

## General Description

FSMOS<sup>®</sup> MOSFET is based on Oriental Semiconductor's unique device design to achieve low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. The low  $V_{th}$  series is specially designed to use in synchronous rectification power systems with low driving voltage.

## Features

- Low  $R_{DS(ON)}$  & FOM
- Extremely low switching loss
- Excellent reliability and uniformity
- Fast switching and soft recovery



## Applications

- PD charger
- Motor driver
- Switching voltage regulator
- DC-DC convertor
- Switched mode power supply

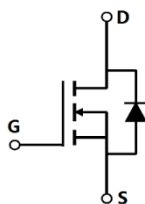
## Key Performance Parameters

Parameter	Value	Unit
$V_{DS, min} @ T_{j(max)}$	40	V
$I_D, pulse$	360	A
$R_{DS(ON) max} @ V_{GS}=10V$	2.1	m $\Omega$
$Q_g$	85.6	nC

## Marking Information

Product Name	Package	Marking
SFS04R021PF	TO220	SFS04R021P

## Package & Pin information



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

Parameter	Symbol	Value	Unit
Drain source voltage	$V_{DS}$	40	V
Gate source voltage	$V_{GS}$	$\pm 20$	V
Continuous drain current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$	$I_D$	120	A
Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$	$I_{D, pulse}$	360	A
Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$	$I_S$	120	A
Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$	$I_{S, Pulse}$	360	A
Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$	$P_D$	120	W
Single pulsed avalanche energy <sup>5)</sup>	$E_{AS}$	144	mJ
Operation and storage temperature	$T_{stg}, T_j$	-55 to 150	$^{\circ}\text{C}$

**Thermal Characteristics**

Parameter	Symbol	Value	Unit
Thermal resistance, junction-case	$R_{\theta JC}$	1.04	$^{\circ}\text{C/W}$
Thermal resistance, junction-ambient <sup>4)</sup>	$R_{\theta JA}$	62	$^{\circ}\text{C/W}$

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Drain-source breakdown voltage	$BV_{DSS}$	40			V	$V_{GS}=0\text{ V}, I_D=250\ \mu\text{A}$
Gate threshold voltage	$V_{GS(th)}$	1.2		2.5	V	$V_{DS}=V_{GS}, I_D=250\ \mu\text{A}$
Drain-source on-state resistance	$R_{DS(ON)}$		1.6	2.1	$\text{m}\Omega$	$V_{GS}=10\text{ V}, I_D=55\text{ A}$
Drain-source on-state resistance	$R_{DS(ON)}$		3.0	4.0	$\text{m}\Omega$	$V_{GS}=4.5\text{ V}, I_D=55\text{ A}$
Gate-source leakage current	$I_{GSS}$			100	nA	$V_{GS}=20\text{ V}$
				-100		$V_{GS}=-20\text{ V}$
Drain-source leakage current	$I_{DSS}$			1	$\mu\text{A}$	$V_{DS}=40\text{ V}, V_{GS}=0\text{ V}$
Gate resistance	$R_G$		3.2		$\Omega$	$f=1\text{ MHz}, \text{Open drain}$

### Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Input capacitance	$C_{iss}$		5453		pF	$V_{GS}=0\text{ V}$ , $V_{DS}=25\text{ V}$ , $f=100\text{ kHz}$
Output capacitance	$C_{oss}$		1951		pF	
Reverse transfer capacitance	$C_{rss}$		113		pF	
Turn-on delay time	$t_{d(on)}$		23.9		ns	$V_{GS}=10\text{ V}$ , $V_{DS}=40\text{ V}$ , $R_G=2\ \Omega$ , $I_D=40\text{ A}$
Rise time	$t_r$		16.9		ns	
Turn-off delay time	$t_{d(off)}$		80.4		ns	
Fall time	$t_f$		97.7		ns	

### Gate Charge Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Total gate charge	$Q_g$		85.6		nC	$V_{GS}=10\text{ V}$ , $V_{DS}=40\text{ V}$ , $I_D=40\text{ A}$
Gate-source charge	$Q_{gs}$		17.6		nC	
Gate-drain charge	$Q_{gd}$		14.5		nC	
Gate plateau voltage	$V_{plateau}$		3.6		V	

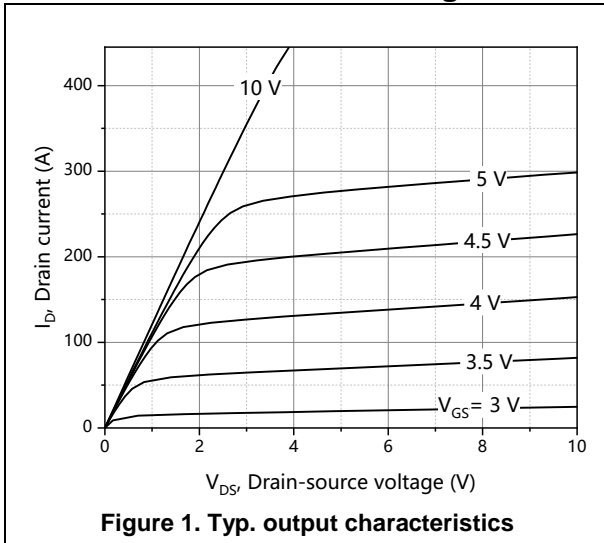
### Body Diode Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Diode forward voltage	$V_{SD}$			1.3	V	$I_S=20\text{ A}$ , $V_{GS}=0\text{ V}$
Reverse recovery time	$t_{rr}$		71.1		ns	$V_R=40\text{ V}$ , $I_S=40\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		50.1		nC	
Peak reverse recovery current	$I_{rrm}$		1.2		A	

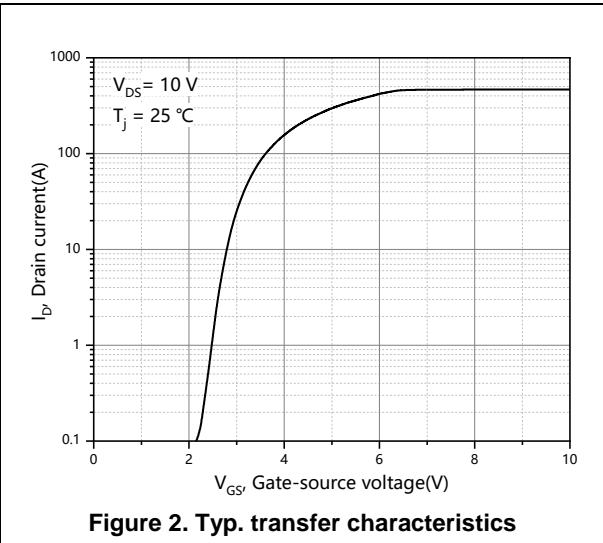
### Note

- 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)  $V_{DD}=30\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=0.3\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .

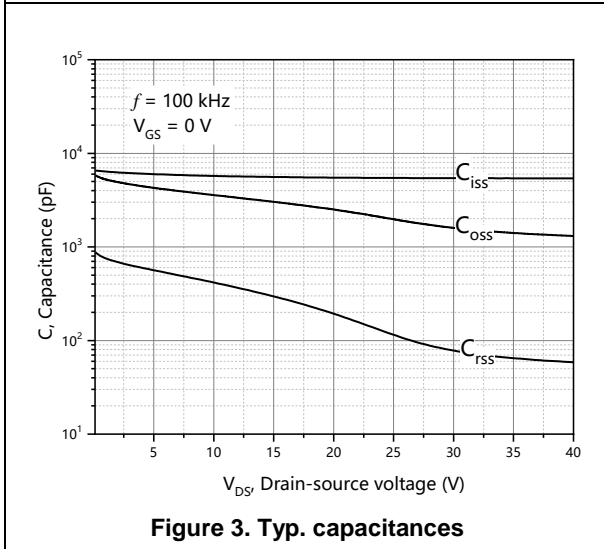
**Electrical Characteristics Diagrams**



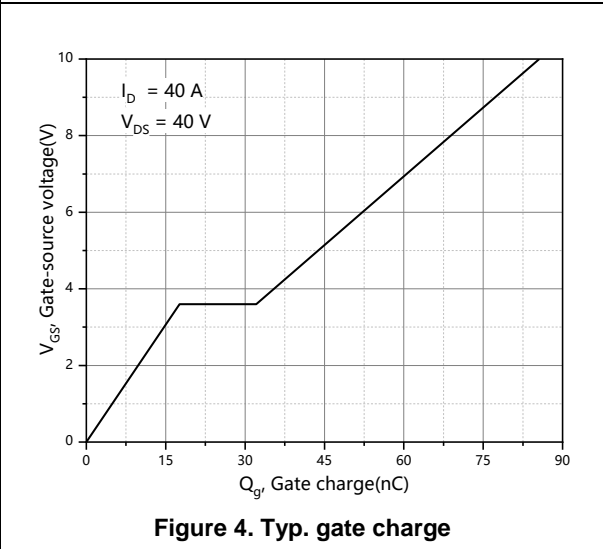
**Figure 1. Typ. output characteristics**



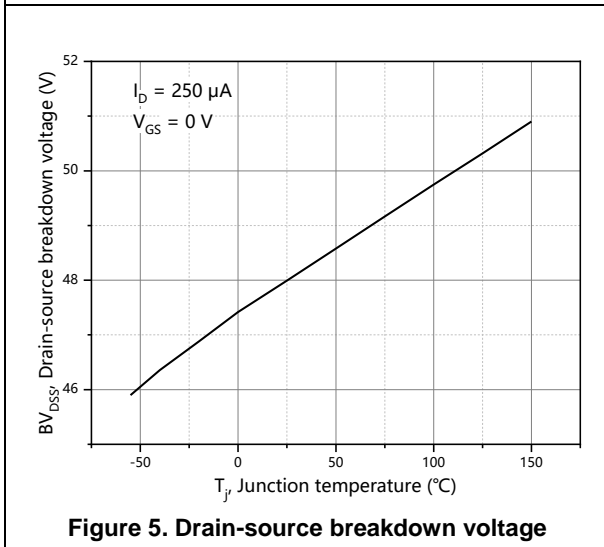
**Figure 2. Typ. transfer characteristics**



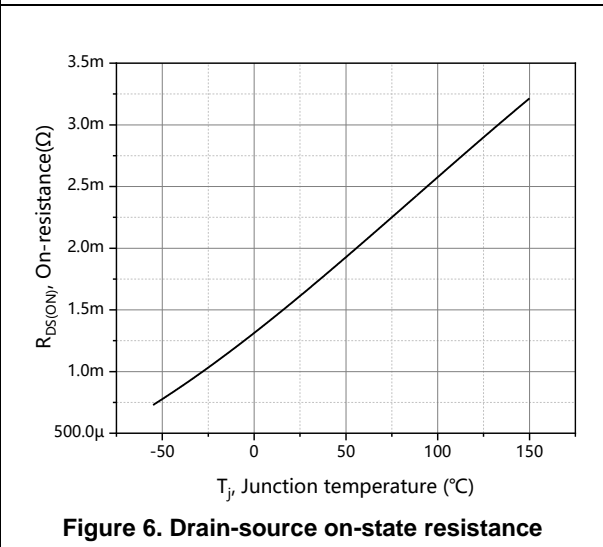
**Figure 3. Typ. capacitances**



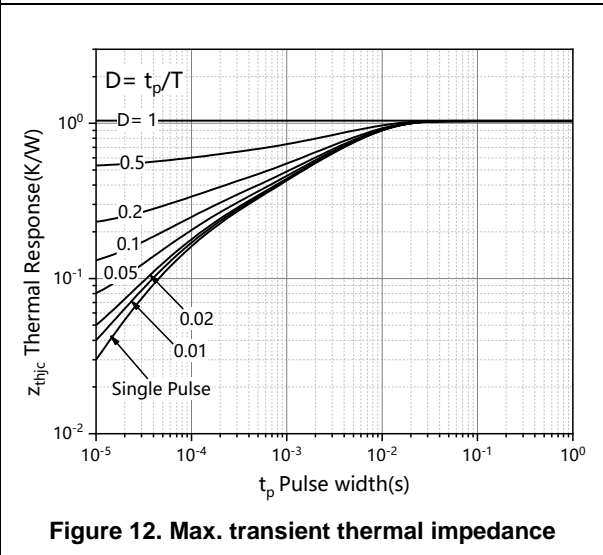
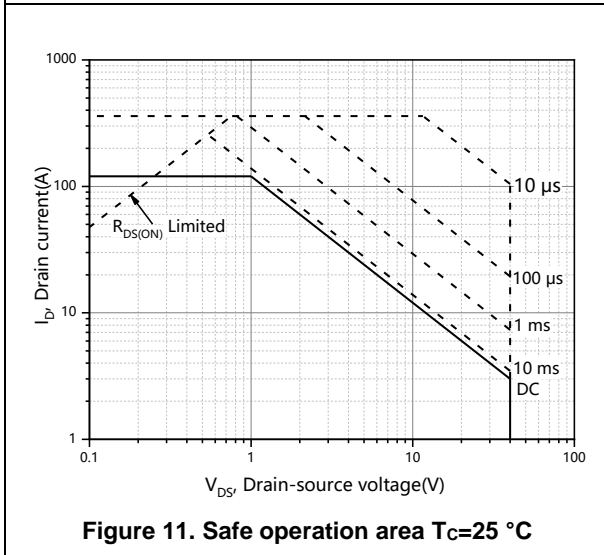
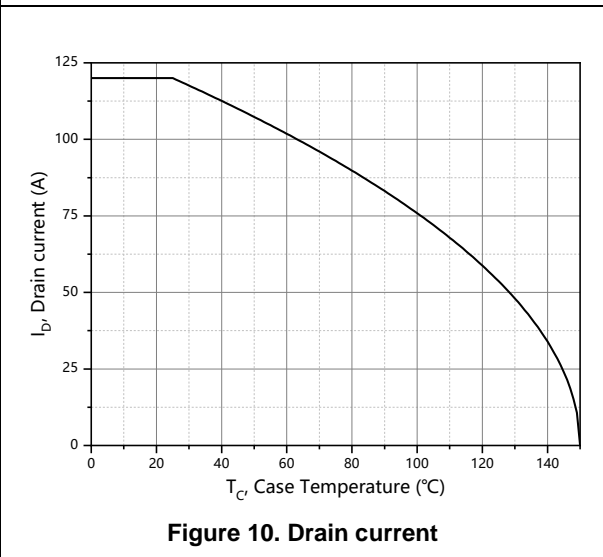
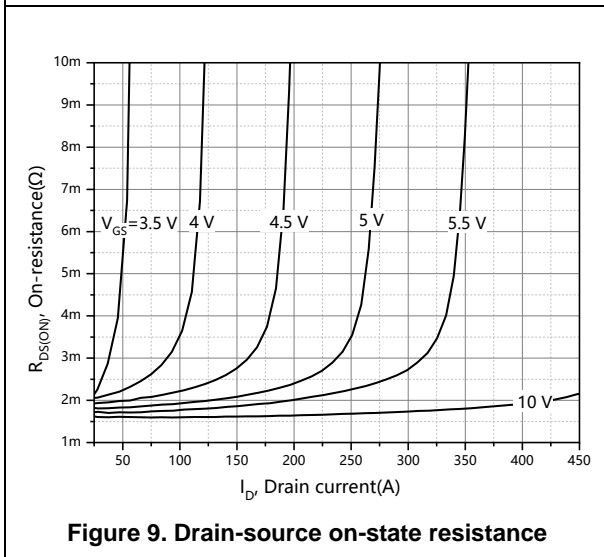
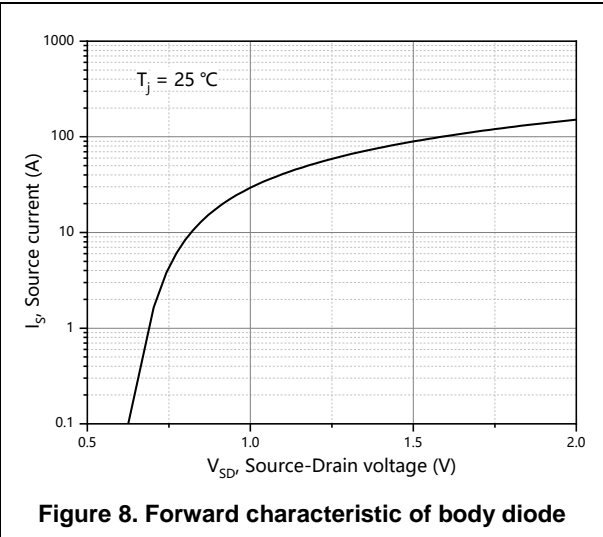
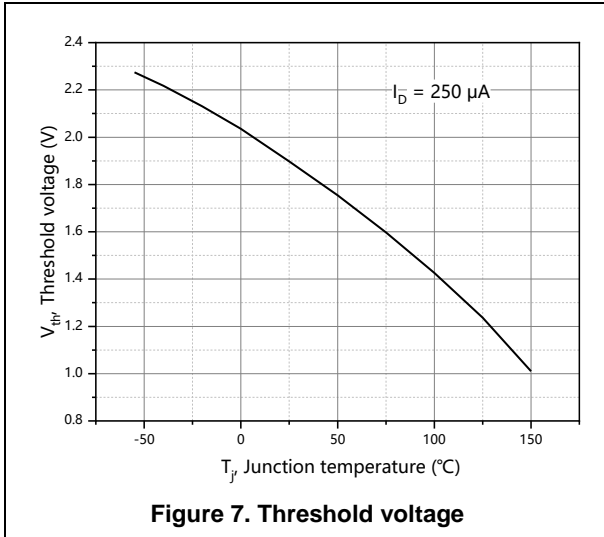
**Figure 4. Typ. gate charge**



**Figure 5. Drain-source breakdown voltage**



**Figure 6. Drain-source on-state resistance**



**Test circuits and waveforms**



**Figure 1. Gate charge test circuit & waveform**



**Figure 2. Switching time test circuit & waveforms**

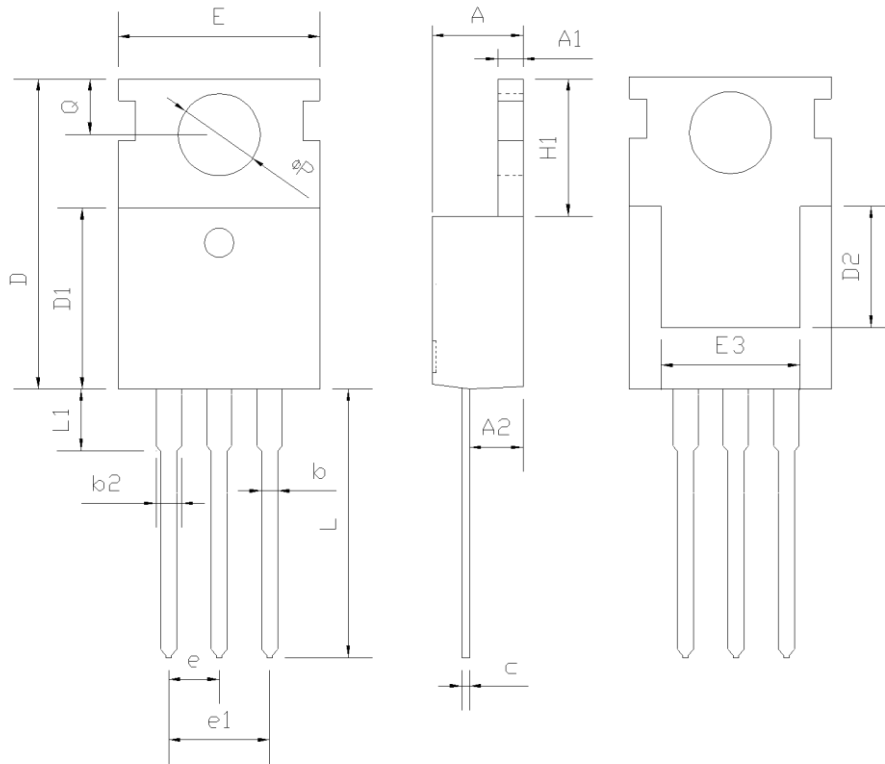


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



**Figure 4. Diode reverse recovery test circuit & waveforms**

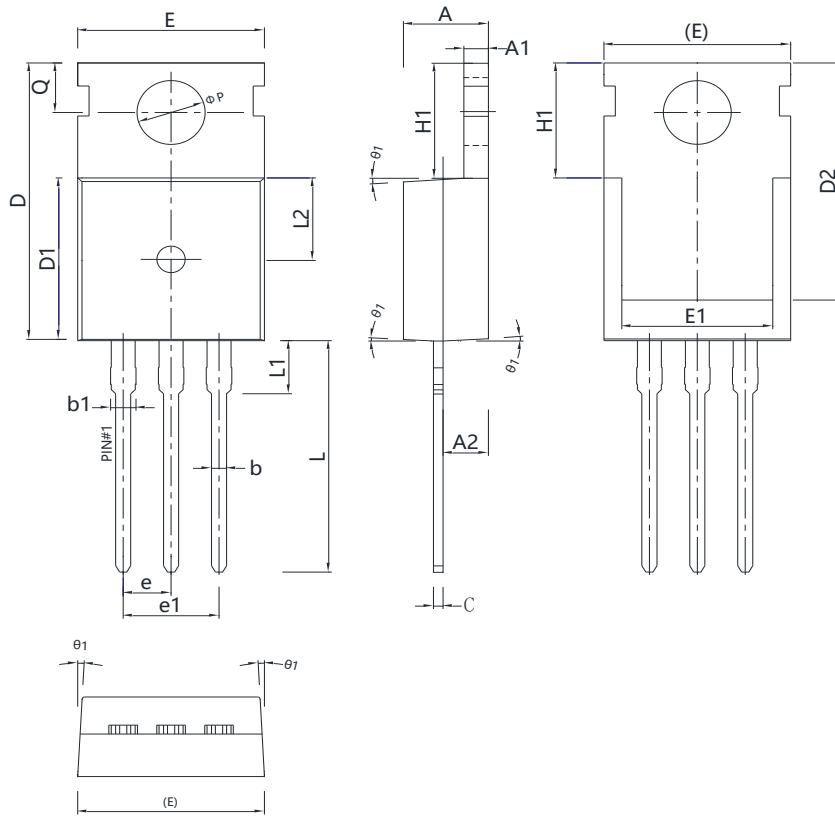
**Package Information**



Symbol	mm		
	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

Version 1: TO220-P package outline dimension

**Package Information**



Symbol	mm		
	Min	Nom	Max
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	-	0.90
b1	1.27	-	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	-	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.54 BSC		
e1	5.08 BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	-	-	3.50
L2	4.60 REF		
ΦP	3.55	3.60	3.65
Q	2.73	-	2.87
θ1	1°	3°	5°

Version 2: TO220-J package outline dimension

## Ordering Information

Package Type	Units/ Tube	Tubes / Inner Box	Units/ Inner Box	Inner Box/ Carton Box	Units/ Carton Box
TO220-P	50	20	1000	6	6000
TO220-J	50	20	1000	5	5000

## Product Information

Product	Package	Pb Free	RoHS	Halogen Free
SFS04R021PF	TO220	yes	yes	yes

## Legal Disclaimer

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