HG65C1R070T

Preliminary Datasheet

650V, 70mΩ typ., Gallium Nitride (GaN) FET in TOLL Package

1. General Description

The HG65C1R070T is a 650V, 70 mΩ Gallium Nitride (GaN) FET in a TOLL 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

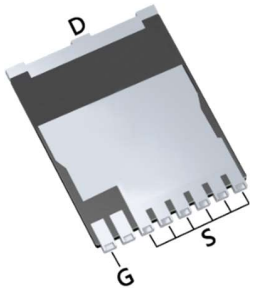
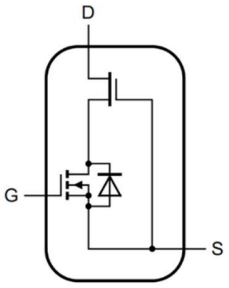
4. Key Specifications

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	22	A
$R_{DS(on),\ typ}$	Drain-source on-state resistance	70	mΩ
$Q_{G,\ typ}$	Total gate charge	15	nC
$Q_{RR,\ typ}$	Reverse recovered charge	110	nC

5. Pin Description

Table 2. Pin Description

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

6. Ordering Information

Table 3. Ordering Information

Part number	Package	Marking Code
HG65C1R070T	TOLL	HG65C1R070T

7. Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings (Tc=25℃ 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 ≤ 10ms at 25°C
Gate to source voltage	V_{GSS}	-20	20		
Maximum power dissipation	P_D	-	74	W	T_C = 25°C, Fig.1
Continuous drain current	I_D	-	22	A	T_C = 25°C
		-	14	A	T_C = 100°C
Pulsed drain current	I_{DM}	-	128	A	Pulsed, t_P ≤ 100μs, T_C = 25°C
Operating temperature	T_J	-55	150	°C	
Storage temperature	T_S	-55	150	°C	

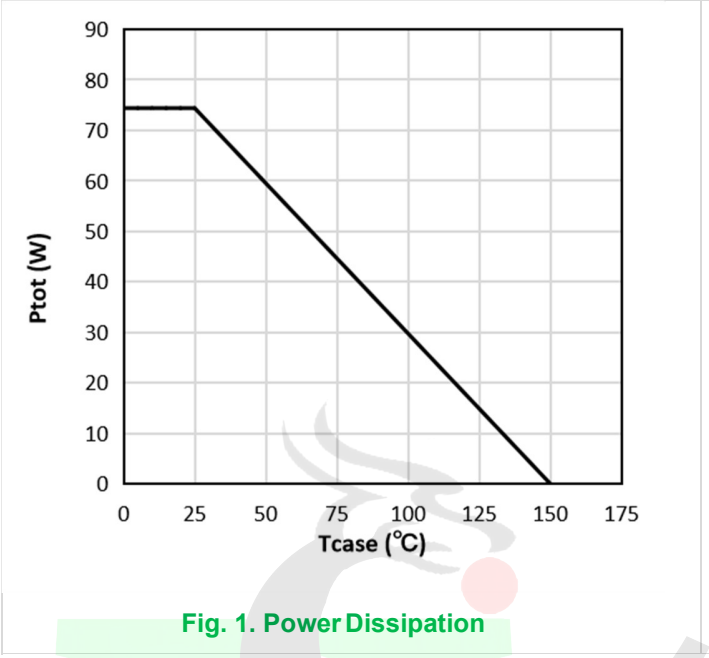


Fig. 1. Power Dissipation

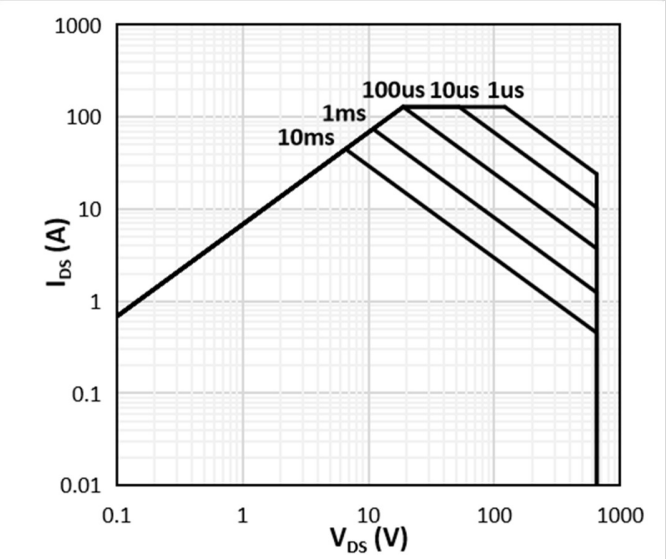


Fig 2. Safe Operating Area T_C = 25°C

8. Thermal Characteristics

Table 5. Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Thermal resistance (Junction-to-case)	$R_{th(j-c)}$	-	-	1.68	°C /W	
Thermal resistance (Junction-to-ambient) [a]	$R_{th(j-a)}$	-	-	41	°C /W	
Reflow soldering temperature	T_{SOLD}	-	-	260	°C	Reflow MSL3

Notes:

a. Device on one layer epoxy PCB for source connection (vertical and without air stream cooling, with 6cm^2 copper area and 70μm thickness).

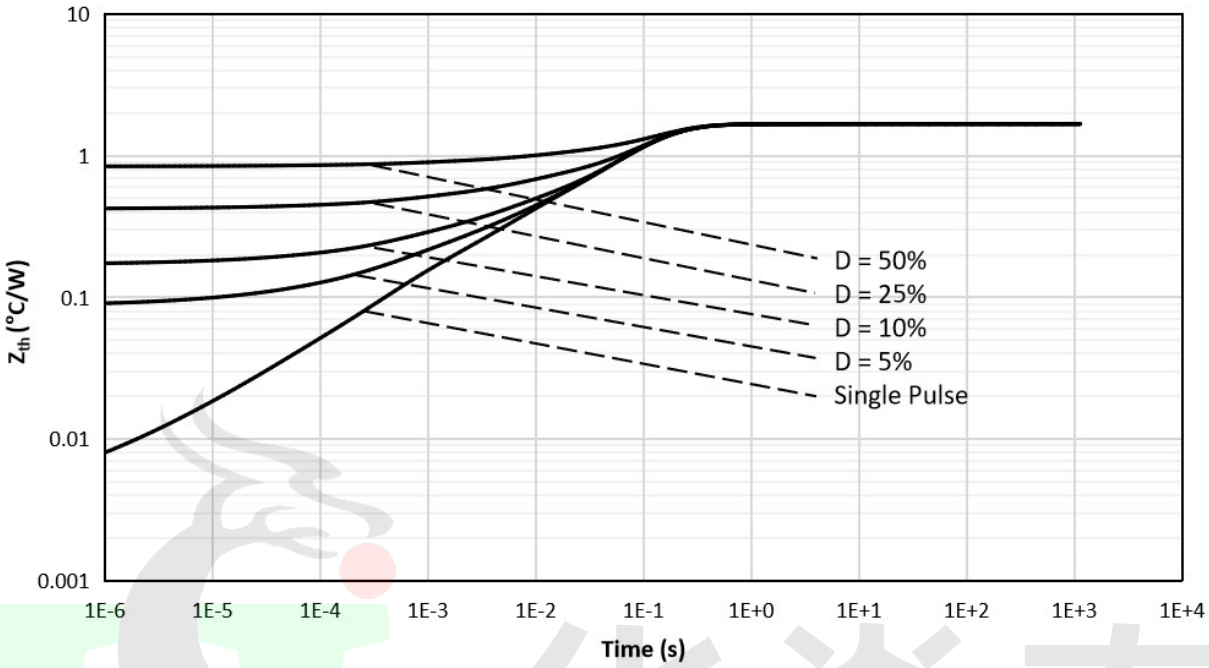


Fig. 3. Transient Thermal Impedance

9. Electrical Characteristics

Table 6. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Forward Device Characteristics						
Gate threshold voltage	$V_{GS(th)}$	3	3.8	4.6	V	V_{DS} = V_{GS}, I_D = 0.7mA, T_J = 25°C
		-	2.4	-		V_{DS} = V_{GS}, I_D = 0.7mA, T_J = 150°C
Drain-source on-state resistance [b]	$R_{DS(on)}$	-	70	87.5	mΩ	V_{GS} = 12V, I_D = 16A, T_J = 25°C, Fig.18, Fig.19
		-	147	-		V_{GS} = 12V,I_D = 16A, T_J = 150°C, Fig.18, Fig.19
Drain-to-source leakage current	I_{DSS}	-	5	25	μA	V_{DS} = 650V, V_{GS} = 0V, T_J = 25°C
		-	40	-		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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input capacitance	C_{ISS}	-	770	-	pF	V_{GS} = 0V, V_{DS} = 400V, f = 1MHz, Fig.8
Output capacitance	C_{OSS}	-	71	-		
Reverse transfer capacitance	C_{RSS}	-	1.3	-		
Output capacitance, energy related [c]	$C_{O(er)}$	-	123	-	pF	V_{GS} = 0V, V_{DS} = 0V to 400V, Fig.9, Fig.10
Output capacitance, time related [d]	$C_{O(tr)}$	-	238	-		
Total gate charge	Q_G	-	15	-	nC	V_{DS} = 400V, V_{GS} = 0V to 12V, I_D = 16A, Fig.11
Gate-source charge	Q_{GS}	-	3.9	-		
Gate-drain charge	Q_{GD}	-	5.5	-		
Output charge	Q_{OSS}	-	95.3	-	nC	V_{GS} = 0V, V_{DS} = 0V to 400V
Turn-on delay	$t_{D(on)}$	-	32	-	ns	V_{DS} = 400V, V_{GS} = 0V to 12V, I_D = 16A, R_{G_on} = 51Ω, R_{G_off} = 2Ω, Fig.14, Fig.15
Rise time	t_R	-	16	-		
Turn-off delay	$t_{D(off)}$	-	30	-		
Fall time	t_F	-	7	-		
Reverse Device Characteristics						
Reverse voltage [e]	V_{SD}	-	2	-	V	V_{GS} = 0V, I_S = 16A, Fig.12
		-	1.4	-		V_{GS} = 0V, I_S = 8A, Fig.12
Reverse recovery time	t_{RR}	-	30	-	ns	I_S = 16A, V_{DD} = 400V, di/dt = 1000A/us, Fig.16, Fig.17
Reverse recovery charge	Q_{RR}	-	110	-	nC	

Notes:
b. Dynamic $R_{DS(on)}$ value
c. Equivalent capacitance to give same stored energy from 0V to 400V
d. Equivalent capacitance to give same charging time from 0V to 400V
e. Includes dynamic $R_{DS(on)}$ effect

9.1 Electrical characteristics(curves) (T_C=25°C unless otherwise stated)

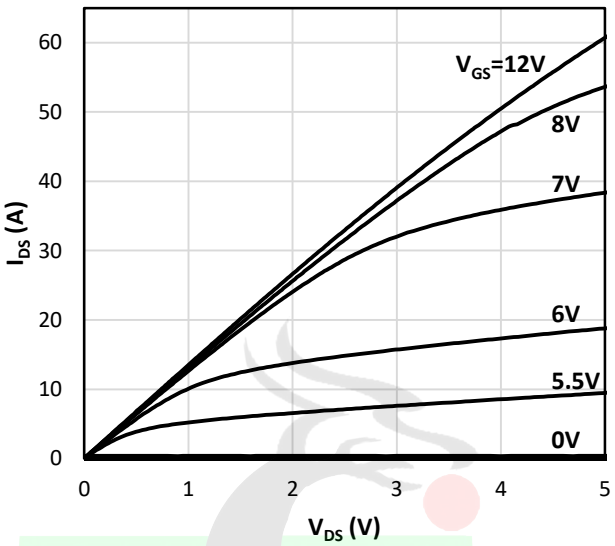


Fig. 4. Typical Output Characteristics
T_J = 25°C

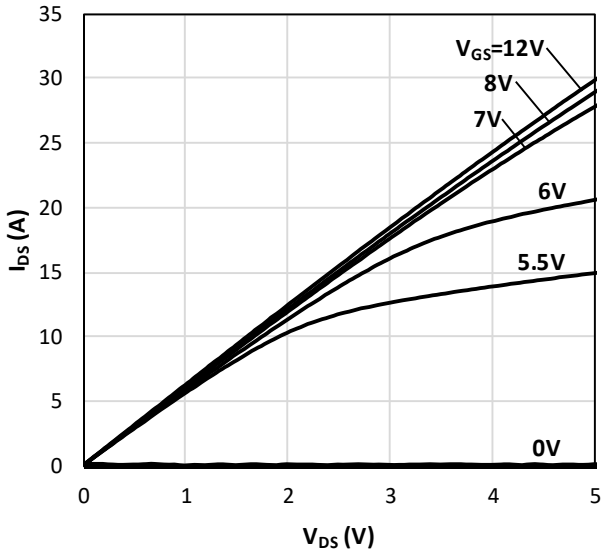


Fig. 5. Typical Output Characteristics
T_J = 150°C

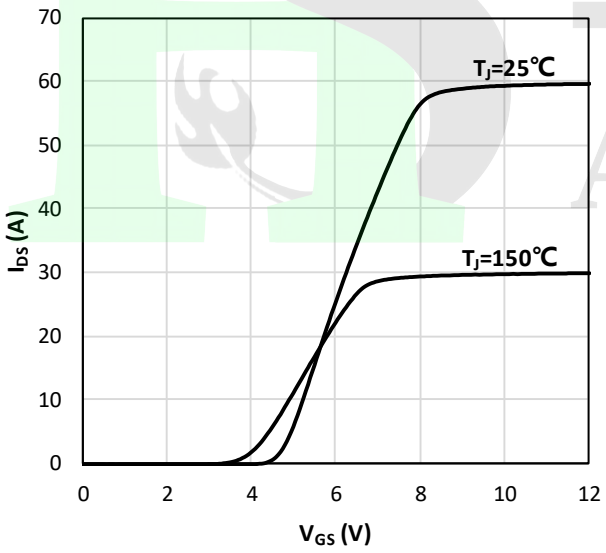


Fig. 6. Typical Transfer Characteristics
V_{DS}= 5V

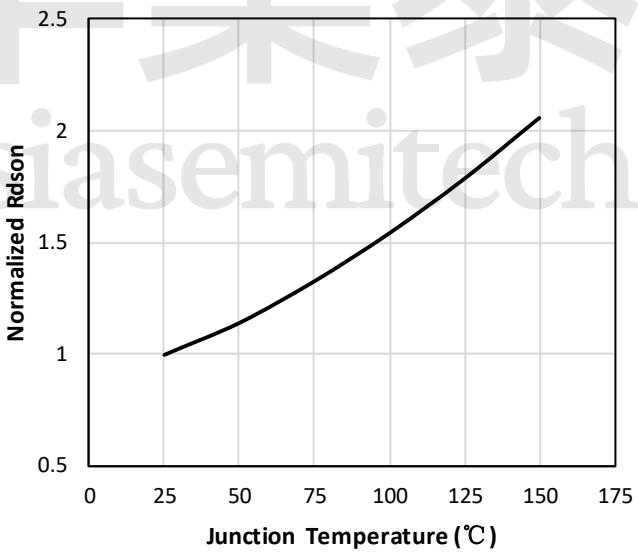


Fig. 7. Normalized On-resistance
I_D= 16A, V_{GS} = 12V

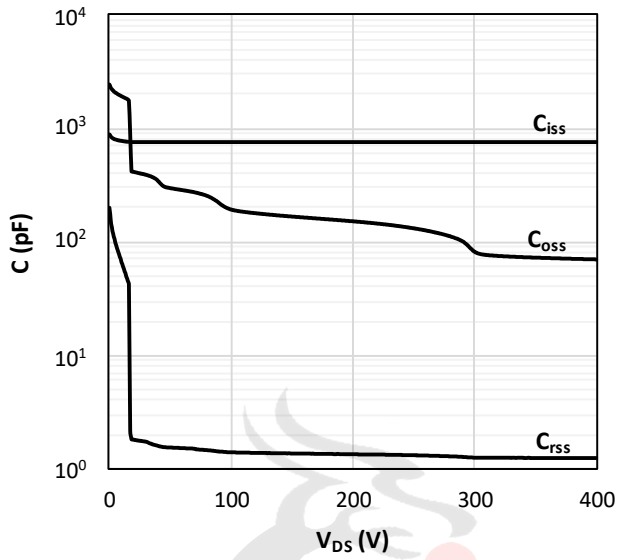


Fig. 8. Typical Capacitance
V_{GS} = 0V, f = 1MHz

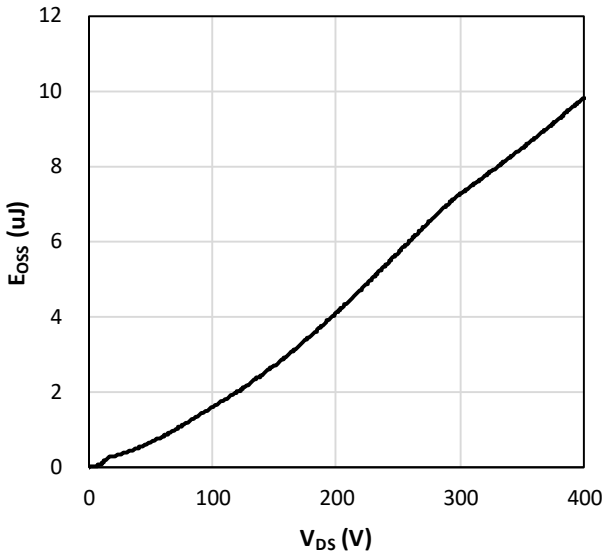


Fig. 9. Typical Coss Stored Energy
V_{GS} = 0V, f = 1MHz

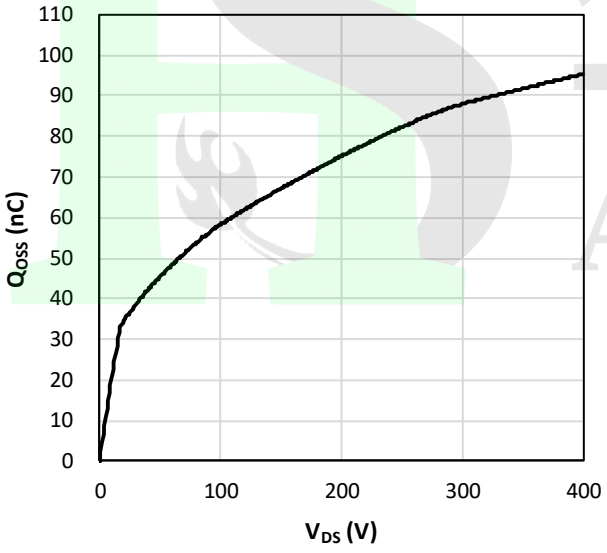


Fig. 10. Typical Q_{OSS}

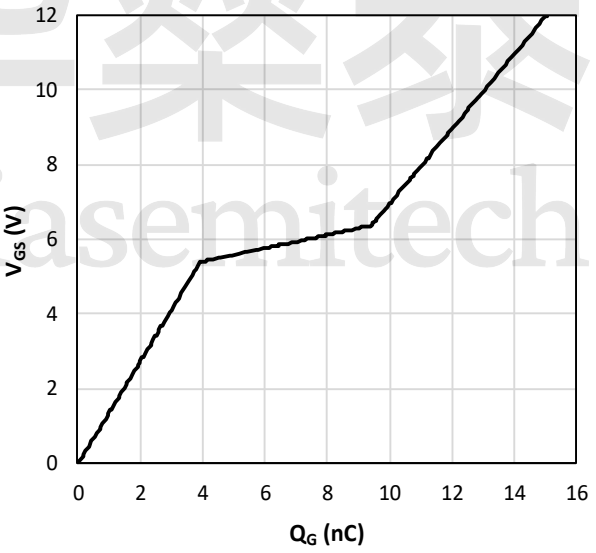


Fig. 11. Typical Gate Charge
I_{DS}= 16A, V_{DS} = 400V

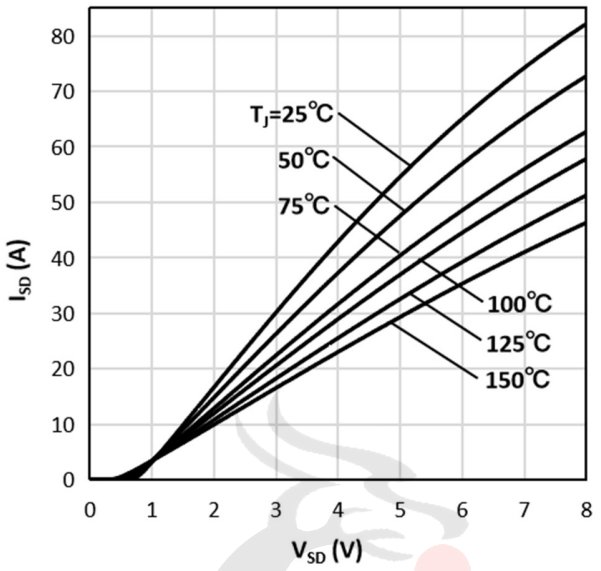


Fig. 12. Forward Characteristics of Rev. Diode
$I_{SD} = f(V_{SD})$

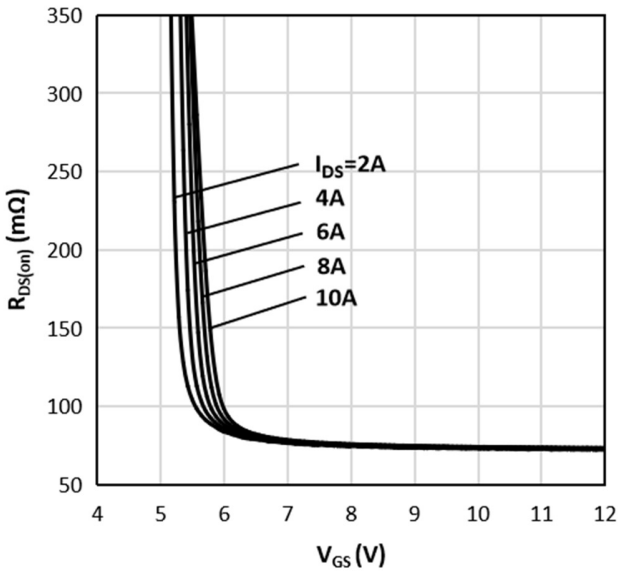


Fig. 13. Typical $R_{DS}(on)$

10. Test Circuits

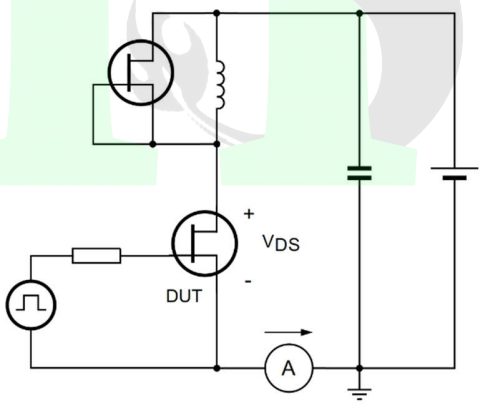


Fig. 14. Switching Time Test Circuit

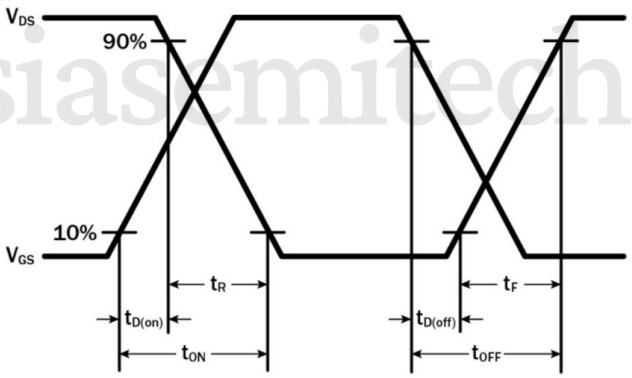


Fig. 15. Switching Time Waveform

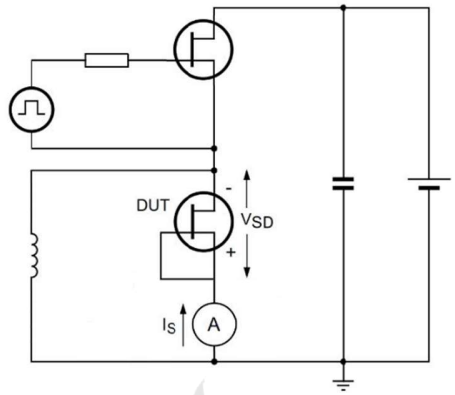


Fig. 16. Diode Characteristics Test Circuit

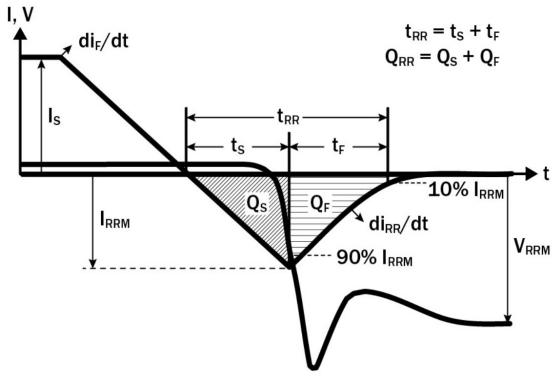


Fig. 17. Diode Recovery Waveform

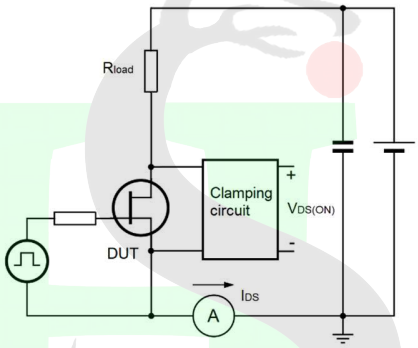


Fig. 18. Dynamic $R_{DS(on)eff}$ Test Circuit

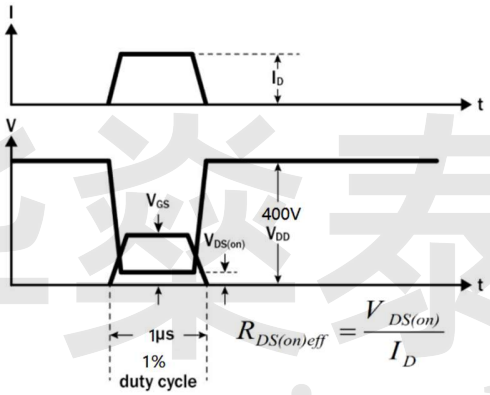


Fig. 19. Dynamic $R_{DS(on)eff}$ Waveform

11. Package Information

11.1 TOLL Package Information

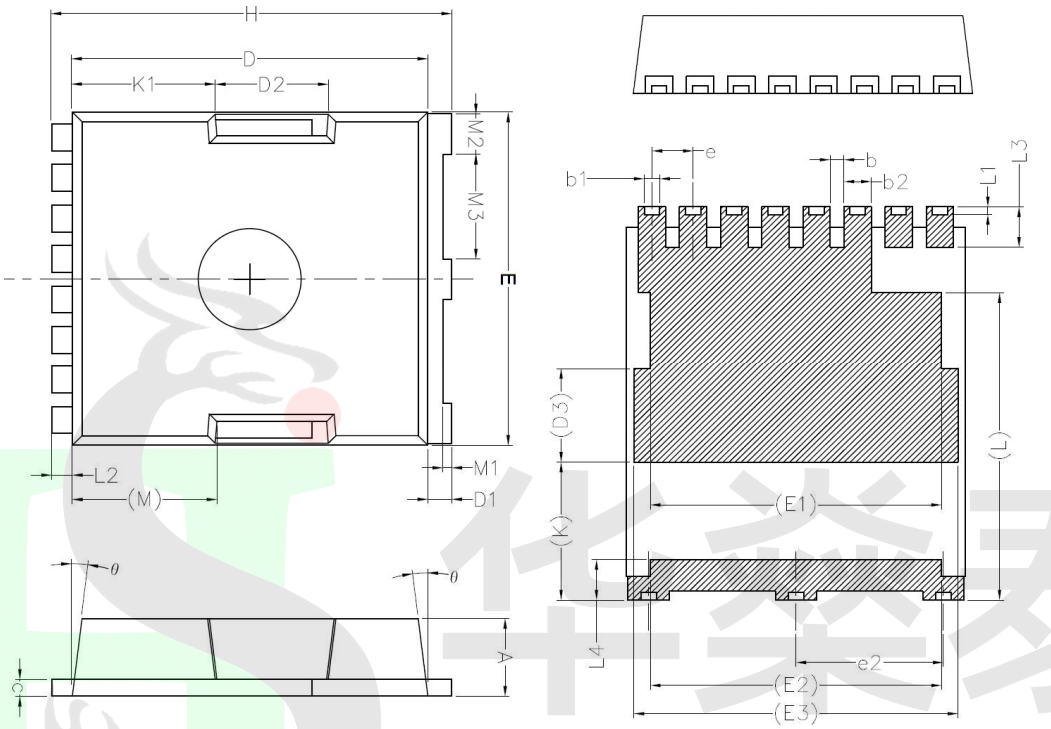


Fig. 20. TOLL Package Outline

SYMBOL	MIN	MAX	SYMBOL	MIN	MAX
A	2.20	2.40	H	11.48	11.88
b	0.30	0.50	K	(4.08)	
b1	0.35	0.55	K1	(4.17)	
b2	0.70	0.90	L	(9.13)	
c	0.40	0.60	L1	0.13	0.33
D	10.28	10.58	L2	0.50	0.70
D1	0.60	0.80	L3	1.10	1.30
D2	(3.30)		L4	1.10	1.30
D3	(2.77)		M	(4.23)	
E	9.70	10.10	M1	0.16	0.36
E1	(8.50)		M2	1.10	1.30
E2	(8.50)		M3	3.00	3.20
E3	(9.46)		θ	4°	10°
e	1.10	1.30	e2	4.20	4.40

12. Important Notice

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Revision History

Revision	Date	Changes
1.0	25/09/2023	Release Preliminary Datasheet
1.1	22/01/2024	Preliminary Datasheet $R_{DS(on)}$ updated
1.2	09/05/2025	Preliminary Datasheet P_D,I_D,I_{DM} updated