

1.3Ω, 650V, Super Junction N-Channel Power MOSFET
SRC65R1K3ES
General Description

The Sanrise SRC65R1K3ES 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 SRC65R1K3ES break down voltage is 650V and it has a high rugged avalanche characteristics. The SRC65R1K3ES is available in TO-251, TO-252, TO-220F and TO-220F Narrow packages.

Features

- Ultra Low $R_{DS(ON)} = 1.3\Omega @ V_{GS} = 10V$.
- Ultra Low Gate Charge, $Q_g = 8.0nC$ typ.
- Fast switching capability
- Robust design with better EAS performance
- EMI Improved (*SnowMOS™ Gen.2*)

Application

- TV Power
- High Performance Charger / Adapter
- LED Lighting Power

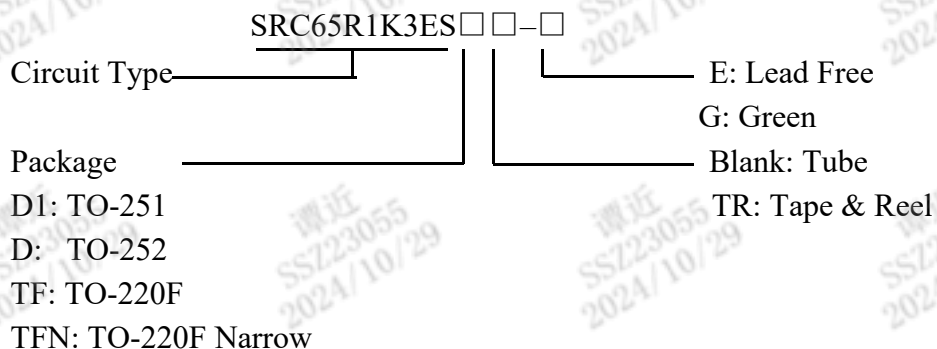
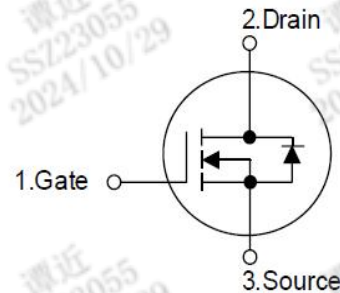
Ordering Information

Symbol


Figure 1 Symbol of SRC65R1K3ES

Package Type


Figure 2 Package Types of SRC65R1K3ES

Package	Part Number	Marking ID	Packing Type
TO-251	SRC65R1K3ESD1-G	SRC65R1K3ESD1G	Tube
TO-252	SRC65R1K3ESDTR-G	SRC65R1K3ESDTRG	Tape & Reel
TO-220F	SRC65R1K3ESTF-G	SRC65R1K3ESTFG	Tube
TO-220F Narrow	SRC65R1K3ESTFN-G	SRC65R1K3ESTFNG	Tube

1.3Ω, 650V, Super Junction N-Channel Power MOSFET
SRC65R1K3ES
Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Drain-Source Voltage (Note2)		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	±30	V
Continuous Drain Current	$T_C=25^{\circ}C$	I_D	3.2	A
	$T_C=125^{\circ}C$		1.5	
Power Dissipation ($T_c=25^{\circ}C$,TO-220F,TO-220F Narrow)		P_{tot}	14.5	W
Power Dissipation ($T_c=25^{\circ}C$,TO-252, ,TO-251)		P_{tot}	30.8	W
Pulsed Drain Current (Note 3)		I_{DM}	9.8	A
Avalanche Energy, Single Pulse (Note 4)		E_{AS}	50	mJ
Avalanche Energy, Repetitive (Note 3)		E_{AR}	0.1	mJ
Avalanche Current, Repetitive (Note 3)		I_{AR}	0.8	A
Continuous Diode Forward Current		I_S	3.2	A
Diode Pulse Current		$I_{S,PULSE}$	9.8	A
Operating Junction Temperature		T_J	150	°C
Storage Temperature		T_{STG}	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	°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. For voltage spike during switching.
3. Repetitive Rating: Pulse width limited by maximum junction temperature
4. $I_{AS} = 0.8A$, $V_{DD} = 60V$, $R_G = 25\Omega$, Starting $T_J = 25^{\circ}C$

Thermal Resistance

Parameter		Symbol	Min	Typ	Max	Unit
Thermal resistance, Junction-to-Case	TO-220F	R_{thJC}			8.6	°C /W
	TO-220F Narrow				8.6	
	TO-252				4.3	
	TO-251				4.3	
Thermal resistance, Junction-to-Ambient	TO-220F	R_{thJA}			62	°C /W
	TO-220F Narrow				62	
	TO-252				62	
	TO-251				62	

Electrical Characteristics

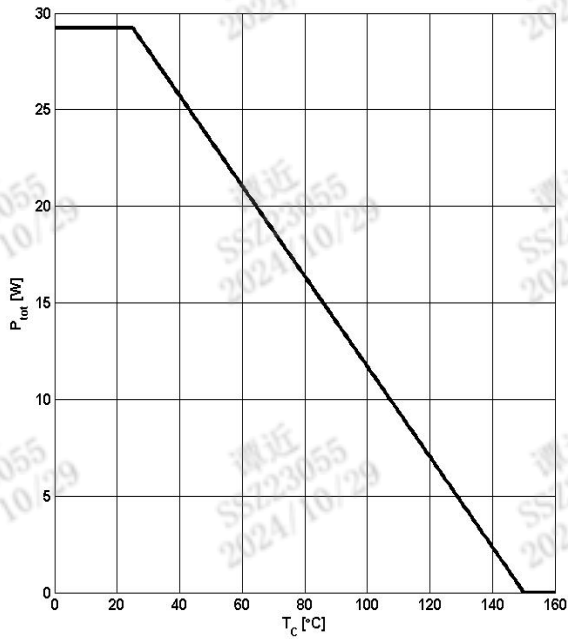
 T_J = 25 °C, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =250μA	650			V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =650V, V _{GS} =0V			1	μA
Gate-Body Leakage Current	Forward	I _{GSSF}	V _{GS} =30V, V _{DS} =0V		100	nA
	Reverse	I _{GSSR}	V _{GS} =-30V, V _{DS} =0V		-1.0	μA
Gate Threshold Voltage	V _{GS(TH)}	V _{DS} =V _{GS} , I _D =250μA	2.2	3.2	4.2	V
Static Drain-Source On-Resistance	R _{DSON}	V _{GS} =10V, I _D =1.5A		1.07	1.3	Ω
Gate Resistance	R _G	f=1MHz, Open Drain		97		Ω
Dynamic Characteristics						
Input Capacitance	C _{ISS}	V _{DS} =50V, V _{GS} =0V, f=1MHz		165		pF
Output Capacitance	C _{OSS}			13.5		
Reverse Transfer Capacitance	C _{RSS}			7.9		
Effective output capacitance, energy related ^{NOTE5}	C _{O(er)}	V _{GS} =0V, V _{DS} =0...480V		6.8		pF
Effective output capacitance, time related ^{NOTE6}	C _{O(tr)}			30.6		
Turn-on Delay Time	t _{d(on)}	V _{DD} =400V, I _D =1.5A R _G =10.2Ω, V _{GS} =10V		30		ns
Rise Time	t _r			33		
Turn-off Delay Time	t _{d(off)}			71		
Fall Time	t _f			27		
Gate Charge Characteristics						
Gate to Source Charge	Q _{gs}	V _{DD} =480V, I _D =1.5A V _{GS} =0 to 10V		1.2		nC
Gate to Drain Charge	Q _{gd}			4.3		
Gate Charge Total	Q _g			8.0		
Gate Plateau Voltage	V _{plateau}			5.6		V
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _{SD} =1.5A		0.83	1.1	V
Reverse Recovery Time	t _{rr}	V _R =400V, I _F =1.5A dI _F /dt=100A/μs		108		ns
Reverse Recovery Charge	Q _{rr}			0.44		μC
Peak Reverse Recovery Current	I _{rrm}			8.2		A

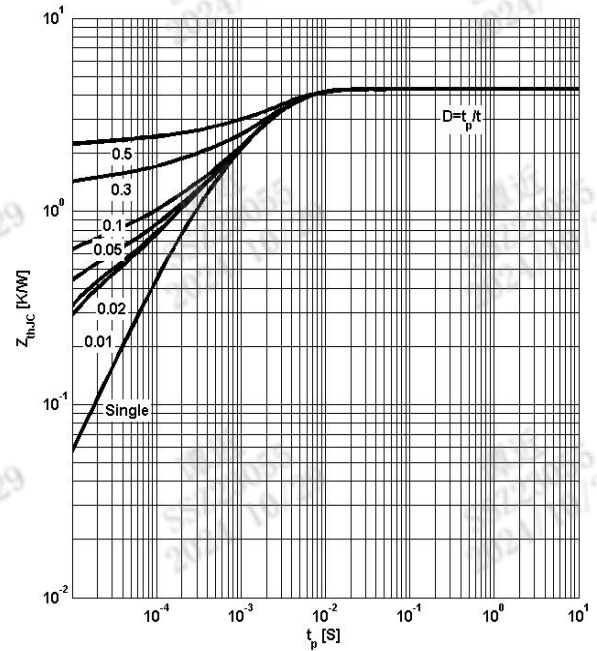
Note:

 5. C_{O(er)} is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 480V

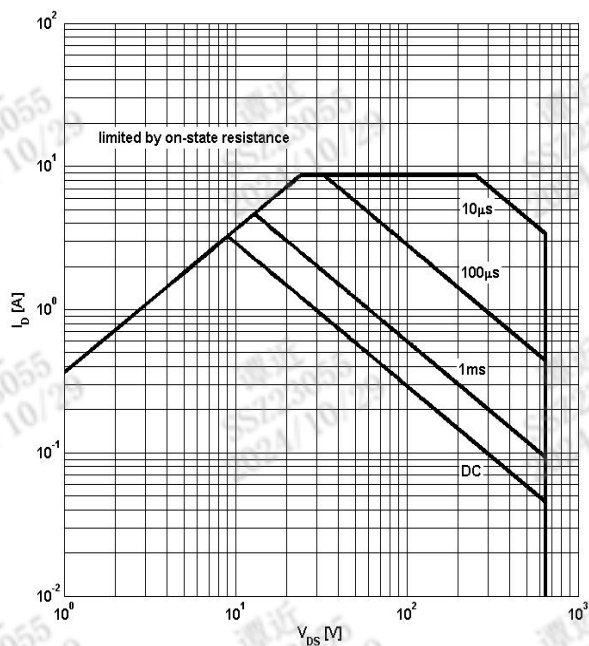
 6. C_{O(tr)} is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 480V

Typical Performance Characteristics
Figure 3: Power Dissipation


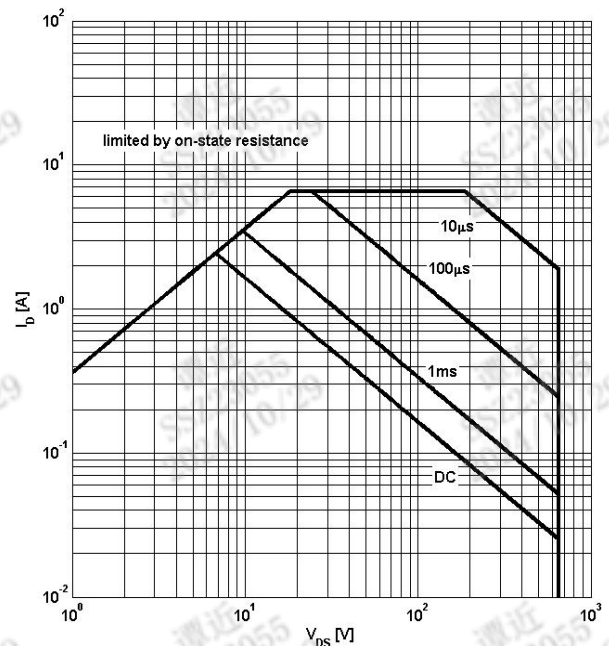
$$P_{tot} = f(T_c)$$

Figure 4: Max. Transient Thermal Impedance


$$Z_{(th)jc} = f(t_p); \text{ parameter: } D = t_p/T$$

Figure 5: Safe Operating Area


$$I_D = f(V_{DS}); T_c = 25^\circ\text{C}; V_{GS} > 7\text{V}; \text{ parameter } t_p$$

Figure 6: Safe Operating Area


$$I_D = f(V_{DS}); T_c = 80^\circ\text{C}; V_{GS} > 7\text{V}; \text{ parameter } t_p$$

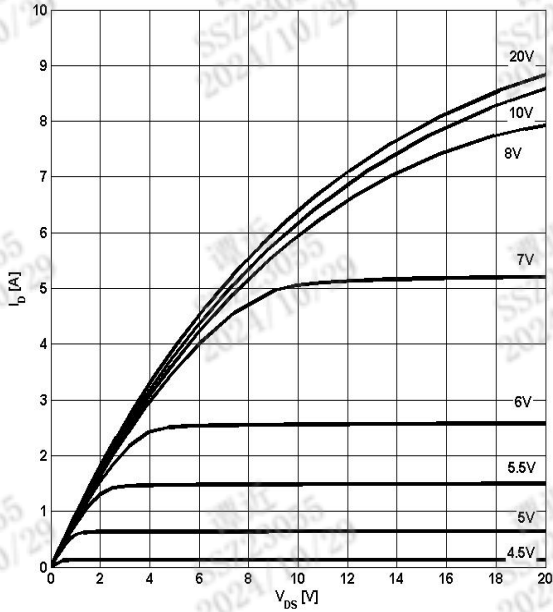
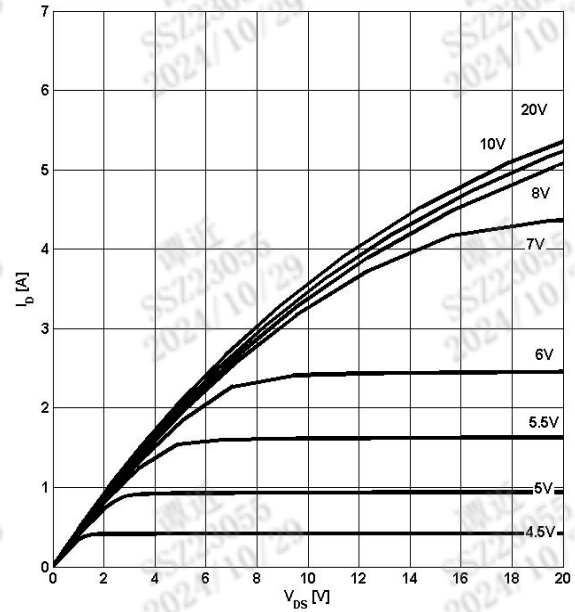
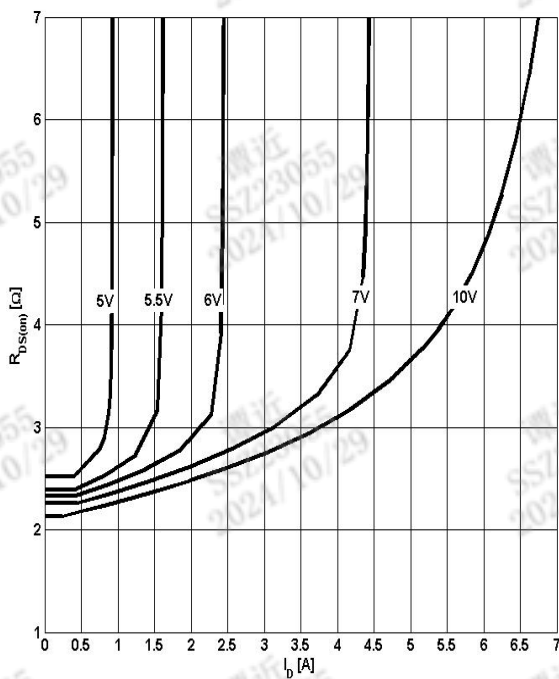
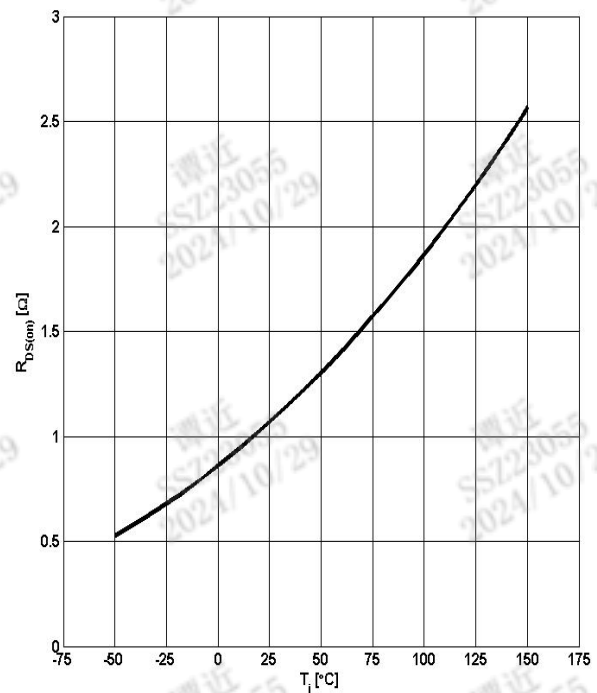
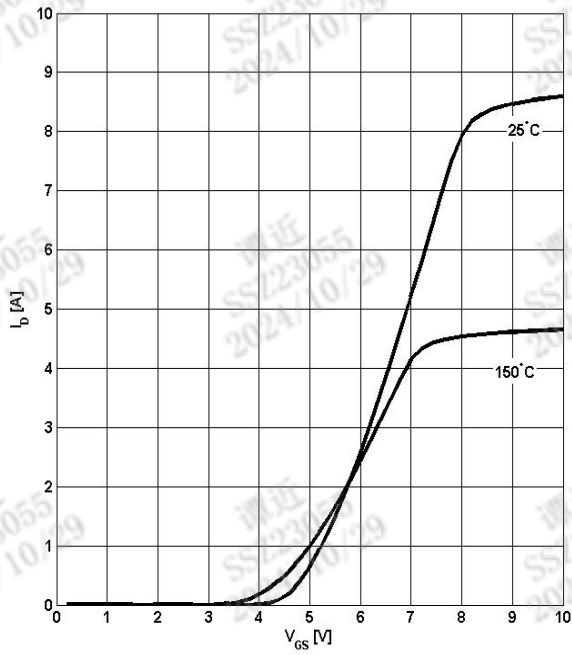
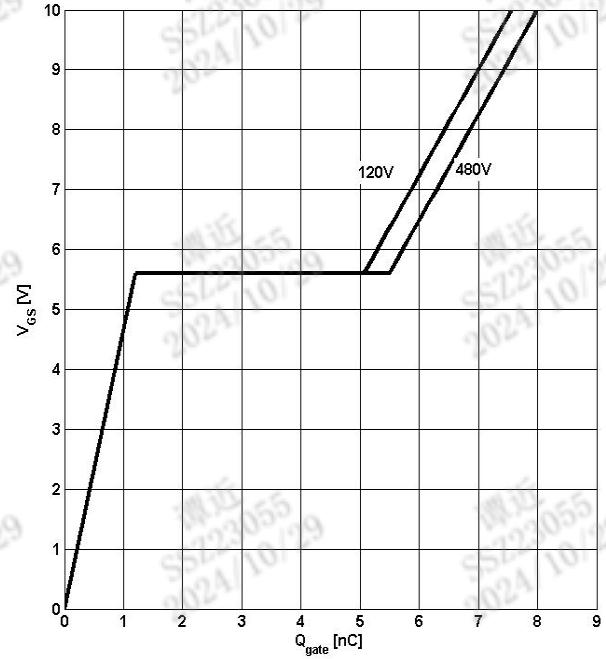
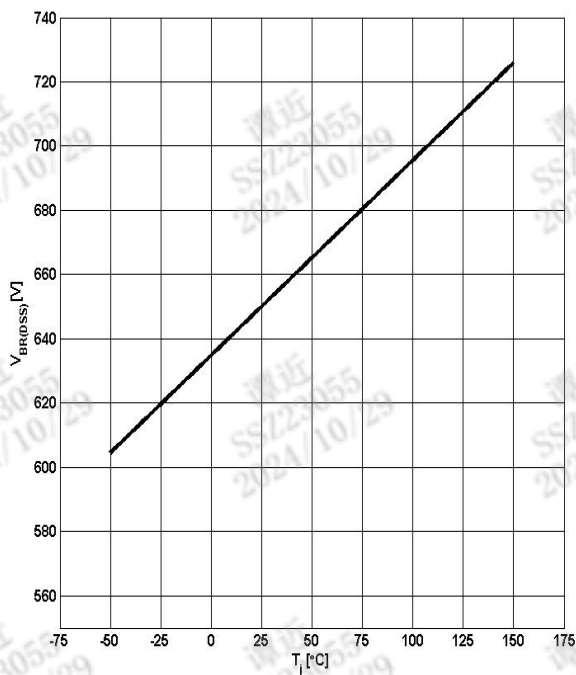
Figure 7: Typ. Output Characteristics

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

 $R_{DS(ON)} = f(T_j); I_D = 1.5\text{A}; V_{GS} = 10\text{V}$

Figure 11: Typ. Transfer Characteristics


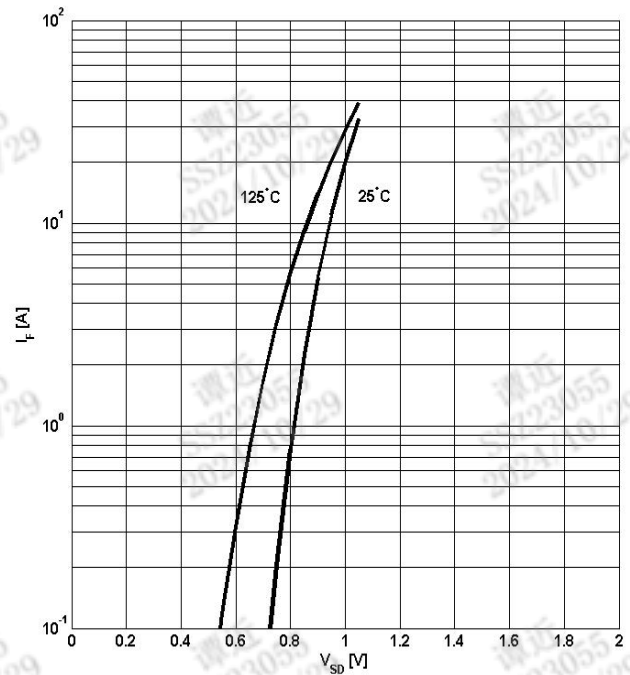
$$I_D = f(V_{GS}); V_{DS} = 20V$$

Figure 12: Typ. Gate Charge


$$V_{GS} = f(Q_{gate}), I_D = 1.5A \text{ pulsed}$$

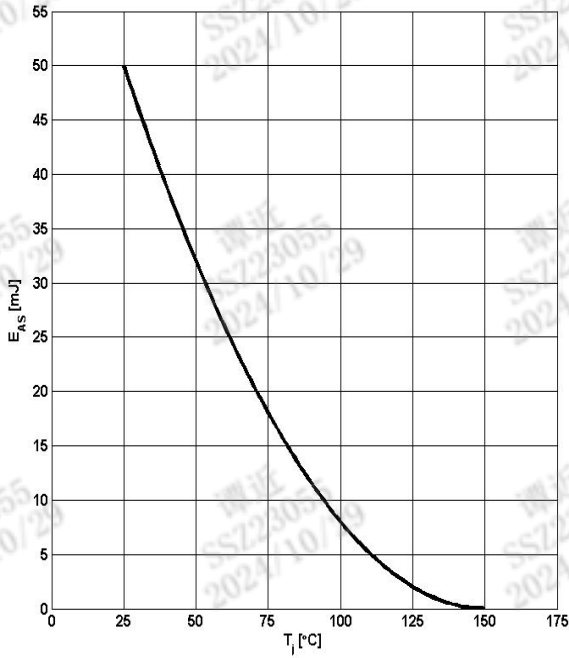
Figure 13: Drain-Source Breakdown Voltage


$$V_{BR(DSS)} = f(T_j); I_D = 1mA$$

Figure 14: Forward Characteristics of Reverse Diode


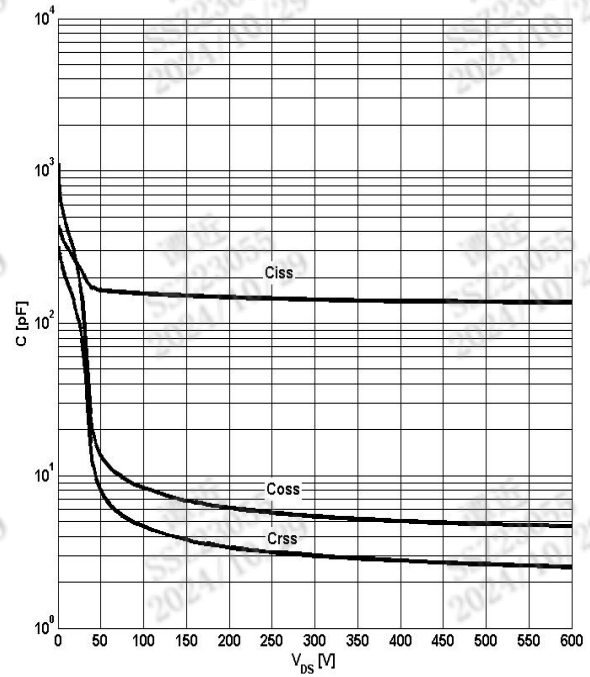
$$I_R = f(V_{SD}); \text{parameter: } T_j$$

Figure 15: Avalanche Energy



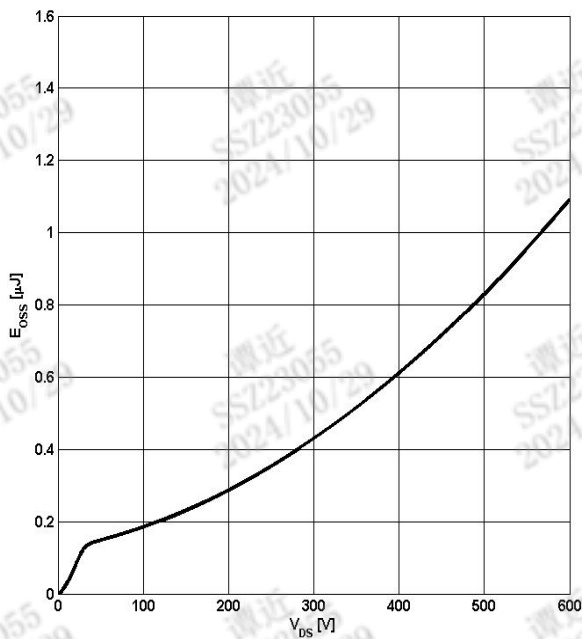
$E_{AS}=f(T_j)$; $I_D=0.8A$; $V_{DD}=60V$

Figure 16: Typ. Capacitances



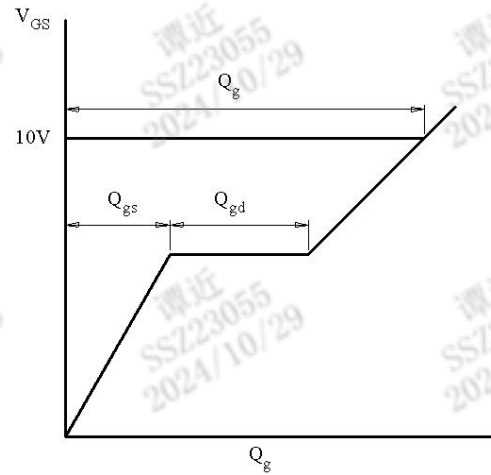
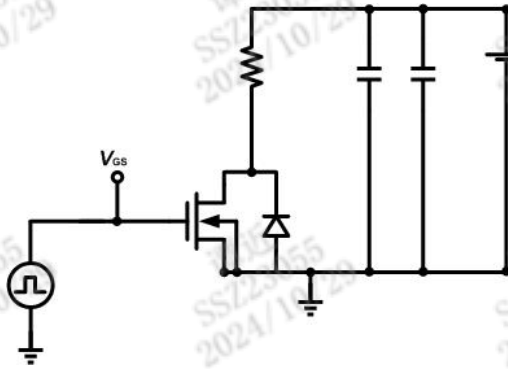
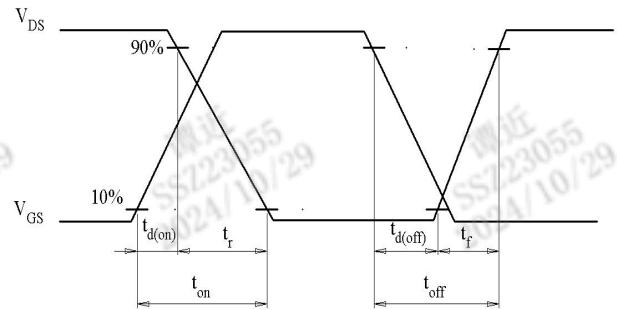
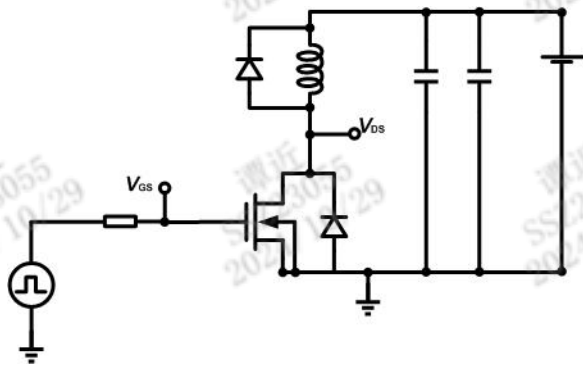
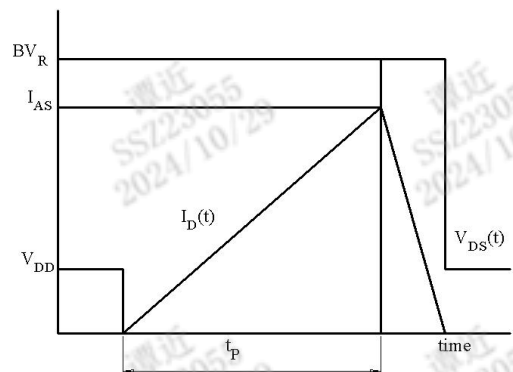
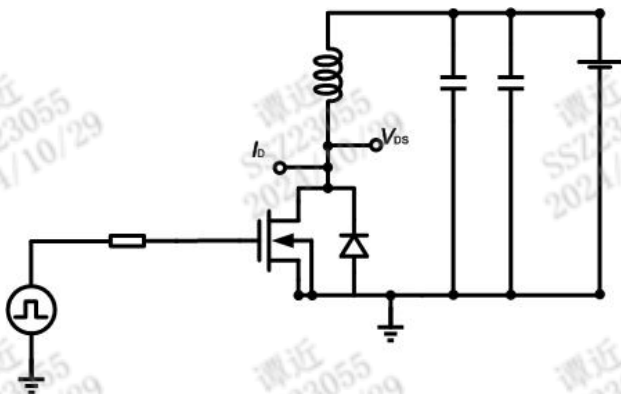
$C=f(V_{DS})$; $V_{GS}=0$; $f=1MHz$

Figure 17: Coss Stored Energy



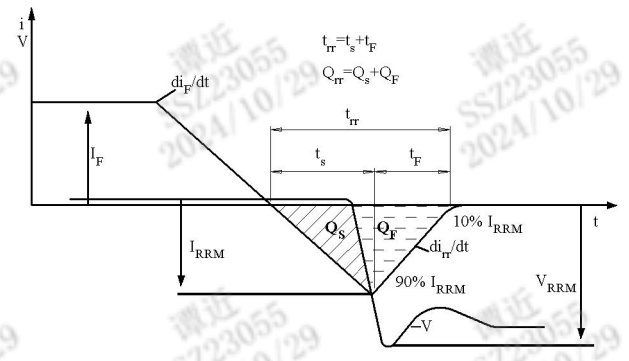
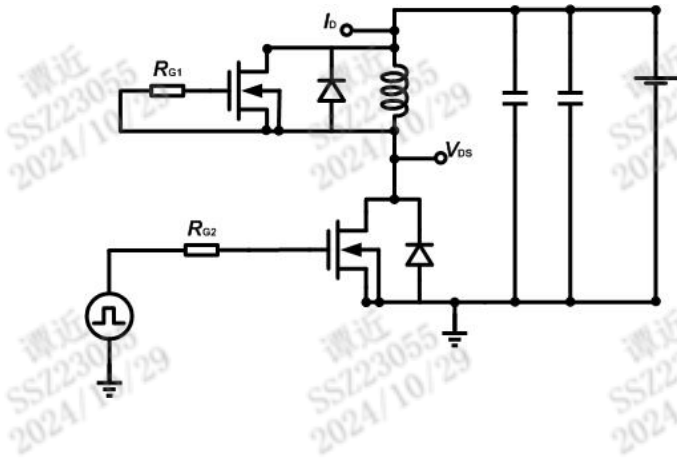
$E_{oss}=f(V_{DS})$

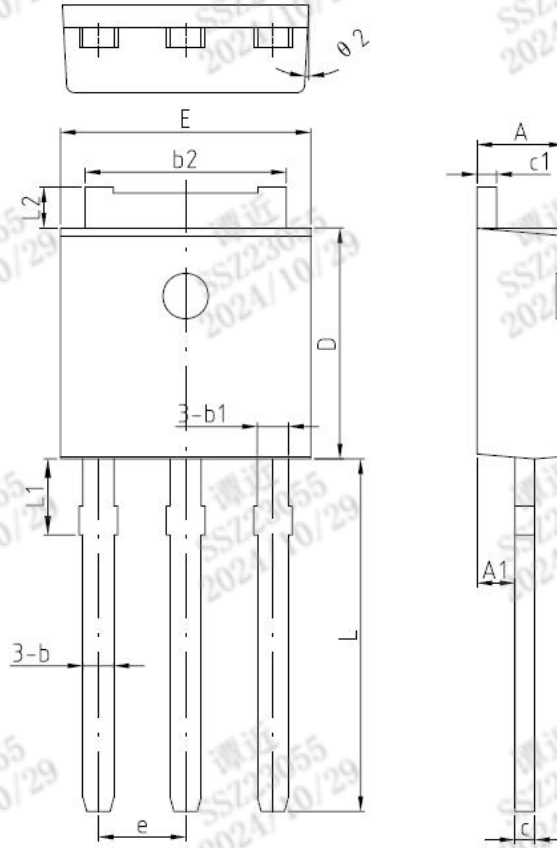
Test Circuits

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

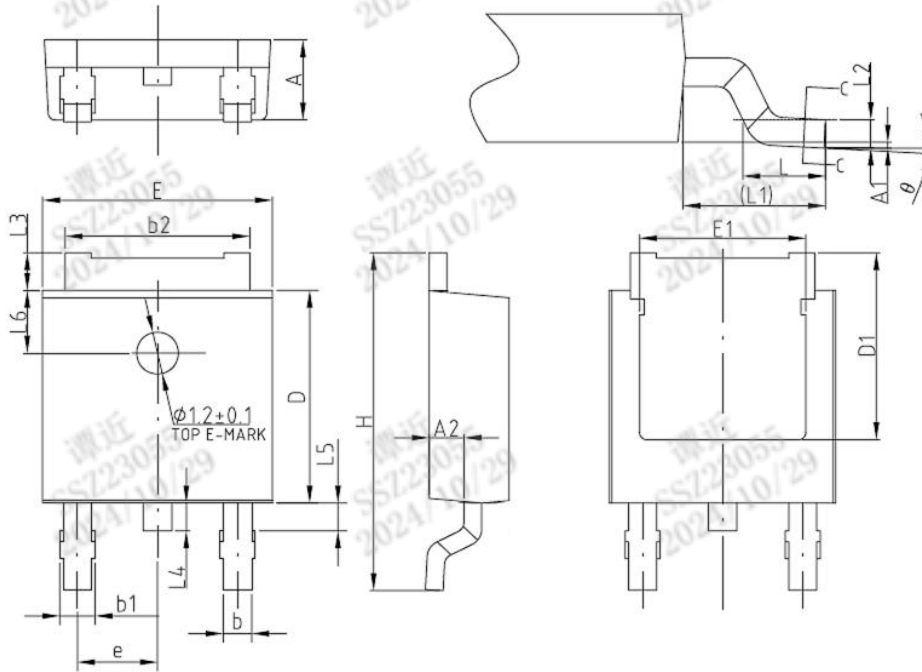
1.3Ω, 650V, Super Junction N-Channel Power MOSFET

SRC65R1K3ES

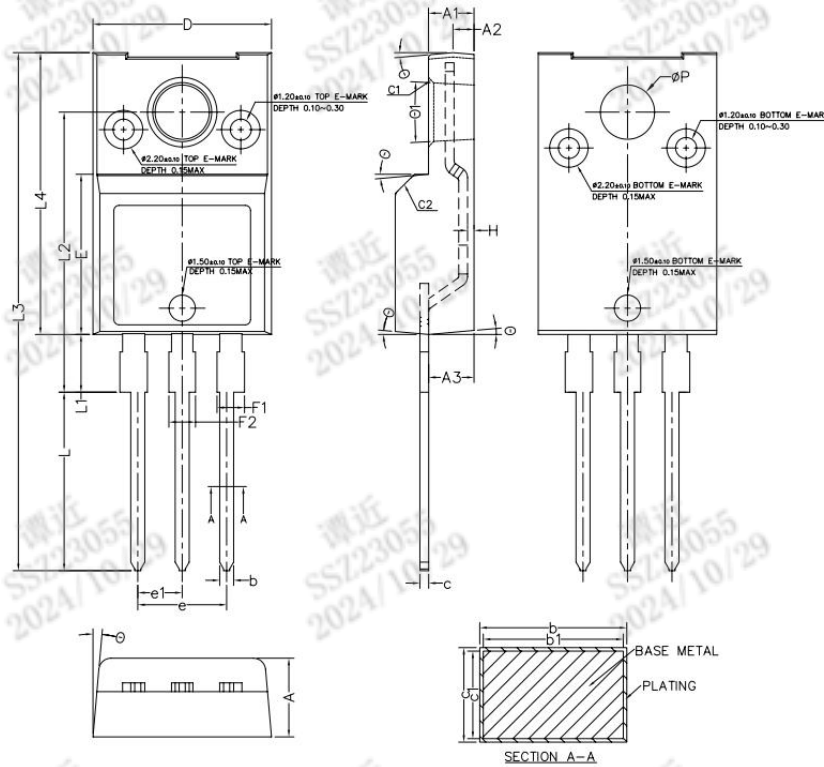


Mechanical Dimensions
TO-251
Unit: mm


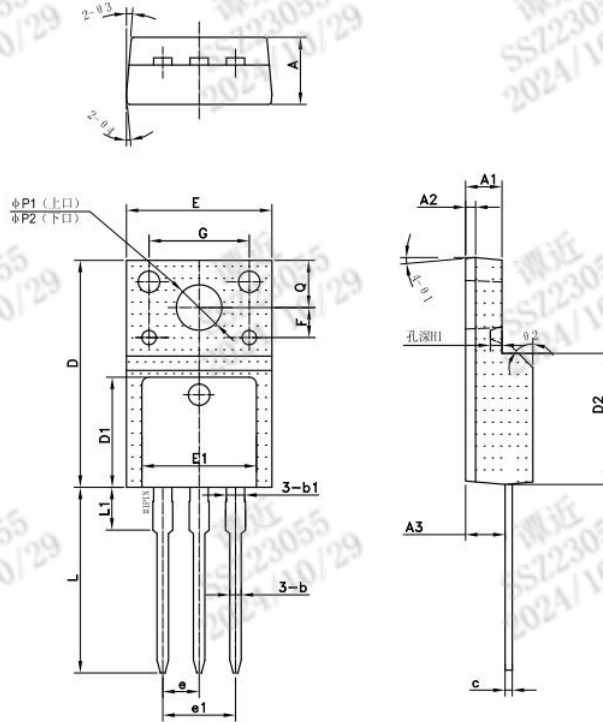
Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	2.20	2.30	2.40
A1	0.90	1.01	1.17
b	0.50	-	0.91
b1	-	0.81	-
b2	5.13	5.33	5.46
c	0.46	0.50	0.60
c1	0.46	0.50	0.60
D	5.95	6.10	6.25
E	6.45	6.60	6.75
e	2.286(BSC)		
L	9.00	9.30	9.60
L1	-	2.00	-
L2	0.90	-	1.25
θ_1	-	5°	-
θ_2	-	3°	-

Mechanical Dimensions (Continued)
TO-252
Unit: mm


Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	2.20	2.30	2.40
A1	0	-	0.10
A2	0.90	1.00	1.17
b	0.70	0.76	0.90
b1	0.77	-	1.10
b2	5.13	5.33	5.46
c	0.45	-	0.60
D	5.95	6.10	6.25
D1	-	5.30	-
E	6.45	6.60	6.75
E1	-	4.80	-
e	2.286(BSC)		
H	9.70	10.10	10.40
L	1.25	1.50	1.75
L1	-	2.90	-
L2	-	0.51	-
L3	0.90	-	1.25
L4	-	0.80	-
L5	-	1.00	-
L6	-	1.80	-
θ	0°	-	8°

Mechanical Dimensions
TO-220F (Package 1)
Unit: mm


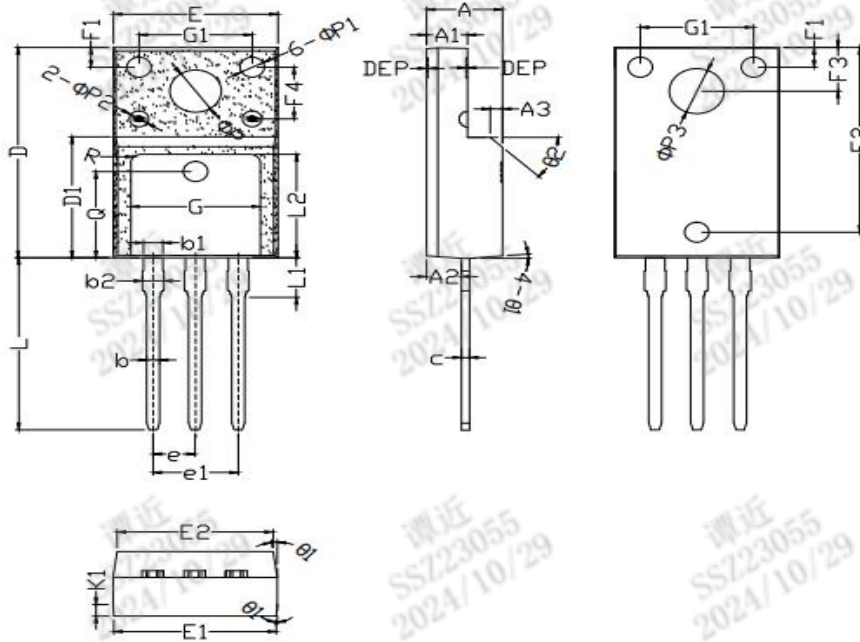
Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.40	4.50	4.60
A1	2.50	2.60	2.70
A2	1.10	1.20	1.30
A3	2.49	2.59	2.69
b	0.76	-	0.89
b1	0.75	0.80	0.85
c	0.46	-	0.59
c1	0.45	0.50	0.55
C1	0.20	0.30	0.40
C2	1.00	1.10	1.20
D	10.10	10.20	10.30
E	9.05	9.15	9.25
e	4.98	5.08	5.18
e1	2.44	2.54	2.64
F1	1.22	-	1.60
F2	1.17	-	1.55
H	0.32	0.37	0.42
L	10.00	10.20	10.40
L1	3.15	3.30	3.45
L2	15.85	16.00	16.15
L3	29.30	29.60	29.90
L4	16.00	16.10	16.20
P	3.00	3.10	3.20
θ	3°	5°	7°
θ1	4°	6°	8°

Mechanical Dimensions
TO-220F (Package 2)
Unit: mm


Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.50	4.70	4.90
A1	2.34	2.54	2.70
A2	-	0.70	-
A3	2.56	2.76	2.96
b	0.70	0.80	0.95
b1	-	1.28	-
c	0.45	0.50	0.65
D	15.67	15.87	16.07
D1	-	7.70	-
D2	-	9.12	-
E	9.96	10.16	10.36
E1	-	8.00	-
e	2.54		
e1	5.08		
F	2.1		
G	7		
H1	-	0.81	-
L	12.48	12.98	13.20
L1	-	2.93	-
ΦP1 (上口)	2.98	3.18	3.38
ΦP2 (下口)	3.20	3.40	3.60
Q	3.10	3.30	3.50
θ1	5°		
θ2	45°		
θ2	5°		
θ3	5°		

Mechanical Dimensions
TO-220F (Package 3)

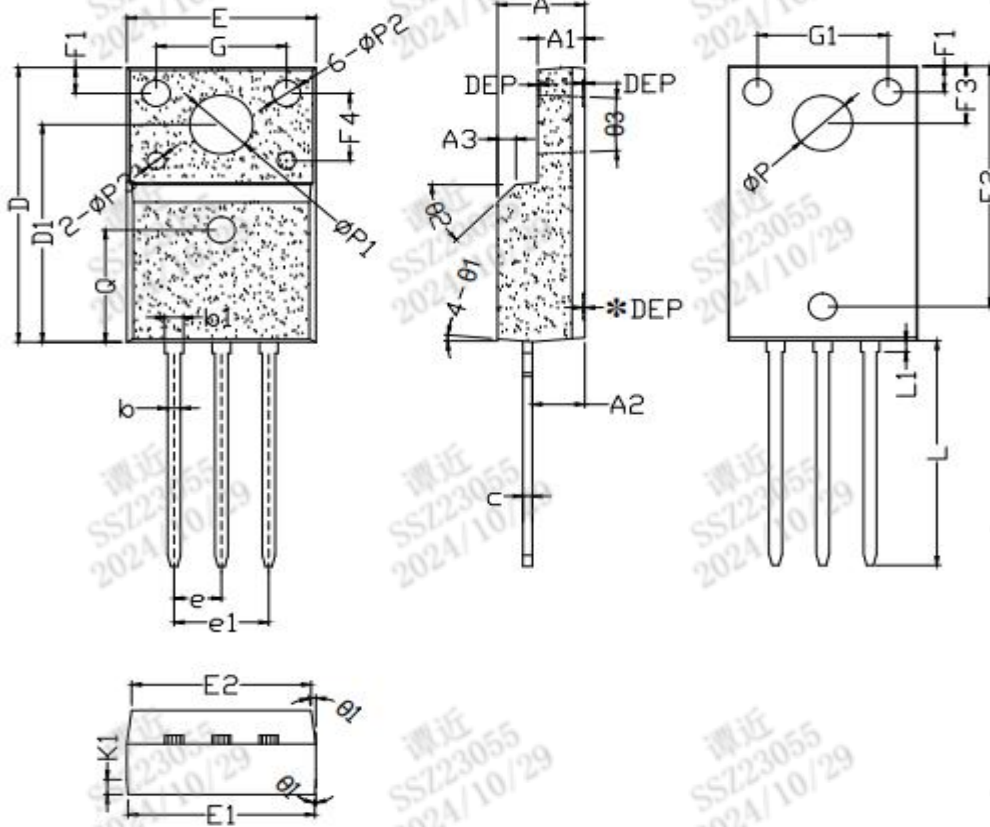
Unit: mm



Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	2.60	2.80	2.95
A3	1.0REF		
b	0.75	0.80	0.85
b1	1.18	1.20	1.24
b2	1.18	1.24	1.30
c	0.45	0.50	0.55
D	15.67	15.87	16.07
D1	9.04	9.12	9.20
E	10.00	10.16	10.30
E1	9.94	10.06	10.30
E2	9.40	9.50	9.60
e	2.50	2.54	2.58
e1	5.08REF		
L	12.78	12.98	13.18
L1	2.70	2.92	3.20
L2	7.70	7.80	7.90
Q	6.50REF		
ΦP	3.08	3.18	3.28
ΦP1	1.45	1.55	1.65
ΦP2	0.95	1.15	1.35
ΦP3	3.30	3.40	3.50
θ1	3°	5°	7°
θ2	42°	45°	48°
F1	1.40	1.50	1.60
F2	13.80	13.90	14.00
F3	3.20	3.30	3.40
F4	3.70	3.90	4.10
G	7.80	8.00	8.20
G1	6.90	7.00	7.10
K1	0.65	0.70	0.75

Mechanical Dimensions
TO-220F Narrow

Unit: mm



Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.60	4.70	4.80	E1	9.94	10.06	10.20
A1	2.34	2.54	2.74	E2	9.30	9.40	9.50
A2	2.56	2.76	2.93	F1	1.40	1.50	1.60
A3	1.0REF			F2	13.80	13.90	14.00
b	0.60	0.70	0.80	F3	3.20	3.30	3.40
b1	0.90	1.00	1.10	F4	3.70	3.90	4.10
c	0.45	0.50	0.55	G1	6.90	7.00	7.10
D	15.67	15.87	16.07	K1	0.65	0.70	0.75
D1	12.37	12.57	12.77	L	12.78	12.98	13.18
E	10.06	10.16	10.26	L1	-	-	0.85
e	2.50	2.54	2.58	Q	6.50REF		
e1	5.08REF			ΦP	3.08	3.18	3.28
ΦP1	3.30	3.40	3.50	ΦP3	0.90	1.00	1.10
ΦP2	1.40	1.50	1.60	θ1	3°	5°	7°
θ2	42°	45°	48°	θ3	3°	5°	7°
DEF	0.05	0.10	0.15				

1.3Ω, 650V, Super Junction N-Channel Power MOSFET**SRC65R1K3ES**

TM

Sanrise Tech
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