

## FEATURES

- $R_{DS(ON)} < 2.8\Omega @ V_{GS}=10V$
- Fast switching capability
- Lead free in compliance with EU RoHS directive
- Green molding compound

## MECHANICAL DATA

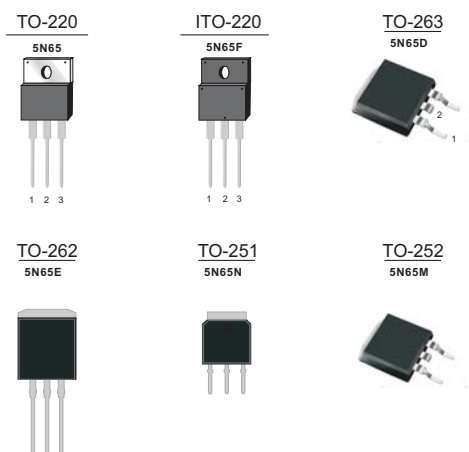
- Case: TO-220, ITO-220, TO-251, TO-252  
TO-262, TO-263 Package

## Ordering Information

Part No.	Package Type	Package	Quality (box)
4N65-TU	TO-220	Tube	1000
4N65F-TU	ITO-220	Tube	1000
4N65E-TU	TO-262	Tube	1000
4N65D-TR	TO-263	Tape & Reel	800
4N65N-TU	TO-251	Tube	1000
4N65M-TR	TO-252	Tape & Reel	3000

## PRODUCT SUMMARY

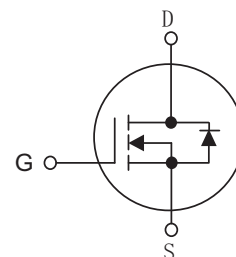
$V_{DS}$ (V)	$R_{DS(ON)}$ ( $\Omega$ )	$I_D$ (A)
650	2.4 @ $V_{GS}=10V$	4.5



## Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source



## ABSOLUTE MAXIMUM RATINGS ( $T_C=25\text{ C}$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	$V_{DS}$	650	V
Gate-Source Voltage	$V_{GS}$	3.0	V
Continuous Drain Current	$I_D$	4.5	A
Pulsed Drain Current (Note 1)	$I_{DM}$	18	A
Avalanche Energy (Note 5)	$E_{AS}$	200	mJ
Power Dissipation	TO-220/TO-263/TO-262	75	W
	TO-251/TO-252		
	ITO-220	45	
Junction Temperature	$T_J$	+150	C
Storage Temperature	$T_{STG}$	-55 ~ +150	C

# 5N65 5N65F 5N65D 5N65E 5N65M 5N65N

## THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-251/TO-252 TO-262/TO-263	$\theta_{JA}$	62.5	C/W
	ITO-220			
Junction to Case	TO-220/TO-263/TO-262	$\theta_{JC}$	1.67	C/W
	TO-251/TO-252			
	ITO-220	4.17		

## ELECTRICAL CHARACTERISTICS ( $T_c=25\text{ C}$ , unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>							
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	$\mu A$
Gate- Source Leakage Current	Forward	$I_{GSS}$	$V_{GS}=30V$			100	nA
	Reverse		$V_{GS}=-30V$			-100	nA
<b>ON CHARACTERISTICS(Note 3)</b>							
Gate Threshold Voltage		$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2		4	V
Drain-Source On-State Resistance		$R_{DS(ON)}$	$V_{GS}=10V, I_D=2.25A$		2.4	2.8	$\Omega$
<b>DYNAMIC CHARACTERISTICS(Note 4)</b>							
Input Capacitance		$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1MHz$		610		pF
Output Capacitance		$C_{OSS}$			53		pF
Reverse Transfer Capacitance		$C_{RSS}$			3.5		pF
<b>SWITCHING CHARACTERISTICS (Note 4)</b>							
Turn-On Delay Time		$t_{D(ON)}$	$V_{DD}=320V, I_D=4.5A,$ $R_G=10\Omega$		14		ns
Turn-On Rise Time		$t_R$			16		ns
Turn-Off Delay Time		$t_{D(OFF)}$			32		ns
Turn-Off Fall Time		$t_F$			11		ns
Total Gate Charge		$Q_G$	$V_{DS}=520V, I_D=4.5A,$ $V_{GS}=10V$		14.5		nC
Gate-Source Charge		$Q_{GS}$			3		nC
Gate-Drain Charge		$Q_{GD}$			6.5		nC
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>							
Drain-Source Diode Forward Voltage		$V_{SD}$	$V_{GS}=0V, I_S=4.5A$			1.5	V
Maximum Continuous Drain-Source Diode Forward Current (Note 2)		$I_S$				4.5	A
Reverse Recovery Time		$t_{rr}$	$V_{GS}=0V, I_S=4.5A$		256		ns
Reverse Recovery Charge		$Q_{rr}$	$di_F/dt=100A/\mu s$ (Note 1)		1200		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,  $I_D=6.3A, V_{DD}=50V, V_{GATE}=650V$ , Starting  $T_J=25\text{ C}$

Typical characteristics Diagrams

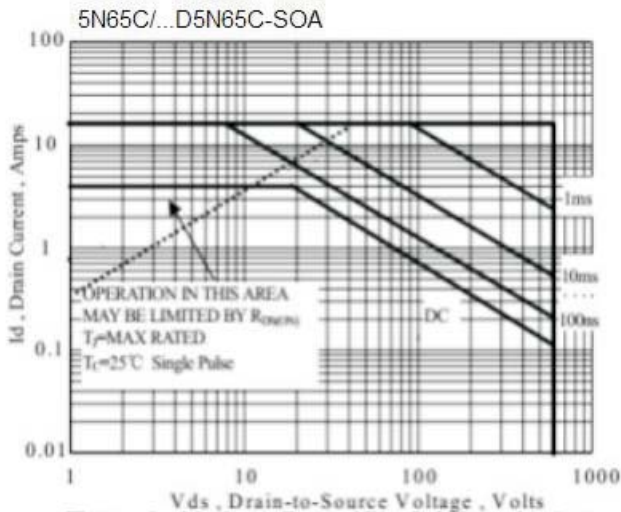


Figure 1 Maximum Forward Bias Safe Operating Area

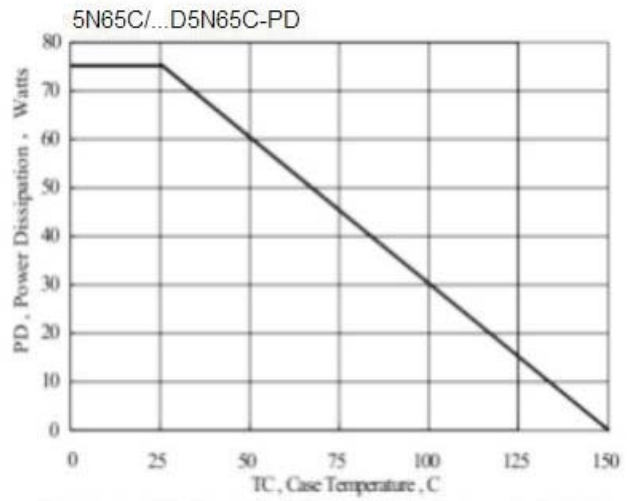


Figure 2 Maximum Power Dissipation vs Case Temperature

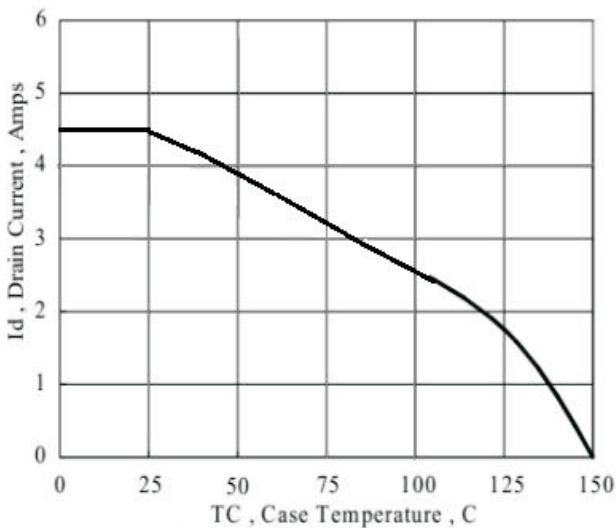


Figure 3 Maximum Continuous Drain Current vs Case Temperature

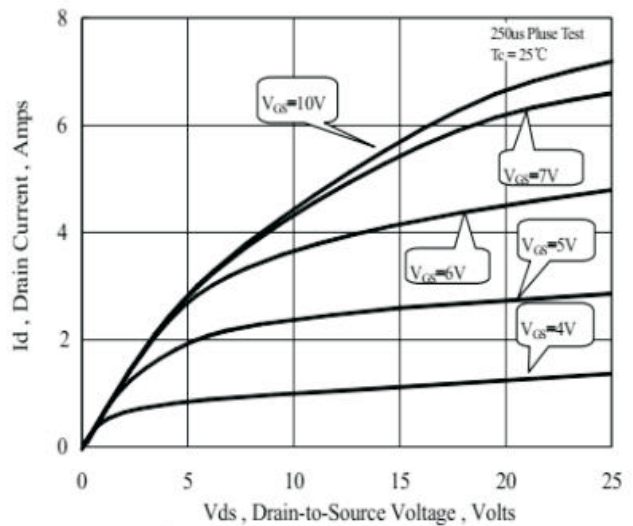


Figure 4 Typical Output Characteristics

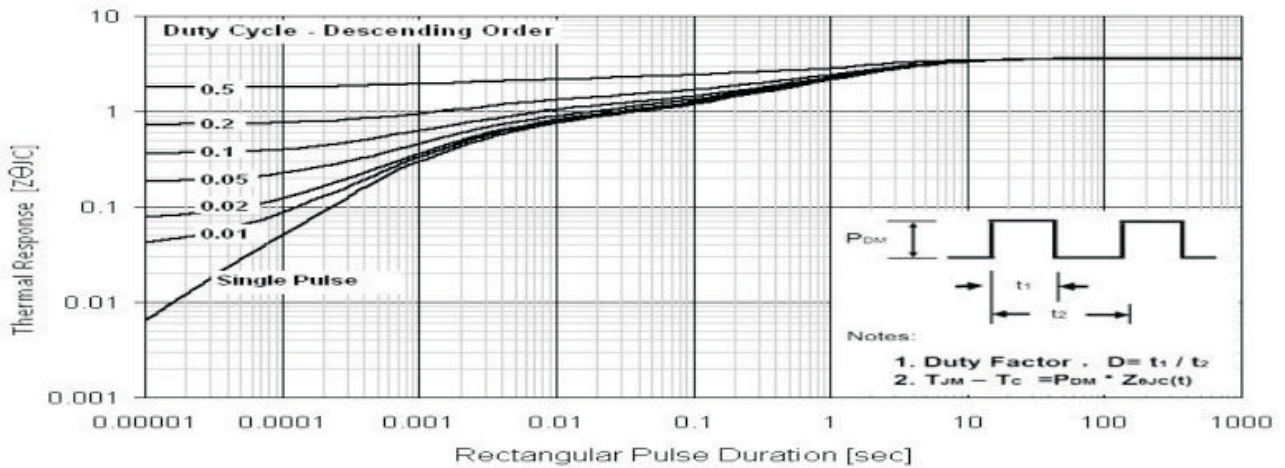


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

Typical characteristics Diagrams

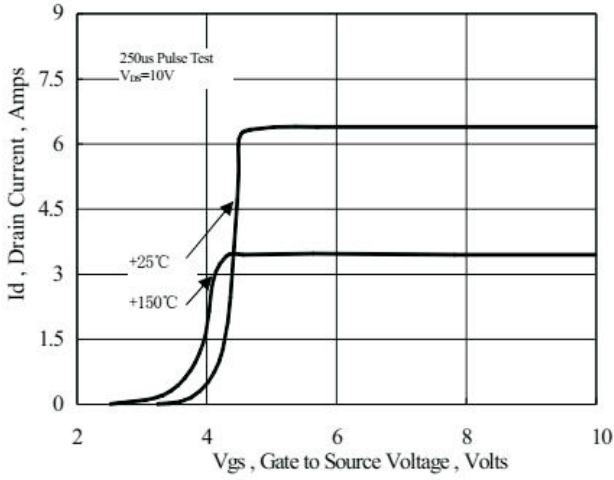


Figure 6 Typical Transfer Characteristics

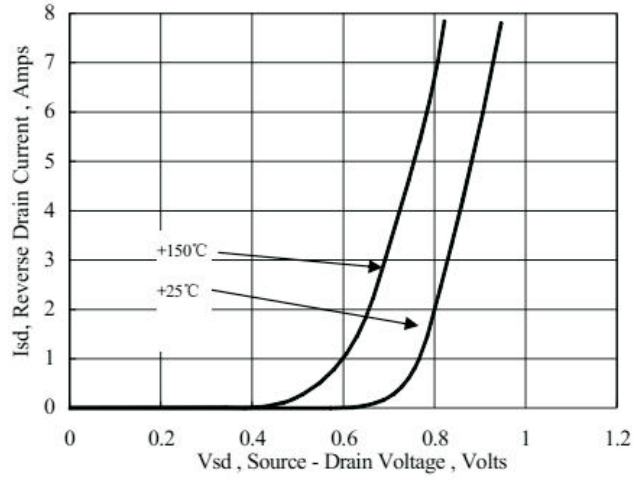


Figure 7 Typical Body Diode Transfer Characteristics

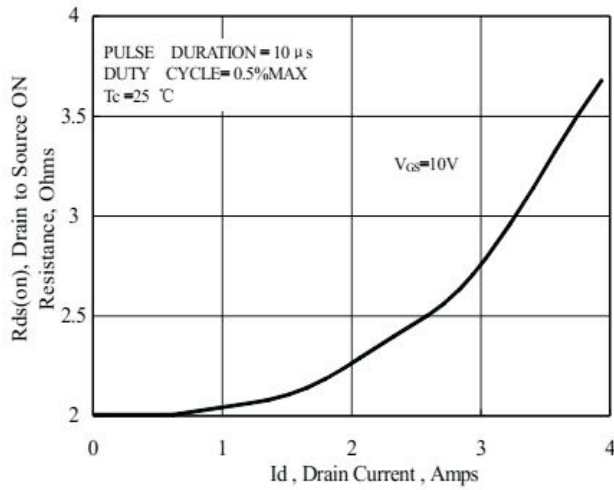


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

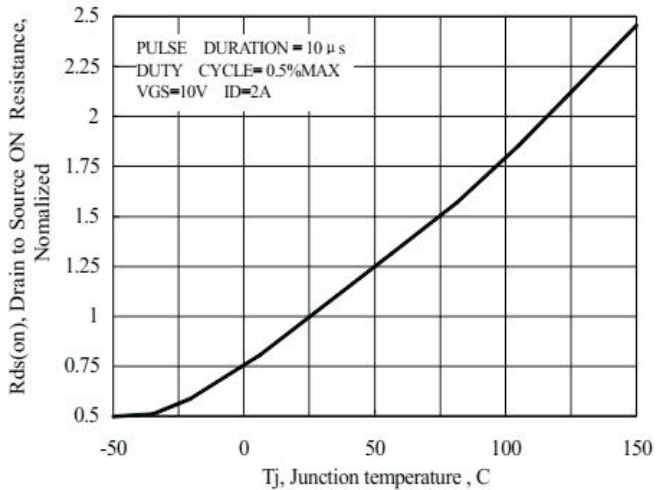


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

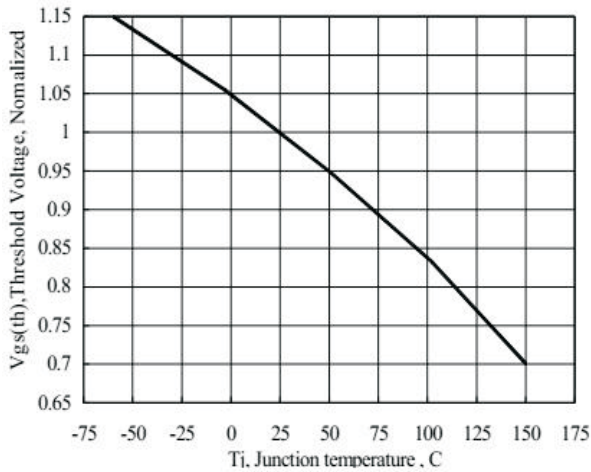


Figure 10 Typical Threshold Voltage vs Junction Temperature

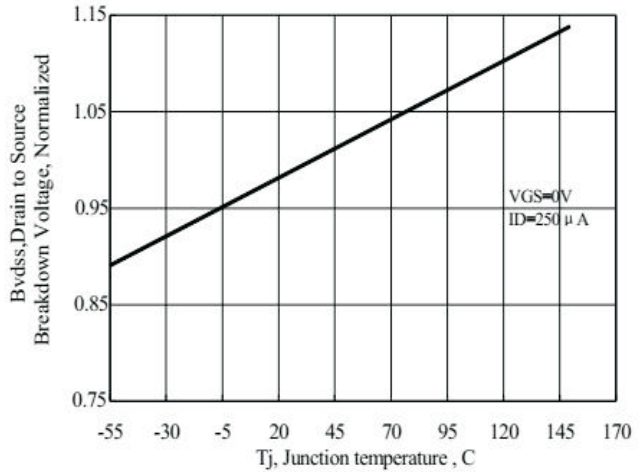


Figure 11 Typical Breakdown Voltage vs Junction Temperature

Typical characteristics Diagrams

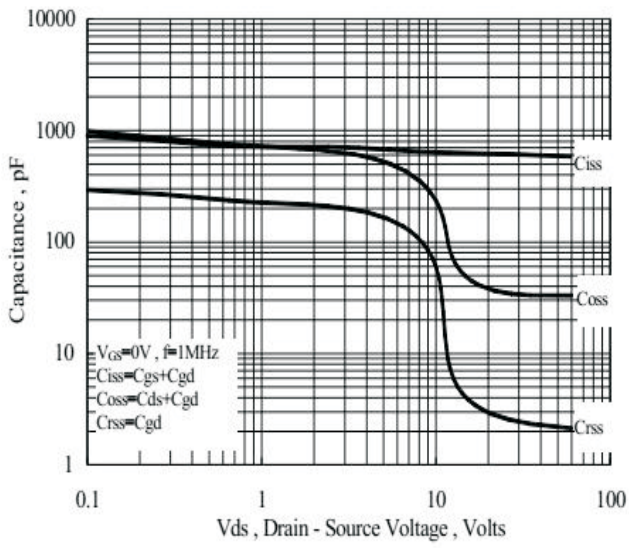


Figure 12 Typical Capacitance vs Drain to Source Voltage

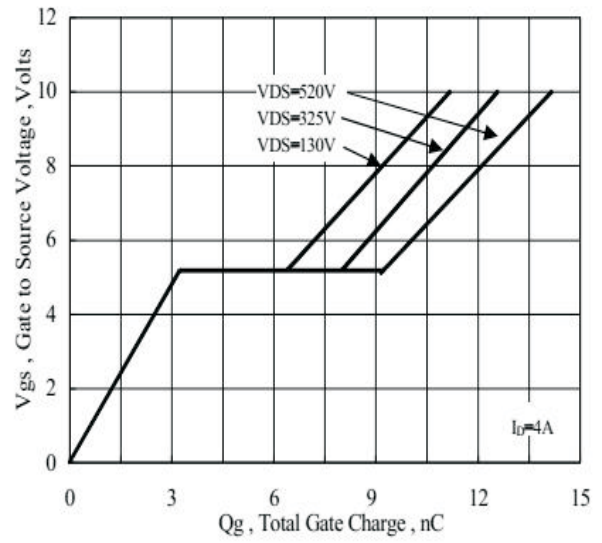
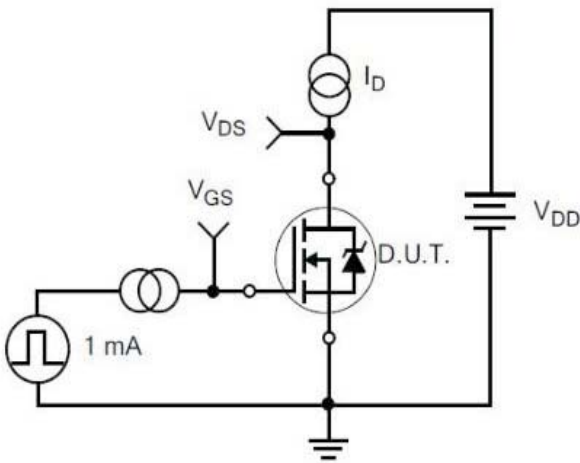


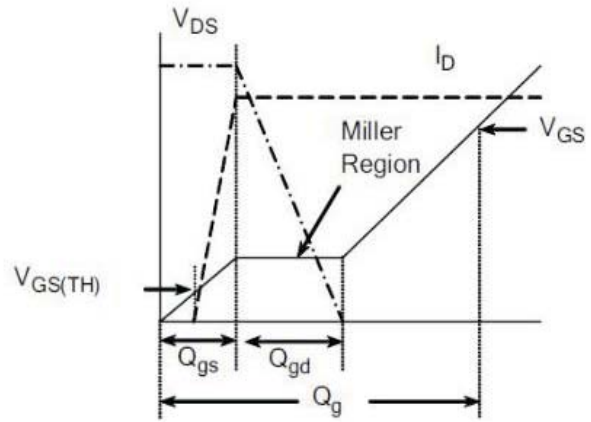
Figure 13 Typical Gate Charge vs Gate to Source Voltage



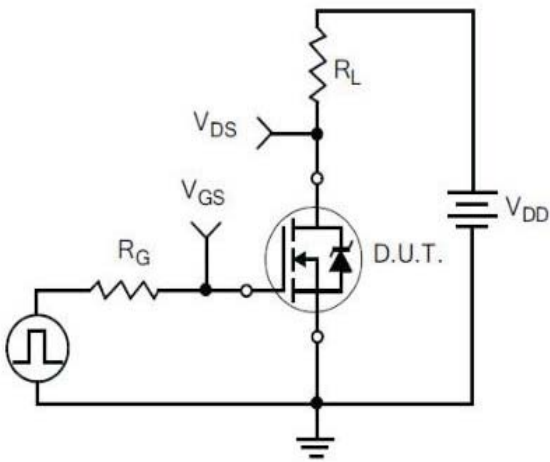
TYPICAL TEST CIRCUIT



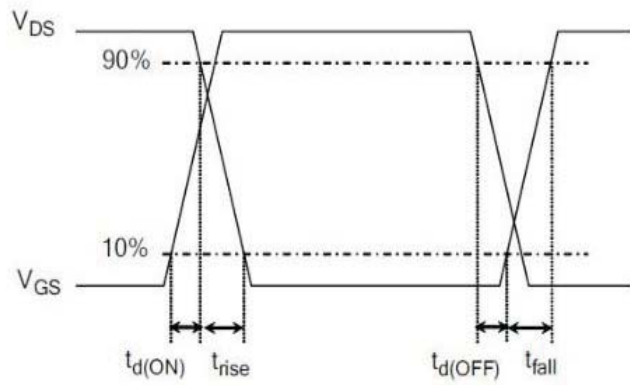
1) Gate Charge Test Circuit



2) . Gate Charge Waveform



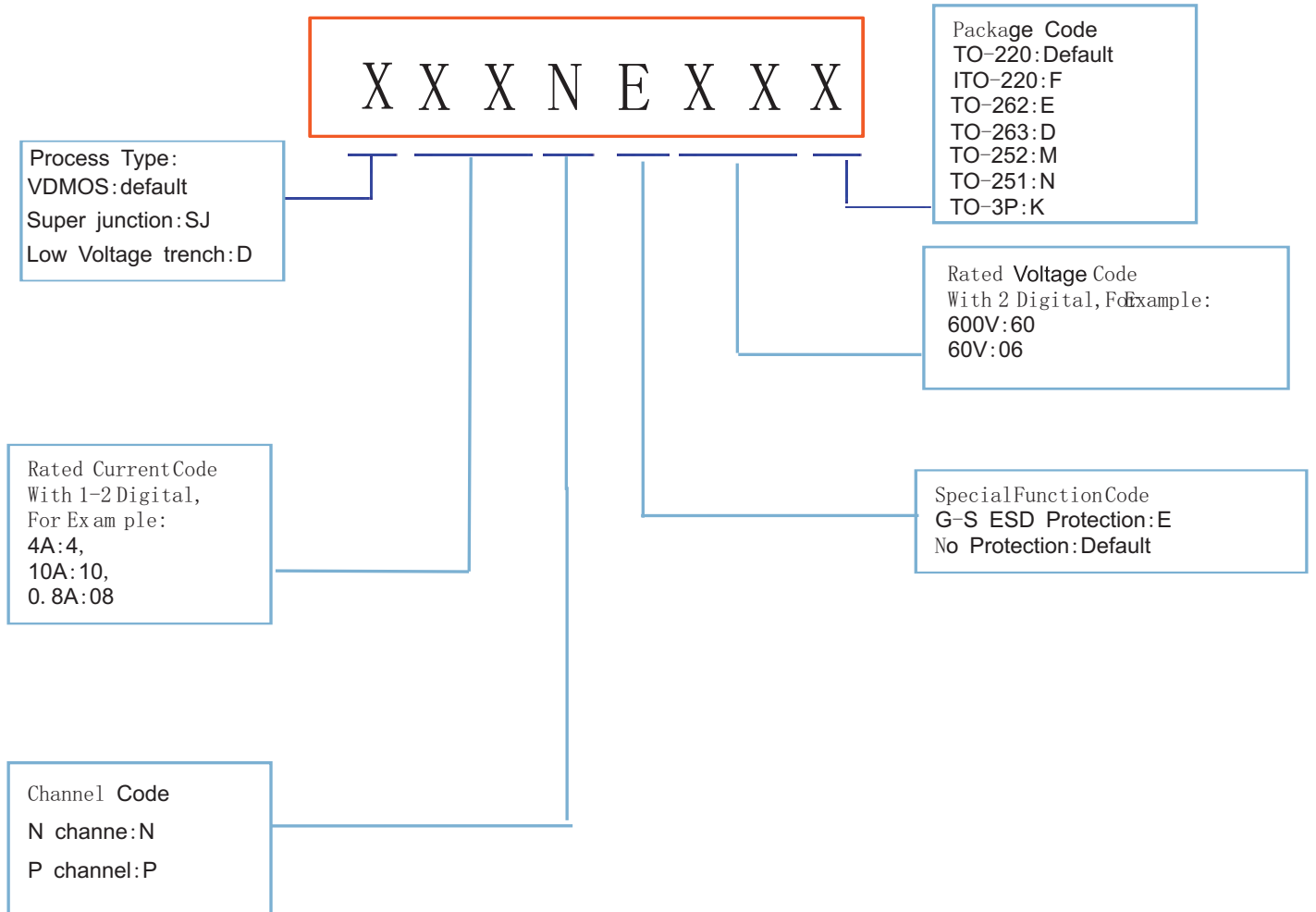
3) Resistive Switching Test Circuit



4) Resistive Switching Waveforms

5N65 5N65F 5N65D 5N65E 5N65M 5N65N

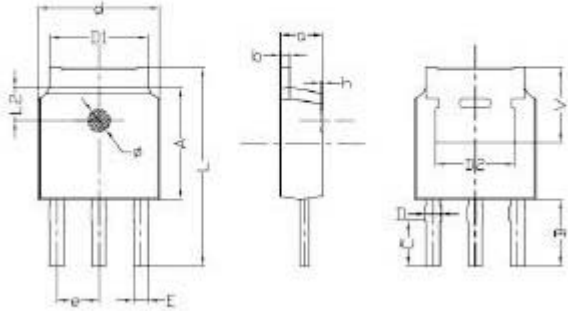
TYPICAL TEST CIRCUIT AND WAVEFORM (CONTINUES)



# 5N65 5N65F 5N65D 5N65E 5N65M 5N65N

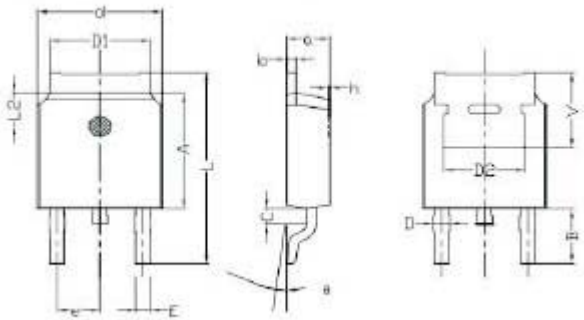
## Dimensions

TO-251 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
a	2.20	2.40	0.087	0.0946
b	0.46	0.58	0.018	0.023
C	2.45	2.65	0.097	0.104
D	0.80	0.90	0.032	0.035
d	6.30	6.70	0.248	0.264
D1	5.00	5.50	0.197	0.217
D2	TYP 4.83		TYP 0.190	
A	5.80	6.20	0.228	0.244
e	2.19	2.39	0.086	0.094
L	10.40	11.00	0.4098	0.4334
B	3.50	3.70	0.1379	0.1458
L2	1.5	1.8	0.059	0.071
φ	1.10	1.30	0.0433	0.0512
h	0.00	0.30	0.000	0.012
V	5.25	5.85	0.207	0.230
E	0.60	0.80	0.0236	0.0315

TO-252 PACKAGE OUTLINE DIMENSIONS



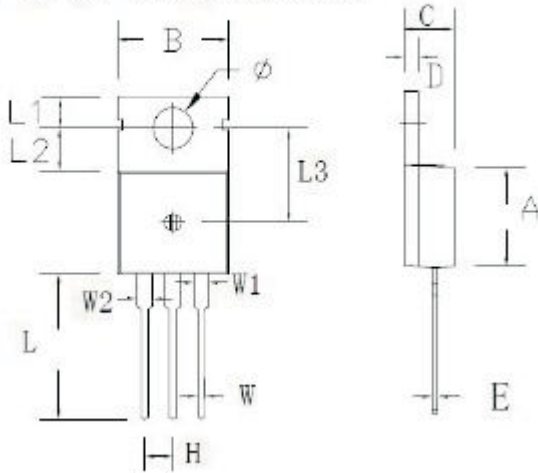
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
a	2.20	2.40	0.087	0.095
b	0.46	0.58	0.018	0.023
c	0.70	0.90	0.028	0.035
D	0.80	1.00	0.032	0.039
d	6.30	6.70	0.248	0.264
D1	5.00	5.50	0.197	0.217
D2	TYP 4.83		TYP 0.190	
A	5.80	6.20	0.228	0.244
e	2.19	2.39	0.086	0.094
L	9.40	10.40	0.370	0.409
B	2.6	3.2	0.102	0.126
L2	1.5	1.8	0.059	0.071
θ	0	8	0	8
h	0	0.3	0	0.012
V	5.25	5.85	0.207	0.230



5N65 5N65F 5N65D 5N65E 5N65M 5N65N

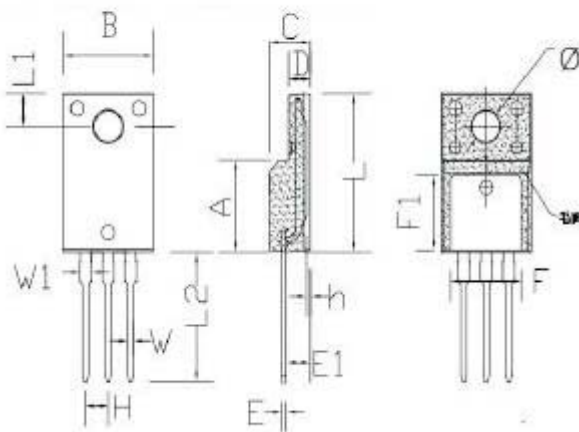
Dimensions

TO-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
phi	3.50	3.90	0.138	0.154

ITO-220 PACKAGE OUTLINE DIMENSIONS

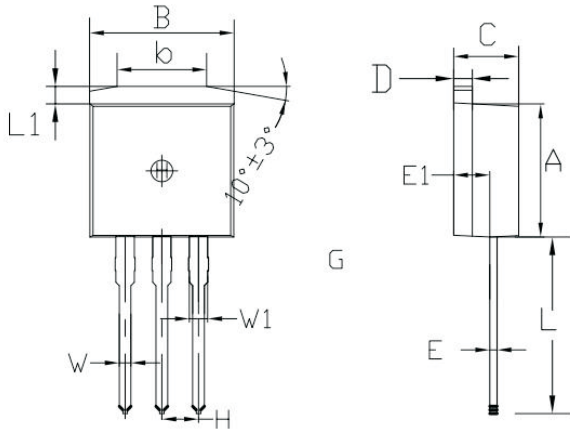


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035
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
phi	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

5N65 5N65F 5N65D 5N65E 5N65M 5N65N

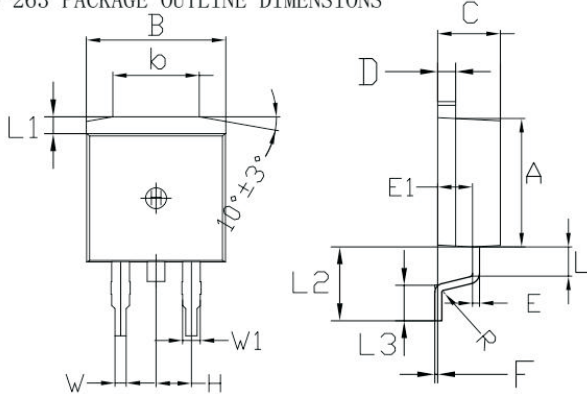
Dimensions

TO-262 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
L	12.25	13.75	0.482	0.541
L1	1.15	1.45	0.045	0.057
E1	2.4	2.6	0.0945	0.1024
W	0.80	0.82	0.0315	0.034
W1	1.20	1.30	0.047	0.051
H	2.54 TYP		0.200 TYP	
b	5.50	6.50	0.216	0.256

TO-263 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
L	1.90	2.30	0.075	0.091
L1	1.15	1.45	0.045	0.057
R	0.24	0.26	0.0095	0.0102
W	0.80	0.82	0.0315	0.0323
W1	1.20	1.30	0.047	0.051
H	2.54 TYP		0.200 TYP	
b	5.50	6.50	0.216	0.256
E1	2.4	2.6	0.0946	0.1024
L2	5.20	5.80	0.205	0.228
L3	2.20	3.20	0.087	0.126
F	0.03	0.23	0.0012	0.0091