

# 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

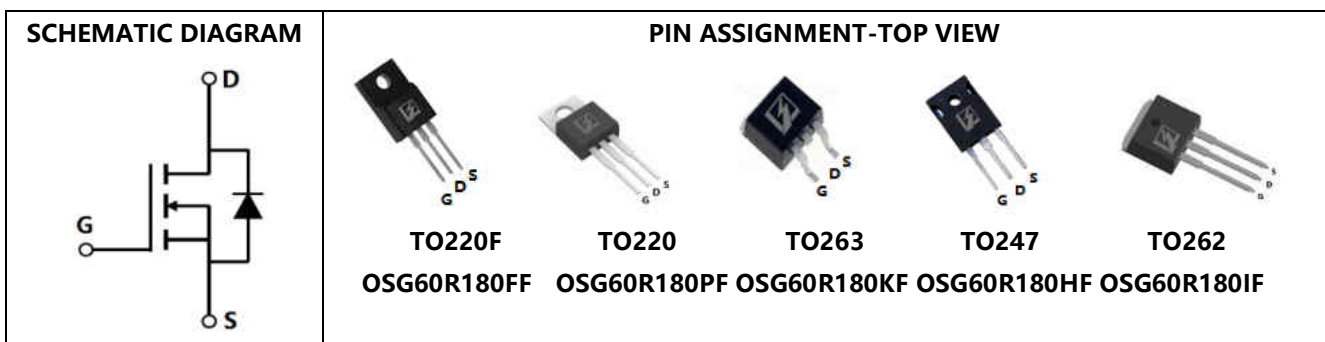


## ■ General Description

OSG60R180xF use advanced GreenMOST™ 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.

◆ $V_{DS, min@T_{jmax}}$	650 V
◆ $I_{D, pulse}$	60 A
◆ $R_{DS(ON), max @ V_{GS}=10 V}$	180 mΩ
◆ $Q_g$	23.3 nC

## ■ Schematic and Package Information



## ■ 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> , $T_C=25^\circ\text{C}$	$I_D$	20	A
Continuous drain current <sup>1)</sup> , $T_C=100^\circ\text{C}$		12.5	
Pulsed drain current <sup>2)</sup> , $T_C=25^\circ\text{C}$	$I_{D, pulse}$	60	A
Power dissipation <sup>3)</sup> for TO220, TO263, TO262, TO247, $T_C=25^\circ\text{C}$	$P_D$	151	W
Power dissipation <sup>3)</sup> for TO220F, $T_C=25^\circ\text{C}$		34	
Single pulsed avalanche energy <sup>5)</sup>	$E_{AS}$	600	mJ
MOSFET dv/dt ruggedness, $V_{DS}=0\text{...}480\text{ V}$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS}=0\text{...}480\text{ V}$ , $I_{SD}\leq I_D$	dv/dt	15	V/ns
Operation and storage temperature	$T_{stg}, T_j$	-55 to 150	°C



## ■ Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO220/TO263/TO247/TO262	TO220F	
Thermal resistance, junction-case	$R_{\theta JC}$	0.82	3.67	°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	716			$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$ , $T_j=150\text{ }^\circ\text{C}$
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	$R_{DS(on)}$		0.15	0.18	$\Omega$	$V_{GS}=10\text{ V}$ , $I_D=10\text{ A}$
			0.38			$V_{GS}=10\text{ V}$ , $I_D=10\text{ A}$ , $T_j=150\text{ }^\circ\text{C}$
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	$C_{iss}$		1440		pF	$V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$
Output capacitance	$C_{oss}$		105		pF	
Reverse transfer capacitance	$C_{rss}$		3.94		pF	
Turn-on delay time	$t_{d(on)}$		40.3		ns	$V_{GS}=10\text{ V}$ , $V_{DS}=480\text{ V}$ , $R_G=25\text{ }\Omega$ , $I_D=20\text{ A}$
Rise time	$t_r$		49.3		ns	
Turn-off delay time	$t_{d(off)}$		60		ns	
Fall time	$t_f$		59.2		ns	



## ■ Gate Charge Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Total gate charge	$Q_g$		23.3		nC	$I_D=20\text{ A}$ , $V_{DS}=480\text{ V}$ , $V_{GS}=10\text{ V}$
Gate-source charge	$Q_{gs}$		6.6		nC	
Gate-drain charge	$Q_{gd}$		8.3		nC	
Gate plateau voltage	$V_{\text{plateau}}$		5.6		V	

## ■ Body Diode Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Diode forward current	$I_S$			20	A	$V_{GS}<V_{th}$
Pulsed source current	$I_{SP}$			60		
Diode forward voltage	$V_{SD}$			1.4	V	$I_S=20\text{ A}$ , $V_{GS}=0\text{ V}$
Reverse recovery time	$t_{rr}$		367.2		ns	$V_R=400\text{ V}$ , $I_S=20\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		4.2		$\mu\text{C}$	
Peak reverse recovery current	$I_{rrm}$		24.3		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

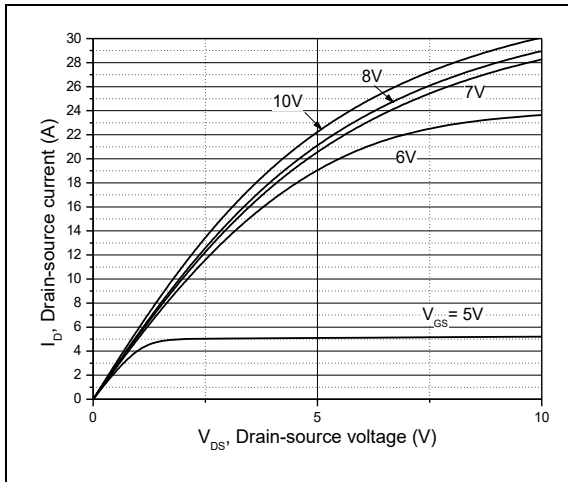


Figure 1, Typ. output characteristics

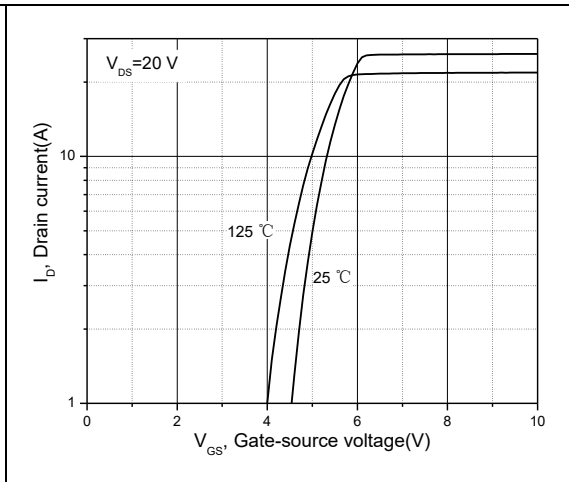


Figure 2, Typ. transfer characteristics

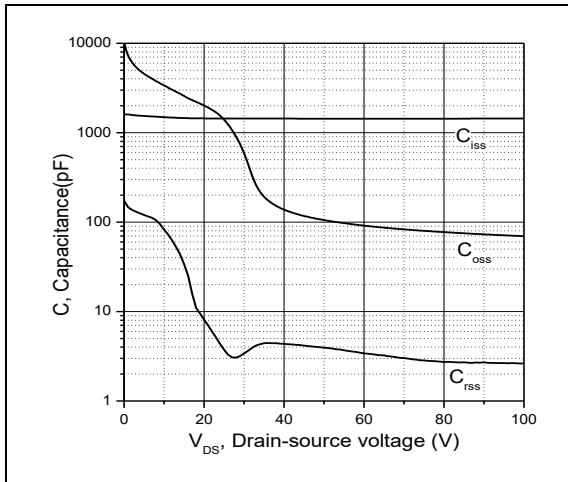


Figure 3, Typ. capacitances

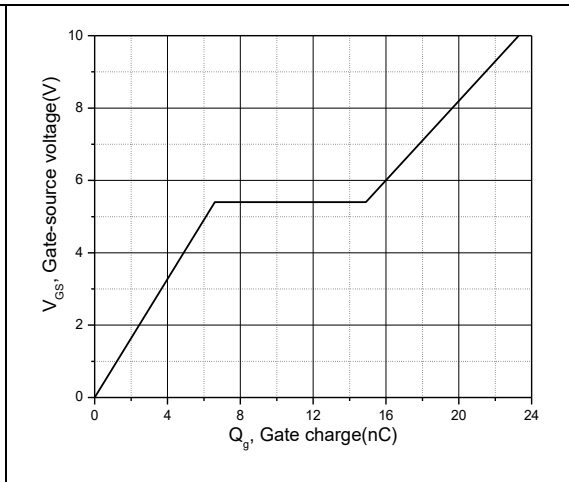


Figure 4, Typ. gate charge

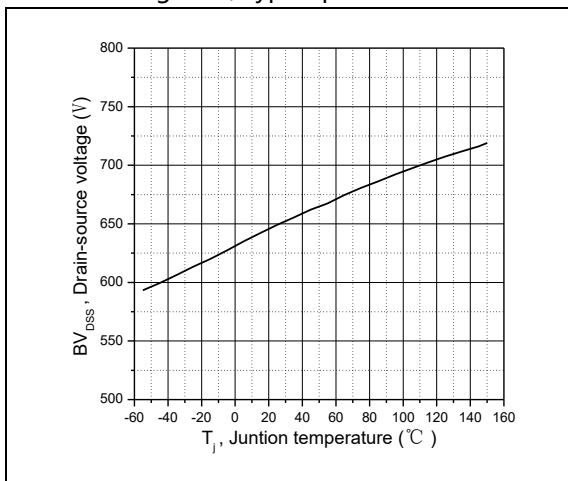


Figure 5, Drain-source breakdown voltage

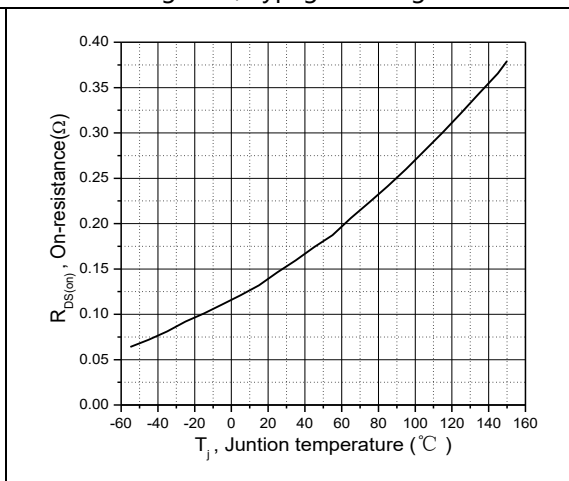


Figure 6, Drain-source on-state resistance

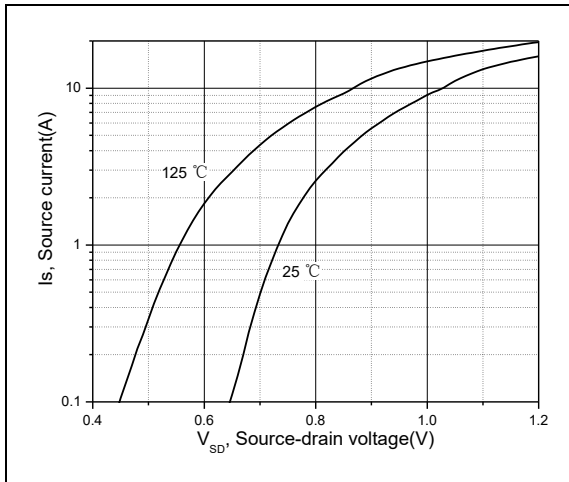


Figure 7, Forward characteristic of body diode

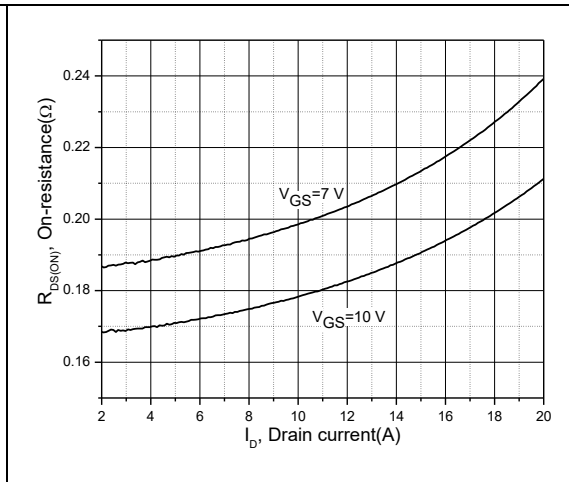


Figure 8, Drain-source on-state resistance

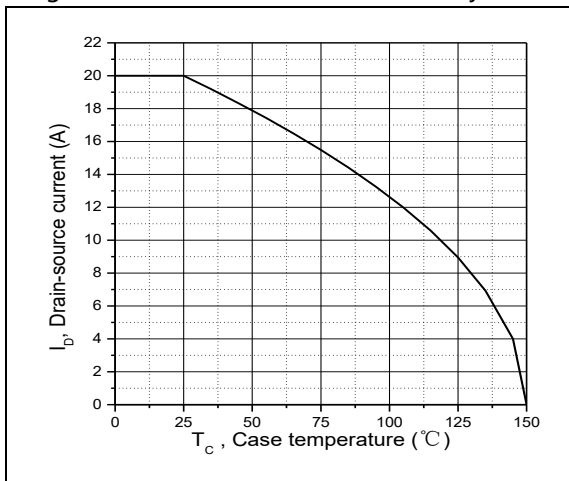


Figure 9, Drain current

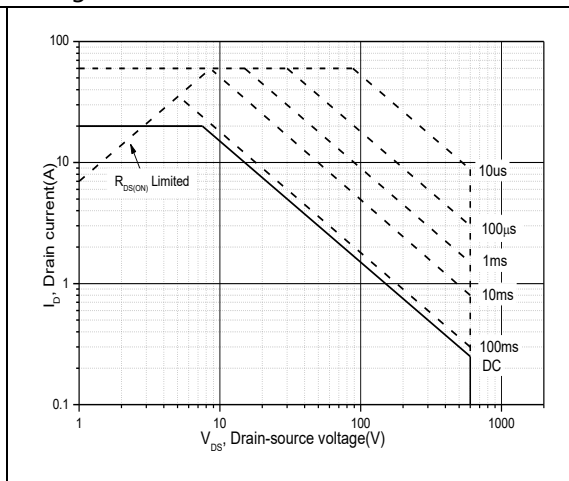


Figure 10, Safe operation area for TO220/TO263/TO247/TO262  $T_C=25\text{ }^\circ\text{C}$

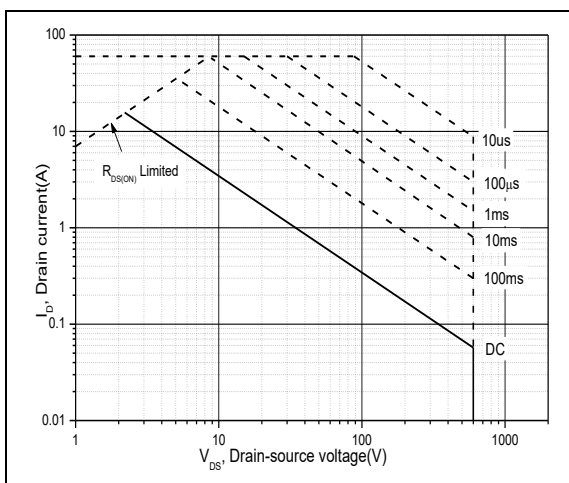
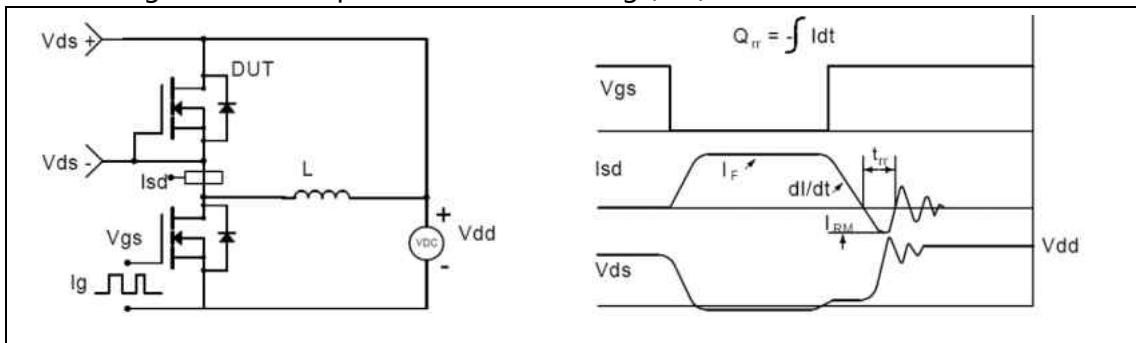
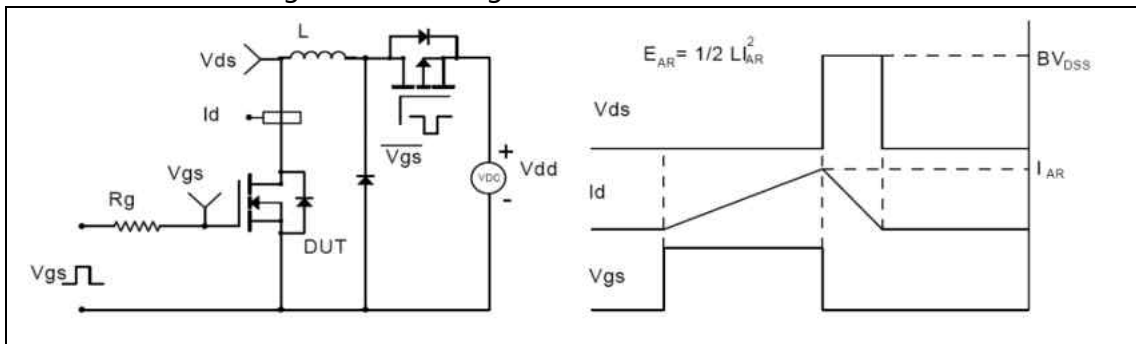
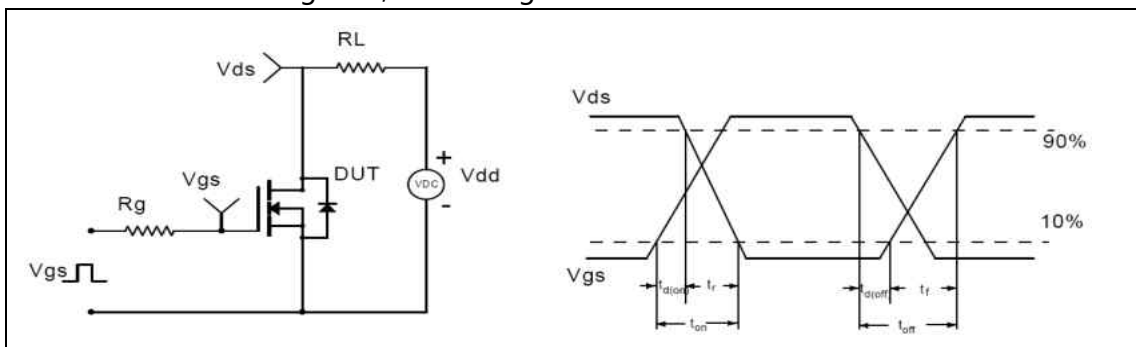
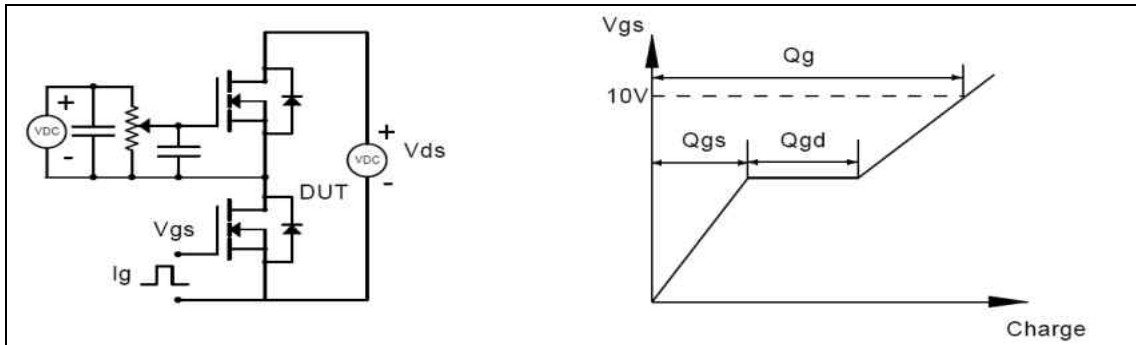


Figure 11, Safe operation area for TO220F  $T_C=25\text{ }^\circ\text{C}$



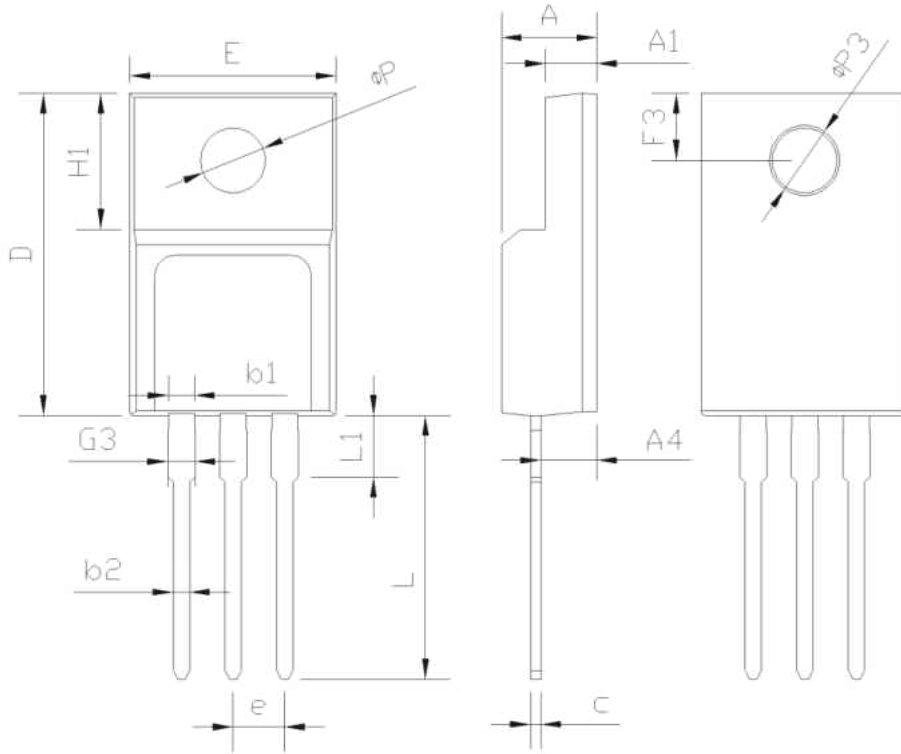
### ■ Test circuits and waveforms





■ Package Information

Figure1, TO220F package outline dimension



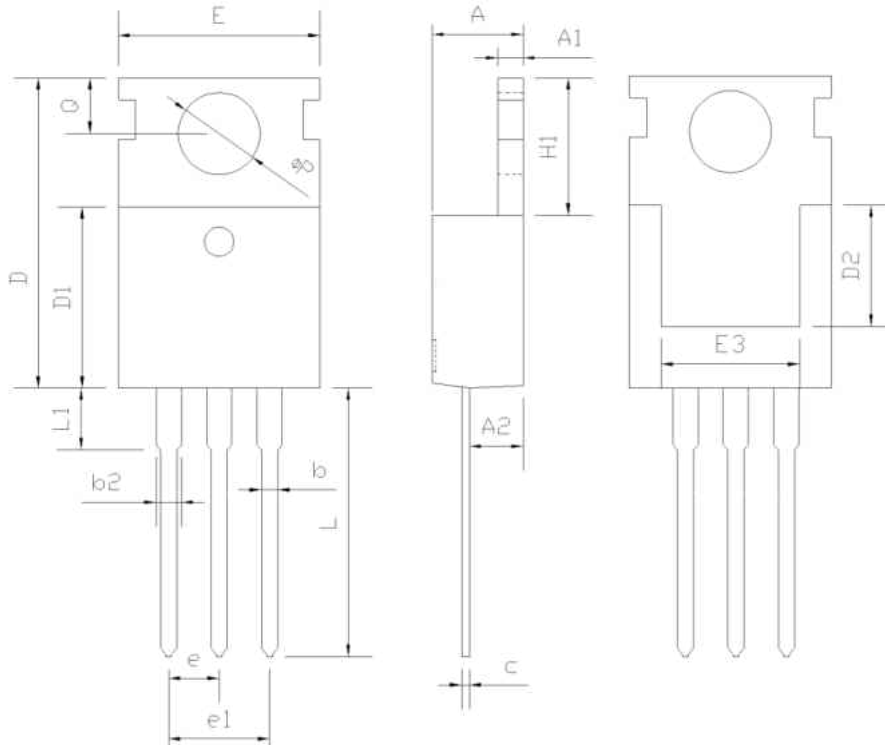
SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80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





■ Package Information

Figure2, TO220 package outline dimension

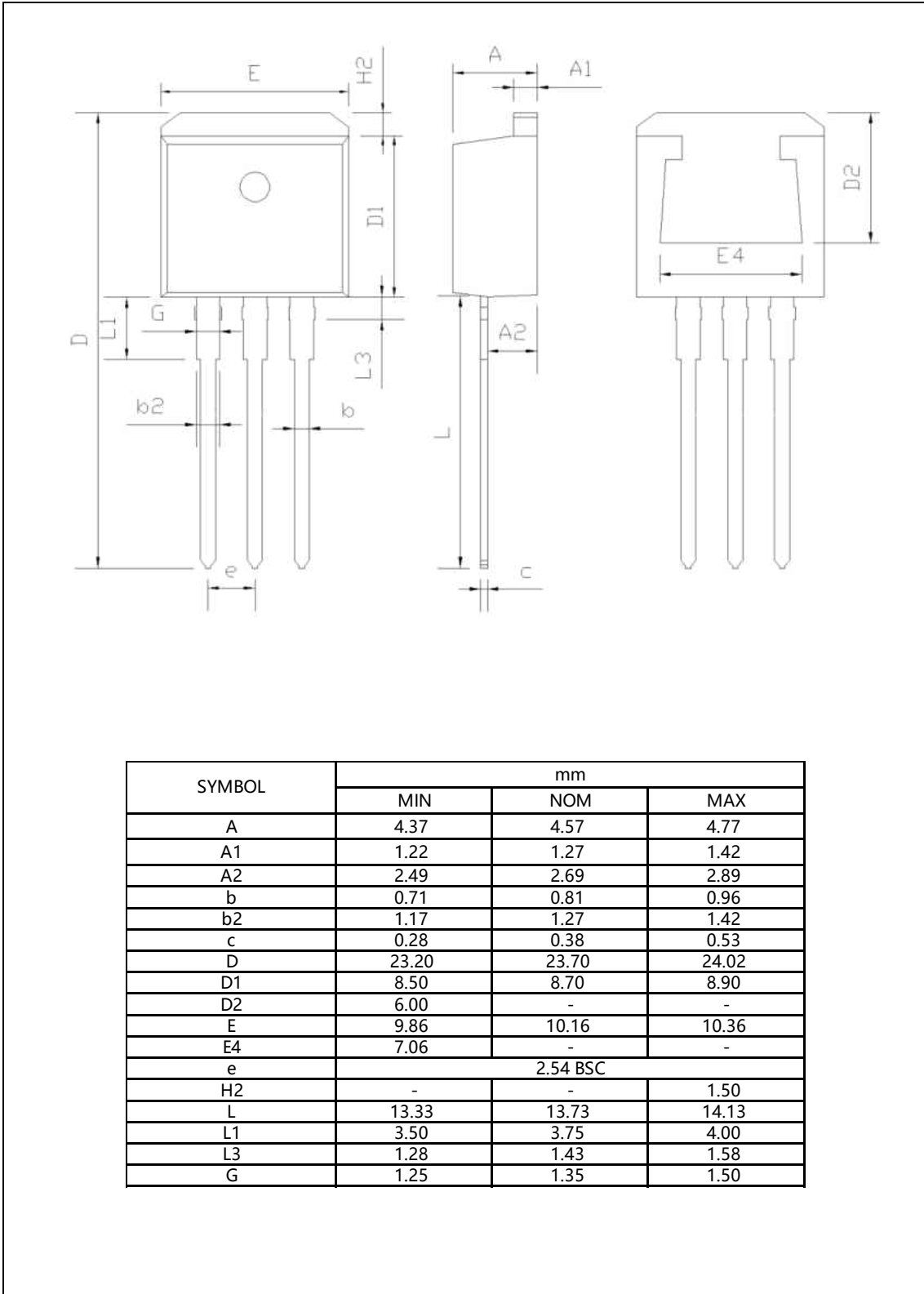


SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00



■ Package Information

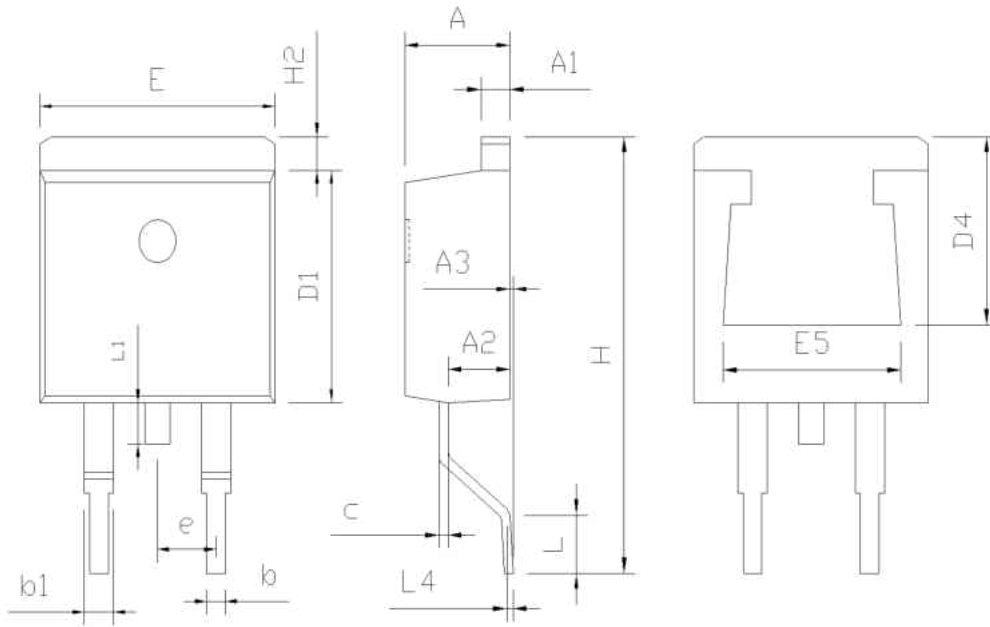
Figure3, TO262 package outline dimension





■ Package Information

Figure4, TO263 package outline dimension

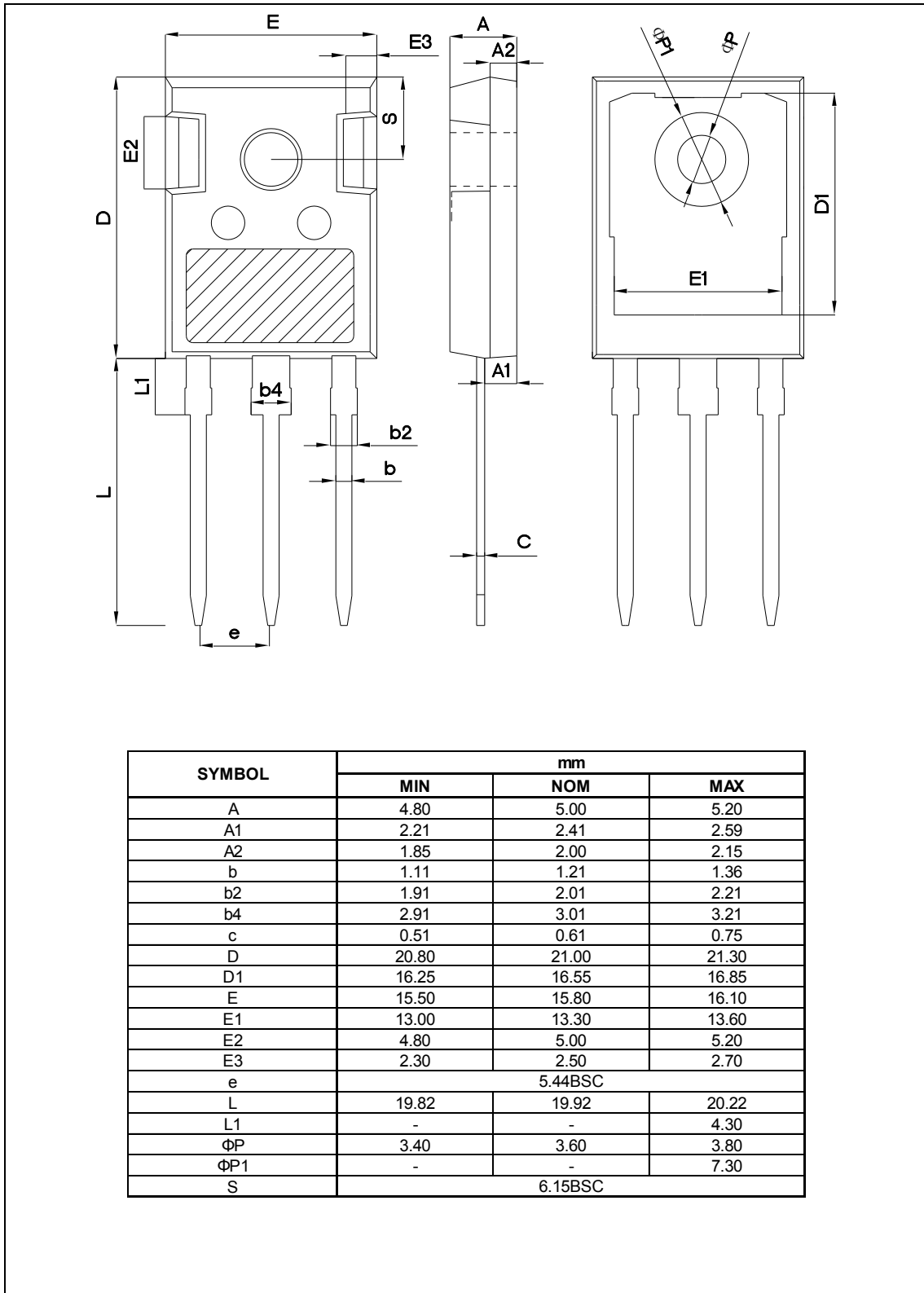


SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0.00	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25 BSC		



■ Package Information

Figure5, TO247 package outline dimension





## ■ Ordering Information

Package	Units/Tube	Tubes/Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO220F	50	20	1000	6	6000
TO220	50	20	1000	6	6000
TO263	50	20	1000	6	6000
TO247	30	11	330	6	1980
TO262	50	20	1000	6	6000

## ■ Product Information

Product	Package	Pb Free	RoHS	Halogen Free
OSG60R180FF	TO220F	yes	yes	yes
OSG60R180PF	TO220	yes	yes	yes
OSG60R180KF	TO263	yes	yes	yes
OSG60R180HF	TO247	yes	yes	yes
OSG60R180IF	TO262	yes	yes	yes