

# N-Channel Enhancement Mode Power MOSFET

## MTN12N65FP

**$BV_{DSS}$  : 650V**  
 **$R_{DS(ON)}$  : 0.6  $\Omega$  (typ.)**  
 **$I_D$  : 12A**

### Description

The MTN12N65FP is a N-channel enhancement-mode MOSFET, providing the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost effectiveness. The TO-220FP package is universally preferred for all commercial-industrial applications

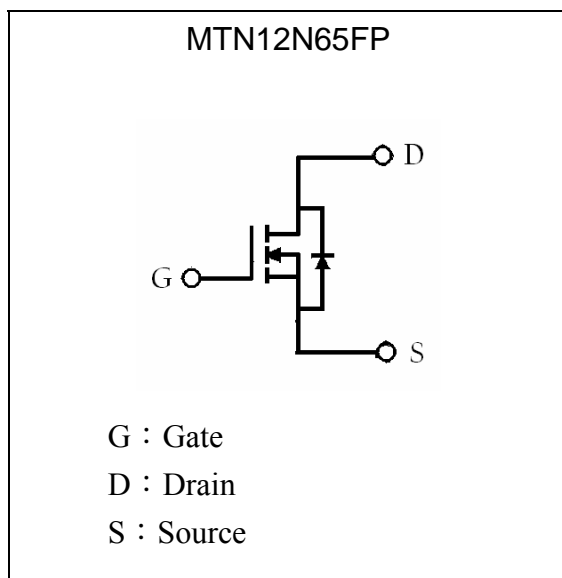
### Features

- Low On Resistance
- Simple Drive Requirement
- Fast Switching Characteristic
- Insulating package, front/back side insulating voltage=2500V(AC)
- RoHS compliant package

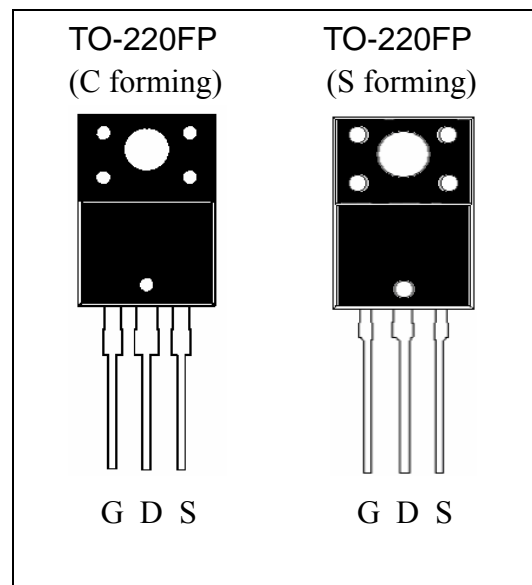
### Applications

- Adapter
- Switching Mode Power Supply

### Symbol



### Outline



**Absolute Maximum Ratings** ( $T_C=25^{\circ}\text{C}$ )

Parameter	Symbol	Limits	Unit
Drain-Source Voltage	$V_{DS}$	650	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	V
Continuous Drain Current	$I_D$	12*	A
Continuous Drain Current @ $T_C=100^{\circ}\text{C}$	$I_D$	7.2*	A
Pulsed Drain Current @ $V_{GS}=10\text{V}$ (Note 1)	$I_{DM}$	48*	A
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	624	mJ
Avalanche Current (Note 1)	$I_{AR}$	12	A
Repetitive Avalanche Energy (Note 1)	$E_{AR}$	5.1	mJ
Peak Diode Recovery $dv/dt$ (Note 3)	$dv/dt$	4.5	V/ns
Maximum Temperature for Soldering @ Lead at 0.125 in(0.318mm) from case for 10 seconds	$T_L$	300	$^{\circ}\text{C}$
Total Power Dissipation ( $T_C=25^{\circ}\text{C}$ )		51	W
Linear Derating Factor		0.41	W/ $^{\circ}\text{C}$
Operating Junction and Storage Temperature	$T_j, T_{stg}$	-55~+150	$^{\circ}\text{C}$

\*Drain current limited by maximum junction temperature

Note : 1.Repetitive rating; pulse width limited by maximum junction temperature.

2.  $I_{AS}=12\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $L=8\text{mH}$ ,  $R_G=25\Omega$ , starting  $T_J=+25^{\circ}\text{C}$ .3.  $I_{SD}\leq 12\text{A}$ ,  $dI/dt\leq 100\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , starting  $T_J=+25^{\circ}\text{C}$ .**Thermal Data**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-case, max	$R_{th,j-c}$	2.43	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-ambient, max	$R_{th,j-a}$	62.5	$^{\circ}\text{C}/\text{W}$



**Characteristics (Tj=25°C, unless otherwise specified)**

Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>Static</b>					
BV <sub>DSS</sub>	650	-	-	V	V <sub>GS</sub> =0, I <sub>D</sub> =250μA, T <sub>j</sub> =25°C
ΔBV <sub>DSS</sub> /ΔT <sub>j</sub>	-	0.5	-	V/°C	Reference to 25°C, I <sub>D</sub> =250μA
V <sub>GS(th)</sub>	2.0	-	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> =250μA
*G <sub>FS</sub>	-	5	-	S	V <sub>DS</sub> =15V, I <sub>D</sub> =7A
I <sub>GSS</sub>	-	-	±100	nA	V <sub>GS</sub> =±30
I <sub>DSS</sub>	-	-	1	μA	V <sub>DS</sub> =650V, V <sub>GS</sub> =0
	-	-	10		V <sub>DS</sub> =520V, V <sub>GS</sub> =0, T <sub>j</sub> =125°C
*R <sub>DS(ON)</sub>	-	0.6	0.65	Ω	V <sub>GS</sub> =10V, I <sub>D</sub> =6A
<b>Dynamic</b>					
*Q <sub>g</sub>	-	38	49	nC	I <sub>D</sub> =12A, V <sub>DS</sub> =520V, V <sub>GS</sub> =10V
*Q <sub>gs</sub>	-	8.2	-		
*Q <sub>gd</sub>	-	13.7	-		
*t <sub>d(ON)</sub>	-	30	70	ns	V <sub>DS</sub> =325V, I <sub>D</sub> =12A, V <sub>GS</sub> =10V, R <sub>G</sub> =25Ω
*t <sub>r</sub>	-	85	180		
*t <sub>d(OFF)</sub>	-	140	280		
*t <sub>f</sub>	-	90	190		
C <sub>iss</sub>	-	1835	2385	pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz
C <sub>oss</sub>	-	185	240		
C <sub>rss</sub>	-	16	21		
<b>Source-Drain Diode</b>					
*I <sub>S</sub>	-	-	12	A	
*I <sub>SM</sub>	-	-	48		
*V <sub>SD</sub>	-	-	1.5	V	I <sub>S</sub> =12A, V <sub>GS</sub> =0V
*t <sub>rr</sub>	-	420	-	ns	V <sub>GS</sub> =0, I <sub>F</sub> =12A, dI/dt=100A/μs
*Q <sub>rr</sub>	-	4.9	-	μC	

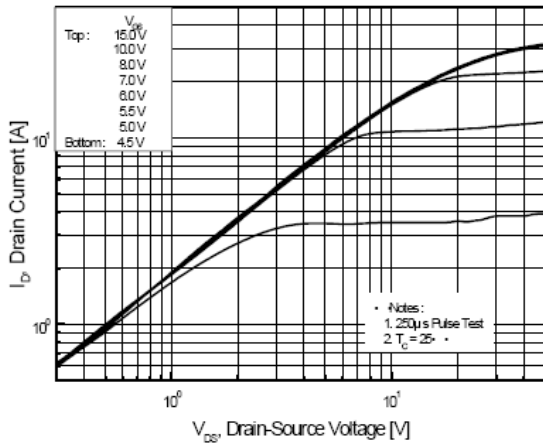
\*Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%

**Ordering Information**

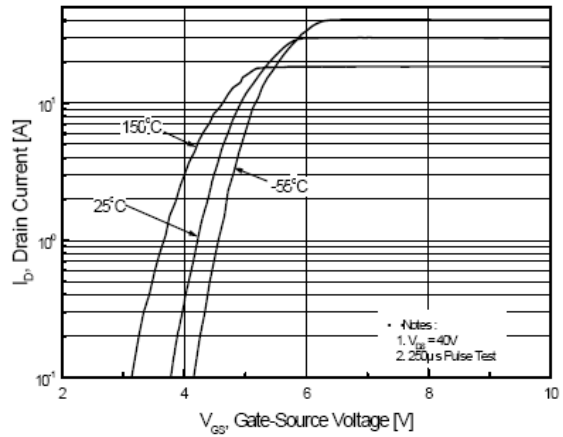
Device	Package	Shipping
MTN12N65FP	TO-220FP(C forming) (RoHS compliant)	50 pcs/tube, 20 tubes/box, 4 boxes / carton
MTN12N65FPS	TO-220FP(S forming) (RoHS compliant)	50 pcs/tube, 20 tubes/box, 4 boxes / carton

**Typical Characteristics**

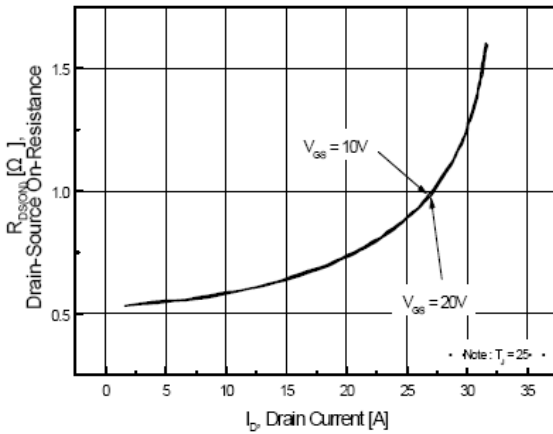
**Figure 1. On-Region Characteristics**



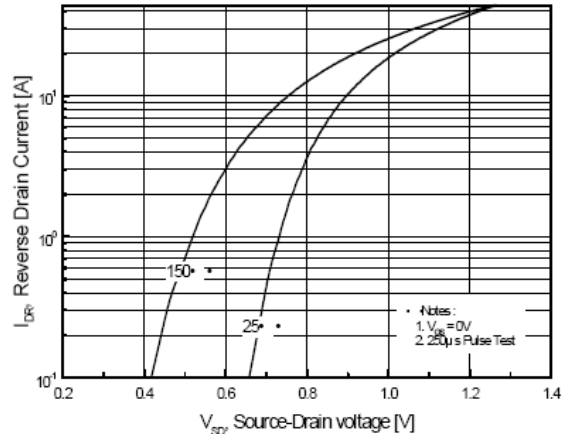
**Figure 2. Transfer Characteristics**



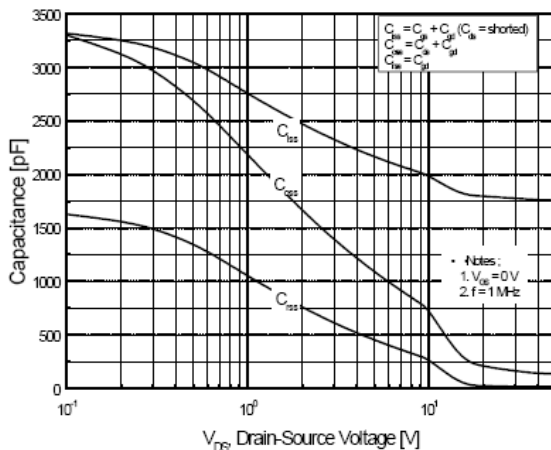
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



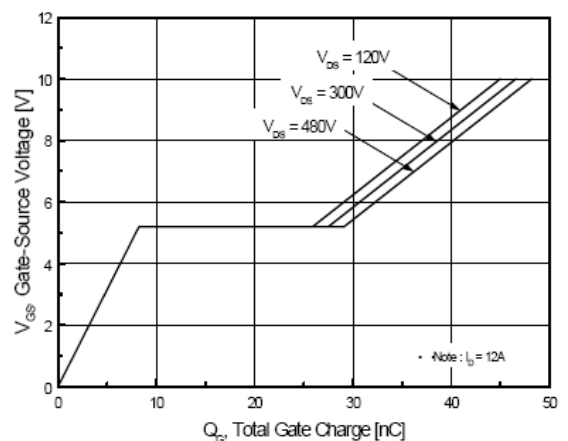
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

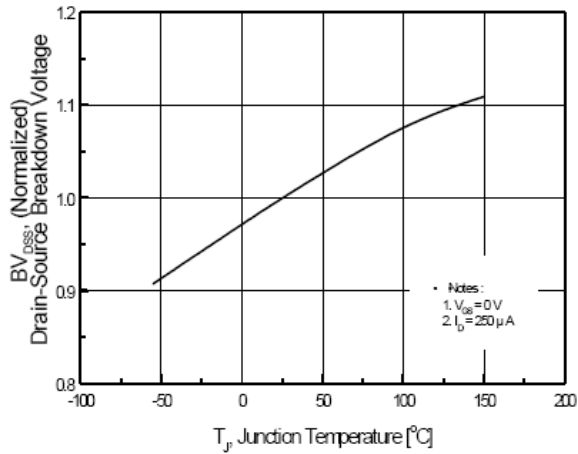


**Figure 6. Gate Charge Characteristics**

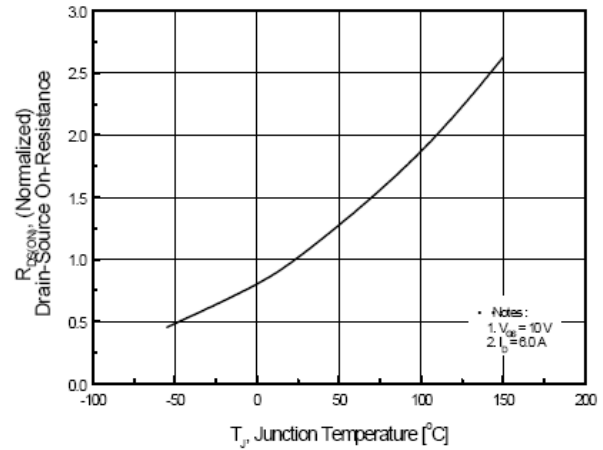


**Typical Characteristics(Cont.)**

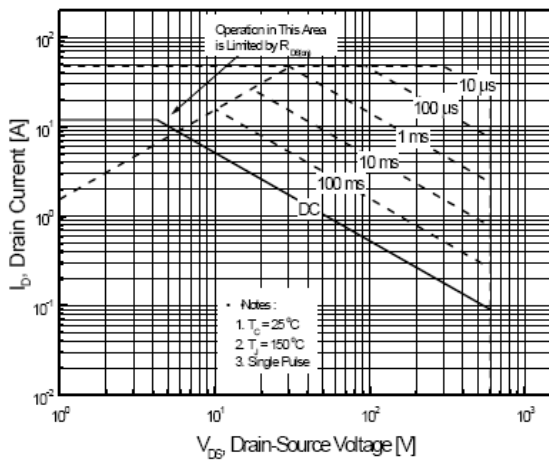
**Figure 7. Breakdown Voltage Variation vs. Temperature**



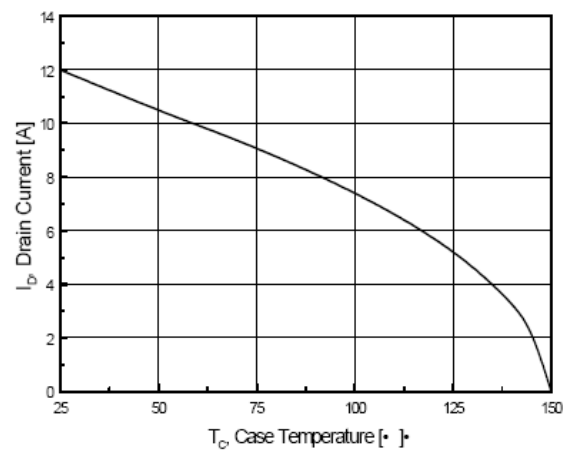
**Figure 8. On-Resistance Variation vs. Temperature**



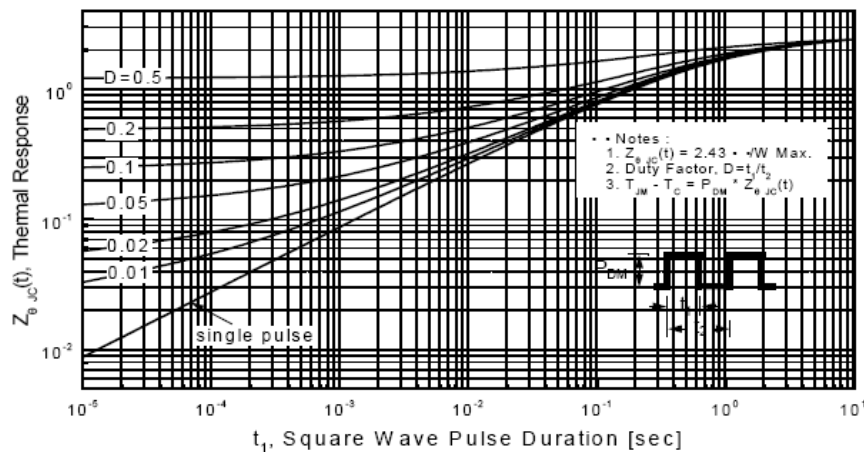
**Figure 9. Maximum Safe Operating Area**



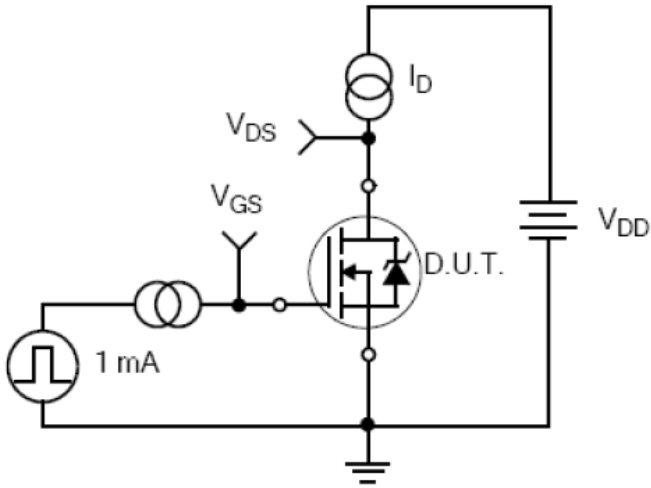
**Figure 10. Maximum Drain Current vs. Case Temperature**



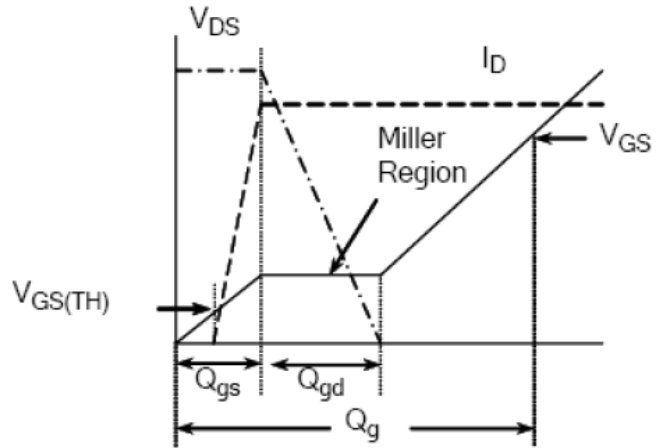
**Figure 11. Transient Thermal Response Curve**



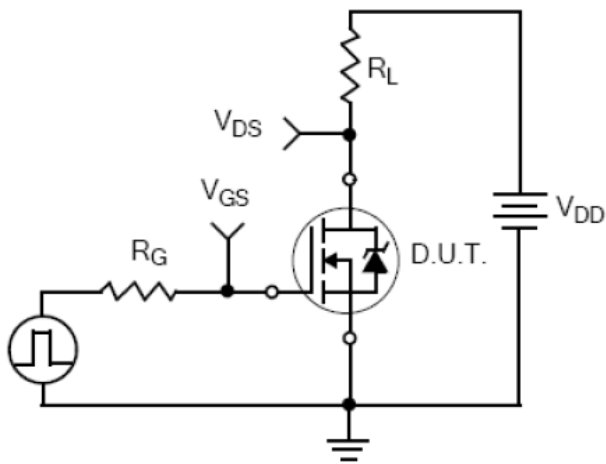
**Test Circuit and Waveforms**



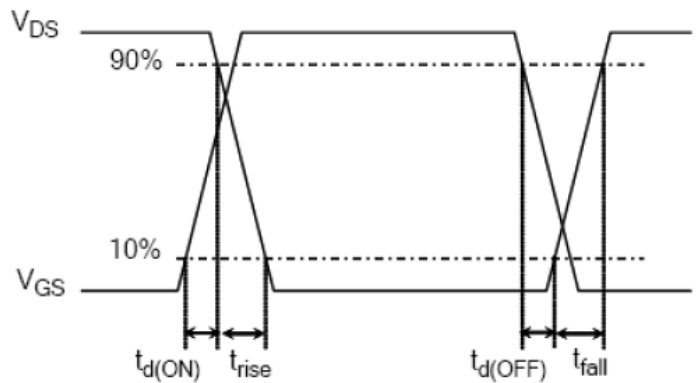
**Figure 12. Gate Charge Test Circuit**



**Figure 13. Gate Charge Waveform**

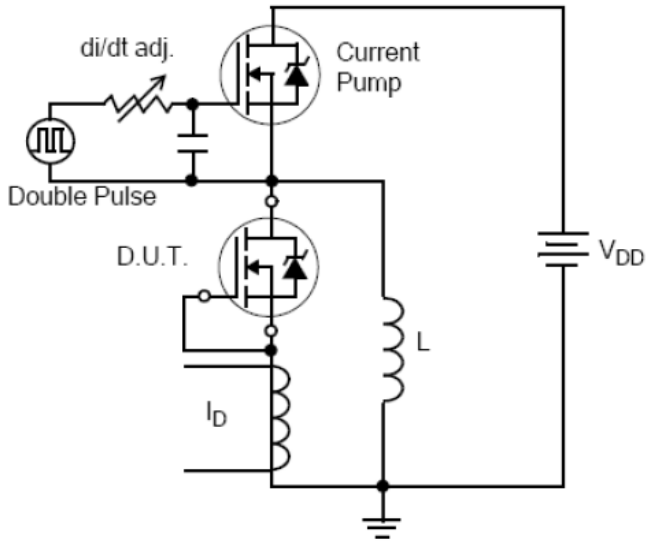


**Figure 14. Resistive Switching Test Circuit**

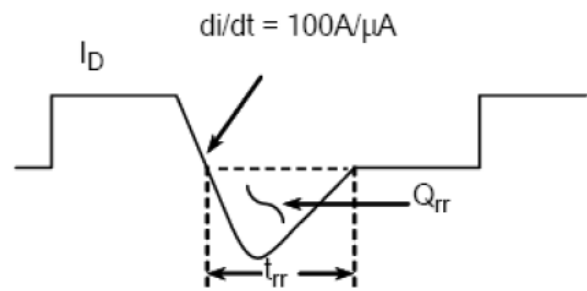


**Figure 15. Resistive Switching Waveforms**

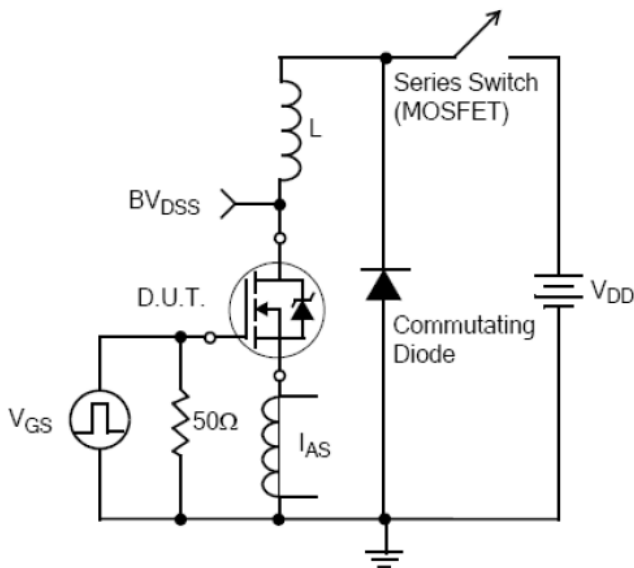
**Test Circuit and Waveforms(Cont.)**



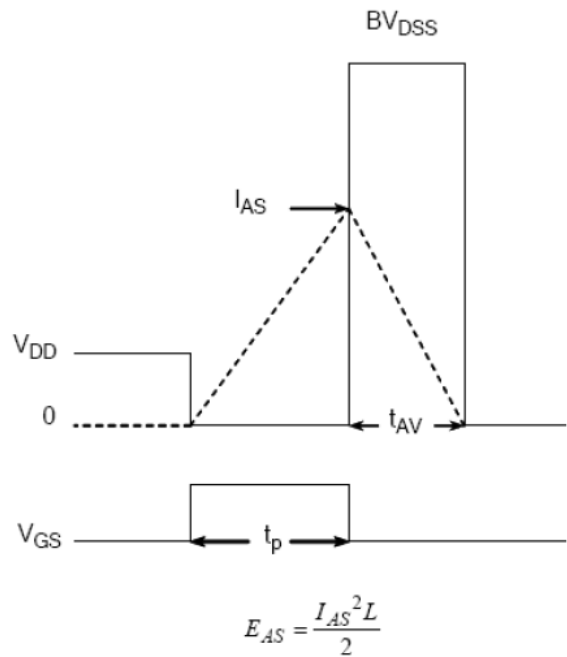
**Figure 16. Diode Reverse Recovery Test Circuit**



**Figure 17. Diode Reverse Recovery Waveform**

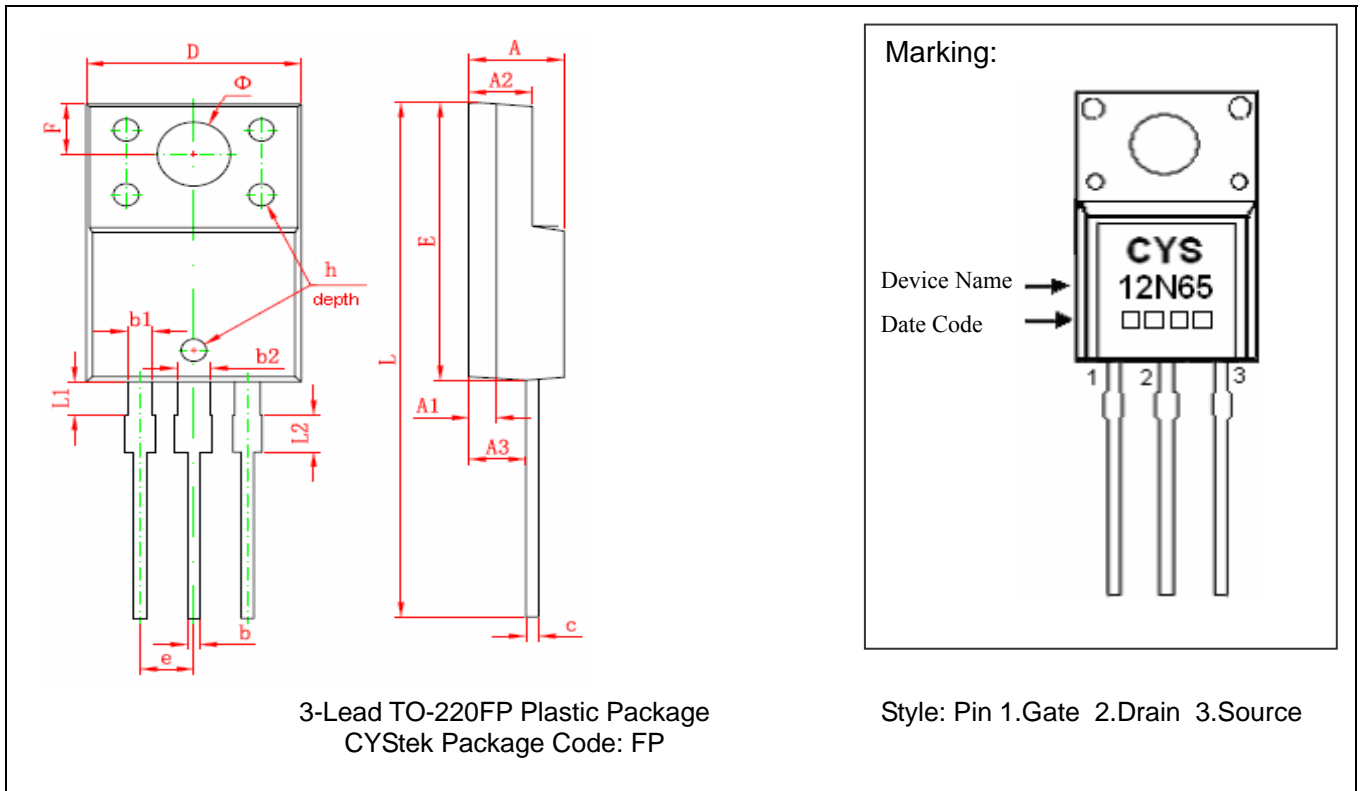


**Figure 18. Unclamped Inductive Switching Test Circuit**



**Figure 19. Unclamped Inductive Switching Waveforms**

**TO-220FP (C Forming) Dimension**



3-Lead TO-220FP Plastic Package  
 CYStek Package Code: FP

Style: Pin 1.Gate 2.Drain 3.Source

\*Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.169	0.185	4.300	4.700	E	0.583	0.598	14.800	15.200
A1	0.051 REF		1.300 REF		e	0.100*		2.540*	
A2	0.110	0.126	2.800	3.200	F	0.106 REF		2.700 REF	
A3	0.098	0.114	2.500	2.900	Φ	0.138 REF		3.500 REF	
b	0.020	0.030	0.500	0.750	h	0.000	0.012	0.000	0.300
b1	0.043	0.053	1.100	1.350	L	1.102	1.118	28.000	28.400
b2	0.059	0.069	1.500	1.750	L1	0.067	0.075	1.700	1.900
c	0.020	0.030	0.500	0.750	L2	0.075	0.083	1.900	2.100
D	0.392	0.408	9.960	10.360					

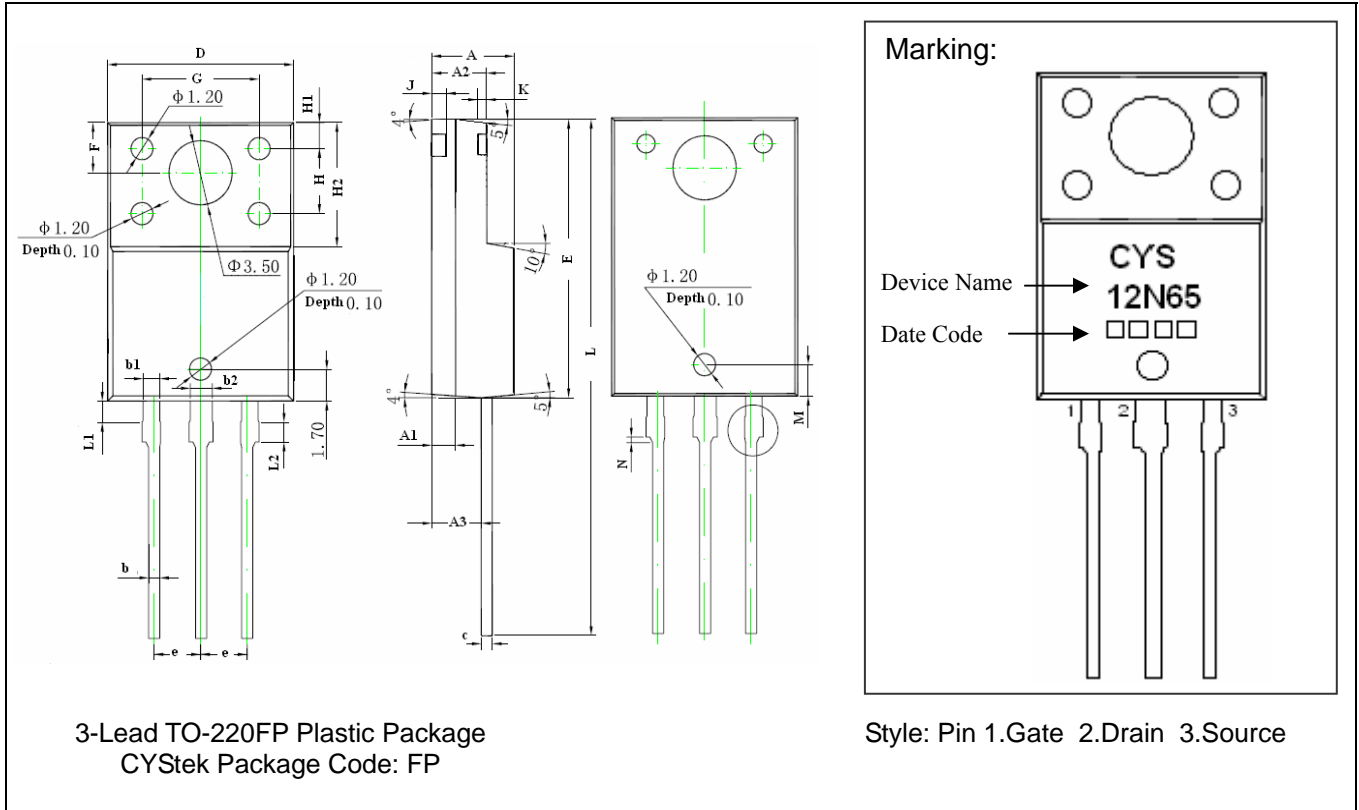
- Notes: 1.Controlling dimension: millimeters.  
 2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.  
 3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

**Material:**

- Lead: Pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.



**TO-220FP (S Forming) Dimension**



3-Lead TO-220FP Plastic Package  
 CYStek Package Code: FP

Marking:  
 Device Name → **CYS 12N65**  
 Date Code → □□□□

Style: Pin 1.Gate 2.Drain 3.Source

\*Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.171	0.183	4.35	4.65	G	0.246	0.258	6.25	6.55
A1	0.051 REF		1.300 REF		H	0.138 REF	3.50 REF		
A2	0.112	0.124	2.85	3.15	H1	0.055 REF	1.40 REF		
A3	0.102	0.110	2.60	2.80	H2	0.256	0.272	6.50	6.90
b	0.020	0.030	0.50	0.75	J	0.031 REF		0.80 REF	
b1	0.031	0.041	0.80	1.05	K	0.020		0.50 REF	
b2	0.047 REF		1.20 REF		L	1.102	1.118	28.00	28.40
c	0.020	0.030	0.500	0.750	L1	0.043	0.051	1.10	1.30
D	0.396	0.404	10.06	10.26	L2	0.036	0.043	0.92	1.08
E	0.583	0.598	14.80	15.20	M	0.067 REF		1.70 REF	
e	0.100 *		2.54*		N	0.012 REF		0.30 REF	
F	0.106 REF		2.70 REF						

Notes: 1.Controlling dimension: millimeters.  
 2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.  
 3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

**Material:**

- Lead: Pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.

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