

1. General Description

The HG65C1R200C is a 650V, 200 mΩ Gallium Nitride (GaN) FET in a TO-220F package. It is a normally-off device that combines asiasemitech latest high-voltage GaN HEMT with a low voltage silicon MOSFET to offer superior reliability and performance.

2. Features and Benefits

- JEDEC-qualified GaN technology
- Dynamic $R_{DS(on)eff}$ production tested
- Wide gate safety margin
- Capable of reverse conduction
- Low gate charge
- RoHS compliant and Halogen-free packaging
- Achieves increased efficiency in both hard- and soft- switched circuits
 - Increased power density
 - Reduced system size and weight
 - Overall lower system cost
- Easy to drive with commonly-used gate drivers

3. Applications

- Fast charger
- Telecom power
- Data center
- Lighting

4. Key Specifications

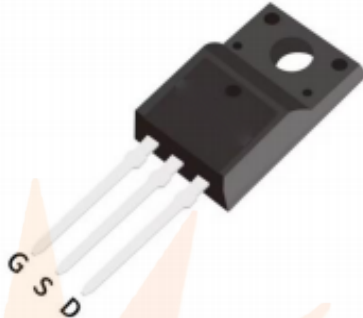
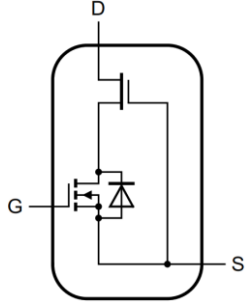
Table 1. Key Specifications

Symbol	Parameter	Value	Unit
$V_{DS, max}$	Drain-source voltage	650	V
I_D, max	Continuous drain current @Tc = 25°C	TBD	A
$R_{DS(on), typ}$	Drain-source on-state resistance	200	mΩ
Q_G, typ	Total gate charge	15	nC
$Q_{RR, typ}$	Reverse recovered charge	44	nC

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5. Pin Description

Table 2. Pin Description

Pin	Description	Top View	Graphic Symbol
G	Gate		
D	Drain		
S	Source		

6. Ordering Information

Table 3. Ordering Information

Part number	Package	Marking Code
HG65C1R200C	TO-220F	65C1R200

7. Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings (Tc=25℃ unless otherwise noted)

Parameter	Symbol	Min.	Max.	Unit.	Conditions
Drain to source voltage	V_{DS}	-	650	V	$V_{GS} = 0V$
Transient drain to source voltage	$V_{DS(TR)}$	-	800		Non-repetitive Pulse for $\leq 10ms$ at 25℃
Gate to source voltage	V_{GS}	-20	20		
Maximum power dissipation	P_D	-	TBD	W	$T_C = 25^\circ C$, Fig.1
Continuous drain current	I_D	-	TBD	A	$T_C = 25^\circ C$
		-	TBD	A	$T_C = 100^\circ C$
Pulsed drain current	I_{DM}	-	TBD	A	Pulsed, $t_p \leq 200\mu s$, $T_C = 25^\circ C$
Operating temperature	T_J	-55	150	℃	
Storage temperature	T_S	-55	150	℃	

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Fig. 1. Power Dissipation



Fig 2. Safe Operating Area T_C = 25°C

8. Thermal Characteristics

Table 5. Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Thermal resistance (Junction-to-case)	R _{th(j-c)}	-	-	TBD	°C/W	
Thermal resistance (Junction-to-ambient) ^a	R _{th(j-a)}	-	-	TBD	°C/W	
Reflow soldering temperature	T _{SOLD}	-	-	260	°C	reflow MSL3

Notes:

- Device on one layer epoxy PCB for drain connection (vertical and without air stream cooling, with 6cm² copper area and 70μm thickness).

TBD

Fig. 3. Transient Thermal Impedance

9. Electrical Characteristics

Table 6. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Forward Device Characteristics						
Gate threshold voltage	$V_{GS(th)}$	-	1.9	-	V	$V_{DS} = V_{GS}$, $I_D = 0.5mA$, $T_J = 25^\circ C$
		-	1.0	-		$V_{DS} = V_{GS}$, $I_D = 0.5mA$, $T_J = 150^\circ C$
Drain-source on-state resistance ^a	$R_{DS(on)}$	-	200	-	mΩ	$V_{GS} = 8V$, $I_D = 5A$, $T_J = 25^\circ C$, Fig.18 , Fig.19
		-	420	-		$V_{GS} = 8V$, $I_D = 5A$, $T_J = 150^\circ C$, Fig.18 , Fig.19
Drain-to-source leakage current	I_{DSS}	-	9	-	μA	$V_{DS} = 650V$, $V_{GS} = 0V$, $T_J = 25^\circ C$
		-	12	-		$V_{DS} = 650V$, $V_{GS} = 0V$, $T_J = 150^\circ C$
Gate-to-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS} = 20V$, $V_{DS} = 0V$, $T_J = 25^\circ C$
		-	-	-100		$V_{GS} = -20V$, $V_{DS} = 0V$, $T_J = 25^\circ C$

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Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input capacitance	Ciss	-	1097	-	pF	V _{GS} = 0V, V _{DS} = 400V, f = 1MHz, Fig.8
Output capacitance	Coss	-	25	-		
Reverse transfer capacitance	Crss	-	1.6	-		
Output capacitance, energy related ^b	C _{O(er)}	-	37	-	pF	V _{GS} = 0V, V _{DS} = 0V to 400V, Fig.9
Output capacitance, time related ^c	C _{O(tr)}	-	75	-		
Total gate charge	Q _G	-	15	-	nC	V _{DS} = 400V, V _{GS} = 0V to 8V, I _D = 5A, Fig.11
Gate-source charge	Q _{GS}	-	3.1	-		
Gate-drain charge	Q _{GD}	-	4.4	-		
Output charge	Q _{OSS}	-	29.2	-	nC	V _{GS} = 0V, V _{DS} = 0V to 400V
Turn-on delay	t _{D(on)}	-	39	-	ns	V _{DS} = 400V, V _{GS} = 0V to 8V, I _D = 4A, R _{G_on} = 33Ω, R _{G_off} =2.2Ω, Fig.14 , Fig.15
Rise time	t _r	-	8	-		
Turn-off delay	t _{D(off)}	-	51	-		
Fall time	t _f	-	10	-		
Reverse Device Characteristics						
Reverse voltage ^d	V _{SD}	-	1.7	-	V	V _{GS} = 0V, I _S = 5A, T _J = 25°C, Fig.12
		-	1.1	-		V _{GS} = 0V, I _S = 2A, T _J = 25°C, Fig.12
Reverse recovery time	t _{RR}	-	14	-	ns	I _S = 5A, V _{DD} = 400V, di/dt = 1000A/us, Fig.16 , Fig.17
Reverse recovery charge	Q _{RR}	-	44	-	nC	V _{GS} = 0V, I _S = 5A, T _J = 25°C, Fig.16 , Fig.17

Notes:

- Dynamic R_{DS(on)} value
- Equivalent capacitance to give same stored energy from 0V to 400V
- Equivalent capacitance to give same charging time from 0V to 400V
- Includes dynamic R_{DS(on)} effect

9.1 Electrical characteristics(curves) ($T_C=25^{\circ}\text{C}$ unless otherwise stated)

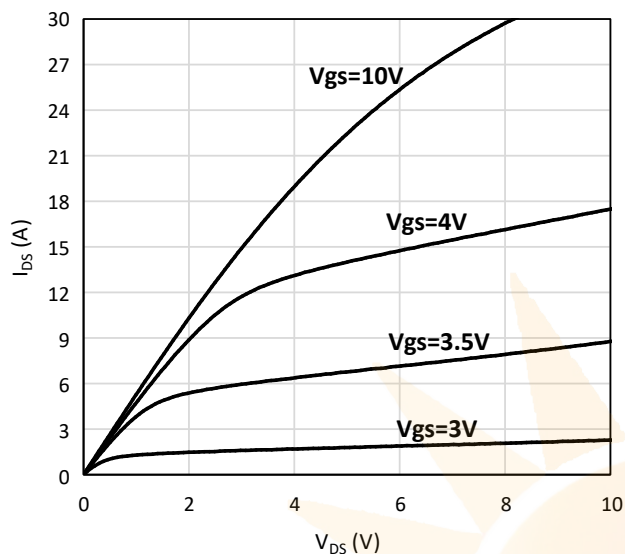


Fig. 4. Typical Output Characteristics

$T_J = 25^{\circ}\text{C}$

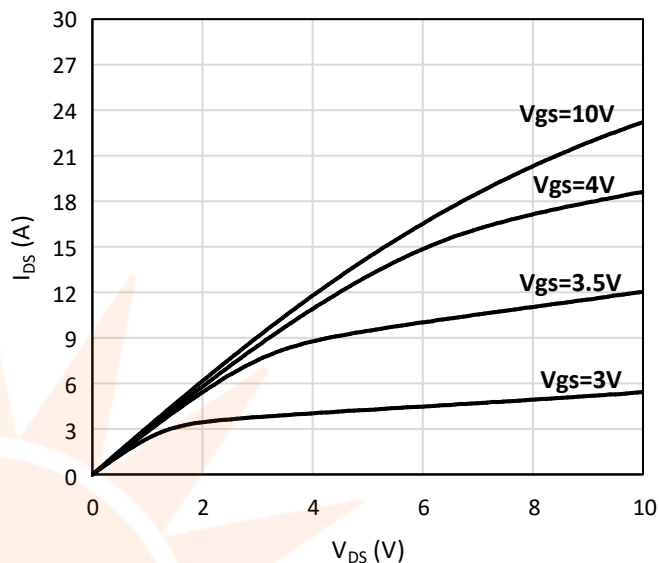


Fig. 5. Typical Output Characteristics

$T_J = 150^{\circ}\text{C}$

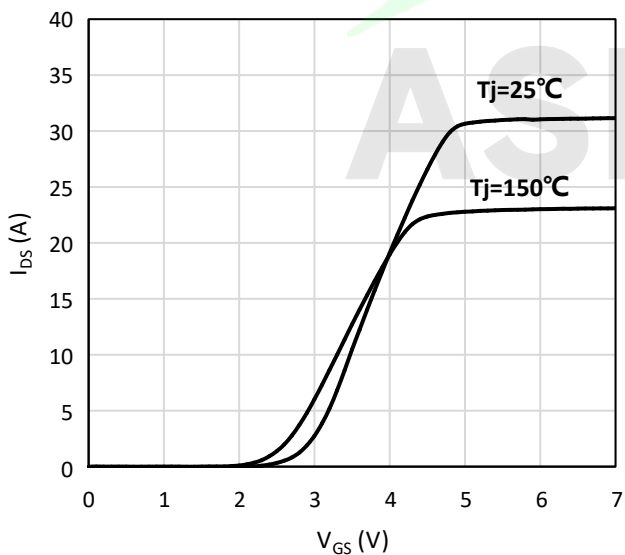


Fig. 6. Typical Transfer Characteristics
 $V_{DS} = 10\text{V}$

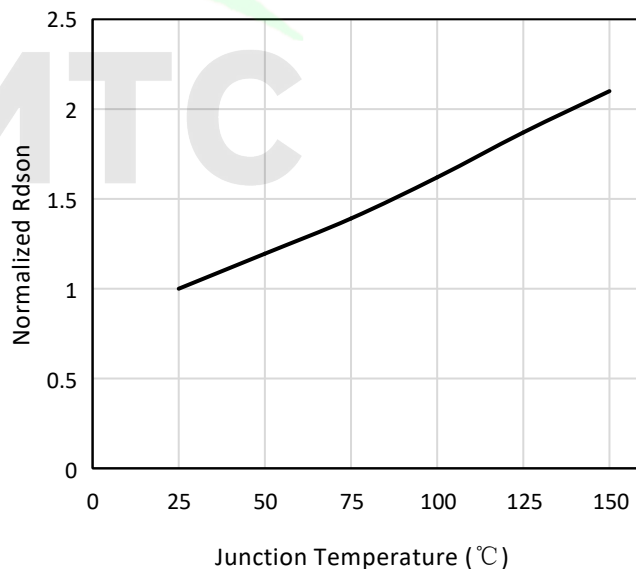


Fig. 7. Normalized On-resistance
 $I_D = 5\text{A}$, $V_{GS} = 8\text{V}$

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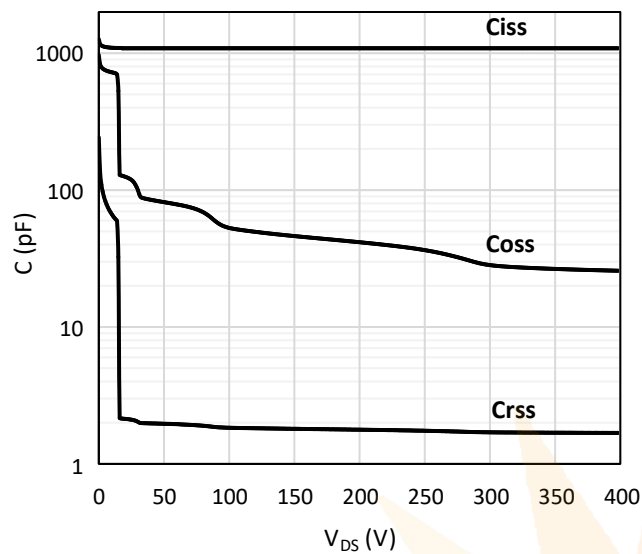


Fig. 8. Typical Capacitance
 $V_{GS} = 0V, f = 1MHz$

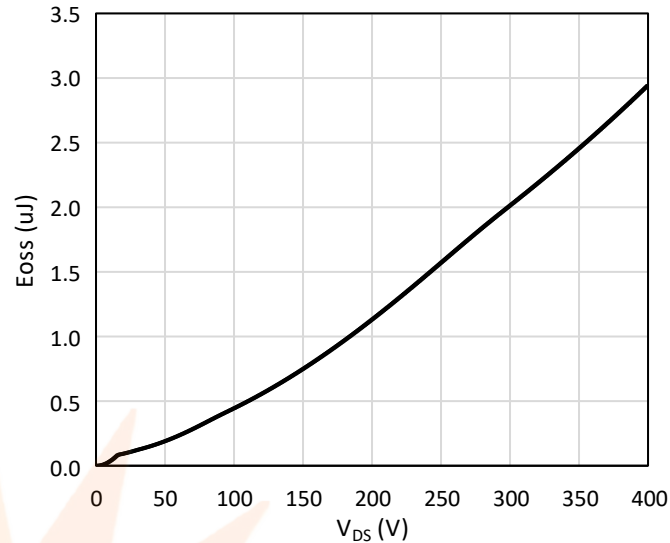


Fig. 9. Typical Coss Stored Energy
 $V_{GS} = 0V, f = 1MHz$

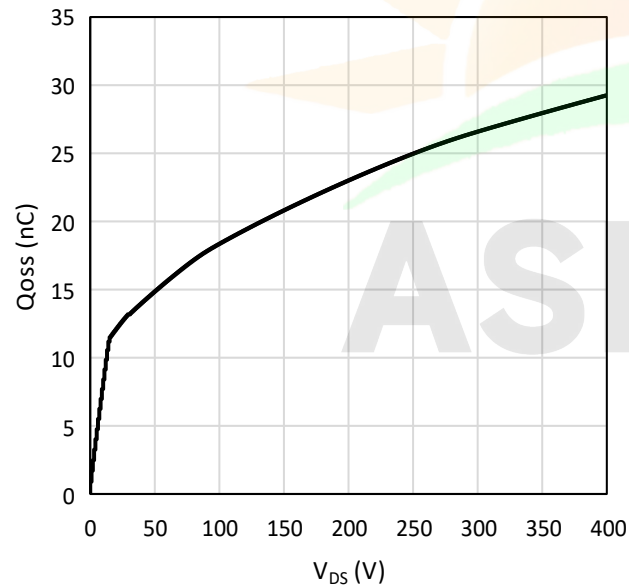


Fig. 10. Typical Q_{oss}

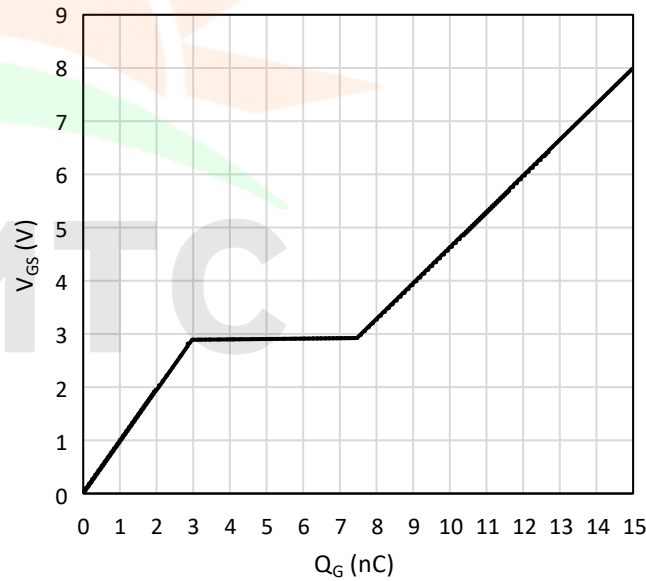


Fig. 11. Typical Gate Charge
 $I_{DS} = 5A, V_{DS} = 400V$

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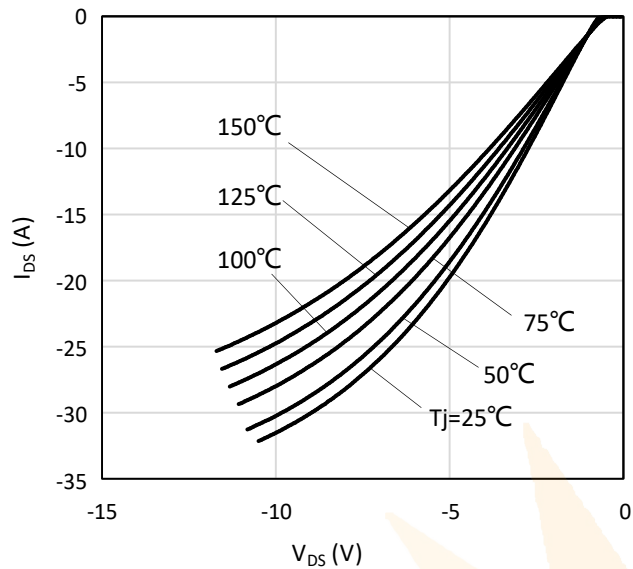


Fig. 12. Forward Characteristics of Rev. Diode

$I_{DS} = f(V_{DS})$

10. Test Circuits

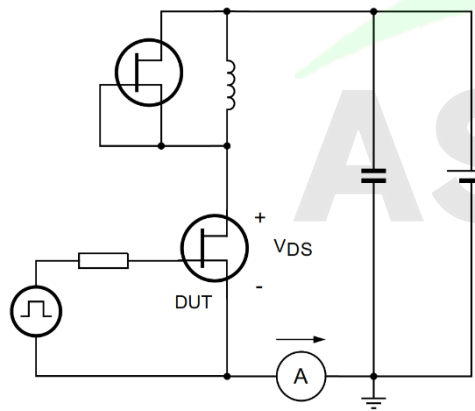


Fig. 14. Switching Time Test Circuit

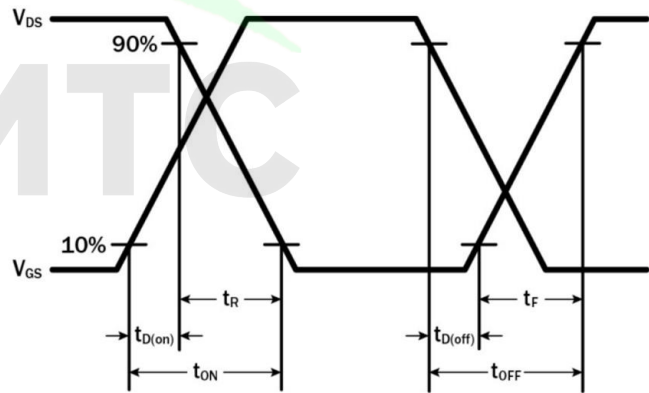


Fig. 15. Switching Time Waveform

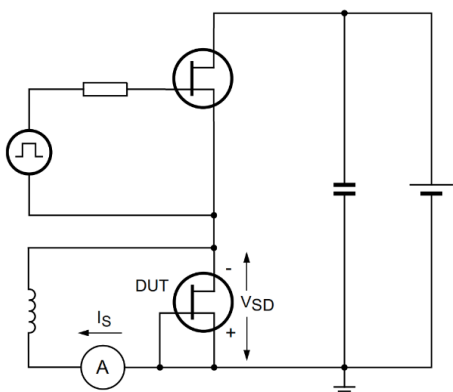


Fig. 16. Diode Characteristics Test Circuit

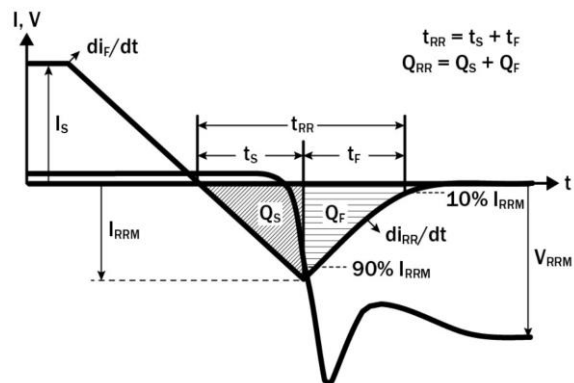


Fig. 17. Diode Recovery Waveform

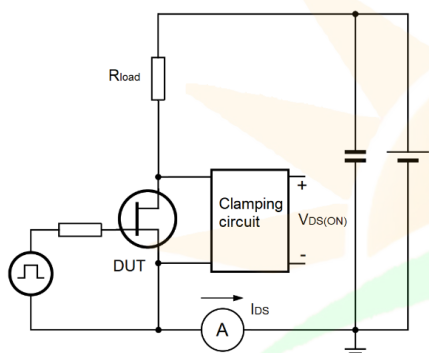


Fig. 18. Dynamic $R_{DS(on)eff}$ Test Circuit

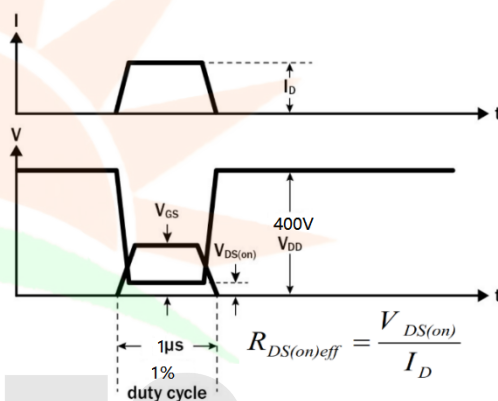


Fig. 19. Dynamic $R_{DS(on)eff}$ Waveform

11. Package Information

11.1 TO-220F Package Information

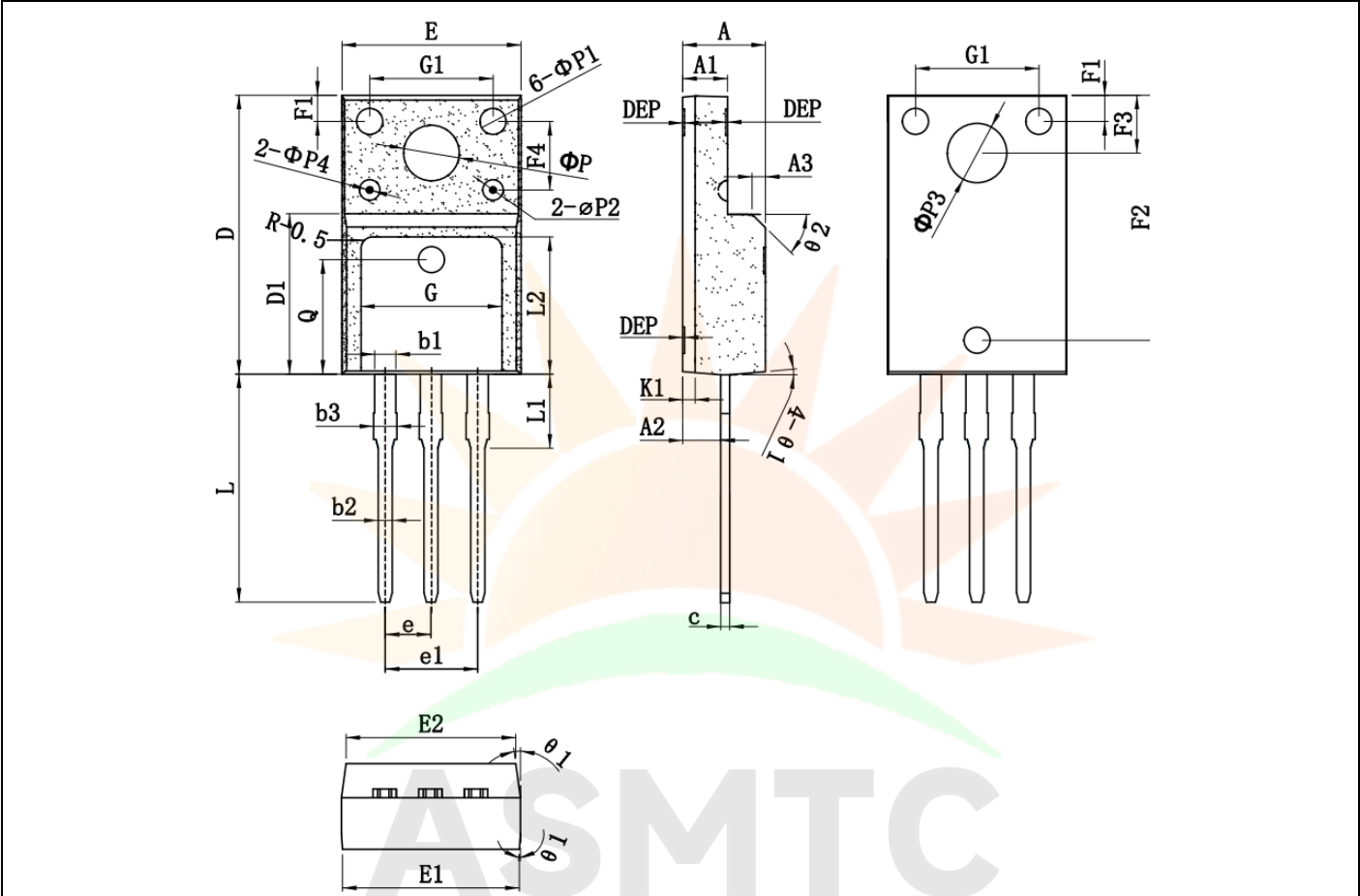


Fig. 22. TO-220F Package Outline

SYMBOL	MIN	NOM	MAX	SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90	F3	3.20	3.30	3.40
A1	2.34	2.54	2.74	F4	3.70	3.90	4.10
A2	2.66	2.76	2.86	G	7.80	8.00	8.20
A3	1.0REF			G1	6.90	7.00	7.10
b1	1.18	1.20	1.24	K1	0.65	0.70	0.75
b2	0.75	0.80	0.85	L	12.78	12.98	13.18
b3	1.22	1.30	1.38	L1	3.13	3.23	3.33
C	0.45	0.50	0.55	L2	7.20	7.40	7.60
D	15.67	15.87	16.07	Q	6.50REF		
D1	9.04	9.12	9.20	ΦP	3.08	3.18	3.28
Se	2.50	2.54	2.58	Φp1	1.45	1.55	1.65

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e1	5.08 REF			Φp2	0.95	1.15	1.35
E	10.00	10.16	10.3	Φp3	3.30	3.40	3.50
E1	9.94	10.06	10.20	Φp4	0.15	0.20	0.25
E2	9.40	9.50	9.60	ø1	3°	5°	7°
F1	1.40	1.50	1.60	ø2	42°	45°	48°
F2	13.80	13.90	14.00	DEP	0.05	0.10	0.15



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Revision History

Revision	Date	Changes
1.0	15/8/2023	Release Preliminary Datasheet

