

1. General Description

The HG65C1R070G is a 650V, 70 mΩ Gallium Nitride (GaN) FET in a TO-247 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

- Industrial power supplies
- Telecom power
- Data center
- Consumer

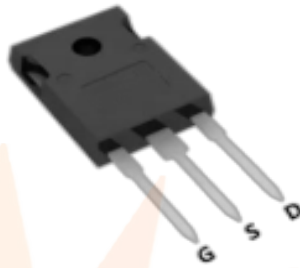
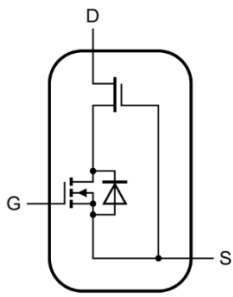
4. Key Specifications

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	32	A
$R_{DS(on), typ}$	Drain-source on-state resistance	70	mΩ
Q_G, typ	Total gate charge	13	nC
$Q_{RR, typ}$	Reverse recovered charge	140	nC

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
HG65C1R070G	TO-247	65C1R070

7. Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings (Tc=25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit.	Conditions
Drain to source voltage	V_{DSS}	650	-	V	$V_{GS} = 0V$
Transient drain to source voltage	$V_{DSS(TR)}$	-	800		Non-repetitive Pulse for $\leq 10ms$ at 25°C
Gate to source voltage	V_{GSS}	-20	20		
Maximum power dissipation	P_D	-	156	W	$T_C = 25^\circ C$ Fig.1
Continuous drain current	I_D	-	32	A	$T_C = 25^\circ C$
		-	20	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	°C	
Storage temperature	T_S	-55	150	°C	

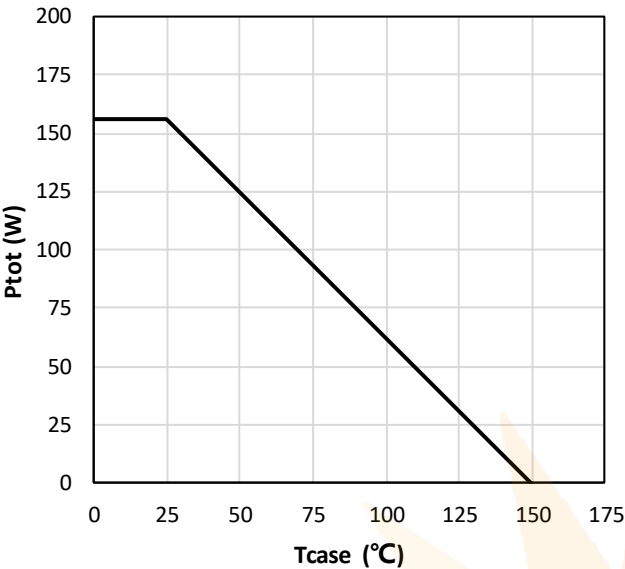


Fig. 1. Power Dissipation

TBD

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)}	-	-	0.8	°C/W	
Thermal resistance (Junction-to-ambient)	R _{th(j-a)}	-	-	40	°C/W	
Reflow soldering temperature	T _{SOLD}	-	-	260	°C	reflow MSL3

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)}	-	4.5	-	V	V _{DS} = V _{GS} , I _D = 0.7mA , T _J = 25°C
		-	2.6	-		V _{DS} = V _{GS} , I _D = 0.7mA, T _J = 150°C
Drain-source on-state resistance	R _{DS(on)}	-	70	-	mΩ	V _{GS} = 12V, I _D = 16A, T _J = 25°C
		-	152	-		V _{GS} = 12V, I _D = 16A, T _J = 150°C
Drain-to-source leakage current	I _{DSS}	-	5	-	μA	V _{DS} = 650V, V _{GS} = 0V, T _J = 25°C
		-	80	-		V _{DS} = 650V, V _{GS} = 0V, T _J = 150°C
Gate-to-source leakage current	I _{GSS}	-	-	100	nA	V _{GS} = 20V, V _{DS} = 0V, T _J = 25°C
		-	-	-100		V _{GS} = -20V, V _{DS} = 0V, T _J = 25°C

650V, 70mΩ typ., Gallium Nitride (GaN) FET in TO-247

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input capacitance	C _{iss}	-	676	-	pF	V _{GS} = 0V, V _{DS} = 400V, f = 1MHz, Fig.8
Output capacitance	C _{Oss}	-	61	-		
Reverse transfer capacitance	C _{rss}	-	0.8	-		
Output capacitance, energy related ^a	C _{O(er)}	-	111	-	pF	V _{GS} = 0V, V _{DS} = 0V to 400V, Fig.9, Fig.10
Output capacitance, time related ^b	C _{O(tr)}	-	216	-		
Total gate charge	Q _G	-	13	-	nC	V _{DS} = 400V, V _{GS} = 0V to 12V, I _D = 16A, Fig.11
Gate-source charge	Q _{GS}	-	4	-		
Gate-drain charge	Q _{GD}	-	4.6	-		
Output charge	Q _{Oss}	-	87.4	-	nC	V _{GS} = 0V, V _{DS} = 0V to 400V
Turn-on delay	t _{D(on)}	-	33	-	ns	V _{DS} = 400V, V _{GS} = 0V to 12V, I _D = 18A, R _{G_on} = 51Ω, R _{G_off} =2Ω, Fig.14, Fig.15
Rise time	t _R	-	20	-		
Turn-off delay	t _{D(off)}	-	30	-		
Fall time	t _F	-	7	-		
Reverse Device Characteristics						
Reverse voltage	V _{SD}	-	1.8	-	V	V _{GS} = 0V, I _S = 16A, T _J = 25°C, Fig.12
		-	1.3	-		V _{GS} = 0V, I _S = 8A, T _J = 25°C, Fig.12
Reverse recovery time	t _{RR}	-	30	-	ns	I _S = 16A, V _{DD} = 400V, T _J = 25°C, di/dt = 1000A/us, Fig.16, Fig.17
Reverse recovery charge	Q _{RR}	-	140	-	nC	

Notes:

- Equivalent capacitance to give same stored energy from 0V to 400V
- Equivalent capacitance to give same charging time from 0V to 400V

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

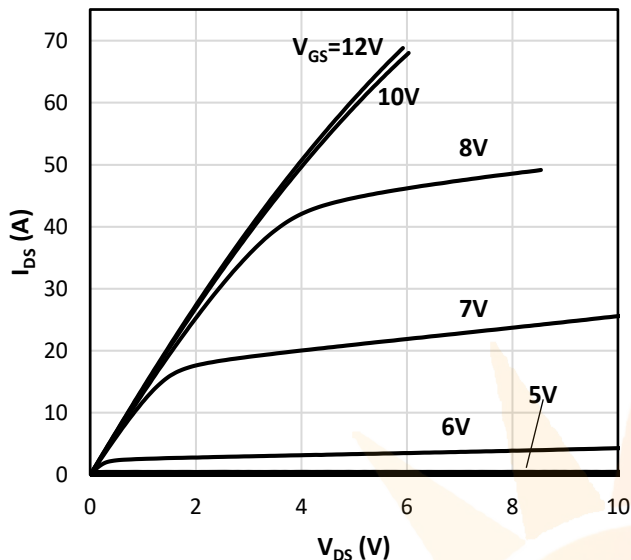


Fig. 4. Typical Output Characteristics

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

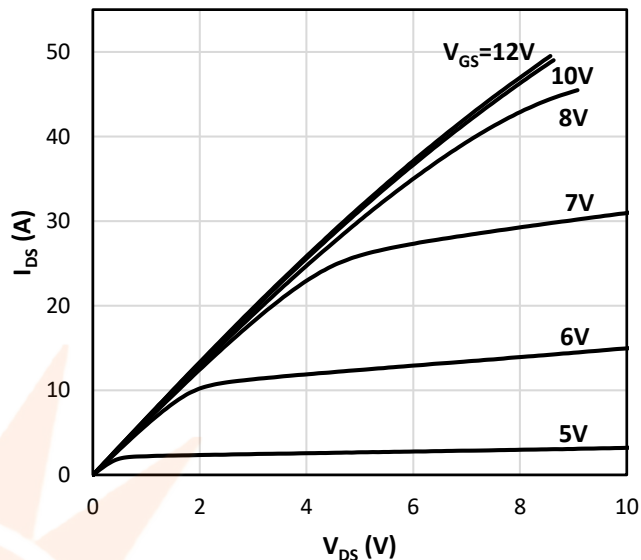


Fig. 5. Typical Output Characteristics

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

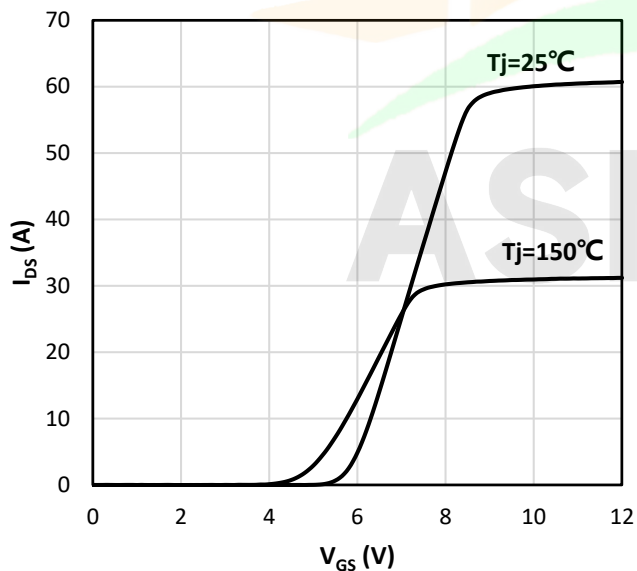


Fig. 6. Typical Transfer Characteristics

$V_{DS} = 5\text{V}$

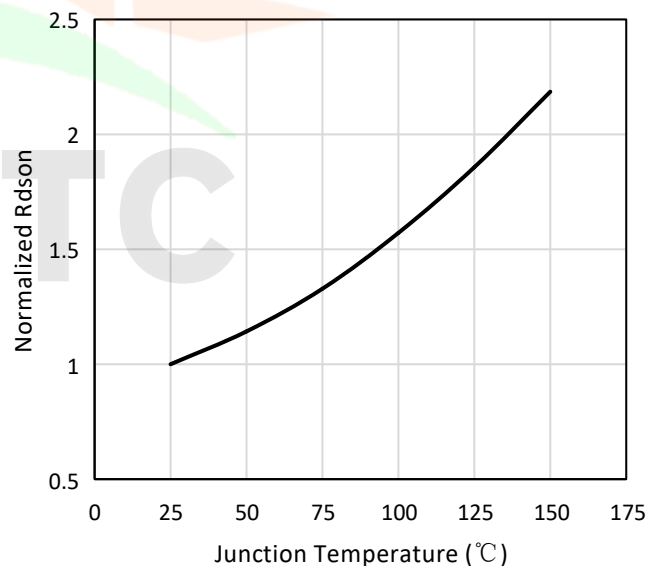


Fig. 7. Normalized On-resistance

$I_D = 16\text{A}, V_{GS} = 12\text{V}$

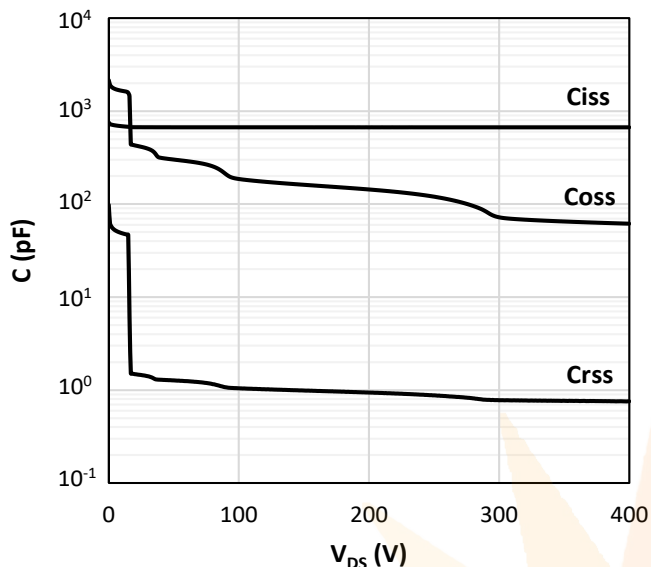


Fig. 8. Typical Capacitance

$V_{GS} = 0V$, $f = 1MHz$

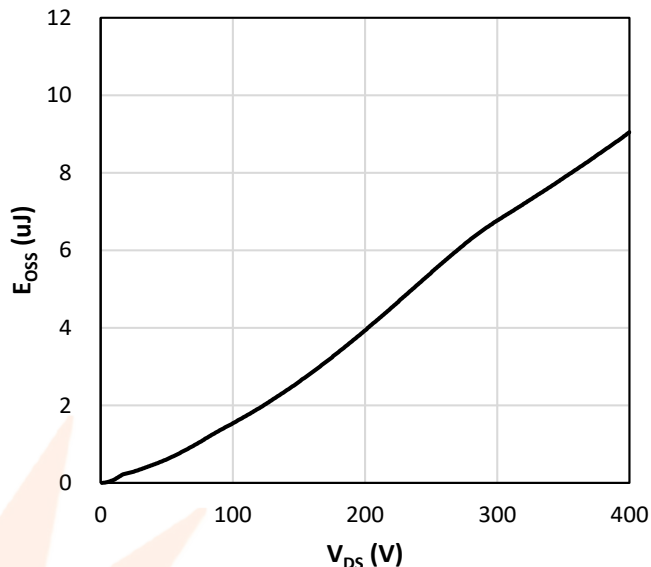


Fig. 9. Typical Coss Stored Energy

$V_{GS} = 0V$, $f = 1MHz$

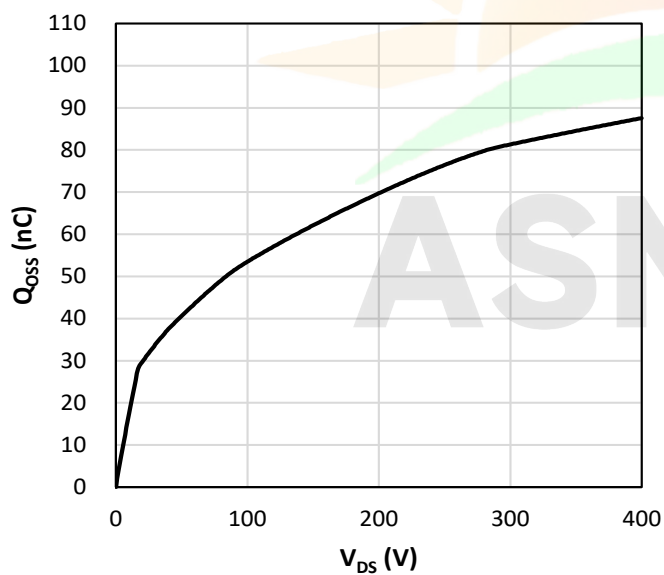


Fig. 10. Typical Q_{oss}

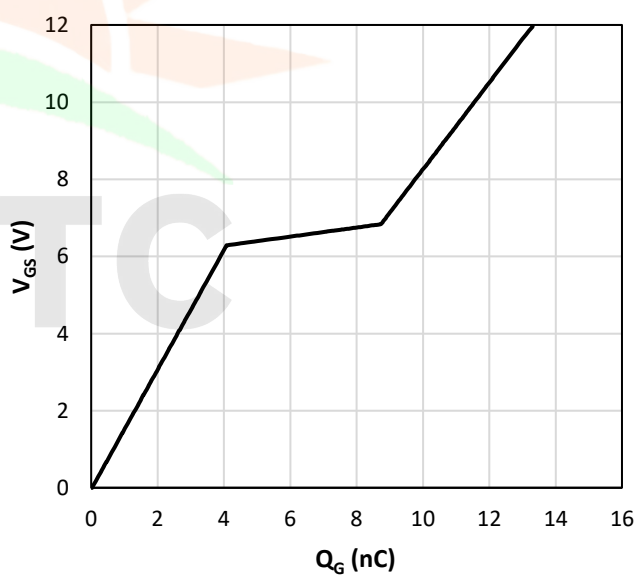


Fig. 11. Typical Gate Charge

$I_{DS} = 16A$, $V_{DS} = 400V$

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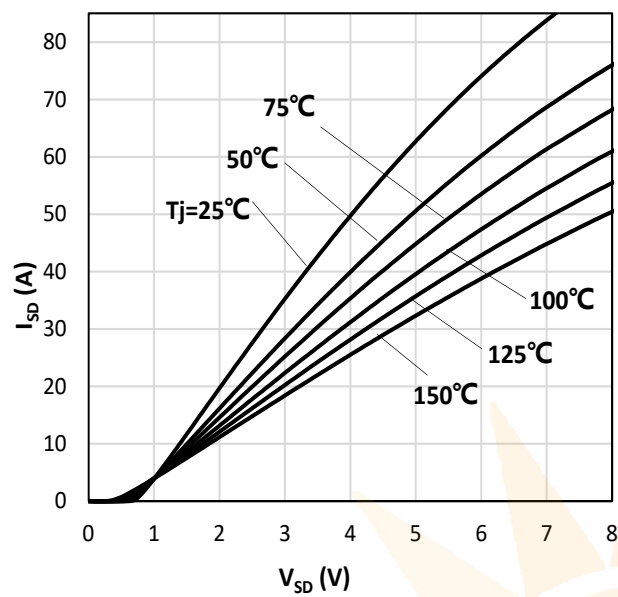


Fig. 12. Forward Characteristics of Rev. Diode
 $I_{SD} = f(V_{SD})$

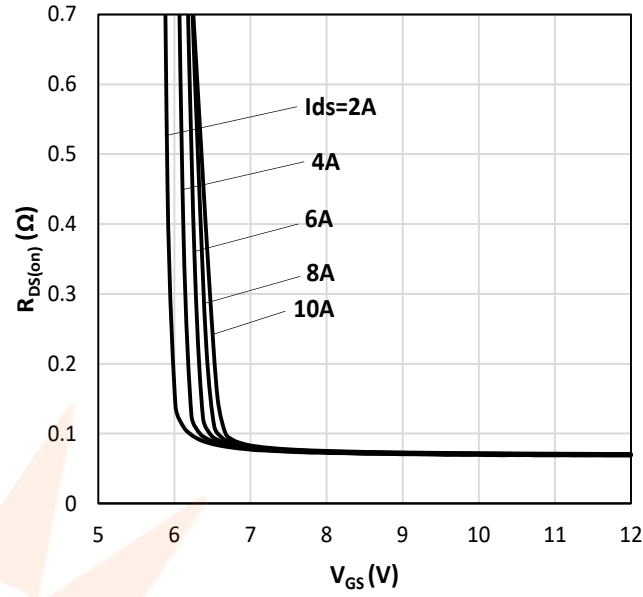


Fig. 13. Typical $R_{DS(on)}$

10. Test Circuits

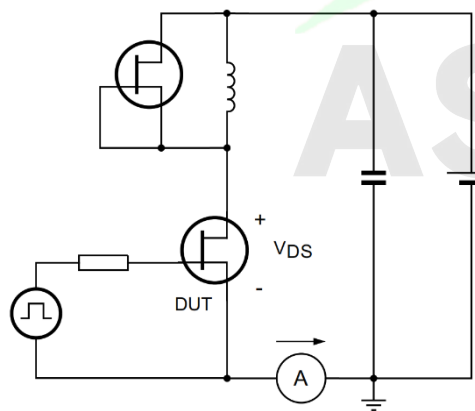


Fig. 14. Switching Time Test Circuit

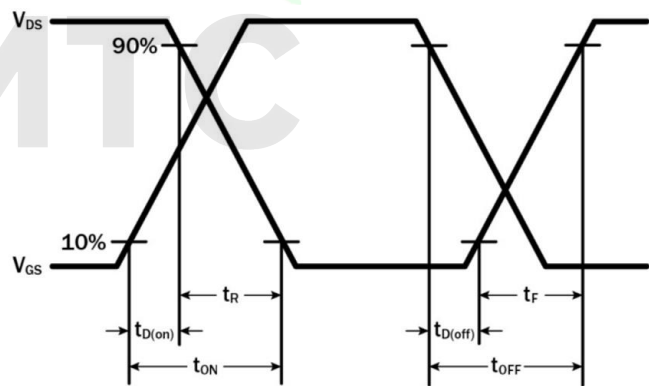


Fig. 15. Switching Time Waveform

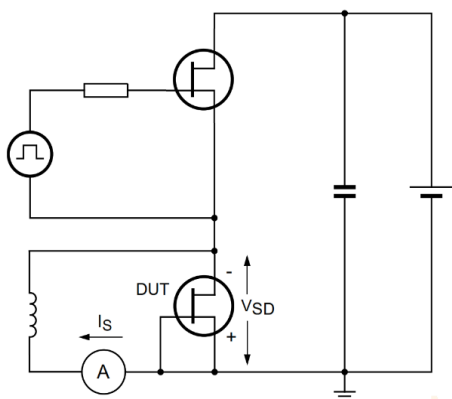


Fig. 16. Diode Characteristics Test Circuit

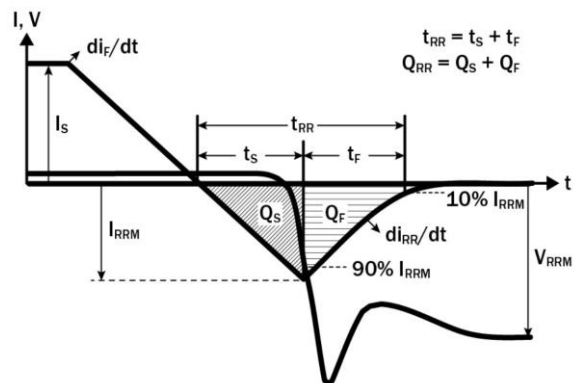


Fig. 17. Diode Recovery Waveform

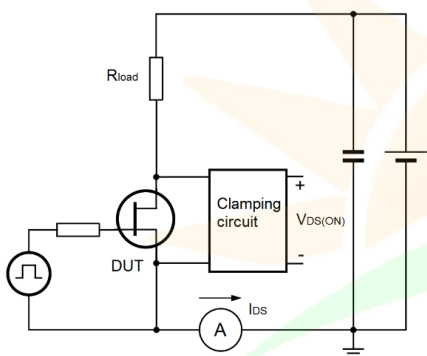


Fig. 18. Dynamic $R_{DS(on)eff}$ Test Circuit

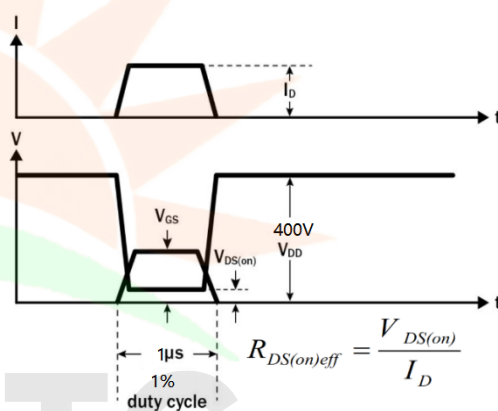


Fig. 19. Dynamic $R_{DS(on)eff}$ Waveform

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11. Package Information

11.1 TO-247 Package Information

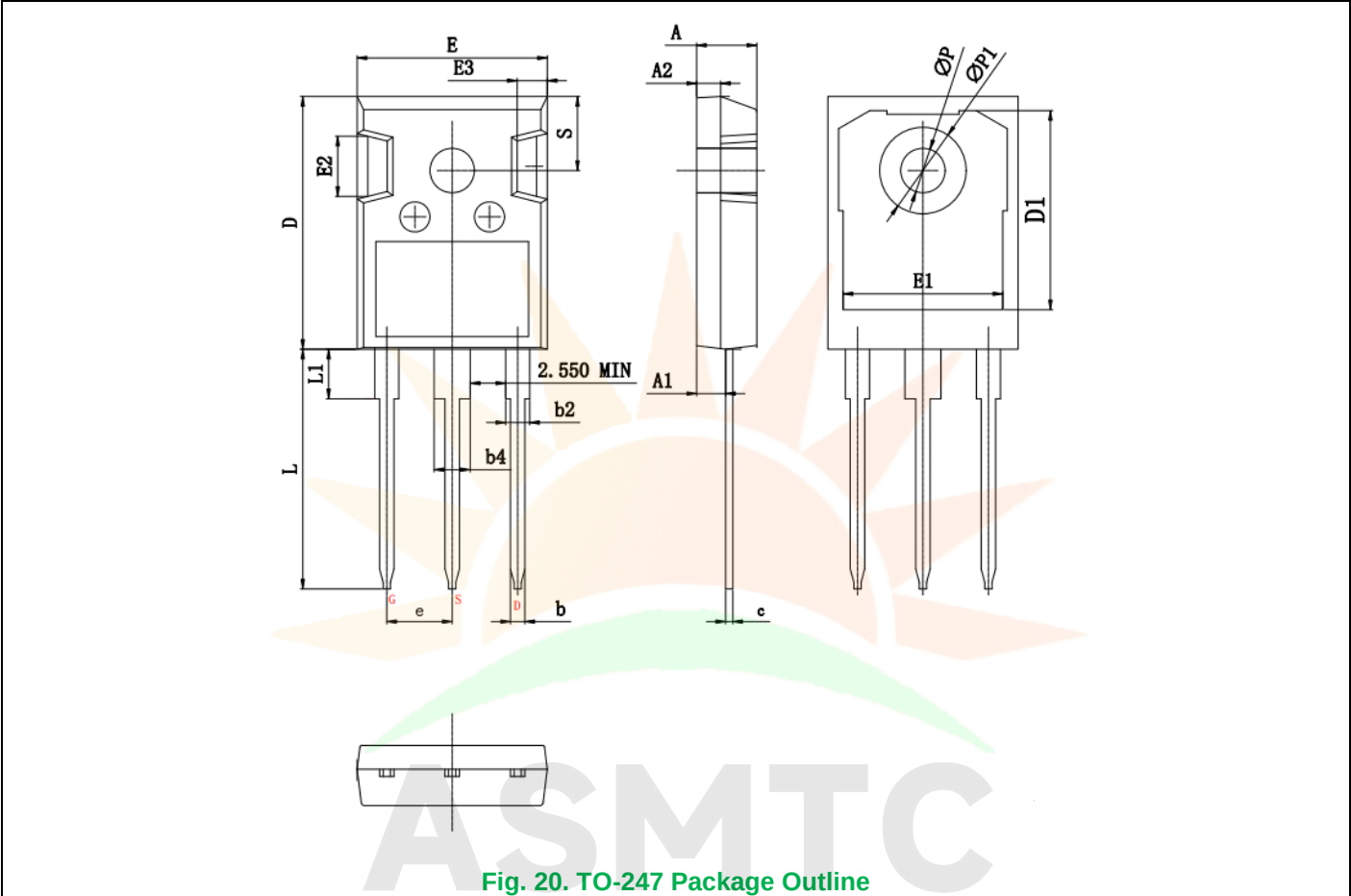


Fig. 20. TO-247 Package Outline

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.800	5.000	5.200
A1	2.210	2.410	2.590
A2	1.850	2.000	2.150
b	1.110	1.210	1.360
b2	1.910	2.010	2.210
b4	2.910	3.010	3.210

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c	0.510	0.610	0.750
D	20.800	21.000	21.300
D1	16.250	16.550	16.850
E	15.500	15.800	16.100
E1	13.000	13.300	13.600
E2	4.800	5.000	5.200
E3	2.300	2.500	2.700
e	5.440BSC		
L	19.820	19.920	20.220
L1	--	--	4.300
ΦP	3.400	3.600	3.800
ΦP1	--	--	7.300
S	6.150BSC		

12. Important Notice

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Revision History

Revision	Date	Changes
1.0	27/10/2023	Release Preliminary Datasheet

