

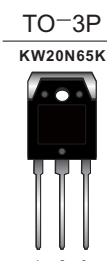
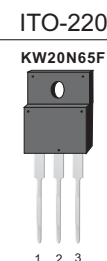
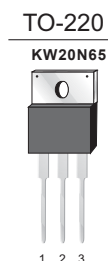
650V N-Channel Power MOSFET

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 Package



Ordering Information

Part No.	Package Type	Package	Quality(box)
KW20N65	TO-220	Tube	1000
KW20N65F	ITO-220	Tube	1000
KW20N65K	TO-3P	Tube	600

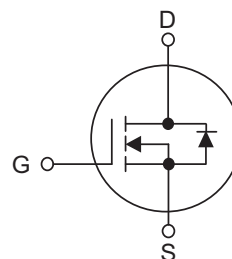
PRODUCT SUMMARY

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

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	80	
Junction Temperature	T_J	+150	$^\circ C$
Storage Temperature	T_{STG}	-55 ~ +150	$^\circ C$

THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220	θ_{JA}	62.5	C/W
	ITO-220		41.7	
Junction to Case	TO-220/TO-3P	θ_{JC}	0.5	C/W
	ITO-220		1.47	

ELECTRICAL CHARACTERISTICS

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

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V, I _D =250μA	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 =250μA	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 =25Ω		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		390		ns
Reverse Recovery Charge		Q _{RR}	dI _F /dt=100A/μs (Note 1)		3400		nC

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

2. Surface mounted on FR4 Board, $t \leq 10\text{sec}$

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 $T_J=25^\circ\text{C}$

Typical characteristics Diagrams

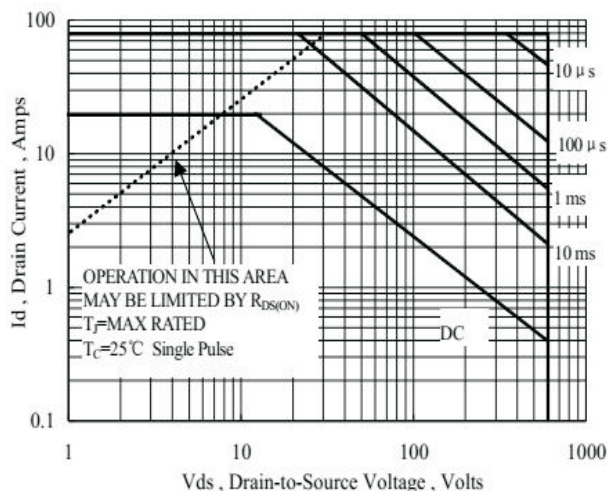


Figure 1 Maximum Forward Bias Safe Operating Area

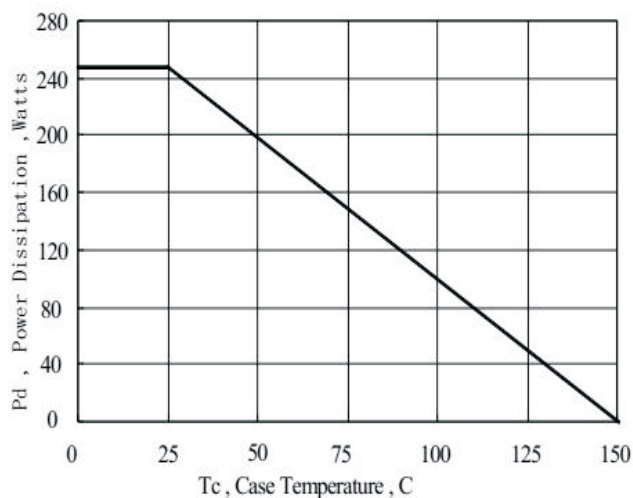


Figure 2 Maximum Power Dissipation vs Case Temperature

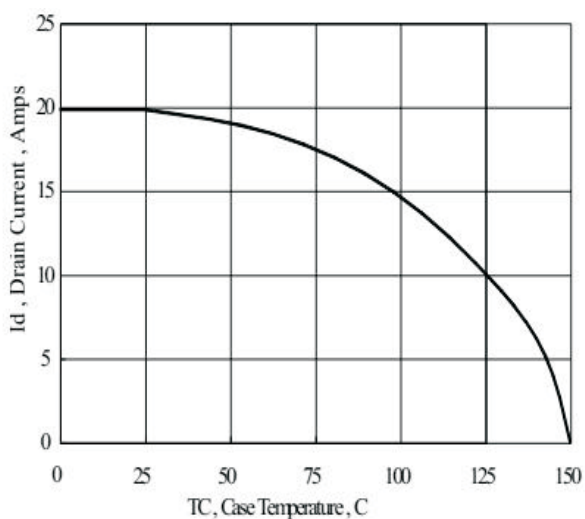


Figure 3 Maximum Continuous Drain Current vs Case Temperature

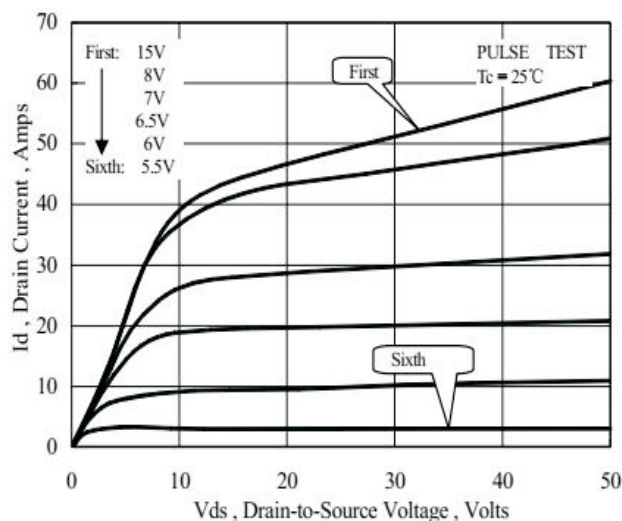


Figure 4 Typical Output Characteristics

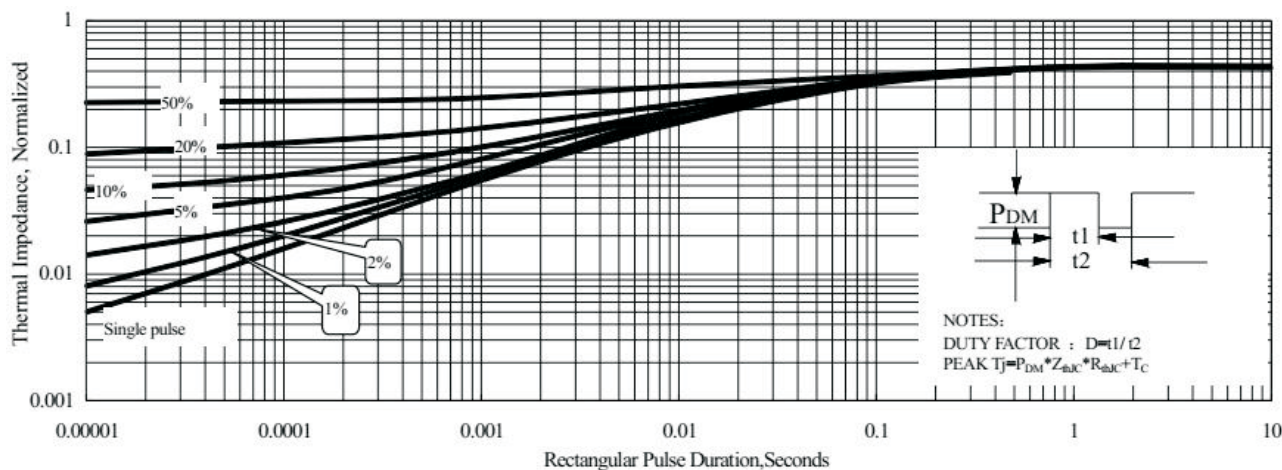


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

Typical characteristics Diagrams

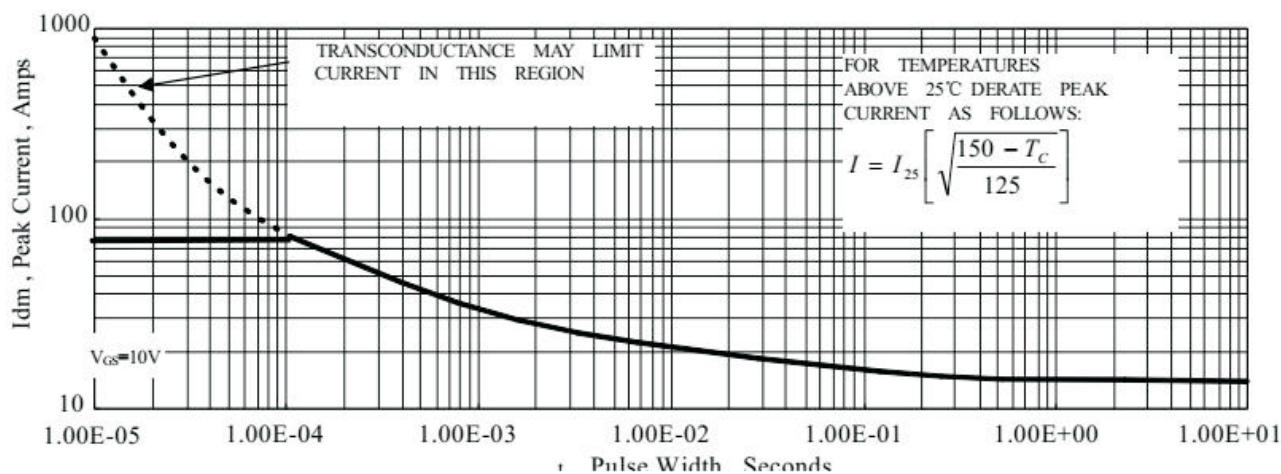


Figure 6 Maximun Peak Current Capability

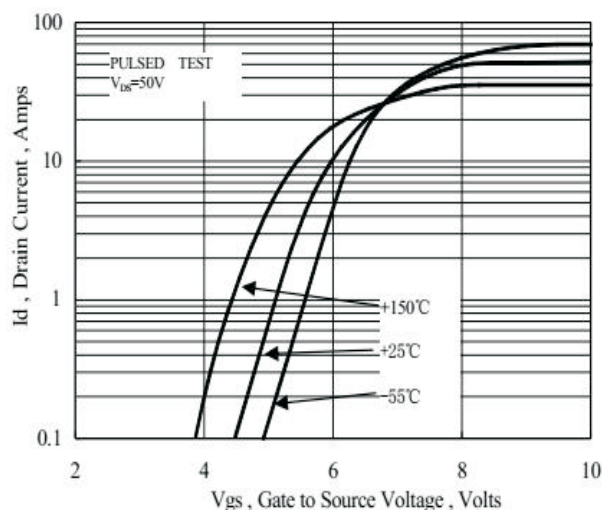


Figure 7 Typical Transfer Characteristics

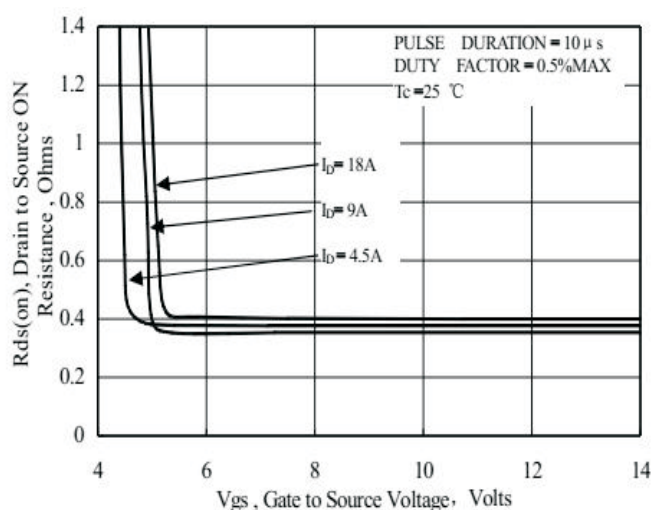


Figure 8 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

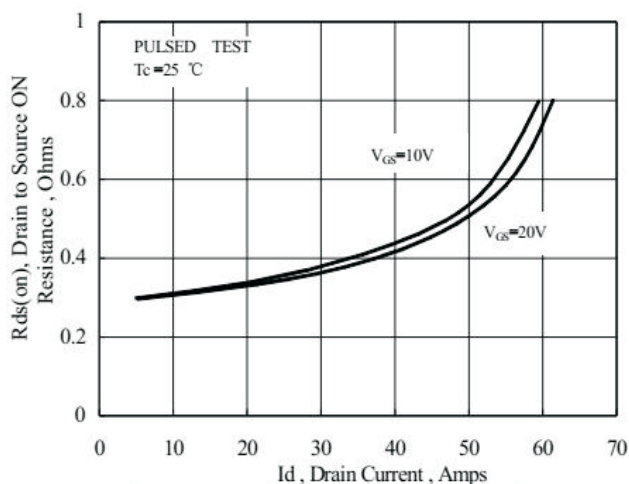


Figure 9 Typical Drain to Source ON Resistance vs Drain Current

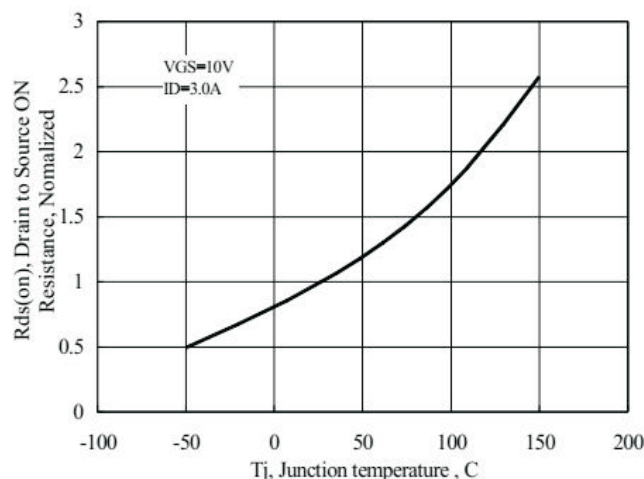


Figure 10 Typical Drain to Source on Resistance vs Junction Temperature

Typical characteristics Diagrams

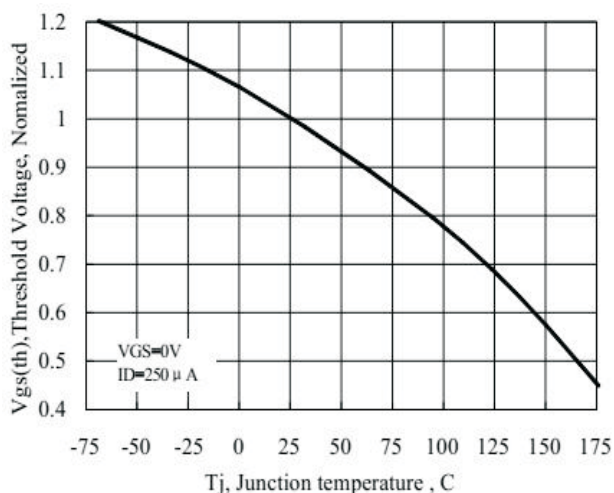


Figure 11 Typical Theshold Voltage vs Junction Temperature

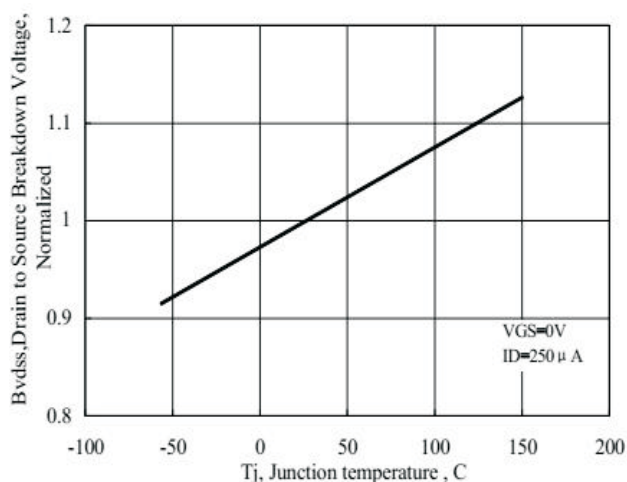


Figure 12 Typical Breakdown Voltage vs Junction Temperature

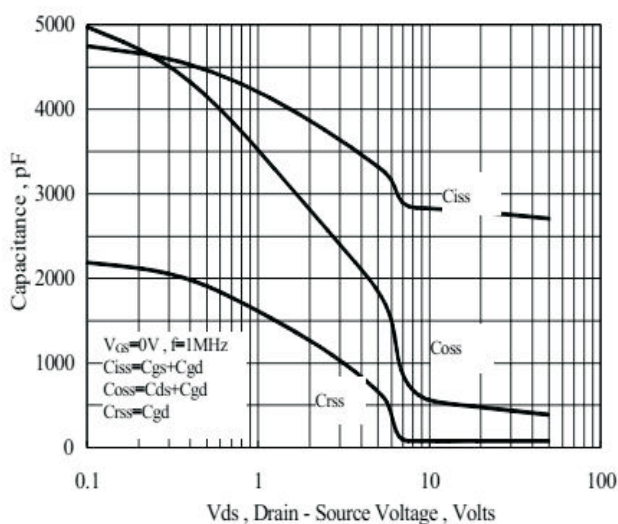


Figure 13 Typical Capacitance vs Drain to Source Voltage

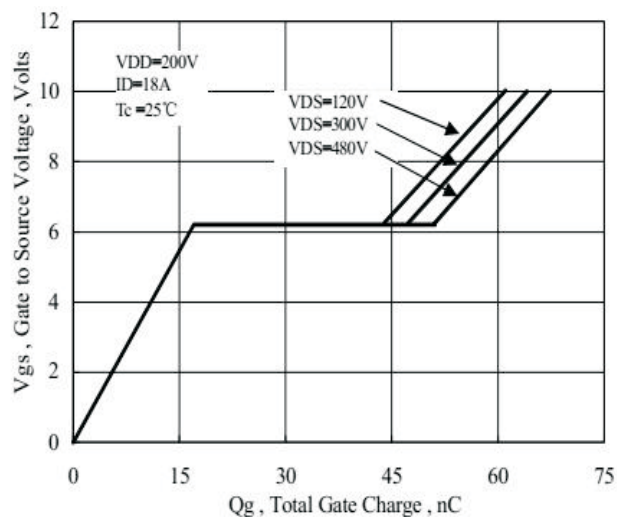


Figure 14 Typical Gate Charge vs Gate to Source Voltage

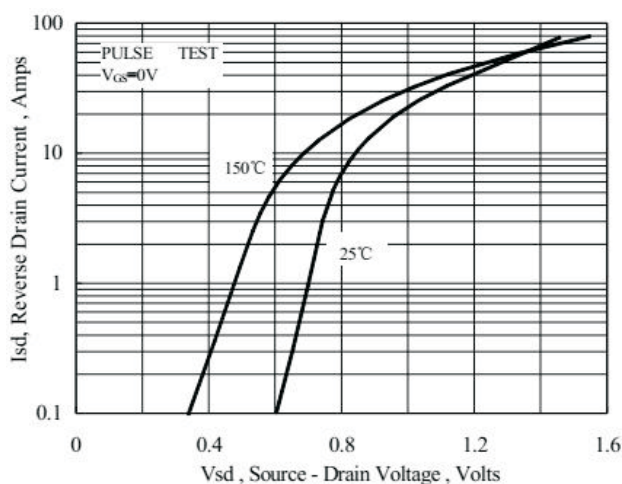


Figure 15 Typical Body Diode Transfer Characteristics

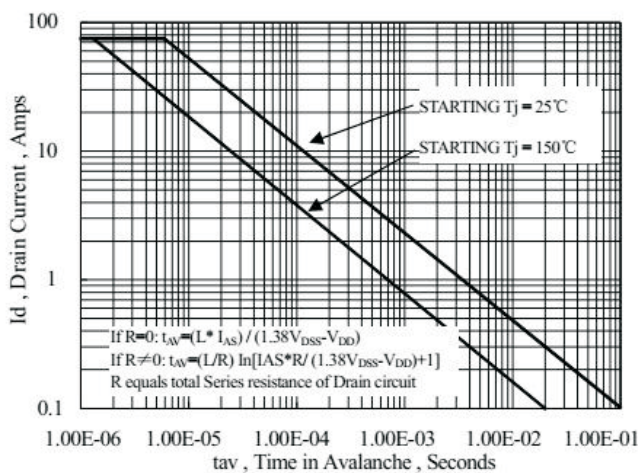


Figure 16 Unclamped Inductive Switching Capability

Typical characteristics Diagrams

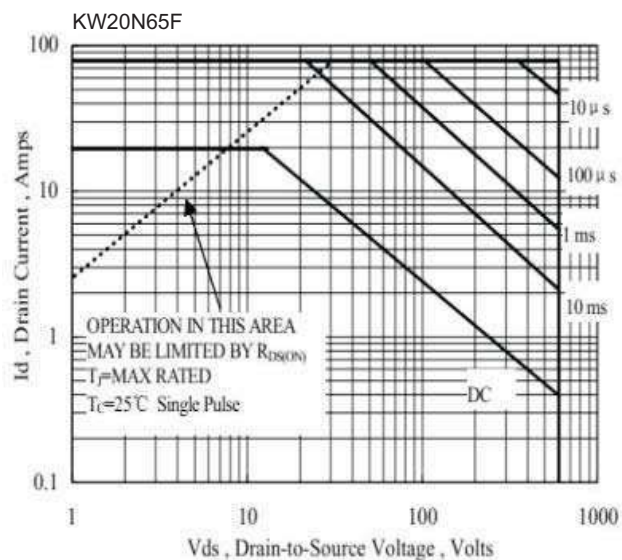


Figure 17 Maximum Forward Bias Safe Operating Area

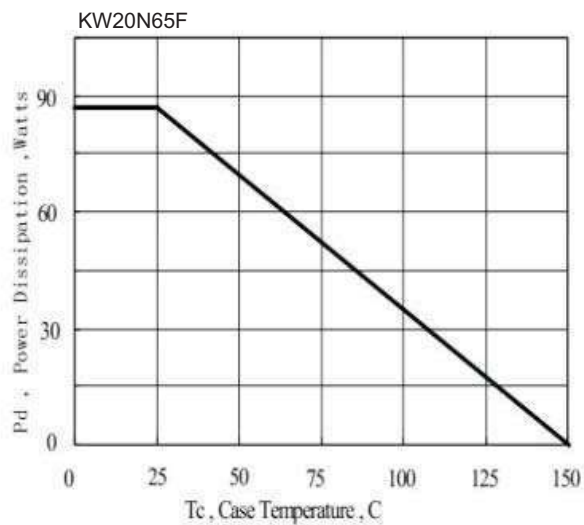
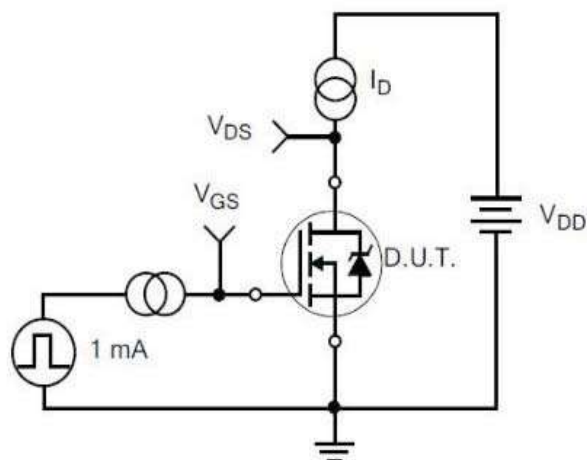
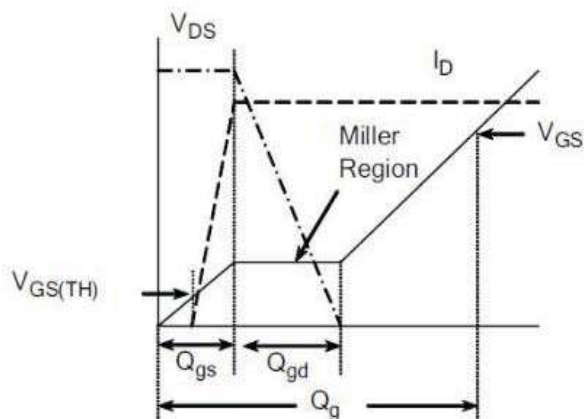


Figure 18 Maximum Power Dissipation vs Case Temperature

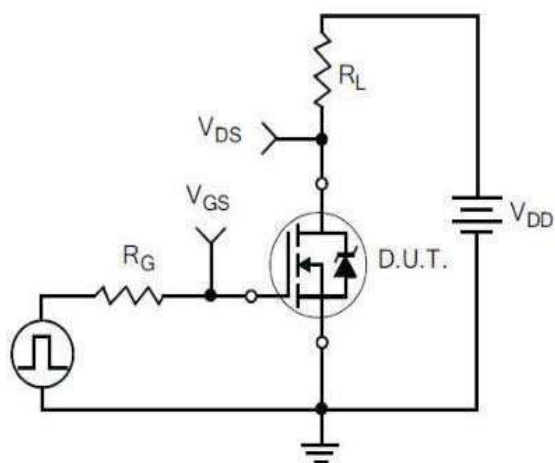
TYPICAL TEST CIRCUIT



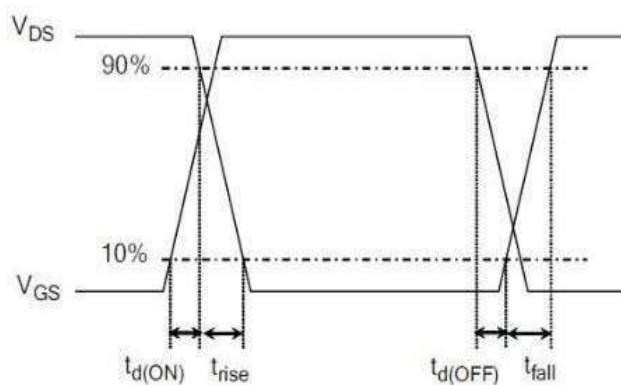
1) Gate Charge Test Circuit



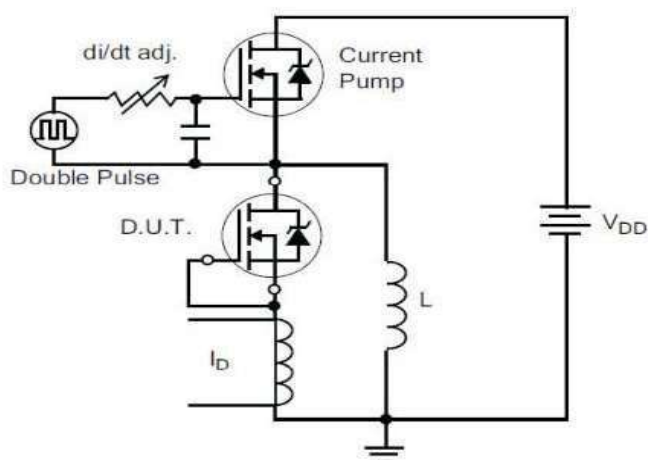
2) Gate Charge Waveform



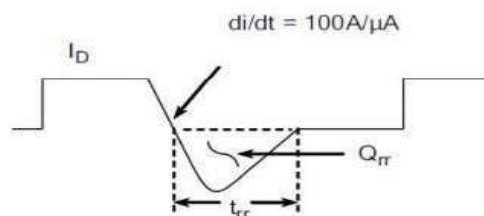
3) Resistive Switching Test Circuit



4) Resistive Switching Waveforms

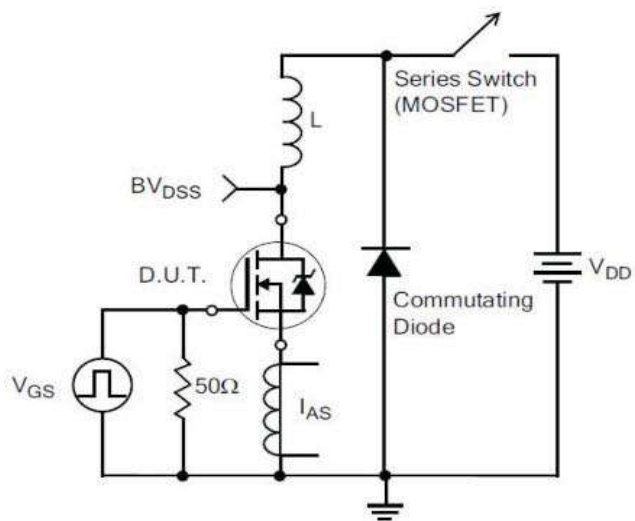


5) Diode Reverse Recovery Test Circuit

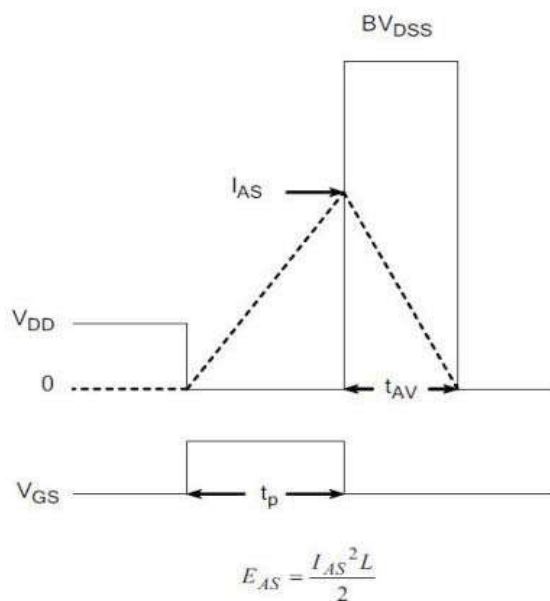


6) Diode Reverse Recovery Waveform

TYPICAL TEST CIRCUIT AND WAVEFORM(CONTINUES)



7) . Unclamped Inductive Switching Test Circuit



8) Unclamped Inductive Switching Waveforms

Product Names Rules

X X X N E X X X

Process Type:
VDMOS:default
Super junction:SJ
Low Voltage trench:D

Rated Current Code
With 1-2 Digital,
For Example:
4A:4,
10A:10,
0.8A:08

Channel Code
N channel:N
P channel:P

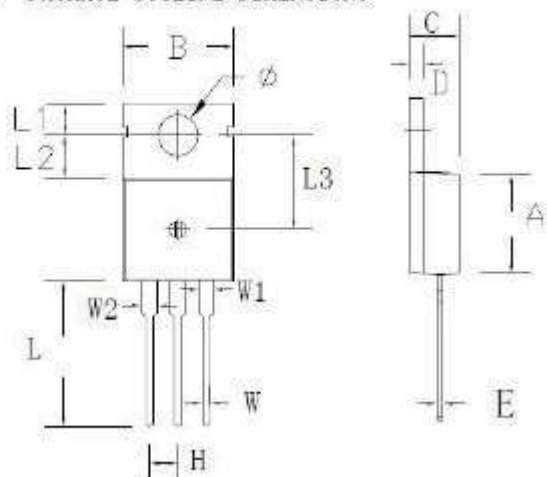
Package Code
TO-220:Default
ITO-220:F
TO-262:E
TO-263:D
TO-252:M
TO-251:N
TO-3P:K

Rated Voltage Code
With 2 Digital,For Example:
600V:60
60V:06

Special Function Code
G-S ESD Protection:E
No Protection:Default

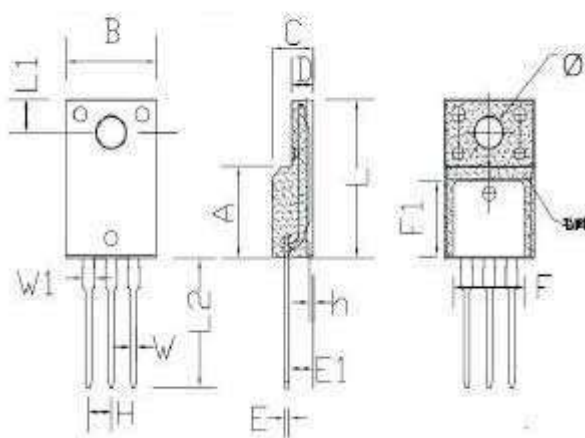
Dimensions

T0-220 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

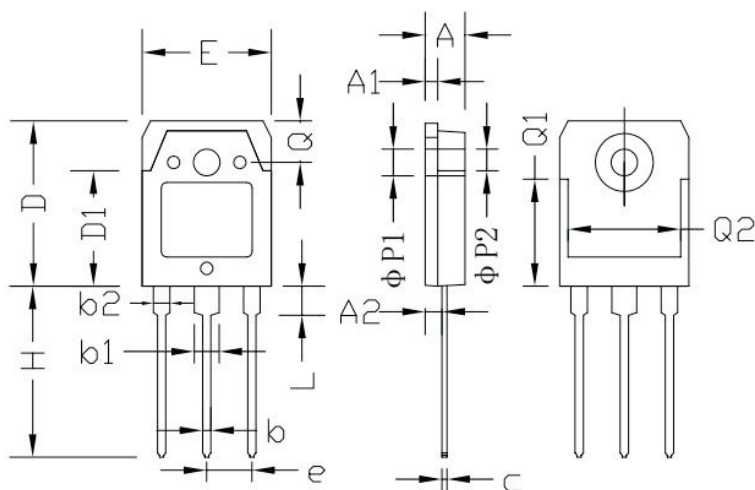
ITO-220 PACKAGE OUTLINE DIMENSIONS



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

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
Φ P1	3.20 TYP		0.126 TYP	
Φ P2	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	-