

650V, 200mΩ typ., GaN FET in TO-252 Package

1. General Description

The HG65C1R200L is a 650V, 200 mΩ Gallium Nitride (GaN) FET in a TO-252 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

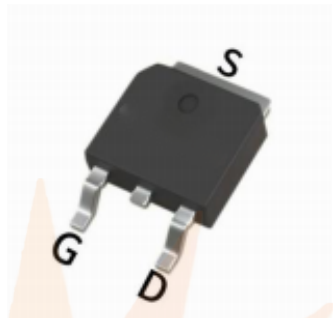
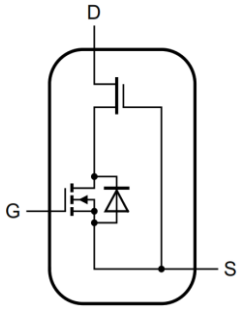
Table 1. Key Specifications

Symbol	Parameter	Value	Unit
$V_{DS, max}$	Drain-source voltage	650	V
I_D, max	Continuous drain current @Tc = 25°C	12	A
$R_{DS(on), typ}$	Drain-source on-state resistance	167	mΩ
Q_G, typ	Total gate charge	11.1	nC
$Q_{RR, typ}$	Reverse recovered charge	43	nC

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5. Pin Description

Table 2. Pin Description

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

6. Ordering Information

Table 3. Ordering Information

Part number	Package	Package Configuration	Marking Code
HG65C1R200L	TO-252	Source	65C1R200

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	-	52	W	$T_C = 25^\circ C$, Fig.1
Continuous drain current	I_D	-	12	A	$T_C = 25^\circ C$
		-	7	A	$T_C = 100^\circ C$
Pulsed drain current	I_{DM}	-	30	A	Pulsed, $t_p \leq 100\mu s$, $T_C = 25^\circ C$
Operating temperature	T_J	-55	150	°C	
Storage temperature	T_S	-55	150	°C	

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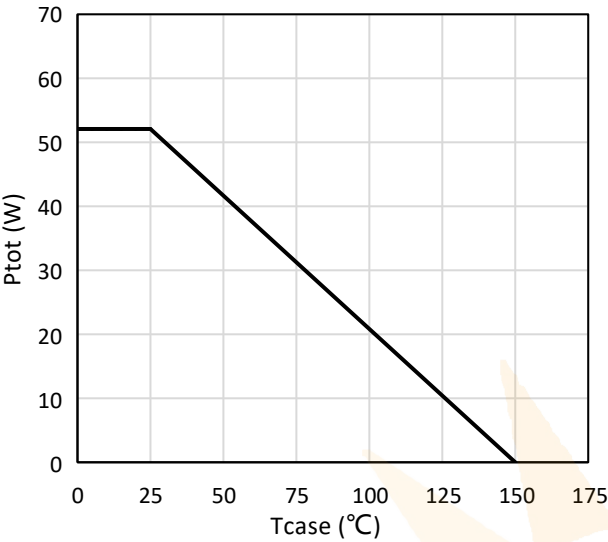


Fig. 1. Power Dissipation

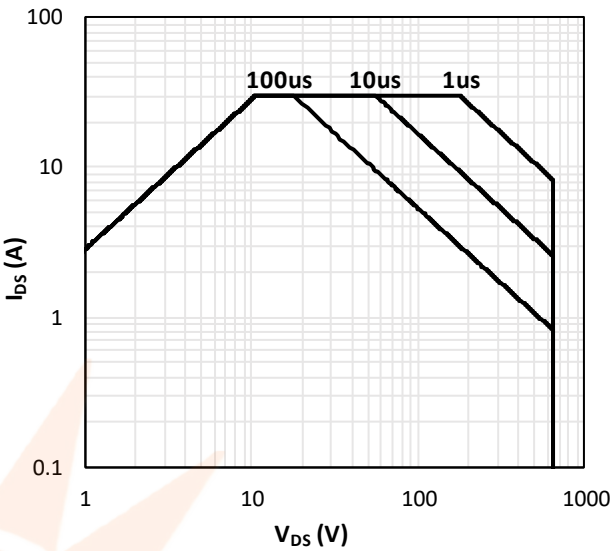


Fig. 2. Safe Operating Area T_C = 25°C

8. Thermal Characteristics

Table 5. Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Thermal resistance (Junction-to-case)	R _{th(j-c)}	-	-	2.4	°C/W	
Thermal resistance (Junction-to-ambient)	R _{th(j-a)}	-	-	62	°C/W	
Reflow soldering temperature	T _{SOLD}	-	-	260	°C	Reflow MSL3

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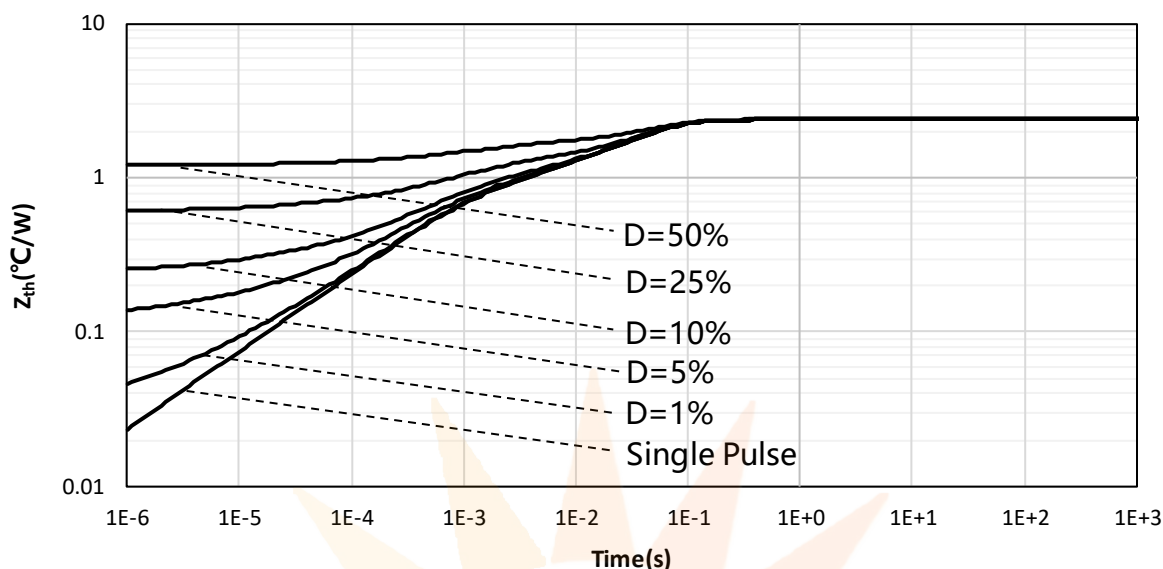


Fig. 3. Transient Thermal Impedance

9. Electrical Characteristics (T_J=25°C unless otherwise stated)

Table 6. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Forward Device Characteristics						
Gate threshold voltage	V _{GS(th)}	-	1.7	-	V	V _{DS} = V _{GS} , I _D = 0.5mA, T _J = 25°C
		-	0.8	-		V _{DS} = V _{GS} , I _D = 0.5mA, T _J = 150°C
Drain-source on-state resistance	R _{DS(on)}	-	167	-	mΩ	V _{GS} = 8V, I _D = 5A, T _J = 25°C
		-	352	-		V _{GS} = 8V, I _D = 5A, T _J = 150°C
Drain-to-source leakage current	I _{DSS}	-	7	-	μA	V _{DS} = 650V, V _{GS} = 0V, T _J = 25°C
		-	60	-		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

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Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input capacitance	C _{ISS}	-	599	-	pF	V _{GS} = 0V, V _{DS} = 400V, f = 1MHz, Fig.8
Output capacitance	C _{OSS}	-	29	-		
Reverse transfer capacitance	C _{RSS}	-	1	-		
Output capacitance, energy related ^a	C _{O(er)}	-	44	-	pF	V _{GS} = 0V, V _{DS} = 0V to 400V, Fig. 9 , Fig. 10
Output capacitance, time related ^b	C _{O(tr)}	-	79	-		
Total gate charge	Q _G	-	11.1	-	nC	V _{DS} = 400V, V _{GS} = 0V to 8V, I _D = 4A, Fig. 11
Gate-source charge	Q _{GS}	-	1.4	-		
Gate-drain charge	Q _{GD}	-	4.7	-		
Output charge	Q _{OSS}	-	31	-	nC	V _{GS} = 0V, V _{DS} = 0V to 400V
Turn-on delay	t _{D(on)}	-	17	-	ns	V _{DS} = 400V, V _{GS} = 0V to 8V, I _D = 4A, R _{G_on} = 30Ω, R _{G_off} =2Ω, Fig.14 , Fig.15
Rise time	t _r	-	7	-		
Turn-off delay	t _{D(off)}	-	37	-		
Fall time	t _f	-	12	-		
Reverse Device Characteristics						
Reverse voltage	V _{SD}	-	1.6	-	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}	-	13	-	ns	V _{DD} = 400V, di/dt = 1000A/us, V _{GS} = 0V, I _S = 5A, T _J = 25°C, Fig.16 , Fig. 17
Reverse recovery charge	Q _{RR}	-	43	-	nC	

Notes:

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

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

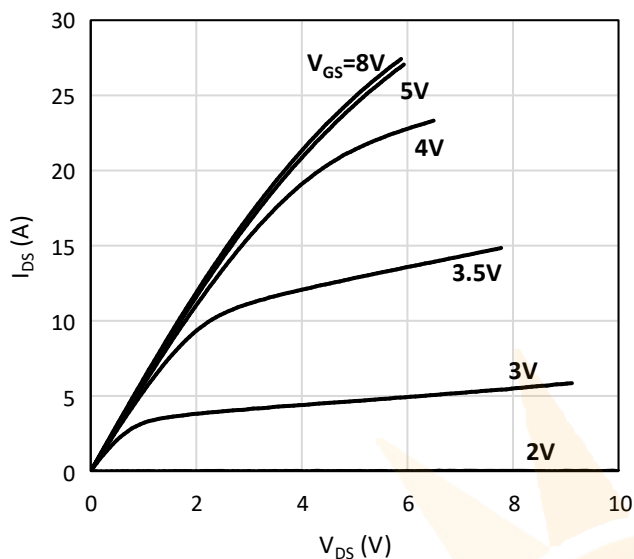


Fig. 4. Typical Output Characteristics

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

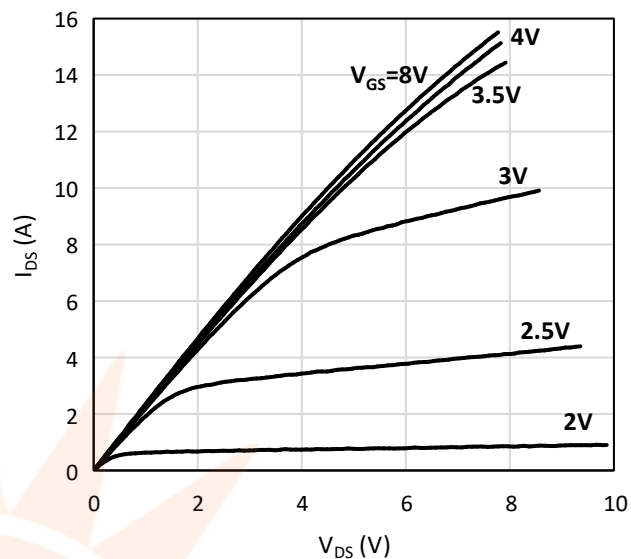


Fig. 5. Typical Output Characteristics

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

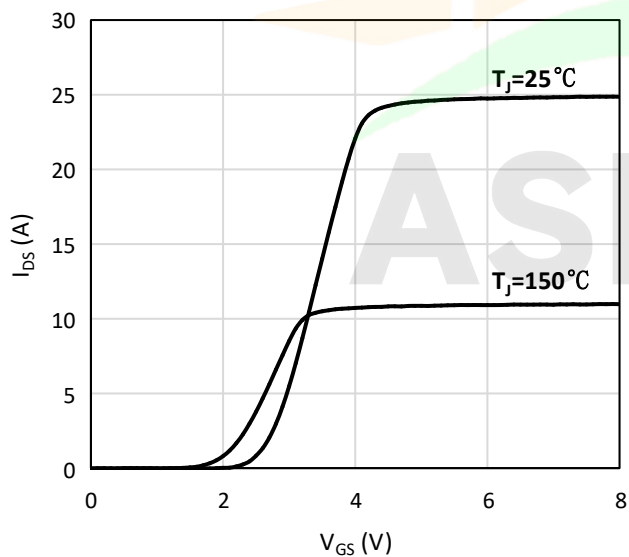


Fig. 6. Typical Transfer Characteristics

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

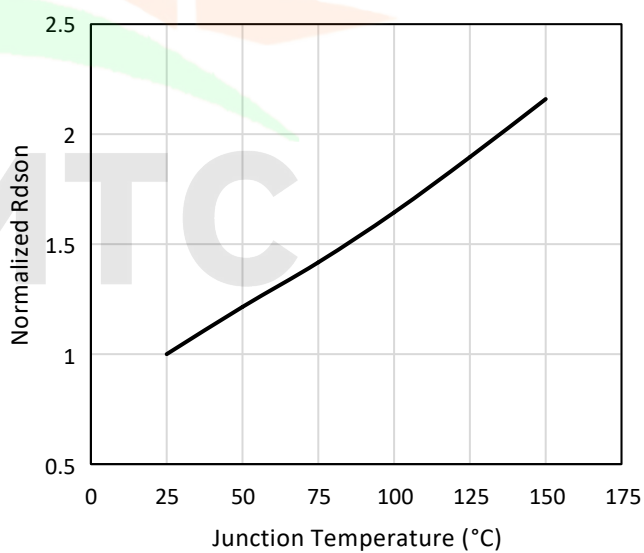


Fig. 7. Normalized On-resistance

$I_D = 5\text{A}$, $V_{GS} = 8\text{V}$

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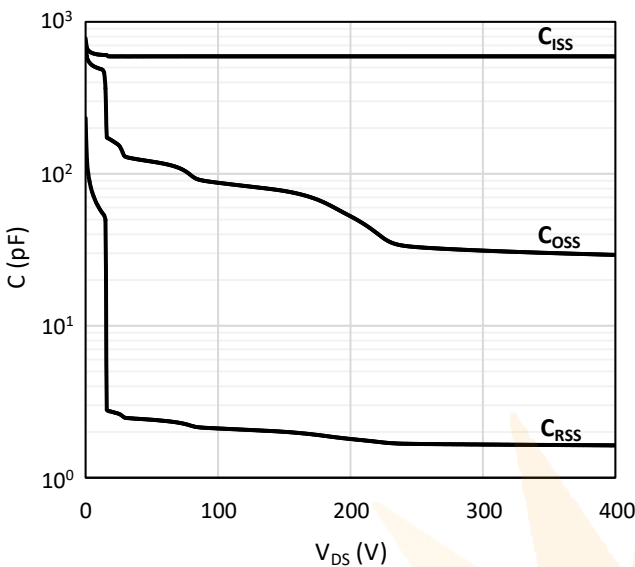


Fig. 8. Typical Capacitance

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

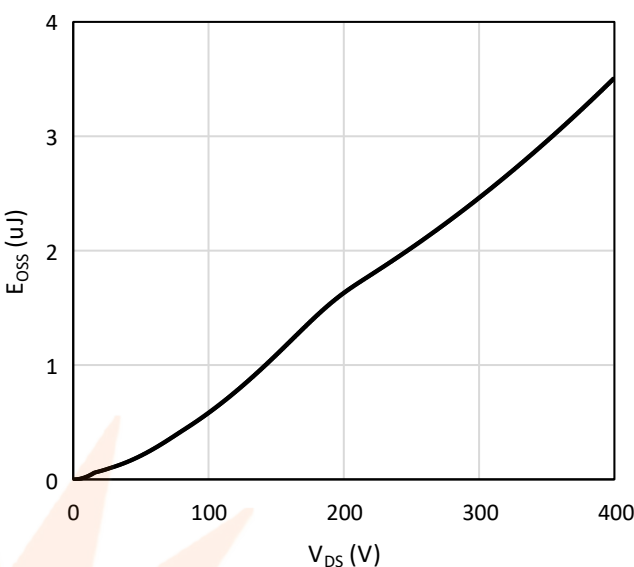


Fig. 9. Typical Coss Stored Energy

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

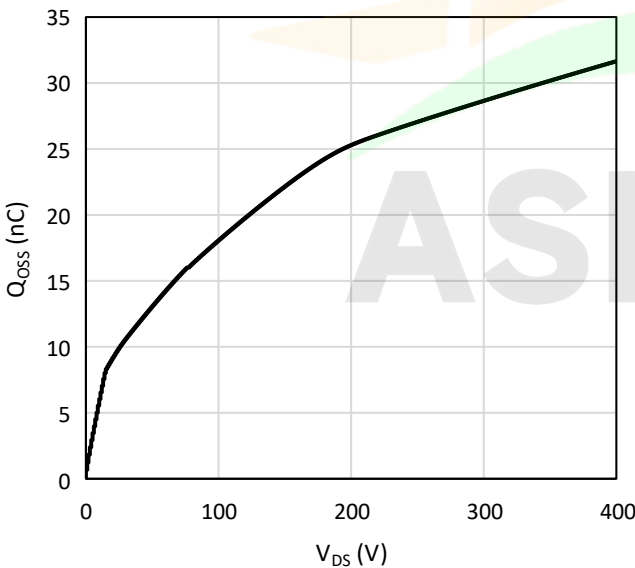


Fig. 10. Typical Q_{oss}

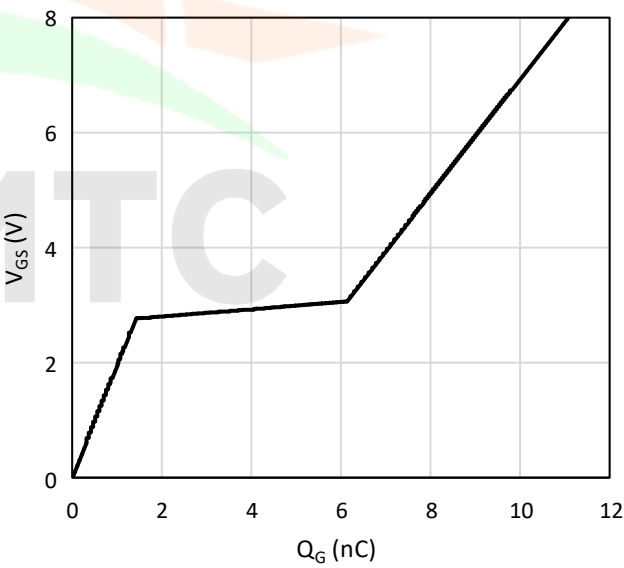


Fig. 11. Typical Gate Charge

$I_{DS} = 4A, V_{DS} = 400V$

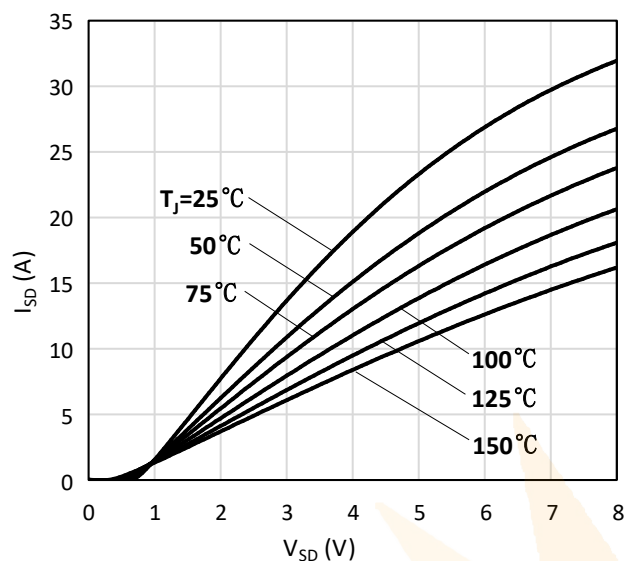


Fig. 12. Forward Characteristics of Rev. Diode

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

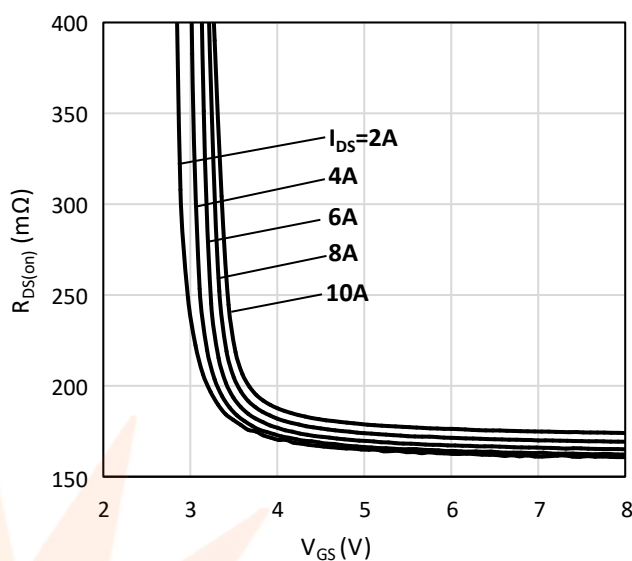


Fig. 13. Typical $R_{DS(on)}$

10. Test Circuits

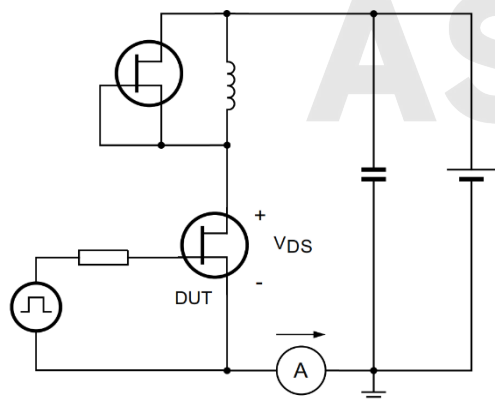


Fig. 14. Switching Time Test Circuit

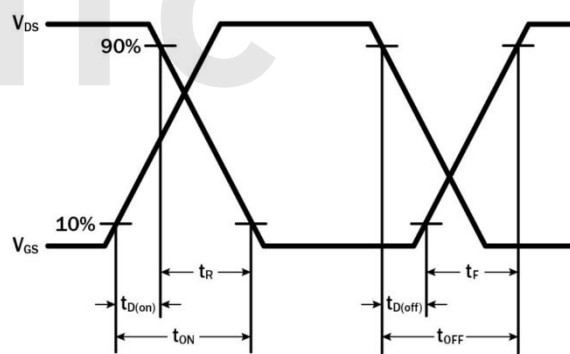


Fig. 15. Switching Time Waveform

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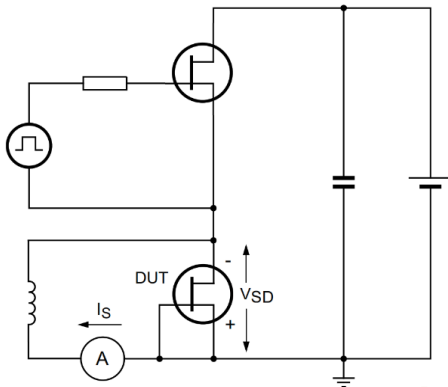


Fig. 16. Diode Characteristics Test Circuit

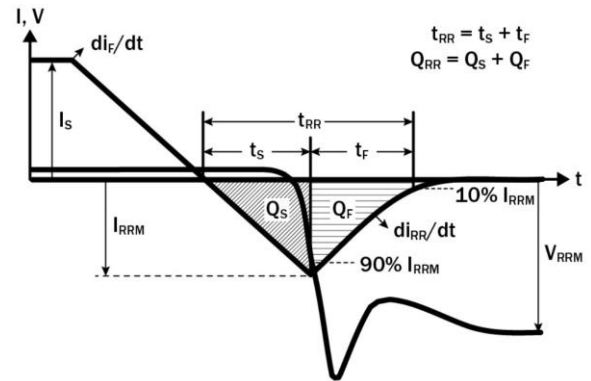


Fig. 17. Diode Recovery Waveform

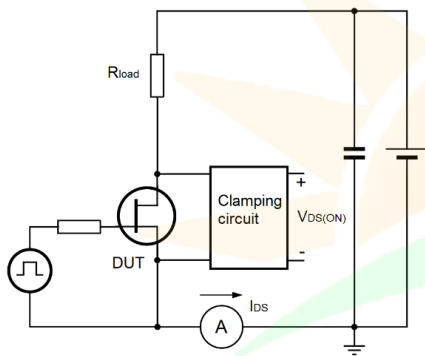


Fig. 18. Dynamic $R_{DS(on)eff}$ Test Circuit

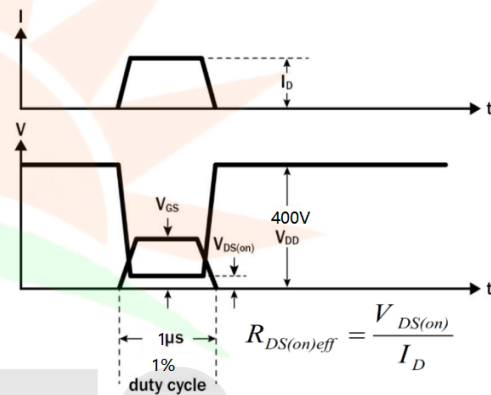
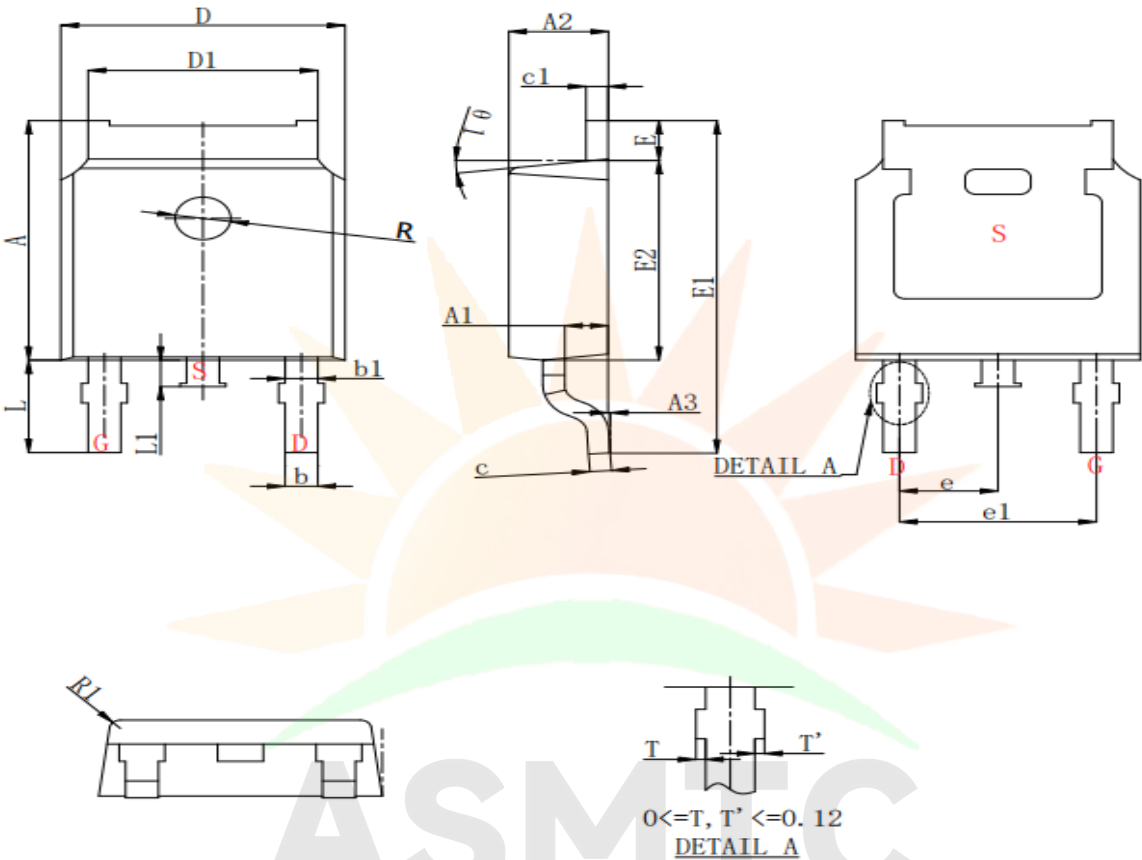


Fig. 19. Dynamic $R_{DS(on)eff}$ Waveform

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11. Package Information

11.1 TO-220 Package Information



SYMBOL	MIN	NOM	MAX	SYMBOL	MIN	NOM	MAX
A	7.050	7.100	7.150	E	0.950	1.000	1.050
A1	0.960	1.010	1.060	E1	9.700	9.900	10.100
A2	2.250	2.300	2.350	E2	6.050	6.100	6.150
A3	0.000	0.050	0.100	e	2.286BSC		
b	0.760REF.			e1	4.572REF		
b1	1.000REF.			L	2.650	2.800	2.950
c	0.508REF			L1	0.700	0.800	0.900
c1	0.508REF			θ 1	7° REF.		
D	6.550	6.600	6.650	R	1.300REF		
D1	5.220	5.320	5.420	R1	0.250REF		

Fig. 17. TO-252 Package Outline

12. Important Notice

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Revision History

Revision	Date	Changes
1.0	2023/11/9	Release Preliminary Datasheet

