

Gallium Nitride E-Mode HEMT

GS700ETA165B: 165mΩ, 700V



Description

This is a 700V GaN-on-Si enhancement-mode power transistor in TO220 package. The properties of GaN allow for high current, high breakdown voltage and high switching frequency. The DFN8x8 package offers low parasitic inductance, strong heat dissipation capability and high solderability, which make GaN apply better to consumer and industrial applications.

Features

- Ultra-low FOM
- Ultra-high switching frequency
- Reverse current capability
- Zero reverse recovery loss
- Monolithic integrated ESD protection
- RoHS, Pb-free, REACH-compliant

Applications

- AC/DC converters
- DC/DC converters
- Bridgeless totem pole PFC
- Fast chargers
- Power adapters
- LED lighting drivers
- Wireless power transfer
- Laser drivers
- TV display

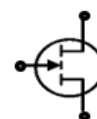
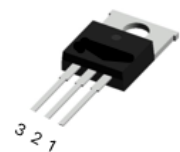


Table 1 Key Performance Parameters at T_j = 25 °C

Parameters	Values	Units
V _{DS, max}	700	V
R _{DS(on), max}	240	mΩ
Q _G	2.5	nC
I _{D, Pulse}	18	A
Q _{oss @ 400 V}	17	nC

Table 2 Pin Information

Gate	Source	Drian
1	2	3

Table 3 Order Information

Ordering Code	Package Type	Product Code	MOQ
GS700EWF165G1	TO220	GS700ETA165B	3k/reel

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1 Maximum ratings

at $T_j = 25\text{ }^{\circ}\text{C}$ unless otherwise specified. Continuous application of maximum ratings can deteriorate transistor lifetime.

Table 3 Maximum rating

Parameters	Symbols	Values	Units	Notes/Test Conditions
Drain-source voltage	$V_{DS, \max}$	700	V	$V_{GS} = 0\text{ V}$ $T_j = -55\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$
Drain-source voltage transient ¹	$V_{DS, \text{transient}}$	800	V	$V_{GS} = 0\text{ V}$
Continuous current, drain-source	I_D	10	A	$T_c = 25\text{ }^{\circ}\text{C}$
Pulsed current, drain-source ²	$I_{D, \text{pulse}}$	18	A	$T_c = 25\text{ }^{\circ}\text{C}$; $V_G = 6\text{ V}$
Pulsed current, drain-source ²	$I_{D, \text{pulse}}$	10	A	$T_c = 125\text{ }^{\circ}\text{C}$; $V_G = 6\text{ V}$
Gate-source voltage, continuous	V_{GS}	-1 to +7	V	$T_j = -55\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$
Gate-source voltage, pulsed	$V_{GS, \text{pulse}}$	-20 to +10	V	$T_j = -55\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$; $t_{\text{Pulse}} = 50\text{ ns}$, $f = 100\text{ kHz}$; open drain
Power dissipation	P_{tot}	75	W	$T_c = 25\text{ }^{\circ}\text{C}$
Operating temperature	T_j	-55 to +150	$^{\circ}\text{C}$	
Storage temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$	

1. $V_{DS, \text{transient}}$ is intended for surge rating during non-repetitive events, $t_{\text{Pulse}} < 1\text{ }\mu\text{s}$.

2. Pulse width = 10 μs .

2 Thermal characteristics

Table 4 Thermal characteristics

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Thermal resistance, junction-ambient	R_{thJA}		80		$^{\circ}\text{C/W}$	
Thermal resistance, junction-case	R_{thJC}	-	1.65	-	$^{\circ}\text{C/W}$	
Reflow soldering temperature	T_{sold}	-	-	260	$^{\circ}\text{C}$	MSL3

3 Electrical characteristics

at $T_j = 25\text{ }^{\circ}\text{C}$, unless specified otherwise.

Table 5 Static characteristics

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Gate threshold voltage	$V_{GS(TH)}$	1.2	1.6	2.5	V	$I_D = 10\text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 25\text{ }^{\circ}\text{C}$
		-	2	-		$I_D = 10\text{ mA}$; $V_{DS} = V_{GS}$; $T_j = 150\text{ }^{\circ}\text{C}$
Drain-source leakage current	I_{DSS}	-	0.01	0.5	μA	$V_{DS} = 700\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$
		-	1.5	-		$V_{DS} = 700\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 150\text{ }^{\circ}\text{C}$
Gate-source leakage current	I_{GSS}	-	2		μA	$V_{GS} = 6\text{ V}$; $V_{DS} = 0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	165	240	$\text{m}\Omega$	$V_{GS} = 6\text{ V}$; $I_D = 3\text{ A}$; $T_j = 25\text{ }^{\circ}\text{C}$
		-	390	-	$\text{m}\Omega$	$V_{GS} = 6\text{ V}$; $I_D = 3\text{ A}$; $T_j = 150\text{ }^{\circ}\text{C}$
Gate resistance	R_G	-	6.5	-	Ω	$f = 5\text{ MHz}$; open drain

Table 6 Dynamic characteristics

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	65	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 100\text{ KHz}$
Output capacitance	C_{oss}	-	20.6	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 100\text{ KHz}$
Reverse transfer capacitance	C_{rss}	-	0.14	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 400\text{ V}$; $f = 100\text{ KHz}$
Effective output capacitance, energy related ¹	$C_{o(er)}$	-	30	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 0\text{ to }400\text{ V}$
Effective output capacitance, time related ²	$C_{o(tr)}$	-	48	-	pF	$V_{GS} = 0\text{ V}$; $V_{DS} = 0\text{ to }400\text{ V}$
Output charge	Q_{oss}	-	17	-	nC	$V_{GS} = 0\text{ V}$; $V_{DS} = 0\text{ to }400\text{ V}$
Turn-on delay time	$t_{d(on)}$	-	2	-	ns	$V_{DS} = 400\text{ V}$; $I_D = 6\text{ A}$; $L = 318\text{ }\mu\text{H}$; $V_{GS} = 6\text{ V}$; $R_{on} = 10\text{ }\Omega$; $R_{off} = 2\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	3	-	ns	
Rise time	t_r	-	4	-	ns	
Fall time	t_f	-	5	-	ns	

1. $C_{o(er)}$ is the fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400 V.
2. $C_{o(tr)}$ is the fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400 V.

Table 7 Gate charge characteristics

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Gate charge	Q_G	-	2.0	-	nC	$V_{GS} = 0 \text{ to } 6 \text{ V}; V_{DS} = 400 \text{ V};$ $I_D = 3 \text{ A}$
Gate-source charge	Q_{GS}	-	0.4	-	nC	
Gate-drain charge	Q_{GD}	-	0.7	-	nC	
Gate plateau voltage	V_{plat}	-	2.5	-	V	$V_{DS} = 400 \text{ V}; I_D = 3 \text{ A}$

Table 8 Reverse conduction characteristics

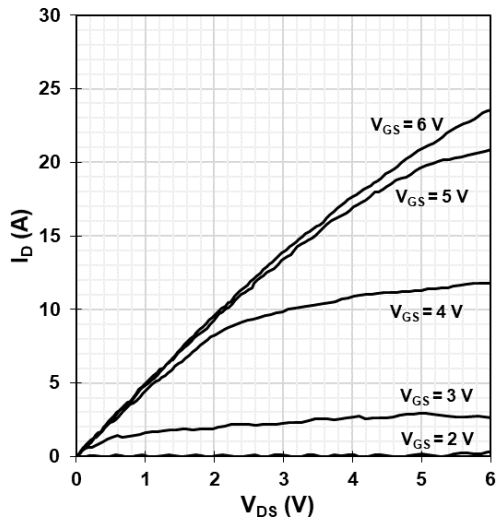
Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Source-drain reverse voltage	V_{SD}	-	4.0	-	V	$V_{GS} = 0 \text{ V}; I_{SD} = 3 \text{ A}$
Pulsed current, reverse	$I_{S, pulse}$	-	-	18	A	$V_{GS} = 6 \text{ V}$
Reverse recovery charge ¹	Q_{rr}	-	0	-	nC	$I_{SD} = 3 \text{ A}; V_{DS} = 400 \text{ V}$
Reverse recovery time	t_{rr}	-	0	-	ns	
Peak reverse recovery current	I_{rm}	-	0	-	A	

1. Excluding Q_{oss}

4 Electrical characteristics diagrams

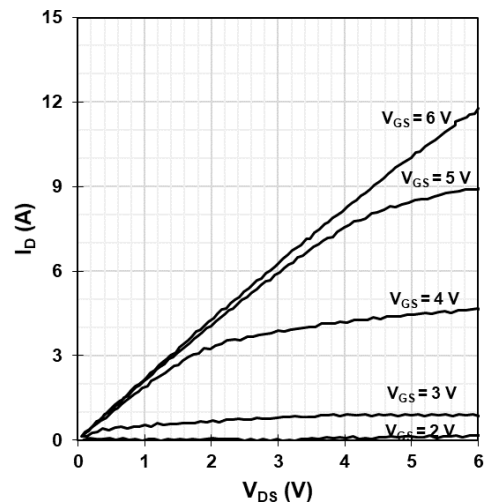
at $T_j = 25\text{ }^{\circ}\text{C}$, unless specified otherwise.

Figure 1 Typ. output characteristics



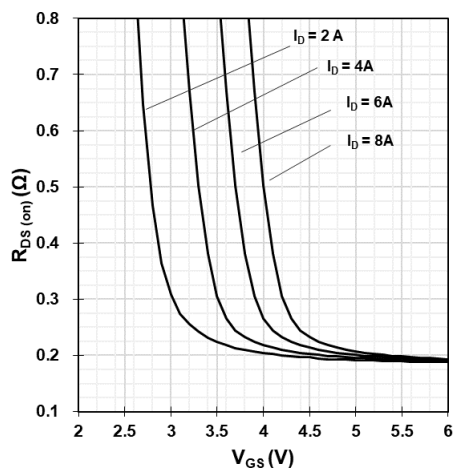
$$I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ }^{\circ}\text{C}$$

Figure 2 Typ. output characteristics



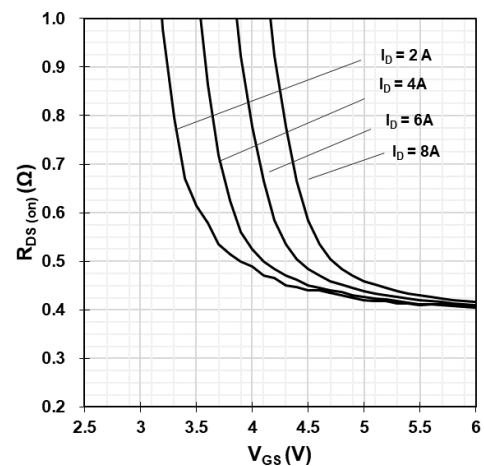
$$I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ }^{\circ}\text{C}$$

Figure 3 Typ. drain-source on-state resistance



$$R_{DS(on)} = f(I_D, V_{GS}); T_j = 25\text{ }^{\circ}\text{C}$$

Figure 4 Typ. drain-source on-state resistance



$$R_{DS(on)} = f(I_D, V_{GS}); T_j = 125\text{ }^{\circ}\text{C}$$

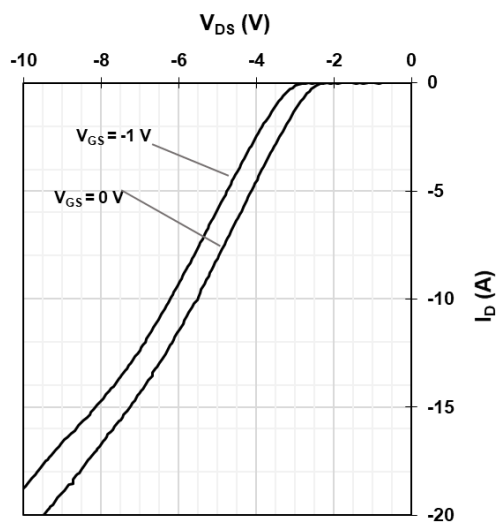
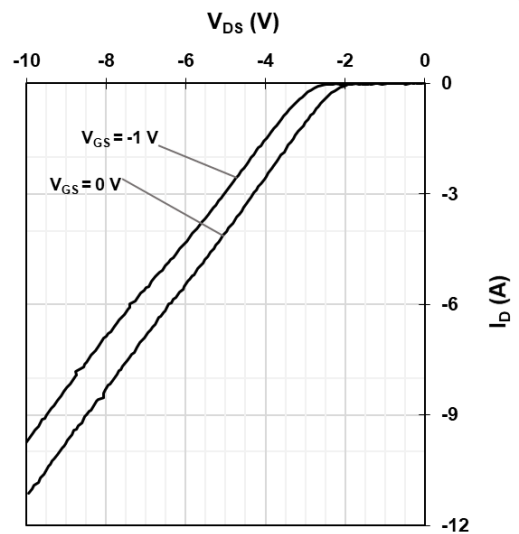
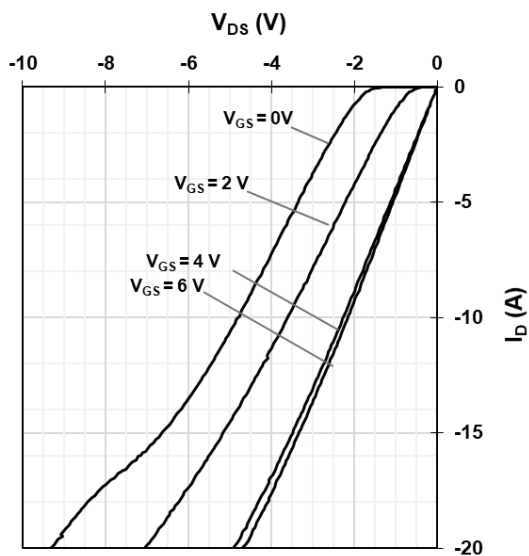
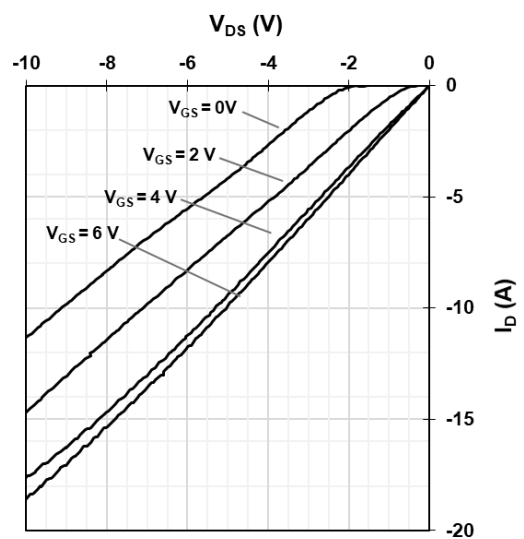
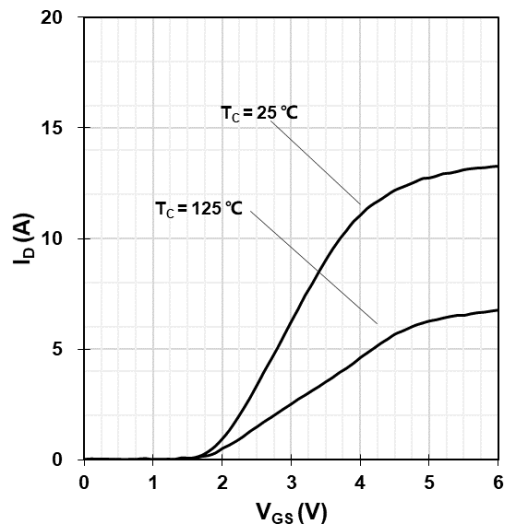
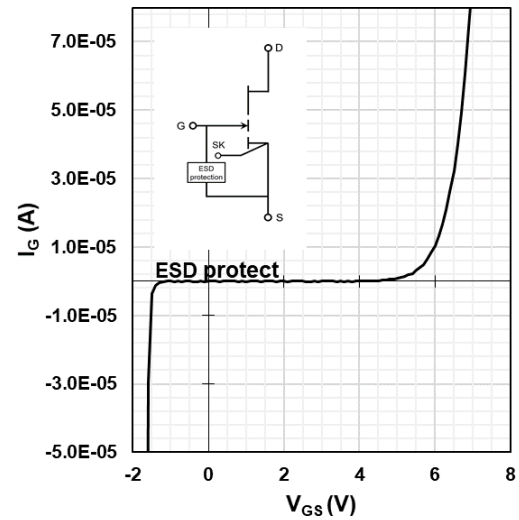
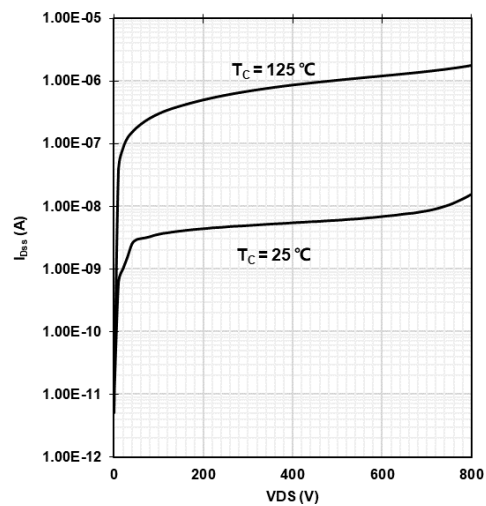
Figure 5 Typ. channel reverse characteristics

 $I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ }^{\circ}\text{C}$
Figure 6 Typ. channel reverse characteristics

 $I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ }^{\circ}\text{C}$
Figure 7 Typ. channel reverse characteristics

 $I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ }^{\circ}\text{C}$
Figure 8 Typ. channel reverse characteristics

 $I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ }^{\circ}\text{C}$

Figure 9 Typ. transfer characteristics


$$I_D = f(V_{GS}); V_{DS} = 3\text{ V}$$

Figure 10 Typ. gate-to-source leakage


$$I_G = f(V_{GS}); V_D = \text{open}$$

Figure 11 Drain-source leakage characteristics


$$I_{DSS} = f(V_{DS}); V_{GS} = 0\text{ V}$$

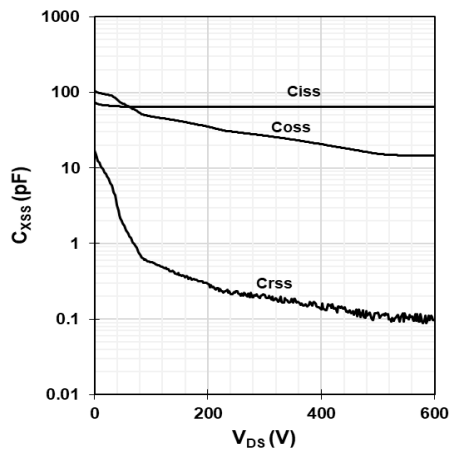
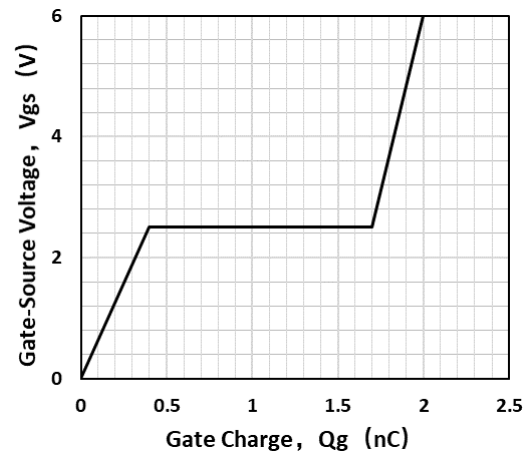
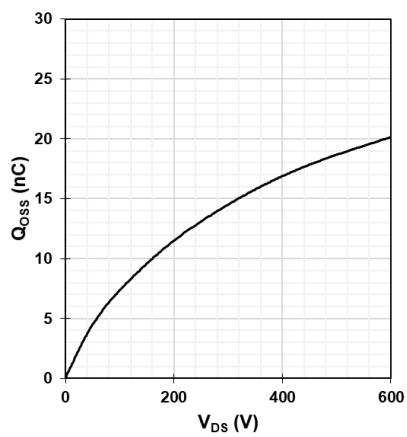
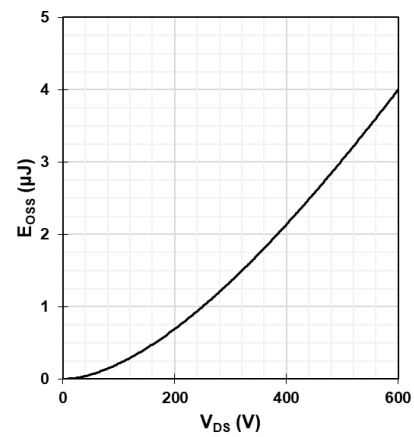
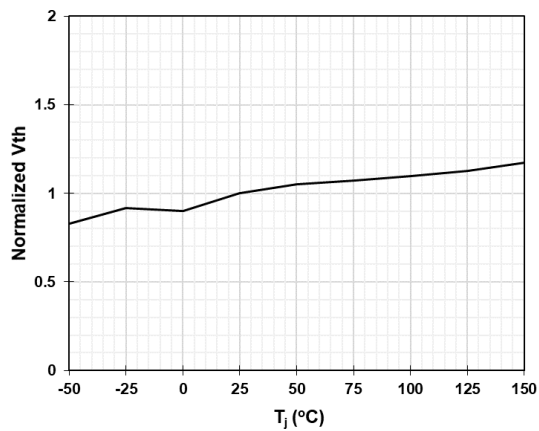
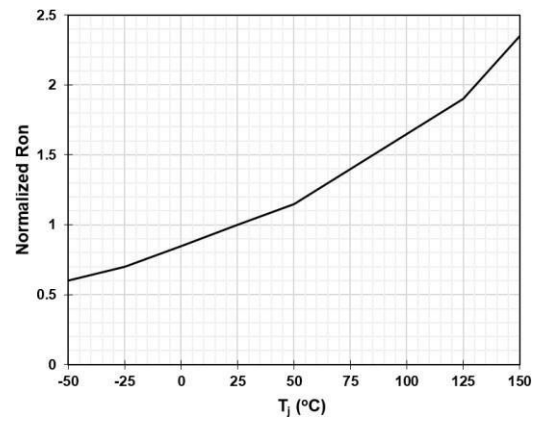
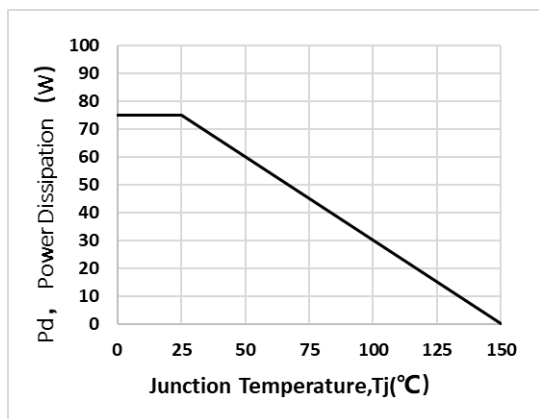
Figure 12 Typ. capacitances

 $C_{XSS} = f(V_{DS}); \text{Freq.} = 100\text{kHz}$
Figure 13 Typ. gate charge

 $V_{GS} = f(Q_G); V_{DS} = 400\text{V}; I_D = 3\text{A}$
Figure 14 Typ. output charge

 $Q_{OSS} = f(V_{DS}); \text{Freq.} = 100\text{kHz}$
Figure 15 Typ. C_oss stored energy

 $E_{OSS} = f(V_{DS}); \text{Freq.} = 100\text{kHz}$

Figure 16 Gate threshold voltage


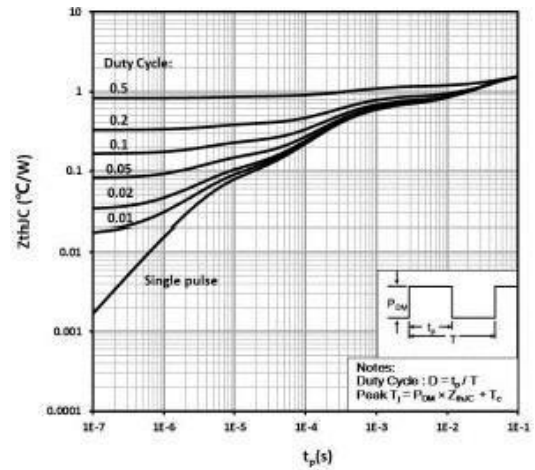
$$V_{GS(TH)} = f(T_j); V_{GS} = V_{DS}; I_D = 16 \text{ mA}$$

Figure 17 Drain-source on-state resistance


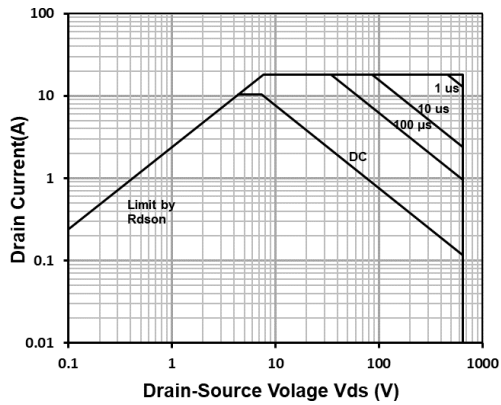
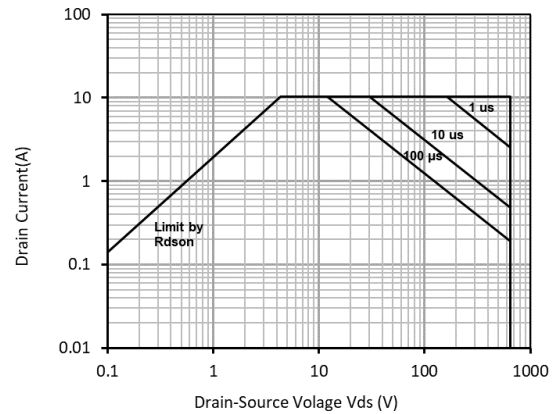
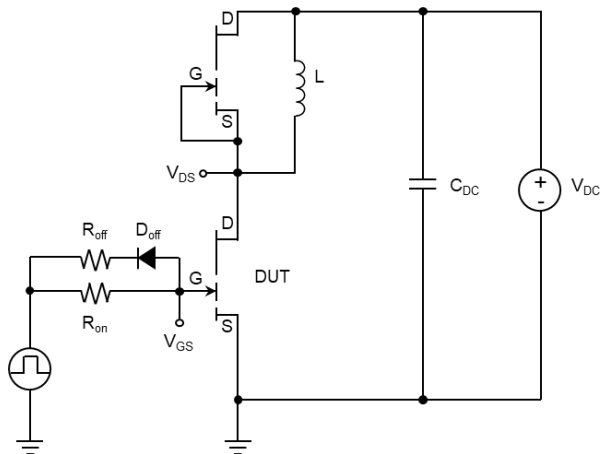
$$R_{DS(on)} = f(T_j); I_D = 3 \text{ A}; V_{GS} = 6 \text{ V}$$

Figure 18 Power dissipation


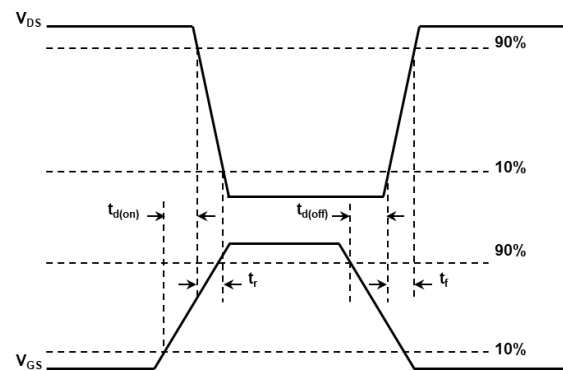
$$P_{tot} = f(T_c)$$

Figure 19 Max.transient thermal impedance


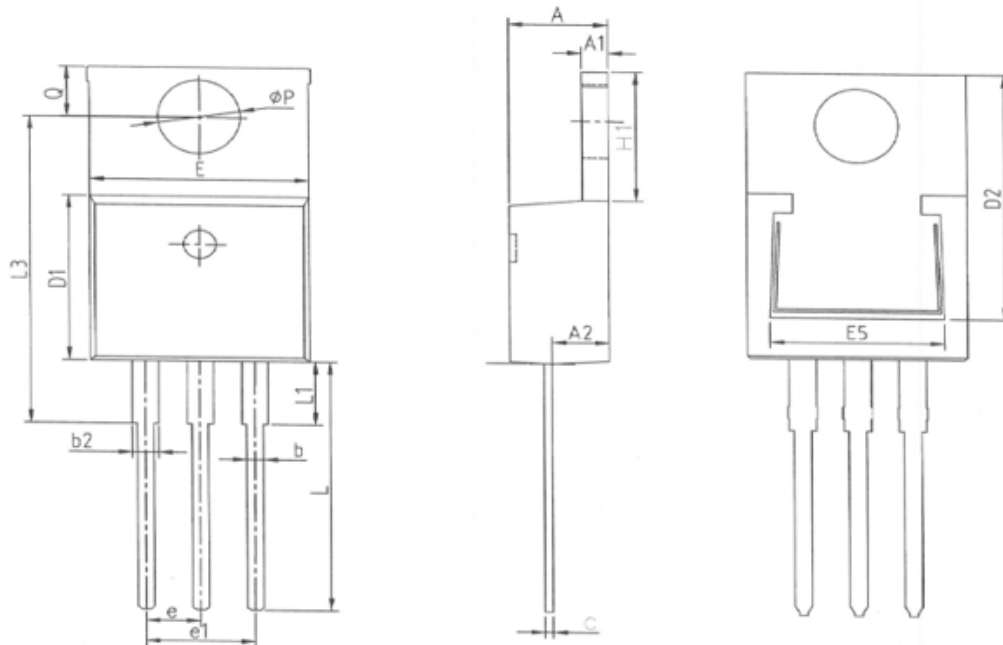
$$Z_{thjc} = f(t_p, D)$$

Figure 20 Safe Operation Area

 $I_d = f(V_{ds}); T_c = 25^\circ\text{C}$
Figure 21 Safe Operation Area

 $I_d = f(V_{ds}); T_c = 125^\circ\text{C}$
Figure 22 Switching time test circuit


$V_{DS} = 400\text{ V}, I_D = 6\text{ A}, L = 318\text{ }\mu\text{H}, V_{GS} = 6\text{ V},$
 $R_{on} = 10\text{ }\Omega, R_{off} = 2\text{ }\Omega$

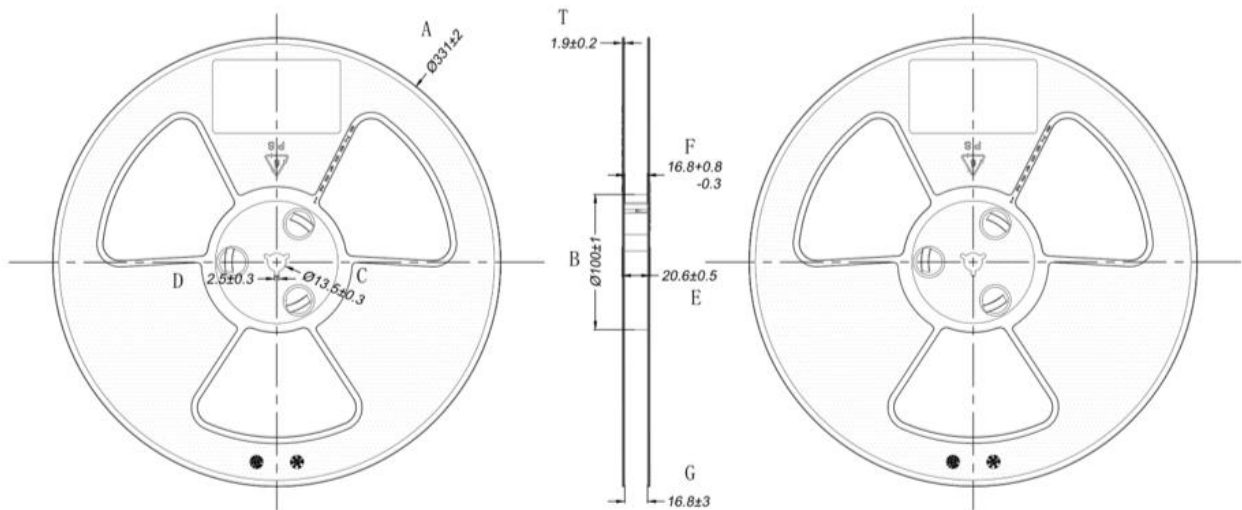
Figure 23 Typ. switching time waveforms


5 Package Outlines



SYMBOL	MM			SYMBOL	MM		
	MIN	NOM	MAX		MIN	NOM	MAX
A	4.37	4.57	4.77	E5	6.80	8.20	8.60
A1	1.22	1.27	1.42	e	2.54 BSC		
A2	2.49	2.69	2.89	e1	5.08 BSC		
b	0.75	0.81	0.96	H1	6.10	6.30	6.50
b2	1.22	1.27	1.47	L	13.10	13.40	13.70
c	0.30	0.38	0.48	L1	-	3.75	4.10
D1	8.50	8.70	8.90	L3	15.80	16.00	16.40
D2	12.00	12.40	12.80	ΦP	3.70	3.84	3.99
E	9.86	10.16	10.36	Q	2.54	2.74	2.94

6 Reel Information



$A \pm 2$	$B \pm 1$	$C \pm 0.3$	$D \pm 0.3$	$E \pm 0.5$	$F^{+0.8}_{-0.3}$	$G \pm 3$	$T \pm 0.2$
$\Phi 331$	$\Phi 100$	$\Phi 13.5$	2.5	20.6	16.8	16.8	1.9

7 Revision history

Major changes since the last revision

Revision	Date	Description of changes
1.0	2025-01-23	1.0 version release
2.0	2025-04-28	Implemented Electrical Characteristic Diagram and Data and Reel Information