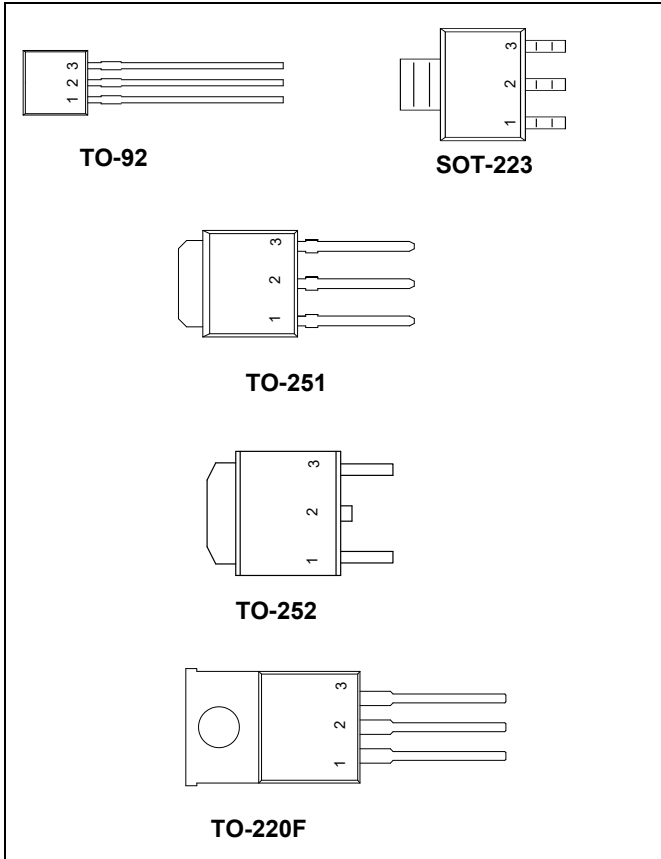




%B* \$

B!7 <5 BB9 @ACG: 9H



A5-B7 <5 F57 H9F-GH7 G

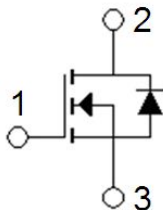
I_D	1A
V_{DSS}	600V
$R_{DS(ON)} (V_{GS}=10V)$	9.3Ω
Q_G	5nC

APPLICATIONS

- High efficiency switch mode power supplies
- Electronic lamp ballasts based on half bridge
- LED power supplies

FEATURES

- Low gate charge
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS product



- 1 Gate
- 2 Drain
- 3 Source

1N60

ABSOLUTE RATINGS (T_C=25°C, unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Drain-Source Breakdown Voltage	V _{DSS}	600	V
Continuous Drain Current	I _D	T _C =25°C	1*
		T _C =100°C	0.5*
Drain Current pulsed (note 1)	I _{DM}	4.8*	A
Gate-Source Voltage	V _{GSS}	±30	V
Single Pulsed Avalanche Energy (note 2)	E _{AS}	50	mJ
Repetitive Avalanche Current (note 1)	E _{AR}	4.0	mJ
Peak Diode Recovery dv/dt (note 3)	dv/dt	4.5	V/ns
Operating Junction Temperature	T _J	150	°C
Storage Temperature	T _{STG}	-55~+150	°C

* Drain current is limited by junction temperature.

ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV _{DSS}	I _D =250μA, V _{GS} =0V	600	-	-	V
Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /ΔT _J	I _D =250μA, referenced to 25°C	-	0.4	-	V/°C
Drain-Source leakage Current	I _{DSS}	V _{DS} =600V, V _{GS} =0V	-	-	10	μA
		V _{DS} =520V, T _C =125°C	-	-	10	μA
Gate-Source leakage current	Forward	I _{GSS}	V _{DS} =0V, V _{GS} =30V	-	-	100
	Reverse					

1N60

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
On Characteristics						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2	-	4	V
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=0.6A$	-	9.3	11.5	Ω
Forward Transconductance	g_{FS}	$V_{DS}=40V, I_D=2A$ (note 4)	1	-	-	S
Dynamic Characteristics						
Input capacitance	C_{ISS}	$V_{DS}=25V, V_{GS}=0V,$ $f=1MHz$	-	120	-	pF
Output capacitance	C_{OSS}		-	20	-	
Reverse transfer capacitance	C_{RSS}		-	3	-	
Switching Characteristics						
Turn on delay time	$t_{d(ON)}$	$V_{DD}=325V, I_D=1.2A,$ $R_G=50\Omega$ (note 4, 5)	-	5	-	ns
Rise time	t_r		-	25	-	
Turn off delay time	$t_{d(off)}$		-	12	-	
Fall time	t_f		-	22	-	
Total Gate Charge	Q_G	$V_{DS}=480V, I_D=1.2A,$ $V_{GS}=10V$ (note 4, 5)	-	5.7	-	nC
Gate-Source charge	Q_{GS}		-	1.1	-	
Gate-Drain charge	Q_{GD}		-	2.6	-	
Source-Drain Diode Characteristics						
Continuous Forward Current	I_S		-	-	1.2	A
Pulsed Forward Current	I_{SM}		-	-	4.8	A
Forward Voltage	V_{SD}	$V_{GS}=0V, I_S=1.2A$	-	-	1.5	V
Reverse recovery time	t_{rr}	$V_{GS}=0V, I_S=1.2A,$ $di_F/dt=100A/\mu s$ (note 4)	-	160	-	ns
Reverse recovery charge	Q_{rr}		-	0.3	-	μC

1N60

HERMAL CHARACTERISTICS

Parameter	Symbol	Max			Unit
		TO-92	TO-252/251	TO-220F	
Thermal Resistance, Junction to Case	$R_{th(j-c)}$	80	4.53	7.4	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient	$R_{th(j-a)}$	140	110	62.5	$^{\circ}\text{C}/\text{W}$

Notes:

1: Pulse width limited by maximum junction temperature

2: $L=60\text{mH}$, $I_{AS}=1\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\ \Omega$, Starting

$T_J=25^{\circ}\text{C}$

3: $I_{SD} \leq 1.2\text{A}$, $di/dt \leq 100\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting

$T_J=25^{\circ}\text{C}$

4: Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$

5: Essentially independent of operating temperature

TYPICAL CHARACTERISTICS (curves)

Fig.1. On-state Characteristics

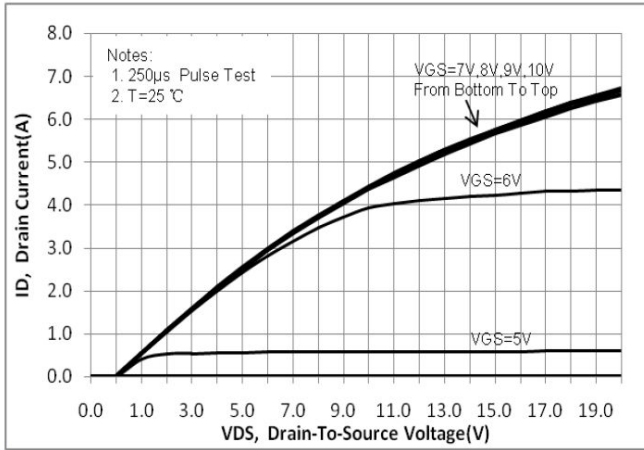


Fig.2. On-resistance variation vs. drain current and gate voltage

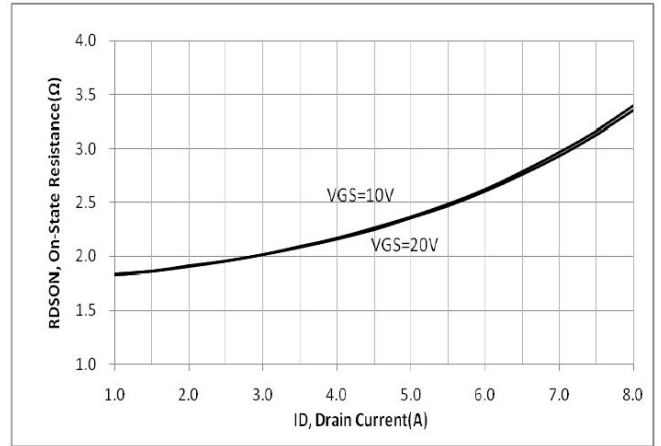


Fig.3. Gate charge characteristics

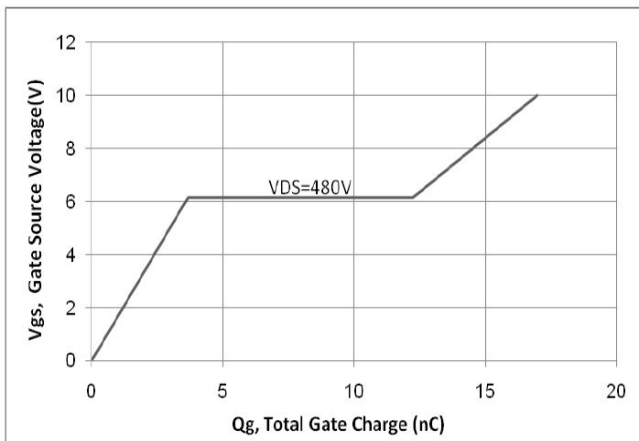


Fig.4. On state current vs. Diode forward voltage

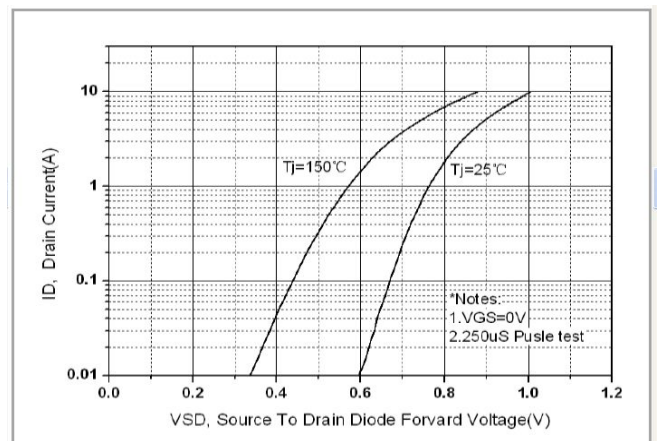


Fig.5. Breakdown voltage variation vs. Junction temperature

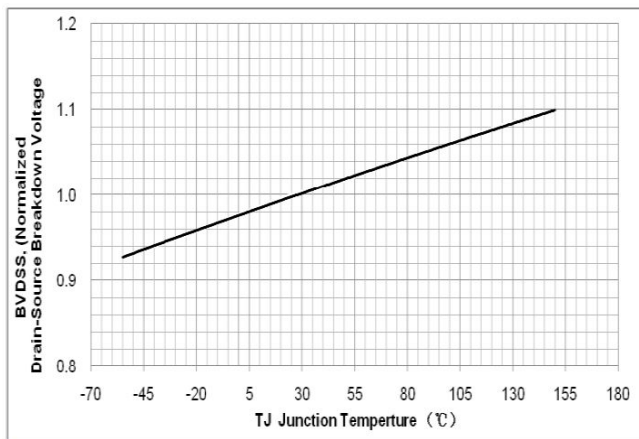


Fig.6. On resistance variation vs. Junction temperature

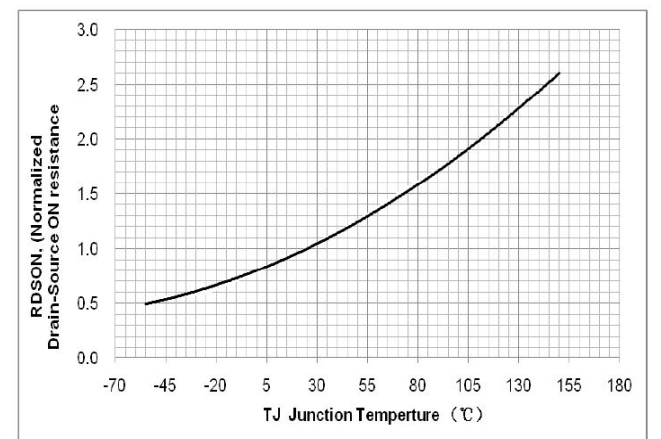


Fig.7. Maximum safe operating area(TO-220F)

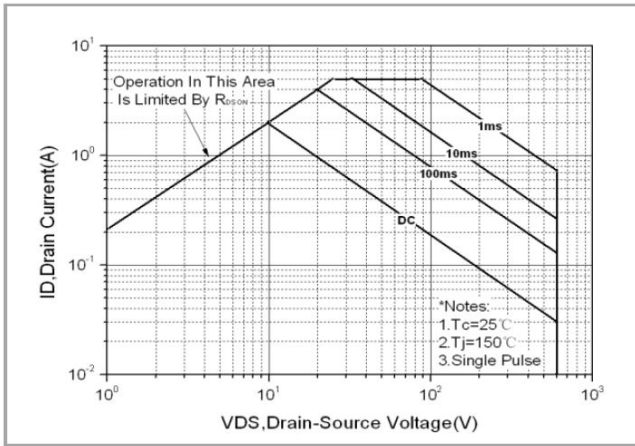


Fig.8. Transient thermal response curve(TO-220F)

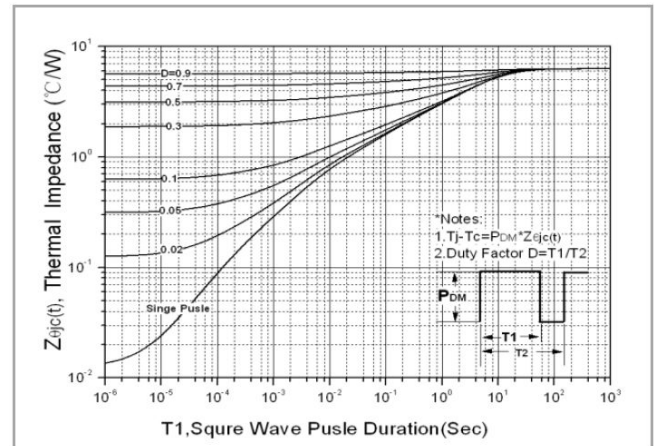


Fig.9. Capacitance characteristics

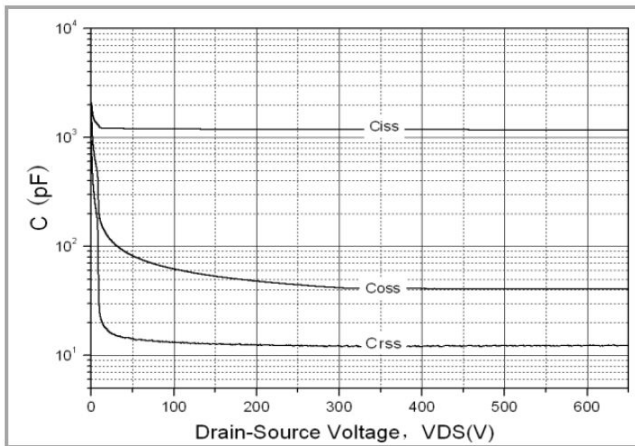


Fig.10. Gate charge test circuit & waveform

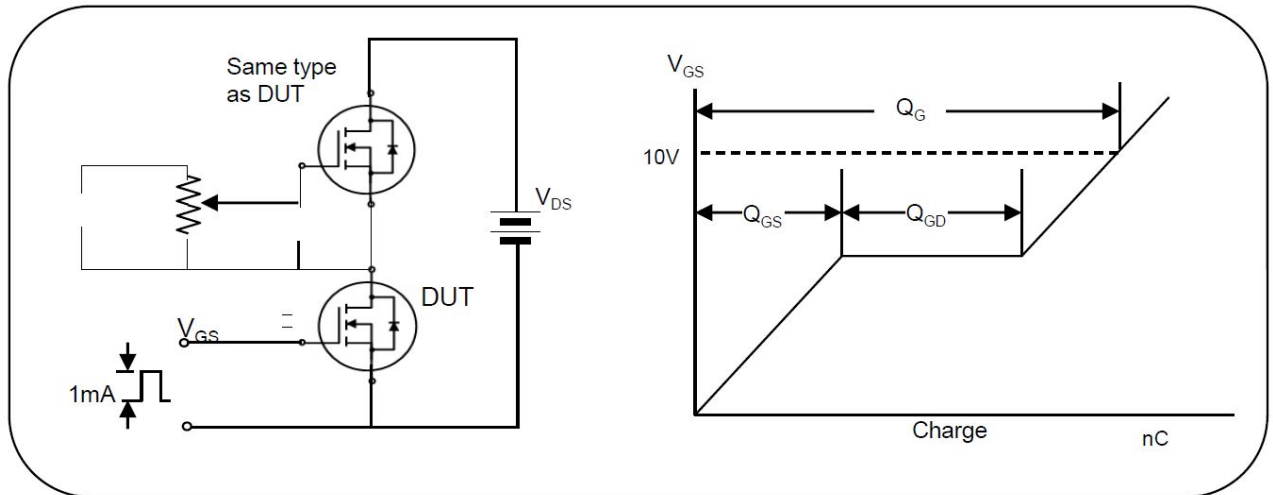


Fig.11. Switching time test circuit & waveform

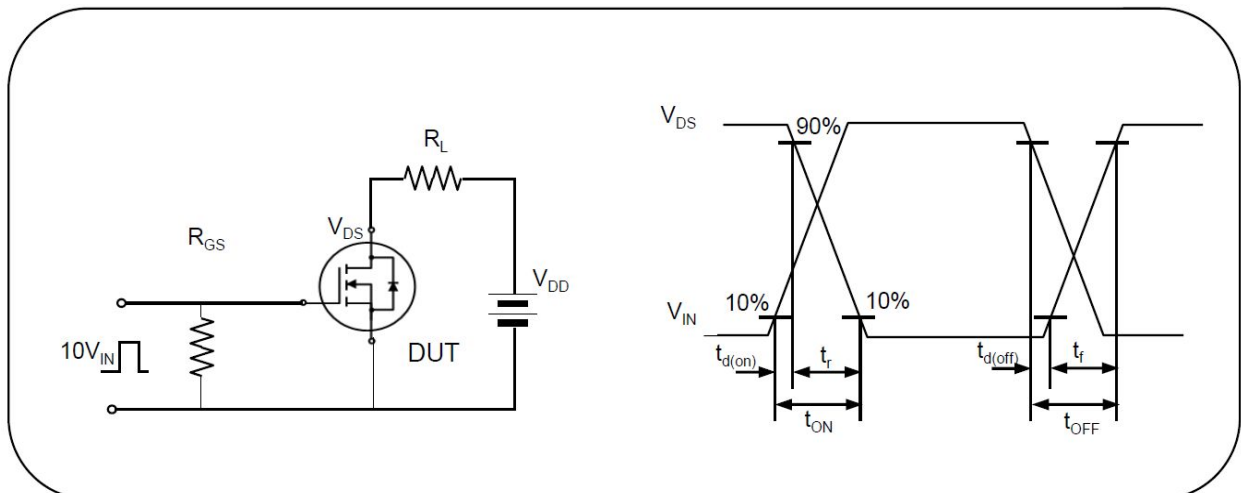


Fig.12. Unclamped inductive switching test circuit & waveform

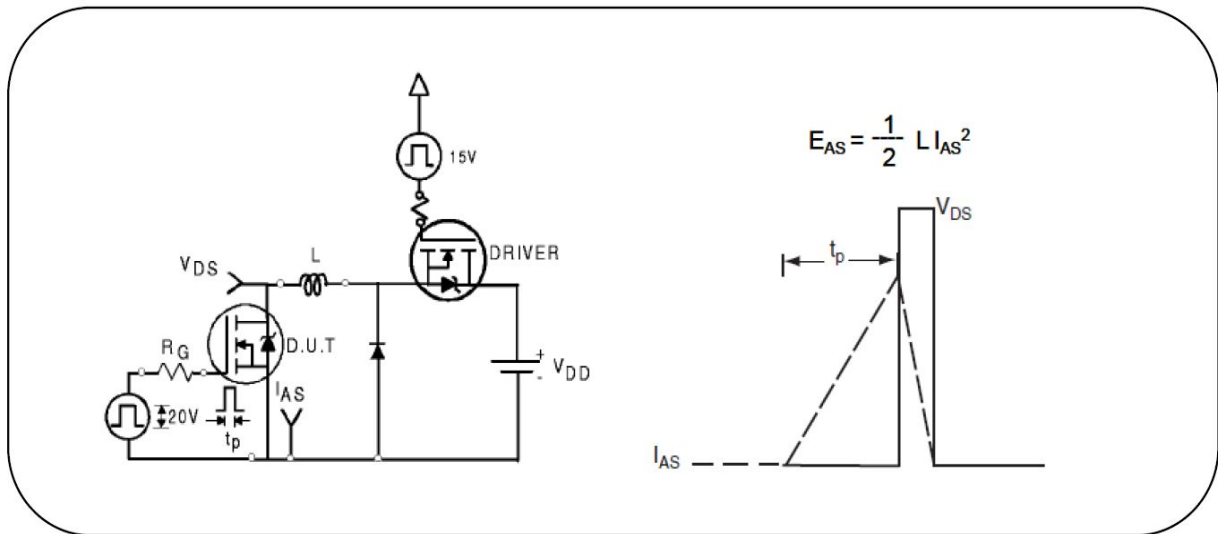
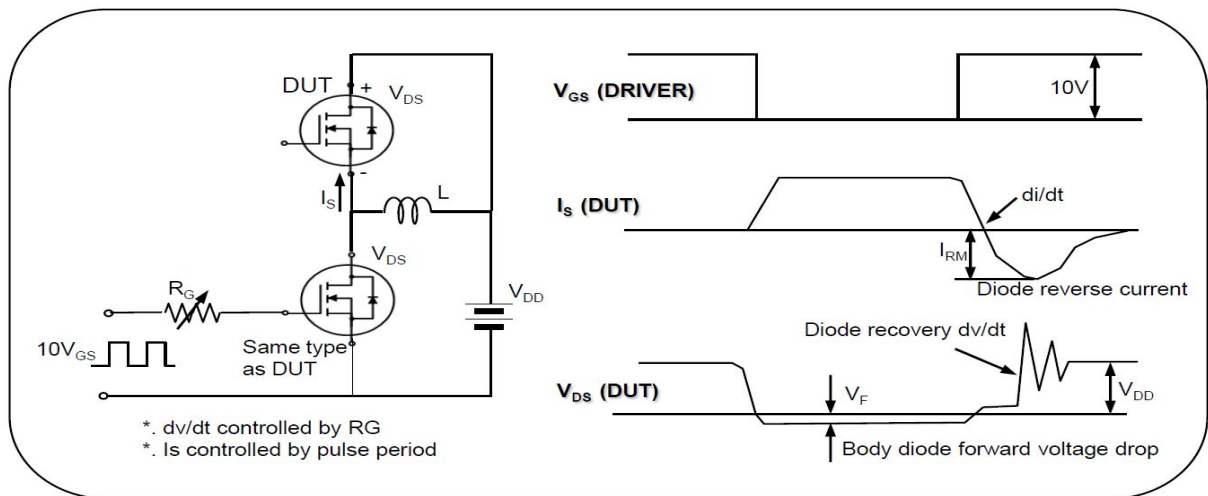
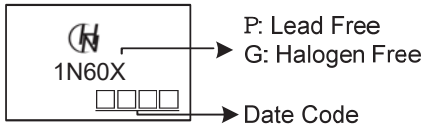
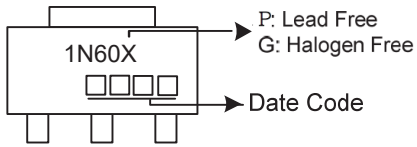


Fig.13. Peak diode recovery dv/dt test circuit & waveform

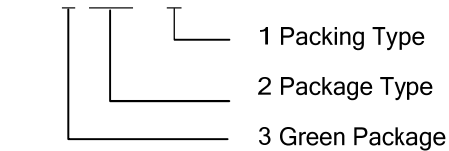


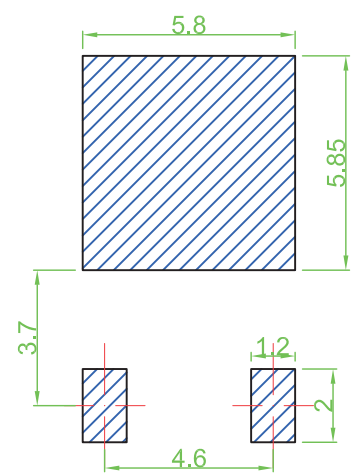
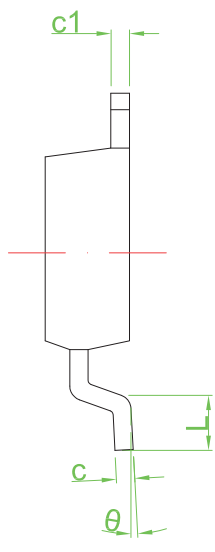
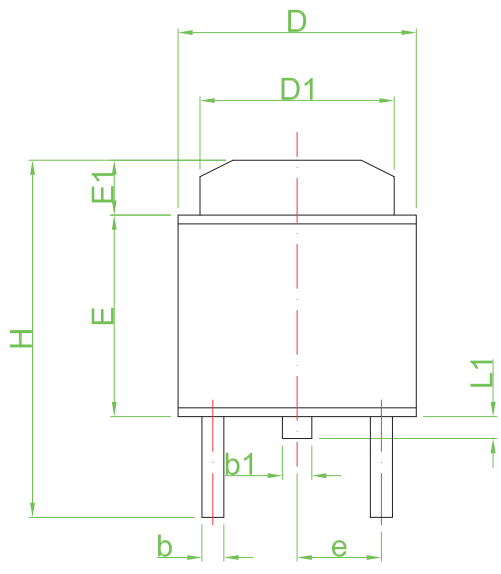
MARKING INFORMATION

PACKAGE	MARKING
TO-92 TO-252 TO-251 TO-220F	 <p>1N60X</p> <p>P: Lead Free G: Halogen Free</p> <p>Date Code</p>
SOT-223	 <p>1N60X</p> <p>P: Lead Free G: Halogen Free</p> <p>Date Code</p>

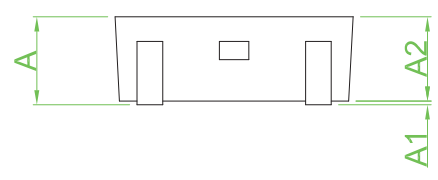
ORDERING INFORMATION

Ordering Number		Package
Lead Free	Halogen Free	
1N60P-TO92-K	1N60G-TO92-K	TO-92
1N60P-T252-R	1N60G-T252-R	TO-252
1N60P-T251-T	1N60G-T251-T	TO-251
1N60P-T20F-T	1N60G-T20F-T	TO-220F
1N60P-S223-R	1N60G-S223-R	SOT-223

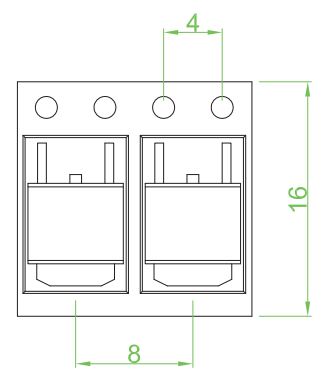
1N60P-TO92 - K  <p>1 Packing Type</p> <p>2 Package Type</p> <p>3 Green Package</p>	<ol style="list-style-type: none"> 1 T: Tube, R: Tape Reel, K: Bulk 2 TO92: TO-92; T252: TO-252; T251: TO-251; T20F: TO-220F; S223: SOT-223 3 P: Lead Free G: Halogen Free and Lead Free
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Recommended Land Pattern



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.25	2.65	0.089	0.104
A1	0.00	0.15	0.000	0.006
A2	2.20	2.40	0.087	0.094
b	0.50	0.70	0.020	0.028
b1	0.70	0.90	0.028	0.035
c	0.46	0.66	0.018	0.026
c1	0.46	0.66	0.018	0.026
D	6.30	6.70	0.248	0.264
D1	5.20	5.40	0.205	0.213
E	5.30	5.70	0.209	0.224
E1	1.40	1.60	0.055	0.063
H	9.40	9.90	0.370	0.390
e	2.30 TYP		0.09 TYP	
L	1.40	1.77	0.055	0.070
L1	0.50	0.70	0.020	0.028
θ	0°	8°	0°	8°



Q'ty / Reel	Reel Size
2500pcs	13"



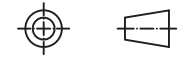
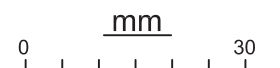
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SCALE

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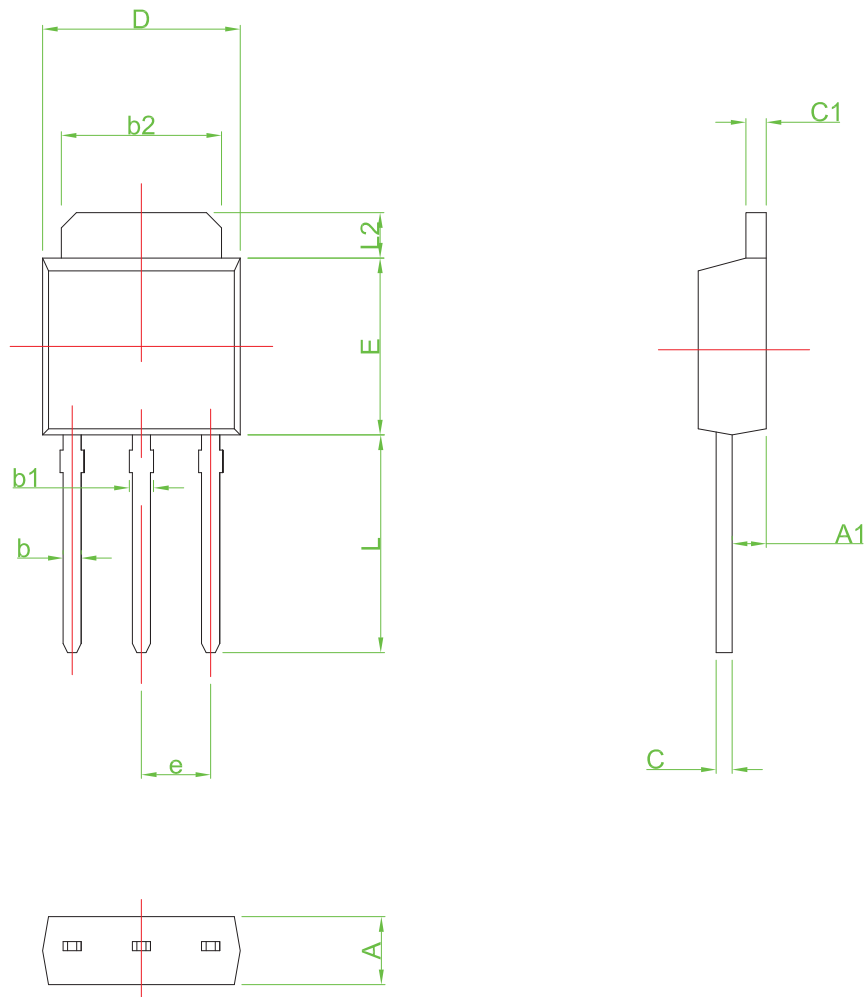
1 of 1



DWG NO:HN-TO-252-01-A1

TITLE

TO-252



Syntd	Dimensions in Millimeters		Dimensions in Inches	
	Mn	Max	Mn	Max
A	2.10	2.40	0.083	0.094
A1	0.89	1.50	0.035	0.059
b	0.50	0.70	0.020	0.028
b1	0.70	0.95	0.028	0.037
b2	5.20	5.40	0.205	0.213
C	0.46	0.61	0.018	0.024
C1	0.46	0.89	0.018	0.035
D	6.35	6.73	0.250	0.265
E	5.33	6.30	0.210	0.248
e	2.29TYP		0.090TYP	
L	6.50	7.90	0.256	0.311
L2	1.35	1.65	0.053	0.065



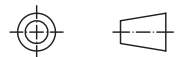
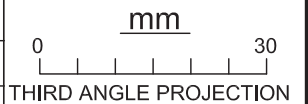
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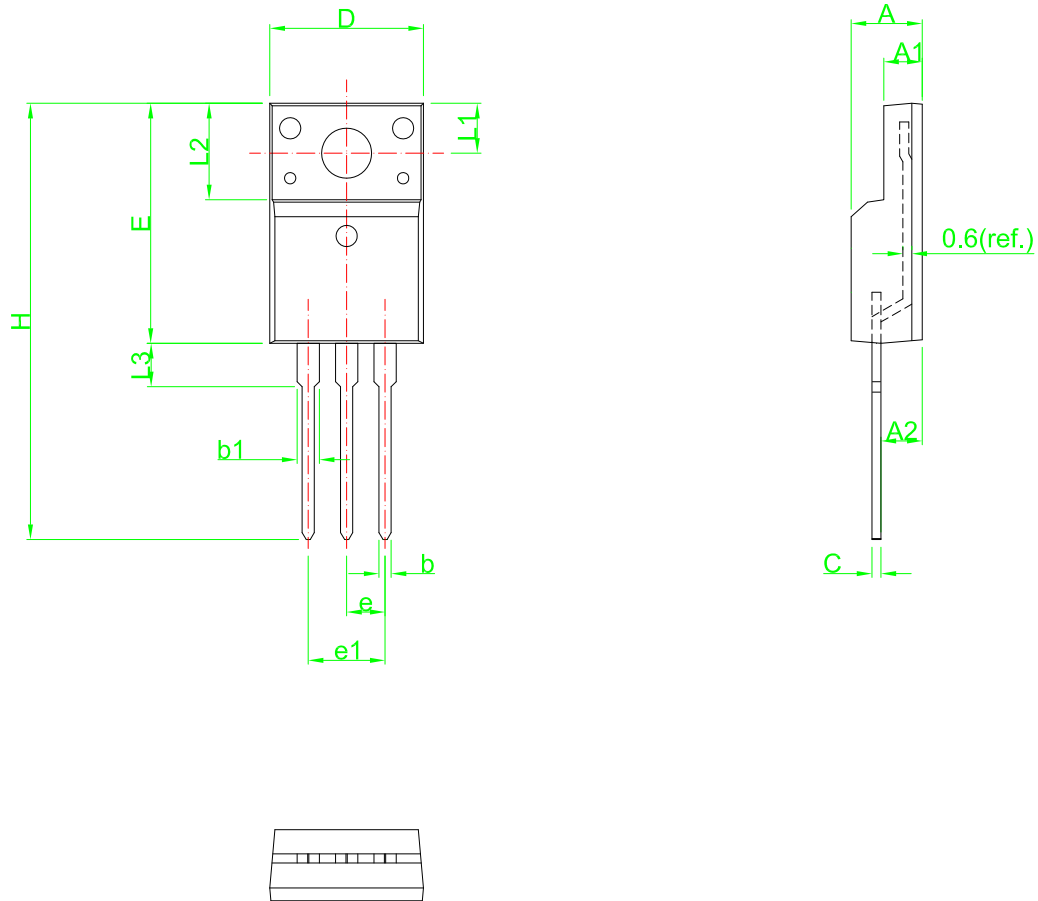
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DWG NO:HN-TO-251-01-A1

TITLE

TO-251



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	4.50	4.90	0.177	0.193
A1	2.34	2.74	0.092	0.108
A2	2.56	2.96	0.101	0.117
b	0.70	0.90	0.028	0.035
b1	1.47REF		0.058REF	
C	0.45	0.65	0.018	0.026
D	9.96	10.36	0.392	0.408
E	15.67	16.07	0.617	0.633
e	2.54TYP		0.100TYP	
e1	4.68	5.48	0.184	0.216
H	28.25	29.45	1.112	1.159
L1	3.20	3.40	0.126	0.134
L2	6.48	6.88	0.255	0.271
L3	3.13	3.33	0.123	0.131



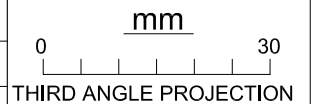
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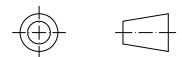
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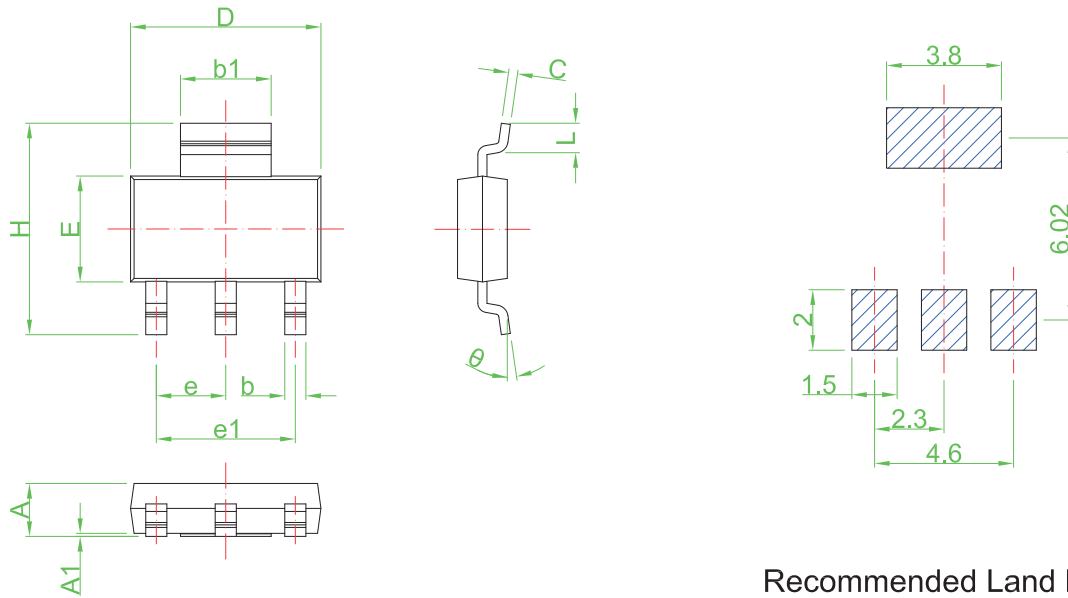


DWG NO:HN-TO-220F-01-A1

TITLE

TO-220F





Recommended Land Pattern

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.50	1.70	0.059	0.067
A1	---	0.10	---	0.004
b	0.60	0.82	0.024	0.032
b1	2.90	3.10	0.114	0.122
C	0.24	0.35	0.009	0.014
D	6.15	6.65	0.242	0.262
E	3.30	3.70	0.130	0.146
e	2.30 TYP		0.091 TYP	
e1	4.50	4.70	0.177	0.185
H	6.70	7.30	0.264	0.287
L	0.80	1.15	0.031	0.045
θ	0°	10°	0°	10°



BRILLIANT ENERGY MICROELECTRONICS TECHNOLOGY CO.,LTD

SCALE

4 : 1

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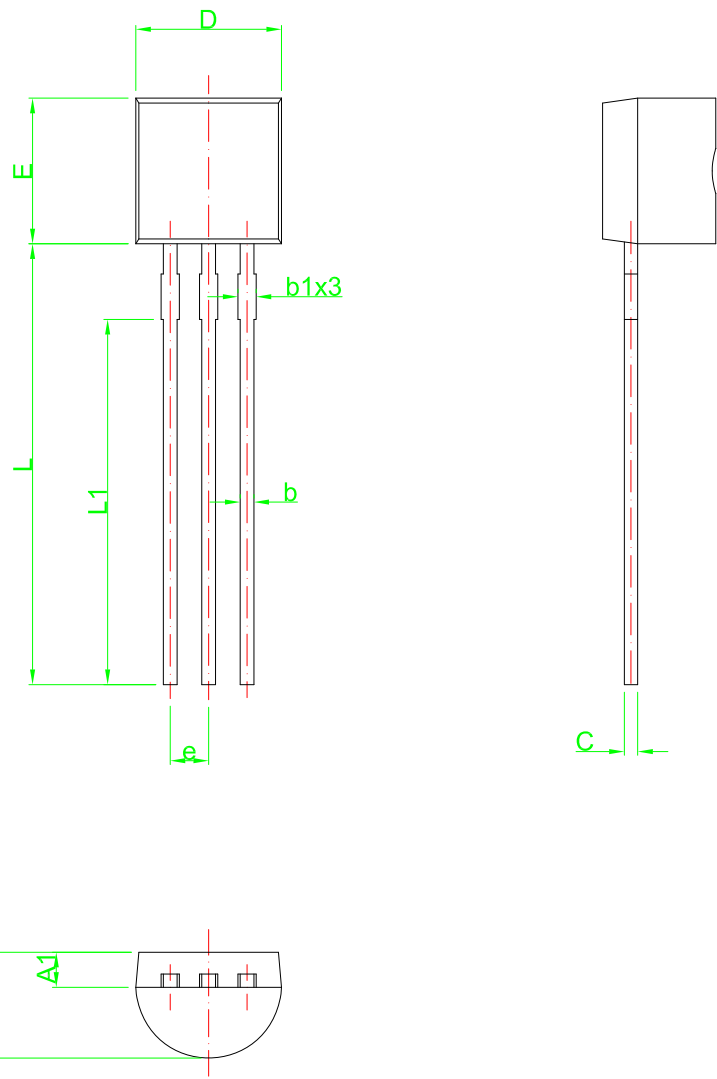
1 of 1



DWG NO:HN-SOT-223-01-A1

TITLE

SOT-223



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	3.30	3.70	0.130	0.146
A1	1.10	1.40	0.043	0.055
b	0.34	0.55	0.013	0.022
b1	0.50	0.70	0.020	0.028
C	0.34	0.54	0.013	0.021
D	4.33	4.83	0.170	0.190
E	4.33	4.83	0.170	0.190
e	1.27 TYP		0.05 TYP	
L	14.07	14.87	0.554	0.585
L1	12.47 TYP		0.491 TYP	



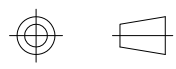
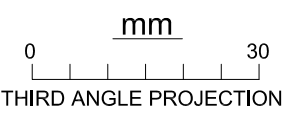
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1 of 1



DWG NO:HN-TO-92-01-A1

TITLE TO-92