

FEATURES

- $R_{DS(ON)} < 0.8\Omega @ V_{GS}=10V$
- Fast switching capability
- Low Gate Charge
- Lead free in compliance with EU RoHS directive.

MECHANICAL DATA

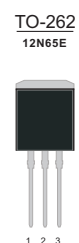
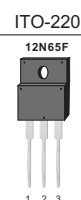
- Case: TO-220, ITO-220, TO-262, TO-263 Package

Ordering Information

Part No.	Package Type	Package	Quality(box)
12N65-TU	TO-220	Tube	1000
12N65F-TU	ITO-220	Tube	1000
12N65E-TU	TO-262	Tube	1000
12N65D-TU	TO-263	Tape & Reel	800

PRODUCT SUMMARY

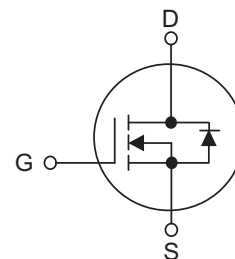
$V_{DS}(V)$	$R_{DS(ON)}(TYP)(\Omega)$	$I_D(A)$
650	0.66 @ $V_{GS}=10V$	12



Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source



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	12	A
Pulsed Drain Current (Note 1)	I_{DM}	48	A
Avalanche Energy(Note 5)	E_{AS}	550	mJ
Power Dissipation	TO-220/TO-263/TO-262	150	W
	ITO-220	42	
Junction Temperature	T_J	+150	C
Storage Temperature	T_{STG}	-55 ~ +150	C

12N65 12N65F 12N65D 12N65E

THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-251/TO-252 TO-262/TO-263	θ_{JA}	62.5	C/W
	ITO-220			
Junction to Case	TO-220/TO-263/TO-262	θ_{JC}	0.83	C/W
	ITO-220		2.98	

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 =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 =6A		0.66	0.8	Ω
DYNAMIC CHARACTERISTICS(Note 4)							
Input Capacitance		C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1MHz		1993		pF
Output Capacitance		C _{OSS}			160		pF
Reverse Transfer Capacitance		C _{RSS}			9.5		pF
SWITCHING CHARACTERISTICS (Note 4)							
Turn-On Delay Time		t _{D(ON)}	V _{DD} =325V, I _D =12A, R _G =10Ω		28		ns
Turn-On Rise Time		t _R			26		ns
Turn-Off Delay Time		t _{D(OFF)}			64		ns
Turn-Off Fall Time		t _F			45		ns
Total Gate Charge		Q _G	V _{DS} =520V, I _D =12A, V _{GS} =10V		40		nC
Gate-Source Charge		Q _{GS}			10		nC
Gate-Drain Charge		Q _{GD}			14		nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} =0V, I _S =12A			1.5	V
Maximum Continuous Drain-Source Diode Forward Current (Note 2)		I _S				12	A
Reverse Recovery Current		I _{RRM}			13.2		A
Reverse Recovery Time		t _{rr}	V _{GS} =0V, I _S =12A		651		ns
Reverse Recovery Charge		Q _{RR}	di/dt=100A/μs (Note 1)		4297		nC

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

2. Surface mounted on FR4 Board ,t_s≤10sec

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

4. Guaranteed by design,not subject to production.

5. L=10mH,I_D=10.5A,V_{DD}=50V,R_G=25Ω,Starting T_J=25°C

Typical characteristics Diagrams

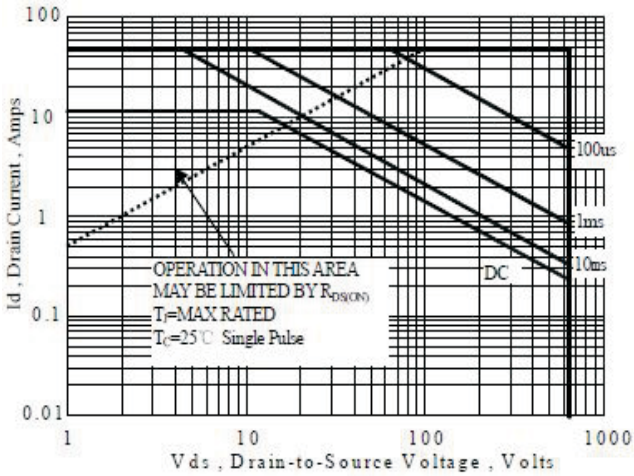


Figure 1 Maximum Forward Bias Safe Operating Area

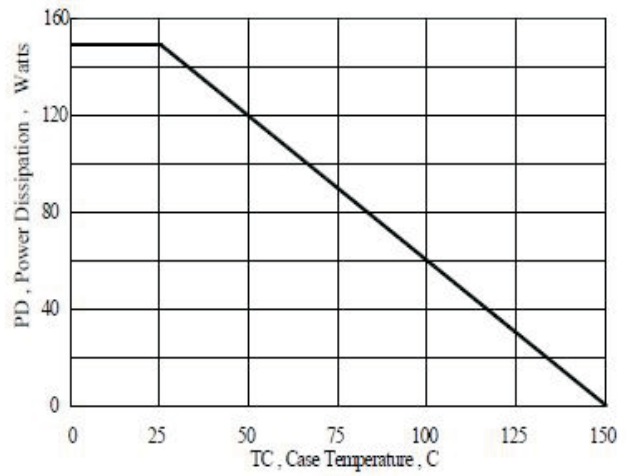


Figure 2 Maximum Power Dissipation vs Case Temperature

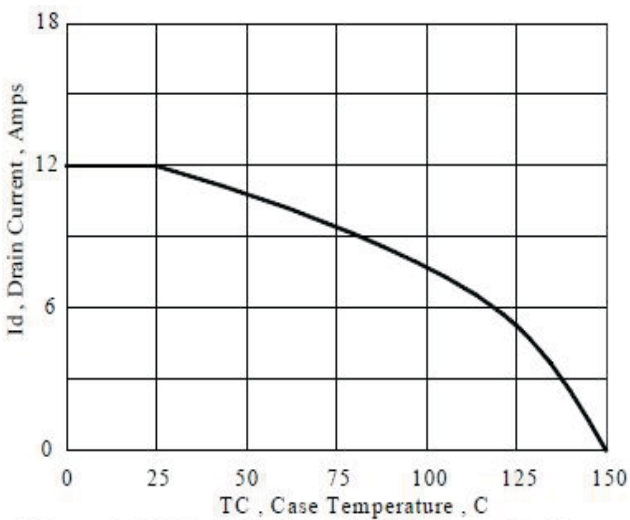


Figure 3 Maximum Continuous Drain Current vs Case Temperature

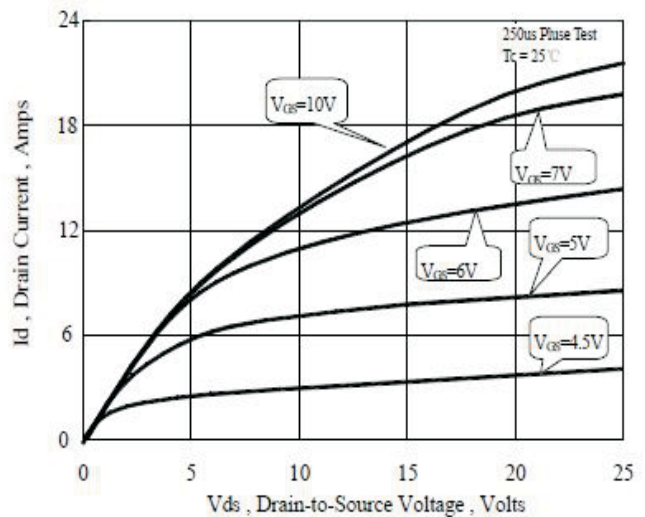


Figure 4 Typical Output Characteristics

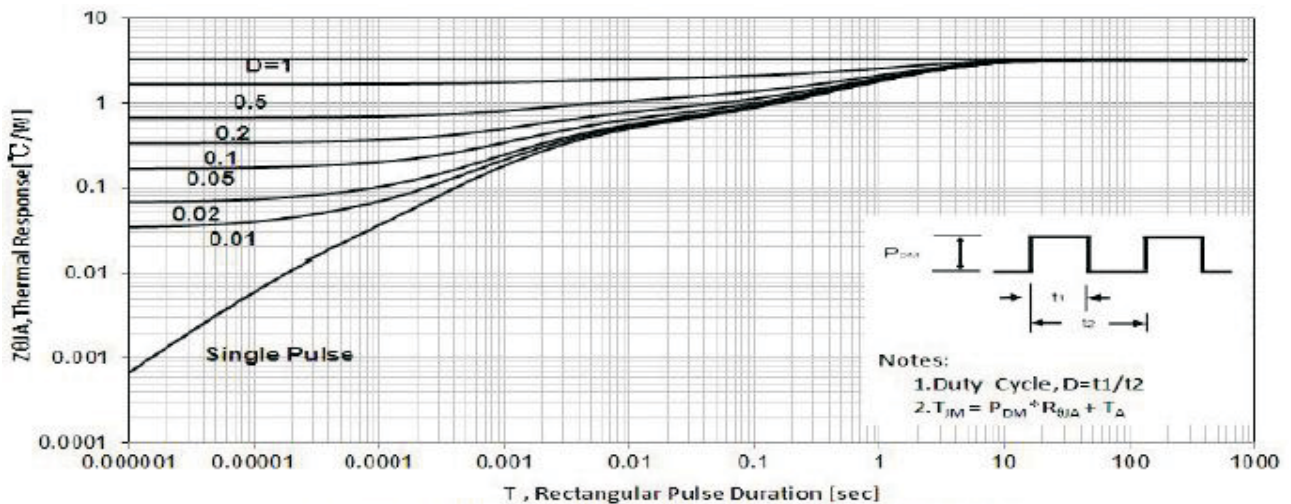


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

Typical characteristics Diagrams

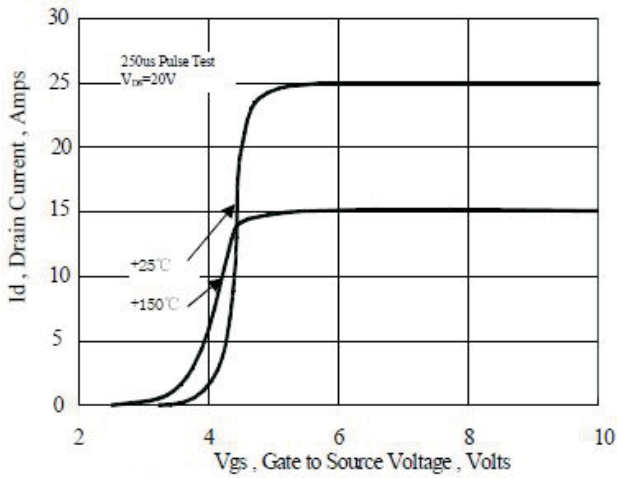


Figure 6 Typical Transfer Characteristics

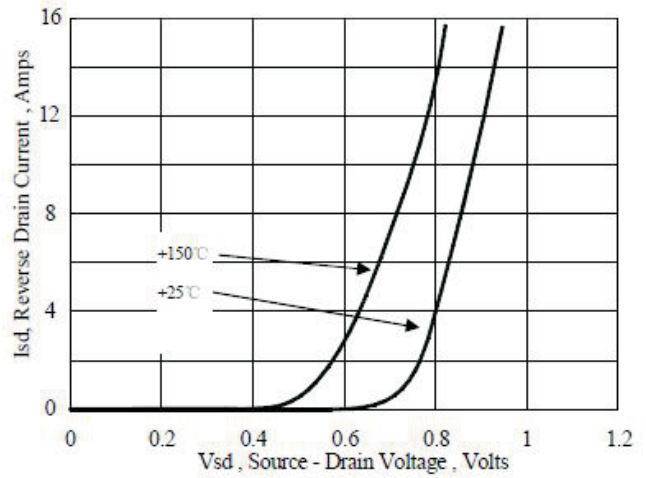


Figure 7 Typical Body Diode Transfer Characteristics

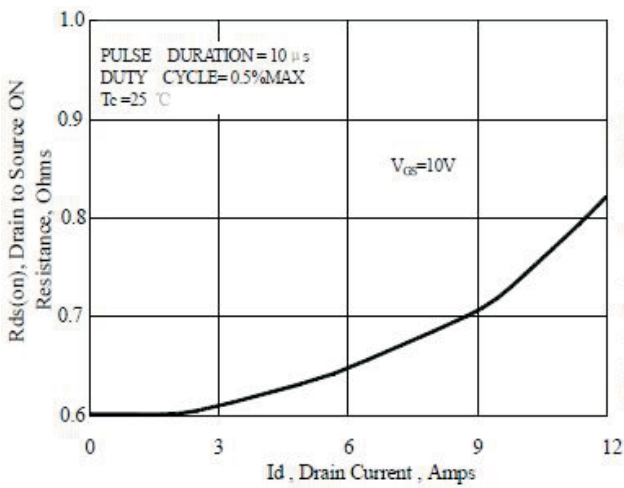


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

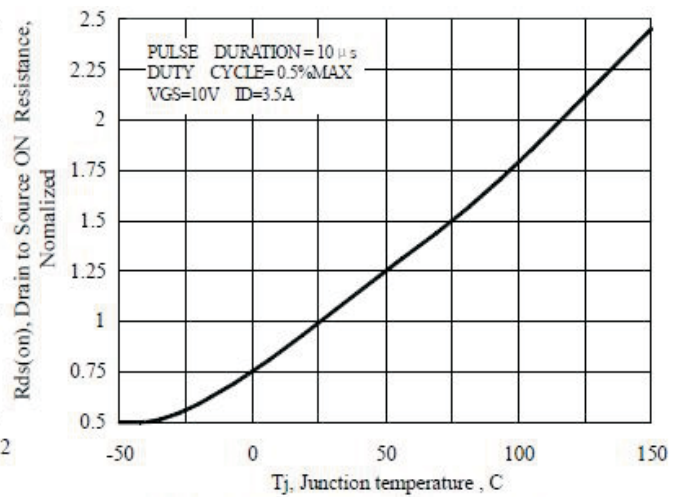


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

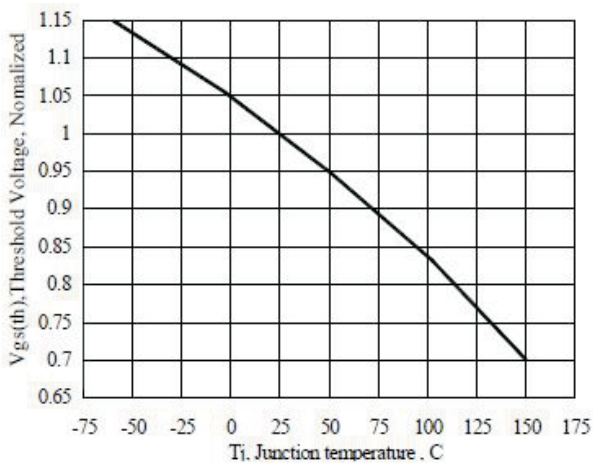


Figure 10 Typical Threshold Voltage vs Junction Temperature

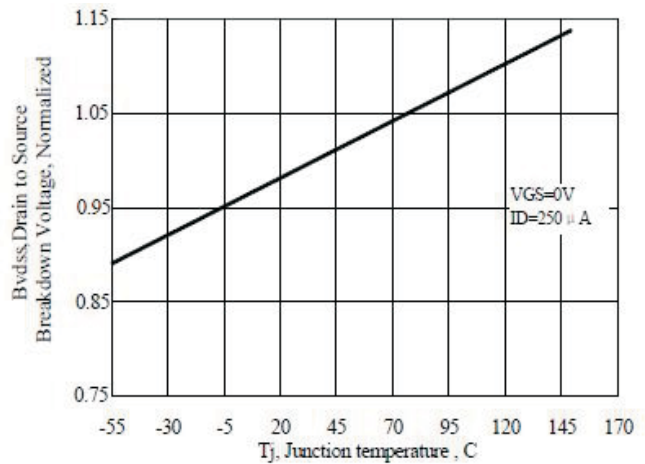


Figure 11 Typical Breakdown Voltage vs Junction Temperature

Typical characteristics Diagrams

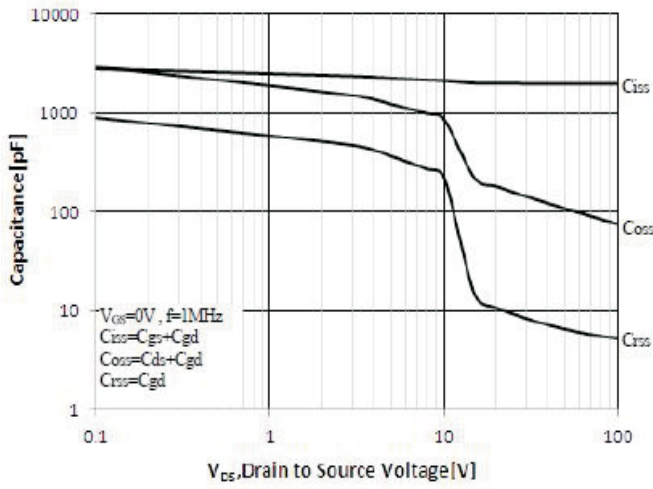


Figure 12 Typical Capacitance vs Drain to Source Voltage

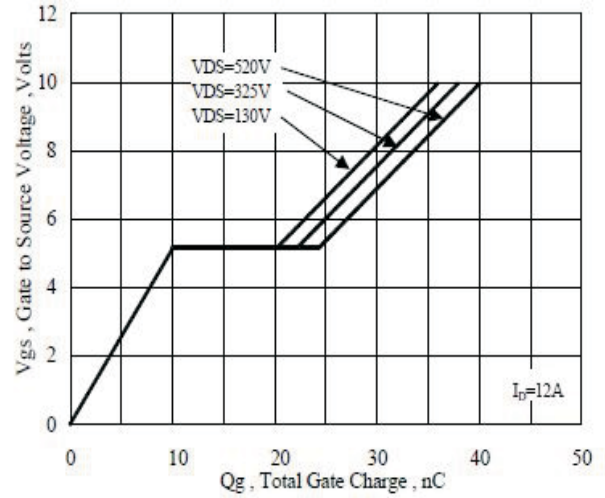


Figure 13 Typical Gate Charge vs Gate to Source Voltage

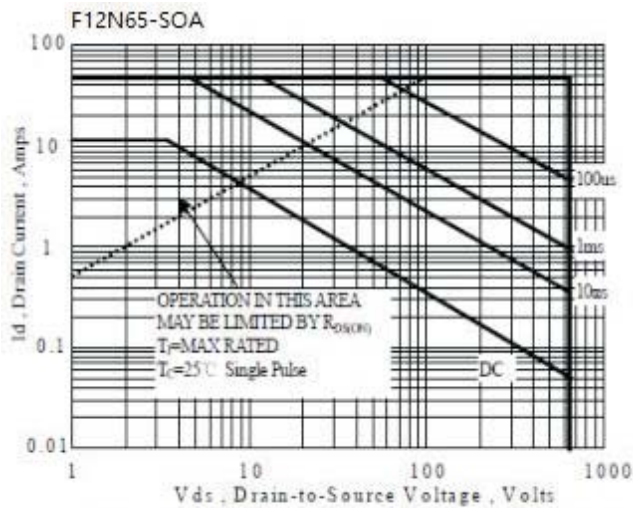


Figure 14 Maximum Forward Bias Safe Operating Area

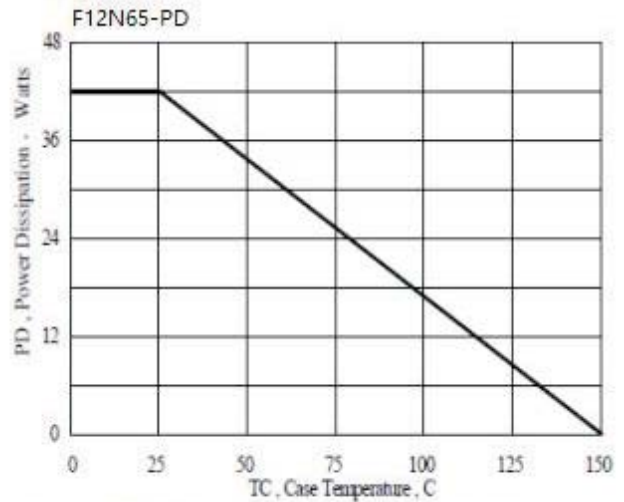


Figure 15 Maximum Power Dissipation vs Case Temperature

TYPICAL TEST CIRCUIT

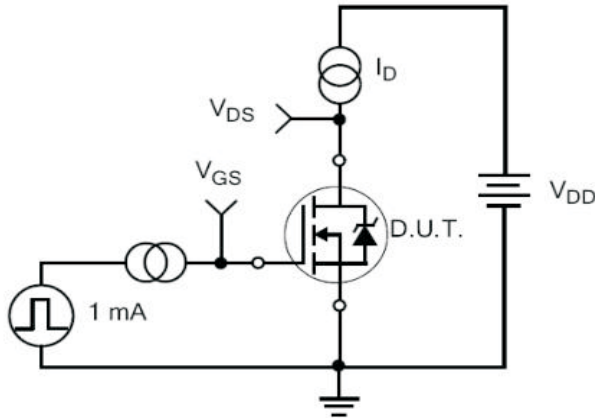


Figure 17. Gate Charge Test Circuit

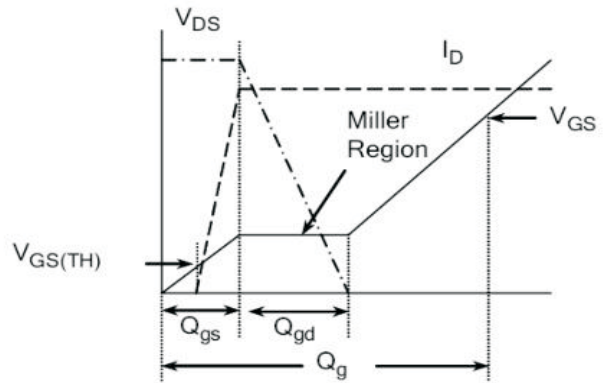


Figure 18. Gate Charge Waveform

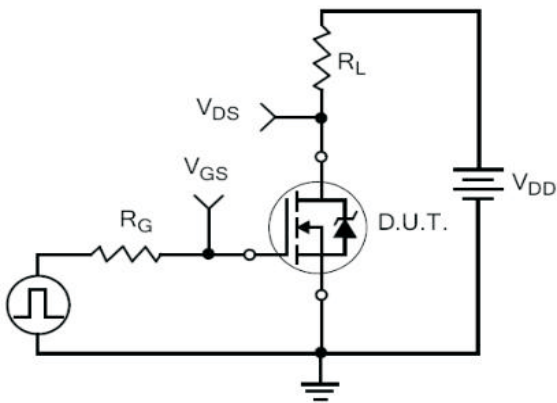


Figure 19. Resistive Switching Test Circuit

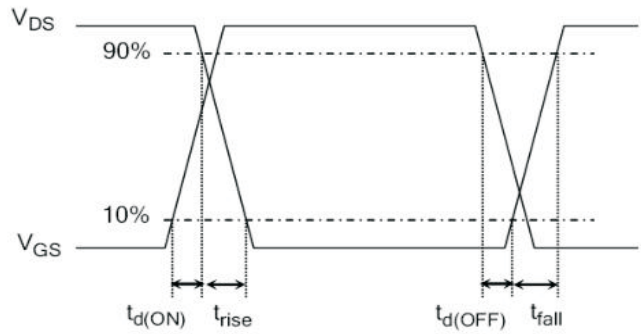


Figure 20. Resistive Switching Waveforms

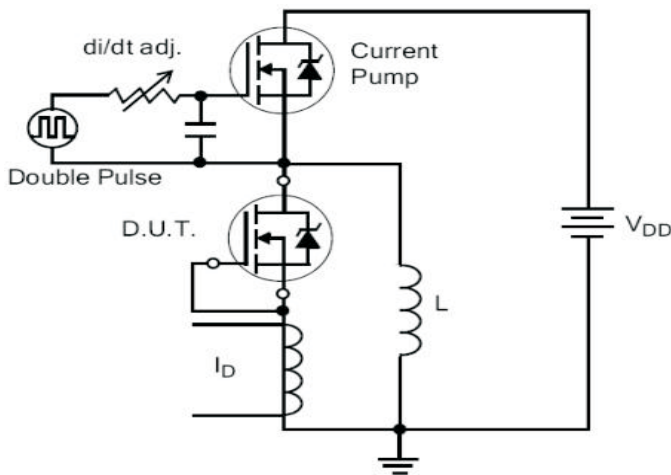


Figure 21. Diode Reverse Recovery Test Circuit

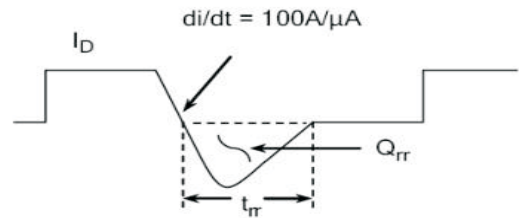


Figure 22. Diode Reverse Recovery Waveform

TYPICAL TEST CIRCUIT AND WAVEFORM(CONTINUES)

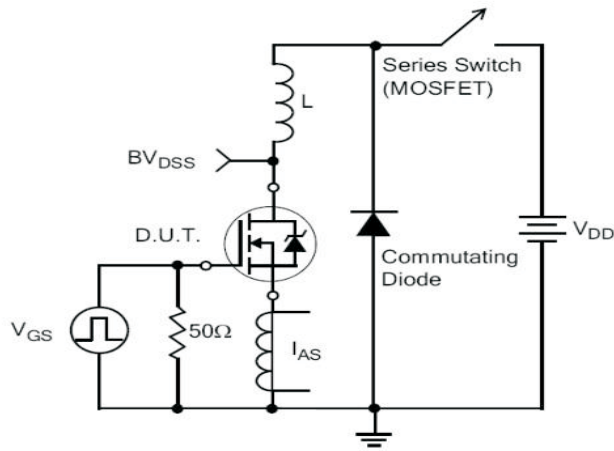


Figure 23. Unclamped Inductive Switching Test Circuit

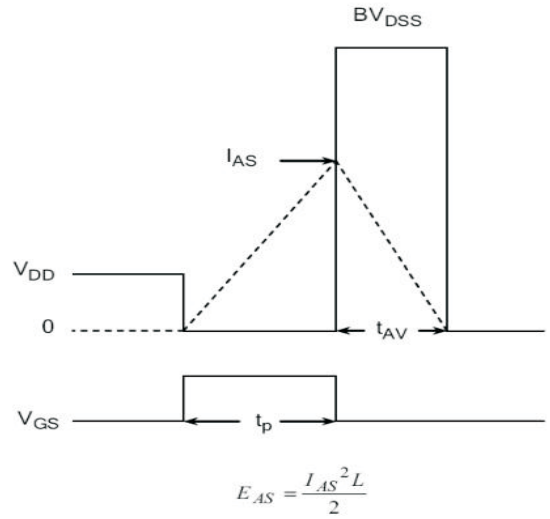
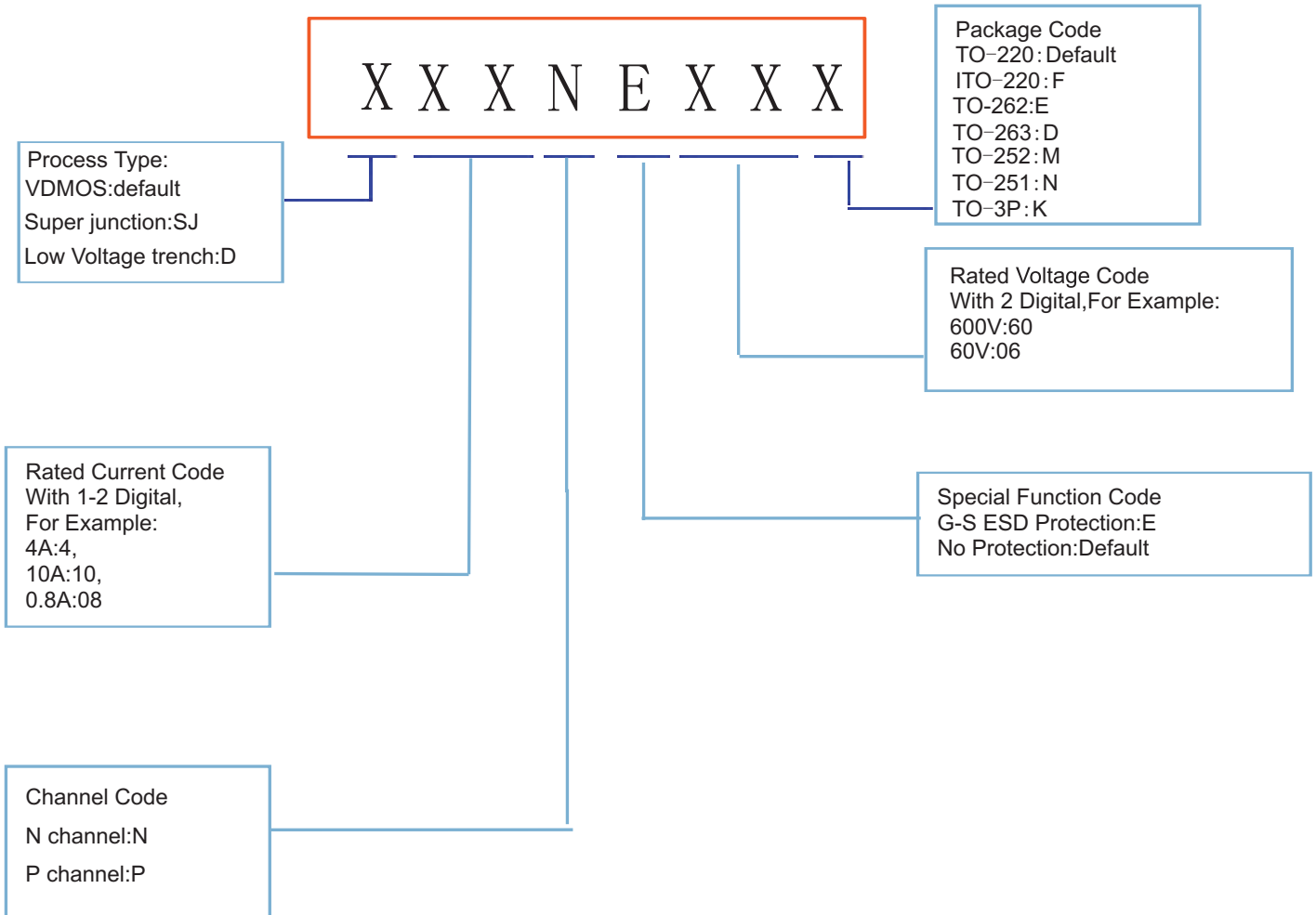


Figure 24. Unclamped Inductive Switching Waveforms

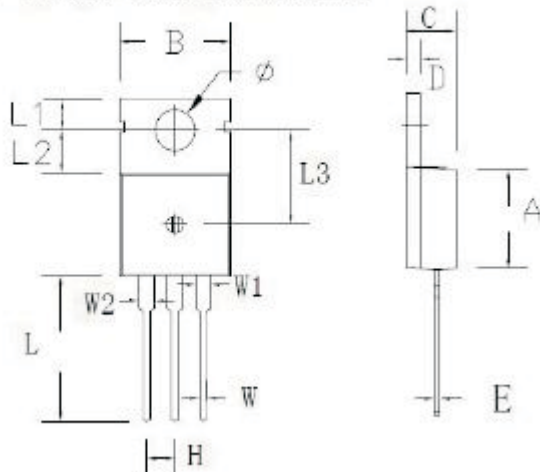
Product Names Rules



12N65 12N65F 12N65D 12N65E

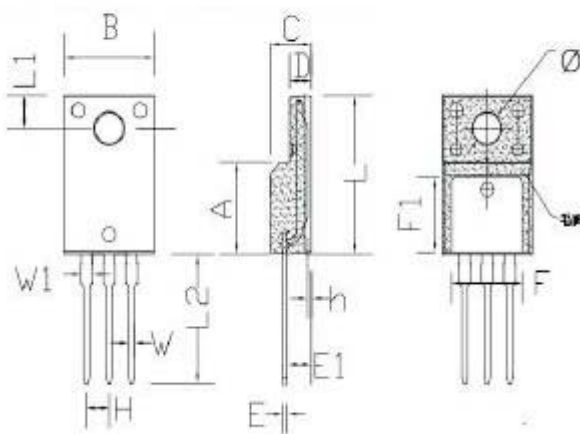
Dimensions

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

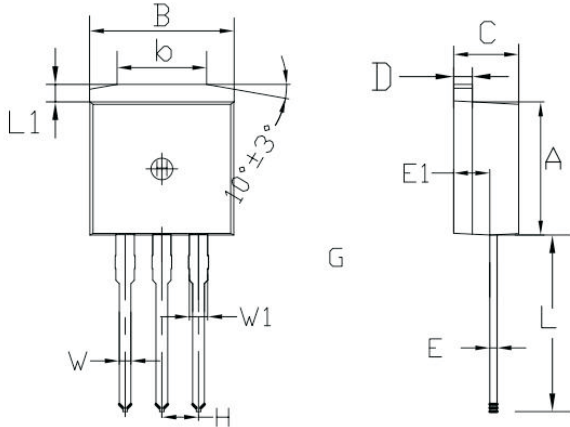


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035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

12N65 12N65F 12N65D 12N65E

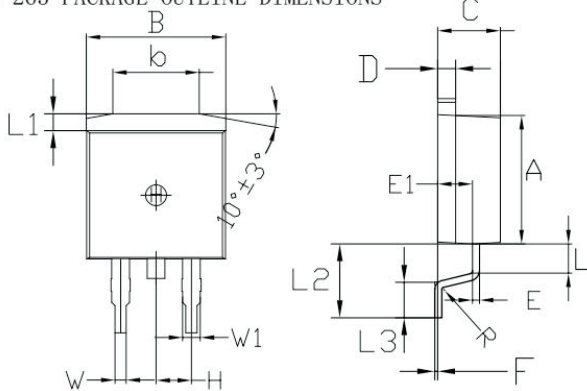
Dimensions

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