# Gallium Nitride E-Mode HEMT

## GS700EWF250G1: 250mΩ, 700V

### Description

This is a 700V GaN-on-Si enhancement-mode power transistor. The properties of GaN allow for high current, high breakdown voltage and high switching frequency.

### 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 |
| $R_{DS(on), Typ}$ | 250 | mΩ |
| $Q_G$ | 1.5 | nC |
| $I_{D, Pulse}$ | 10 | A |
| $Q_{OSS}$ @ 400 V | 13 | nC |
| $Q_{rr}$ | 0 | nC |

**Table2 Ordering Information**

| Ordering Code | Package | Product code |
|---|---|---|
| GS700EWF250G1 | Wafer | GS700EWF250G1 |

# Table of contents

# 1 Maximum ratings

at $T_j$ = 25 ℃ 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 V<br>Tj = -55℃ to 150℃ |
| Drain-source voltage transient [1] | $V_{DS, transient}$ | 800 | V | $V_{GS}$ = 0 V |
| Continuous current, drain-source | $I_D$ | 6 | A | $T_c$ = 25 °C |
| Pulsed current, drain-source [2] | $I_{D, pulse}$ | 10 | A | $T_c$ = 25 °C; $V_G$ = 6 V |
| Pulsed current, drain-source [2] | $I_{D, pulse}$ | 6 | A | $T_c$ = 125 °C; $V_G$ = 6 V |
| Gate-source voltage, continuous | $V_{GS}$ | -1 to +6 | 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;<br>$t_{Pulse}$ = 50 ns, f = 100 kHz;<br>open drain |
| Power dissipation | $P_{tot}$ | 50 | 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 surge rating during non-repetitive events, $t_{Pulse}$ < 1 µs.
2. Pulse width = 10 µs.

# 2 Electrical characteristics

at $T_j$ = 25 ℃, unless specified otherwise.

**Table 4 Static characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate threshold voltage | $V_{GS(TH)}$ | 1.0 | 1.6 | 2.5 | V | $I_D$ = 6 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C |
| | | - | 2 | - | | $I_D$ = 6 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 150 °C |
| Drain-source leakage current | $I_{DSS}$ | - | 0.01 | 0.6 | μA | $V_{DS}$ = 700 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C |
| | | - | 0.6 | - | | $V_{DS}$ = 700 V; $V_{GS}$ = 0 V; $T_j$ = 150 °C |
| Gate-source leakage current | $I_{GSS}$ | - | 2 | | μA | $V_{GS}$ = 6 V; $V_{DS}$ = 0 V |
| Drain-source on-state Resistance[1] | $R_{DS(on)}$ | - | 250 | 310 | mΩ | $V_{GS}$ = 6 V; $I_D$ = 2.2 A; $T_j$ = 25 °C |
| | | - | 590 | - | mΩ | $V_{GS}$ = 6 V; $I_D$ = 2.2 A; $T_j$ = 150 °C |
| Gate resistance | $R_G$ | - | 11 | - | Ω | f = 5 MHz; open drain |

1. $R_{DS(on)}$ is the test of fresh devices

**Table 5 Dynamic characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 50 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100KHZ |
| Output capacitance | $C_{oss}$ | - | 15 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100KHZ |
| Reverse transfer capacitance | $C_{rss}$ | - | 0.2 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100KHZ |
| Effective output capacitance, energy related [1] | $C_{o(er)}$ | - | 17 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Effective output capacitance, time related [2] | $C_{o(tr)}$ | - | 24 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Output charge | $Q_{OSS}$ | - | 11 | - | nC | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Turn-on delay time | $t_{d(on)}$ | - | 0.9 | - | ns | $V_{DS}$ = 400 V; $I_D$ = 4.4 A; L = 318 μH; $V_{GS}$ = 6 V; $R_{on}$ = 10 Ω; $R_{off}$ = 2 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 1.2 | - | ns | |
| Rise time | $t_r$ | - | 3.5 | - | ns | |
| Fall time | $t_f$ | - | 6.1 | - | 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 6 Gate charge characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate charge | $Q_G$ | - | 1.5 | - | nC | $V_{GS}$ = 0 to 6 V; $V_{DS}$ = 400 V; $I_D$ = 2.2 A |
| Gate-source charge | $Q_{GS}$ | - | 0.15 | - | nC | |
| Gate-drain charge | $Q_{GD}$ | - | 0.5 | - | nC | |
| Gate plateau voltage | $V_{plat}$ | - | 2.5 | - | V | $V_{DS}$ = 400 V; $I_D$ = 2.2 A |

**Table 7 Reverse conduction characteristics**

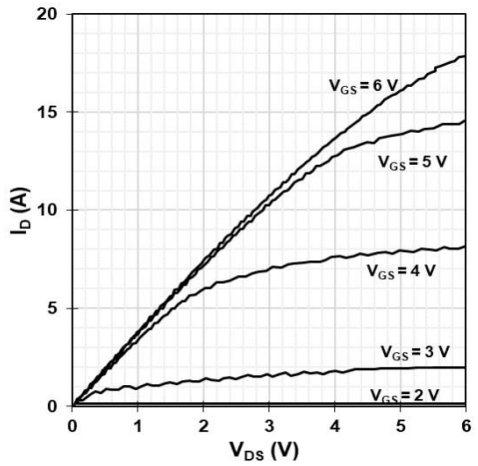
| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Source-drain reverse voltage | $V_{SD}$ | - | 4 | - | V | $V_{GS}$ = 0 V; $I_{SD}$ = 2.2 A |
| Pulsed current, reverse | $I_{S,\ pulse}$ | - | - | 10 | A | $V_{GS}$ = 6 V |
| Reverse recovery charge [1] | $Q_{rr}$ | - | 0 | - | nC | $I_{SD}$ = 2.2 A; $V_{DS}$ = 400 V |
| Reverse recovery time | $t_{rr}$ | - | 0 | - | ns | |
| Peak reverse recovery current | $I_{rrm}$ | - | 0 | - | A | |

1. Excluding $Q_{OSS}$

# 3 Electrical characteristics diagrams

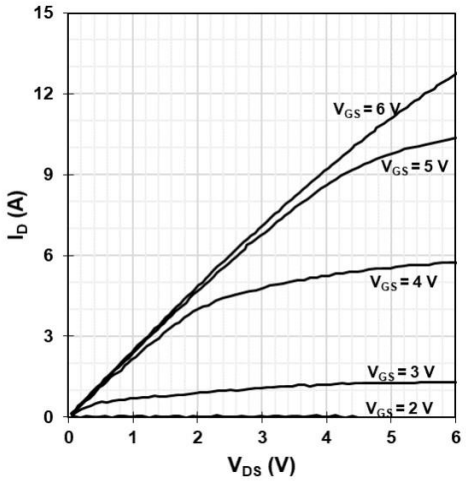
at $T_j$ = 25 °C, unless specified otherwise.

**Figure 1 Typ. output characteristics**



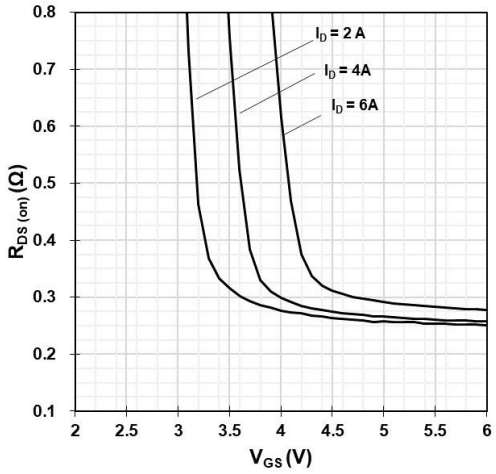

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 25 °C

**Figure 2 Typ. output characteristics**



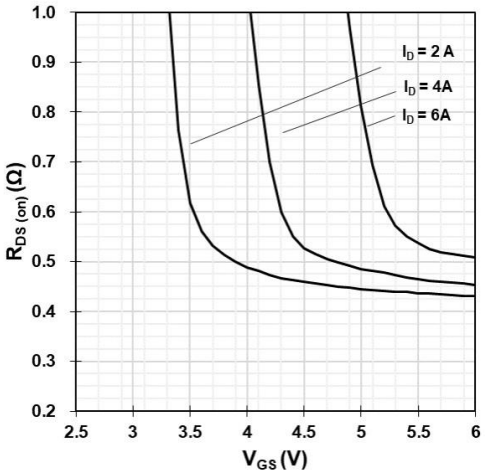

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 125 °C

**Figure 3 Typ. drain-source on-state resistance**

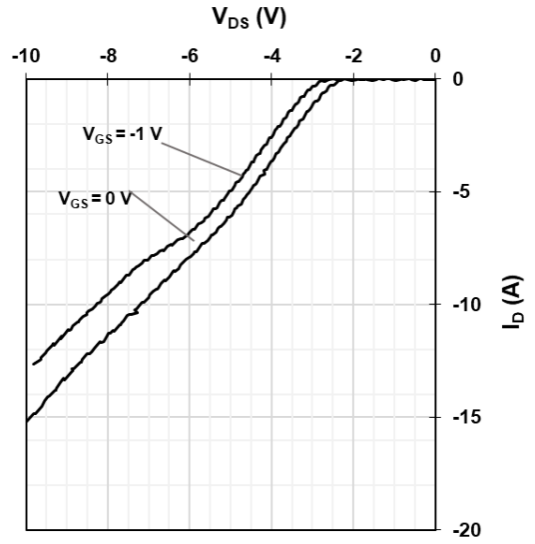
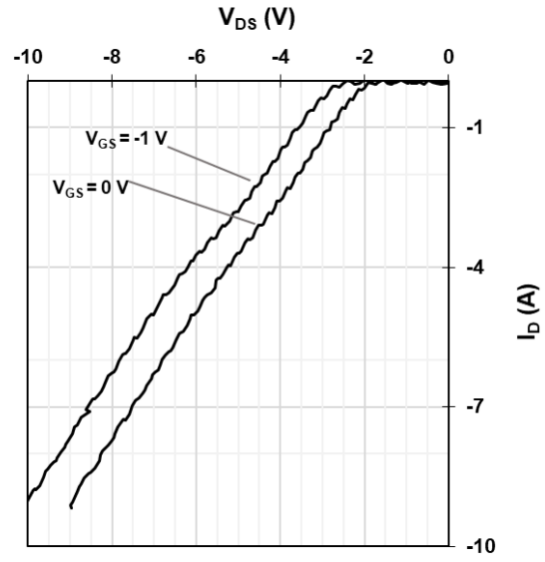



$R_{DS(on)} = f(I_D, V_{GS})$; $T_j$ = 25 °C

**Figure 4 Typ. drain-source on-state resistance**




$R_{DS(on)} = f(I_D, V_{GS})$; $T_j$ = 125 °C

| 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 |





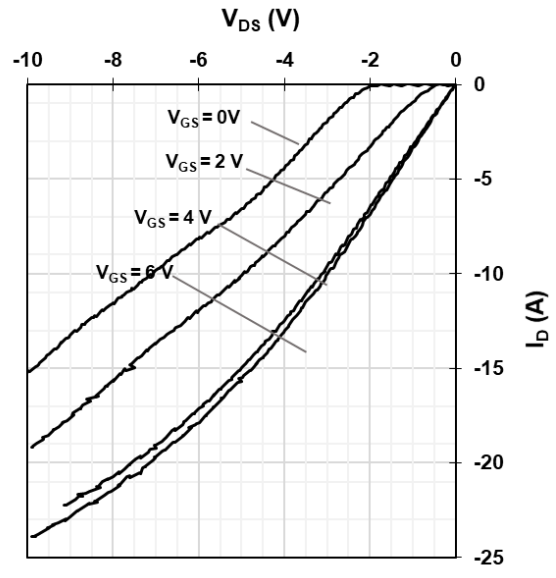
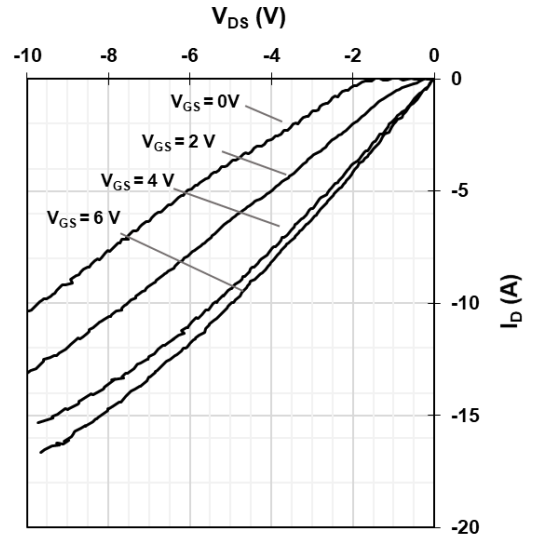
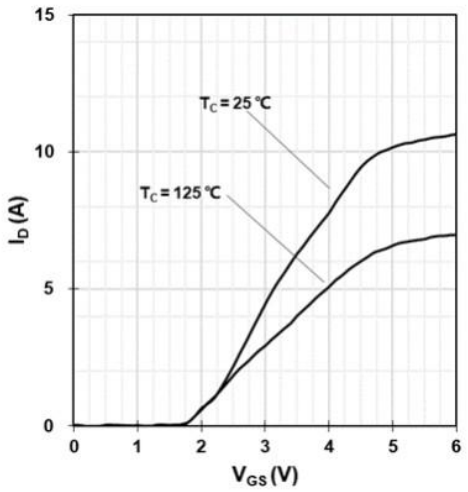
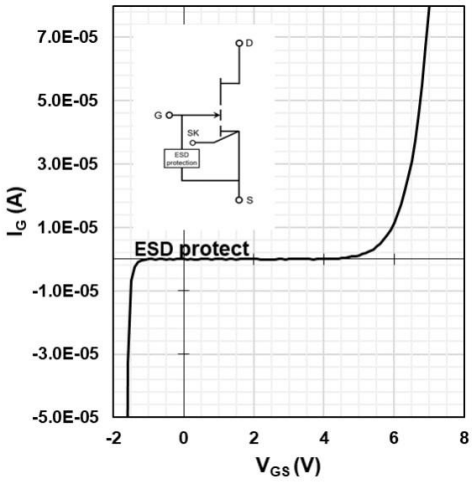
| Figure 7 Typ. channel reverse characteristics | Figure 8 Typ. channel reverse characteristics |
|---|---|
|  |  |
| $I_D = f(V_{DS}, V_{GS})$; $T_j$ = 25 °C | $I_D = f(V_{DS}, V_{GS})$; $T_j$ = 125 °C |

**Figure 9 Typ. transfer characteristics**



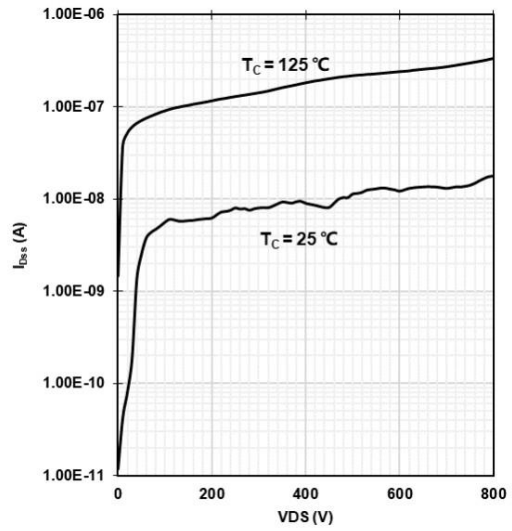

$I_D = f(V_{GS})$; $V_{DS}$ = 3 V

**Figure 10 Typ. gate-to-source leakage**

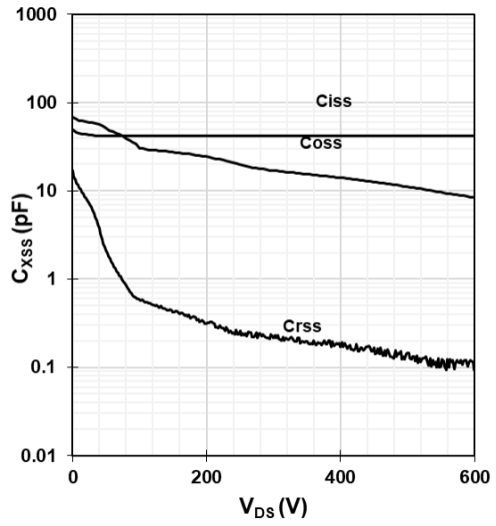
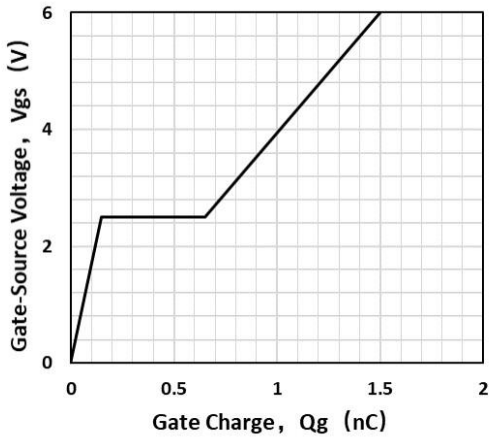



$I_G = f(V_{GS})$; $V_D$ = open

**Figure 11 Drain-source leakage characteristics**

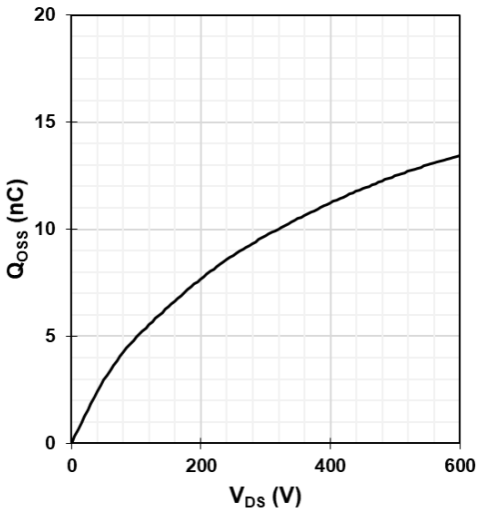
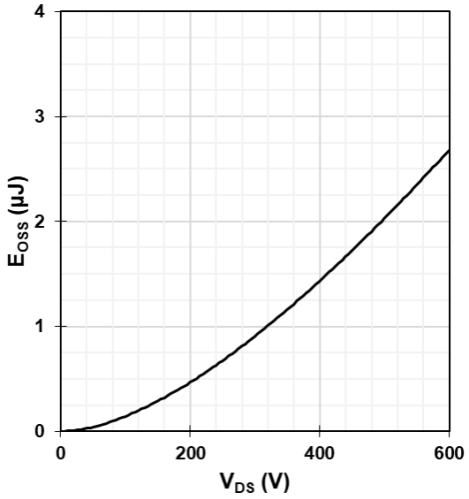


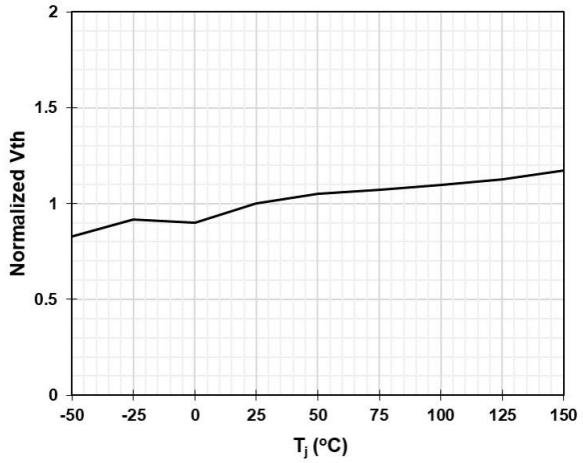
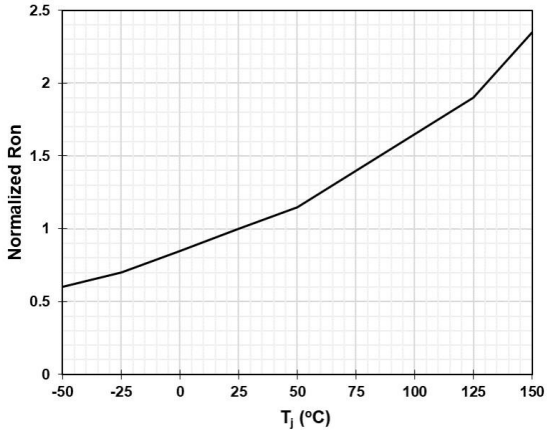

Idss = f(Vds); Vgs = 0V

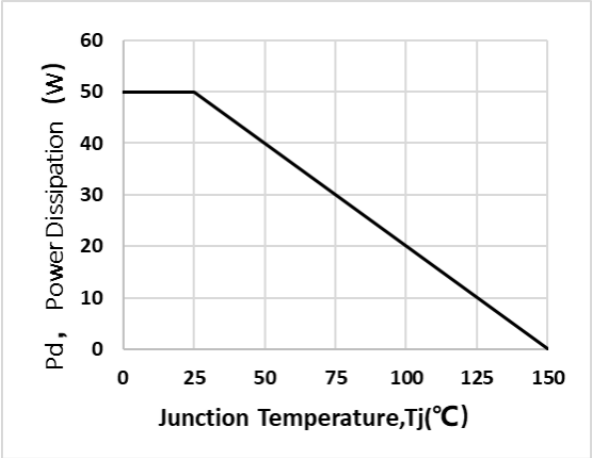
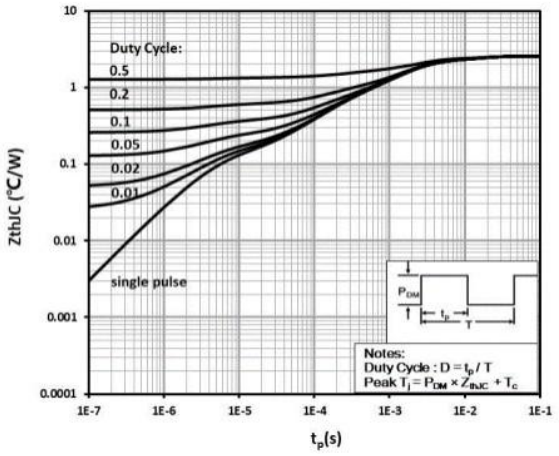
| Figure 12 Typ. capacitances | Figure 13 Typ. gate charge |
|---|---|
|  |  |
| $C_{XSS}$ = f($V_{DS}$); Freq. = 100kHz | $V_{GS}$ = f($Q_G$); $V_{DS}$ = 400 V; $I_D$ = 2.2 A |

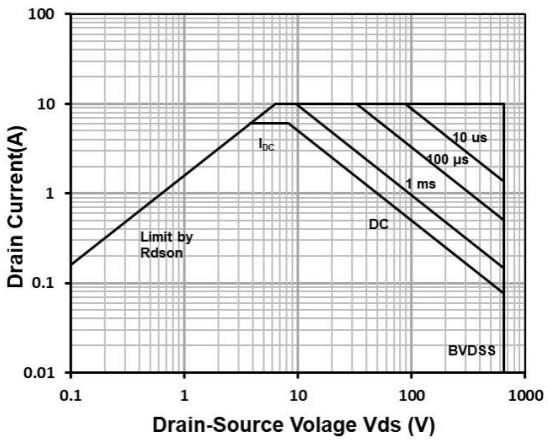
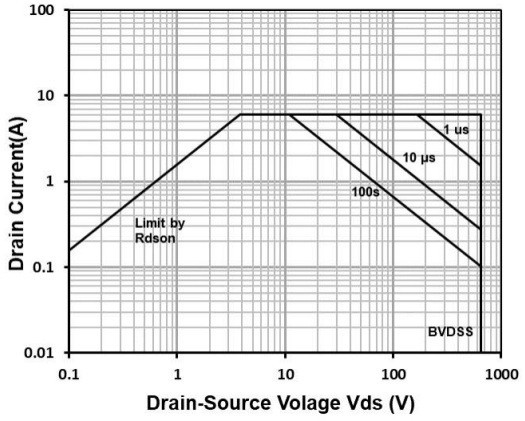


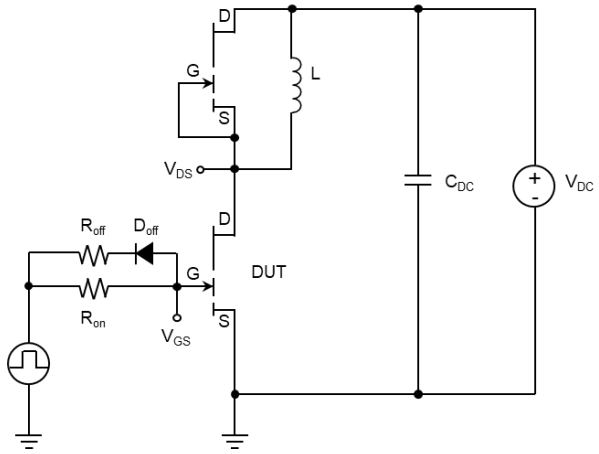
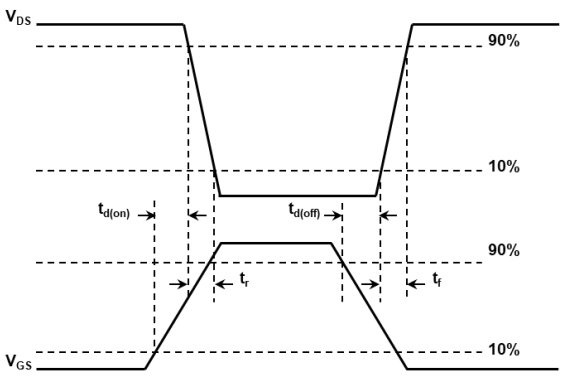


| Figure 14 Typ. output charge | Figure 15 Typ. $C_{oss}$ stored energy |
|---|---|
|  |  |
| $Q_{OSS}$ = f($V_{DS}$); Freq. = 100khz | $E_{OSS}$ = f($V_{DS}$); Freq. = 100khz |

| Figure 16 Gate threshold voltage | Figure 17 Drain-source on-state resistance |
|---|---|
|  |  |
| $V_{GS(TH)}$ = f($T_j$); $V_{GS}$ = $V_{DS}$; $I_D$ = 6 mA | $R_{DS(on)}$ = f($T_j$); $I_D$ = 2.2 A; $V_{GS}$ = 6 V |

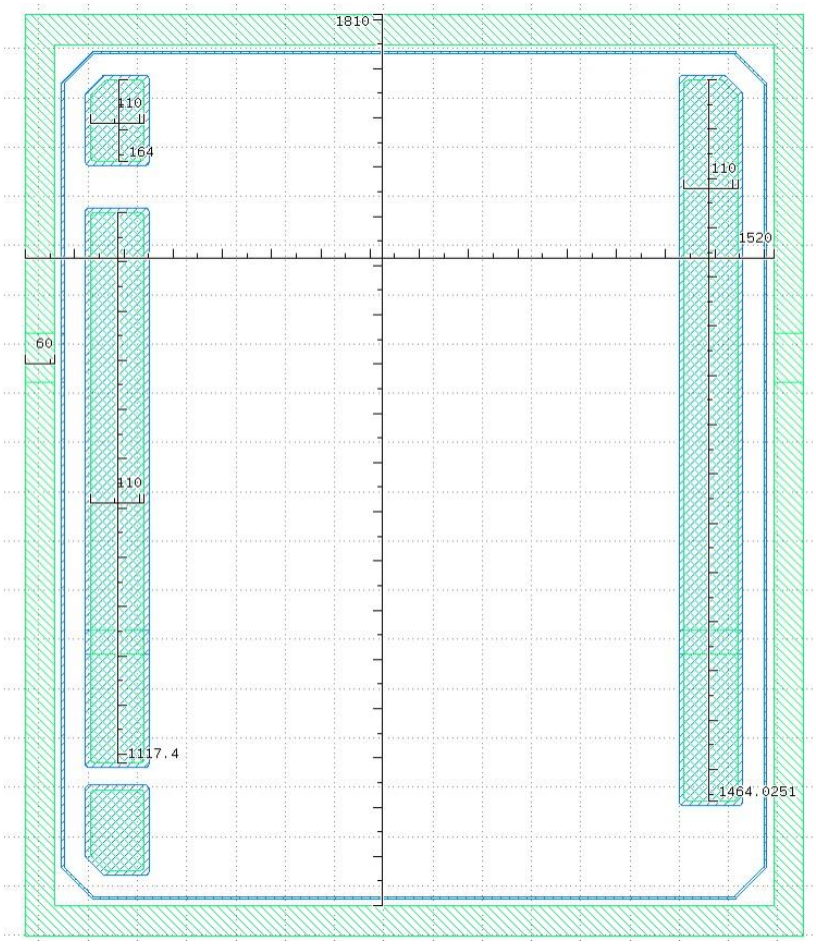
| Figure 18 Power dissipation | Figure 19 Max.transient thermal impedance |
|---|---|
|  |  |
| Ptot = f(Tc) | Zthjc = f(tp,D) |

| Figure 20 Safe Operation Area | Figure 21 Safe Operation Area |
|---|---|
|  |  |
| Id = f(Vds); Tc = 25℃ | Id = f(Vds); Tc = 125℃ |

| Figure 22 Switching time test circuit | Figure 23 Typ. switching time waveforms |
|---|---|
|  |  |
| $V_{DS}$ = 400 V, $I_D$ = 4.4 A, L = 318 µH, $V_{GS}$ = 6 V, | $R_{on}$ = 10 Ω, $R_{off}$ = 2 Ω |

# 4 Chip Information

| Parameter | |
|---|---|
| Wafer Size | 6inch |
| Die size（With SL） | 1810um*1520um |
| Gate Pad Size | 164um*110um |
| Source Pad Size | 1117um*110um |
| Drain Pad Size | 1520um*110um |
| Scribe Line Size（PI CD） | 60um |
| Top metal | 4um, AlSi |
| Chip surface | 3 um SiO2 + 0.5um SiN+10um PI |
| Recommended dicing method | Direct cutting without laser grooving |



# 5 Wafer Information

基本资料设定

* Wafer Size: * 6 寸
Technology ID: D65PX11
Product ID: * AC0030A1
Query

* Shot Size
* Width 19.91 mm
* Height 19.76 mm

* Shot Die数量
* X Die 11 颗
* Y Die 13 颗

Die Size
X Die 1.810000 mm
Y Die 1.520000 mm

Query PCM修改

* 外围设定
* 缩进量 10 mm

* 圆心位移
* 横向 0 μm
* 纵向 0 μm

平边位置
* 大边 度
小边 度

平边尺寸
* 大边 mm
小边 mm

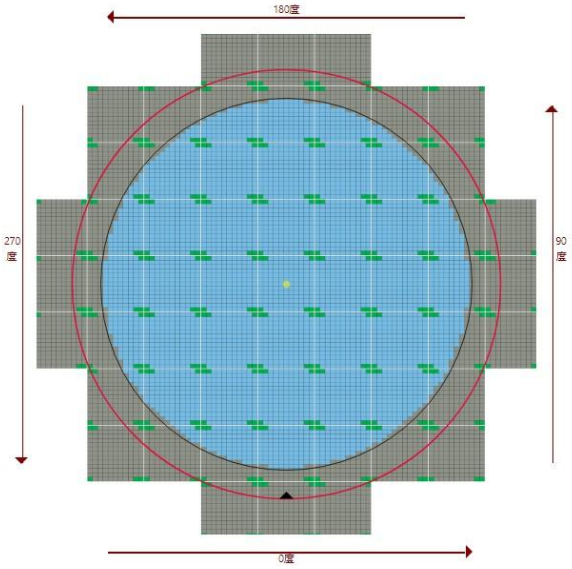
Notch位置
* 0 度

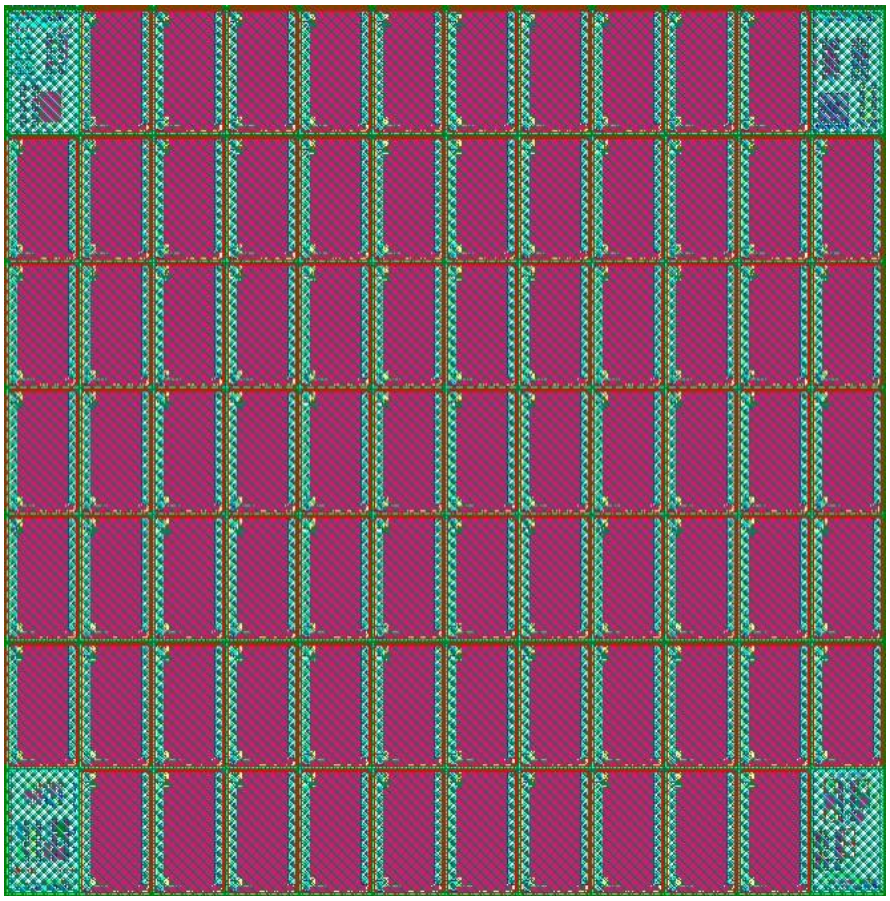
预览

绘图结果

| | | | | | |
|---|---|---|---|---|---|
| Gross Die数量: | 4483 | Die Pitch_X(μm): | 1810.0 | Die Pitch_Y(μm): | 1520.0 |
| PCM In Die: | 192 | Complete Shot: | 21 | Partial Shot: | 24 |

导出 导出Map 保存

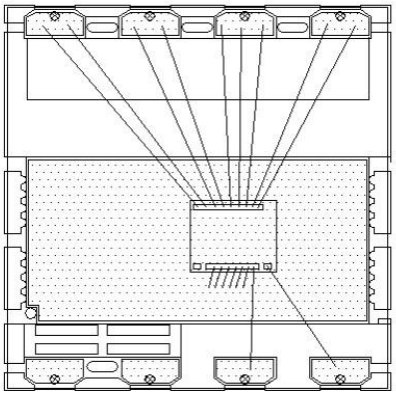


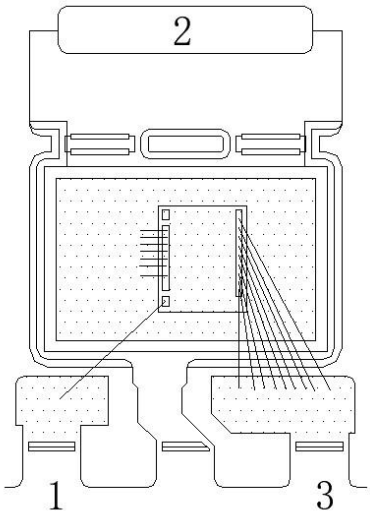
# 6 Bonding Information

| | |
|---|---|
| Recommended wire | Cu Wire |
| Recommended wire diameter | 1mil to 1.5mil |
| Recommended Package | DFN8*8, TO252，DFN5*6 |

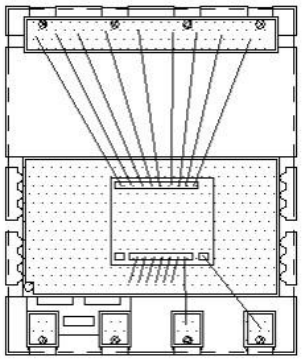
| PKG | DFN8*8 |
|---|---|
| Pad | 1.5mils Cu Wires |
| Gate | 1 |
| Source | 6 |
| Drain | 9 |
| SK | 1 |



| PKG | TO252 |
|---|---|
| Pad | 1.5mils Cu Wires |
| Gate | 1 |
| Source | 7 |
| Drain | 9 |




| PKG | DFN5*6 |
|---|---|
| Pad | 1.5mils Cu Wires |
| Gate | 1 |
| Source | 6 |
| Drain | 9 |
| SK | 1 |



# 7 Revision history

Major changes since the last revision

| Revision | Date | Description of changes |
|---|---|---|
| 1.0 | 2025-10-23 | 1.0 version release |