

# MOSFET

## 600V CoolMOS™ G7 SJ Power Device

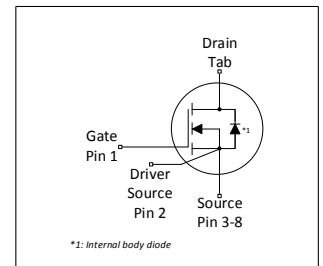
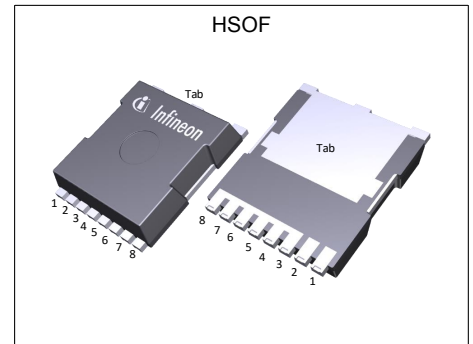
The C7 GOLD series (G7) for the first time brings together the benefits of the C7 GOLD CoolMOS™ technology, 4 pin Kelvin Source capability and the improved thermal properties of the TOLL package to enable a possible SMD solution for high current topologies such as PFC up to 3kW

### Features

- C7 Gold gives best in class FOM  $R_{DS(on)} \cdot E_{oss}$  and  $R_{DS(on)} \cdot Q_g$ .
- Suitable for hard and soft switching (PFC and high performance LLC)
- C7 Gold technology enables best in class  $R_{DS(on)}$  in smallest footprint.
- TOLL package has inbuilt 4<sup>th</sup> pin Kelvin Source configuration and low parasitic source inductance (~1nH).
- TOLL package is MSL1 compliant, total Pb-free and has easy visual inspection grooved leads.
- TOLL SMD package combined with lead free die attach process enables improved thermal performance  $R_{th}$ .

### Benefits

- C7 Gold FOM  $R_{DS(on)} \cdot Q_g$  is 15% better than previous C7 600V enabling faster switching leading to higher efficiency.
- Increased economies of scale by use in PFC and PWM topologies in the application
- C7 Gold can reach 28mΩ in in TOLL 115mm<sup>2</sup> footprint, whereas previous BIC C7 600V was 40mΩ in 150mm<sup>2</sup> D<sup>2</sup>PAK footprint.
- Reducing parasitic source inductance by Kelvin Source improves efficiency by faster switching and ease of use due to less ringing.
- TOLL package is easy to use and has the highest quality standards.
- Improved thermals enable SMD TOLL package to be used in higher current designs than has been previously possible.



RoHS

### Potential applications

PFC stages and PWM stages (TTF, LLC) for high power/performance SMPS e.g. Computing, Server, Telecom, UPS and Solar.

### Product validation

Fully qualified according to JEDEC for Industrial Applications

*Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.*

**Table 1 Key Performance Parameters**

| Parameter                              | Value | Unit |
|----------------------------------------|-------|------|
| $V_{DS} @ T_{j,max}$                   | 650   | V    |
| $R_{DS(on),max}$                       | 50    | mΩ   |
| $Q_{g,typ}$                            | 68    | nC   |
| $I_{D,pulse}$                          | 135   | A    |
| $I_{D,continuous} @ T_j < 150^\circ C$ | 57    | A    |
| $E_{oss}@400V$                         | 8.1   | μJ   |
| Body diode di/dt                       | 870   | A/μs |

| Type / Ordering Code | Package   | Marking  | Related Links  |
|----------------------|-----------|----------|----------------|
| IPT60R050G7          | PG-HSOF-8 | 60R050G7 | see Appendix A |

**Table of Contents**

Description ..... 1

Maximum ratings ..... 3

Thermal characteristics ..... 4

Electrical characteristics ..... 5

Electrical characteristics diagrams ..... 7

Test Circuits ..... 11

Package Outlines ..... 12

Appendix A ..... 13

Revision History ..... 14

Trademarks ..... 14

Disclaimer ..... 14

## 1 Maximum ratings

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

**Table 2 Maximum ratings**

| Parameter                              | Symbol        | Values |      |          | Unit             | Note / Test Condition                                                                         |
|----------------------------------------|---------------|--------|------|----------|------------------|-----------------------------------------------------------------------------------------------|
|                                        |               | Min.   | Typ. | Max.     |                  |                                                                                               |
| Continuous drain current <sup>1)</sup> | $I_D$         | -      | -    | 44<br>28 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$                                             |
| Pulsed drain current <sup>2)</sup>     | $I_{D,pulse}$ | -      | -    | 135      | A                | $T_C=25^\circ\text{C}$                                                                        |
| Avalanche energy, single pulse         | $E_{AS}$      | -      | -    | 159      | mJ               | $I_D=6.4\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                        |
| Avalanche energy, repetitive           | $E_{AR}$      | -      | -    | 0.80     | mJ               | $I_D=6.4\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                        |
| Avalanche current, single pulse        | $I_{AS}$      | -      | -    | 6.4      | A                | -                                                                                             |
| MOSFET dv/dt ruggedness                | dv/dt         | -      | -    | 120      | V/ns             | $V_{DS}=0\dots400\text{V}$                                                                    |
| Gate source voltage (static)           | $V_{GS}$      | -20    | -    | 20       | V                | static;                                                                                       |
| Gate source voltage (dynamic)          | $V_{GS}$      | -30    | -    | 30       | V                | AC ( $f>1\text{ Hz}$ )                                                                        |
| Power dissipation                      | $P_{tot}$     | -      | -    | 245      | W                | $T_C=25^\circ\text{C}$                                                                        |
| Storage temperature                    | $T_{stg}$     | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                             |
| Operating junction temperature         | $T_j$         | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                             |
| Mounting torque                        | -             | -      | -    | n.a.     | Ncm              | -                                                                                             |
| Continuous diode forward current       | $I_S$         | -      | -    | 44       | A                | $T_C=25^\circ\text{C}$                                                                        |
| Diode pulse current <sup>2)</sup>      | $I_{S,pulse}$ | -      | -    | 135      | A                | $T_C=25^\circ\text{C}$                                                                        |
| Reverse diode dv/dt <sup>3)</sup>      | dv/dt         | -      | -    | 25       | V/ns             | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 9.9\text{A}$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Maximum diode commutation speed        | di/dt         | -      | -    | 870      | A/ $\mu\text{s}$ | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 9.9\text{A}$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Insulation withstand voltage           | $V_{ISO}$     | -      | -    | n.a.     | V                | $V_{rms}$ , $T_C=25^\circ\text{C}$ , $t=1\text{min}$                                          |

<sup>1)</sup> Limited by  $T_{j,max}$ .

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Identical low side and high side switch

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                               | Symbol     | Values |      |      | Unit | Note / Test Condition                                                                                                                                                               |
|---------------------------------------------------------|------------|--------|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                         |            | Min.   | Typ. | Max. |      |                                                                                                                                                                                     |
| Thermal resistance, junction - case                     | $R_{thJC}$ | -      | -    | 0.51 | °C/W | -                                                                                                                                                                                   |
| Thermal resistance, junction - ambient                  | $R_{thJA}$ | -      | -    | 62   | °C/W | device on PCB, minimal footprint                                                                                                                                                    |
| Thermal resistance, junction - ambient for SMD version  | $R_{thJA}$ | -      | 35   | 45   | °C/W | Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm <sup>2</sup> (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling. |
| Soldering temperature, wave- & reflow soldering allowed | $T_{sld}$  | -      | -    | 260  | °C   | reflow MSL1                                                                                                                                                                         |

### 3 Electrical characteristics

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

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |                |            | Unit          | Note / Test Condition                                                                                                                       |
|----------------------------------|---------------|--------|----------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |               | Min.   | Typ.           | Max.       |               |                                                                                                                                             |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 600    | -              | -          | V             | $V_{GS}=0\text{V}$ , $I_D=1\text{mA}$                                                                                                       |
| Gate threshold voltage           | $V_{(GS)th}$  | 3      | 3.5            | 4          | V             | $V_{DS}=V_{GS}$ , $I_D=0.8\text{mA}$                                                                                                        |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -              | 1          | $\mu\text{A}$ | $V_{DS}=600$ , $V_{GS}=0\text{V}$ , $T_j=25^{\circ}\text{C}$<br>$V_{DS}=600$ , $V_{GS}=0\text{V}$ , $T_j=150^{\circ}\text{C}$               |
| Gate-source leakage current      | $I_{GSS}$     | -      | -              | 100        | nA            | $V_{GS}=20\text{V}$ , $V_{DS}=0\text{V}$                                                                                                    |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.043<br>0.108 | 0.050<br>- | $\Omega$      | $V_{GS}=10\text{V}$ , $I_D=15.9\text{A}$ , $T_j=25^{\circ}\text{C}$<br>$V_{GS}=10\text{V}$ , $I_D=15.9\text{A}$ , $T_j=150^{\circ}\text{C}$ |
| Gate resistance                  | $R_G$         | -      | 0.8            | -          | $\Omega$      | $f=1\text{MHz}$ , open drain                                                                                                                |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                              |
|------------------------------------------------------------|--------------|--------|------|------|------|----------------------------------------------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                                                                    |
| Input capacitance                                          | $C_{iss}$    | -      | 2670 | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=400\text{V}$ , $f=250\text{kHz}$                                      |
| Output capacitance                                         | $C_{oss}$    | -      | 55   | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=400\text{V}$ , $f=250\text{kHz}$                                      |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 101  | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=0\ldots400\text{V}$                                                   |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 1050 | -    | pF   | $I_D=\text{constant}$ , $V_{GS}=0\text{V}$ , $V_{DS}=0\ldots400\text{V}$                           |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 22   | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=15.9\text{A}$ ,<br>$R_G=3.3\Omega$ ; see table 9 |
| Rise time                                                  | $t_r$        | -      | 6    | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=15.9\text{A}$ ,<br>$R_G=3.3\Omega$ ; see table 9 |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 72   | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=15.9\text{A}$ ,<br>$R_G=3.3\Omega$ ; see table 9 |
| Fall time                                                  | $t_f$        | -      | 3    | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=15.9\text{A}$ ,<br>$R_G=3.3\Omega$ ; see table 9 |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                                                  |
|-----------------------|---------------|--------|------|------|------|------------------------------------------------------------------------|
|                       |               | Min.   | Typ. | Max. |      |                                                                        |
| Gate to source charge | $Q_{gs}$      | -      | 13   | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=15.9\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 24   | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=15.9\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate charge total     | $Q_g$         | -      | 68   | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=15.9\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.0  | -    | V    | $V_{DD}=400\text{V}$ , $I_D=15.9\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |

<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

<sup>2)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit    | Note / Test Condition                                         |
|-------------------------------|-----------|--------|------|------|---------|---------------------------------------------------------------|
|                               |           | Min.   | Typ. | Max. |         |                                                               |
| Diode forward voltage         | $V_{SD}$  | -      | 0.8  | -    | V       | $V_{GS}=0V$ , $I_F=15.9A$ , $T_J=25^{\circ}C$                 |
| Reverse recovery time         | $t_{rr}$  | -      | 370  | -    | ns      | $V_R=400V$ , $I_F=15.9A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 5.8  | -    | $\mu C$ | $V_R=400V$ , $I_F=15.9A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 33   | -    | A       | $V_R=400V$ , $I_F=15.9A$ , $di_F/dt=100A/\mu s$ ; see table 8 |

## 4 Electrical characteristics diagrams

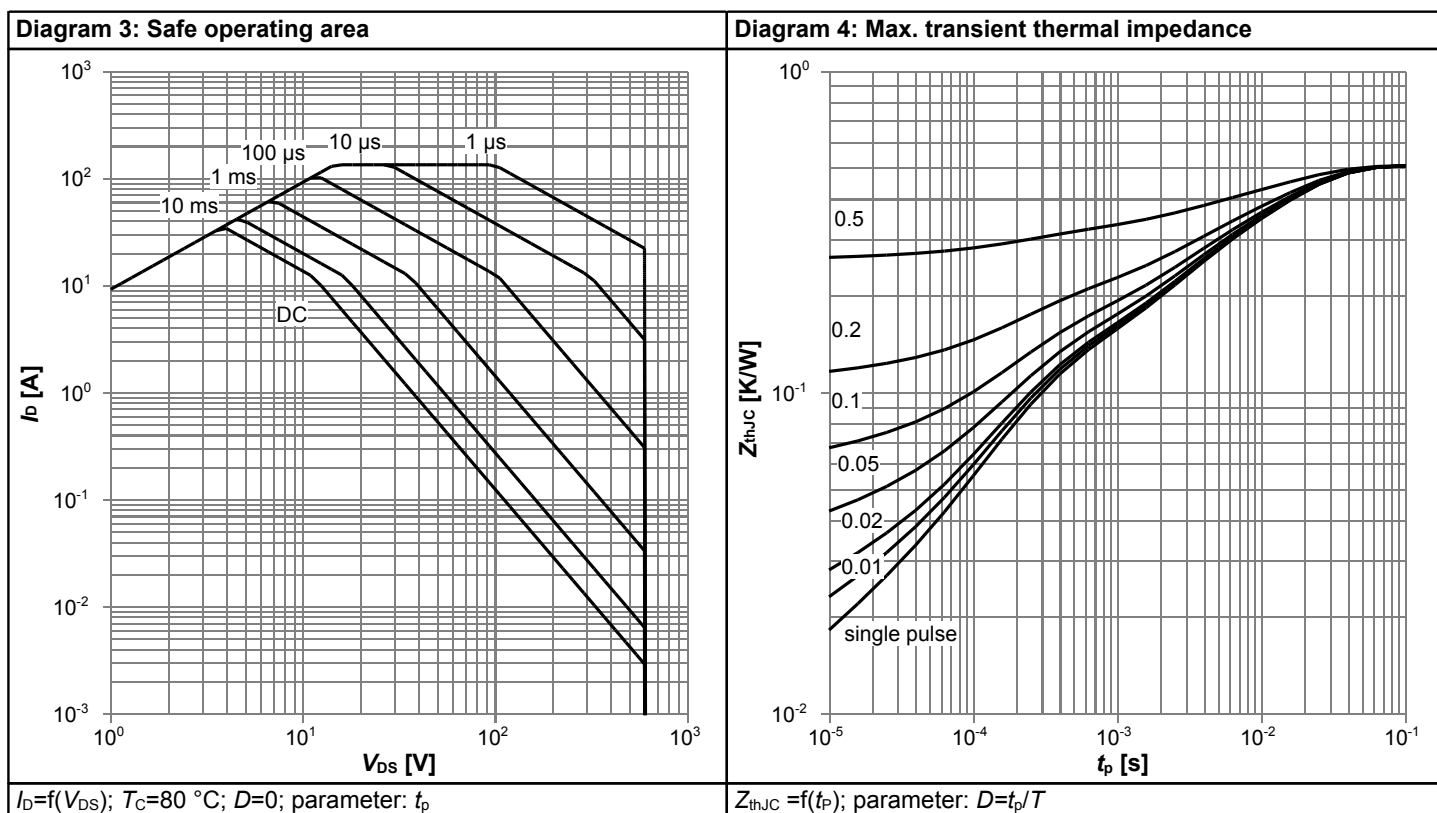
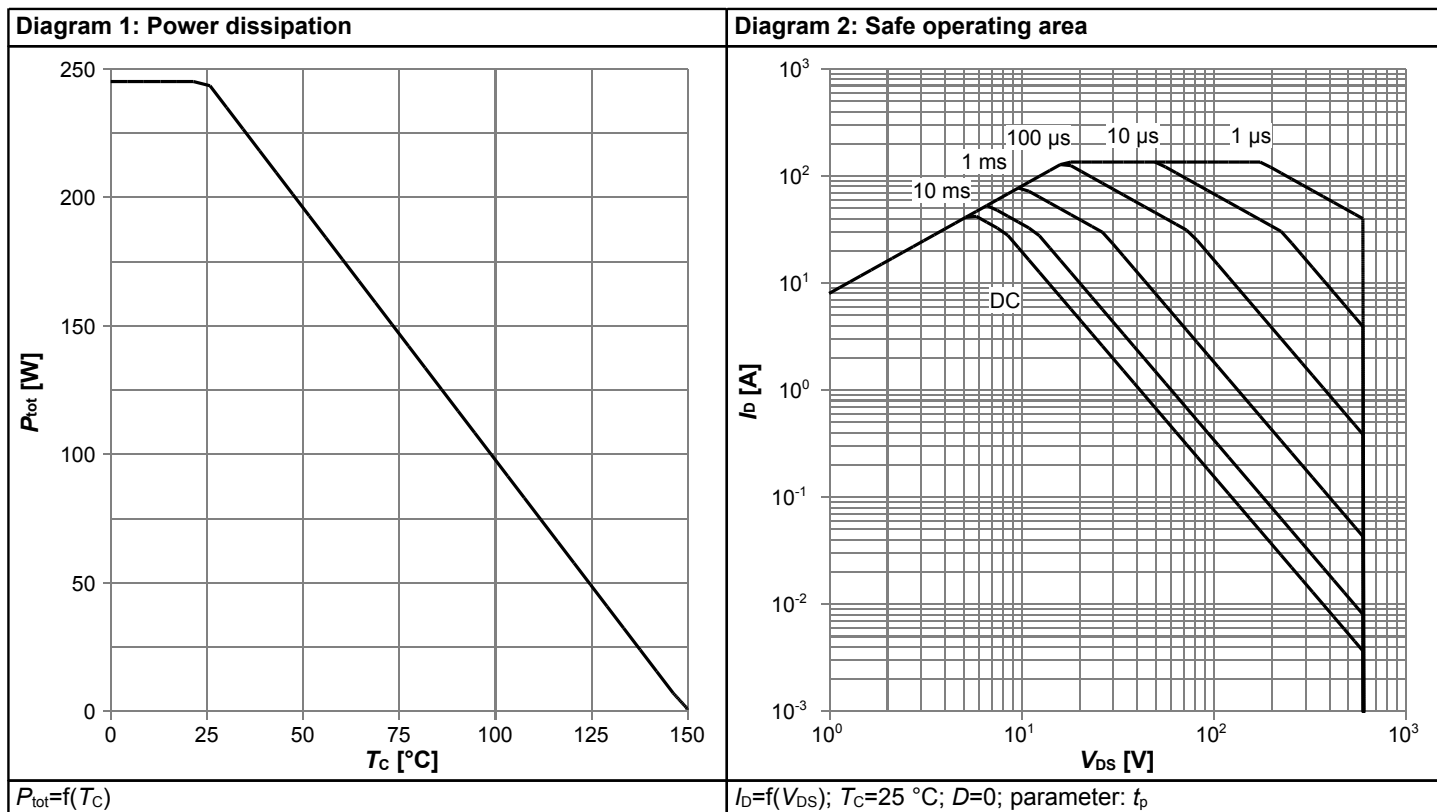
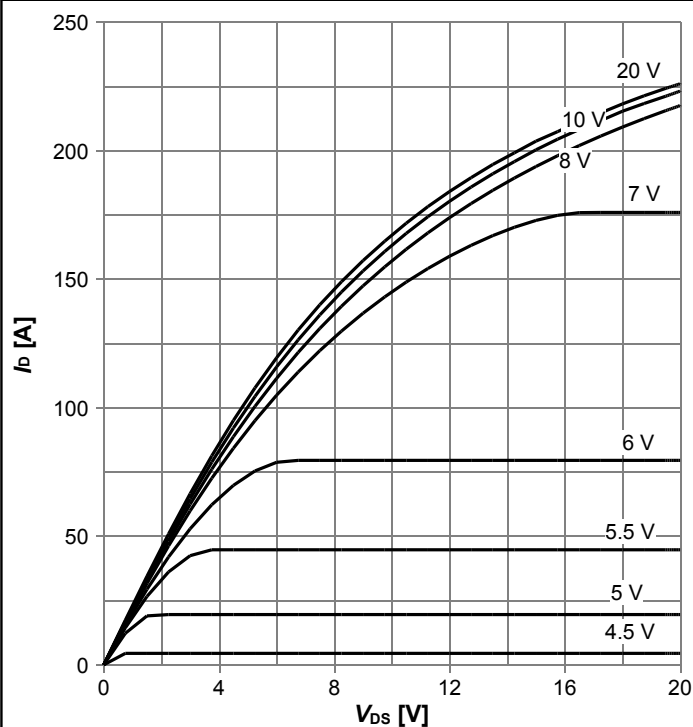
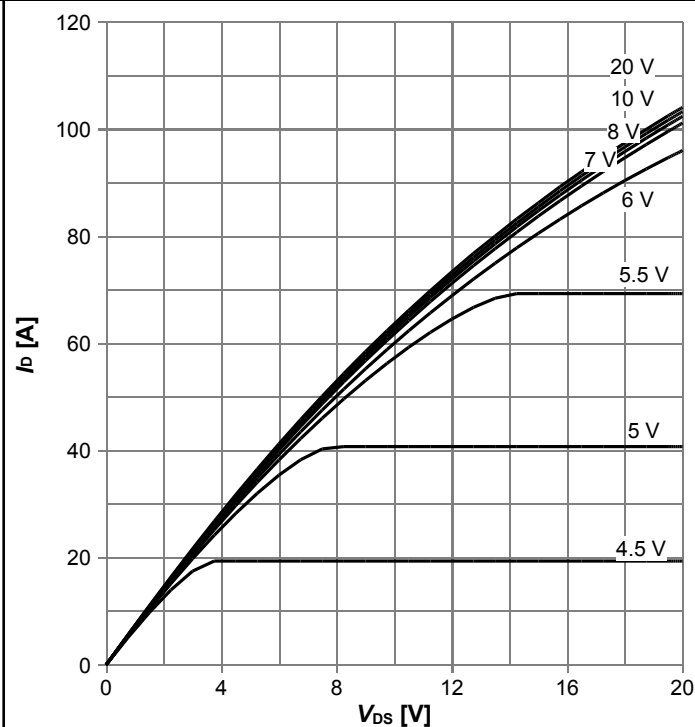


Diagram 5: Typ. output characteristics



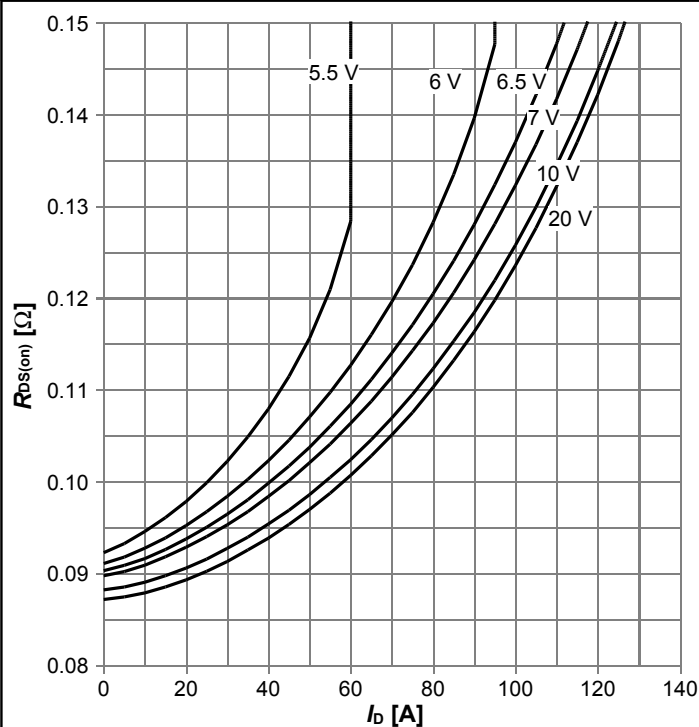
$I_D = f(V_{DS})$ ;  $T_J = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



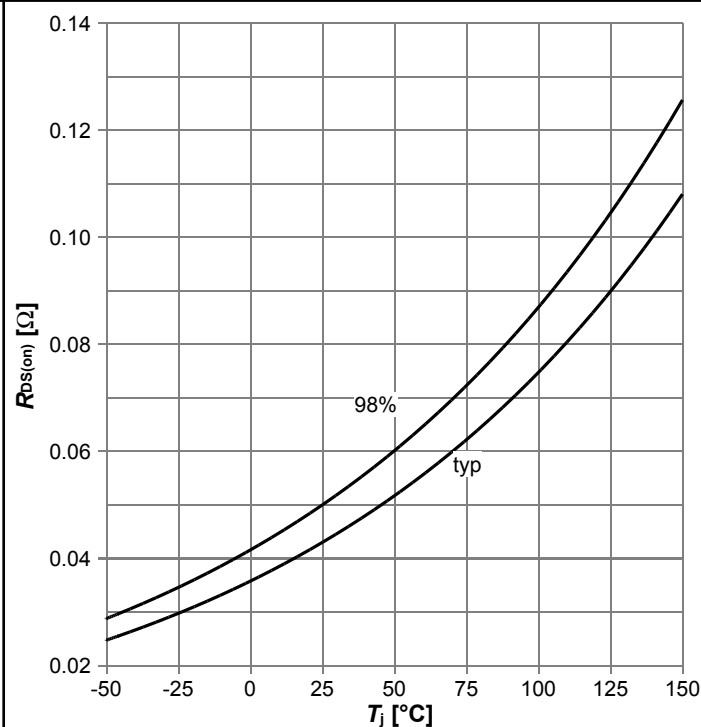
$I_D = f(V_{DS})$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. drain-source on-state resistance



$R_{DS(on)} = f(I_D)$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

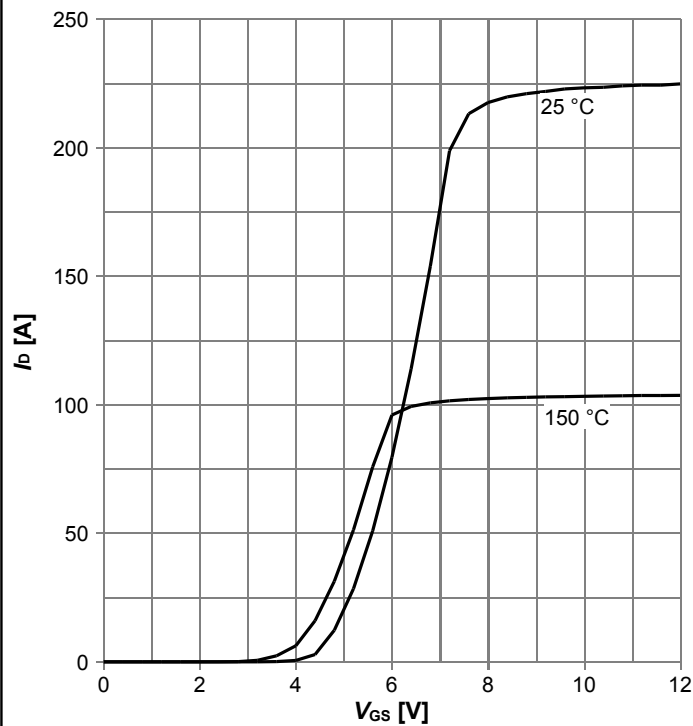
Diagram 8: Drain-source on-state resistance



$R_{DS(on)} = f(T_J)$ ;  $I_D = 15.9\text{ A}$ ;  $V_{GS} = 10\text{ V}$

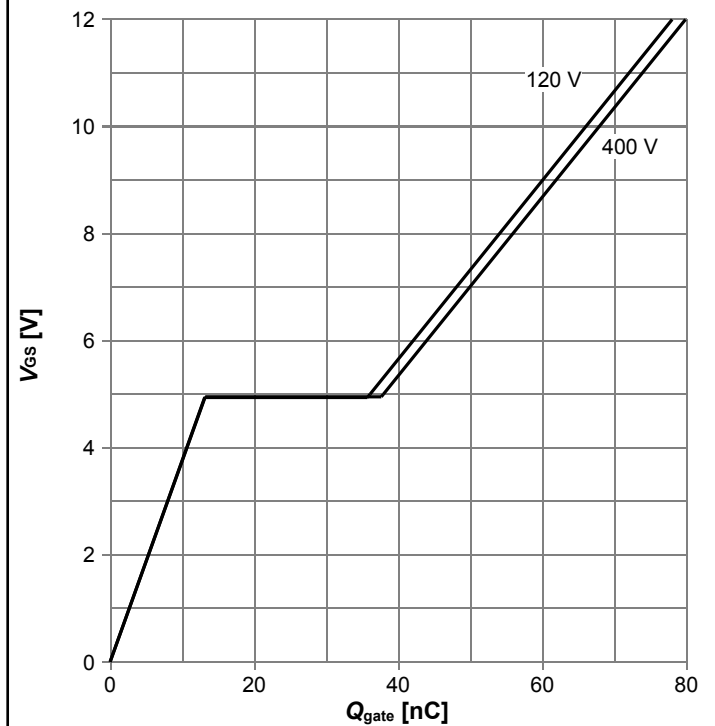


**Diagram 9: Typ. transfer characteristics**



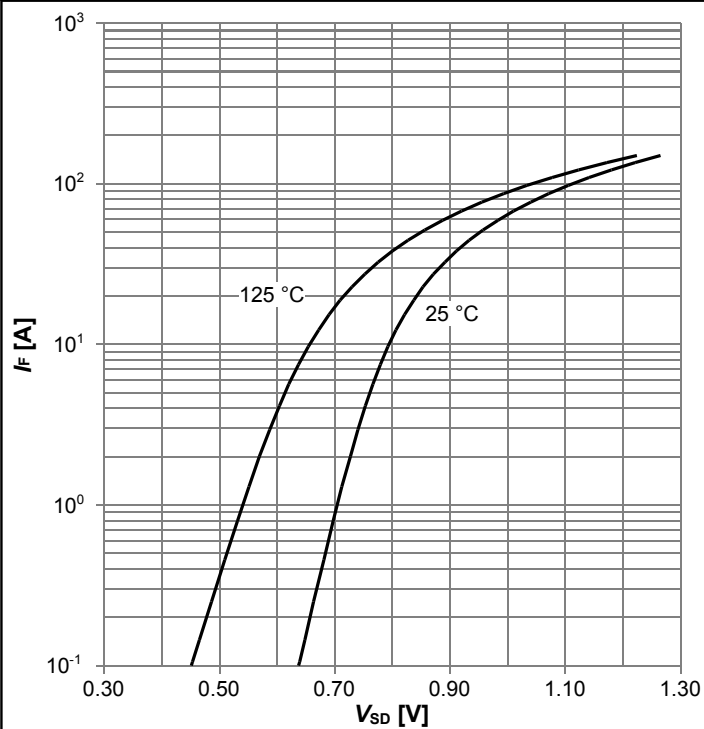
$I_D=f(V_{GS})$ ;  $V_{DS}=20V$ ; parameter:  $T_j$

**Diagram 10: Typ. gate charge**



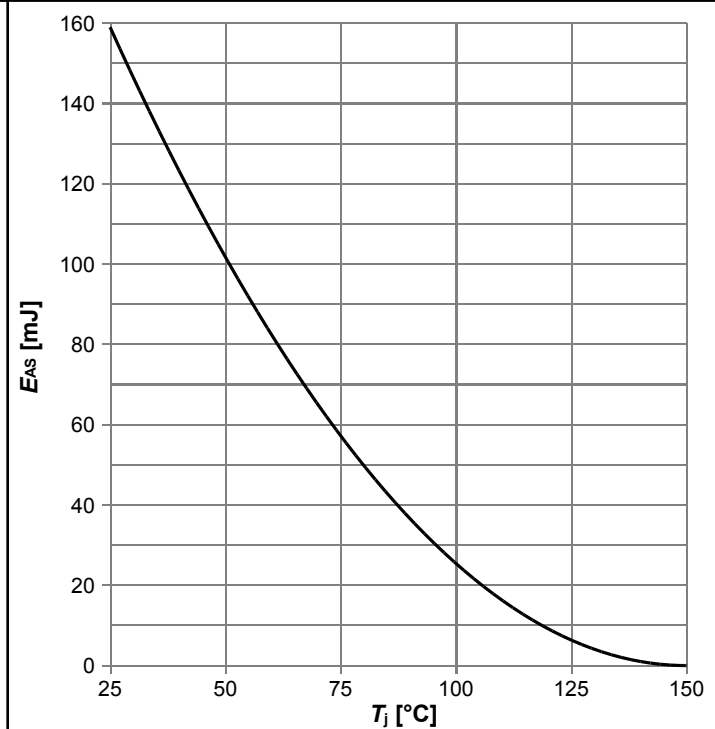
$V_{GS}=f(Q_{gate})$ ;  $I_D=15.9 A$  pulsed; parameter:  $V_{DD}$

**Diagram 11: Forward characteristics of reverse diode**



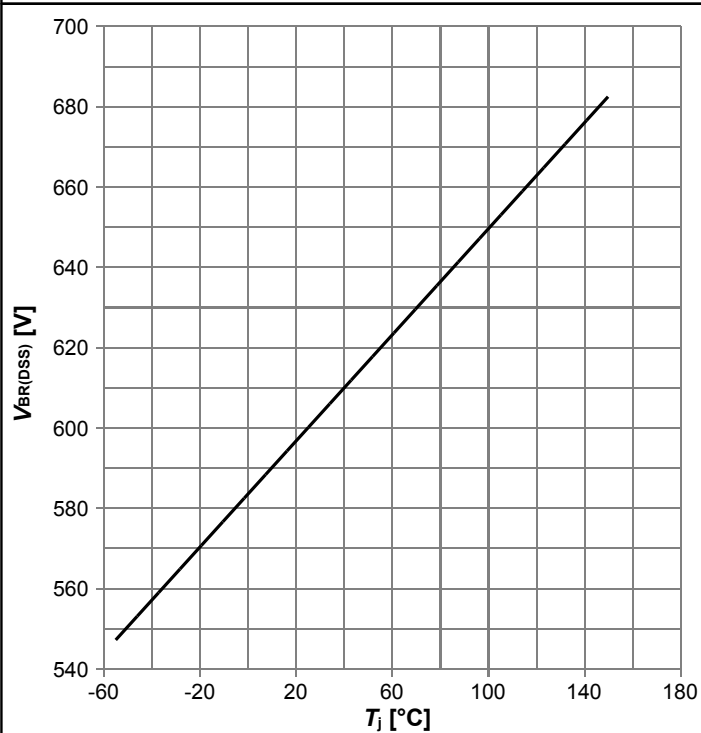
$I_F=f(V_{SD})$ ; parameter:  $T_j$

**Diagram 12: Avalanche energy**



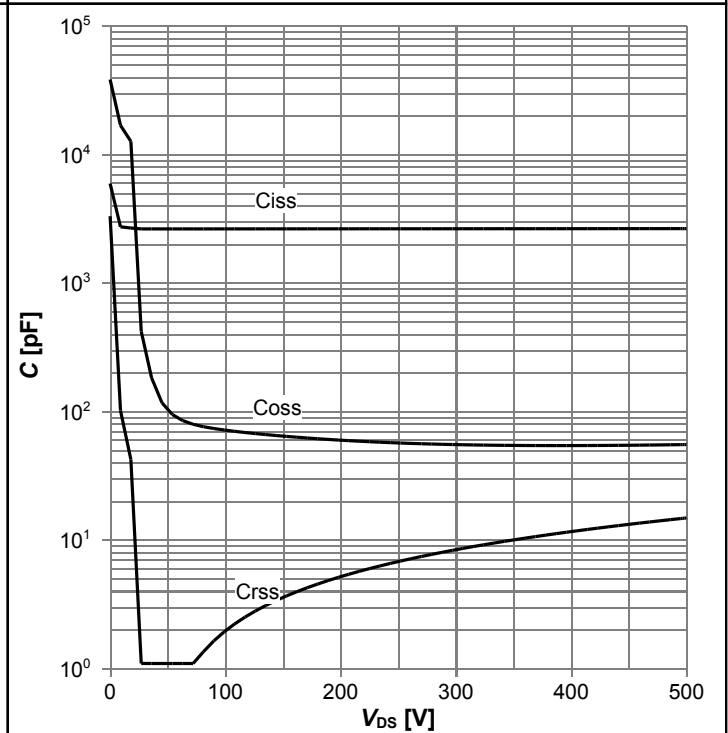
$E_{AS}=f(T_j)$ ;  $I_D=6.4 A$ ;  $V_{DD}=50 V$

Diagram 13: Drain-source breakdown voltage



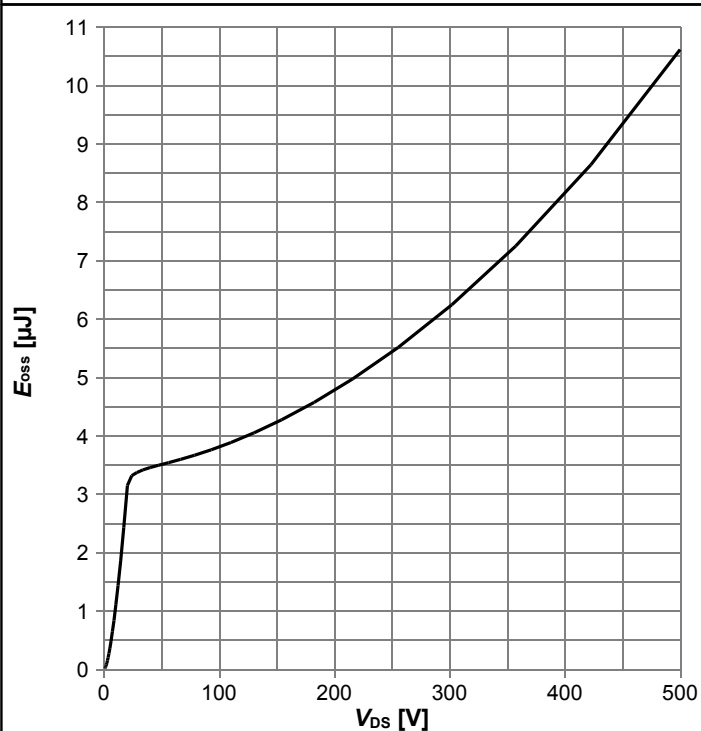
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

Diagram 14: Typ. capacitances



$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 250 \text{ kHz}$

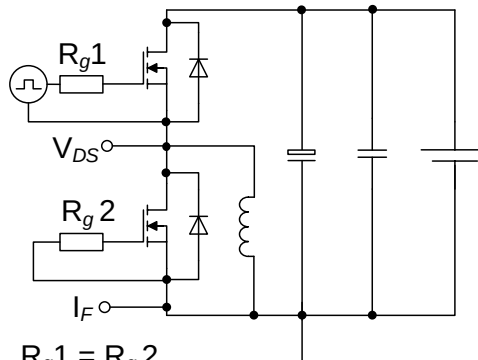
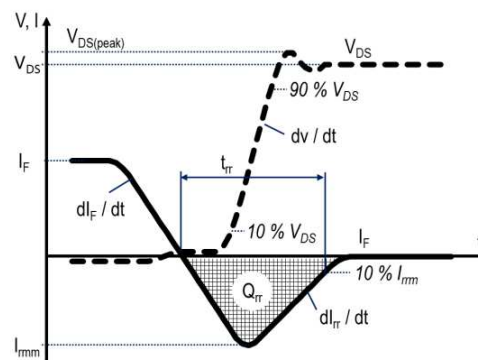
Diagram 15: Typ. Coss stored energy



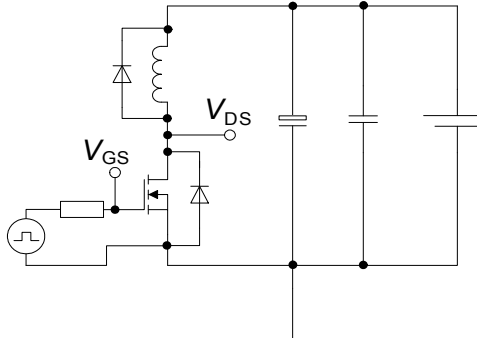
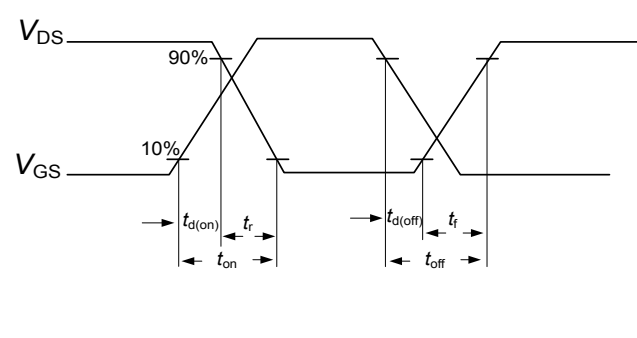
$E_{oss} = f(V_{DS})$

## 5 Test Circuits

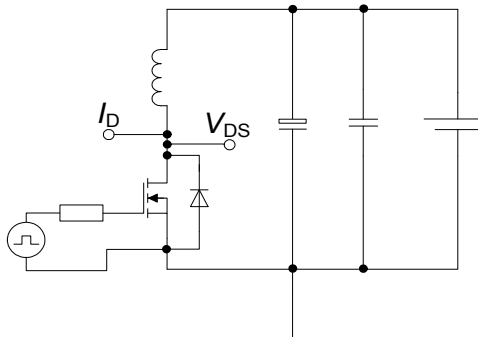
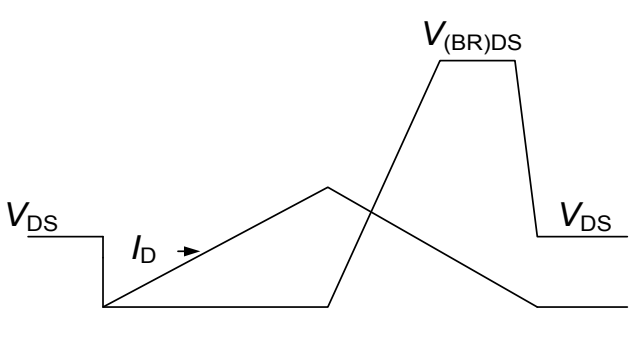
**Table 8 Diode characteristics**

| Test circuit for diode characteristics                                                                                | Diode recovery waveform                                                            |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  <p><math>R_{g1} = R_{g2}</math></p> |  |

**Table 9 Switching times (ss)**

| Switching times test circuit for inductive load                                    | Switching times waveform                                                            |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |

**Table 10 Unclamped inductive load (ss)**

| Unclamped inductive load test circuit                                               | Unclamped inductive waveform                                                         |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

## 6 Package Outlines

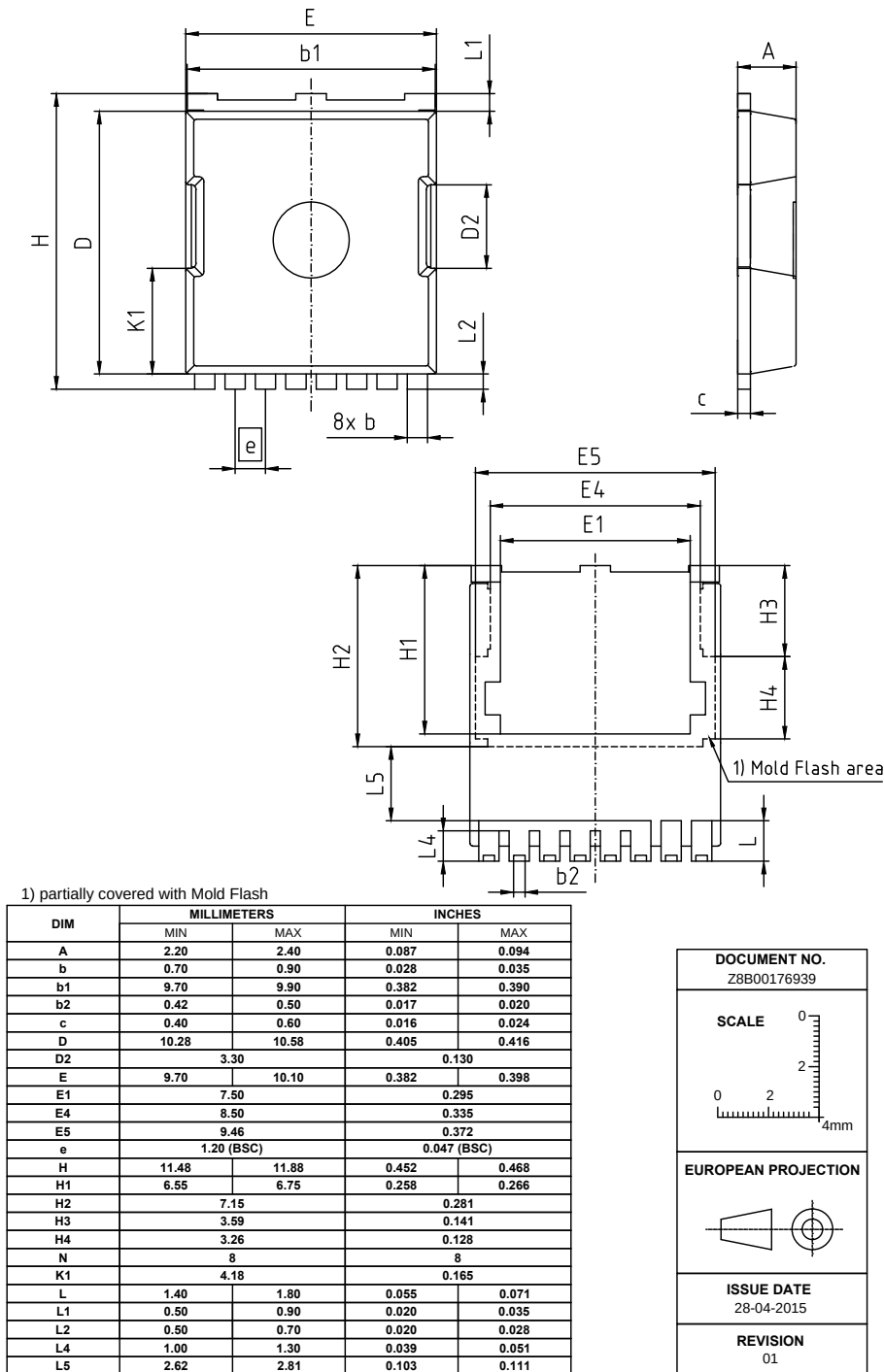


Figure 1 Outline PG-HSOF-8, dimensions in mm/inches

## **7 Appendix A**

### **Table 11 Related Links**

- IFX CoolMOS™ G7 Webpage: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ G7 application note: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ G7 simulation model: [www.infineon.com](http://www.infineon.com)
- IFX Design tools: [www.infineon.com](http://www.infineon.com)

## Revision History

IPT60R050G7

**Revision: 2020-10-27, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision)       |
|----------|------------|----------------------------------------------------|
| 2.0      | 2017-01-27 | Release of final version                           |
| 2.1      | 2020-10-27 | Content update diagram 2,3,4,7,8 and format update |

### Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

### We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:

**erratum@infineon.com**

### Published by

**Infineon Technologies AG**

**81726 München, Germany**

**© 2020 Infineon Technologies AG**

**All Rights Reserved.**

### Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

### Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

### Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Infineon:](#)

[IPT60R050G7XTMA1](#)