

650V Enhancement-mode GaN Transistor

Description

650V Normally-OFF GaN			
$V_{DS}(V)$	$R_{DS(on)}(m\Omega)$	$I_{DS}(A)$	$Q_G(nC)$
650	160	16	7.9

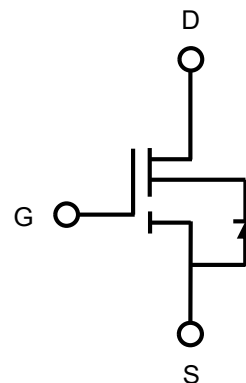

TO-220F (Top View)

Feature

- Normally-off device combines high voltage GaN HEMT and low voltage silicon MOSFET
- Normally off power switch
- Low reverse-recovery charge
- High switching frequency
- Low gate charge, low output charge
- Qualified for industrial applications according to JEDEC Standards
- Package: TO-220F

Applications

- Fast charger
- Renewable energy
- Telecom and data-com
- Servo motors
- Industrial
- Automotive


Circuit Diagram

Absolute maximum rating@25°C

Rating	Symbol	Value	Units
Drain-Source Voltage	V_{DS}	650	V
Drain-Source Voltage-transient ¹⁾	$V_{DS(transient)}$	800	V
Gate-Source Voltage	V_{GS}	-20 to +20	V
Drain Current-Continuous ²⁾	$T_C = 25^\circ C$	16	A
	$T_C = 125^\circ C$	7.0	A
Pulse Drain Current (pulse width: 100 μ s)	I_{DM}	27	A
Maximum Power Dissipation	P_D	78	W
Junction and Storage Temperature Range	T_J, T_{STG}	-55~+150	°C

Notes:

1. In off-state, spike duty cycle $D < 0.01$, spike duration $< 1\mu s$
2. For increased stability at high current operation.

Thermal characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Thermal Resistance, Junction - Case	$R_{\theta JC}$	-	1.6	-	°C/W

Electrical characteristics per line@25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0V$	650	-	-	V
Total Drain Leakage Current	I_{DSS}	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ C$	-	-	10	μA
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^\circ C$	-	-	100	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 1mA$	3.3	4	4.8	V
Gate Threshold Voltage Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		-	-7	-	mV/°C
Gate-Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20V$	-	-	± 100	nA
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 1A, T_J = 25^\circ C$	-	160	220	m Ω
		$V_{GS} = 10V, I_D = 1A, T_J = 150^\circ C$	-	340	-	
Input Capacitance	C_{iss}	$V_{DS} = 400V, V_{GS} = 0V, f = 1MHz$	-	293	-	μF
Output Capacitance	C_{oss}		-	17	-	
Reverse Transfer Capacitance	C_{rss}		-	3.74	-	
Output Charge	Q_{oss}	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V, f = 1MHz$	-	22.2	-	nC
Total Gate Charge	Q_g	$V_{GS} = 0 \text{ to } 10V, V_{DS} = 400V, I_D = 1A$	-	7.9	-	nC
Gate-Source Charge	Q_{gs}		-	2.31	-	
Gate-Drain Charge	Q_{gd}		-	1.65	-	
Turn-on Delay Time	$t_{d(on)}$	$V_{DS} = 400V, V_{GS} = 0V \text{ to } 10V, I_D = 2.1A, R_{G-on(ext)} = 6.8\Omega, R_{G-off(ext)} = 2.2\Omega, L = 250\mu H$	-	3.2	-	ns
Turn-on Rise Time	t_r		-	5.5	-	
Turn-Off Delay Time	$t_{d(off)}$		-	7.4	-	
Turn-Off Fall Time	t_f		-	27	-	
Reverse Device Characteristics						
Diode Forward Voltage	V_{SD}	$V_{GS} = 0V, I_{SD} = 10A$	-	2.5	-	V
Reverse Recovery Time	t_{rr}	$I_F = 10A, V_{DD} = 400V, di_F/dt = 165A/\mu s$	-	14	-	ns
Reverse Recovery Charge	Q_{rr}		-	6.5	-	nC

Typical Characteristics

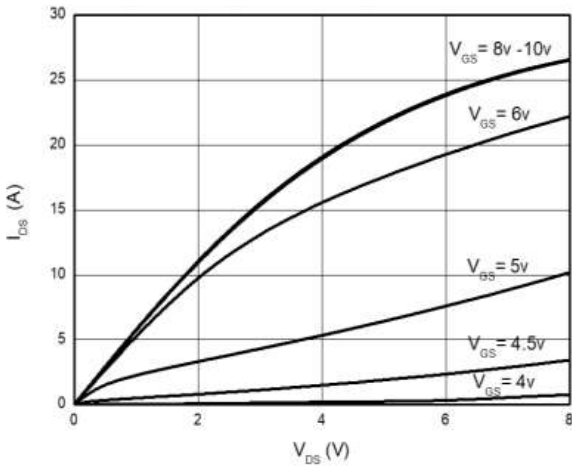


Figure 1. Typical Output Characteristics $T_j=25^\circ\text{C}$

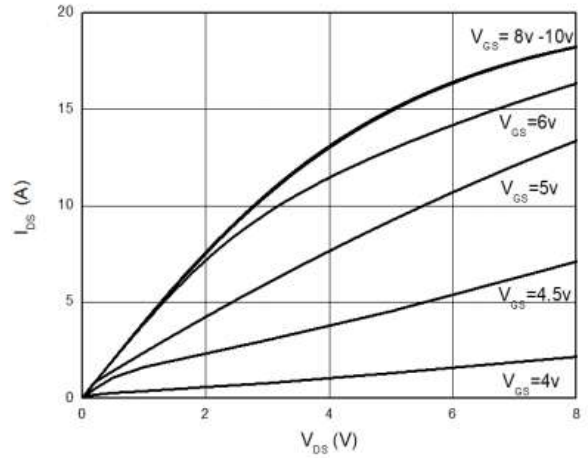


Figure 2. Typical Output Characteristics $T_j=125^\circ\text{C}$

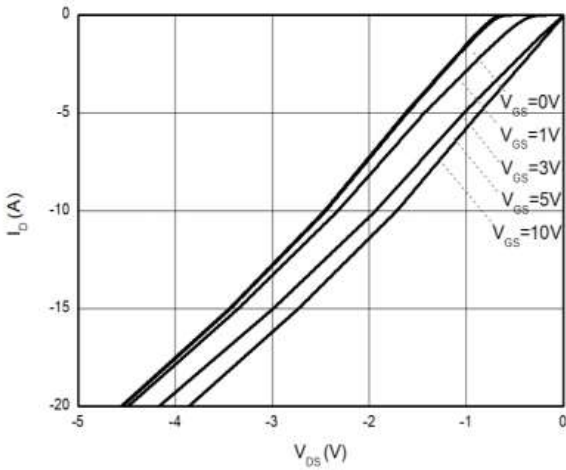


Figure 3. Channel Reverse Characteristics $T_j=25^\circ\text{C}$

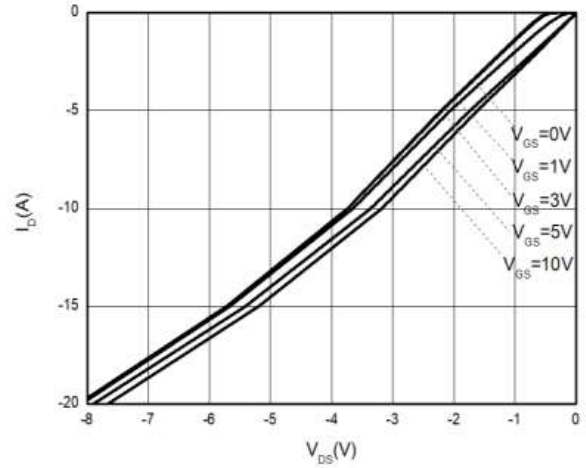


Figure 4. Channel Reverse Characteristics $T_j=125^\circ\text{C}$

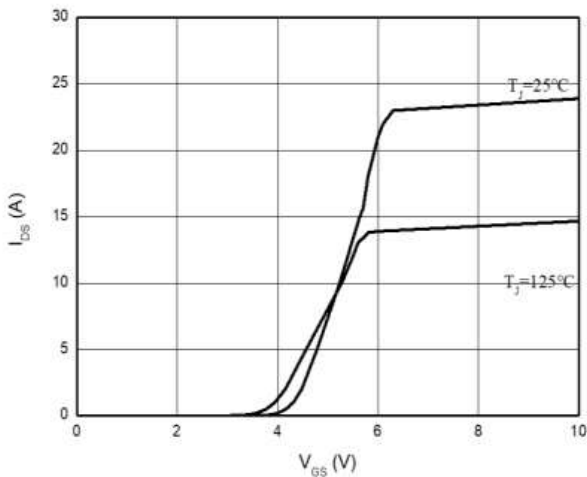


Figure 5. Typical Transfer Characteristics ($V_{ds}=5V$)

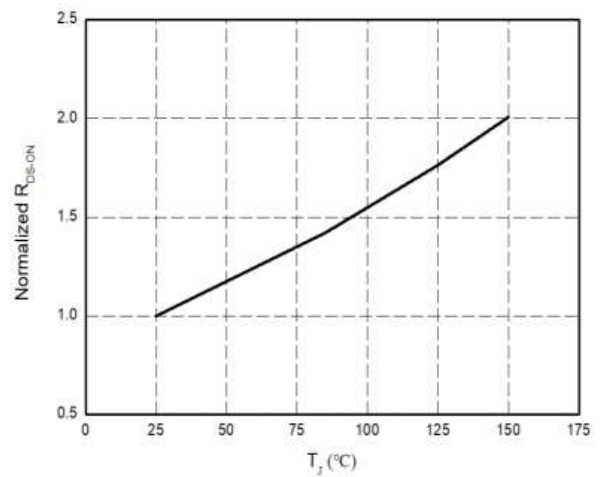


Figure 6. Normalized On-resistance

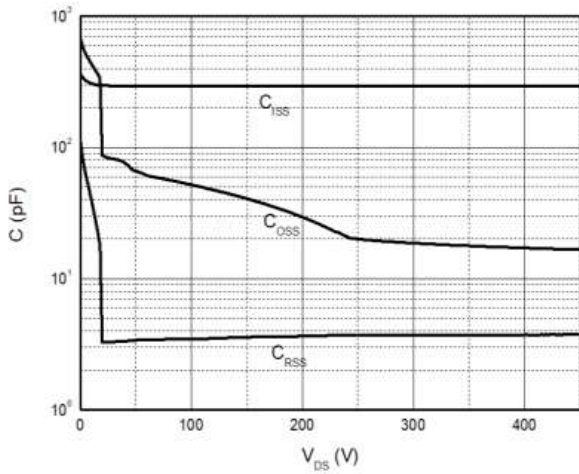


Figure 7. Typical Capacitance (f=1MHz)

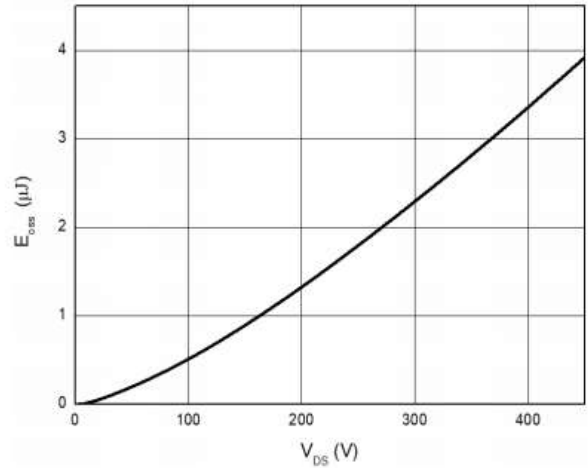


Figure 8. Typical C_{OSS} Stored Energy

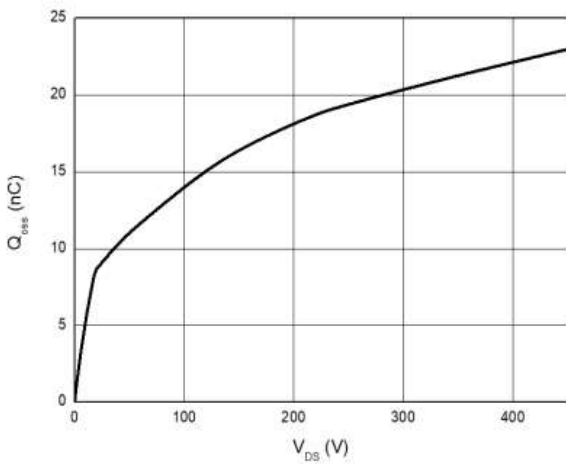


Figure 9. Typical Q_{OSS}

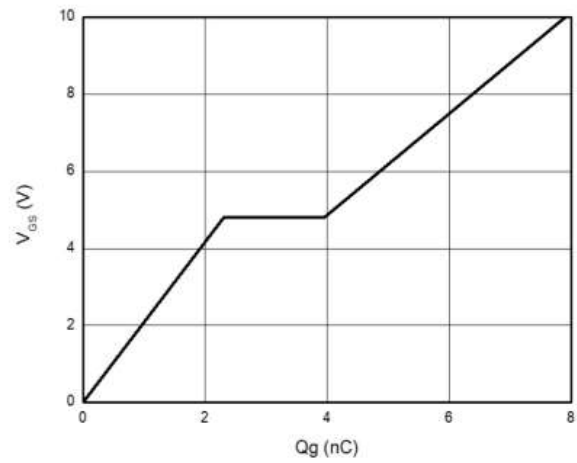


Figure 10. Typical Gate Charge ($V_{DS}=400V$, $I_D=1A$)

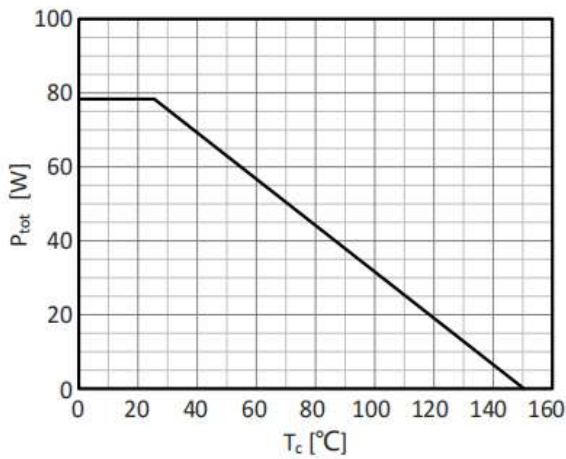


Figure 11. Power Dissipation

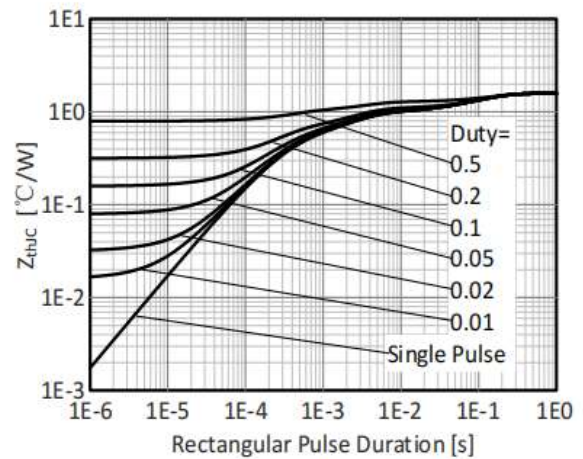


Figure 12. Transient Thermal Resistance

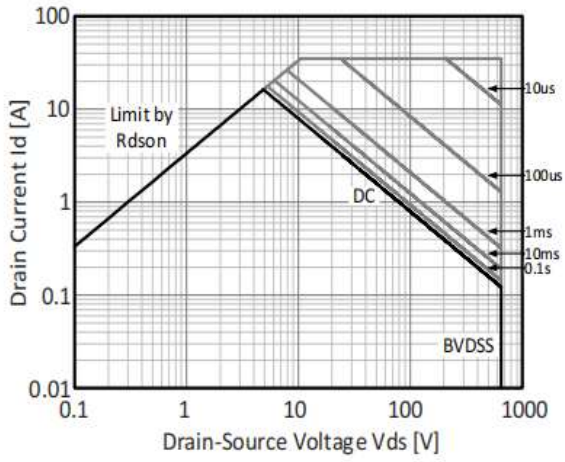


Figure 13. Safe Operating Area $T_c=25^\circ\text{C}$

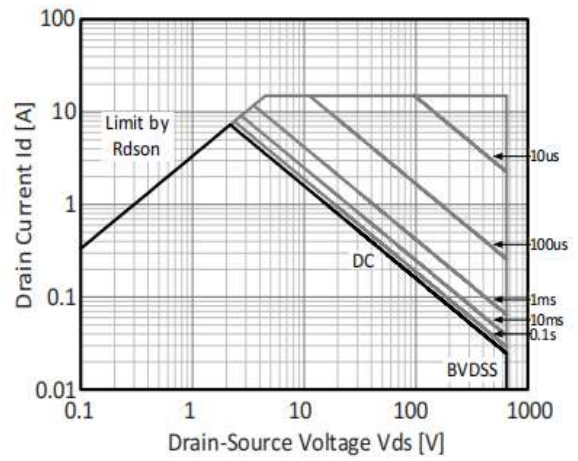
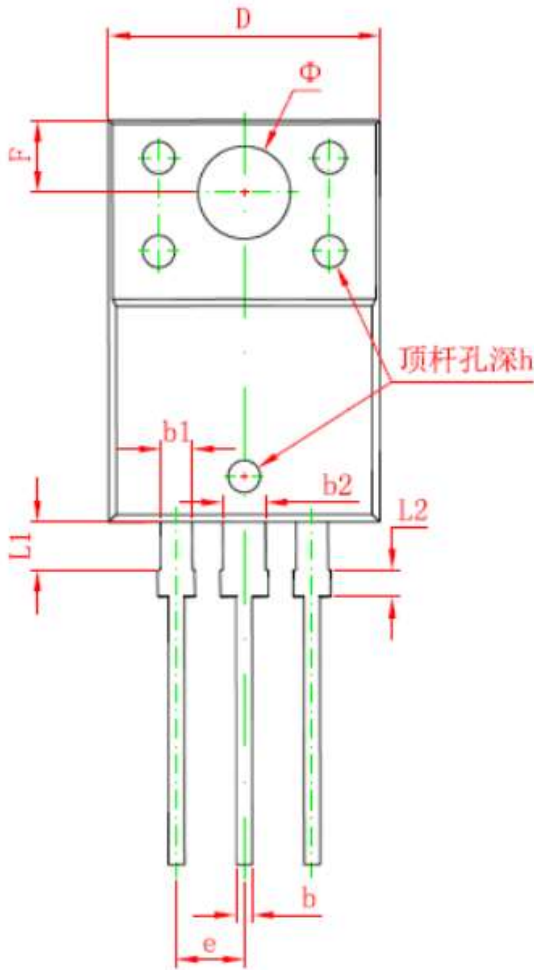


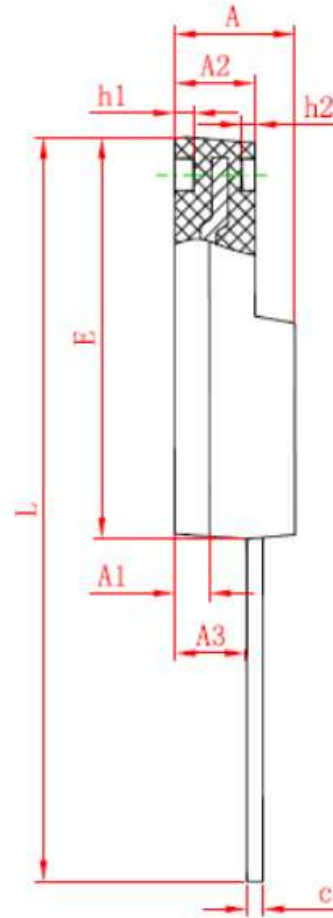
Figure 14. Safe Operating Area $T_c=125^\circ\text{C}$

Product Dimension (TO-220F)

Top view




Side view



Dim	Millimeters		Inches		Dim	Millimeters		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	4.300	4.700	0.169	0.185	e	2.540 TYP.		0.100 TYP.	
A1	1.300 REF.		1.300 REF.		F	2.700REF.		0.106 REF.	
A2	2.800	3.200	0.110	0.126	Φ	3.500 REF.		0.138 REF.	
A3	2.500	2.900	0.098	0.114	h	0.000	0.300	0.000	0.012
b	0.500	0.750	0.020	0.030	h1	0.800 REF.		0.031 REF.	
b1	1.100	1.350	0.043	0.053	h2	0.500 REF.		0.020 REF.	
b2	1.500	1.750	0.059	0.069	L	28.000	28.400	1.102	1.118
c	0.500	0.750	0.020	0.030	L1	1.700	1.900	0.067	0.075
D	9.960	10.360	0.392	0.408	L2	0.900	1.100	0.035	0.043
E	14.800	15.200	0.583	0.598					


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