

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

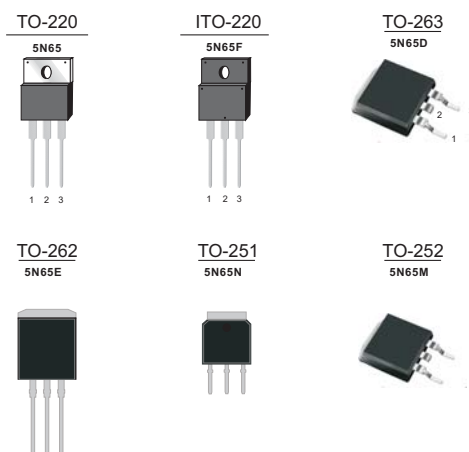
- Case: TO-220, ITO-220, TO-251, TO-252
TO-262, TO-263 Package

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

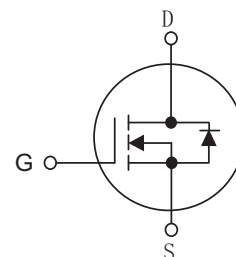
V_{DS} (V)	$R_{DS(ON)}$ (Ω)	I_D (A)
650	2.4 @ $V_{GS}=10V$	4.5



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	P_D	TO-220/TO-263/TO-262	75
		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	θ_{JA}	62.5	C/W
	TO-262/TO-263			
	ITO-220			
Junction to Case	TO-220/TO-263/TO-262	θ_{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
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}	$V_{GS}=30V$			100	nA
	Reverse		$V_{GS}=-30V$			-100	nA
ON CHARACTERISTICS(Note 3)							
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	Ω
DYNAMIC CHARACTERISTICS(Note 4)							
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
SWITCHING CHARACTERISTICS (Note 4)							
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
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
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

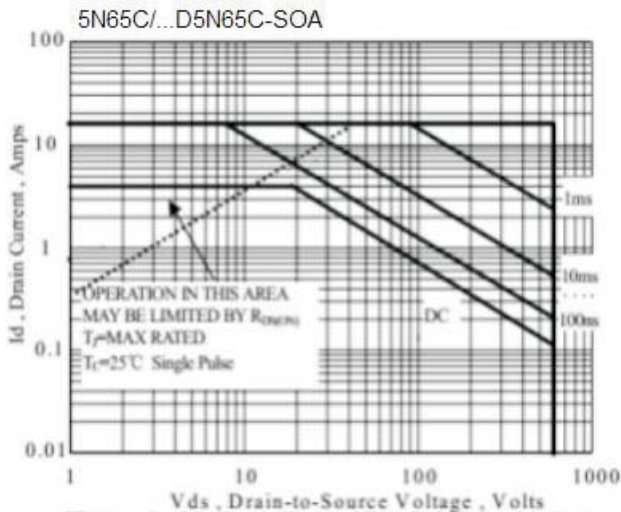


Figure 1 Maximum Forward Bias Safe Operating Area

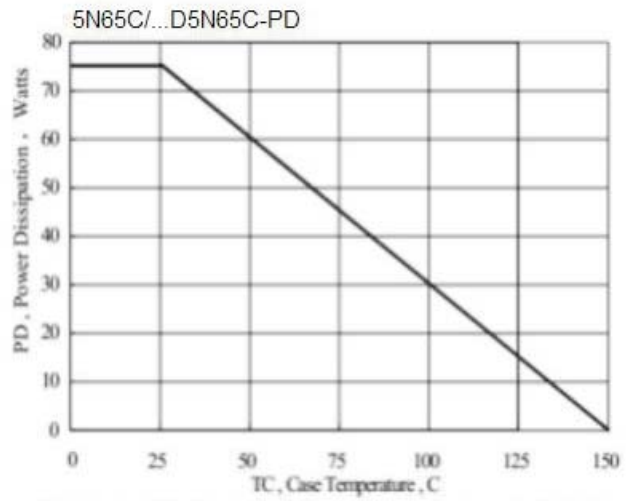


Figure 2 Maximum Power Dissipation vs Case Temperature

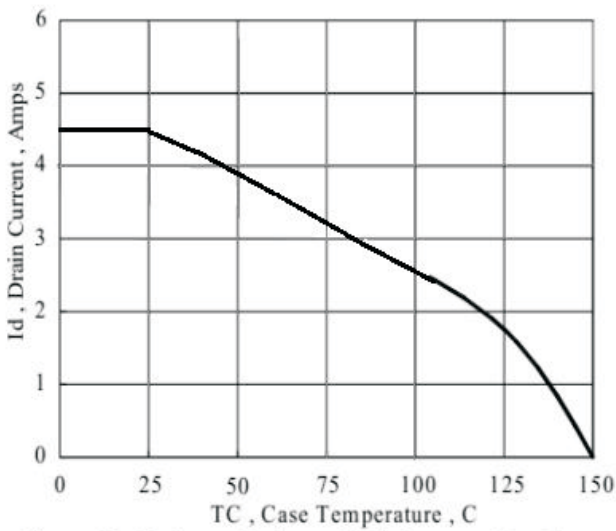


Figure 3 Maximum Continuous Drain Current vs Case Temperature

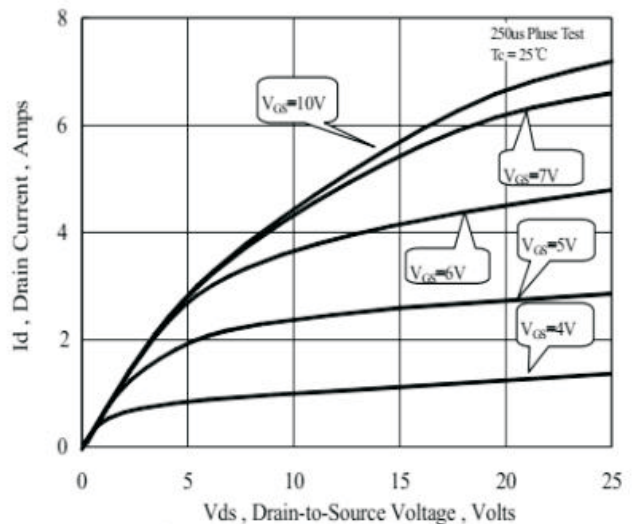


Figure 4 Typical Output Characteristics

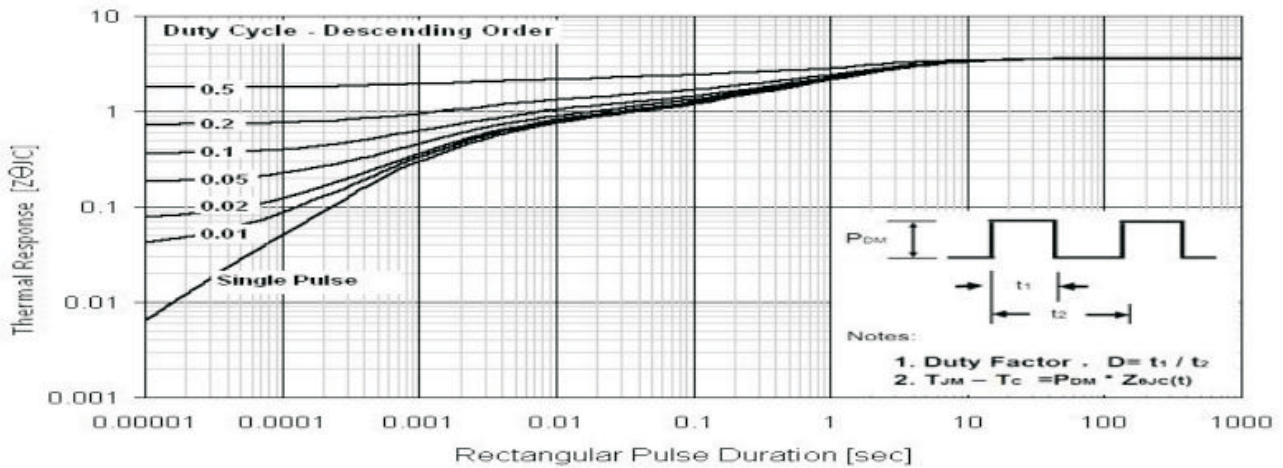


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

Typical characteristics Diagrams

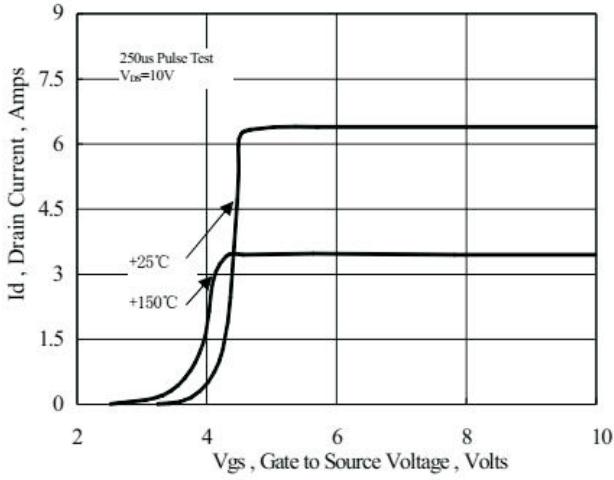


Figure 6 Typical Transfer Characteristics

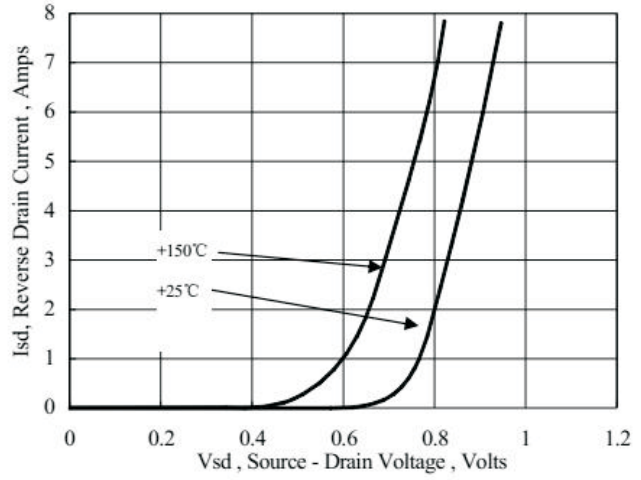


Figure 7 Typical Body Diode Transfer Characteristics

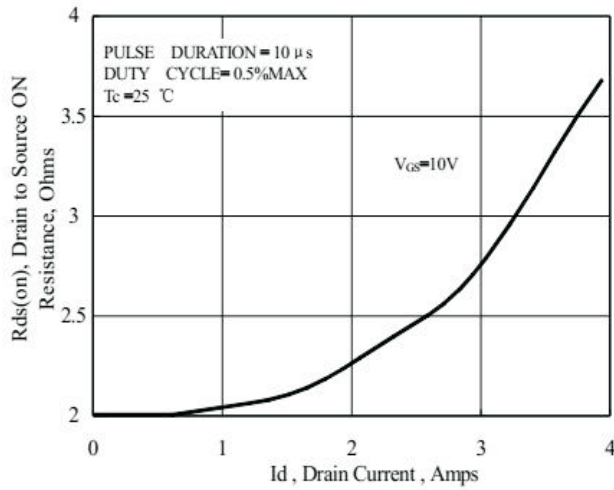


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

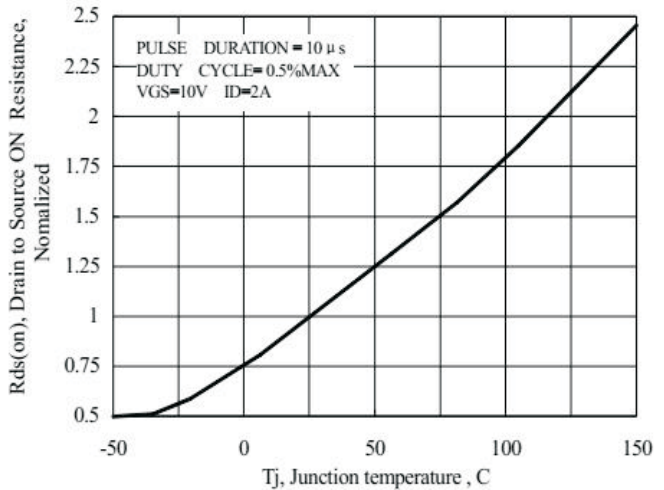


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

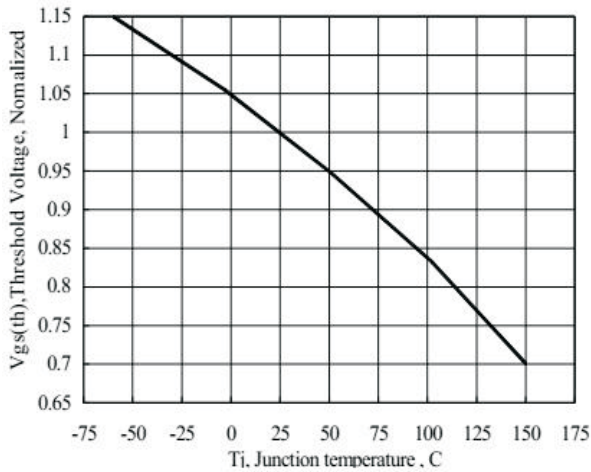


Figure 10 Typical Threshold Voltage vs Junction Temperature

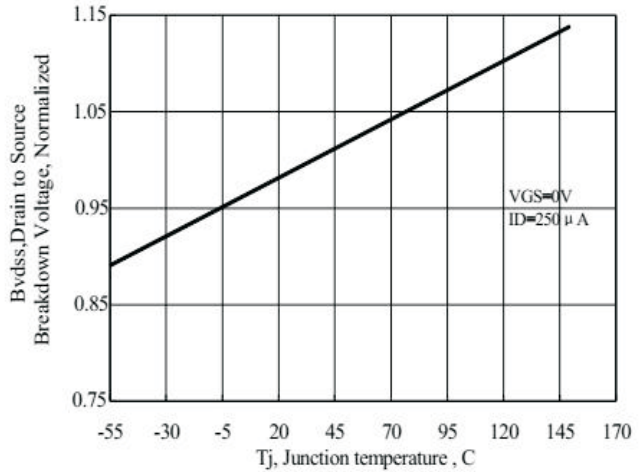


Figure 11 Typical Breakdown Voltage vs Junction Temperature

Typical characteristics Diagrams

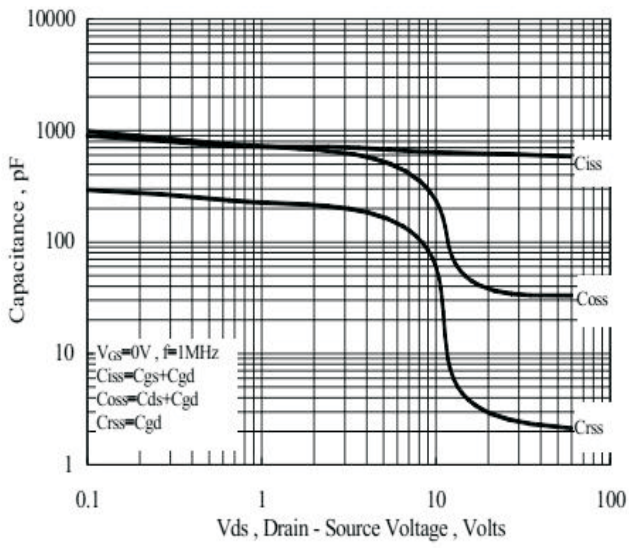


Figure 12 Typical Capacitance vs Drain to Source Voltage

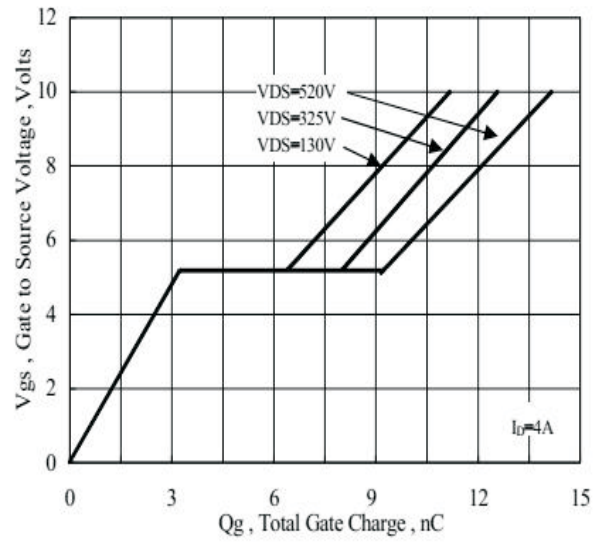
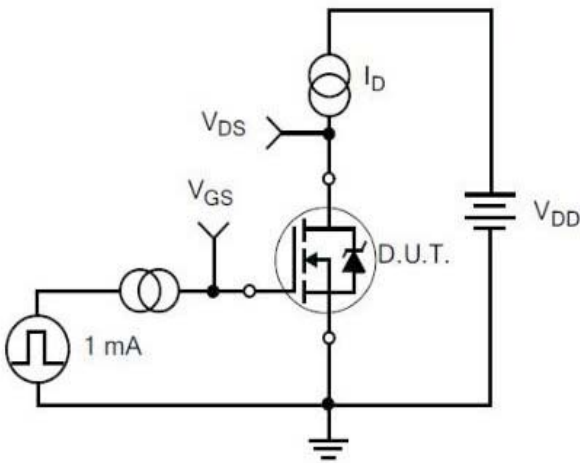
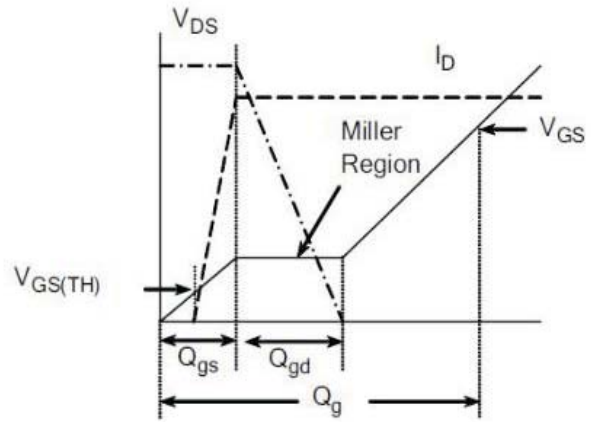


Figure 13 Typical Gate Charge vs Gate to Source Voltage

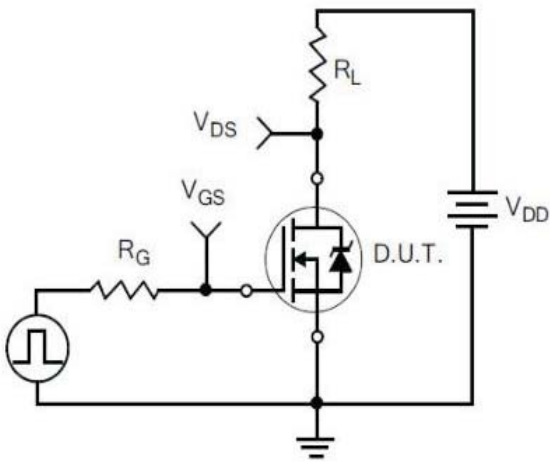
TYPICAL TEST CIRCUIT



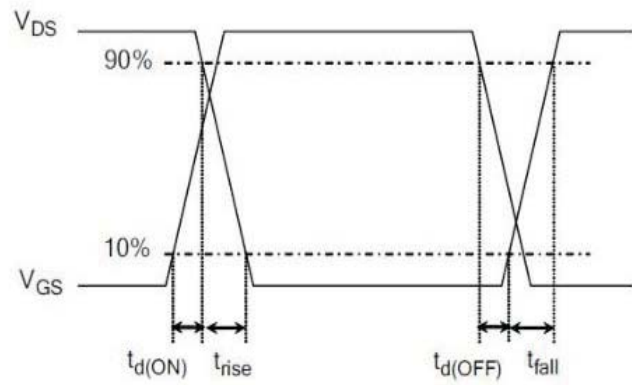
1) Gate Charge Test Circuit



2) . Gate Charge Waveform



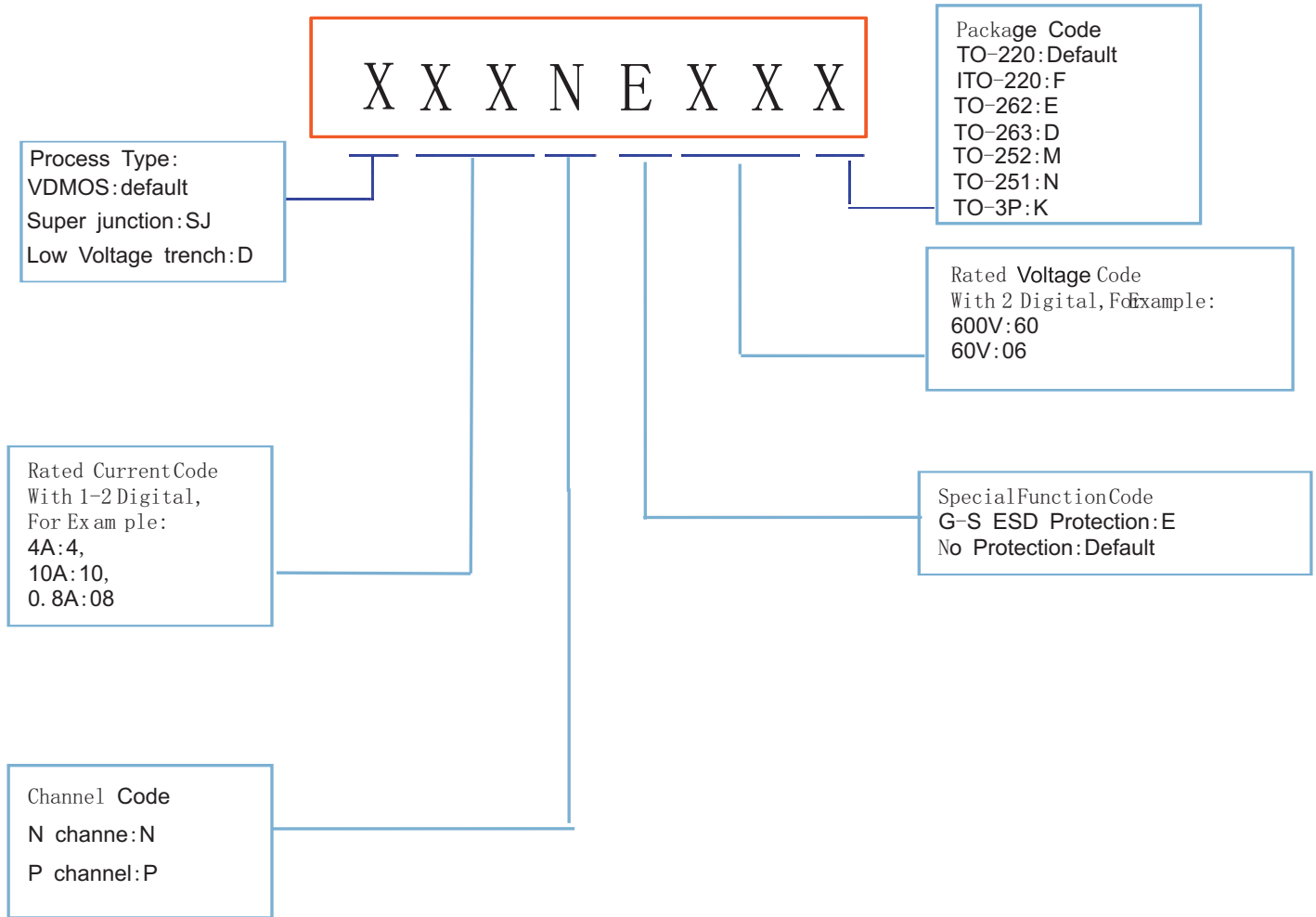
3) Resistive Switching Test Circuit



4) Resistive Switching Waveforms

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

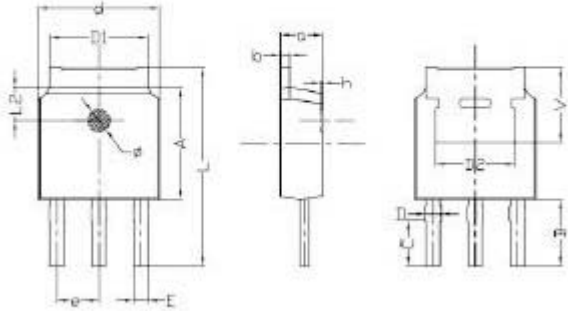
TYPICAL TEST CIRCUIT AND WAVEFORM (CONTINUES)



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

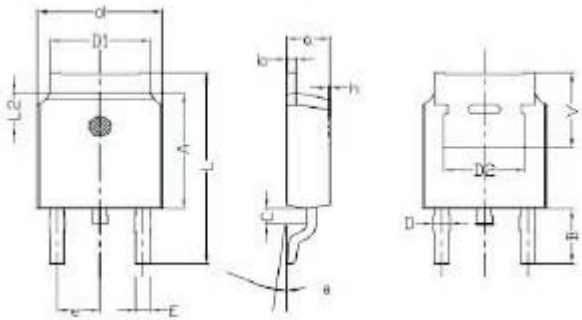
Dimensions

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

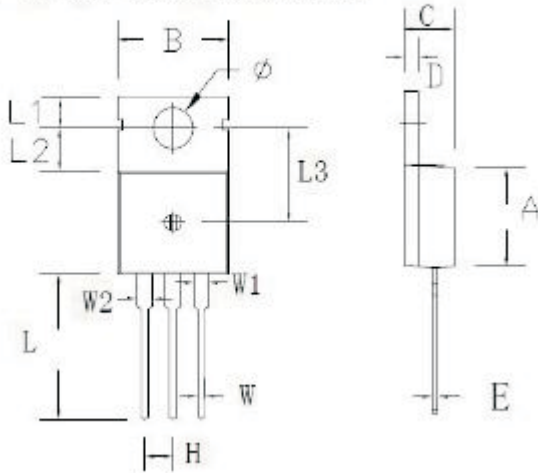


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
a	2.20	2.40	0.087	0.095
b	0.46	0.58	0.018	0.023
c	0.70	0.90	0.028	0.035
D	0.80	1.00	0.032	0.039
d	6.30	6.70	0.248	0.264
D1	5.00	5.50	0.197	0.217
D2	TYP 4.83		TYP 0.190	
A	5.80	6.20	0.228	0.244
e	2.19	2.39	0.086	0.094
L	9.40	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

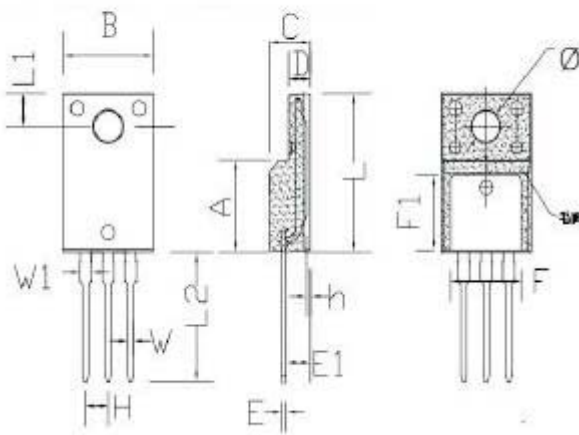
Dimensions

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
φ	3.50	3.90	0.138	0.154

ITO-220 PACKAGE OUTLINE DIMENSIONS

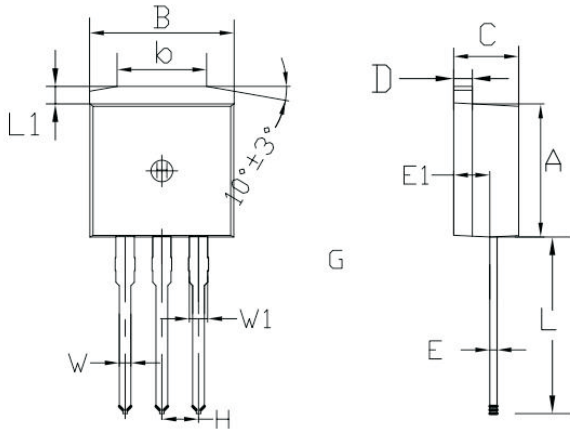


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035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

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

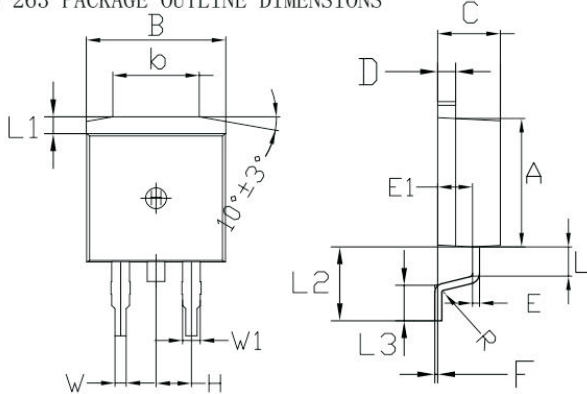
Dimensions

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

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