

## N-Channel Enhancement Mode Power MOSFET

# MTN4N60E3

**$BV_{DSS}$  : 600V**  
 **$R_{DS(ON)}$  : 2.1  $\Omega$  (typ.)**  
 **$I_D$  : 4A**

### Description

The MTN4N60E3 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-220 package is universally preferred for all commercial-industrial applications

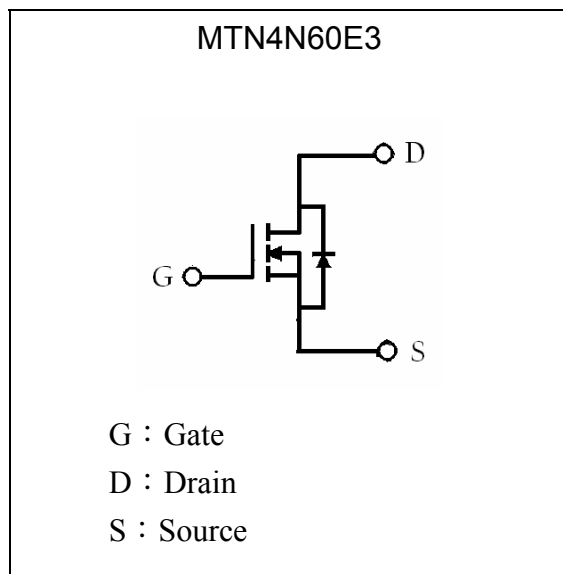
### Features

- Low On Resistance
- Simple Drive Requirement
- Low Gate Charge
- Fast Switching Characteristic
- RoHS compliant package

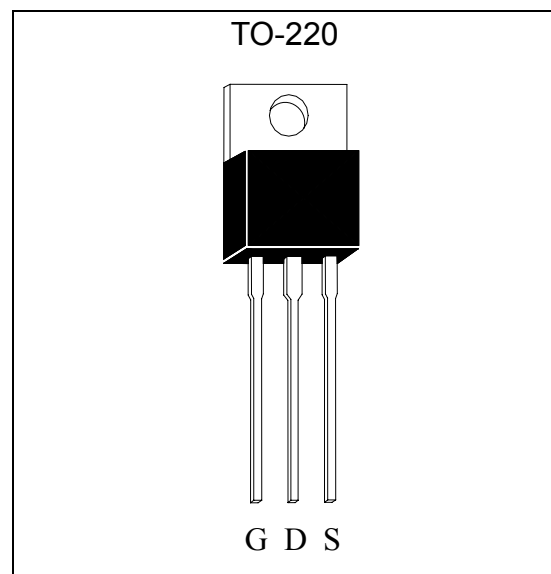
### Applications

- Open Framed Power Supply
- Adapter
- STB

### Symbol



### Outline



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

Parameter	Symbol	Limits	Unit
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	V
Continuous Drain Current	$I_D$	4	A
Continuous Drain Current @ $T_C=100^{\circ}\text{C}$	$I_D$	2.4	A
Pulsed Drain Current @ $V_{GS}=10\text{V}$ (Note 1)	$I_{DM}$	16	A
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	69.8	mJ
Avalanche Current (Note 1)	$I_{AR}$	4	A
Repetitive Avalanche Energy (Note 1)	$E_{AR}$	10	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	$^{\circ}\text{C}$
Maximum Temperature for Soldering @ Package Body for 10 seconds	$T_{PKG}$	260	$^{\circ}\text{C}$
Total Power Dissipation ( $T_C=25^{\circ}\text{C}$ )	$P_d$	100	W
Linear Derating Factor		0.8	W/ $^{\circ}\text{C}$
Operating Junction and Storage Temperature	$T_j, T_{stg}$	-55~+150	$^{\circ}\text{C}$

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

2.  $I_{AS}=4\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $L=8\text{mH}$ ,  $V_G=10\text{V}$ , starting  $T_J=+25^{\circ}\text{C}$ .

3.  $I_{SD}\leq 4\text{A}$ ,  $dI/dt\leq 100\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , starting  $T_J=+25^{\circ}\text{C}$ .

**Thermal Data**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-case, max	$R_{th,j-c}$	1.25	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-ambient, max	$R_{th,j-a}$	62.5	$^{\circ}\text{C}/\text{W}$



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

Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>Static</b>					
BV <sub>DSS</sub>	600	-	-	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>	-	0.6	-	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>	-	3	-	S	V <sub>DS</sub> =15V, I <sub>D</sub> =2A
I <sub>GSS</sub>	-	-	±100	nA	V <sub>GS</sub> =±30
I <sub>DSS</sub>	-	-	1	μA	V <sub>DS</sub> =600V, V <sub>GS</sub> =0
	-	-	10	μA	V <sub>DS</sub> =480V, V <sub>GS</sub> =0, T <sub>j</sub> =125°C
*R <sub>DS(ON)</sub>	-	2.1	2.5	Ω	V <sub>GS</sub> =10V, I <sub>D</sub> =2A
<b>Dynamic</b>					
*Q <sub>g</sub>	-	16	-	nC	I <sub>D</sub> =4A, V <sub>DD</sub> =300V, V <sub>GS</sub> =10V
*Q <sub>gs</sub>	-	3.2	-		
*Q <sub>gd</sub>	-	6.2	-		
*t <sub>d(ON)</sub>	-	9.6	-	ns	V <sub>DD</sub> =300V, I <sub>D</sub> =4A, V <sub>GS</sub> =10V, R <sub>G</sub> =10Ω
*t <sub>r</sub>	-	12.2	-		
*t <sub>d(OFF)</sub>	-	22.3	-		
*t <sub>f</sub>	-	14.8	-		
C <sub>iss</sub>	-	700	-	pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz
C <sub>oss</sub>	-	86	-		
C <sub>rss</sub>	-	20	-		
<b>Source-Drain Diode</b>					
*V <sub>SD</sub>	-	-	1.5	V	I <sub>S</sub> =4A, V <sub>GS</sub> =0V
*I <sub>S</sub>	-	-	4	A	
*I <sub>SM</sub>	-	-	16		
*t <sub>rr</sub>	-	300	-	ns	V <sub>GS</sub> =0, I <sub>S</sub> =4A, dI/dt=100A/μs
*Q <sub>rr</sub>	-	2.6	-	μC	

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

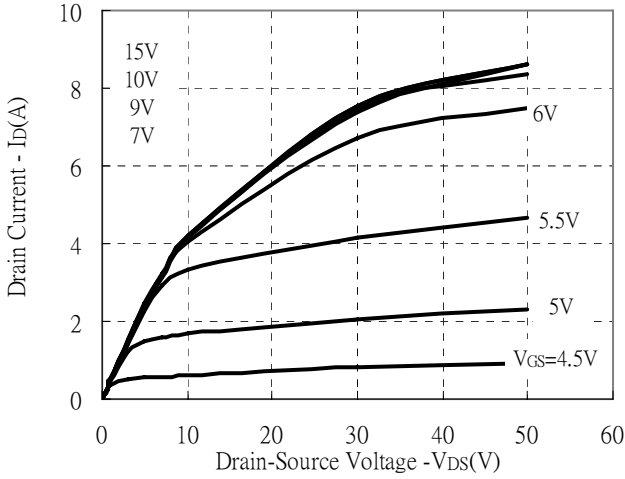
**Ordering Information**

Device	Package	Shipping	Marking
MTN4N60E3	TO-220 (RoHS compliant)	50 pcs/tube, 20 tubes/box, 4 boxes / carton	4N60

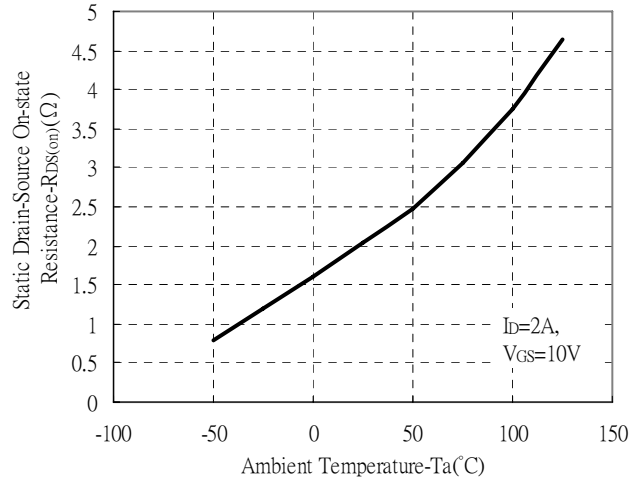


### Typical Characteristics

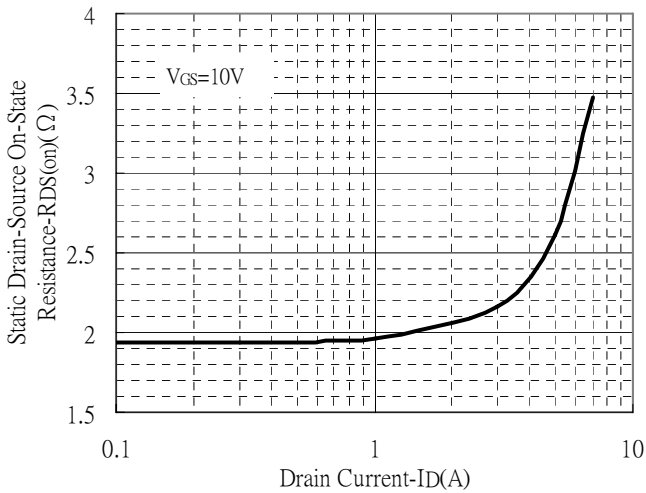
Typical Output Characteristics



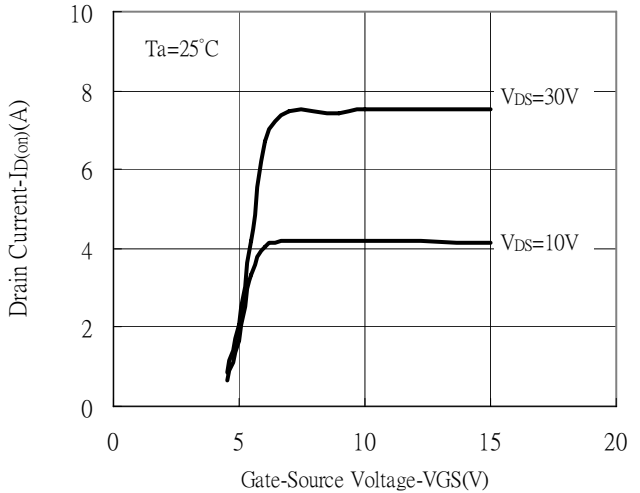
Static Drain-Source On-resistance vs Ambient Temperature



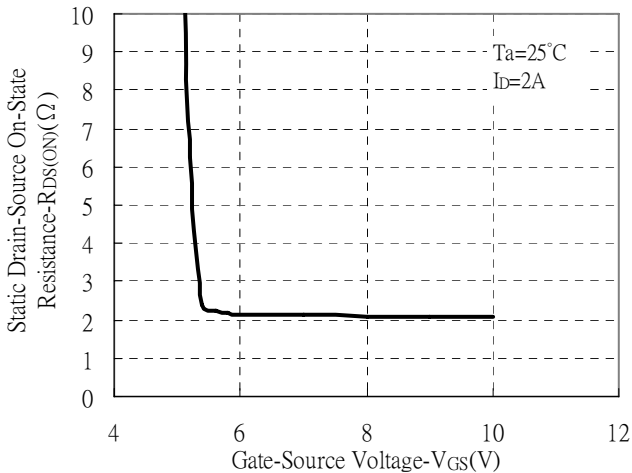
Static Drain-Source On-State resistance vs Drain Current



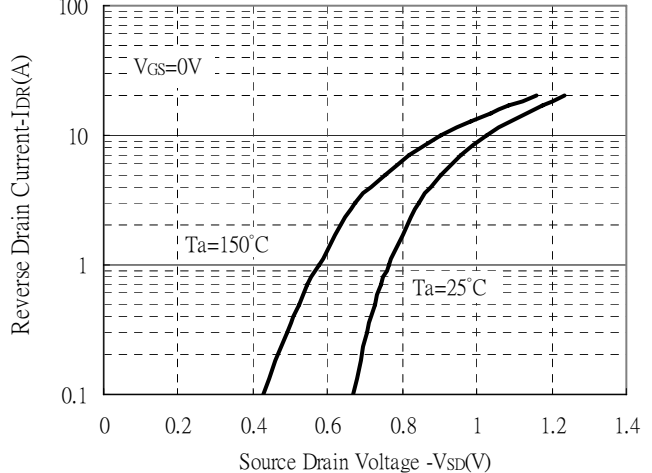
Drain Current vs Gate-Source Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage

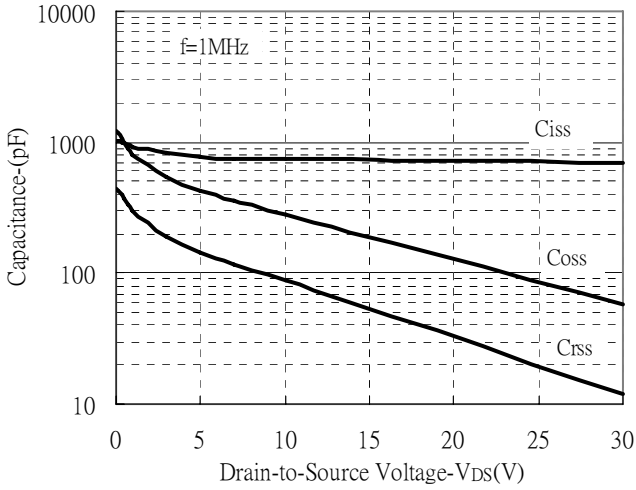


Body Diode Forward Voltage Variation vs Source Current and Temperature

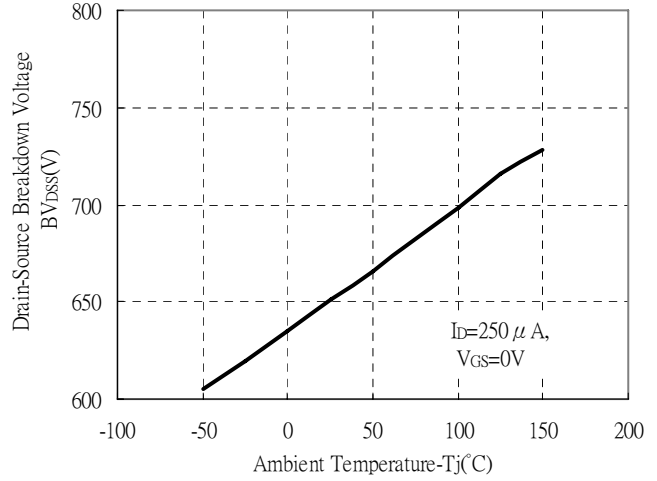


**Typical Characteristics(Cont.)**

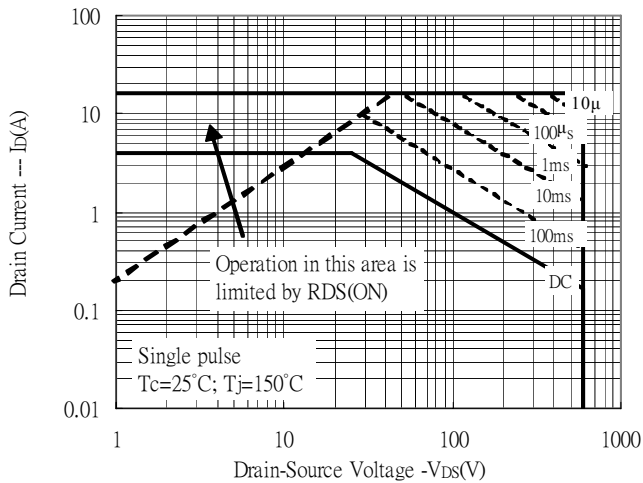
Capacitance vs Reverse Voltage



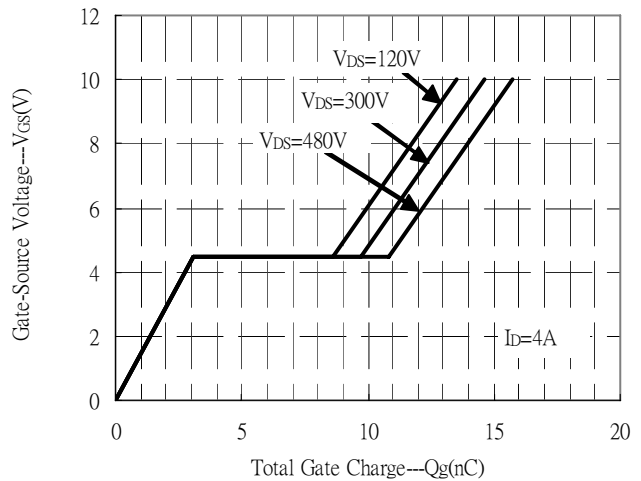
Brekdown Voltage vs Ambient Temperature



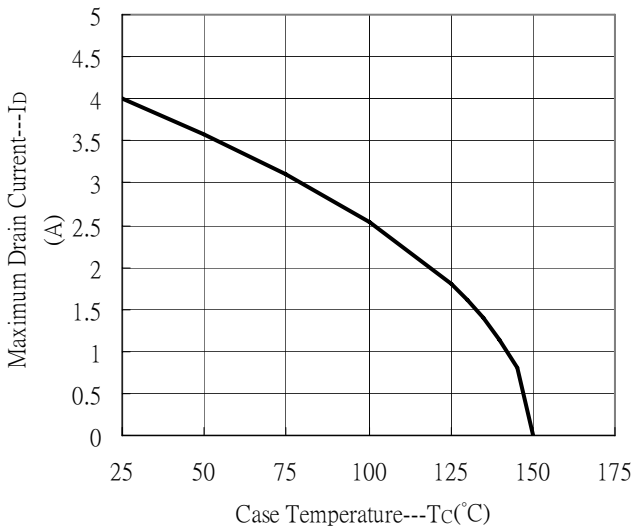
Maximum Safe Operating Area



Gate Charge Characteristics

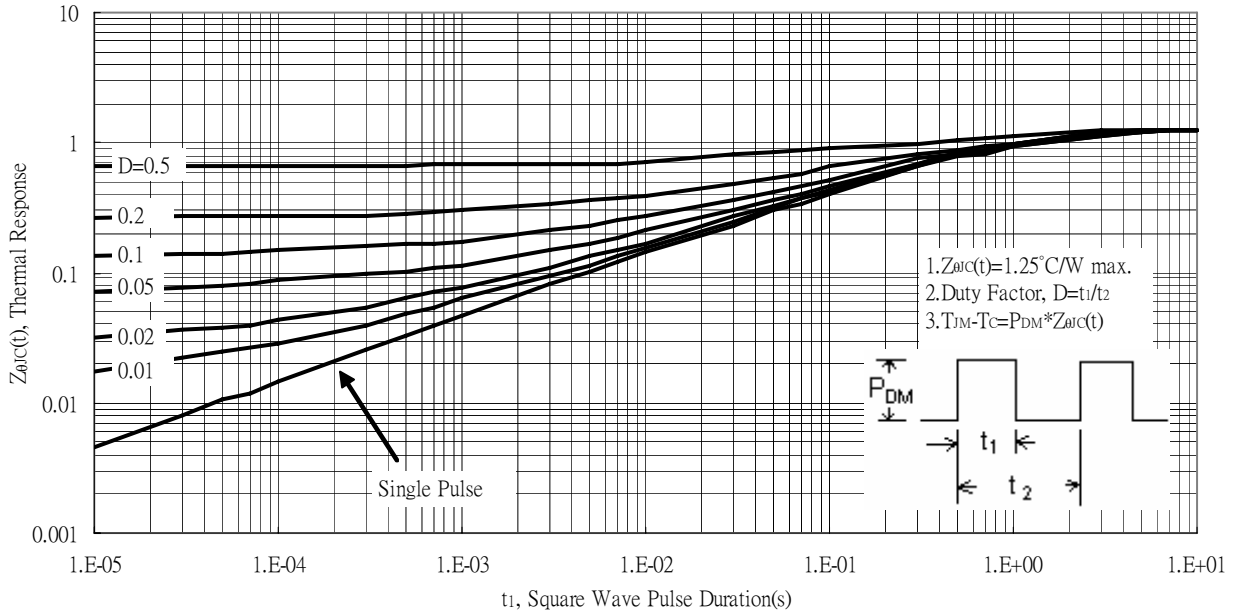


Maximum Drain Current vs Case Temperature



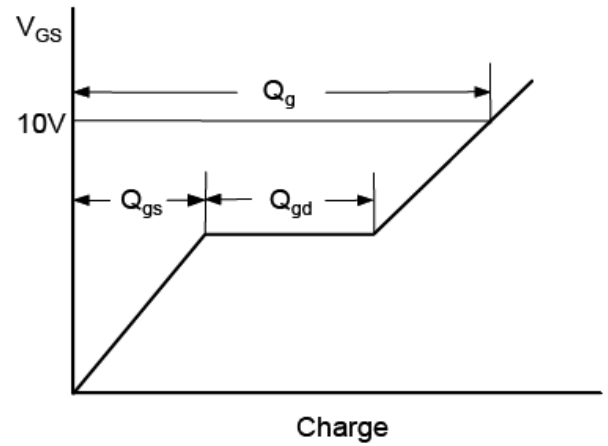
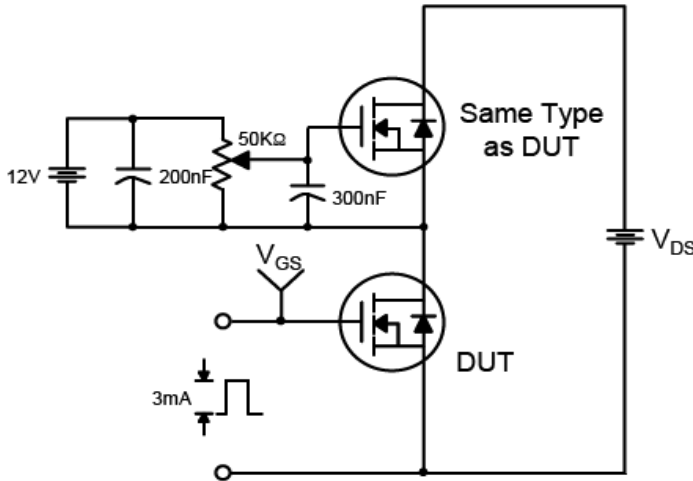
**Typical Characteristics(Cont.)**

Transient Thermal Response Curves

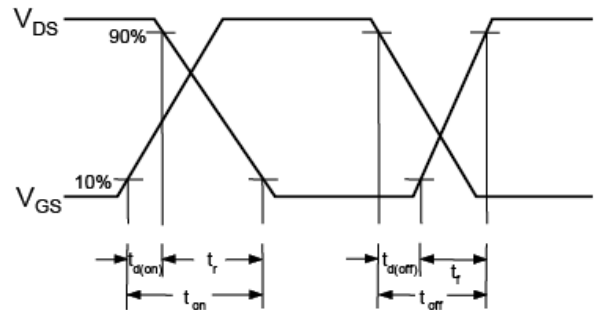
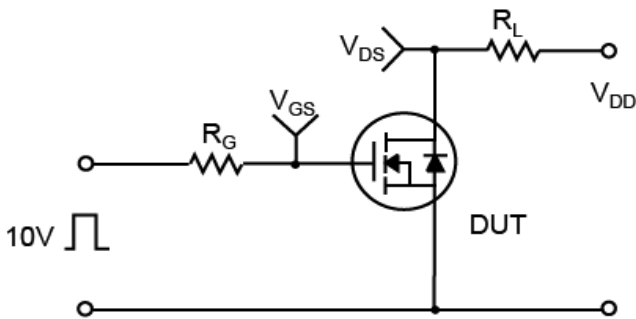


**Test Circuits and Waveforms**

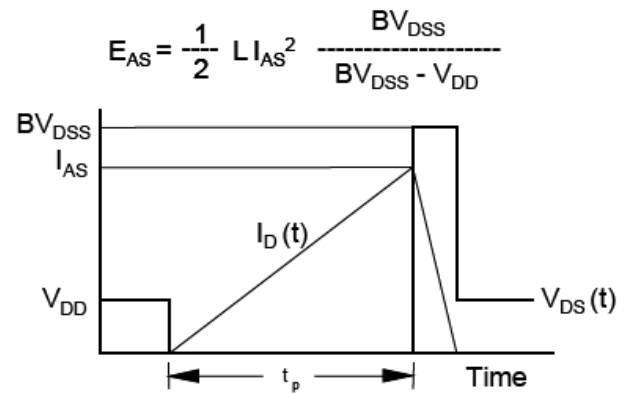
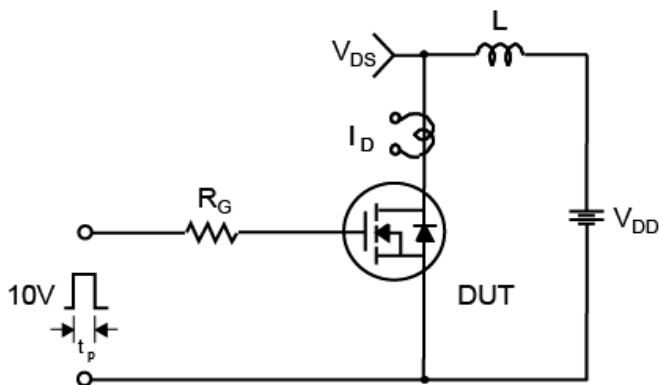
**Gate Charge Test Circuit & Waveform**



**Resistive Switching Test Circuit & Waveforms**

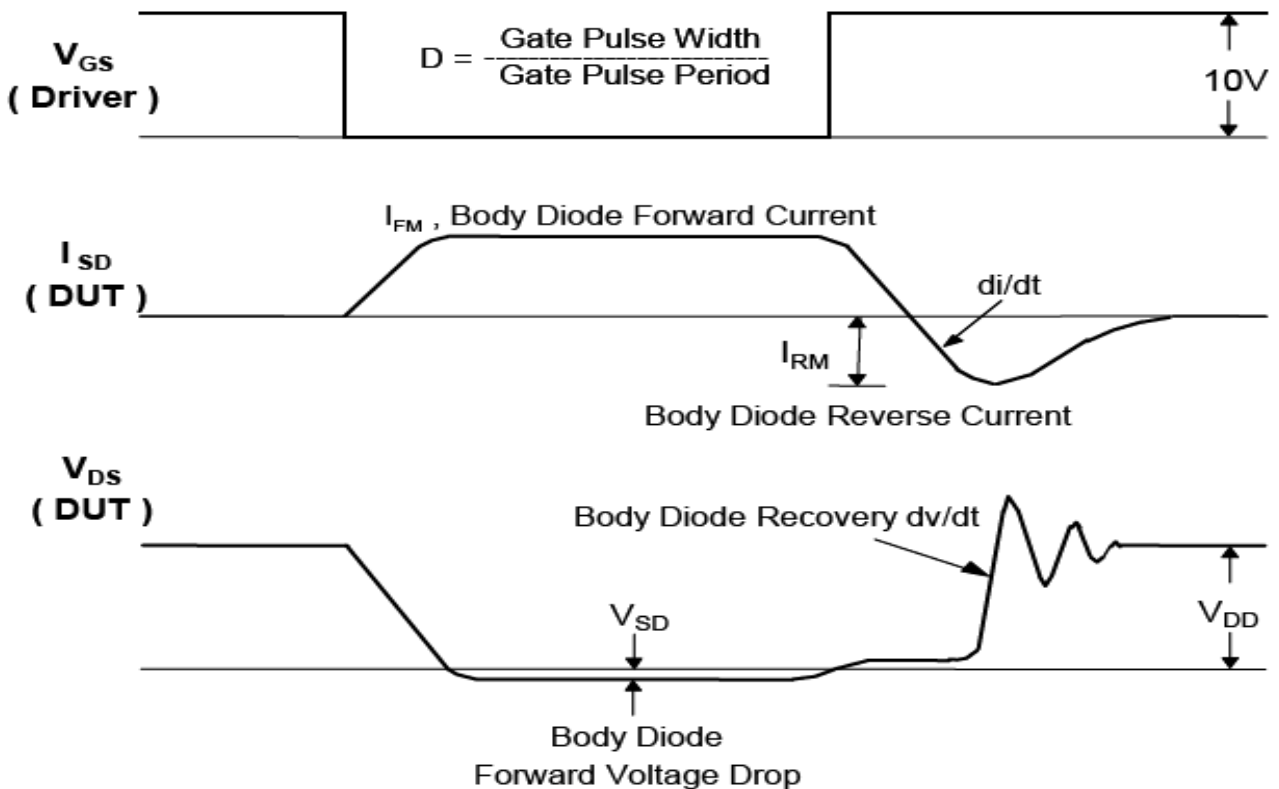
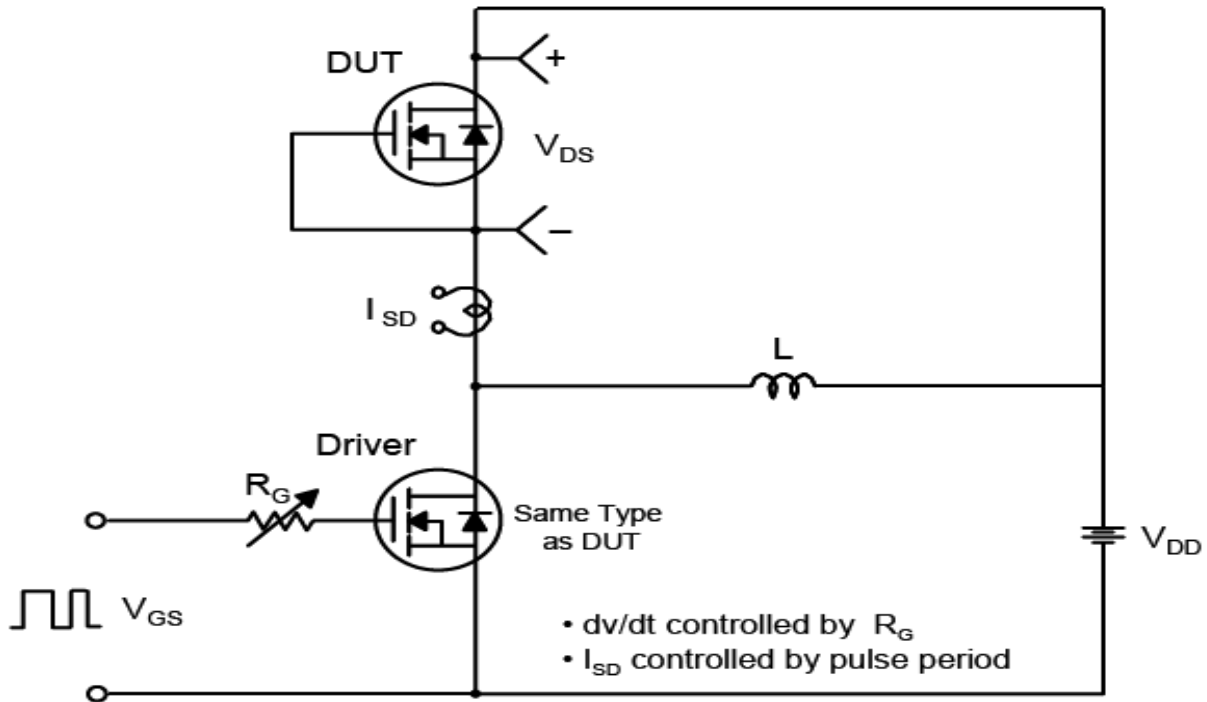


**Unclamped Inductive Switching Test Circuit & Waveforms**



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

**Peak Diode Recovery dv/dt Test Circuit & Waveforms**

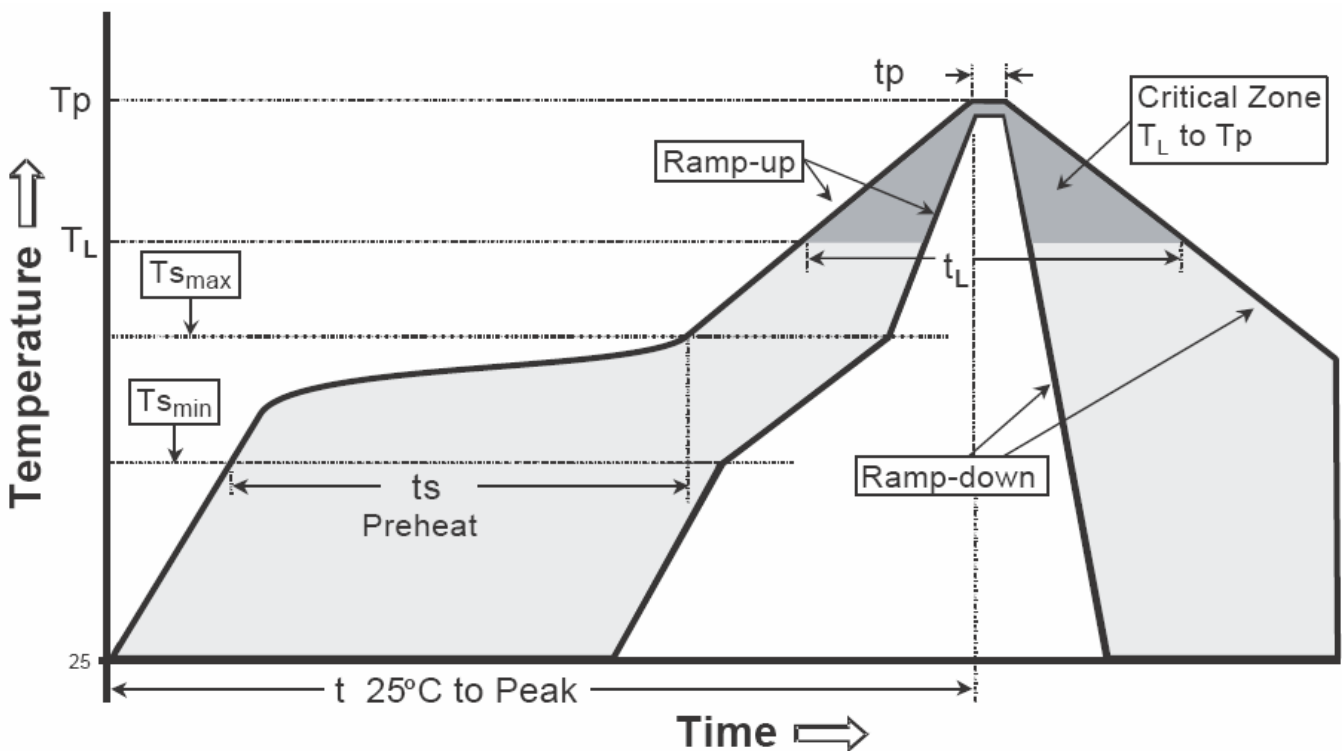




**Recommended wave soldering condition**

Product	Peak Temperature	Soldering Time
Pb-free devices	260 +0/-5 °C	5 +1/-1 seconds

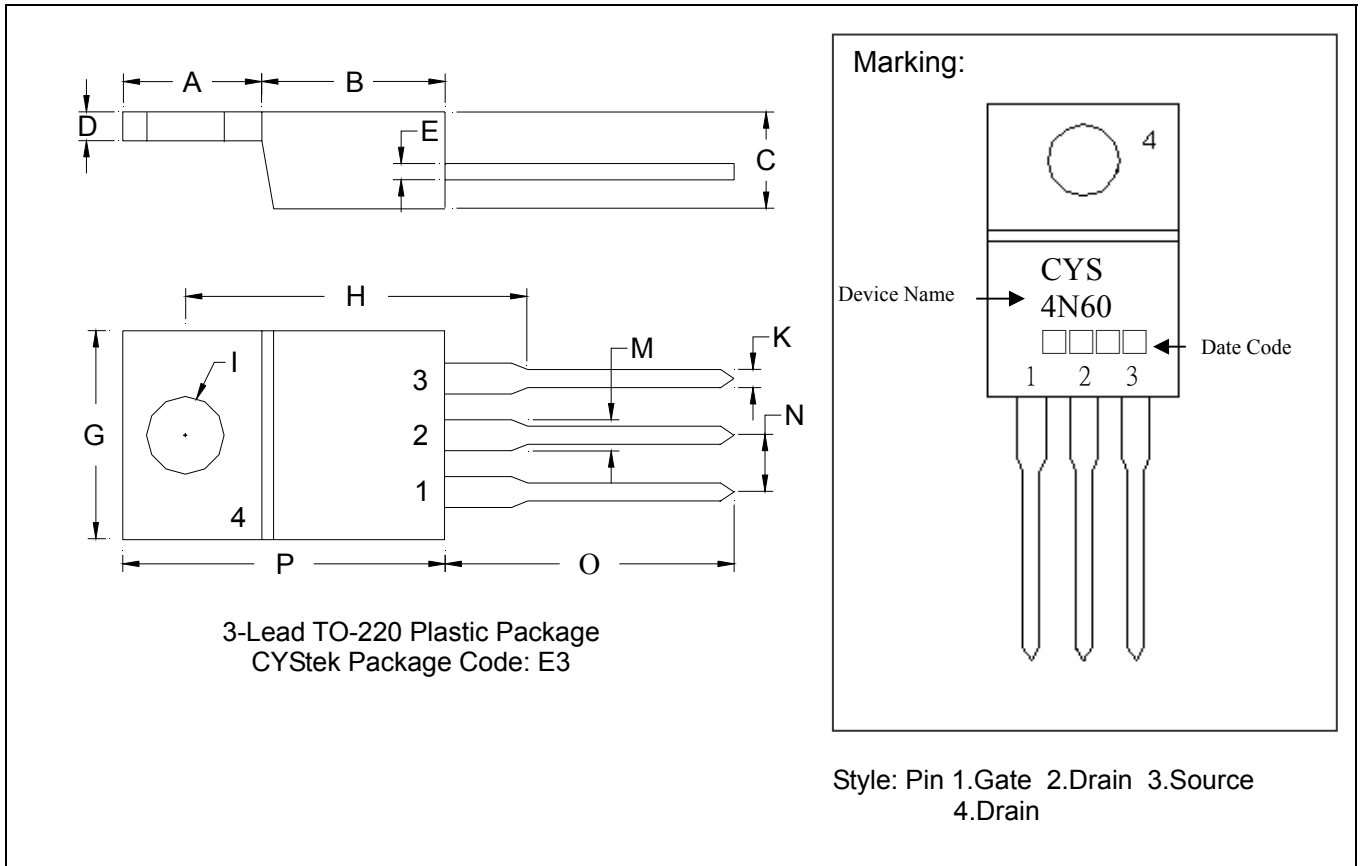
**Recommended temperature profile for IR reflow**



Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> )	3°C/second max.	3°C/second max.
Preheat		
-Temperature Min(T <sub>s min</sub> )	100°C	150°C
-Temperature Max(T <sub>s max</sub> )	150°C	200°C
-Time(t <sub>s min</sub> to t <sub>s max</sub> )	60-120 seconds	60-180 seconds
Time maintained above:		
-Temperature (T <sub>L</sub> )	183°C	217°C
- Time (t <sub>L</sub> )	60-150 seconds	60-150 seconds
Peak Temperature(T <sub>P</sub> )	240 +0/-5 °C	260 +0/-5 °C
Time within 5°C of actual peak temperature(tp)	10-30 seconds	20-40 seconds
Ramp down rate	6°C/second max.	6°C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

Note : All temperatures refer to topside of the package, measured on the package body surface.

**TO-220 Dimension**



\*: Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.2441	0.2598	6.20	6.60	I	-	*0.1508	-	*3.83
B	0.3386	0.3543	8.60	9.00	K	0.0299	0.0394	0.76	1.00
C	0.1732	0.1890	4.40	4.80	M	0.0461	0.0579	1.17	1.47
D	0.0492	0.0571	1.25	1.45	N	-	*0.1000	-	*2.54
E	0.0142	0.0197	0.36	0.50	O	0.5217	0.5610	13.25	14.25
G	0.3858	0.4094	9.80	10.40	P	0.5787	0.6024	14.70	15.30
H	-	*0.6398	-	*16.25					

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: KFC ; pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.

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