

# Enhancement Mode N-Channel Power MOSFET

## Features

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

## Applications

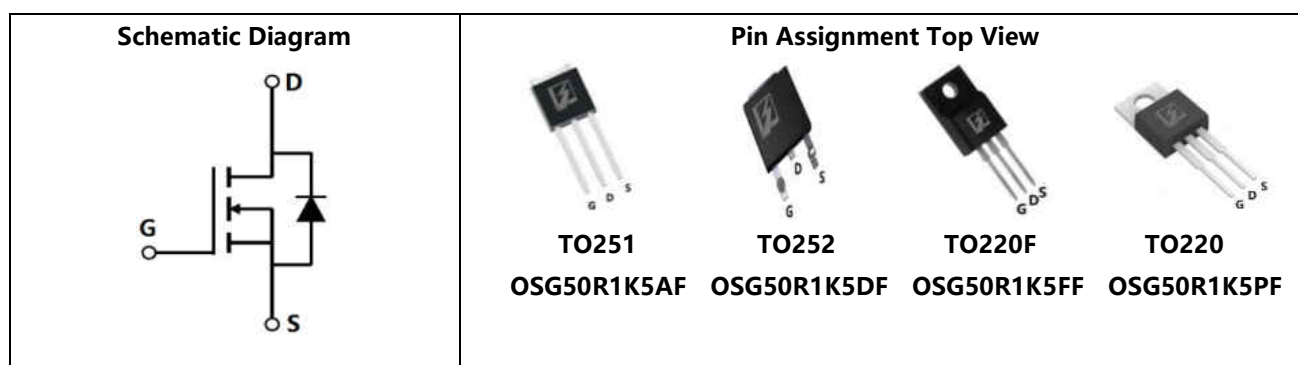
- ◆ Lighting
- ◆ Hard switching PWM
- ◆ Server power supply
- ◆ Charger
- ◆ Lighting

## ■ General Description

OSG50R1K5xF use advanced GreenMOS™ 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.

◆ $V_{DS, min@Tjmax}$	550 V
◆ $I_{D, pulse}$	9 A
◆ $R_{DS(ON), max @ V_{GS}=10 V}$	1.5 $\Omega$
◆ $Q_g$	4.84 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	$V_{DS}$	500	V
Gate source voltage	$V_{GS}$	$\pm 30$	V
Continuous drain current <sup>1)</sup> , $T_C=25^\circ\text{C}$	$I_D$	3	A
Continuous drain current <sup>1)</sup> , $T_C=100^\circ\text{C}$		1.9	
Pulsed drain current <sup>2)</sup> , $T_C=25^\circ\text{C}$	$I_{D, pulse}$	9	A
Power dissipation <sup>3)</sup> for TO251, TO252, TO220, $T_C=25^\circ\text{C}$	$P_D$	20	W
Power dissipation <sup>3)</sup> for TO220F, $T_C=25^\circ\text{C}$		18	
Single pulsed avalanche energy <sup>5)</sup>	$E_{AS}$	60	mJ
MOSFET dv/dt ruggedness, $V_{DS}=0\dots 400\text{ V}$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS}=0\dots 400\text{ V}$ , $I_{SD}\leq I_D$	dv/dt	15	V/ns
Operation and storage temperature	$T_{stg}, T_j$	-55 to 150	$^\circ\text{C}$

## ■ Thermal Characteristics

PARAMETER	SYMBOL	VALUE		UNIT
		TO251/TO252/TO220	TO220F	
Thermal resistance, junction-case	$R_{\theta JC}$	6.25	6.94	°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	$BV_{DSS}$	500			V	$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$
		550	630			$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$ , $T_j=150\text{ }^\circ\text{C}$
Gate threshold voltage	$V_{GS(th)}$	2.9		3.9	V	$V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$
Drain-source on-state resistance	$R_{DS(on)}$		1.3	1.5	$\Omega$	$V_{GS}=10\text{ V}$ , $I_D=1.5\text{ A}$
			3			$V_{GS}=10\text{ V}$ , $I_D=1.5\text{ A}$ , $T_j=150\text{ }^\circ\text{C}$
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	$\mu\text{A}$	$V_{DS}=500\text{ V}$ , $V_{GS}=0\text{ V}$

## ■ Dynamic Characteristics

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input capacitance	$C_{iss}$		130.6		pF	$V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$
Output capacitance	$C_{oss}$		51.7		pF	
Reverse transfer capacitance	$C_{rss}$		1.0		pF	
Turn-on delay time	$t_{d(on)}$		15.3		ns	$V_{GS}=10\text{ V}$ , $V_{DS}=400\text{ V}$ , $R_G=2\text{ }\Omega$ , $I_D=2\text{ A}$
Rise time	$t_r$		4.8		ns	
Turn-off delay time	$t_{d(off)}$		22.0		ns	
Fall time	$t_f$		7.6		ns	



### ■ Gate Charge Characteristics

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Total gate charge	$Q_g$		4.84		nC	$I_D=2\text{ A}$ , $V_{DS}=400\text{ V}$ , $V_{GS}=10\text{ V}$
Gate-source charge	$Q_{gs}$		0.87		nC	
Gate-drain charge	$Q_{gd}$		1.93		nC	
Gate plateau voltage	$V_{\text{plateau}}$		5.8		V	

### ■ Body Diode Characteristics

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Diode forward current	$I_S$			3	A	$V_{GS} < V_{th}$
Pulsed source current	$I_{SP}$			9		
Diode forward voltage	$V_{SD}$			1.4	V	$I_S=3\text{ A}$ , $V_{GS}=0\text{ V}$
Reverse recovery time	$t_{rr}$		146.1		ns	$V_R=400\text{ V}$ , $I_S=2\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		0.7		$\mu\text{C}$	
Peak reverse recovery current	$I_{rrm}$		10.1		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)  $V_{DD}=50\text{ V}$ ,  $R_G=50\text{ }\Omega$ ,  $L=60\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .



## ■ Electrical Characteristics Diagrams

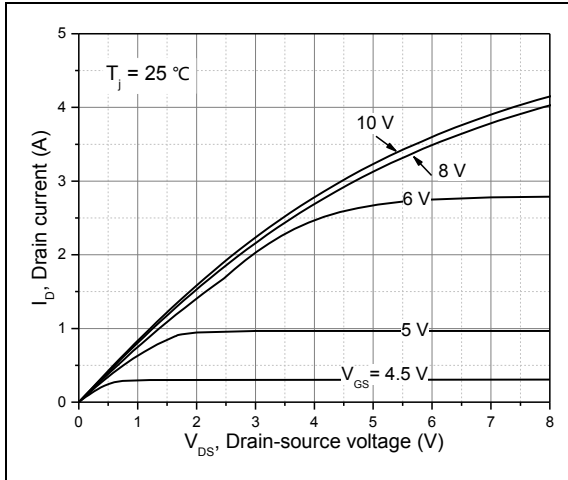


Figure 1, Typ. output characteristics

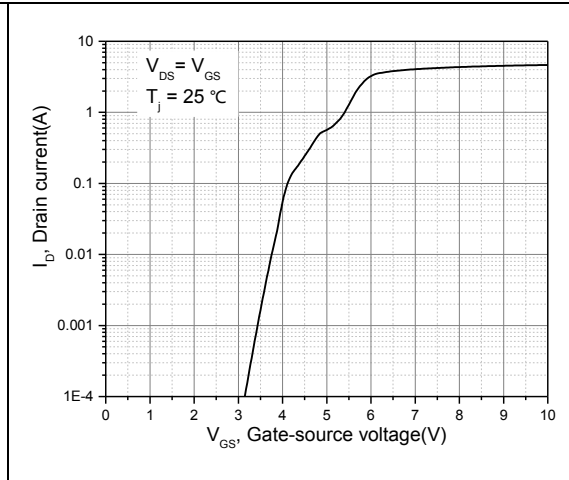


Figure 2, Typ. transfer characteristics

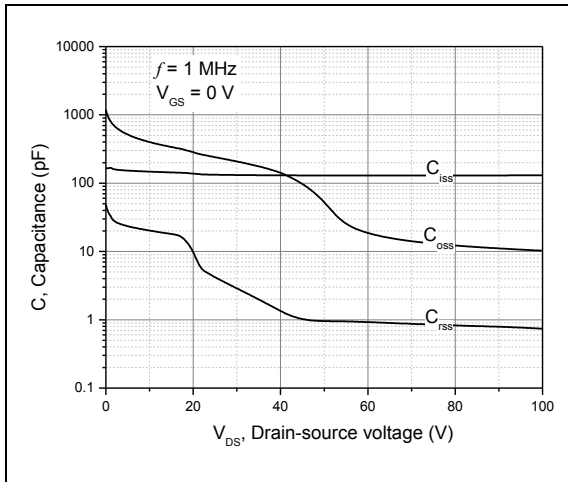


Figure 3, Typ. capacitances

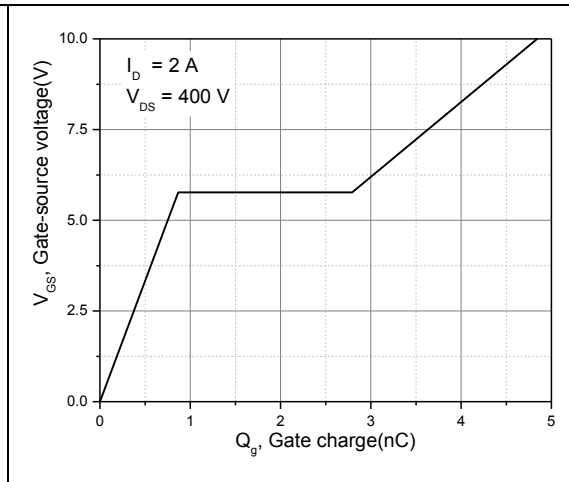


Figure 4, Typ. gate charge

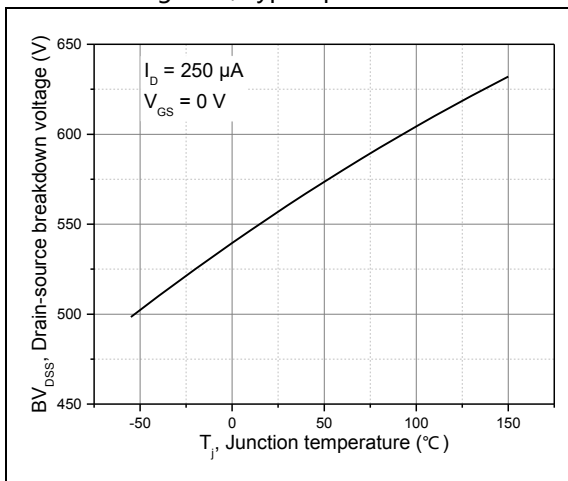


Figure 5, Drain-source breakdown voltage

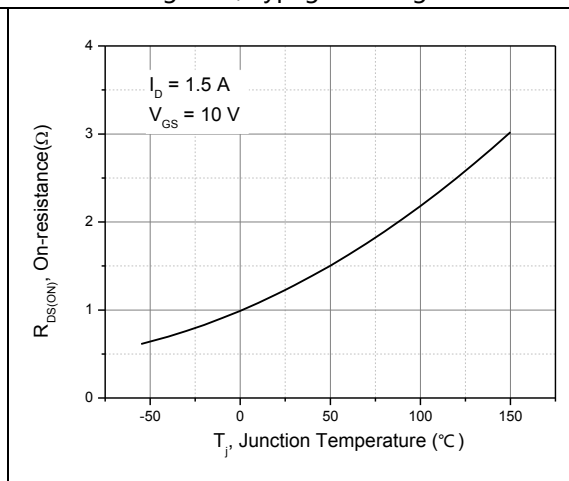


Figure 6, Drain-source on-state resistance

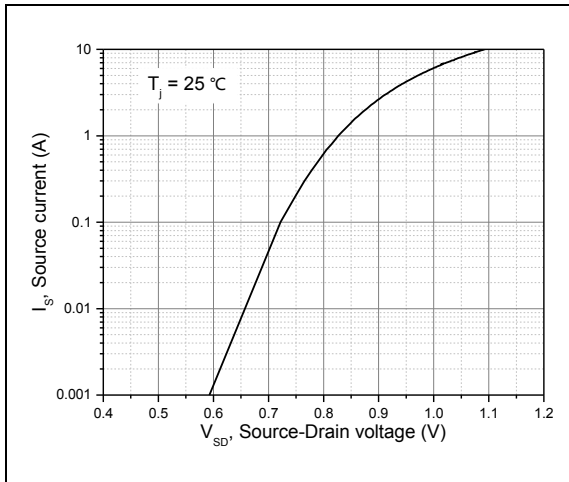


Figure 7, Forward characteristic of body diode

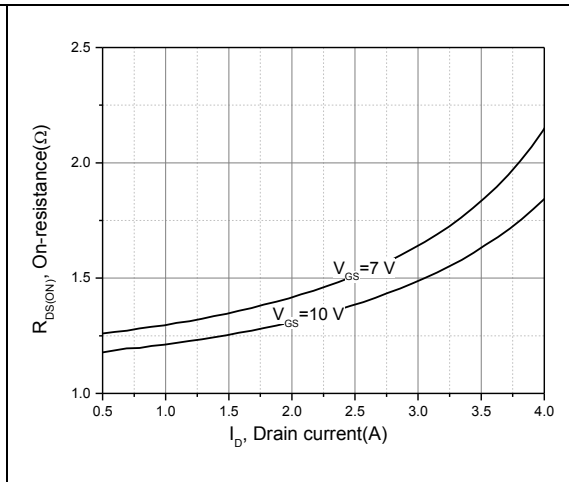


Figure 8, Drain-source on-state resistance

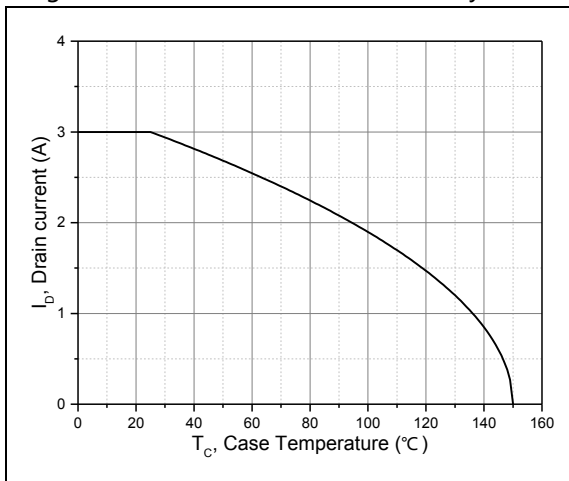


Figure 9, Drain current

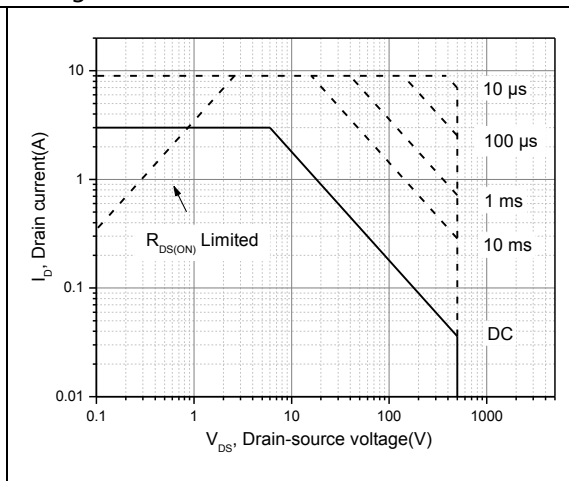


Figure 10, Safe operation area for TO220F  
Tc=25 °C

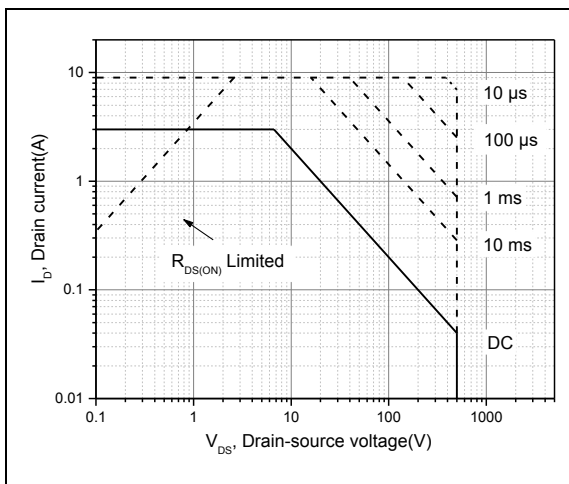
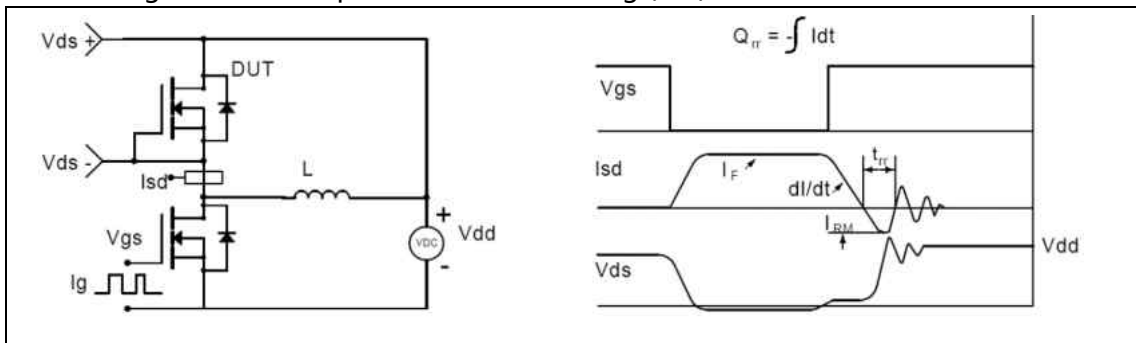
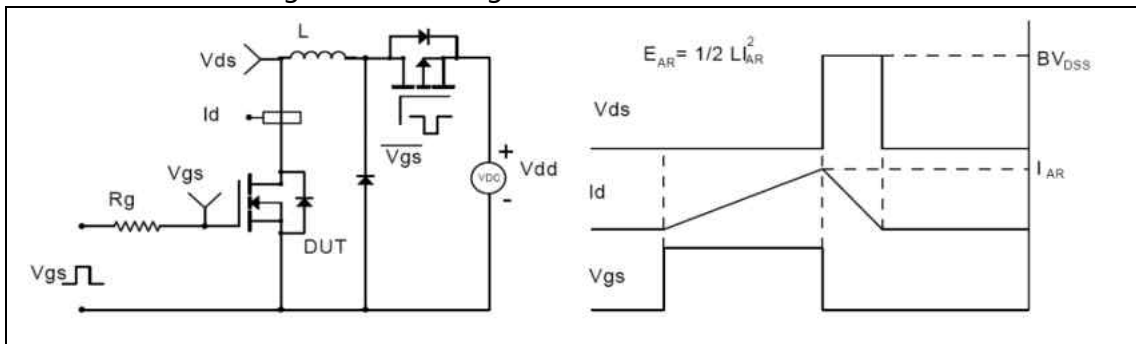
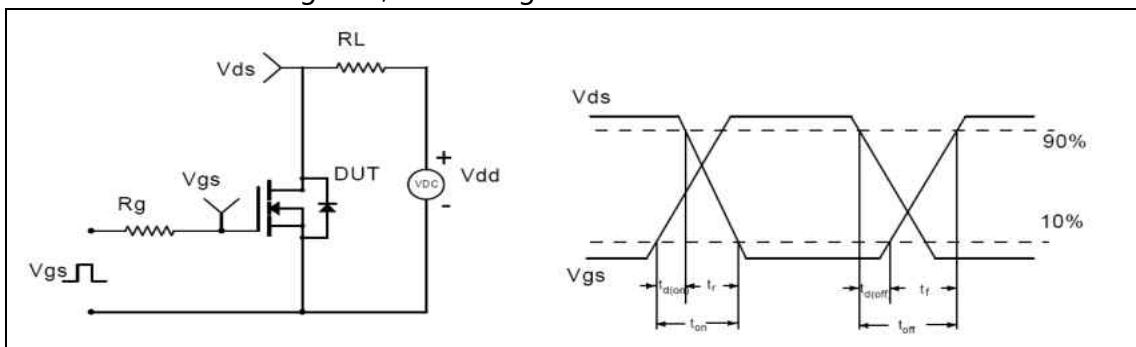
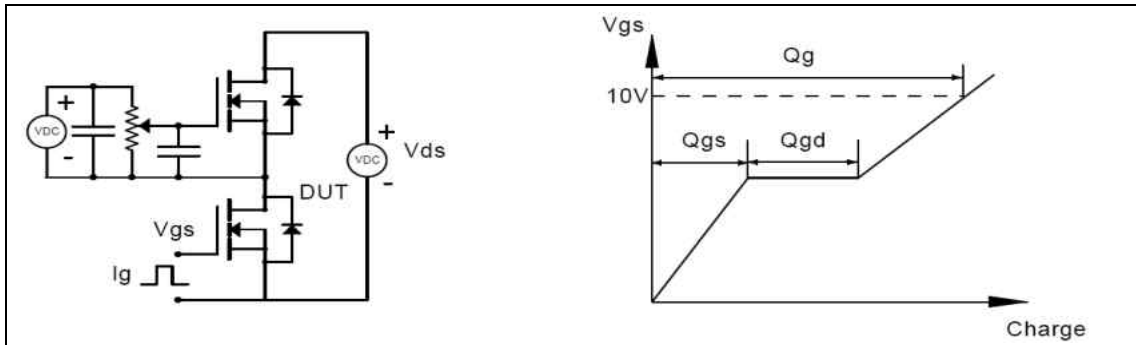


Figure 10, Safe operation area for  
TO251/TO252/TO220 Tc=25 °C



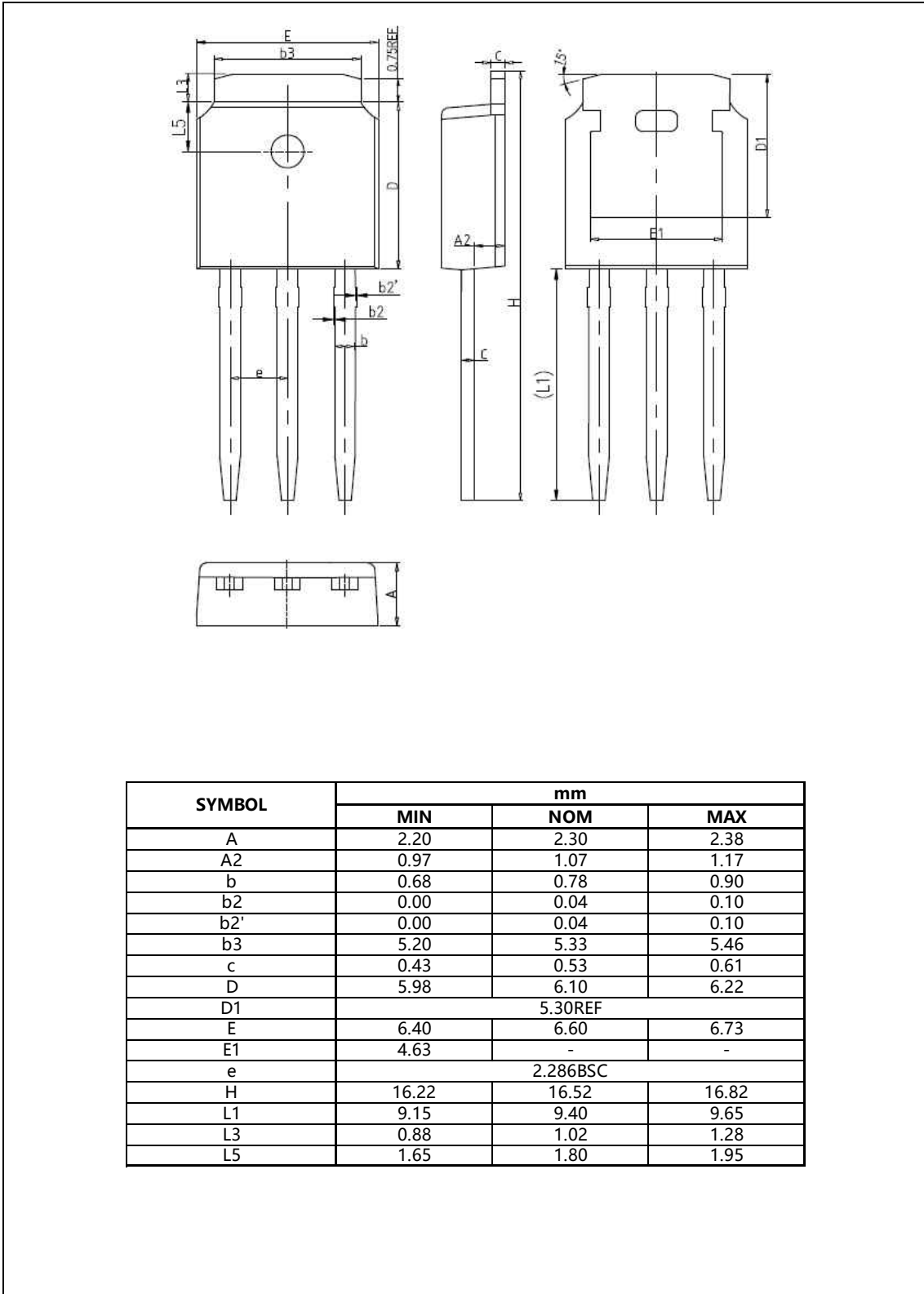
■ Test circuits and waveforms





■ Package Information

Figure1, TO251 package outline dimension

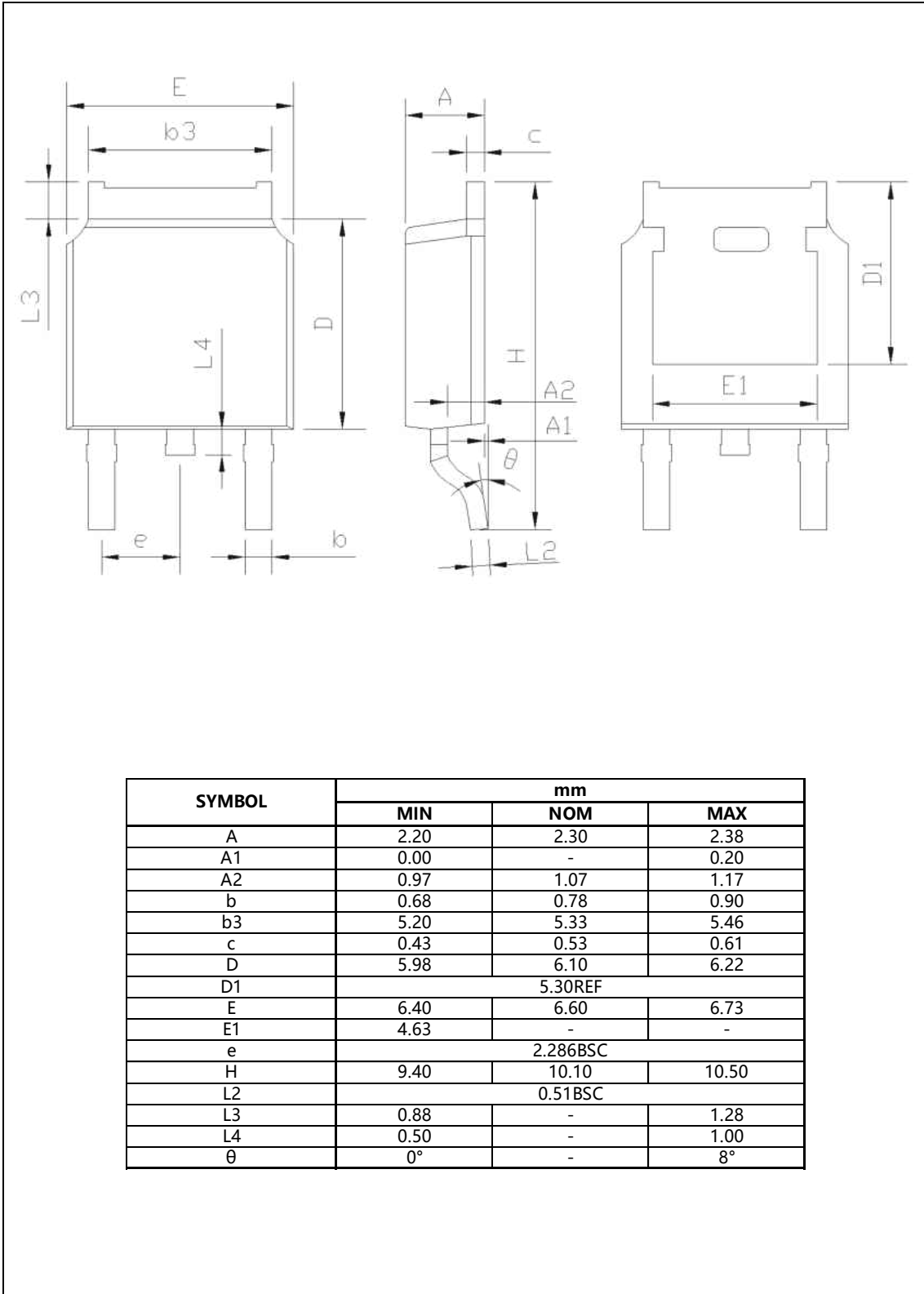






■ Package Information

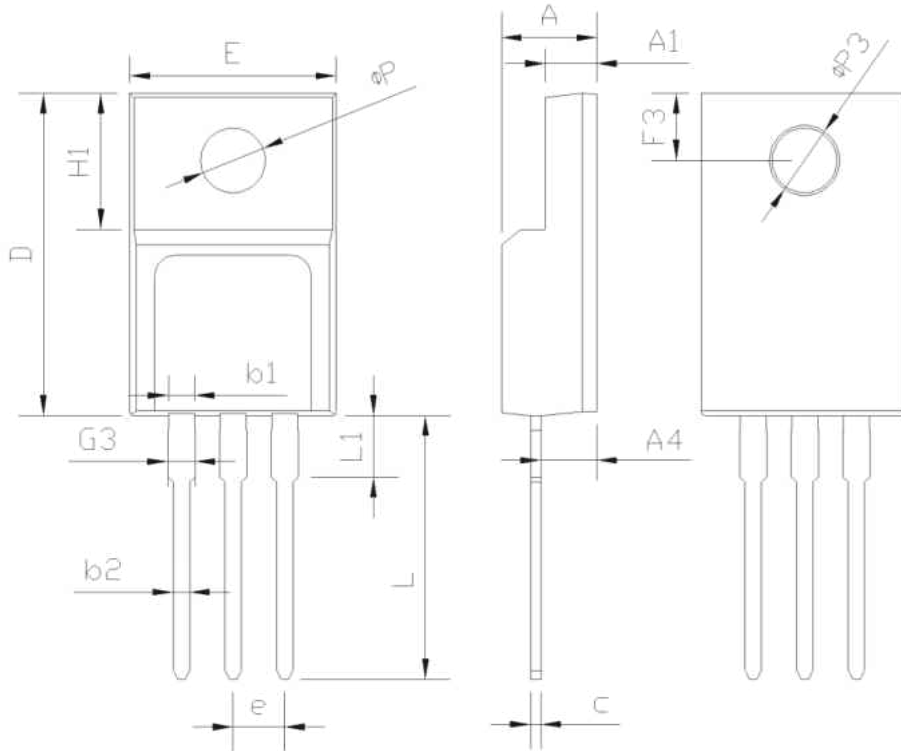
Figure2, TO252 package outline dimension





■ Package Information

Figure3, TO220F package outline dimension

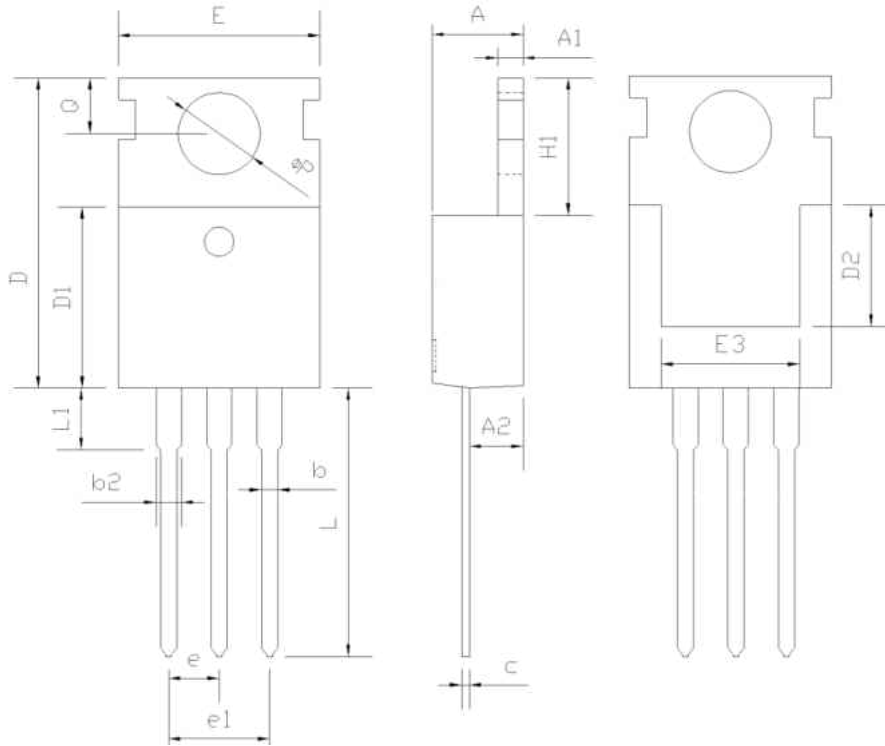


SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80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



■ Package Information

Figure4, 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



## ■ Ordering Information

Package	Units/Tube	Tubes/Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO251	75	66	4950	6	29700
TO220F	50	20	1000	6	6000
TO220	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
OSG50R1K5AF	TO251	yes	yes	yes
OSG50R1K5DF	TO252	yes	yes	yes
OSG50R1K5FF	TO220F	yes	yes	yes
OSG50R1K5PF	TO220	yes	yes	yes