

# Enhancement Mode N-Channel Power MOSFET

## Features

- ◆ Low  $R_{DS(on)}$  & FOM
- ◆ Extremely low switching loss
- ◆ Excellent stability and uniformity
- ◆ Easy to drive

## Applications

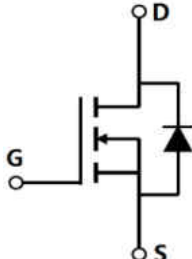

- ◆ Lighting
- ◆ Hard switching PWM
- ◆ Server power supply
- ◆ Charger

## ■ General Description

OSG60R260xF use advanced GreenMOSTM technology to provide low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. This device is suitable for active power factor correction and switching mode power supply applications.

◆ $V_{DS, min@Tjmax}$	650 V
◆ $I_{D, pulse}$	45 A
◆ $R_{DS(ON), max @ V_{GS}=10 V}$	260 mΩ
◆ $Q_g$	17.8 nC

## ■ Schematic and Package Information

<b>Schematic Diagram</b> 	<b>Pin Assignment Top View</b> 
	<b>TO251</b> <b>TO252</b> <b>TO220F</b> <b>TO220</b> <b>TO262</b> <b>OSG60R260AF</b> <b>OSG60R260DF</b> <b>OSG60R260FF</b> <b>OSG60R260PF</b> <b>OSG60R260IF</b>

## ■ Absolute Maximum Ratings at $T_j=25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Value	Unit
Drain source voltage	$V_{DS}$	600	V
Gate source voltage	$V_{GS}$	±30	V
Continuous drain current <sup>1)</sup> , $T_C=25^\circ\text{C}$	$I_D$	15	A
Continuous drain current <sup>1)</sup> , $T_C=100^\circ\text{C}$		9.3	
Pulsed drain current <sup>2)</sup> , $T_C=25^\circ\text{C}$	$I_{D, pulse}$	45	A
Power dissipation <sup>3)</sup> for TO251, TO252, TO220, $T_C=25^\circ\text{C}$	$P_D$	104	W
Power dissipation <sup>3)</sup> for TO220F, $T_C=25^\circ\text{C}$		32	
Single pulsed avalanche energy <sup>5)</sup>	$E_{AS}$	400	mJ
MOSFET dv/dt ruggedness, $V_{DS}=0\dots480\text{ V}$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS}=0\dots480\text{ V}$ , $I_{SD}\leq I_D$	dv/dt	15	V/ns
Operation and storage temperature	$T_{stg}, T_j$	-55 to 150	°C

## ■ Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO251/TO252/TO220/TO262	TO220F	
Thermal resistance, junction-case	$R_{\theta JC}$	1.2	3.9	°C/W
Thermal resistance, junction-ambient <sup>4)</sup>	$R_{\theta JA}$	62	62.5	°C/W

## ■ Electrical Characteristics at $T_j=25\text{ }^\circ\text{C}$ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Drain-source breakdown voltage	$BV_{DSS}$	600			V	$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$
		650	750			$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$ $T_j=150\text{ }^\circ\text{C}$
Gate threshold voltage	$V_{GS(th)}$	2.0		4.0	V	$V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$
Drain-source on-state resistance	$R_{DS(on)}$		0.23	0.26	$\Omega$	$V_{GS}=10\text{ V}$ , $I_D=7.5\text{ A}$
			0.56			$V_{GS}=10\text{ V}$ , $I_D=7.5\text{ A}$ , $T_j=150\text{ }^\circ\text{C}$
Gate-source leakage current	$I_{GSS}$			100	nA	$V_{GS}=30\text{ V}$
				-100		$V_{GS}=-30\text{ V}$
Drain-source leakage current	$I_{DSS}$			1	$\mu\text{A}$	$V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$

## ■ Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Input capacitance	$C_{iss}$		1016		pF	$V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$
Output capacitance	$C_{oss}$		76.4		pF	
Reverse transfer capacitance	$C_{rss}$		3.36		pF	
Turn-on delay time	$t_{d(on)}$		31.3		ns	$V_{GS}=10\text{ V}$ , $V_{DS}=480\text{ V}$ , $R_G=25\text{ }\Omega$ , $I_D=15\text{ A}$
Rise time	$t_r$		40.8		ns	
Turn-off delay time	$t_{d(off)}$		43.7		ns	
Fall time	$t_f$		47.3		ns	

## ■ Gate Charge Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Total gate charge	$Q_g$		17.8		nC	$I_D=15\text{ A}$ , $V_{DS}=480\text{ V}$ , $V_{GS}=10\text{ V}$
Gate-source charge	$Q_{gs}$		5.1		nC	
Gate-drain charge	$Q_{gd}$		6.3		nC	
Gate plateau voltage	$V_{\text{plateau}}$		5.6		V	

## ■ Body Diode Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Diode forward current	$I_S$			15	A	$V_{GS} < V_{th}$
Pulsed source current	$I_{SP}$			45		
Diode forward voltage	$V_{SD}$			1.4	V	$I_S=15\text{ A}$ , $V_{GS}=0\text{ V}$
Reverse recovery time	$t_{rr}$		313.1		ns	$V_R=400\text{ V}$ , $I_S=15\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		3.6		$\mu\text{C}$	
Peak reverse recovery current	$I_{rrm}$		21.7		A	

## ■ Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.
- 4) The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_a=25\text{ }^\circ\text{C}$ .
- 5)  $V_{DD}=150\text{ V}$ ,  $R_G=25\text{ }\Omega$ ,  $L=10.8\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .

■ **Electrical Characteristics Diagrams**

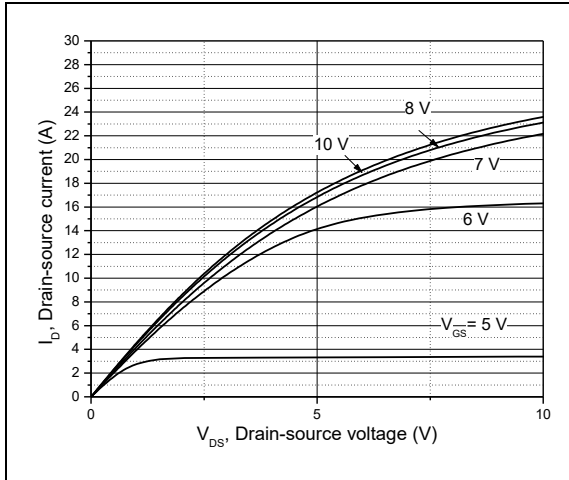


Figure 1, Typ. output characteristics

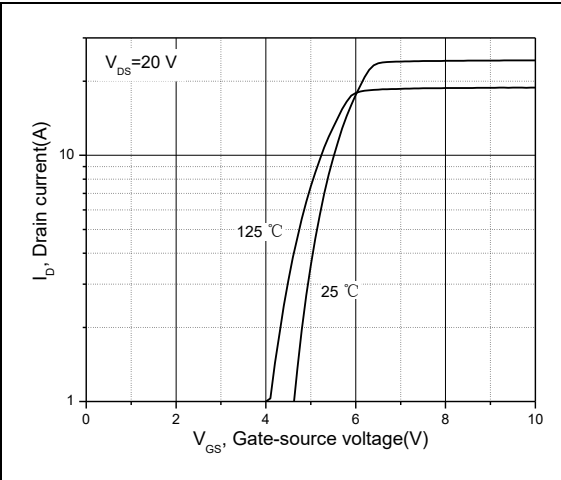


Figure 2, Typ. transfer characteristics

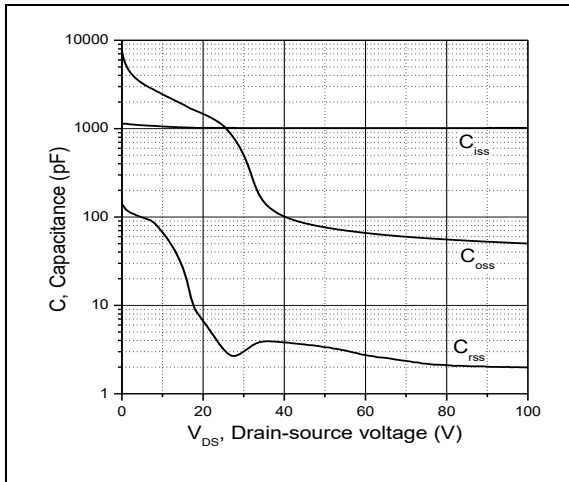


Figure 3, Typ. capacitances

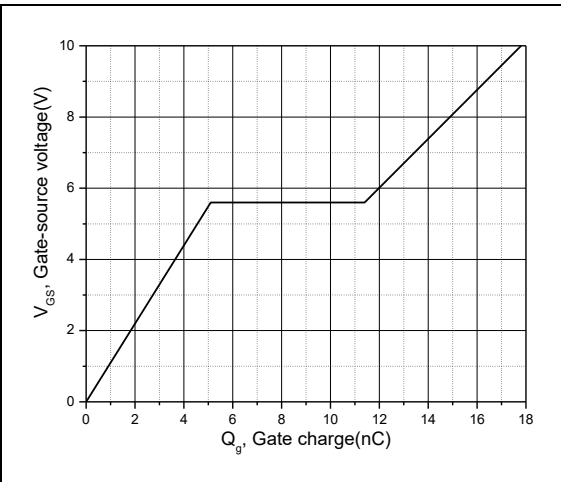


Figure 4, Typ. gate charge

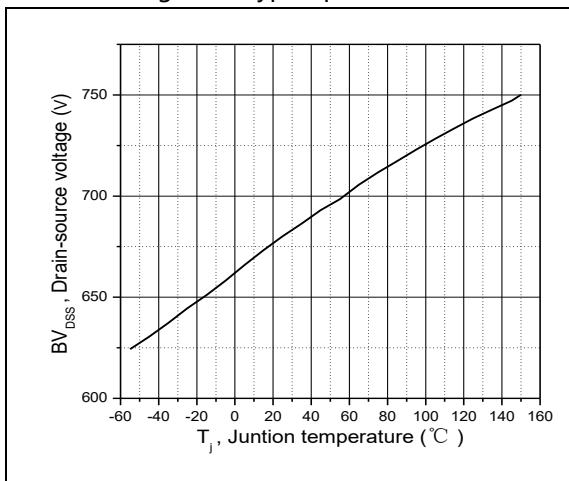


Figure 5, Drain-source breakdown voltage

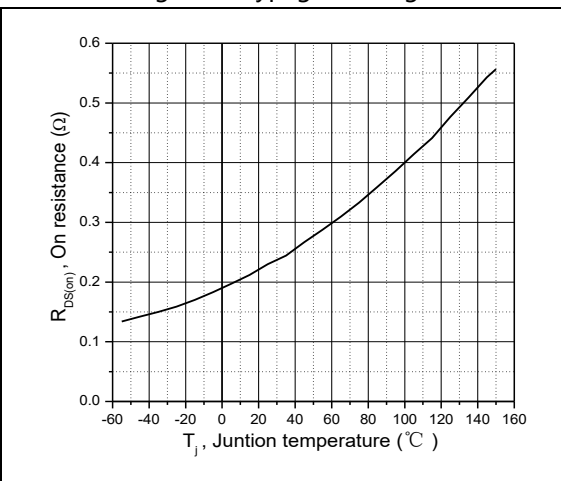


Figure 6, Drain-source on-state resistance

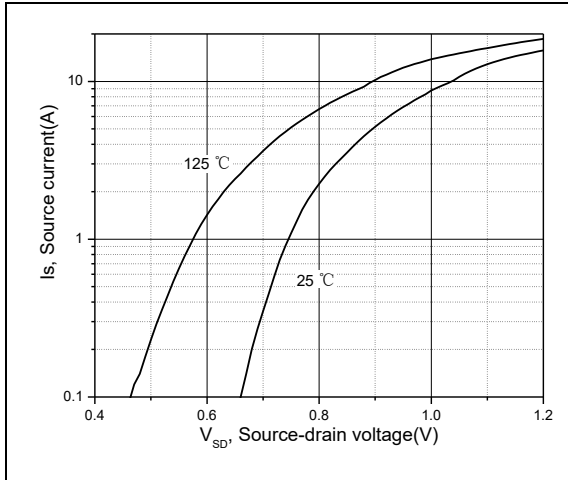


Figure 7, Forward characteristic of body diode

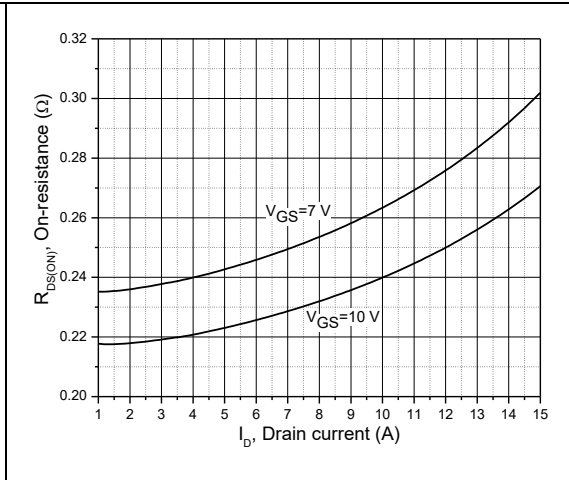


Figure 8, Drain-source on-state resistance

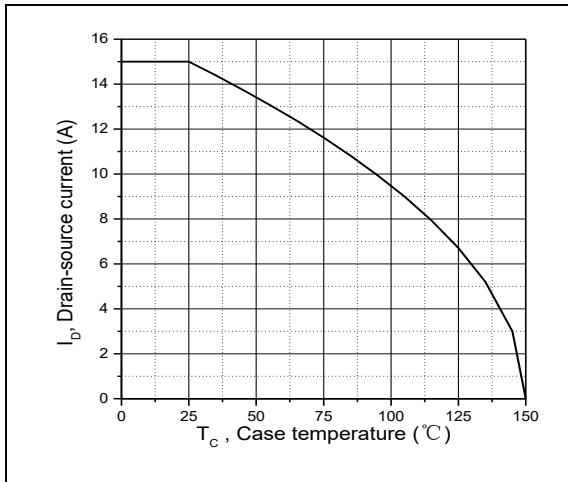


Figure 9, Drain current

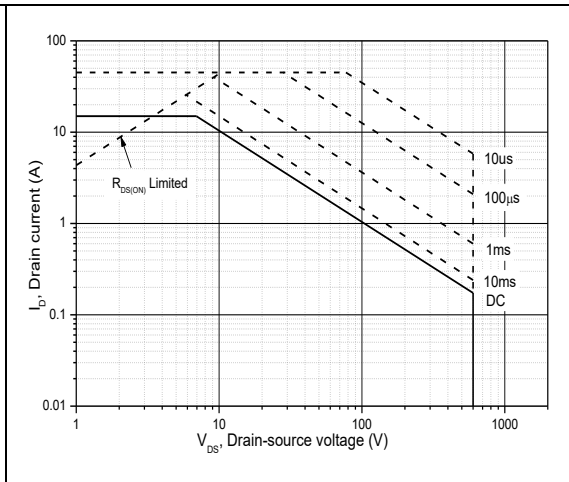


Figure 10, Safe operation area for TO251/TO252/TO220/TO262  $T_C=25\text{ °C}$

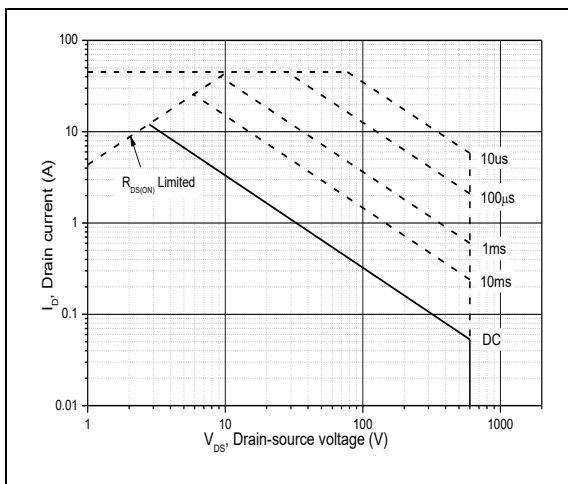


Figure 11, Safe operation area for TO220F  $T_C=25\text{ °C}$

■ Test circuits and waveforms

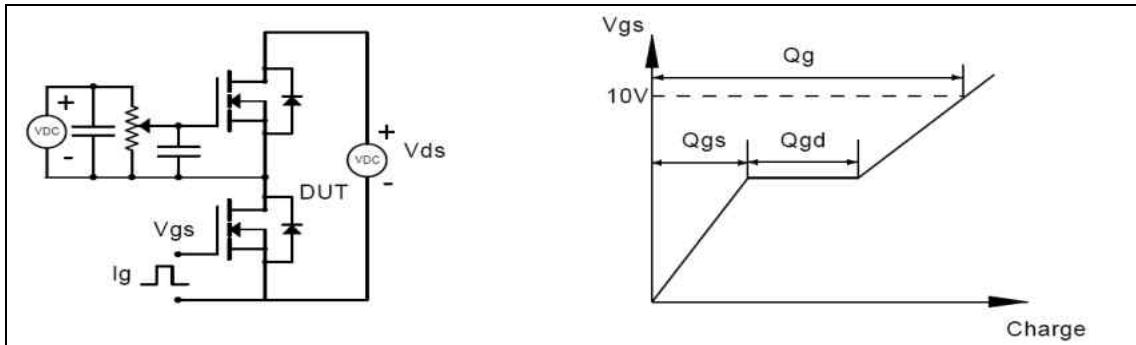


Figure 1, Gate charge test circuit & waveform

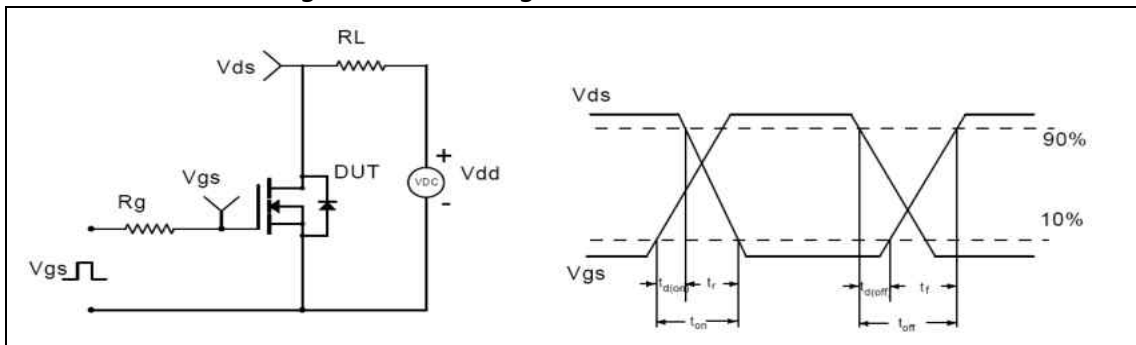


Figure 2, Switching time test circuit & waveforms

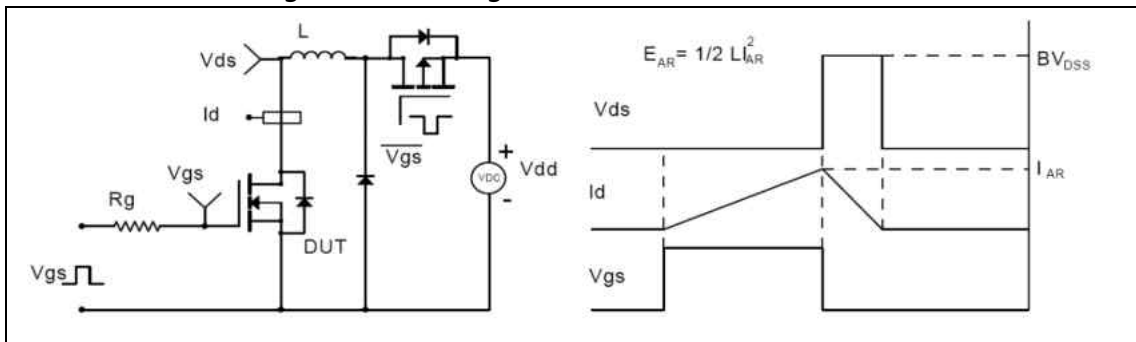


Figure 3, Unclamped inductive switching (UIS) test circuit & waveforms

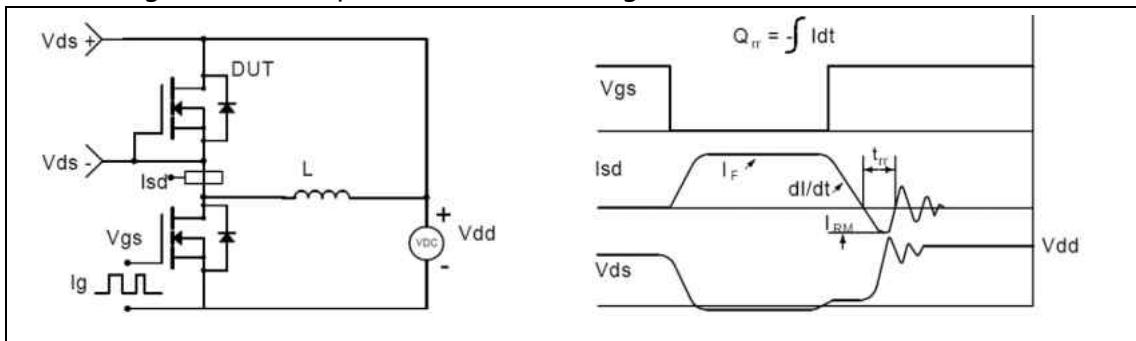
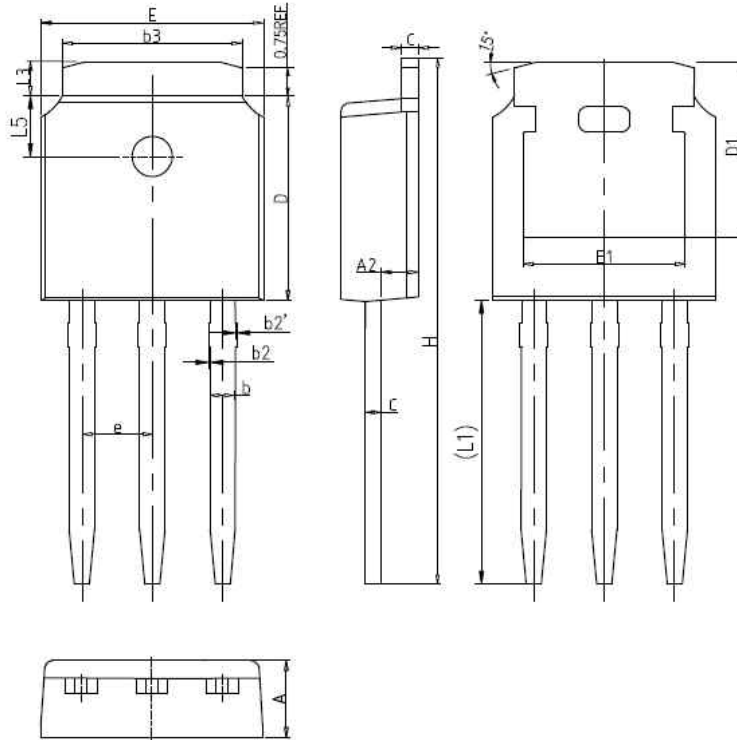


Figure 4, Diode reverse recovery test circuit & waveforms

**■ Package Information**

Figure1, TO251 package outline dimension

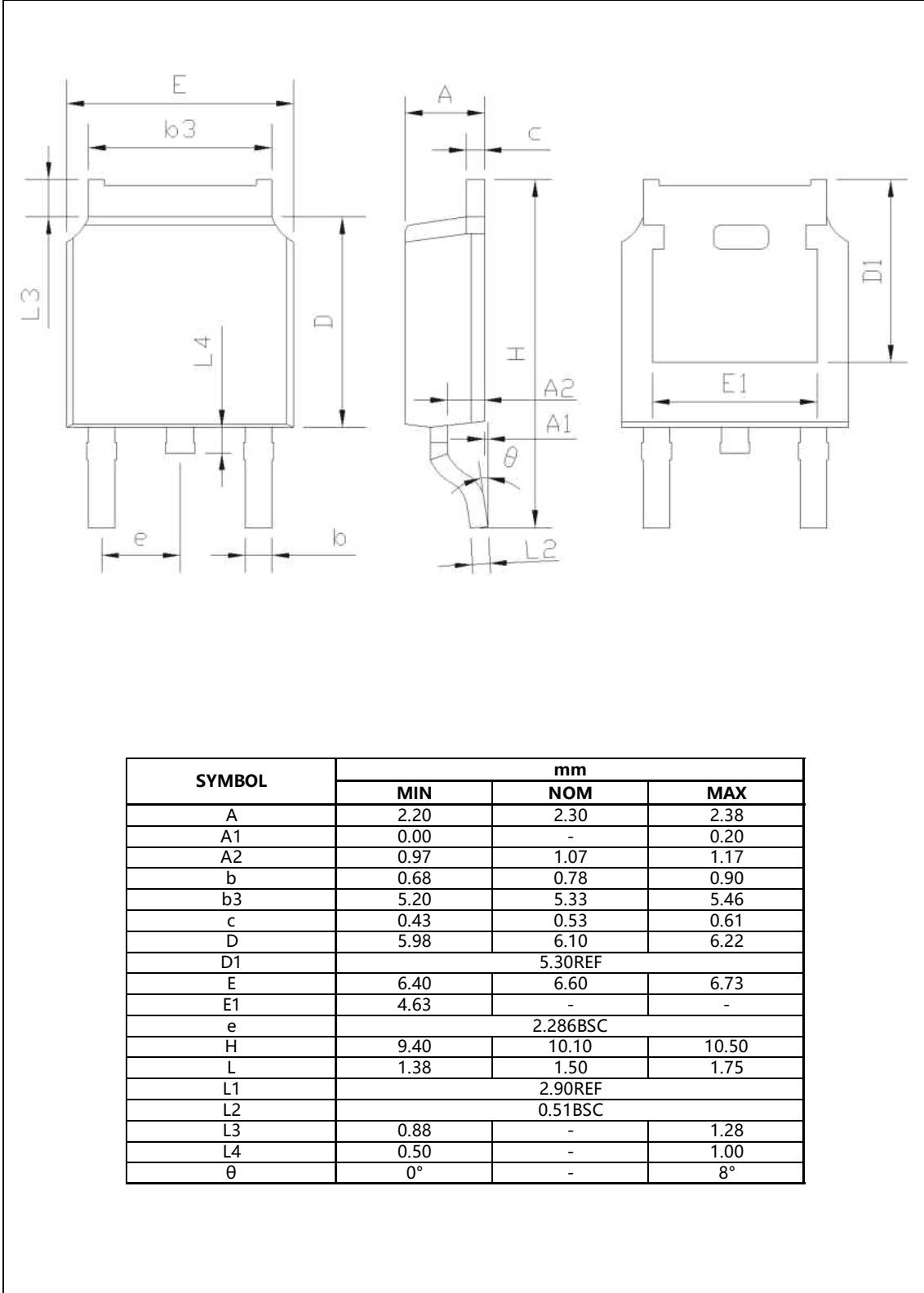


Symbol	Dimension In Millimeters			Dimension In Inches		
	Min	Nom	Max	Min	Nom	Max
A	2.200	2.300	2.400	0.087	0.091	0.094
A2	0.970	1.070	1.170	0.038	0.042	0.046
b	0.680	0.780	0.900	0.027	0.031	0.035
b2	0.000	0.040	0.100	0.000	0.002	0.004
b2'	0.000	0.040	0.100	0.000	0.002	0.004
b3	5.200	5.330	5.500	0.205	0.210	0.217
c	0.430	0.530	0.630	0.017	0.021	0.025
D	5.980	6.100	6.220	0.235	0.240	0.245
D1	5.300REF			0.209REF		
E	6.400	6.600	6.800	0.252	0.260	0.268
E1	4.630	-	-	0.182	-	-
e	2.286BSC			0.090BSC		
H	16.220	16.520	16.820	0.639	0.650	0.662
L1	9.150	9.400	9.650	0.360	0.370	0.380
L3	0.880	1.020	1.280	0.035	0.040	0.050
L5	1.650	1.800	1.950	0.065	0.071	0.077



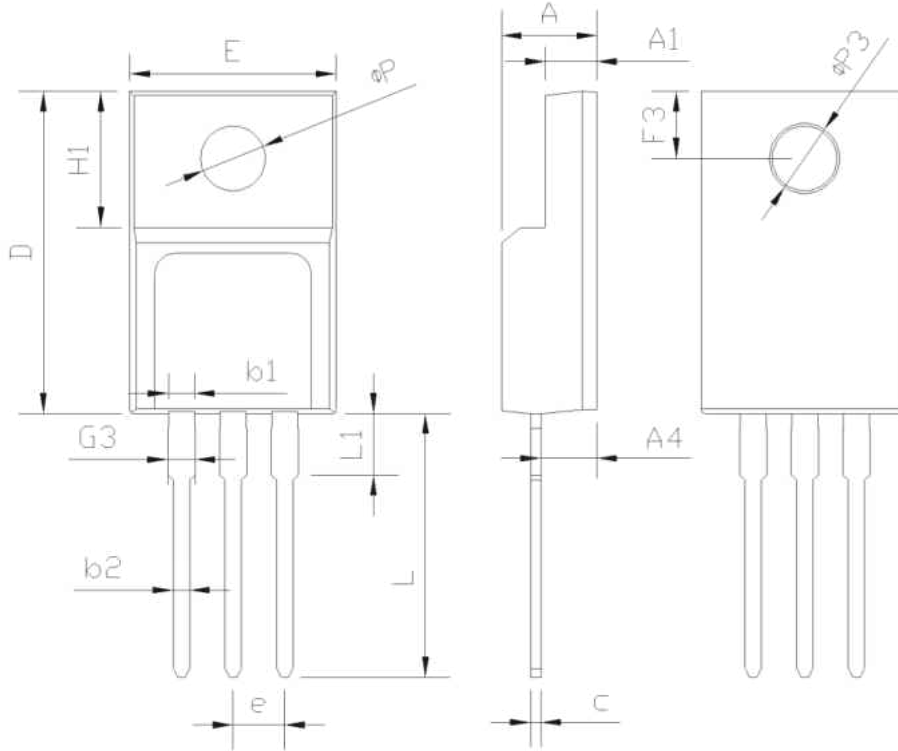
**■ Package Information**

Figure2, TO252 package outline dimension



**■ Package Information**

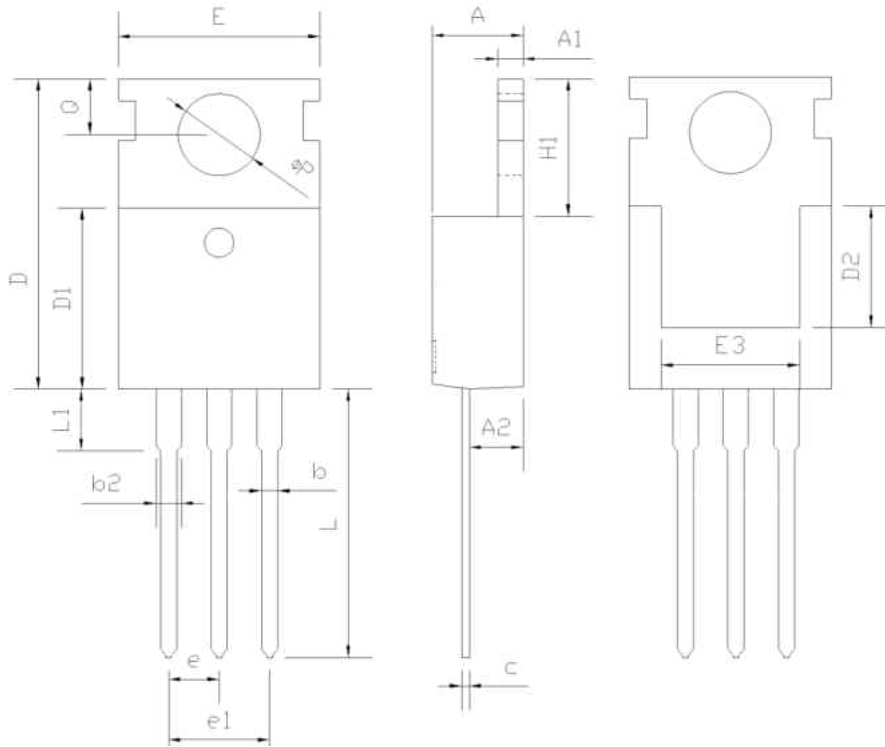
Figure3, TO220F package outline dimension



SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95

**■ Package Information**

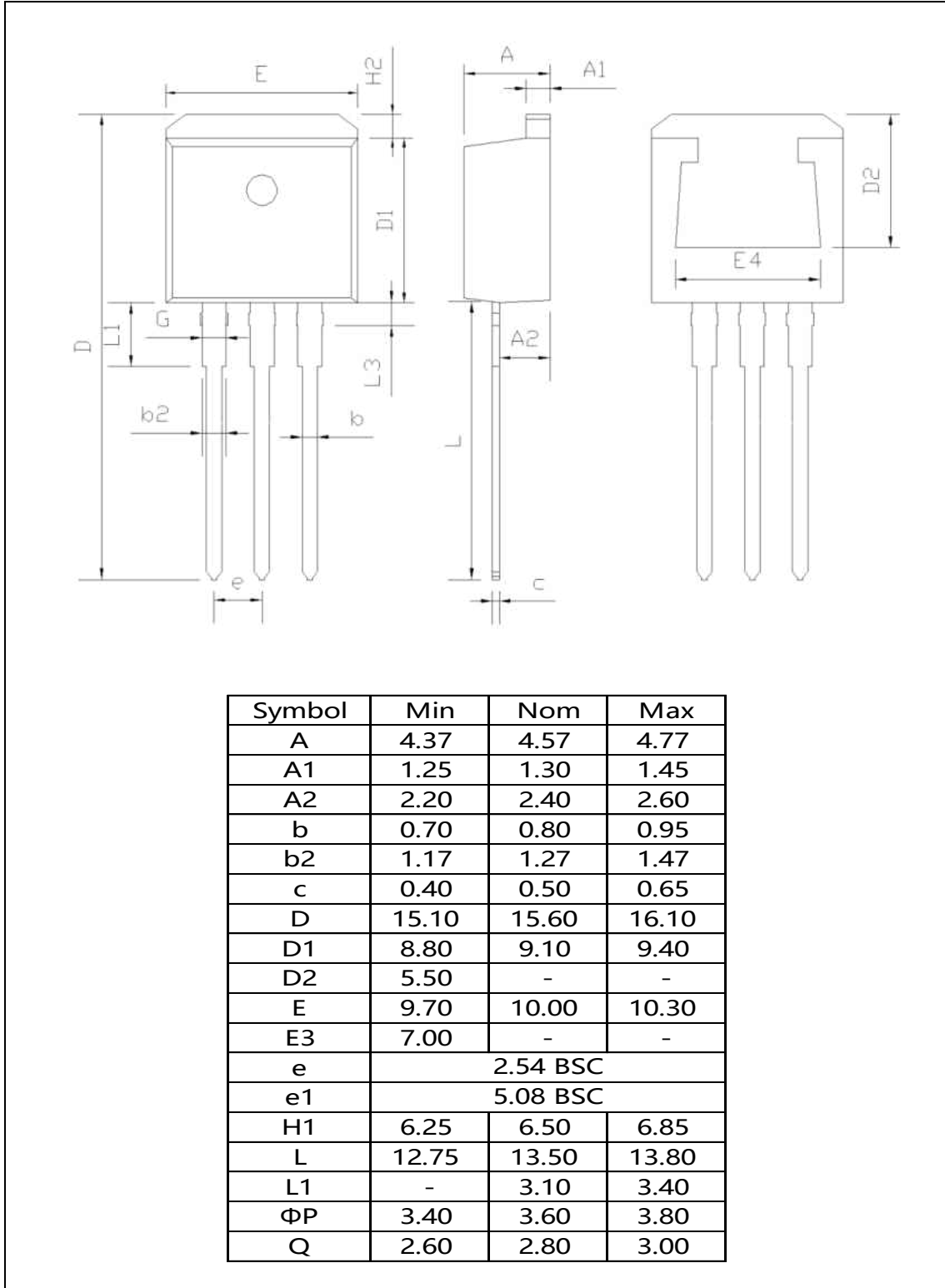
Figure4, TO220 package outline dimension



Symbol	Min	Nom	Max
A	4.37	4.57	4.77
A1	1.25	1.30	1.45
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.40	0.50	0.65
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00

**■ Package Information**

Figure5, TO262 package outline dimension



## ■ Ordering Information

Package	Units/Tube	Tubes/Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO251	75	66	4950	6	29700
TO262	50	20	1000	6	6000
TO220	50	20	1000	6	6000
TO220F	50	20	1000	6	6000

Package	Units/Tape	Tapes/Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO252	2500	2	5000	5	25000

## ■ Product Information

Product	Package	Pb Free	RoHS	Halogen Free
OSG60R260AF	TO251	yes	yes	yes
OSG60R260DF	TO252	yes	yes	yes
OSG60R260FF	TO220F	yes	yes	yes
OSG60R260PF	TO220	yes	yes	yes
OSG60R260IF	TO262	yes	yes	yes