

## General Description

The Sanrise SRC60R022FBS is a high voltage power MOSFET, fabricated using advanced super junction technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and outstanding efficiency.

The SRC60R022FBS break down voltage is 600V and it has a high rugged avalanche characteristics.

The SRC60R022FBS is available in TO-247 package.

## Features

- Ultra Low  $R_{DS(ON)} = 22m\Omega @ V_{GS} = 10V$ .
- $V_{ds@T_{jmax}} = 650v$ .
- Ultra Low Gate Charge,  $Q_g = 168nC$  typ.
- Intrinsic Fast-Recovery Body Diode
- Fast switching capability
- Robust design with better EAS performance
- Non-automotive Qualified
- Ultra-fast body diode

## Application

- EV Charger
- Server / Telecom

## Symbol

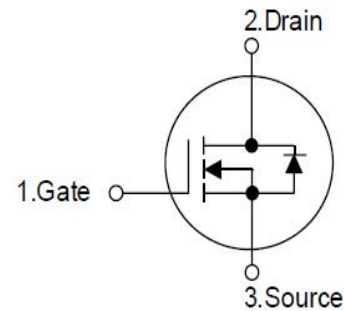
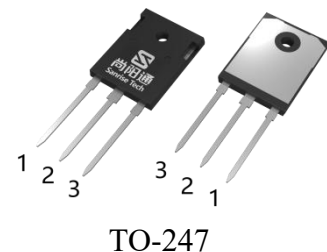


Figure 1 Symbol of SRC60R022FBS

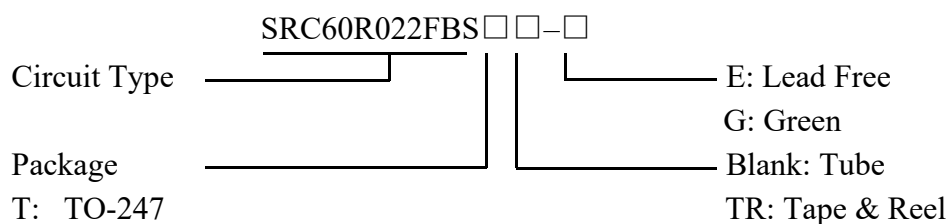
## Package Type



TO-247

Figure 2 Package Type of SRC60R022FBS

## Ordering Information



Package	Part Number	Marking ID	Packing Type
TO-247	SRC60R022FBST-G	SRC60R022FBSTG	Tube

### Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	$V_{DSS}$	600	V
Gate-Source Voltage	$V_{GSS}$	±30	V
Gate-Source Voltage (dynamic), AC ( $f > 1$ Hz)	$V_{GSS}$	±30	V
Power Dissipation( $T_C=25^{\circ}C, TO-247$ )	$P_{tot}$	595	W
Continuous Drain Current	$I_D$	$T_C=25^{\circ}C$	115
		$T_C=100^{\circ}C$	72.7
		$T_C=125^{\circ}C$	51.4
Pulsed Drain Current (Note 2)	$I_{DM}$	345	A
Avalanche Energy, Single Pulse (Note 3)	$E_{AS}$	600	mJ
Avalanche Energy, Single Pulse (Note 4)	$E_{AS}$	3802	mJ
Avalanche Energy, Repetitive (Note 2)	$E_{AR}$	1.6	mJ
Avalanche Current, Repetitive (Note 2)	$I_{AR}$	7.8	A
Continuous Diode Forward Current	$I_S$	115	A
Diode Pulse Current	$I_{S,PULSE}$	345	A
MOSFET dv/dt Ruggedness, $V_{DS} \leq 480V$	dv/dt	80	V/ns
Reverse Diode dv/dt, $V_{DS} \leq 480V, I_{SD} \leq I_D$	dv/dt	50	V/ns
Operating Junction Temperature	$T_J$	150	$^{\circ}C$
Storage Temperature	$T_{STG}$	-55 to 150	$^{\circ}C$
Lead Temperature (Soldering, 10 sec)	$T_{LEAD}$	260	$^{\circ}C$

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3.  $I_{AS} = 7.8A, V_{DD} = 60V, R_G = 25\Omega, \text{Starting } T_J = 25^{\circ}C.$  Finish goods test condition.
4.  $I_{AS} = 19.5A, V_{DD} = 60V, R_G = 25\Omega, \text{Starting } T_J = 25^{\circ}C.$  Typical Eas.

### Thermal characteristics

Parameter	Symbol	Package	Value ( Max.)	Unit
Thermal resistance, junction - case	$R_{thJC}$	TO-247	0.21	$^{\circ}C / W$
Thermal resistance, junction – ambient (Leaded)	$R_{thJA}$	TO-247	62	$^{\circ}C / W$

**Electrical Characteristics**
 $T_J = 25^\circ\text{C}$ , unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Statistic Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			10	$\mu A$
Gate-Body Leakage Current	Forward	$I_{GSSF}, V_{GS}=30V, V_{DS}=0V$			200	nA
	Reverse	$I_{GSSR}, V_{GS}=-30V, V_{DS}=0V$			-200	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=3.0mA$	3.0	4.0	5.0	V
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=57A$		18.6	22	mΩ
Gate Resistance	$R_G$	$f=1MHz, \text{Open Drain}$		1.6		Ω
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=400V, V_{GS}=0V, f=100KHz$		10.3		nF
Output Capacitance	$C_{OSS}$			206		pF
Effective output capacitance, energy related <sup>NOTE5</sup>	$C_{O(er)}$	$V_{GS}=0V, V_{DS}=0\dots 400V$		301.4		pF
Effective output capacitance, time related <sup>NOTE6</sup>	$C_{O(tr)}$			1835.7		
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=400V, I_D=57A, R_G=1.8\Omega, V_{GS}=10V$		29		ns
Rise Time	$t_r$			26		
Turn-off Delay Time	$t_{d(off)}$			74		
Fall Time	$t_f$			6		
<b>Gate Charge Characteristics</b>						
Gate to Source Charge	$Q_{gs}$	$V_{DD}=480V, I_D=57A, V_{GS}=0 \text{ to } 10V$		78		nC
Gate to Drain Charge	$Q_{gd}$			46.5		
Gate Charge Total	$Q_g$			168		
Gate Plateau Voltage	$V_{plateau}$			6.5		V
<b>Reverse Diode Characteristics</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_{SD}=57A$		0.9	1.1	V
Reverse Recovery Time	$t_{rr}$	$V_R=400V, I_F=57A, dI_F/dt=90A/\mu s$		227		ns
Reverse Recovery Charge	$Q_{rr}$			2.2		$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$			16.2		A

Note:

- $C_{O(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 400V
- $C_{O(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 400V

**Typical Performance Characteristics**

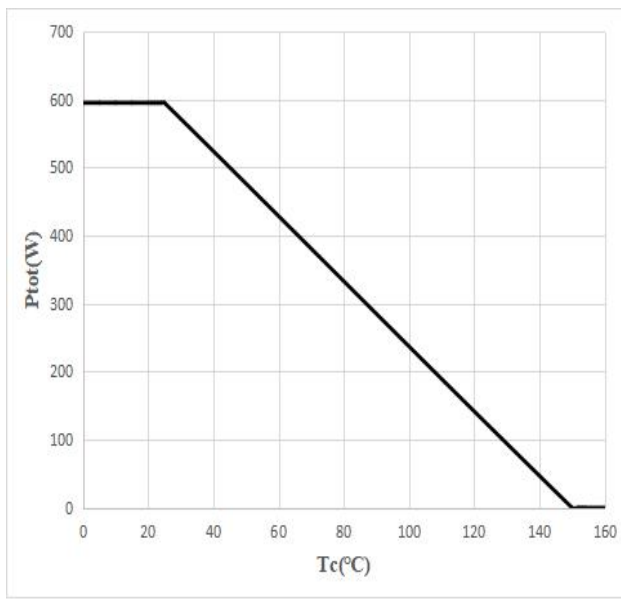
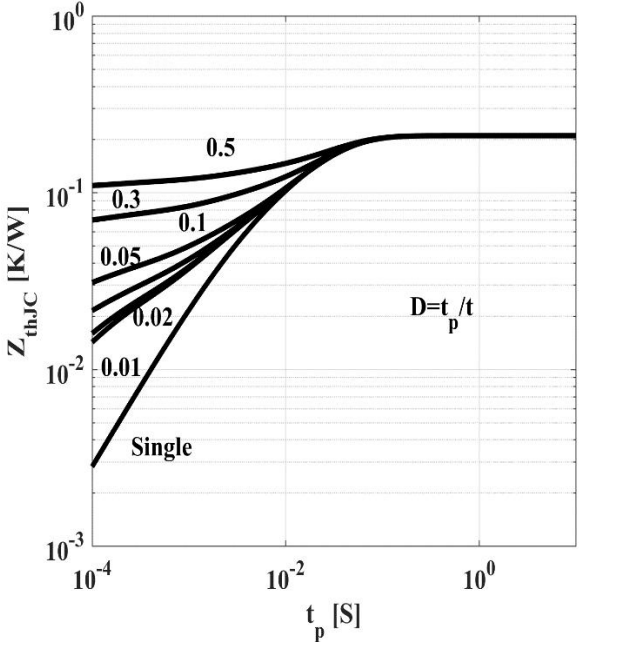
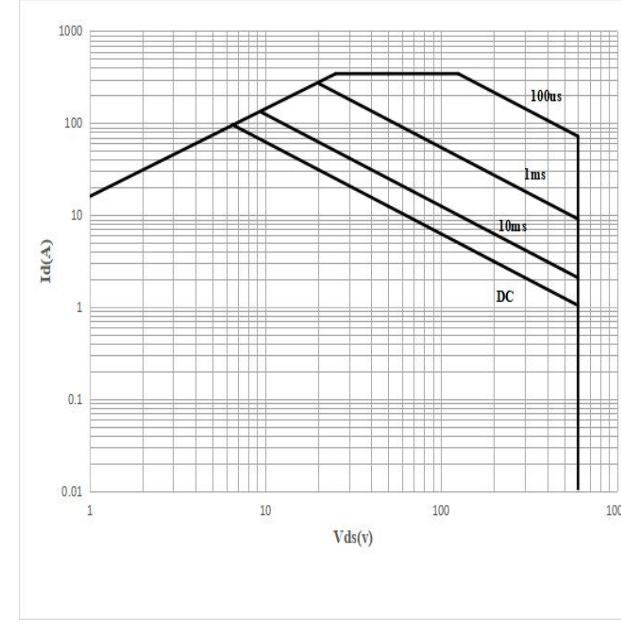
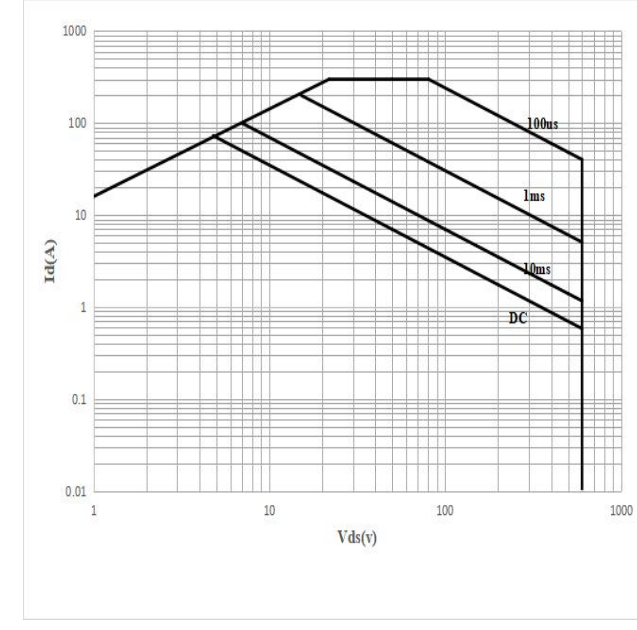
<p><b>Figure 3: Power Dissipation</b></p> 	<p><b>Figure 4: Max. Transient Thermal Impedance</b></p> 
$P_{tot} = f(T_c)$	$Z_{th(JC)} = f(t_p)$ ; parameter: $D = t_p/T$
<p><b>Figure 5: Safe Operating Area</b></p> 	<p><b>Figure 6: Safe Operating Area</b></p> 
$I_D = f(V_{DS})$ ; $T_c = 25^\circ\text{C}$ ; $V_{GS} > 7\text{V}$ ; parameter $t_p$	$I_D = f(V_{DS})$ ; $T_c = 80^\circ\text{C}$ ; $V_{GS} > 7\text{V}$ ; parameter $t_p$

Figure 7: Typ. Output Characteristics

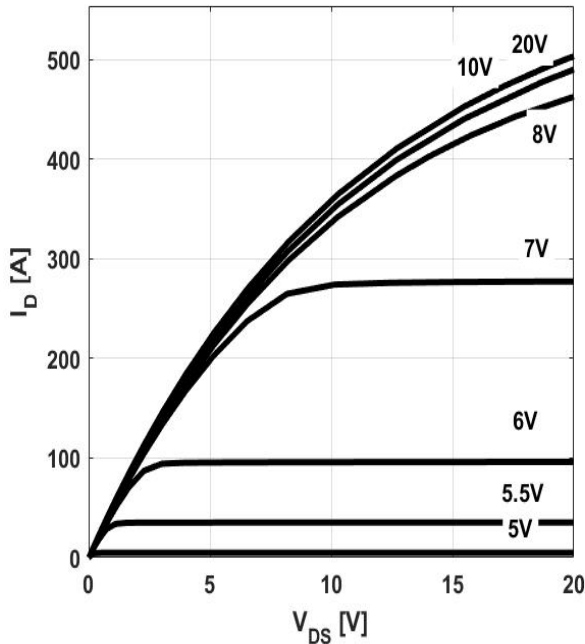

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 

Figure 8: Typ. Output Characteristics

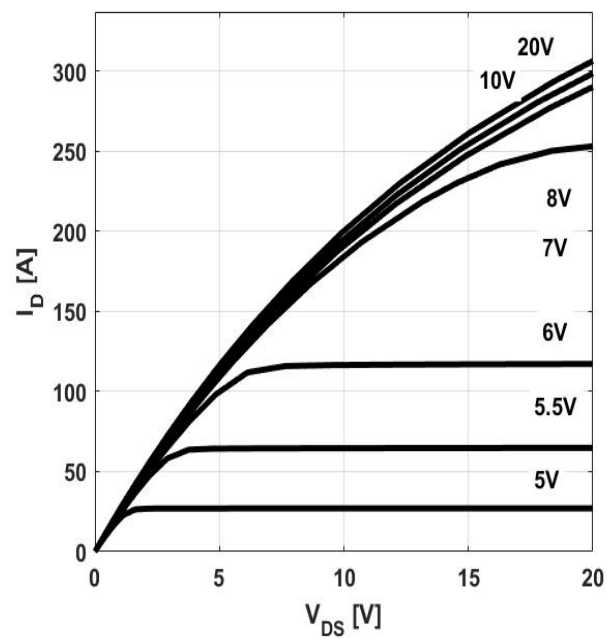

 $I_D = f(V_{DS}); T_j = 125^\circ\text{C}; \text{parameter: } V_{GS}$ 

Figure 9: Typ. Drain-Source On-State Resistance

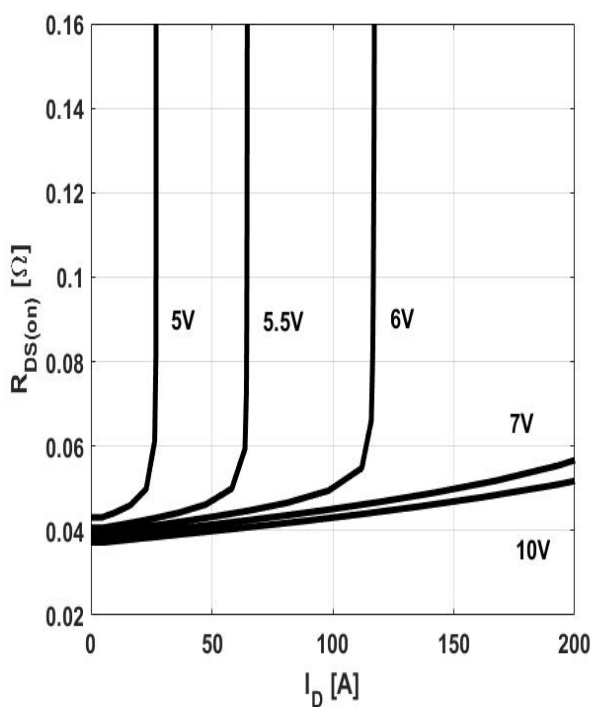
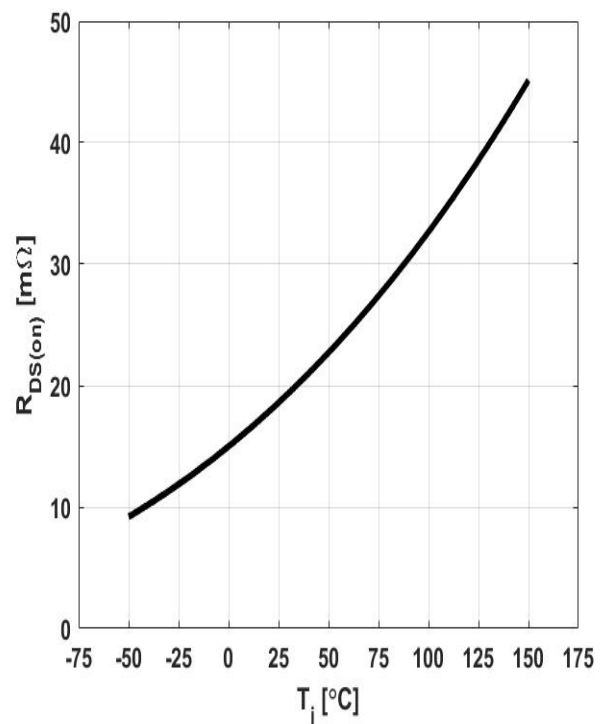
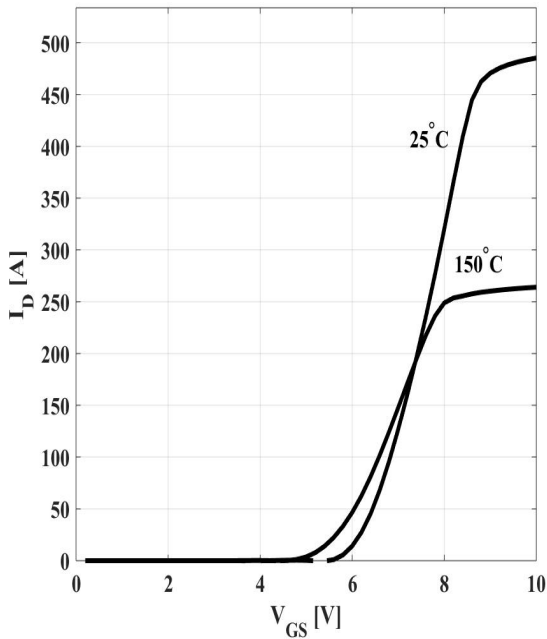
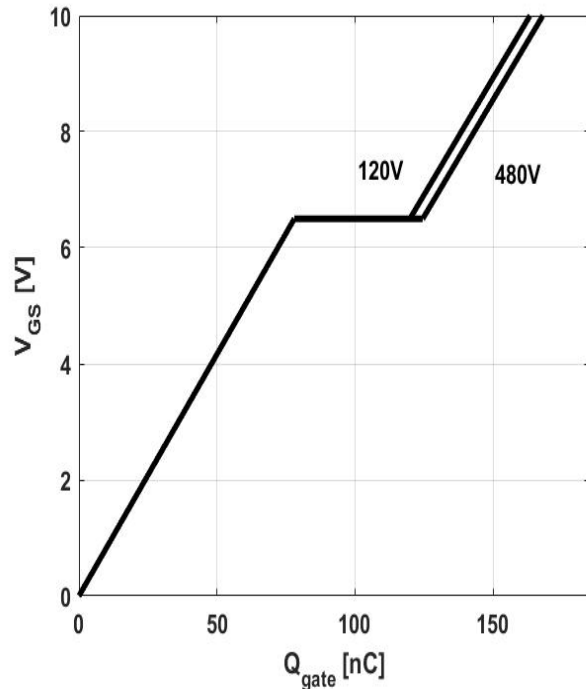
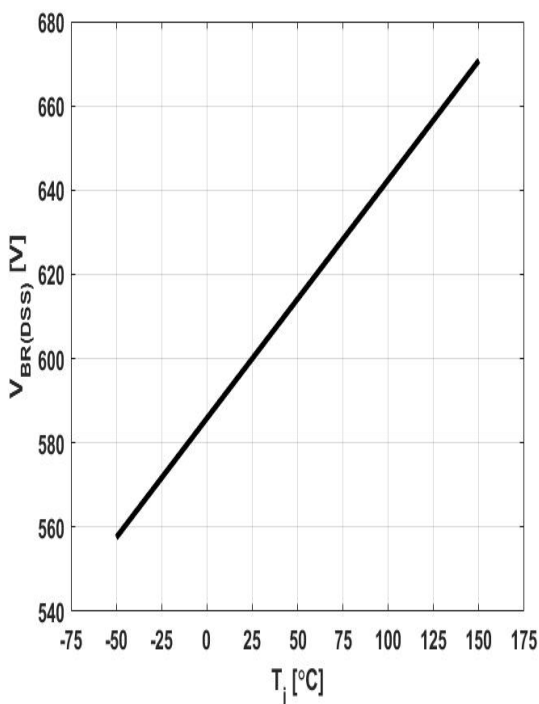
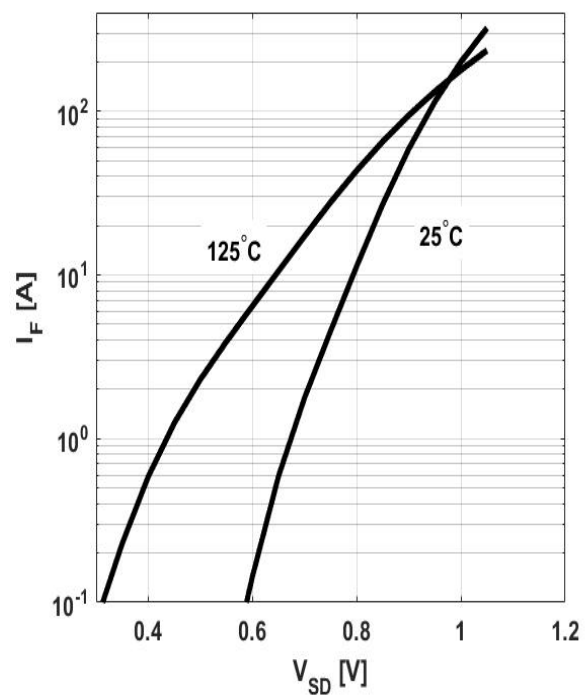
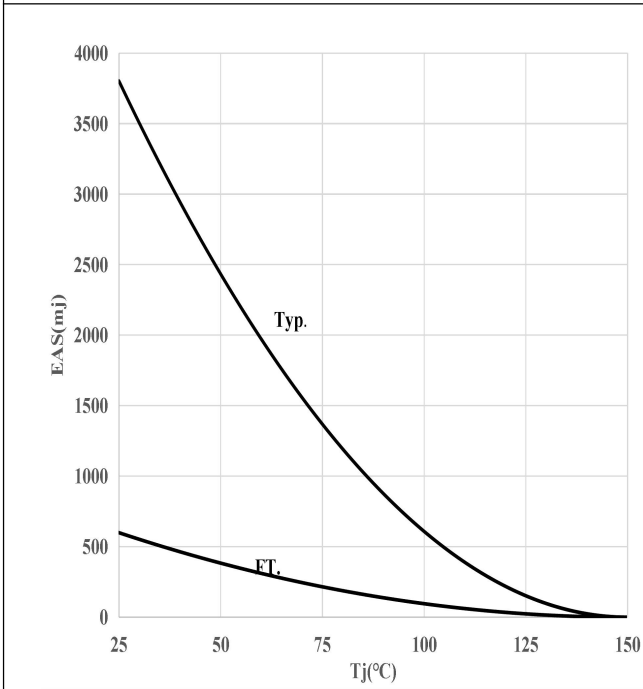

 $R_{DS(ON)} = f(I_D); T_j = 125^\circ\text{C}; \text{parameter: } V_{GS}$ 

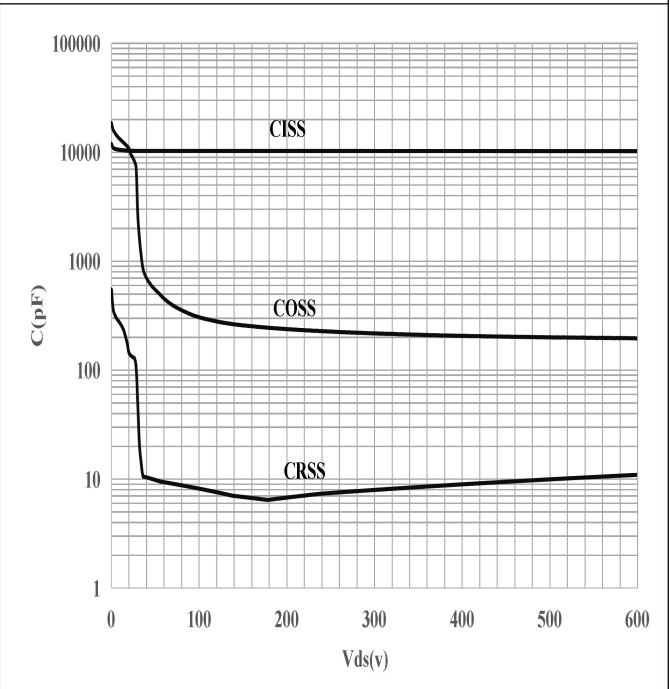
Figure 10: Typ. Drain-Source On-State Resistance


 $R_{DS(ON)} = f(T_j); I_D = 57\text{A}; V_{GS} = 10\text{V}$

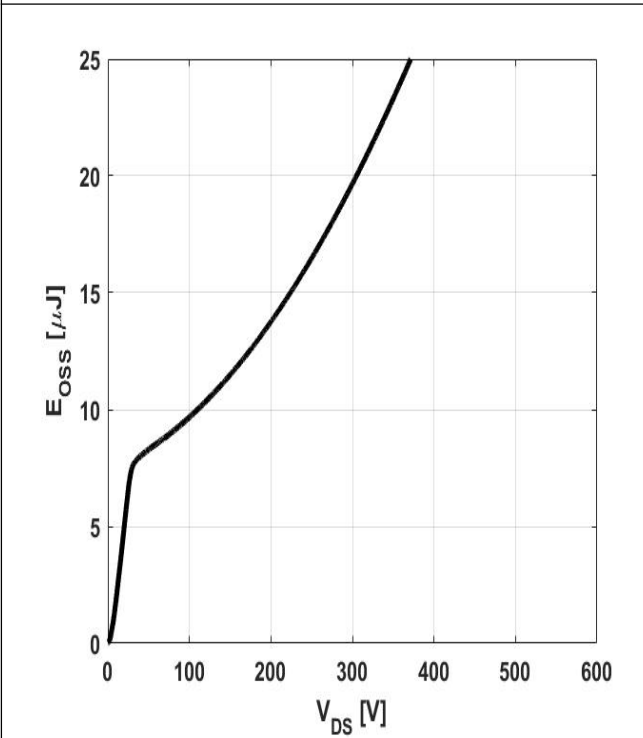
**Figure 11: Typ. Transfer Characteristics**

 $I_D = f(V_{GS}); V_{DS} = 20V$ 
**Figure 12: Typ. Gate Charge**

 $V_{GS} = f(Q_{gate}), I_D = 57A \text{ pulsed}$ 
**Figure 13: Drain-Source Breakdown Voltage**

 Minimum  $V_{BR(DSS)} = f(T_j); I_D = 10mA$ 
**Figure 14: Forward Characteristics of Reverse Diode**

 $I_F = f(V_{SD}); \text{parameter: } T_j$

**Figure 15: Avalanche Energy**


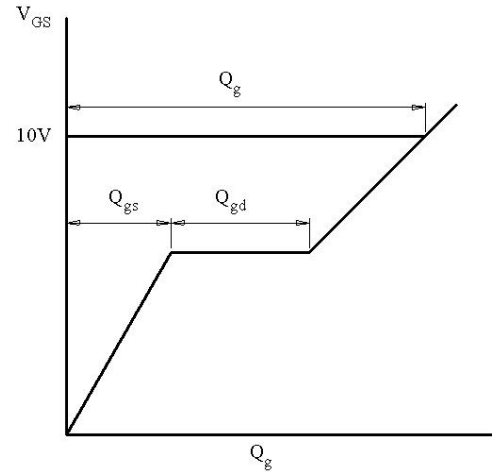
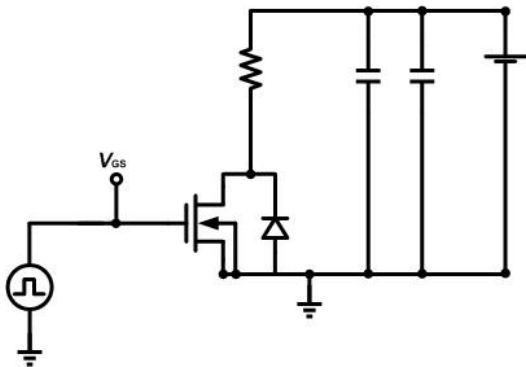
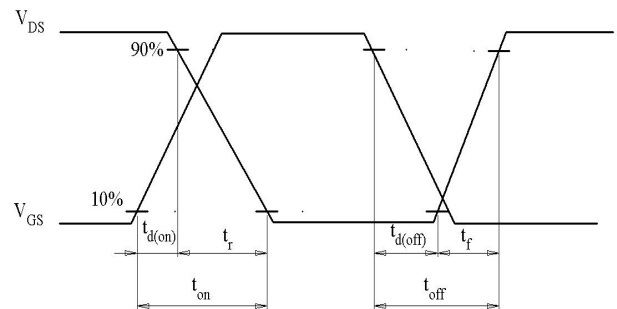
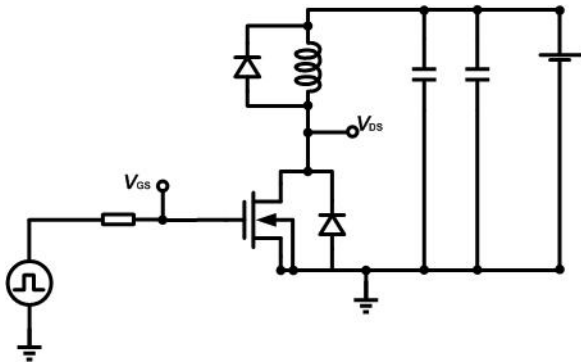
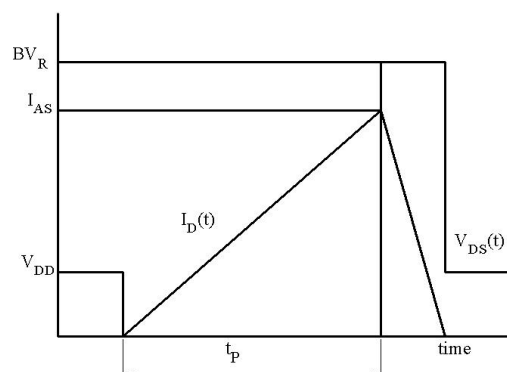
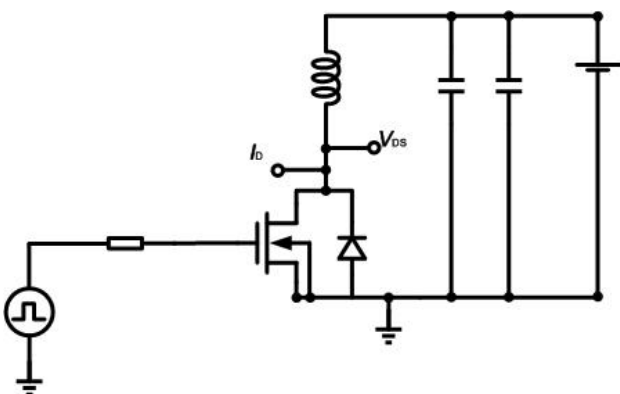
$$E_{AS}=f(T_j); V_{DD}=60V$$

**Figure 16: Typ. Capacitances**


$$C=f(V_{DS}); V_{GS}=0; f=100KHz$$

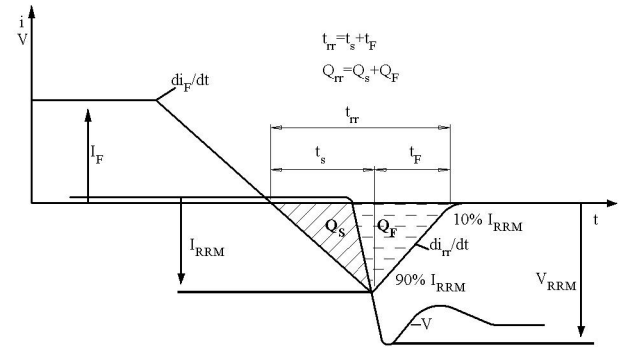
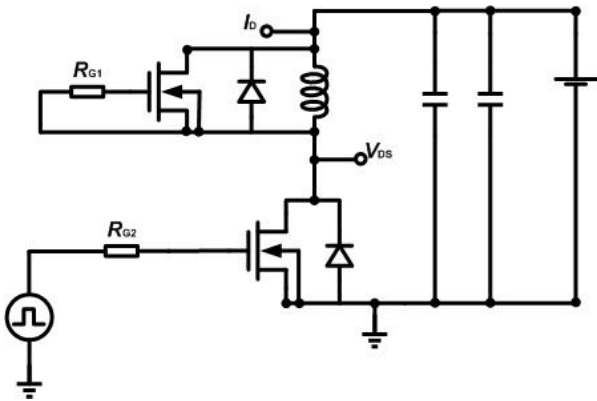
**Figure 17: Coss Stored Energy**


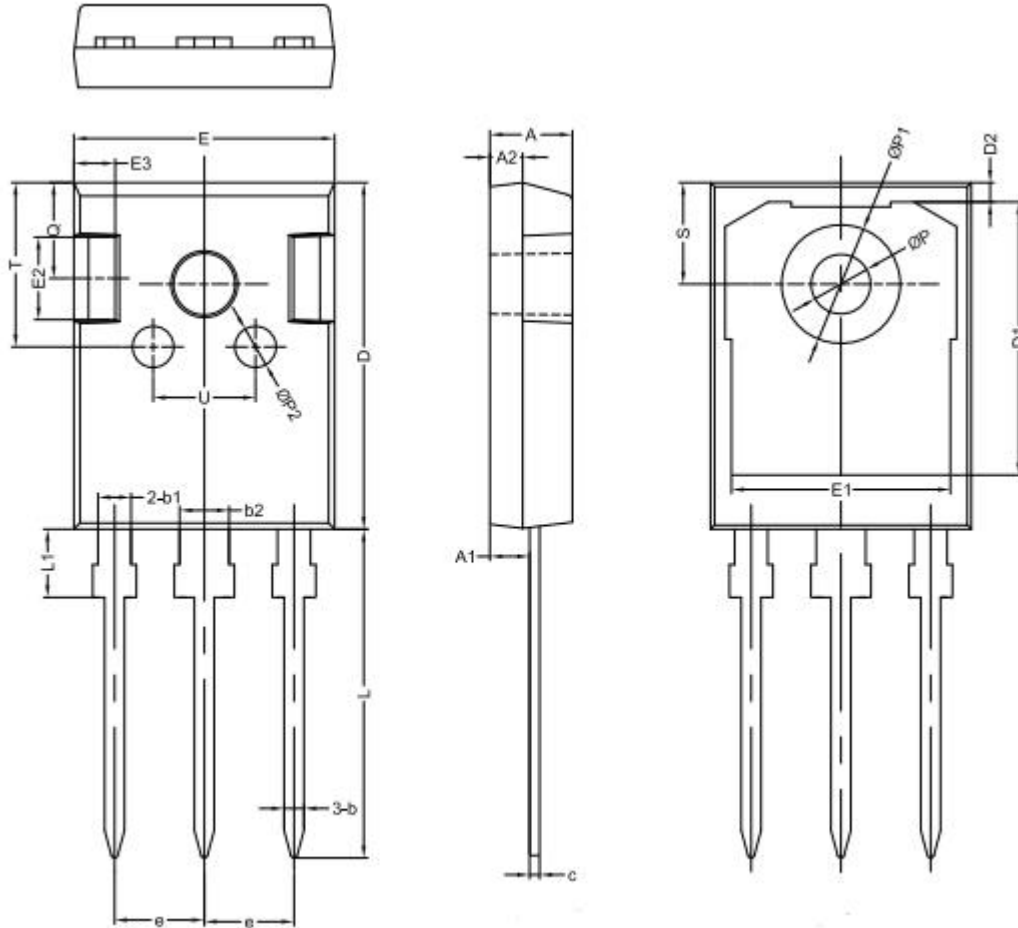
$$E_{OSS}=f(V_{DS})$$

**Test Circuits**
**1. Gate Charge Test Circuit & Waveform**

**2. Switch Time Test Circuit**

**3. Unclaimed Inductive Switching Test Circuit & Waveforms**


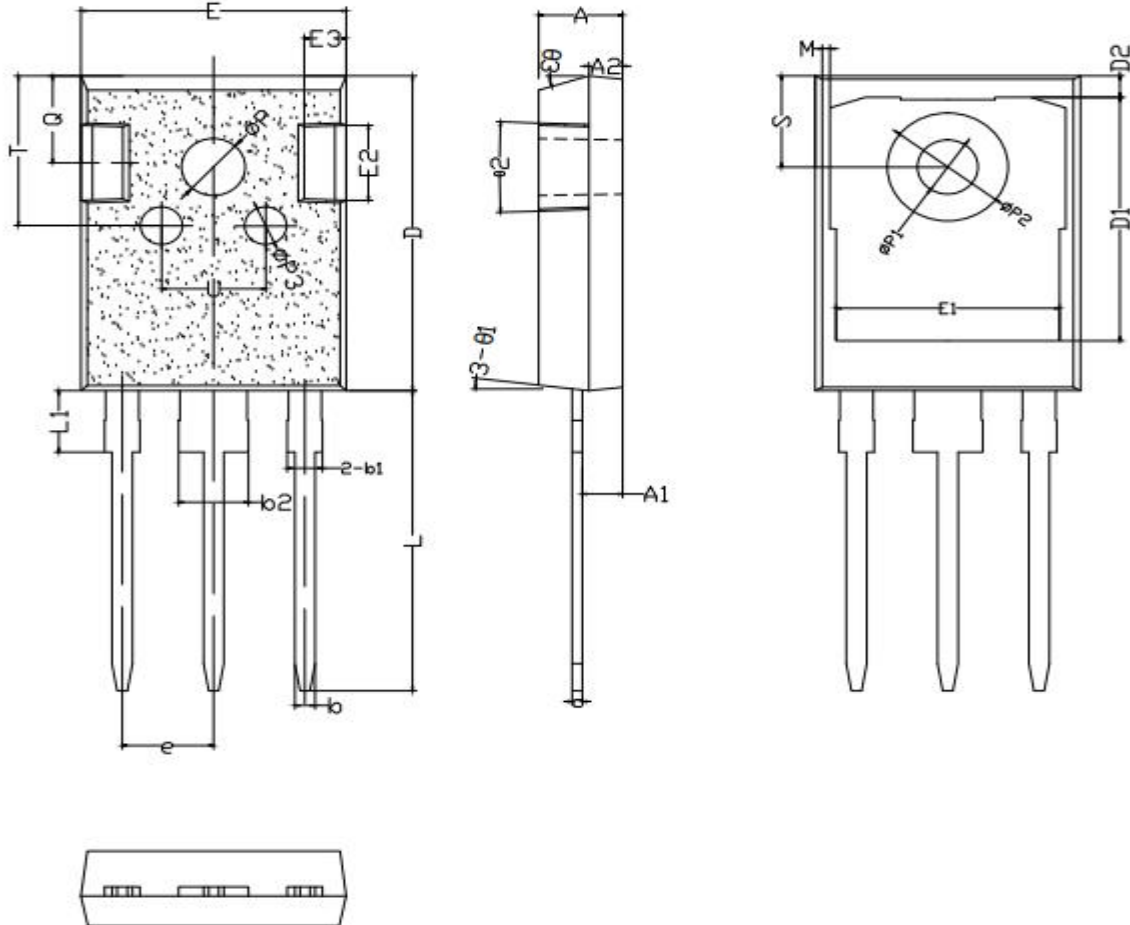


**4. Test Circuit and Waveform for Diode Characteristics**

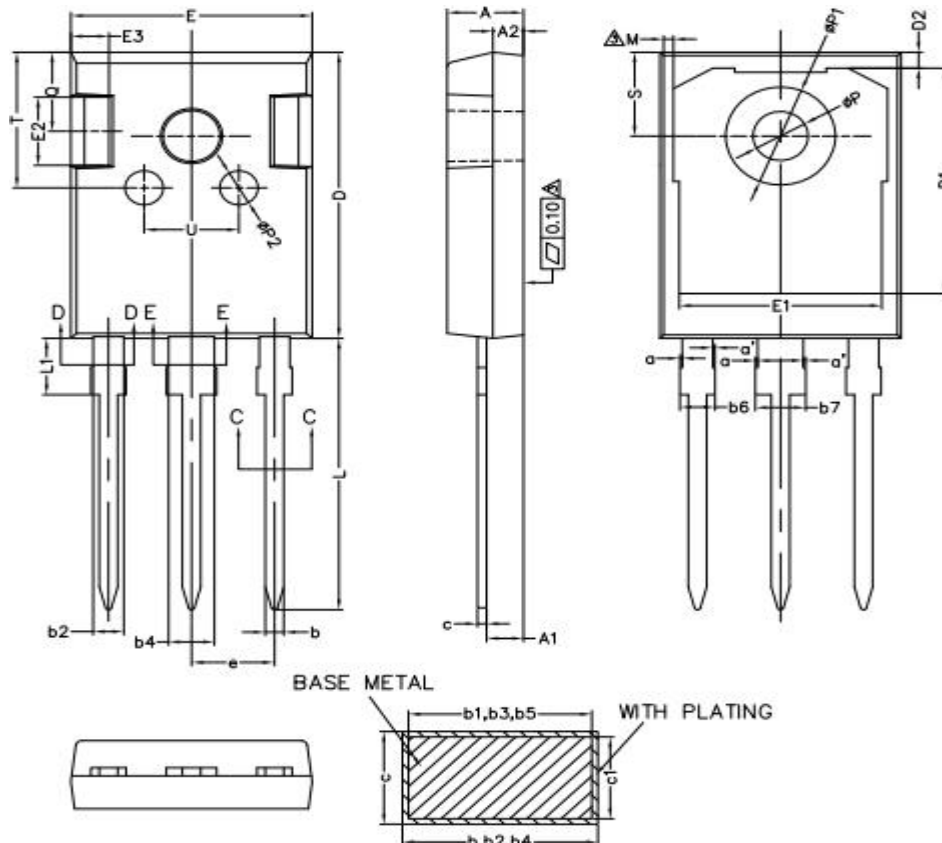


**Mechanical Dimensions**
**TO-247(Package 1)**
**Unit: mm**


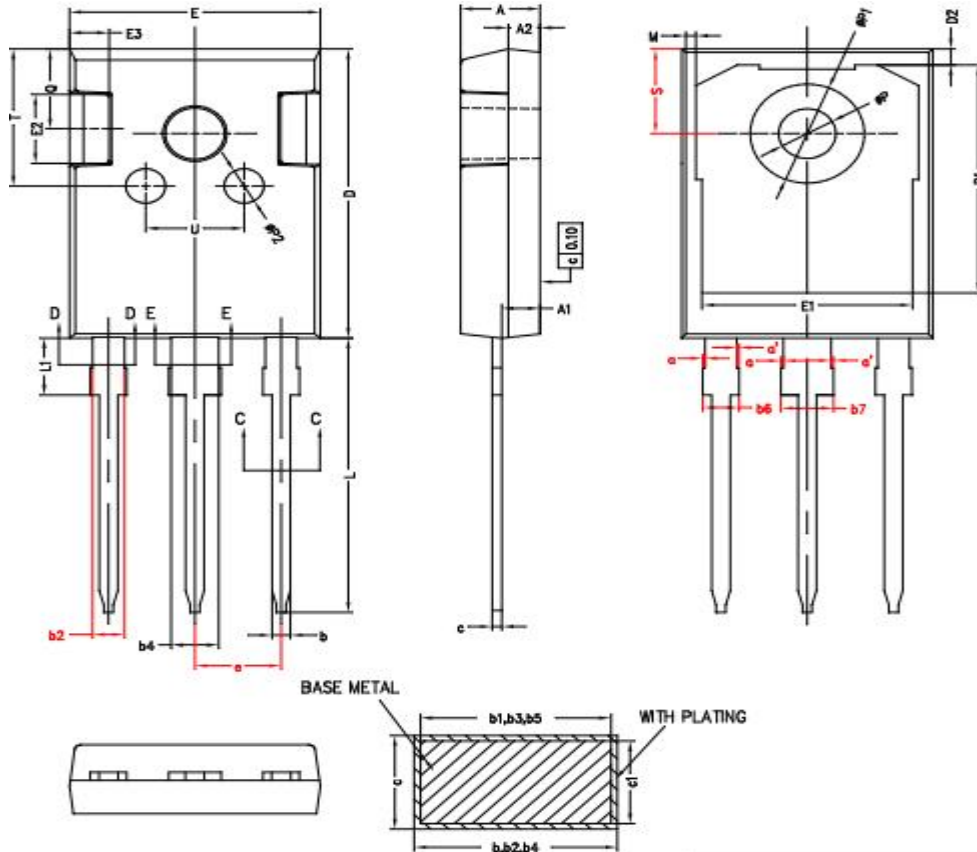
Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.80	5.00	5.20	E1	-	13.30	-
A1	2.21	2.41	2.61	E2	-	5.00	-
A2	1.90	2.00	2.10	E3	-	2.50	-
b	1.10	1.20	1.35	L	19.42	19.92	20.42
b1	-	2.00	-	L1	-	4.13	-
b2	-	3.00	-	P	3.50	3.60	3.70
c	0.55	0.60	0.75	P1	-	7.19	-
D	20.80	21.00	21.20	P2	-	2.50	-
D1	-	16.55	-	Q	-	5.80	-
D2	-	1.20	-	S	6.05	6.15	6.25
E	15.60	15.80	16.0	T	-	10.00	-
U	-	6.20	-				

**Mechanical Dimensions**
**TO-247(Package 2)**
**Unit: mm**


Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.90	5.00	5.10	E1	13.10	13.25	13.40
A1	2.31	2.41	2.51	E2	4.85	4.95	5.10
A2	1.90	2.00	2.10	E3	2.40	2.50	2.60
b	1.15	1.20	1.25	L	19.80	19.98	20.15
b1	1.95	2.10	2.25	L1	-	-	4.30
b2	2.95	3.10	3.25	ΦP	3.60	3.70	3.80
c	0.55	0.60	0.65	ΦP1	3.40	3.50	3.60
D	20.90	21.00	21.10	ΦP2	6.90	7.10	7.30
D1	16.35	16.55	16.75	Q	5.60	5.80	6.00
D2	1.05	1.20	1.35	S	6.05	6.15	6.25
E	15.70	15.80	15.90	T	9.80	10.00	10.20
U	6.00	6.20	6.40	e	5.40	5.44	5.48
Θ1	5°	7°	9°	ΦP3	2.40	2.50	2.60
Θ2	1°	3°	5°	Θ3	13°	15°	17°

**Mechanical Dimensions**
**TO-247(Package 3)**
**Unit: mm**


Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.90	5.00	5.10	c1	0.58	0.60	0.62
A1	2.31	2.41	2.51	D	20.90	21.00	21.10
A2	1.90	2.00	2.10	D1	16.25	16.55	16.85
b	1.16	-	1.26	D2	1.05	1.20	1.35
b1	1.15	1.20	1.22	E	15.70	15.80	15.90
b2	1.96	-	2.06	E1	13.10	13.30	13.50
b3	1.95	2.00	2.02	E2	4.90	5.00	5.10
b4	2.96	-	3.06	E3	2.40	2.50	2.60
b5	2.95	3.00	3.02	e	5.34	5.44	5.54
b6	-	-	2.25	L	19.80	19.92	20.10
b7	-	-	3.25	L1	3.95	4.13	4.30
c	0.59	-	0.66	M	0.35	-	0.95
P	3.50	3.60	3.70	P1	7.00	-	7.40
P2	2.40	2.50	2.60	Q	5.60	-	6.00
S	6.05	6.15	6.25	T	9.80	-	10.20
U	6.00	-	6.40	a	0	-	0.15
a'	0	-	0.15				

**Mechanical Dimensions**
**TO-247(Package 4)**
**Unit: mm**


Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.90	5.00	5.10	E2	4.90	5.00	5.10
A1	2.31	2.41	2.51	E3	2.40	2.50	2.60
A2	1.90	2.00	2.10	e	5.34	5.44	5.54
b	1.12	-	1.22	L	19.80	19.92	20.10
b1	1.11	1.16	1.18	L1	3.95	4.13	4.30
b2	1.96	-	2.06	P	3.50	3.60	3.70
c	0.59	-	0.66	P1	7.00	-	7.40
D	20.90	21.00	21.10	P2	2.40	2.50	2.60
D1	16.25	16.55	16.85	Q	5.60	-	6.00
D2	1.05	1.20	1.35	S	6.05	6.15	6.25
E	15.70	15.80	15.90	T	9.80	-	10.20
E1	13.10	13.30	13.50	U	6.00	-	6.40
b3	1.95	2.00	2.02	b6	-	-	2.25
b4	2.96	-	3.06	b7	-	-	3.25
b5	2.95	3.00	3.02	c1	0.58	0.60	0.62
M	0.35	-	0.95	a	0	-	0.15
a'	0	-	0.15				



Shenzhen Sanrise Technology Co., LTD

<http://www.sanrise-tech.com>

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