

FEATURES

- $R_{DS(ON)} < 0.5\Omega @ V_{GS} = 10V$
- Fast switching capability
- Low Gate Charge
- Lead free in compliance with EU RoHS directive.

MECHANICAL DATA

- Case: TO-220, ITO-220, TO-3P, ITO-220-L Package

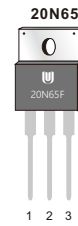
Ordering Information

Part No.	Package Type	Package	Quality(box)
20N65	TO-220	Tube	1000
20N65F	ITO-220	Tube	1000
20N65K	TO-3P	Tube	600
20N65FL	ITO-220-L	Tube	1000

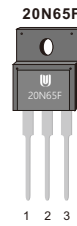
PRODUCT SUMMARY

$V_{DS}(V)$	$R_{DS(ON)}(\Omega)_{TYP}$	$I_D(A)$
650	0.37 @ $V_{GS} = 10V$	20

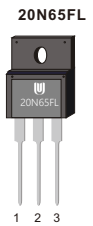
TO-220



ITO-220



ITO-220-L



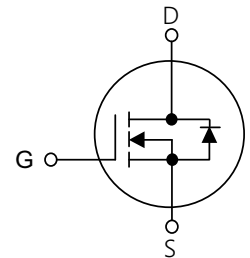
TO-3P



Pin Definition:

1. Gate
2. Drain
3. Source

Block Diagram



ABSOLUTE MAXIMUM RATINGS

($T_C = 25^\circ C$, unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	V_{DS}	650	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current	I_D	20	A
Pulsed Drain Current (Note 1)	I_{DM}	80	A
Avalanche Energy (Note 5)	E_{AS}	550	mJ
Power Dissipation	TO-220/TO-3P	250	W
	ITO-220/ITO-220-L	80	
Junction Temperature	T_J	+150	$^\circ C$
Storage Temperature	T_{STG}	-55 ~ +150	$^\circ C$

20N65 Series

THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220 ITO-220/ITO-220-L	$R_{\theta JA}$	62.5	°C/W
	TO-3P		41.7	
Junction to Case	TO-220/TO-3P	$R_{\theta JC}$	0.5	°C/W
	ITO-220/ITO-220-L		1.47	

ELECTRICAL CHARACTERISTICS (T_c=25°C, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OFF CHARACTERISTICS								
Drain-Source Breakdown Voltage		BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	650			V	
Drain-Source Leakage Current		I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			1	μA	
Gate- Source Leakage Current	Forward	I_{GSS}	$V_{GS}=30V, V_{DS}=0V$			100	nA	
	Reverse		$V_{GS}=-30V, V_{DS}=0V$			-100	nA	
ON CHARACTERISTICS(Note 3)								
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0		4.0	V	
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	$V_{GS}=10V, I_D=10A$		0.37	0.5	Ω	
DYNAMIC CHARACTERISTICS(Note 4)								
Input Capacitance		C_{ISS}	$V_{DS}=25V, V_{GS}=0V, f=1MHz$		2400		pF	
Output Capacitance		C_{OSS}				225		pF
Reverse Transfer Capacitance		C_{RSS}				20		pF
SWITCHING CHARACTERISTICS (Note 4)								
Turn-On Delay Time		$t_{D(ON)}$	$V_{DD}=325V, I_D=20A,$ $R_G=25\Omega$		35		ns	
Turn-On Rise Time		t_R			82		ns	
Turn-Off Delay Time		$t_{D(OFF)}$			180		ns	
Turn-Off Fall Time		t_F			90		ns	
Total Gate Charge		Q_G		$V_{DS}=325V, I_D=20A,$ $V_{GS}=10V$		65		nC
Gate-Source Charge		Q_{GS}			11		nC	
Gate-Drain Charge		Q_{GD}			26		nC	
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS								
Drain-Source Diode Forward Voltage		V_{SD}	$V_{GS}=0V, I_S=20A$			1.5	V	
Maximum Continuous Drain-Source Diode Forward Current (Note 2)		I_S				20	A	
Reverse Recovery Time		t_{rr}	$V_{GS}=0V, I_S=20A$ $di_F/dt=100A/\mu s$ (Note 1)		390		ns	
Reverse Recovery Charge		Q_{RR}			3400		nC	

Note:1. Repetitive Rating : Pulse width limited by maximum junction temperature

2. Surface mounted on FR4 Board , $t_s \leq 10sec$

3. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

4. Guaranteed by design, not subject to production.

5. L=10mH, $I_D=10.5A, V_{DD}=50V, V_{GATE}=650V$, Starting $T_J=25^\circ C$

20N65 Series

Typical characteristics Diagrams

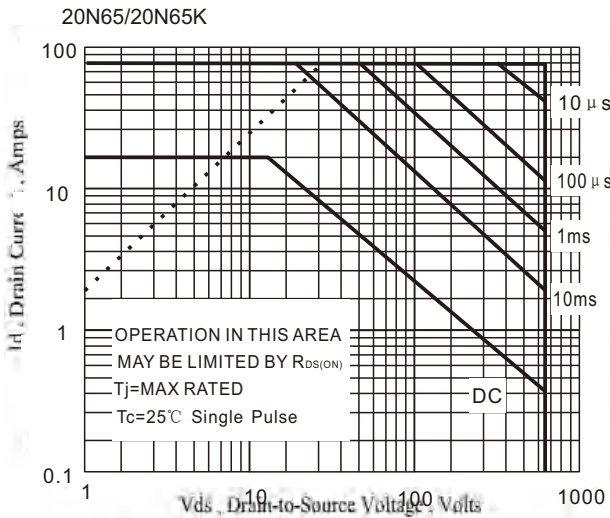


Figure 1 Maximum Forward Bias Safe Operating Area

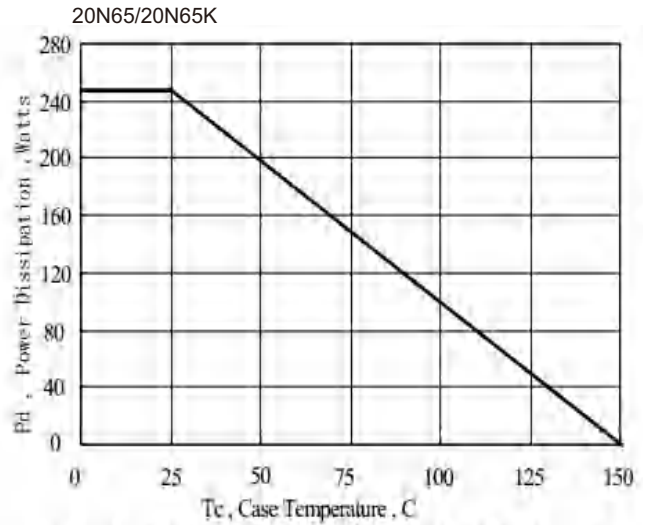


Figure 2 Maximum Power Dissipation vs Case Temperature

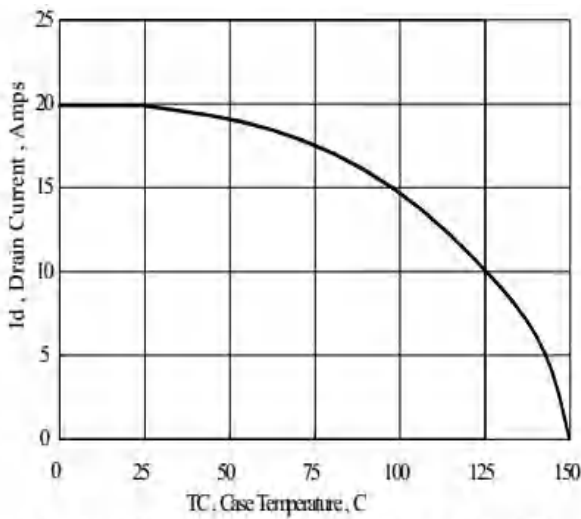


Figure 3 Maximum Continuous Drain Current vs Case Temperature

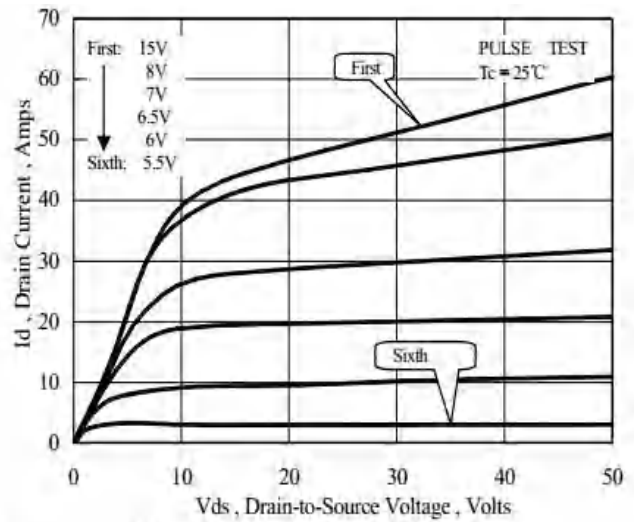


Figure 4 Typical Output Characteristics

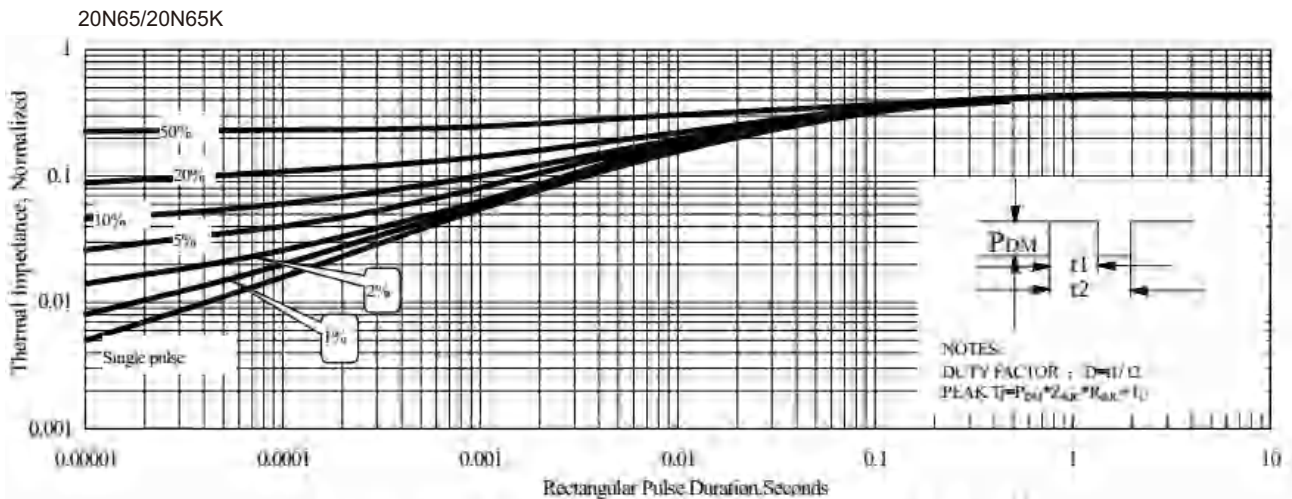


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

Typical characteristics Diagrams

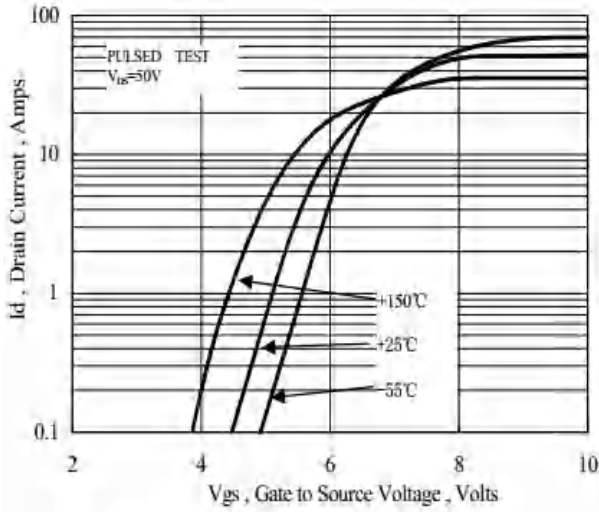


Figure 6 Typical Transfer Characteristics

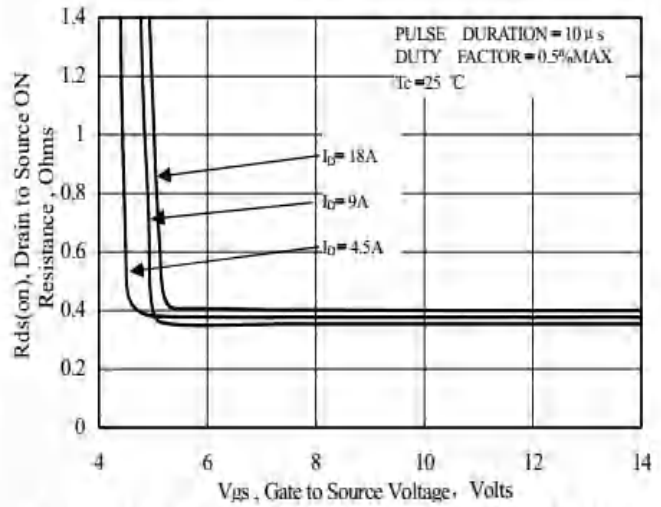


Figure 7 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

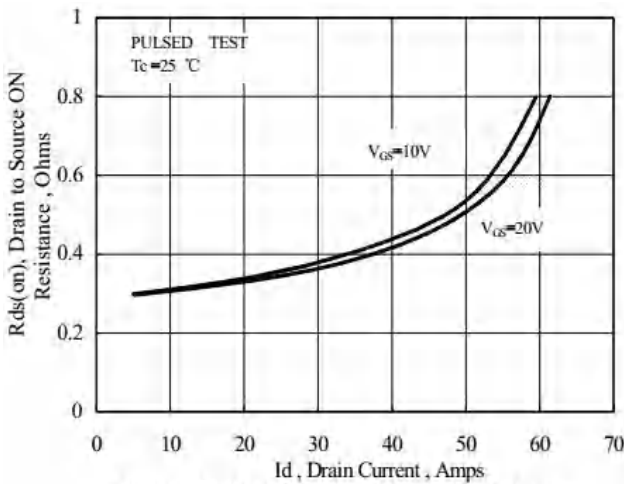


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

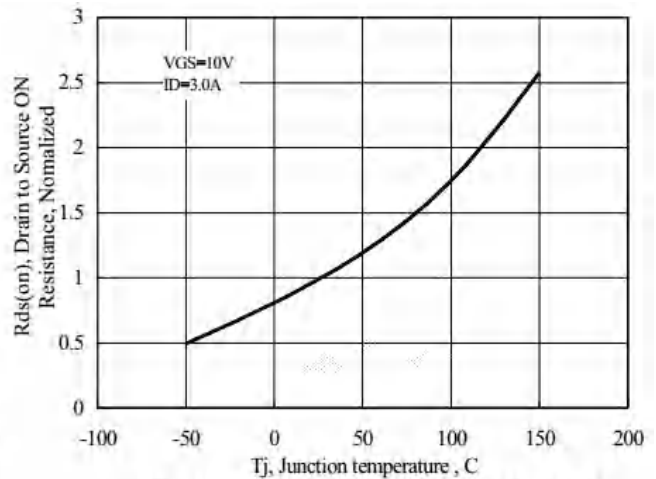


Figure 9 Typical Drain to Source ON Resistance vs Junction Temperature

Typical characteristics Diagrams

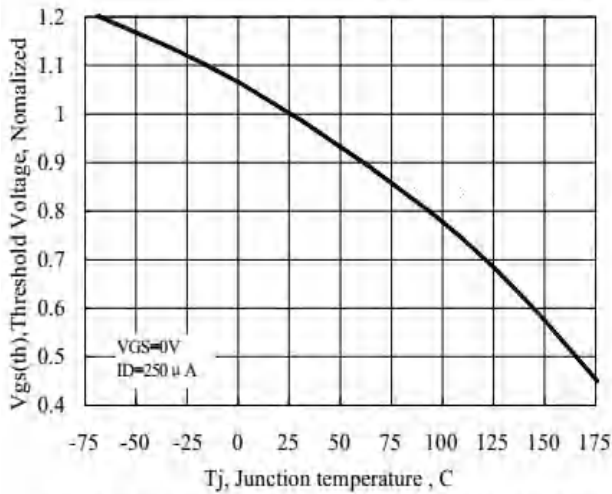


Figure 10 Typical Theshold Voltage vs Junction Temperature

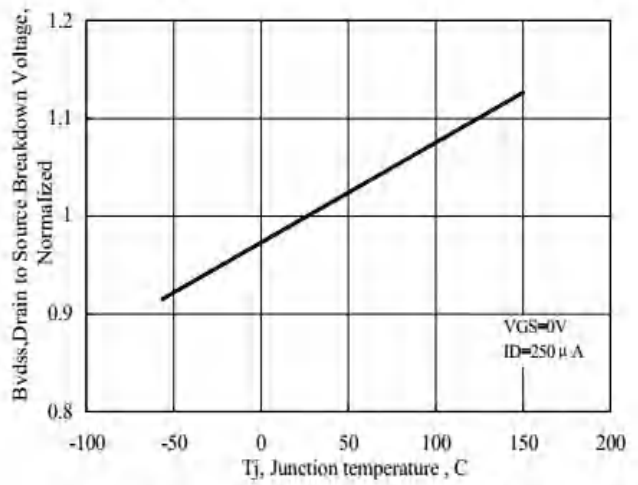


Figure 11 Typical Breakdown Voltage vs Junction Temperature

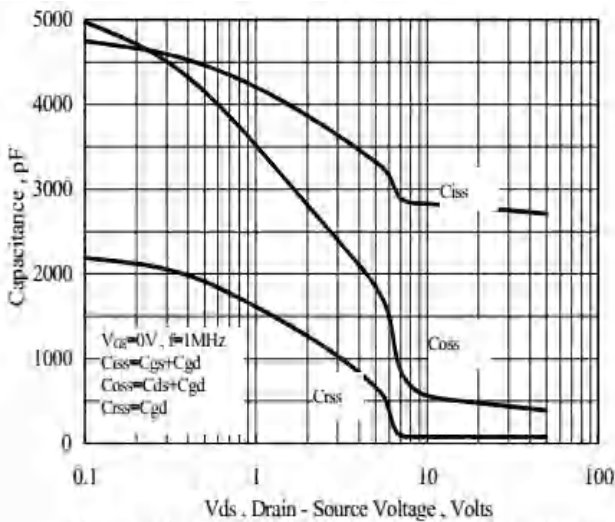


Figure 12 Typical Capacitance vs Drain to Source Voltage

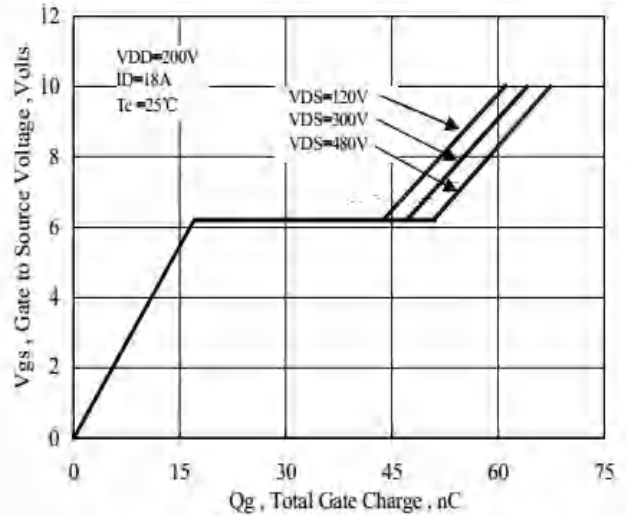


Figure 13 Typical Gate Charge vs Gate to Source Voltage

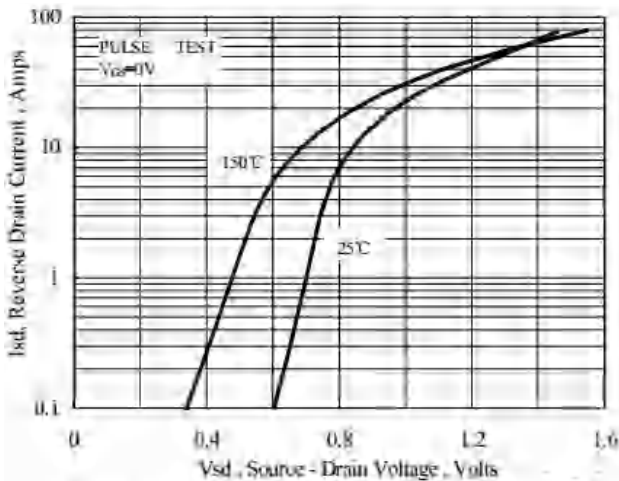


Figure 14 Typical Body Diode Transfer Characteristics

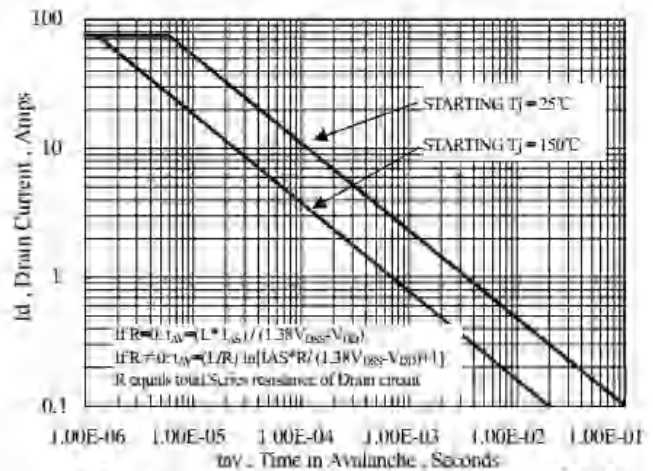


Figure 15 Unclamped Inductive Switching Capability

20N65 Series

Typical characteristics Diagrams

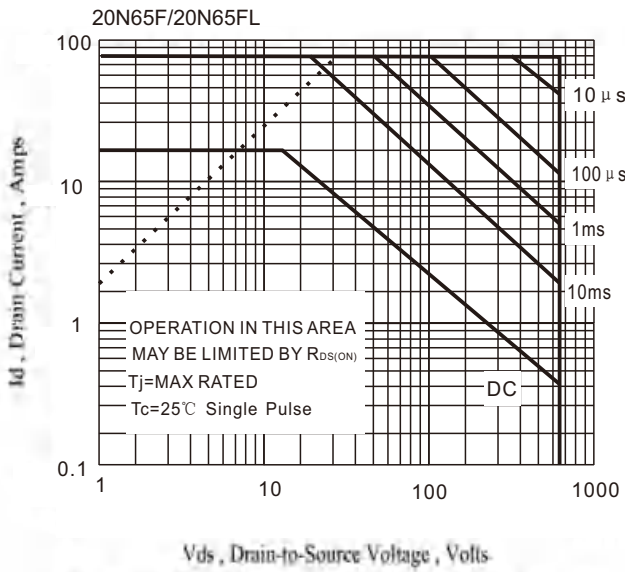


Figure 16 Maximum Forward Bias Safe Operating Area

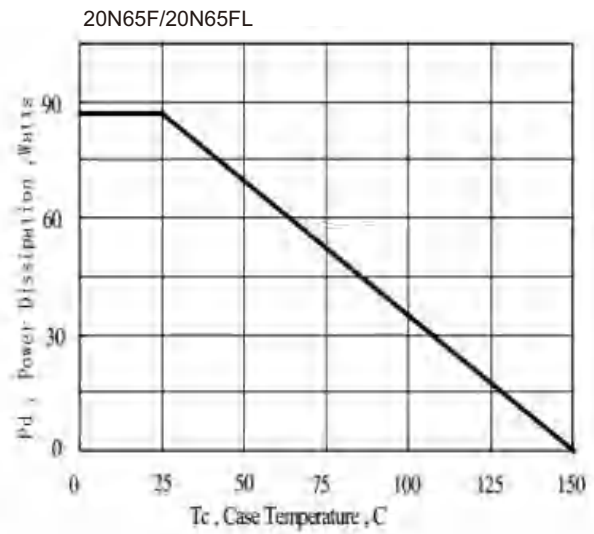


Figure 17 Maximum Power Dissipation vs Case Temperature

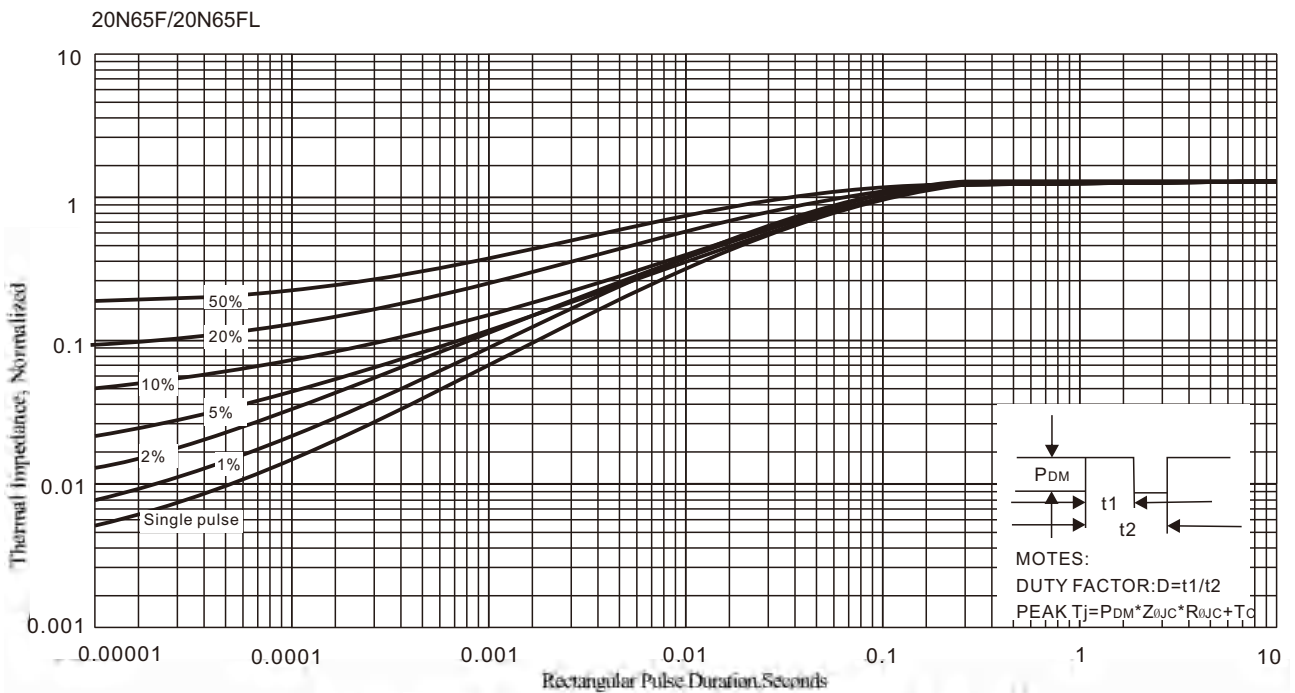
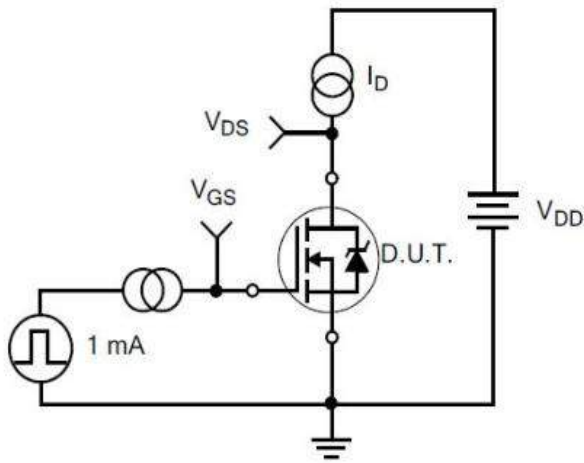
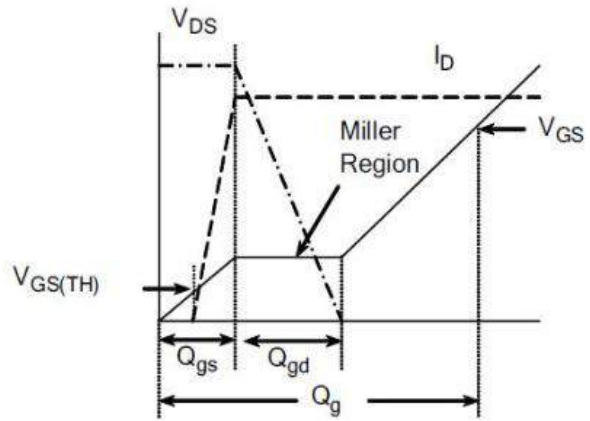


Figure 17 Maximum Effective Thermal Impedance, Junction to Case

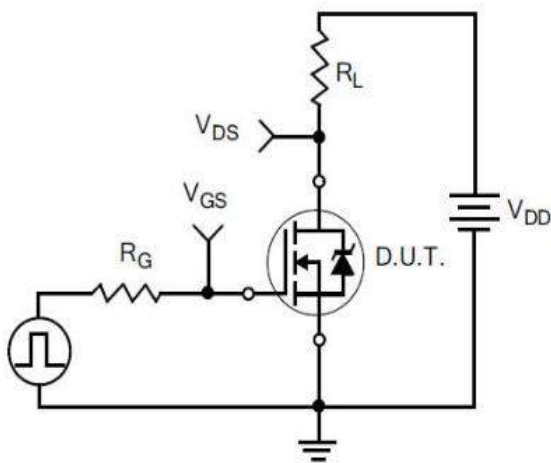
TYPICAL TEST CIRCUIT



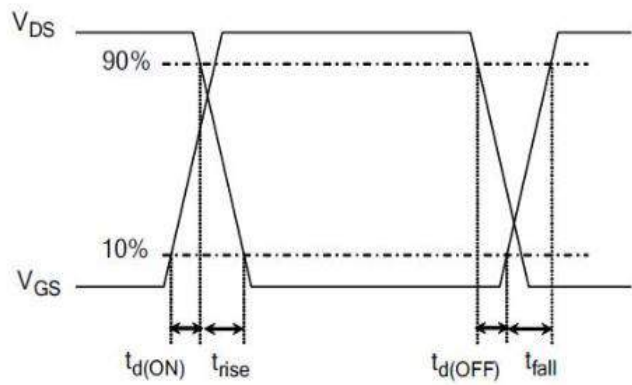
1) Gate Charge Test Circuit



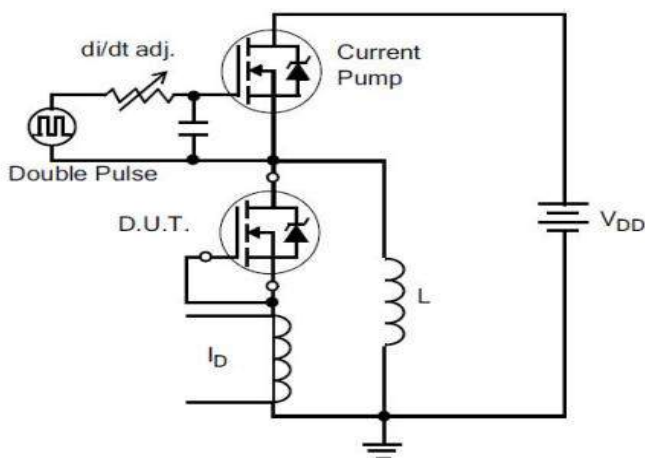
2) Gate Charge Waveform



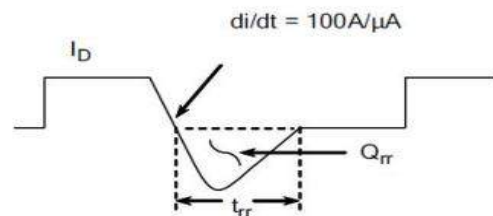
3) Resistive Switching Test Circuit



4) Resistive Switching Waveforms



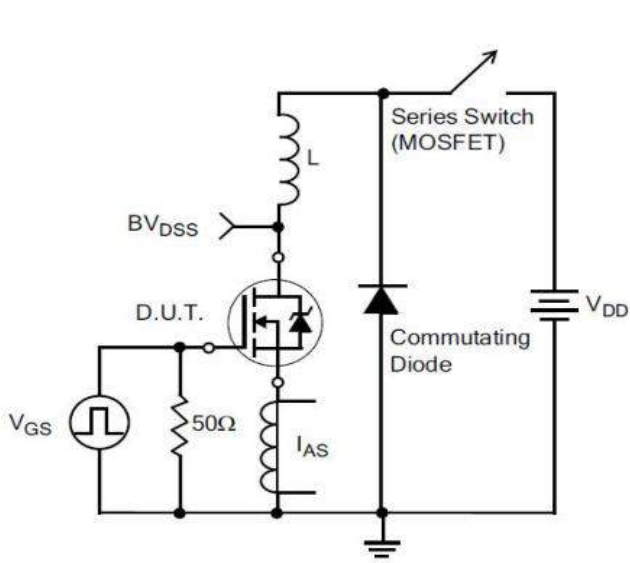
5) Diode Reverse Recovery Test Circuit



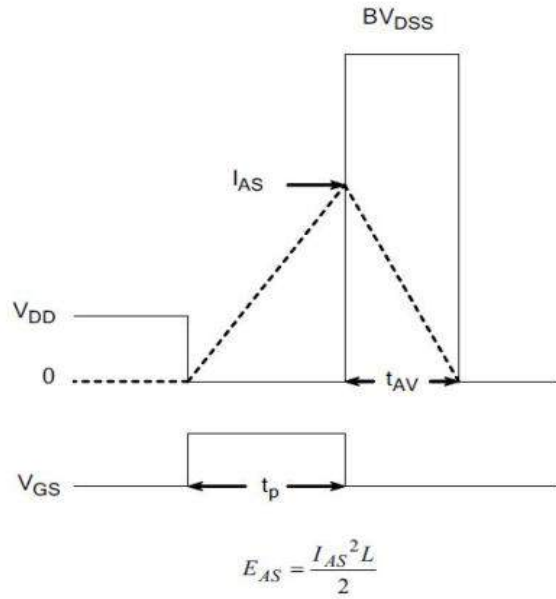
6) Diode Reverse Recovery Waveform

20N65 Series

TYPICAL TEST CIRCUIT AND WAVEFORM(CONTINUES)

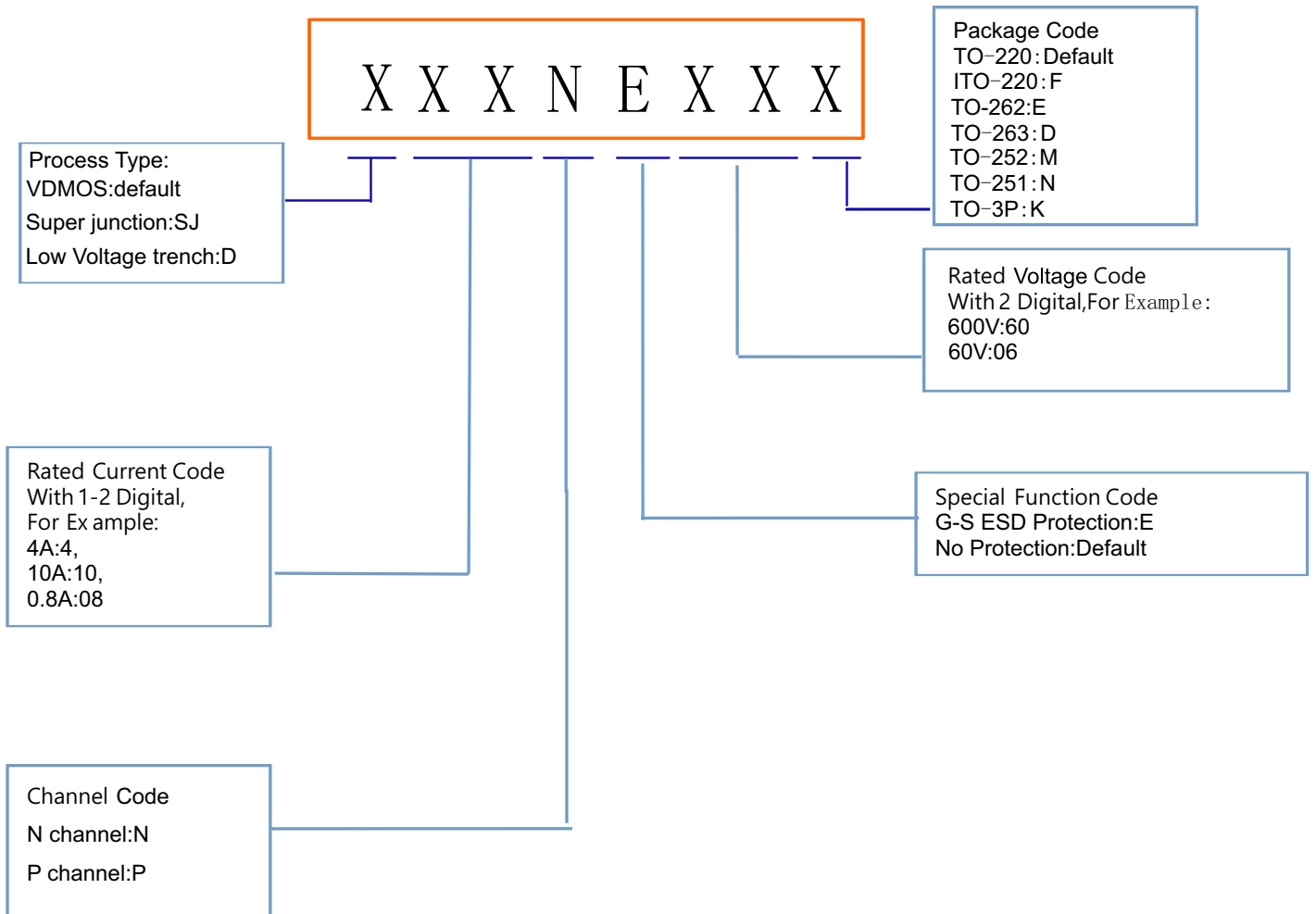


7) . Unclamped Inductive Switching Test Circuit



8) Unclamped Inductive Switching Waveforms

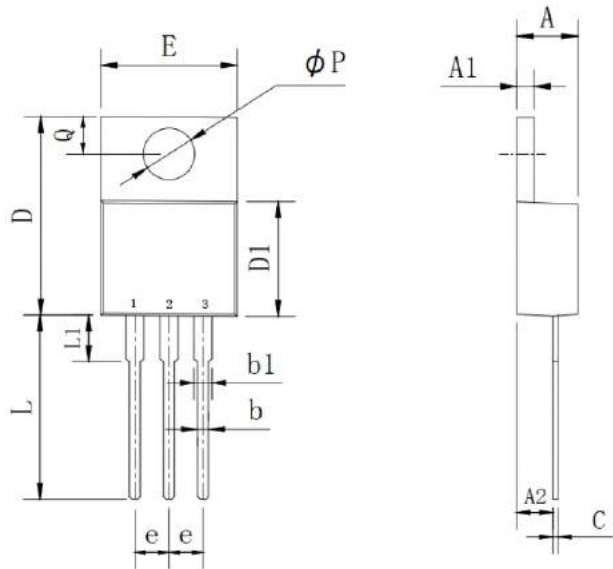
Product Names Rules



20N65 Series

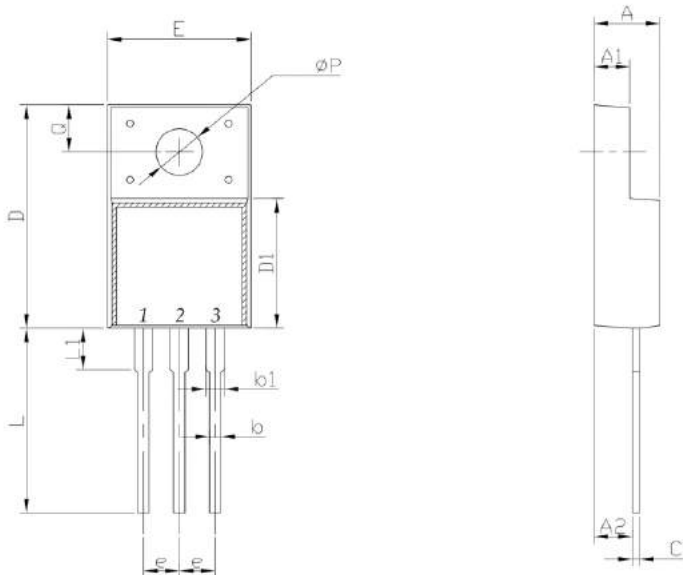
Dimensions

TO-220 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.25	4.87	0.167	0.192
A1	1.07	1.47	0.042	0.058
A2	2.03	2.92	0.080	0.115
b	0.51	1.11	0.020	0.044
b1	0.97	1.6	0.038	0.063
C	0.3	0.7	0.012	0.028
D	14.6	15.9	0.575	0.626
D1	8.04	9.3	0.317	0.366
E	9.57	10.57	0.377	0.416
e	2.34	2.74	0.092	0.108
L	12.58	14.3	0.495	0.563
L1	2.8	4.2	0.110	0.165
P	3.4	4.14	0.134	0.163
Q	2.45	3	0.096	0.118

ITO-220 PACKAGE OUTLINE DIMENSIONS

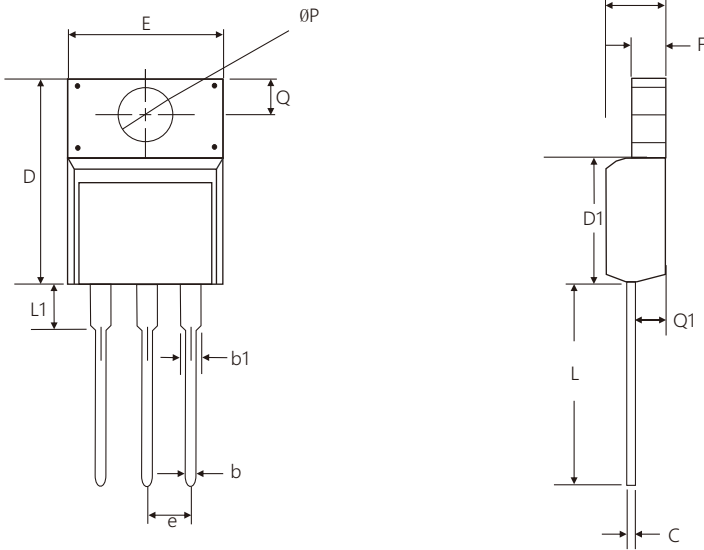


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	4.24	4.9	0.167	0.193
A1	2.3	2.92	0.091	0.115
A2	2.61	2.81	0.103	0.111
b	0.3	1	0.012	0.039
b1	0.9	1.55	0.035	0.061
C	0.3	0.7	0.012	0.028
D	14.5	16.36	0.571	0.644
D1	8.8	9.41	0.346	0.370
E	9.5	10.5	0.374	0.413
e	2.3	2.75	0.091	0.108
L	12.6	14	0.496	0.551
L1	2.45	4.3	0.096	0.169
P	2.9	3.8	0.114	0.150
Q	2.5	3.55	0.098	0.140

20N65 Series

Dimensions

ITO-220AB-L PACKAGE OUTLINE DIMENSIONS(mm)



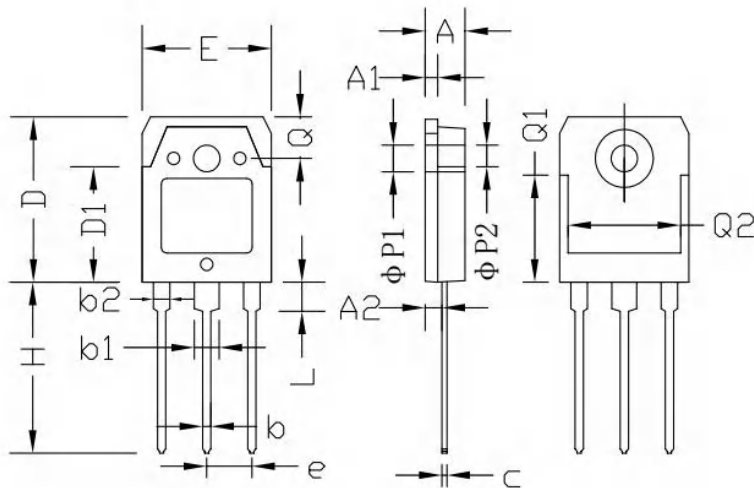
Dimensions in millimeters

ITO-220AB-L		
Dim	Min	Max
A	4.45	4.85
b	0.50	0.70
b1	1.20	1.40
C	0.50	0.70
D	15.50	16.50
D1	9.00	9.50
e	2.54	
E	9.90	10.50
F	2.34	2.74
L	12.60	13.60
L1	2.65	3.05
Q	3.20	3.50
Q1	2.60	2.90
$\varnothing P$	3.00	3.40

20N65 Series

Dimensions

TO-3P PACKAGE OUTLINE DIMENSIONS(mm)



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	—

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