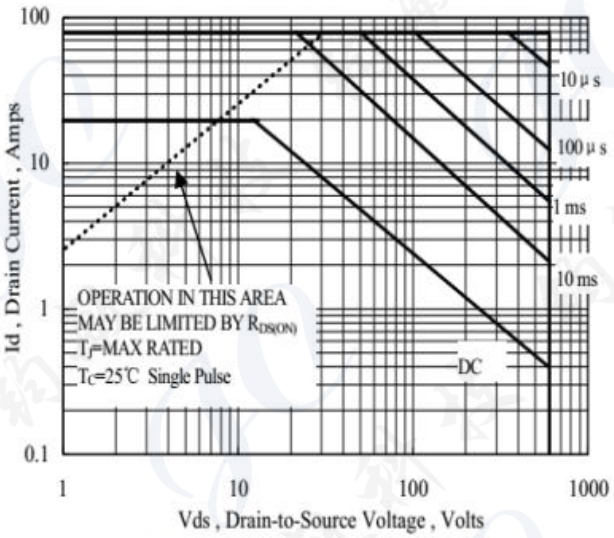


Figure 17 Maximum Forward Bias Safe Operating Area

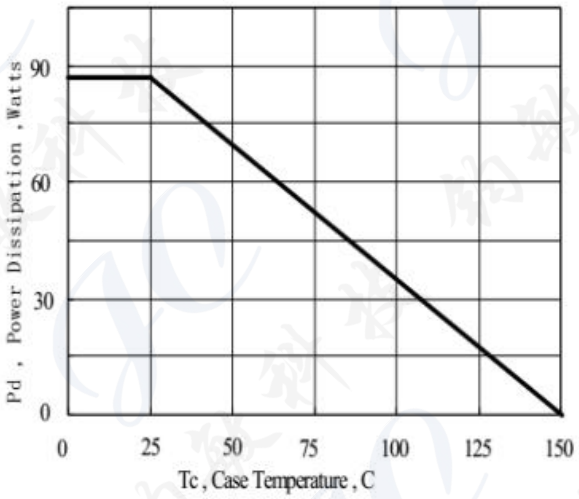
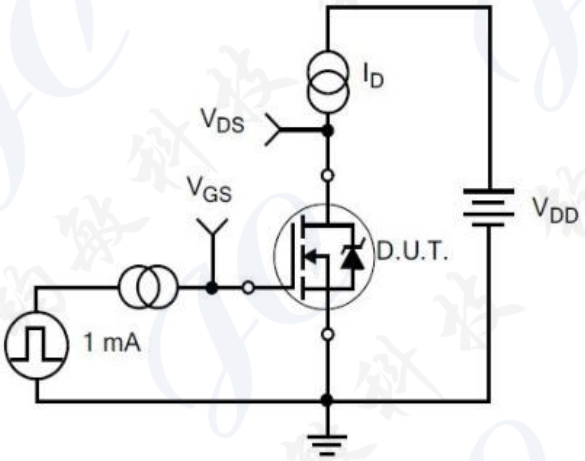
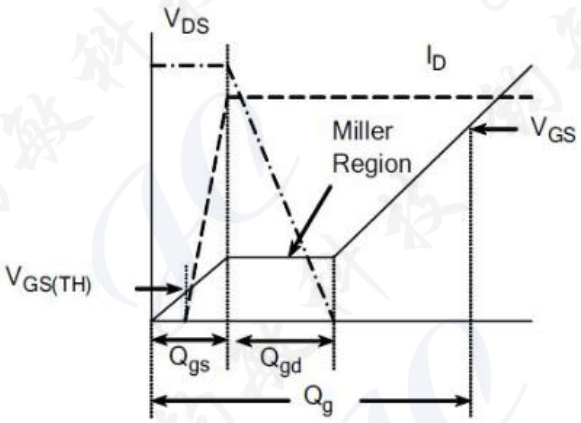


Figure 18 Maximum Power Dissipation vs Case Temperature

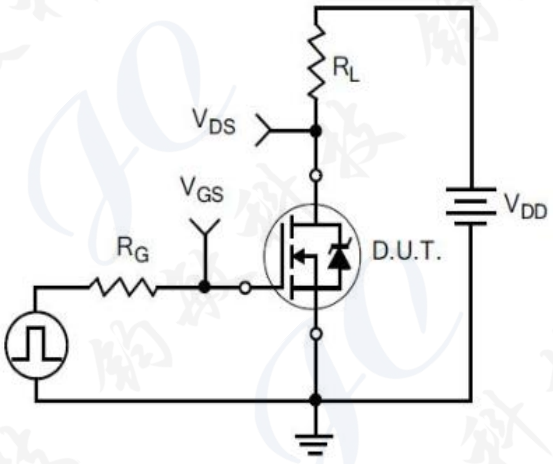
6 Typical Test Circuit and Waveform



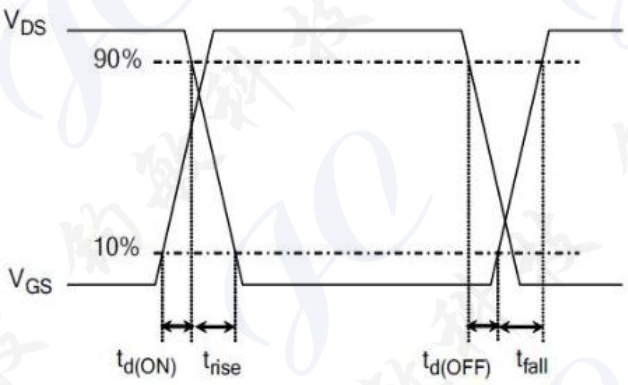
1) Gate Charge Test Circuit



2) . Gate Charge Waveform

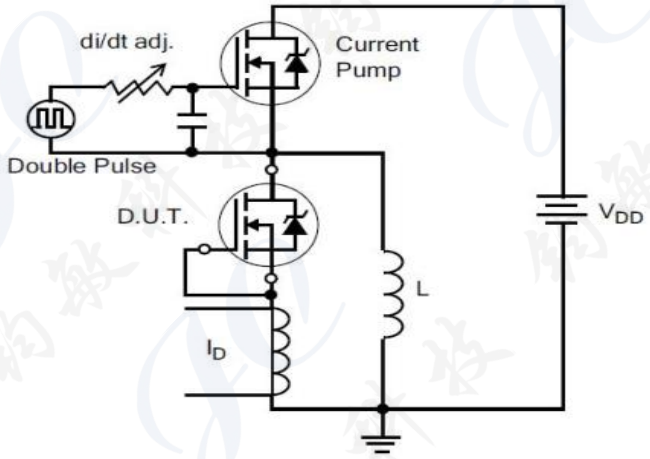


3) Resistive Switching Test Circuit

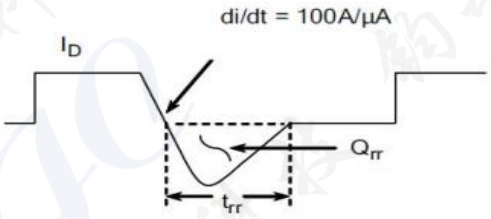


4) Resistive Switching Waveforms

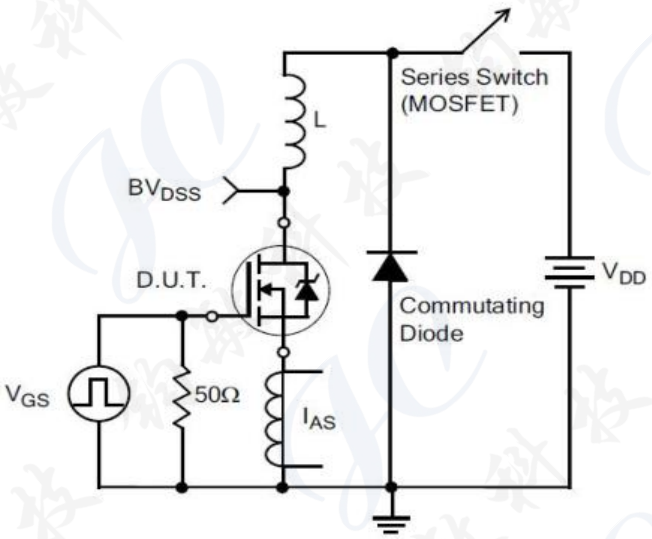
6 Typical Test Circuit and Waveform(continues)



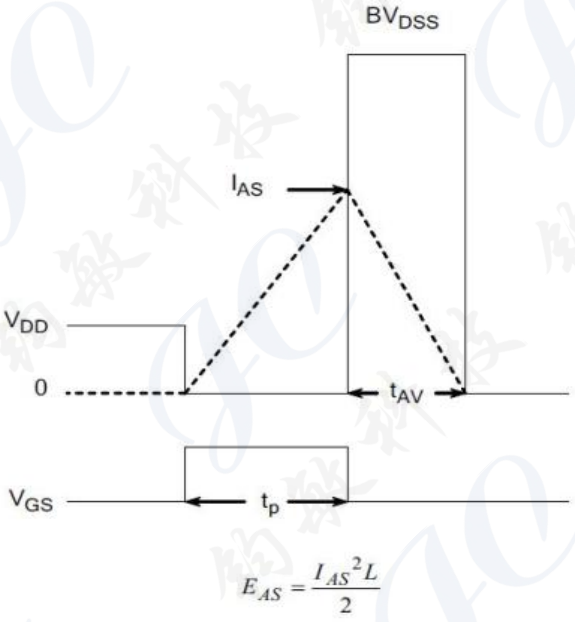
5) Diode Reverse Recovery Test Circuit



6) Diode Reverse Recovery Waveform

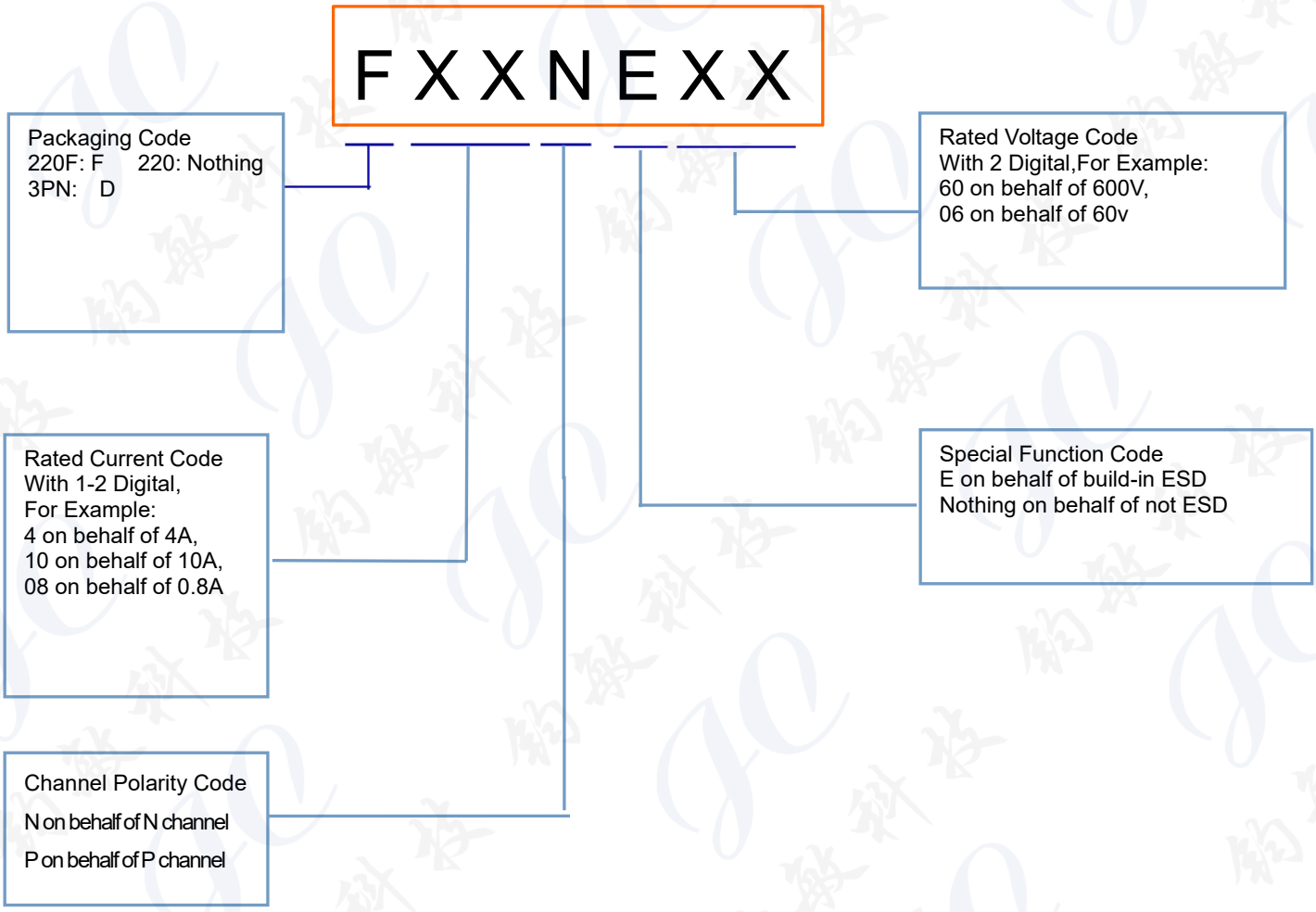


7) . Unclamped Inductive Switching Test Circuit



8) Unclamped Inductive Switching Waveforms

7 Product Names Rules

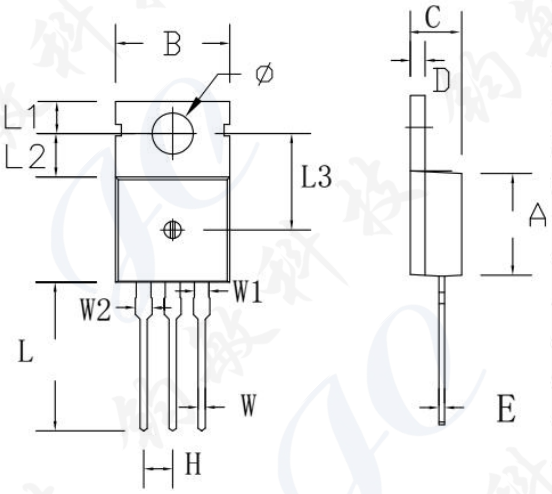


8 Product Specifications and Packaging Models

Product Model	Package Type	Mark Name	Indentification Code	RoHS	Package	Quantity
20N65AQ1	TO-220C	20N65	AQ1	Pb-free	Tube	1000/box
F20N65AQ1	TO-220F	F20N65	AQ1	Pb-free	Tube	1000/box
20N65DAQ1	TO-3PN	20N65D	AQ1	Pb-free	Tube	600/box

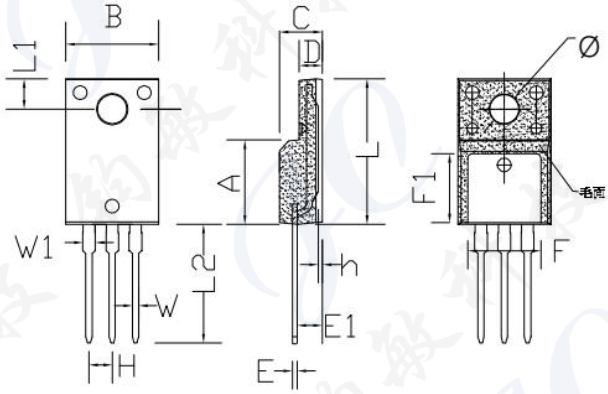
9 Dimensions

TO-220C PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
H	2.54 TYP		0.100 TYP	
W	0.60	0.95	0.024	0.037
W1	1.05	1.45	0.041	0.057
W2	1.20	1.60	0.047	0.063
L	12.60	13.40	0.496	0.528
L1	2.45	2.95	0.096	0.116
L2	3.45	3.95	0.136	0.156
L3	8.15	8.65	0.321	0.341
Φ	3.50	3.90	0.138	0.154

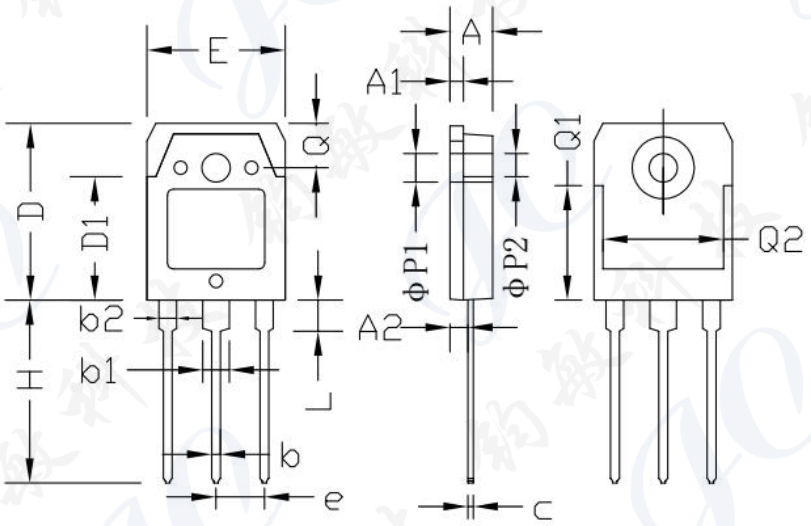
TO-220F PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035
W1	1.15	1.55	0.045	0.061
H	2.54 TYP		0.100 TYP	
E	0.48	0.53	0.019	0.021
Φ	2.90	3.40	0.114	0.134
E1	2.40	2.90	0.094	0.114
F	7.75	8.25	0.305	0.325
F1	7.35	7.85	0.289	0.309

9 Dimensions(continues)

TO-3PN PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.60	5.00	0.181	0.197
A1	1.45	1.65	0.057	0.065
A2	2.20	2.60	0.087	0.102
b	0.80	1.20	0.032	0.047
b1	2.80	3.20	0.110	0.126
b2	1.80	2.20	0.071	0.087
C	0.55	0.75	0.022	0.030
D	19.20	19.70	0.756	0.776
D1	13.10	14.70	0.516	0.578
E	15.40	15.80	0.607	0.623
e	5.45 TYP		0.215 TYP	
H	19.80	20.20	0.780	0.826
L	3.30	3.70	0.130	0.146
ΦP1	3.20 TYP		0.126 TYP	
ΦP2	3.50 TYP		0.138 TYP	
Q	5.00 TYP		0.197 TYP	
Q1	12.40 TYP		0.488 TYP	
Q2	12.6	-	0.496	-

10 Attentions

- Jiangsu Donghai Semiconductor Technology CO.,LTD. reserves the right to change the specification without prior notice! The customer should obtain the latest version of the information before making the order and verify that the information is complete and up to date.
- It is the responsibility of the purchaser for any failure or failure of any semiconductor product under certain conditions. It is the responsibility of the purchaser to comply with safety standards and to take safety measures in the system design and machine manufacturing of Donghai products in order to avoid potential risk of failure. Injury or property damage.
- Product promotion is endless, our company will be dedicated to provide customers with better products.

11 Appendix

Revision history:

Date	REV.	Description	Page
2017.03.09	1.0	Original	