INN700D190B

1. General description

700V GaN-on-Silicon Enhancement-mode Power Transistor in Dual Flat No-lead package (DFN) with 8 mm × 8 mm size

2. Features

· Enhancement mode transistor-Normally off power switch
· Ultra high switching frequency
· No reverse-recovery charge
· Low gate charge, low output charge
· Qualified for industrial applications according to JEDEC Standards
· ESD safeguard
· RoHS, Pb-free, REACH-compliant
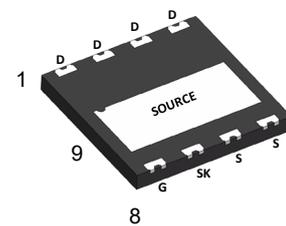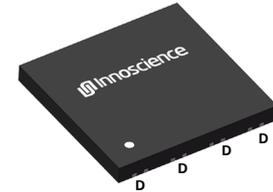
3. Applications

· DCM/BCM PFC
· AHB/LLC/QR Flyback/ACF DCDC converter
· LED driver
· Fast battery charger
· Notebook/AIO adaptor
· Desktop PC/ATX/TV/power tool power supply
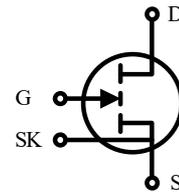
4. Key performance parameters

Table 1   Key performance parameters at T_j = 25 °C

Parameter	Value	Unit
$V_{DS,max}$	700	V
$R_{DS(on),max}$ @ V_{GS} = 6 V	190	mΩ
$Q_{G,typ}$ @ V_{DS} = 400 V	2.8	nC
$I_{D,pulse}$	20.5	A
Q_{OSS} @ V_{DS} = 400 V	24.5	nC
Q_{rr} @ V_{DS} = 400 V	0	nC

5. Pin information

Table 2   Pin information

Gate	Drain	Kelvin Source	Source
8	1,2,3,4	7	5,6,9

Table 3   Ordering information

Type/Ordering Code	Package	Product Code
INN700D190B	DFN 8X8	70D190B

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Table of contents

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6. Maximum ratings

at T_j = 25 °C unless otherwise specified

Exceeding the maximum ratings may destroy the device. For further information, contact Innoscience sales office

Table 4   Maximum ratings

Parameter	Symbol	Values	Unit	Note/Test Condition
Drain source voltage	$V_{DS,max}$	700	V	V_{GS} = 0 V, T_j = -55 °C to 150 °C
Drain source voltage transient [1]	$V_{DS,transient}$	800	V	V_{GS} = 0 V
Drain source voltage, pulsed [2]	$V_{DS,pulse}$	750	V	T_j = 25 °C; total time < 10 h
				T_j = 125 °C; total time < 1 h
Continuous current, drain source	I_D	11.5	A	T_c = 25 °C
Pulsed current, drain source [3]	$I_{D,pulse}$	20.5	A	T_c = 25 °C; V_{GS} = 6 V; t_{PULSE} = 10 µs
Pulsed current, drain source [3]	$I_{D,pulse}$	11.5	A	T_c = 125 °C; V_{GS} = 6 V; t_{PULSE} = 10 µs
Gate source voltage, continuous [4]	V_{GS}	-1.4 to +7	V	T_j = -55 °C to 150 °C
Gate source voltage, pulsed	$V_{GS,pulse}$	-20 to +10	V	T_j = -55 °C to 150 °C; t_{PULSE} = 50 ns, f = 100 kHz; open drain
Power dissipation	P_{tot}	83	W	T_c = 25 °C
Operating temperature	T_j	-55 to +150	°C	
Storage temperature	T_{stg}	-55 to +150	°C	

1    $V_{DS,transient}$ is intended for non-repetitive events, t_{PULSE} < 200 µs

2    $V_{DS,pulse}$ is intended for repetitive pulse, t_{PULSE} < 100 ns

3   Limit was extracted from characterization test, not measured during production

4   The minimum V_{GS} is clamped by ESD protection circuit, as shown in Figure 10

7. Thermal characteristics

Table 5   **Thermal characteristics**

Parameter	Symbol	Values	Unit	Note/Test Condition
Thermal resistance, junction-ambient	R_{thJA} [1]	66	°C/W	
Thermal resistance, junction-case	R_{thJC}	1.49	°C/W	
Maximum reflow soldering temperature	T_{sold}	260	°C	MSL3

1.R_{thJA} is determined with the device mounted on one square inch of copper pad, single layer 2oz copper on FR4 board.

8. Electric characteristics

at T_j = 25 °C, unless specified otherwise

Table 6   Static characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Gate threshold voltage	$V_{GS(th)}$	1.2	1.7	2.5	V	I_D = 12.2 mA; V_{DS} = V_{GS}; T_j = 25 °C
		-	1.7	-		I_D = 12.2 mA; V_{DS} = V_{GS}; T_j = 150 °C
Drain-source leakage current	I_{DSS}	-	0.45	20	µA	V_{DS} = 700 V; V_{GS} = 0 V; T_j = 25 °C
		-	6	-		V_{DS} = 700 V; V_{GS} = 0 V; T_j = 150 °C
Gate-source leakage current	I_{GSS}	-	60	-	µA	V_{GS} = 6 V; V_{DS} = 0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	138	190	mΩ	V_{GS} = 6 V; I_D = 3.9 A; T_j = 25 °C
		-	300	-	mΩ	V_{GS} = 6 V; I_D = 3.9 A; T_j = 150 °C
Gate resistance	R_G	-	5.8	-	Ω	f = 5 MHz; open drain

Table 7   Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	96	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 100 kHz
Output capacitance	C_{oss}	-	30	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 100 kHz
Reverse transfer Capacitance	C_{rss}	-	0.5	-	pF	V_{GS} = 0 V; V_{DS} = 400 V; f = 100 kHz
Effective output capacitance, energy related [1]	$C_{o(er)}$	-	43	-	pF	V_{GS} = 0 V; V_{DS} = 0 to 400 V
Effective output capacitance, time related [2]	$C_{o(tr)}$	-	60	-	pF	V_{GS} = 0 V; V_{DS} = 0 to 400 V
Output charge	Q_{OSS}	-	24.5	-	nC	V_{GS} = 0 V; V_{DS} = 0 to 400 V
Turn-on delay time	$t_{d(on)}$	-	1.4	-	ns	V_{DS} = 400 V; I_D = 8 A; L = 318 µH; V_{GS} = 6 V; R_{on} = 10 Ω; R_{off} = 2 Ω; See Figure 22
Turn-off delay time	$t_{d(off)}$	-	1.7	-	ns	
Rise time	t_r	-	4.0	-	ns	
Fall time	t_f	-	4.0	-	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 8   Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Gate charge	Q_G	-	2.8	-	nC	V_{GS} = 0 to 6 V; V_{DS} = 400 V; I_D = 3.9 A
Gate-source charge	Q_{GS}	-	0.25	-	nC	
Gate-drain charge	Q_{GD}	-	1.1	-	nC	
Gate Plateau Voltage	V_{Plat}	-	2.2	-	V	V_{DS} = 400 V; I_D = 3.9 A

Table 9   Reverse conduction characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Source-Drain reverse voltage	V_{SD}	-	2.6	-	V	V_{GS} = 0 V; I_S = 3.9 A
Pulsed current, reverse	$I_{S,pulse}$	-	-	20.5	A	V_{GS} = 6 V; t_{PULSE} = 10 µs
Reverse recovery charge	Q_{rr}	-	0	-	nC	I_S = 3.9 A; V_{DS} = 400 V
Reverse recovery time	t_{rr}	-	0	-	ns	
Peak reverse recovery current	I_{rrm}	-	0	-	A	

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Datasheet Rev. 1.0
2023/04/21

9. Electric characteristics diagrams

at T_j = 25 °C, unless specified otherwise

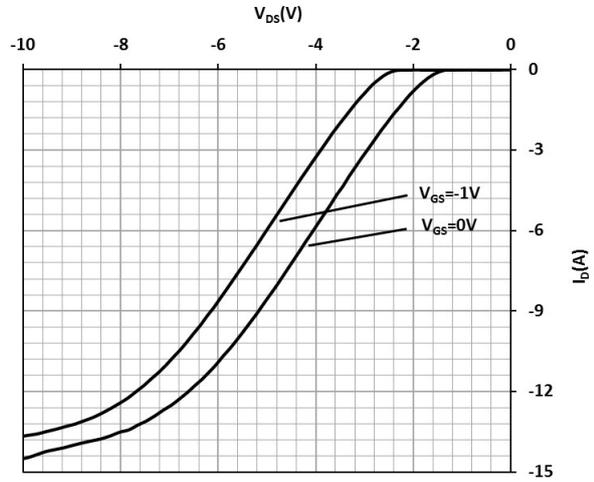| Figure 1 Typ. output characteristics	Figure 2 Typ. output characteristics
I_D = f(V_{DS}, V_{GS}); T_j = 25 °C	I_D = f(V_{DS}, V_{GS}); T_j = 125 °C

Figure 3 Typ. Drain-source on-state resistance	Figure 4 Typ. Drain-source on-state resistance
$R_{DS(on)}$ = f(I_{DS}, V_{GS}); T_j = 25 °C	$R_{DS(on)}$ = f(I_{DS}, V_{GS}); T_j = 125 °C

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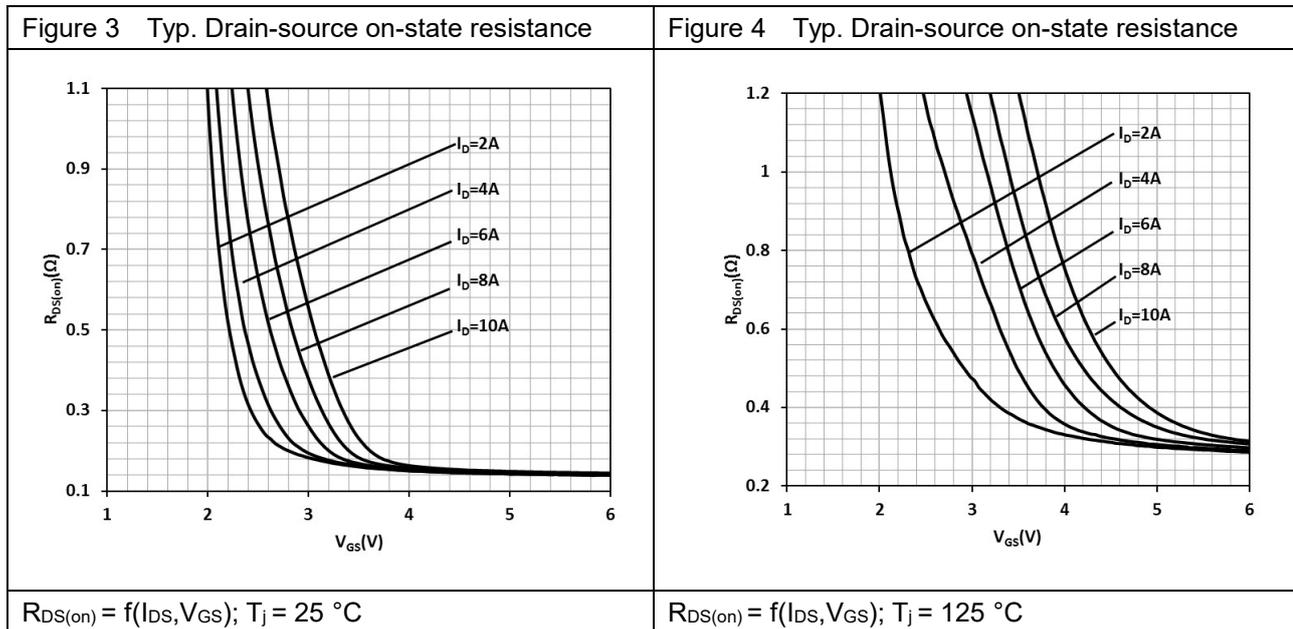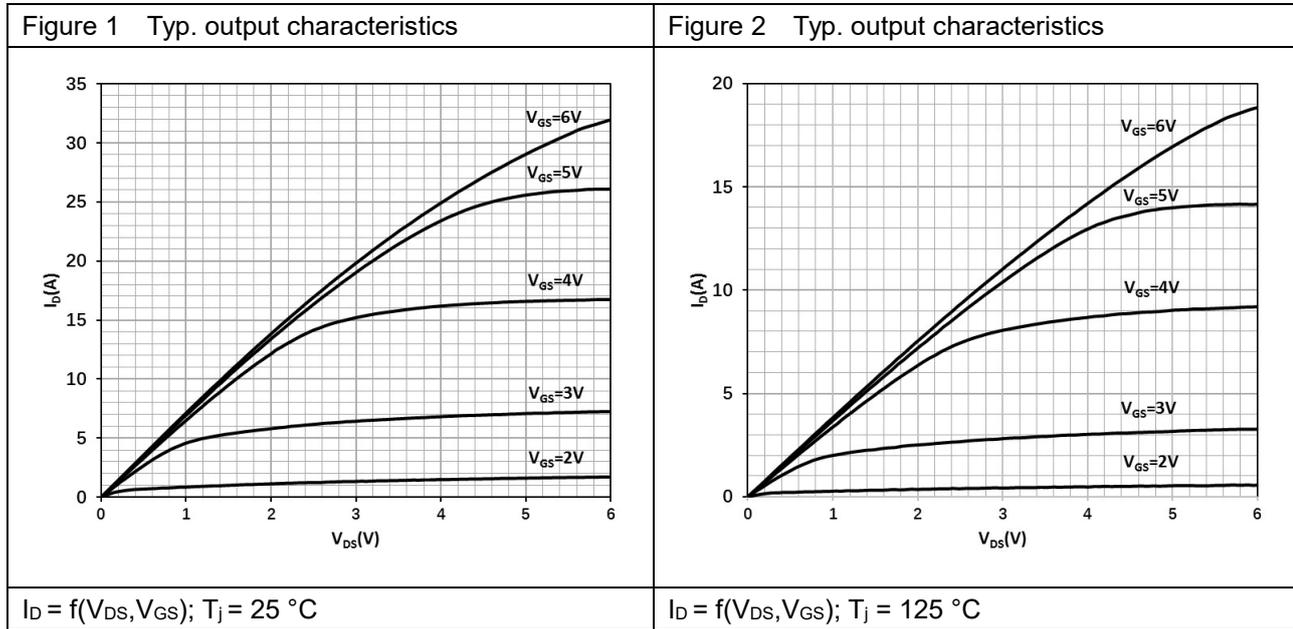
Figure 5 Typ. channel reverse characteristics	Figure 6 Typ. channel reverse characteristics
$I_D = f(V_{DS}, V_{GS})$; T_j = 25 °C	$I_D = f(V_{DS}, V_{GS})$; T_j = 125 °C
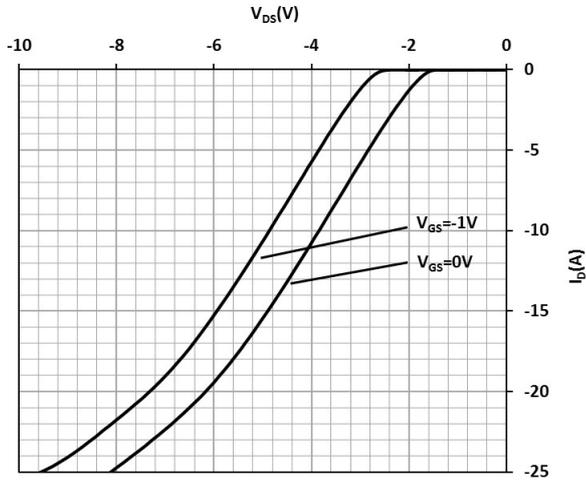
Figure 7 Typ. channel reverse characteristics	Figure 8 Typ. channel reverse characteristics
$I_D = f(V_{DS}, V_{GS})$; T_j = 25 °C	$I_D = f(V_{DS}, V_{GS})$; T_j = 125 °C
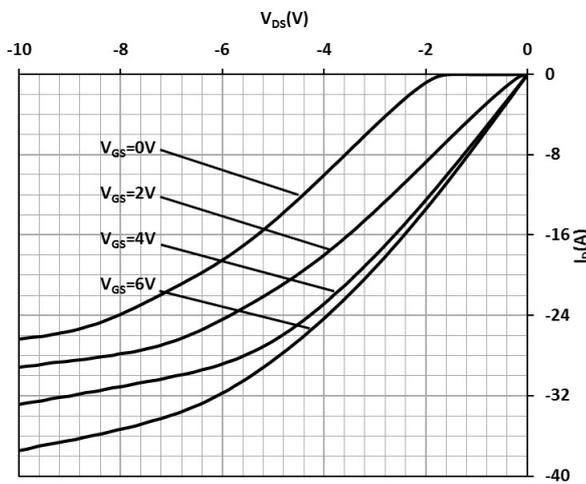
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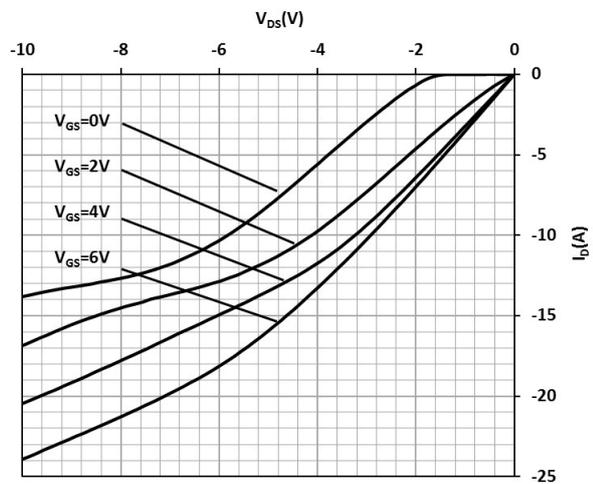
Figure 9 Typ. transfer characteristics	Figure 10 Typ. Gate-to-Source leakage
$I_D = f(V_{GS})$; $V_{DS} = 3$ V	$I_G = f(V_{GS})$; I_G reverse turn on by ESD unit
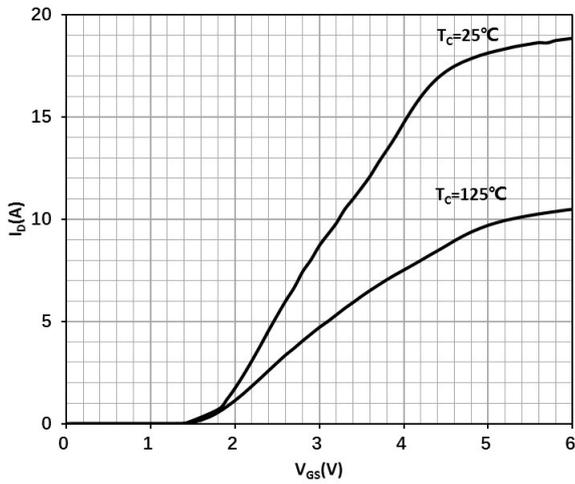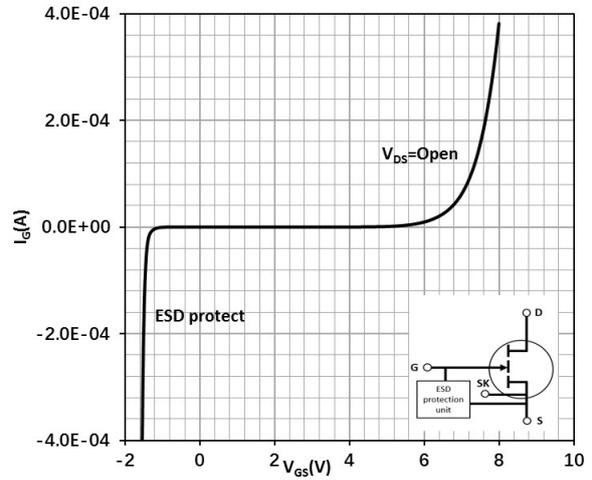
Figure 11 Drain-source leakage characteristics
$I_{DSS} = f(V_{DS})$; $V_{GS} = 0$ V

Page 9
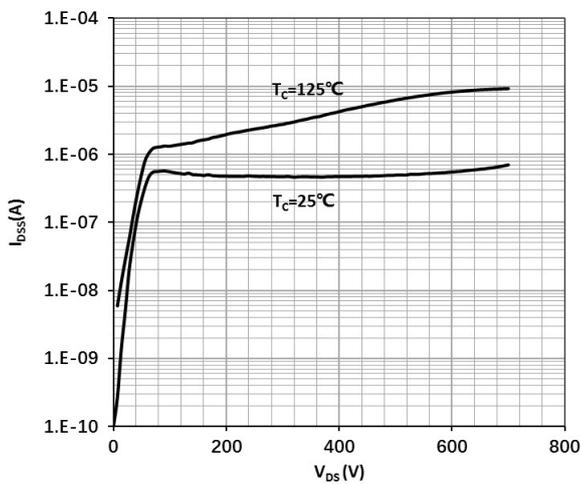
Figure 12 Gate threshold voltage	Figure 13 Drain-source on-state resistance
$V_{TH} = f(T_j)$; $V_{GS} = V_{DS}$; $I_D = 12.2$ mA	$R_{DS(on)} = f(T_j)$; $I_D = 3.9$ A; $V_{GS}=6$V
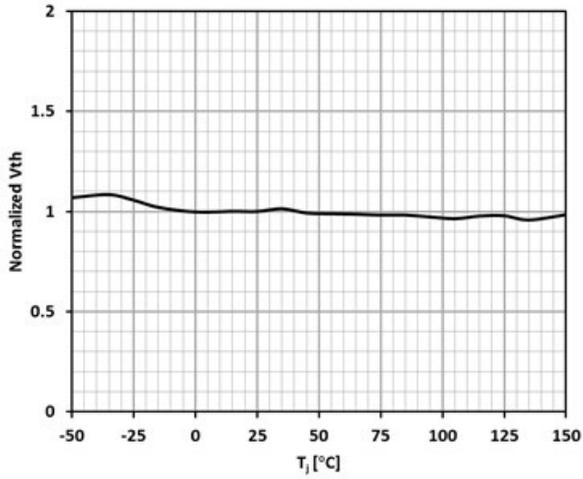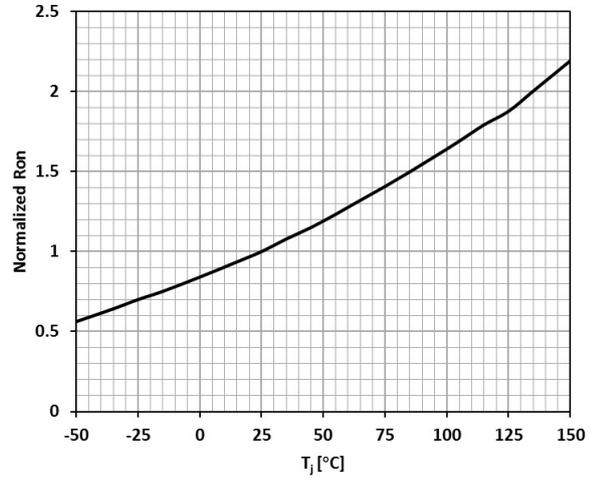
Figure 14 Power dissipation	Figure 15 Max.transient thermal impedance
$P_{tot} = f(T_C)$	$Z_{thJC} = f(t_P, D)$
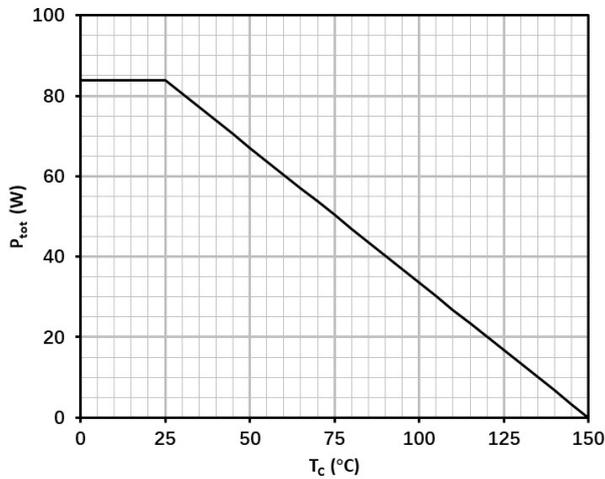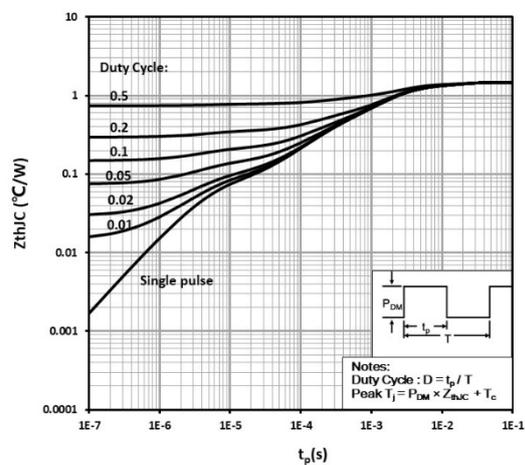
Figure 16 Safe operating area	Figure 17 Safe operating area
$I_D = f(V_{DS})$; $T_C = 25$ °C	$I_D = f(V_{DS})$; $T_C = 125$ °C
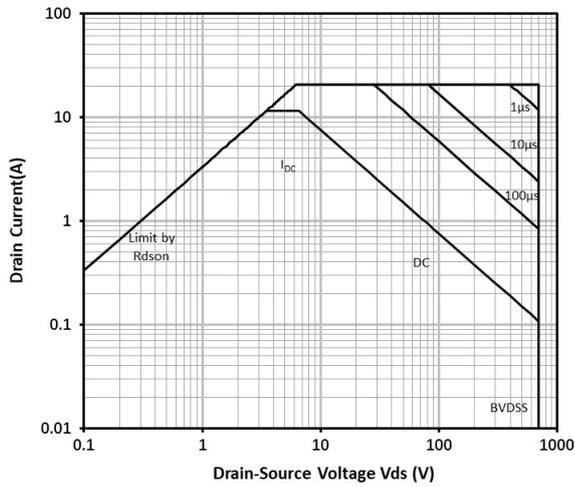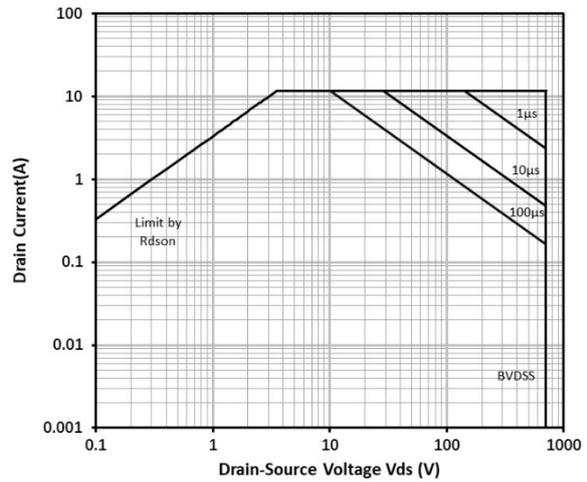
Figure 18 Typ. gate charge	Figure 19 Typ. capacitances
$V_{GS} = f(Q_G)$; $V_{DCLINK} = 400$ V; $I_D = 5$ A	$C_{XSS} = f(V_{DS})$; Freq. = 100 kHz
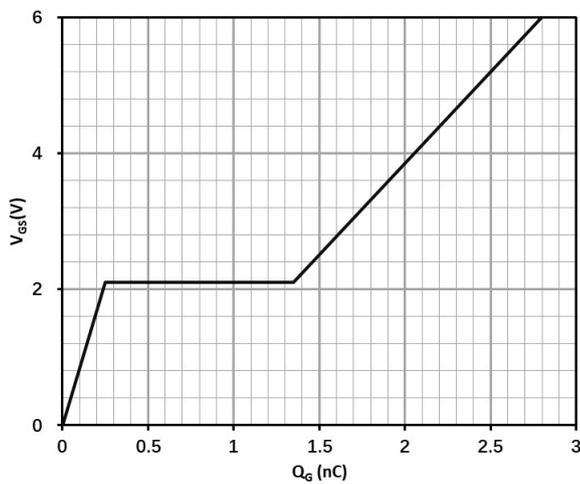
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Datasheet Rev. 1.0
2023/04/21
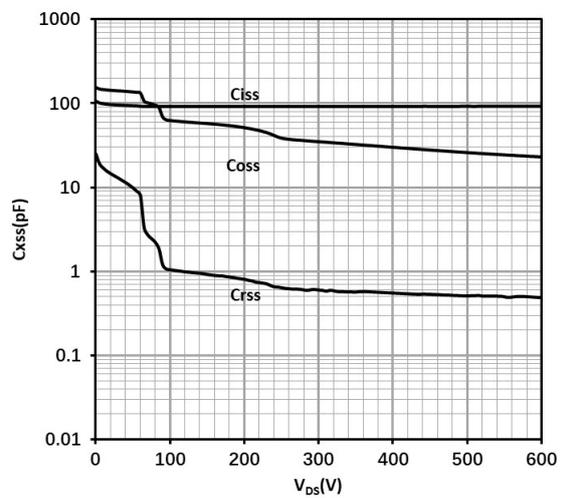
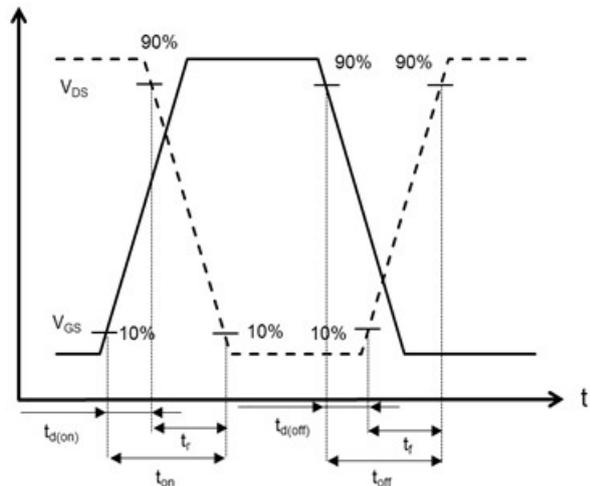| Figure 20 Typ. output charge	Figure 21 Typ. C_OSS stored Energy
$Q_{OSS} = f(V_{DS})$; Freq. = 100 kHz	$E_{OSS} = f(V_{DS})$; Freq. = 100 kHz
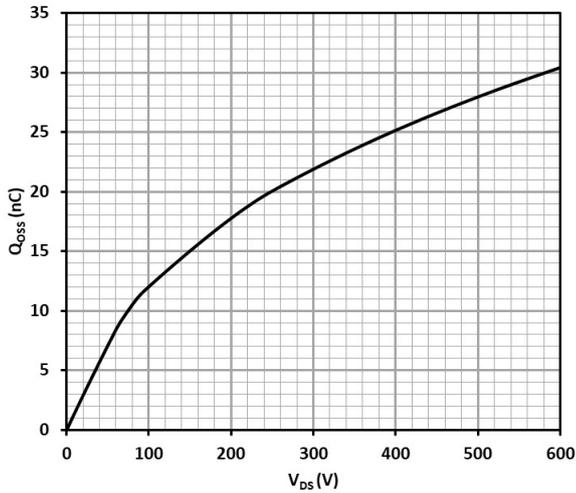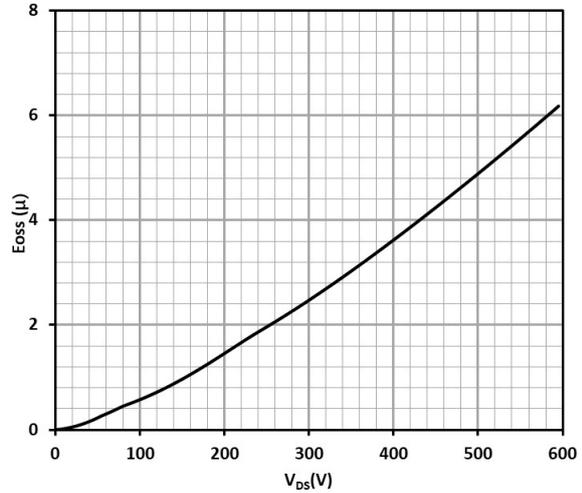
Figure 22 Typ.Switching times with inductive load	Figure 23 Typ.Switching times waveform
V_{DS} = 400 V, I_D = 8 A, L = 318 µH, V_{GS} = 6 V, R_{on} = 10 Ω, R_{off} = 2 Ω	
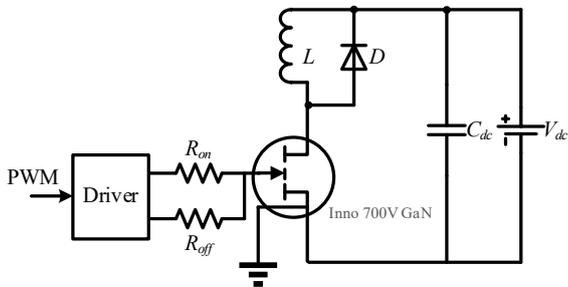
10. Package outlines
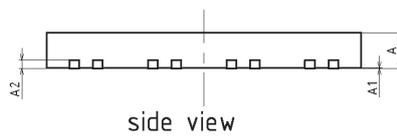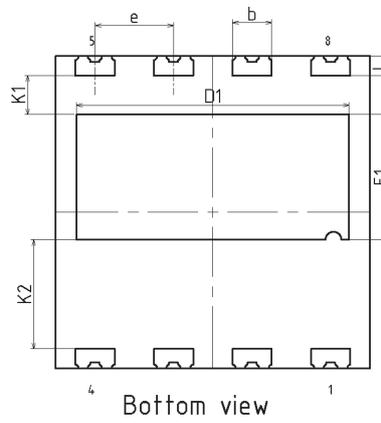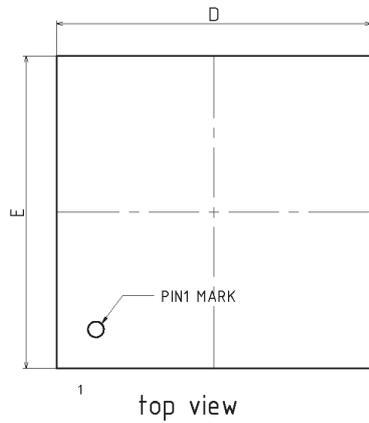
SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
A2	0.203REF		
b	0.95	1.00	1.05
D	8.00 BSC		
D1	6.84	6.94	7.04
E	8.00 BSC		
E1	3.10	3.20	3.30
K1	0.90	1.00	1.10
K2	2.70	2.80	2.90
e	2.00 BSC		
L	0.40	0.50	0.60
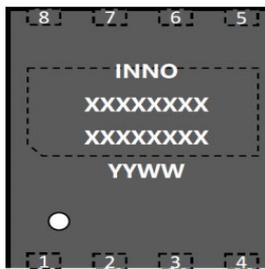
Row	Description	Example
Row1	Company name	INNO
Row2	Product code (In short)	XXXXXXXX
Row3	ASSY lot No.	XXXXXXXX
Row4	Date code	YYWW

Notes:

(1) Dimension and tolerance conform to ASME Y14.5-2009.

(2) All dimension are in millimeters.

(3) Lead coplanarity shall be 0.1 millimeters max.

(4) Complies with JEDEC MO-229.

(5) Drawing is not to scale.

(6) Dimensions do not include mold protrusion.

(7) Package outline exclusive of metal burr dimensions.

Page 13

11. Reel information

SYMBOL	DIMENSION(mm)		
	MIN	NOM	MAX
A	328	330	332
N	98	100	102
C	12.90	13.10	13.30
D	5.10	5.60	6.10
w1	16.40	16.40	18.40
w2	20.60	20.60	22.60
T	1.95	2.10	2.25
K	1.30	1.40	1.55

Page 14
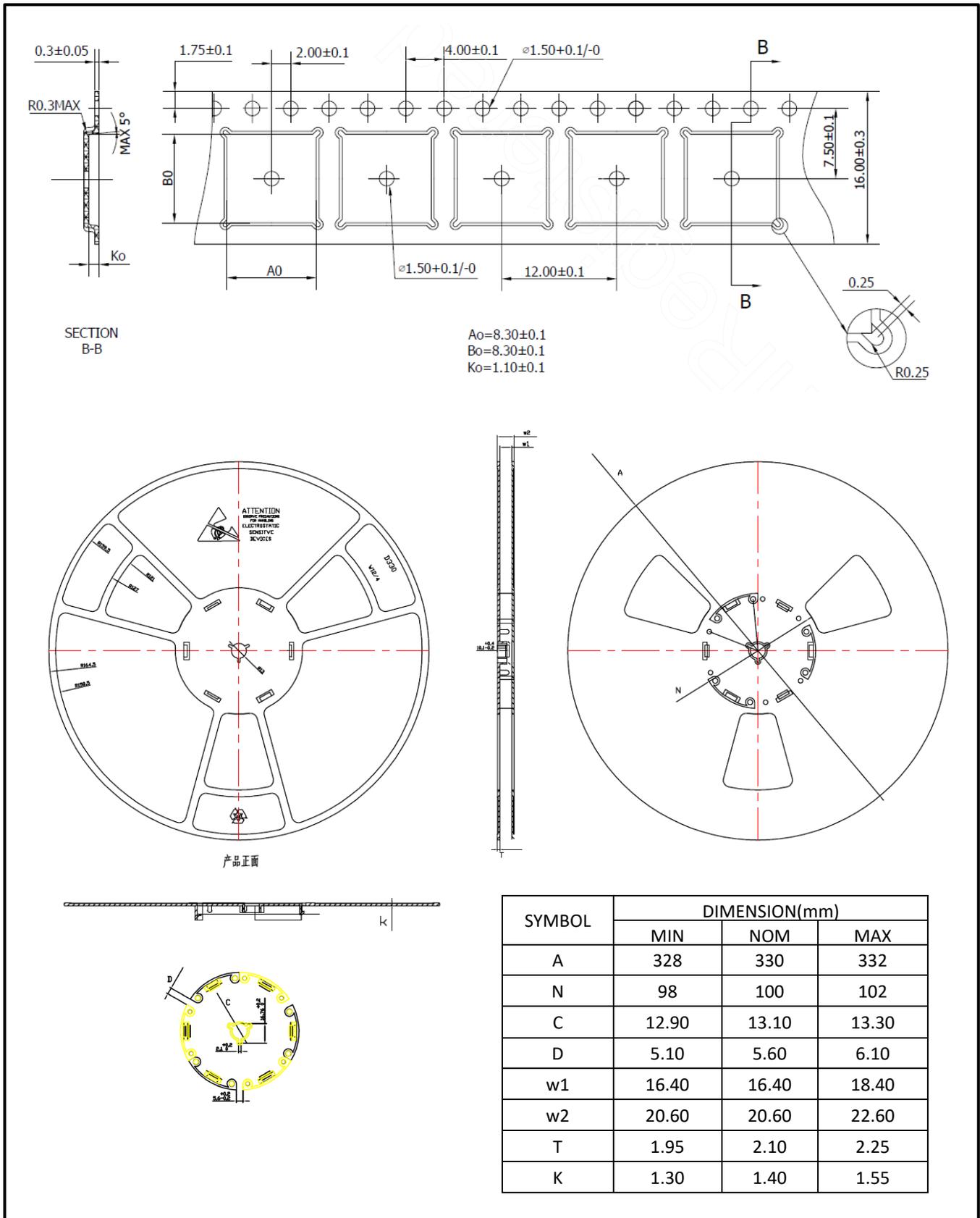
12. Recommended PCB footprint
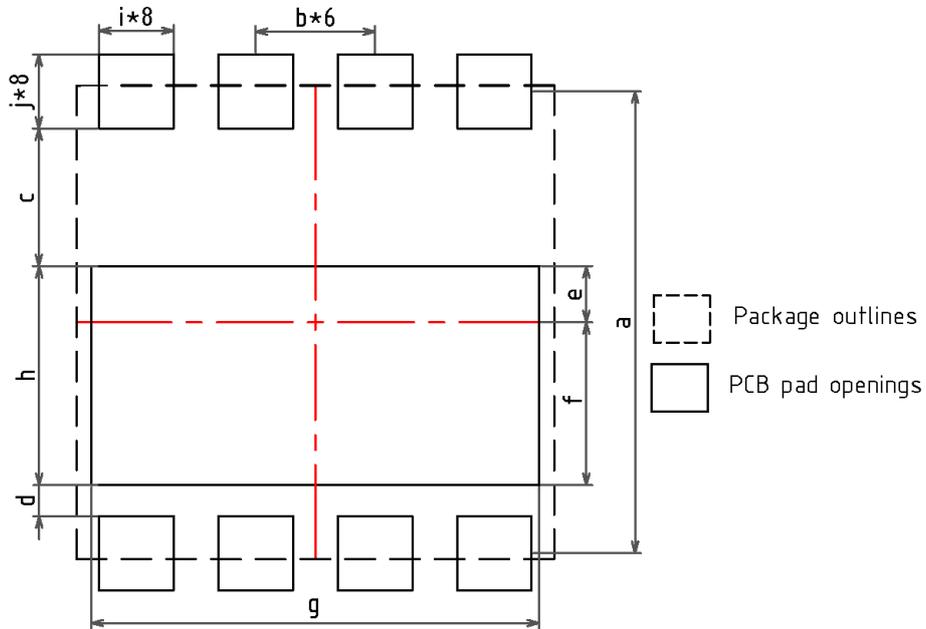
SYMBOL	DIMENSION	SYMBOL	DIMENSION
a	7.800	f	2.750
b	2.000	g	7.500
c	2.325	h	3.700
d	0.525	i	1.400
e	0.950	j	1.250

Notes:
(1) All dimension are in millimeters.
(2) Drawing is not to scale.

13. Revision history

Major changes since the last revision

Revision	Date	Description of changes
1.0	2023-04-21	1.0 version release

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