

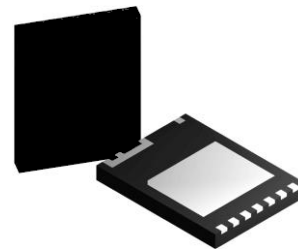
High-Performance 650-V GaN Transistor with Integrated Gate Driver

Features

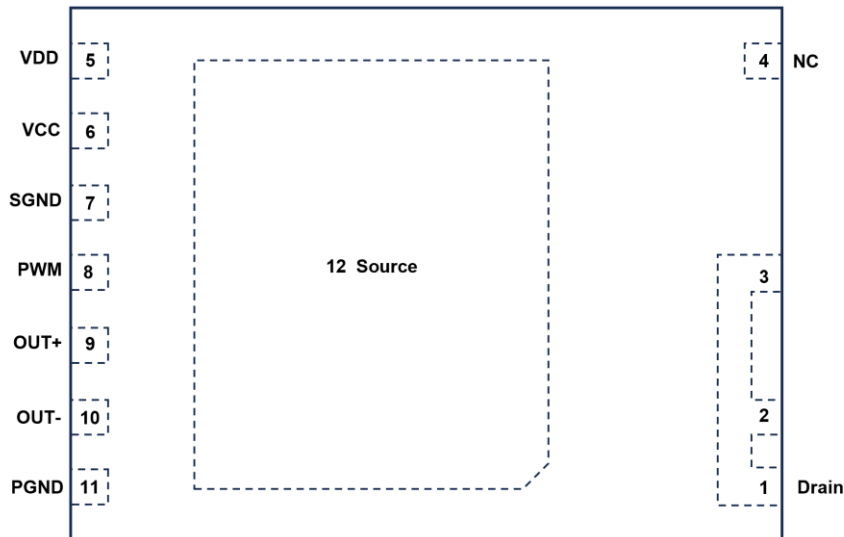
- GaN transistors with integrated gate drive
- 750V Transient Voltage Rating
- 650 V Continuous Voltage Rating
- Zero reverse recovery charge
- Typ./Max. $R_{DS(ON)} = 140/190 \text{ m}\Omega$
- Wide logic input range with hysteresis
- Wide power supply range (10 V ~ 18 V)
- Internal regulator for stable gate drive voltage
- Independent SGND and PGND design
- Programmable turn-on dV/dt
- UVLO protection
- ESD protection of 2 kV (HBM), 1 kV (CDM)
- Up to 2 MHz operation
- 6*8 mm footprint with large cooling pad
- Minimized package inductance

Typical applications

- AC-DC, DC-DC, DC-AC
- Buck, boost, half bridge, full bridge
- Active Clamp Flyback, LLC resonant, Class D
- Quasi-Resonant Flyback
- Mobile fast-chargers, adapters
- LED lighting, solar micro-inverters
- TV / monitor, wireless power
- Server, telecom & networking SMPS



Pin configuration and functions



Package Top View

Pin #	Name	I/O	Description
1,2,3	D	P	Drain of GaN transistor
4	-	NC	Not connected
5	VDD	I	Gate driver supply voltage
6	VCC	P	Logic supply voltage
7	SGND	G	Logic ground
8	PWM	I	Logic input
9	OUT+	-	Gate driver turn-on current set pin (Using R_{gon})
10	OUT-	-	Gate driver turn-on current set pin (Using R_{gon})
11	PGND	G	Gate driver ground. Internally connected to S
12	S	O, G	Source of GaN transistor

I = Input, O = Output, P = Power, G = Ground, NC = No Connect

Ordering information

Ordering No.	Description
CID12N65D	DFN6*8, 2500 pcs/reel

1 Absolute maximum ratings

At $T_j = 25\text{ °C}$ unless otherwise specified. Continuous application of maximum ratings can deteriorate product lifetime. For further information, contact CloudSemi sales office.

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Drain-source voltage	$V_{DS, max}$	-	-	650	V	$V_{GS} = 0\text{ V}, I_D = 10\text{ }\mu\text{A}$
Drain-source voltage transient ¹	$V_{DS, transient}$	-	-	750	V	$V_{GS} = 0\text{ V}, V_{DS} = 750\text{ V}$
V_{CC} -SGND voltage	V_{CC}	-0.3	-	24	V	
V_{DD} -PGND voltage	V_{DD}	-0.3	-	7	V	
SGND-PGND voltage	V_{SP}	-5	-	5	V	
Continuous current, drain-source	I_D	-	-	11.5	A	$T_c = 25\text{ °C}$
Pulsed current, drain-source ²	$I_{D, pulse}$	-	-	20.5	A	$T_c = 25\text{ °C}$
Pulsed current, drain-source ²	$I_{D, pulse}$	-	-	11.5	A	$T_c = 125\text{ °C}$
Operating temperature	T_j	-40	-	125	°C	
Storage temperature	T_{stg}	-55	-	150	°C	

Notes

- $V_{DS, transient}$ is intended for surge rating during non-repetitive events, $t_{pulse} < 1\text{ }\mu\text{s}$.
- Pulse width = 10 μs .

2 Recommended operating conditions

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
V_{DD} -SGND voltage	V_{DD}	10		18	V	
PWM input pin voltage	V_{PWM}	0		18	V	
Gate driver turn-on set resistance	R_{DD}	10			Ω	
Junction temperature	T_j	-40	-	+125	°C	
Ambient temperature	T_a	-40	-	+125	°C	

3 Thermal characteristics

Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
Thermal resistance, junction-case	R_{thJC}	-	-	-	°C/W	
Reflow soldering temperature	T_{sold}	-	-	260	°C	MSL3

4 Electrical characteristics

at $V_{CC} = 12\text{ V}$, $F_{SW} = 500\text{ kHz}$, $T_j = 25\text{ °C}$, unless specified otherwise.

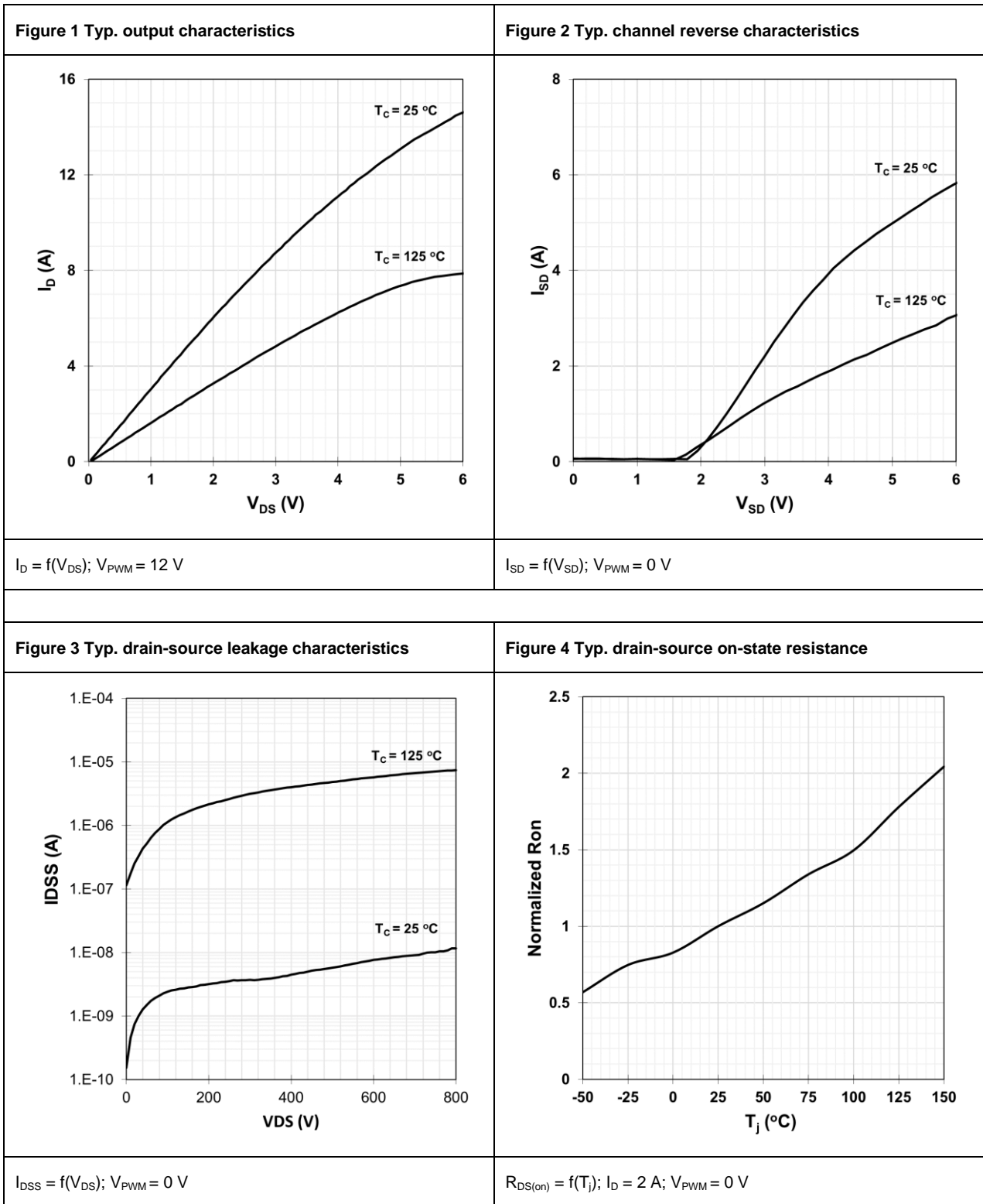
Parameters	Symbols	Values			Units	Notes/Test Conditions
		Min.	Typ.	Max.		
V_{CC} Supply Characteristics						
V _{CC} quiescent current	I _{QCC}		0.42		mA	V _{PWM} = 0 V
V _{CC} operating current	I _{QCC-SW}		1		mA	F _{SW} = 500 kHz; V _{DS} = open
V _{CC} UVLO rising threshold	V _{CC-ON}	8.1	8.4	8.8	V	
V _{CC} UVLO falling threshold	V _{CC-OFF}	7.5	7.8	8.1	V	
V _{CC} UVLO hysteresis	V _{CC-HYS}	0.4	0.6	-	V	
Low-side logic input Characteristics						
Input pin pull-down resistance	R _{PWM-PD}		200		kΩ	
Input pin high logic bias current	I _{PWM-H}		20		μA	
Input logic high threshold (rising edge)	V _{PWMH}	1.7	2.1	2.5	V	
Input logic low threshold (falling edge)	V _{PWML}	0.9	1.2	1.5	V	
Input logic hysteresis	V _{I-HYS}	0.8	0.9		V	
Turn-on propagation delay	T _{ON}		30	60	ns	
Turn-off propagation delay	T _{OFF}		30	60	ns	
Drain rise time	T _R		5		ns	
Drain fall time	T _F		3		ns	
Switching Characteristics						
Switching frequency	F _{SW}			2	MHz	
Pulse width	T _{PW}	0.02		1000	μs	
GaN FET Characteristics						
Drain-source leakage current	I _{DSS}	-	-	10	μA	V _{DS} = 650V; V _{PWM} = 0; T _j = 25°C
		-	-	50		V _{DS} = 650V; V _{PWM} = 0; T _j = 125 °C
Drain-source on-state resistance	R _{DS(on)}	-	138	190	mΩ	V _{PWM} = 12V; I _D = 4A; T _j = 25 °C
		-		-	mΩ	V _{PWM} = 12V; I _D = 4A; T _j = 125 °C
Source-drain reverse voltage	V _{SD}	-	2.6	-	V	V _{PWM} = 0 V; I _{SD} = 4 A
Output charge	Q _{OSS}	-	24.5	-	nC	V _{PWM} = 0 V; V _{DS} = 0 to 400 V
Reverse recovery charge	Q _{rr}	-	0	-	nC	I _{SD} = 4 A; V _{DS} = 400 V
Output capacitance	C _{OSS}	-	30	-	pF	V _{PWM} = 0 V; V _{DS} = 400 V; f = 100 kHz
Effective output capacitance, energy related ¹	C _{O(er)}	-	43	-	pF	V _{PWM} = 0 V; V _{DS} = 0 to 400 V
Effective output capacitance, time related ²	C _{O(tr)}	-	60	-	pF	V _{PWM} = 0 V; V _{DS} = 0 to 400 V

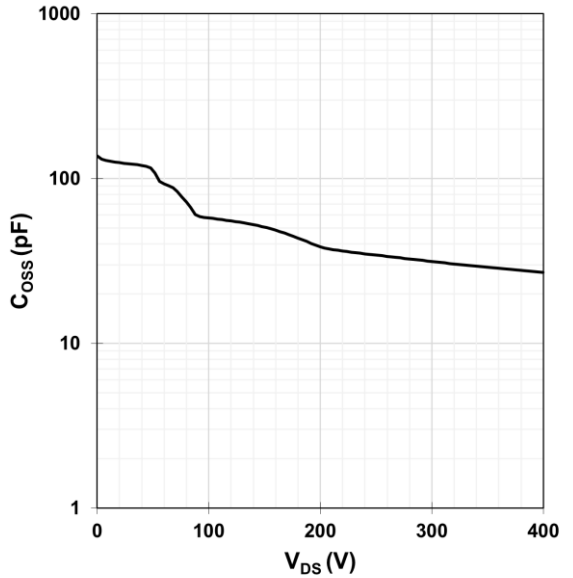
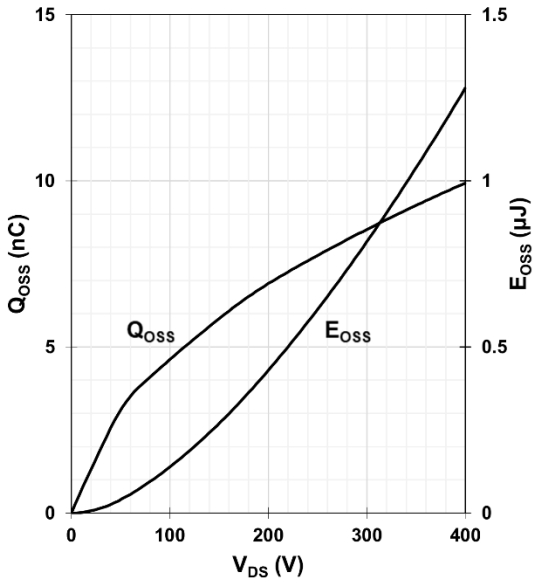
Notes

- 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.
- 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.

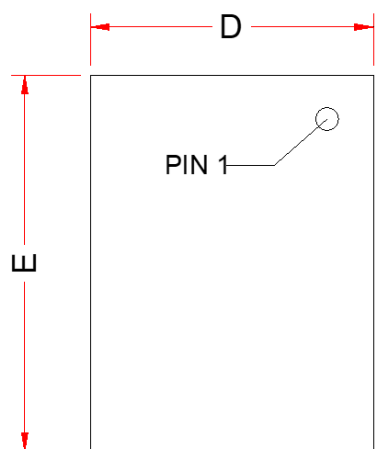
7 Electrical characteristics diagrams

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

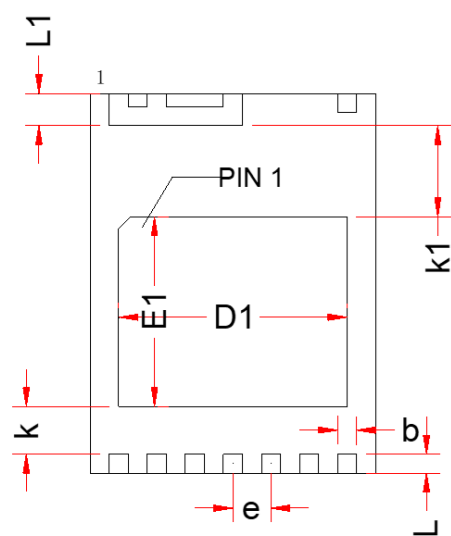


<p>Figure 5 Typ. output capacitance</p>	<p>Figure 6 Typ. C_{OSS} stored energy</p>
	
<p>$C_{OSS} = f(V_{DS}); \text{Freq.} = 100 \text{ kHz}$</p>	<p>$Q_{OSS} = f(V_{DS}); E_{OSS} = f(V_{DS}); \text{Freq.} = 100 \text{ kHz}$</p>
<p>Figure 7 VCC operating current (I_{QCC-SW}) vs. f_{SW}</p>	<p>Figure 8 VCC quiescent current (I_{QCC}) vs. VCC</p>
<p>VCC = 12 V, $V_{PWM} = 0 \text{ V}$</p>	<p>$V_{PWM} = 0 \text{ V}$</p>

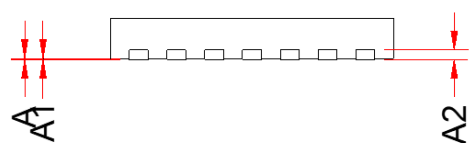
8 Package outlines



TOP VIEW



BOTTOM VIEW



SIDE VIEW

	MIN	MID	MAX
A	0.800	0.850	0.950
A1	0.000	0.020	0.050
A2	0.203REF		
b	0.350	0.400	0.450
D	6.00BSC		
D1	4.750	4.800	4.850
E	8.00BSC		
E1	3.950	4.000	4.050
e	0.800BSC		
k	0.900	1.000	1.100
k1	1.825	1.925	2.025
L	0.350	0.400	0.450
L1	0.625	0.675	0.725