

## GPI65010DF

### N-channel 650V 10A GaNPower HEMT in DFN 5X6 Package

Datasheet version 2.6 Preliminary

### Features

$BV_{dss}$	$R_{dson}$	$I_{ds}$	$Q_g$
650 V	120 m $\Omega$	10 A	2.6 nC

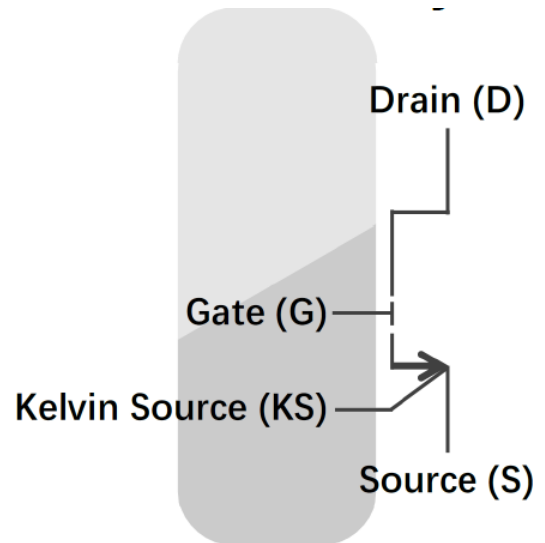
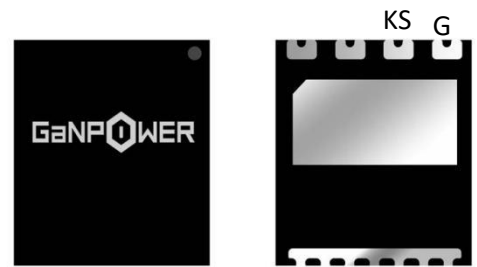
- Ultra-low  $R_{DS(on)}$
- High  $dv/dt$  capability
- Extremely low input capacitance
- Zero  $Q_{rr}$
- Outstanding switching performance
- Low Profile

### Applications

- Switching Power Applications
- Server and Telecom Power Application
- EVOBC and DC-DC Converters
- UPS, Inverters, PV

### Description

These devices are N-channel 650 V Power GaN HEMTs based on proprietary E-mode GaN on silicon technology. The resulting product has extremely low on state resistance, very low input capacitance and zero reverse recovery charge making it especially suitable for applications which require superior power density, ultra-high switching frequency and outstanding efficiency.



## Device Characteristics

Static Parameters				Test data				
	Parameters		Conditions	Min	Typical	Max	Unit	
1	$V_{GS(TH)}$	Gate threshold voltage	$V_{ds}=V_{gs}, I_d=3.5mA$ ( $T_J=25\text{ }^\circ\text{C}$ )	0.8	1.25	1.7	V	
			$V_{ds}=V_{gs}, I_d=3.5mA$ ( $T_J=150\text{ }^\circ\text{C}$ )		1.15		V	
2	$BV_{dss}$	Drain-Source breakdown voltage	$V_{gs}=0V, I_d < 1\text{ }\mu\text{A}$ ( $T_J=25\text{ }^\circ\text{C}$ )		650		V	
3	$I_{dss}$	Zero gate voltage drain leakage current	$V_{gs}=0V, V_{ds}=650V$ $T_J = 25\text{ }^\circ\text{C}$		0.1	10	$\mu\text{A}$	
			$V_{gs} = 0V, V_{ds} = 650V$ $T_J = 150\text{ }^\circ\text{C}$		6		$\mu\text{A}$	
4	$I_{gss}$	Gate-Source Leakage	$V_{gs} = 6V, V_{ds} = 0V$		5	100	$\mu\text{A}$	
5	$R_{dson}$	drain-source on resistance	$V_{gs}=6V, I_d=2.5A$ $T_J = 25\text{ }^\circ\text{C}$		120	140	$\text{m}\Omega$	
			$V_{gs}=6V, I_d=2.5A$ $T_J = 150\text{ }^\circ\text{C}$		300		$\text{m}\Omega$	
6	$V_{sd}$	Reverse conduction voltage	$I_{sd}=1A, V_{gs}=0V$	1.4	2.2	3	V	
7	$R_g$	Gate resistance	$f=25\text{MHz}$ Open drain		1.5		$\Omega$	
Dynamic Parameters				Test data				
	Parameters		Conditions	Min	Typical	Max	Unit	
1	$C_{ISS}$	Input capacitance	$V_{gs} = 0\text{ V}$ $V_{ds} = 500\text{ V}$ $f = 100\text{ kHz}$		78		pf	
2	$C_{OSS}$	Output capacitance				21		pf
3	$C_{RSS}$	Reverse transfer capacitance				0.46		pf
4	$C_{O(er)}$	Effective output capacitance, energy related	$V_{ds} = 0 - 500\text{ V}$		30		pf	
5	$Q_g$	Gate charge	$V_{ds} = 500\text{ V}$		2.6		nC	
6	$Q_{gs}$	Gate to source charge	$I_d = 2.5\text{ A}$ $V_{gs} = 6\text{ V}$		0.5		nC	
7	$Q_{gd}$	Gate to drain charge				0.65		nC
8	$Q_{OSS}$	Output Charge	$V_{ds} = 0 - 500\text{ V}$		24.3		nC	
9	$Q_{rr}$	Reverse recovery charge			0		nC	

Switching Performance				Test data			
	Parameters		Conditions	Min	Typical	Max	Unit
1	td(on)	Turn-on delay time	$V_{ds} = 500\text{ V}$ $I_d = 2.5\text{ A}$ $R_g = 22/2\ \Omega$ $V_{gs} = -3/6\text{ V}$		5		ns
2	tr	Rise time			10		ns
3	td(off)	Turn-off delay time			16		ns
4	tf	Fall time			11		ns

## Absolute Max. Ratings

	Symbols	Parameters	Value	Unit
1	$V_{DS-max}$	Breakdown voltage transient @ $T_{case}=25^\circ\text{C}$	800	V
2	$V_{DS-max}$	Breakdown voltage transient @ $T_{case}=125^\circ\text{C}$	650	V
3	$V_{GS-max}$	Gate to source max. voltage @ $T_{case}=25^\circ\text{C}$	-12 to +7.5	V
4	$I_{ds-max}$	Drain to source DC continuous current @ $T_{case}=25^\circ\text{C}$	10	A
5	$I_{ds-max}$	Drain to source pulse current @ $T_{case}=25^\circ\text{C}$ , pulse width 10 $\mu\text{s}$ , $V_{GS} = 6\text{ V}$	22	A
6	$I_{ds-max}$	Drain to source DC current @ $T_{case}=100^\circ\text{C}$	10	A
7	$dv/dt-max$	Drain to source voltage slew rate	150	V/ns
8	$T_J-max$	Max junction temperature	150	$^\circ\text{C}$
9	$T_S-storage$	Storage temperature	-55 to 150	$^\circ\text{C}$

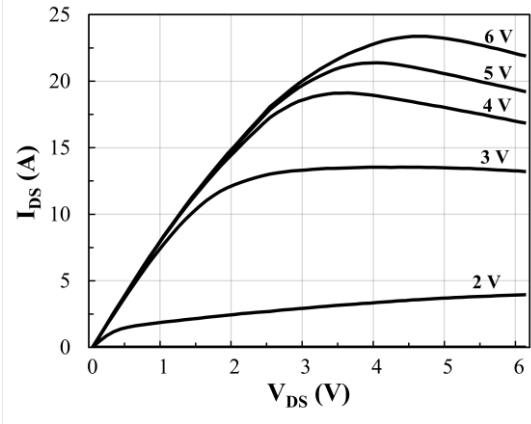
## Thermal and Soldering Characteristics (Typical)

	Symbols	Parameters	Value	Unit
1	$R_{thJC}$	Thermal resistance (junction to case)	1.4	$^\circ\text{C}/\text{W}$
2	$R_{thJA}$	Thermal resistance (junction to ambient)	62	$^\circ\text{C}/\text{W}$
3	$T_{solder}$	Reflow soldering temperature	260	$^\circ\text{C}$

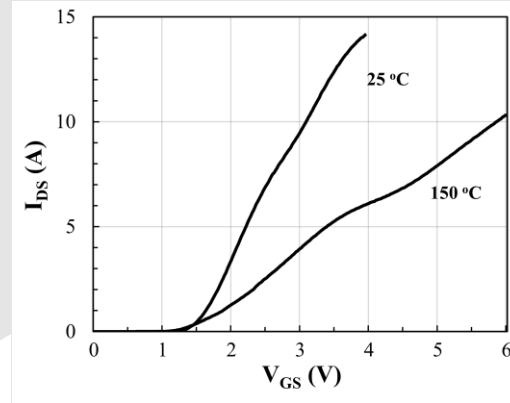
## Ordering

Order Code	Package Type	Packaging Method	Qty
GPI65010DF	DFN5x6		

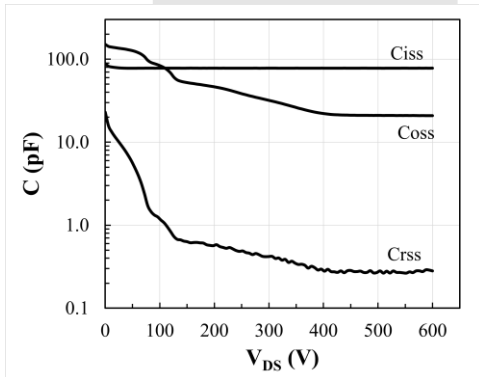
## Electrical Performance



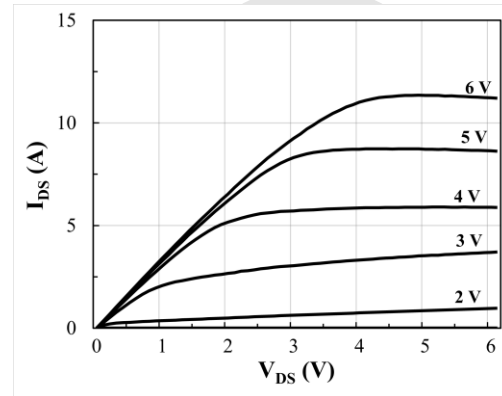
$I_{DS}$  vs.  $V_{DS}$  @  $T_j = 25\text{ }^\circ\text{C}$



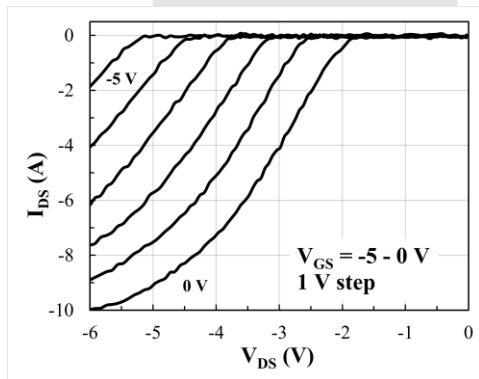
$I_{DS}$  vs.  $V_{GS}$  @  $T_j = 25\text{ }^\circ\text{C}$  and  $150\text{ }^\circ\text{C}$



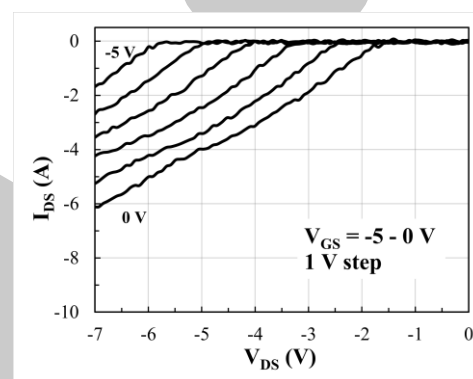
Capacitance vs.  $V_{ds}$  Curve @  $T_j = 25\text{ }^\circ\text{C}$



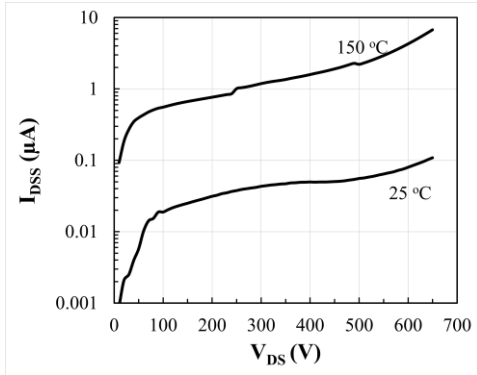
$I_{DS}$  vs.  $V_{DS}$  @  $T_j = 150\text{ }^\circ\text{C}$



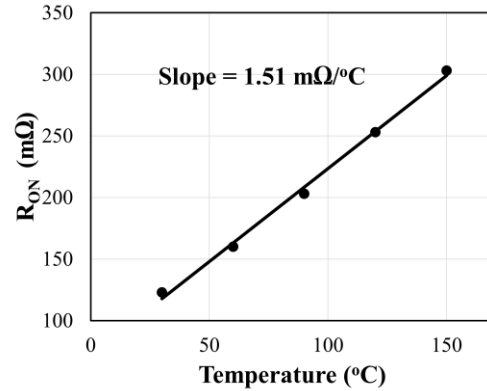
$I_{sd}$  vs.  $V_{sd}$  reverse conduction curve @  $T_j = 25\text{ }^\circ\text{C}$



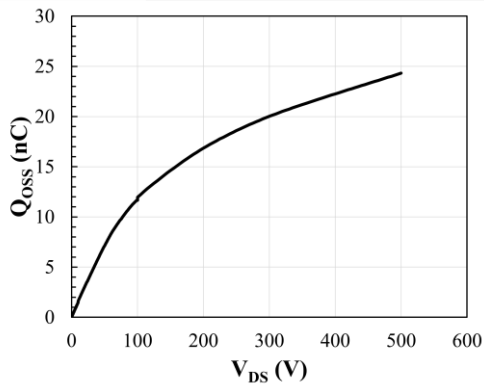
$I_{sd}$  vs.  $V_{sd}$  reverse conduction curve @  $T_j = 150\text{ }^\circ\text{C}$



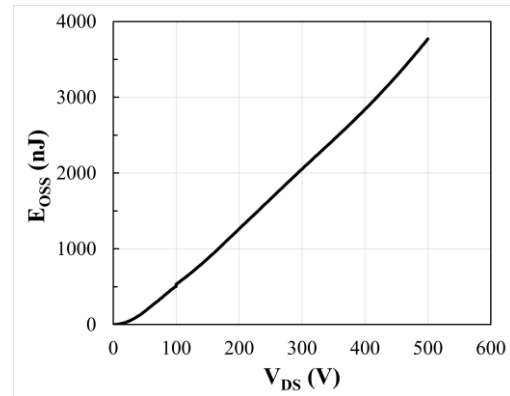
Typical off-state drain leakage current  $I_{DSS}$  vs.  $V_{DS}$  @  $T_J = 25\text{ }^\circ\text{C}$  and  $150\text{ }^\circ\text{C}$



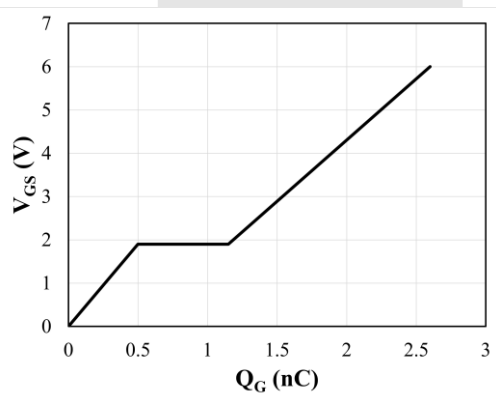
On-state resistance vs.  $T_J$  @  $I_D = 2.5\text{ A}$ ,  $V_{GS} = 6\text{ V}$



Output charge  $Q_{OSS}$  vs.  $V_{DS}$

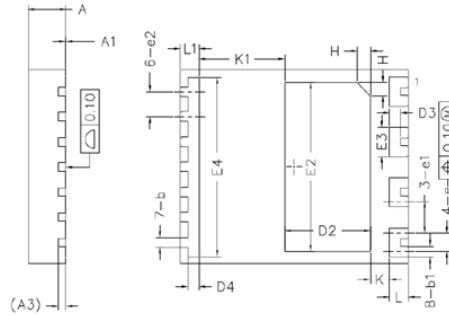
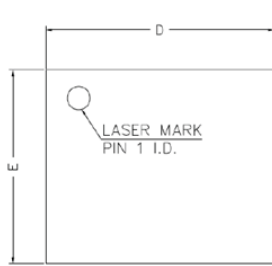


Stored Energy Characteristic  $E_{OSS}$  vs.  $V_{DS}$



Gate charge  $V_{GS}$  vs.  $Q_G$

## Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.90	1.00	1.10
A1	0.00	0.02	0.05
A3	0.203REF		
b	0.20	0.25	0.30
b1	0.225	0.275	0.325
D	5.90	6.00	6.10
E	4.90	5.00	5.10
D2	2.15	2.25	2.35
E2	4.27	4.37	4.47
D3	0.20	0.30	0.40
E3	0.65	0.75	0.85
D4	0.20	0.30	0.40
E4	4.525	4.625	4.725
e	0.375	0.475	0.575
e1	0.725	0.825	0.925
e2	0.55	0.65	0.75
H	0.35REF		
K	0.35	0.50	0.65
K1	2.10	2.25	2.40
L	0.40	0.50	0.60
L1	0.40	0.50	0.60



## GaN HEMT Frequently Asked Questions

1	<p><b>Q: Can we do pin to pin switch for silicon MOSFET or IGBT?</b></p> <p>A: The short answer is no. GaN HEMT power devices are far superior than the best silicon devices such as super junction MOSFETs. However, due to different requirements of gate driving voltage and extremely high dv/dt slew rate, special drivers and optimized PCB layouts are recommended to minimize the impact from circuit parasitics.</p>
2	<p><b>Q: How do GaN power devices compare with SiC?</b></p> <p>A: Currently GaN power HEMT devices are most suitable for low to medium voltage (<math>\leq 1200V</math>) and power (&lt;20KW) applications. GaN is the ideal choice for high frequency applications. SiC devices are better choice for high voltage and high-power applications (&gt;20KW).</p>
3	<p><b>Q: Do we need to parallel an FRD for applications such as inverters?</b></p> <p>A: GaN devices are different from silicon MOSFET or IGBT in that they have no inherent PN junction diodes that cause reverse recovery issue. User do not need to parallel an FRD for the purpose of suppressing the body diode reverse recovery effect, since GaN HEMT can operate in both first and third quadrants. However, care should be taken for the dead time power loss since the Vsd voltage of GaN HEMT is usually close to 2V. This is especially true when a negative gate voltage is applied.</p>
4	<p><b>Q: Can we parallel GaN HEMT devices?</b></p> <p>A: Yes, GaN HEMT is ideal for paralleling, due to the positive temperature coefficient of <math>R_{ds,on}</math>. Hence, paralleling GaN HEMT devices are encouraged.</p>