



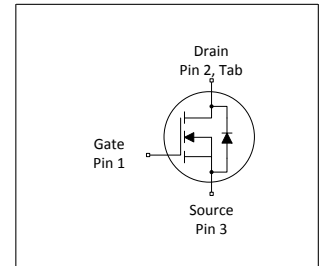
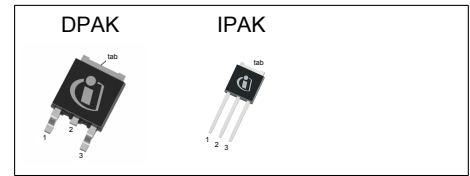
**THE DATASHEET OF  
IPD60R1K0CEAUMA1**



# MOSFET

## 600V CoolMOS™ CE Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE is a price-performance optimized platform enabling to target cost sensitive applications in Consumer and Lighting markets by still meeting highest efficiency standards. The new series provides all benefits of a fast switching Superjunction MOSFET while not sacrificing ease of use and offering the best cost down performance ratio available on the market.



### Features

- Extremely low losses due to very low FOM  $R_{DS(on)} \cdot Q_g$  and  $E_{oss}$
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for standard grade applications

### Applications

PFC stages, hard switching PWM stages and resonant switching stages for e.g. PC Silverbox, Adapter, LCD & PDP TV and indoor lighting.

*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    |
| $R_{DS(on),max}$     | 1000  | mΩ   |
| $I_d$                | 6.8   | A    |
| $Q_{g,typ}$          | 13    | nC   |
| $I_{D,pulse}$        | 12    | A    |
| $E_{oss@400V}$       | 1.3   | μJ   |

| Type / Ordering Code | Package   | Marking  | Related Links  |
|----------------------|-----------|----------|----------------|
| IPD60R1K0CE          | PG-TO 252 | 60S1K0CE | see Appendix A |
| IPU60R1K0CE          | PG-TO 251 |          |                |

## Table of Contents

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## 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> | $I_D$         | -      | -    | 6.8<br>4.3 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$                                     |
| Pulsed drain current <sup>2)</sup>     | $I_{D,pulse}$ | -      | -    | 12         | A                | $T_C=25^\circ\text{C}$  |
| Avalanche energy, single pulse         | $E_{AS}$      | -      | -    | 46         | mJ               | $I_D=0.8\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 11                                |
| Avalanche energy, repetitive           | $E_{AR}$      | -      | -    | 0.13       | mJ               | $I_D=0.8\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 11                                |
| Avalanche current, repetitive          | $I_{AR}$      | -      | -    | 0.8        | A                | -   |
| MOSFET dv/dt ruggedness                | dv/dt         | -      | -    | 50         | V/ns             | $V_{DS}=0\dots480\text{V}$  |
| 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<br>TO-251, TO-252    | $P_{tot}$     | -      | -    | 61         | W                | $T_C=25^\circ\text{C}$  |
| Storage temperature                    | $T_{stg}$     | -40    | -    | 150        | $^\circ\text{C}$ | -   |
| Operating junction temperature         | $T_j$         | -40    | -    | 150        | $^\circ\text{C}$ | -   |
| Continuous diode forward current       | $I_S$         | -      | -    | 4.8        | A                | $T_C=25^\circ\text{C}$  |
| Diode pulse current <sup>2)</sup>      | $I_{S,pulse}$ | -      | -    | 12         | A                | $T_C=25^\circ\text{C}$  |
| Reverse diode dv/dt <sup>3)</sup>      | dv/dt         | -      | -    | 15         | V/ns             | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq I_S$ , $T_j=25^\circ\text{C}$<br>see table 9 |
| Maximum diode commutation speed        | di/dt         | -      | -    | 500        | A/ $\mu\text{s}$ | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq I_S$ , $T_j=25^\circ\text{C}$<br>see table 9 |

## 2 Thermal characteristics

**Table 3 Thermal characteristics TO-251, TO252**

| Parameter   | Symbol     | Values |      |      | Unit               | Note / Test Condition               |
|---|------------|--------|------|------|--------------------|-------------------------------------|
|   |            | Min.   | Typ. | Max. |                    |                                     |
| Thermal resistance, junction - case                           | $R_{thJC}$ | -      | -    | 2.06 | $^\circ\text{C/W}$ | -                                   |
| Thermal resistance, junction - ambient                        | $R_{thJA}$ | -      | -    | 62   | $^\circ\text{C/W}$ | leaded                              |
| Soldering temperature, wavesoldering<br>only allowed at leads | $T_{sold}$ | -      | -    | 260  | $^\circ\text{C}$   | 1.6mm (0.063 in.) from case for 10s |

<sup>1)</sup> Limited by  $T_{j,max}$ . Maximum duty cycle  $D=0.50$

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

<sup>3)</sup> Identical low side and high side switch with identical  $R_G$

**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        | $V_{GS}=0V, I_D=0.25mA$   |
| Gate threshold voltage           | $V_{(GS)th}$  | 2.5    | 3.0  | 3.5  | V        | $V_{DS}=V_{GS}, I_D=0.13mA$   |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -    | 1    | $\mu A$  | $V_{DS}=600, V_{GS}=0V, T_j=25^\circ C$<br>$V_{DS}=600, V_{GS}=0V, T_j=150^\circ C$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -    | 100  | nA       | $V_{GS}=20V, V_{DS}=0V$   |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.86 | 1.00 | $\Omega$ | $V_{GS}=10V, I_D=1.5A, T_j=25^\circ C$<br>$V_{GS}=10V, I_D=1.5A, T_j=150^\circ C$   |
| Gate resistance                  | $R_G$         | -      | 16   | -    | $\Omega$ | $f=1MHz, \text{open drain}$   |

**Table 5 Dynamic characteristics**

| Parameter  | Symbol       | Values |      |      | Unit | Note / Test Condition   |
|--|--------------|--------|------|------|------|---|
|  |              | Min.   | Typ. | Max. |      |   |
| Input capacitance  | $C_{iss}$    | -      | 280  | -    | pF   | $V_{GS}=0V, V_{DS}=100V, f=1MHz$  |
| Output capacitance   | $C_{oss}$    | -      | 21   | -    | pF   | $V_{GS}=0V, V_{DS}=100V, f=1MHz$  |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 14   | -    | pF   | $V_{GS}=0V, V_{DS}=0...480V$  |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 57   | -    | pF   | $I_D=\text{constant}, V_{GS}=0V, V_{DS}=0...480V$                             |
| Turn-on delay time   | $t_{d(on)}$  | -      | 10   | -    | ns   | $V_{DD}=400V, V_{GS}=10V, I_D=1.9A,$<br>$R_G=12.2\Omega; \text{see table 10}$ |
| Rise time  | $t_r$        | -      | 8    | -    | ns   | $V_{DD}=400V, V_{GS}=10V, I_D=1.9A,$<br>$R_G=12.2\Omega; \text{see table 10}$ |
| Turn-off delay time  | $t_{d(off)}$ | -      | 60   | -    | ns   | $V_{DD}=400V, V_{GS}=10V, I_D=1.9A,$<br>$R_G=12.2\Omega; \text{see table 10}$ |
| Fall time  | $t_f$        | -      | 13   | -    | ns   | $V_{DD}=400V, V_{GS}=10V, I_D=1.9A,$<br>$R_G=12.2\Omega; \text{see table 10}$ |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                             |
|-----------------------|---------------|--------|------|------|------|---|
|                       |               | Min.   | Typ. | Max. |      |   |
| Gate to source charge | $Q_{GS}$      | -      | 1.5  | -    | nC   | $V_{DD}=480V, I_D=1.9A, V_{GS}=0 \text{ to } 10V$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 6.5  | -    | nC   | $V_{DD}=480V, I_D=1.9A, V_{GS}=0 \text{ to } 10V$ |
| Gate charge total     | $Q_g$         | -      | 13   | -    | nC   | $V_{DD}=480V, I_D=1.9A, V_{GS}=0 \text{ to } 10V$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.4  | -    | V    | $V_{DD}=480V, I_D=1.9A, V_{GS}=0 \text{ to } 10V$ |

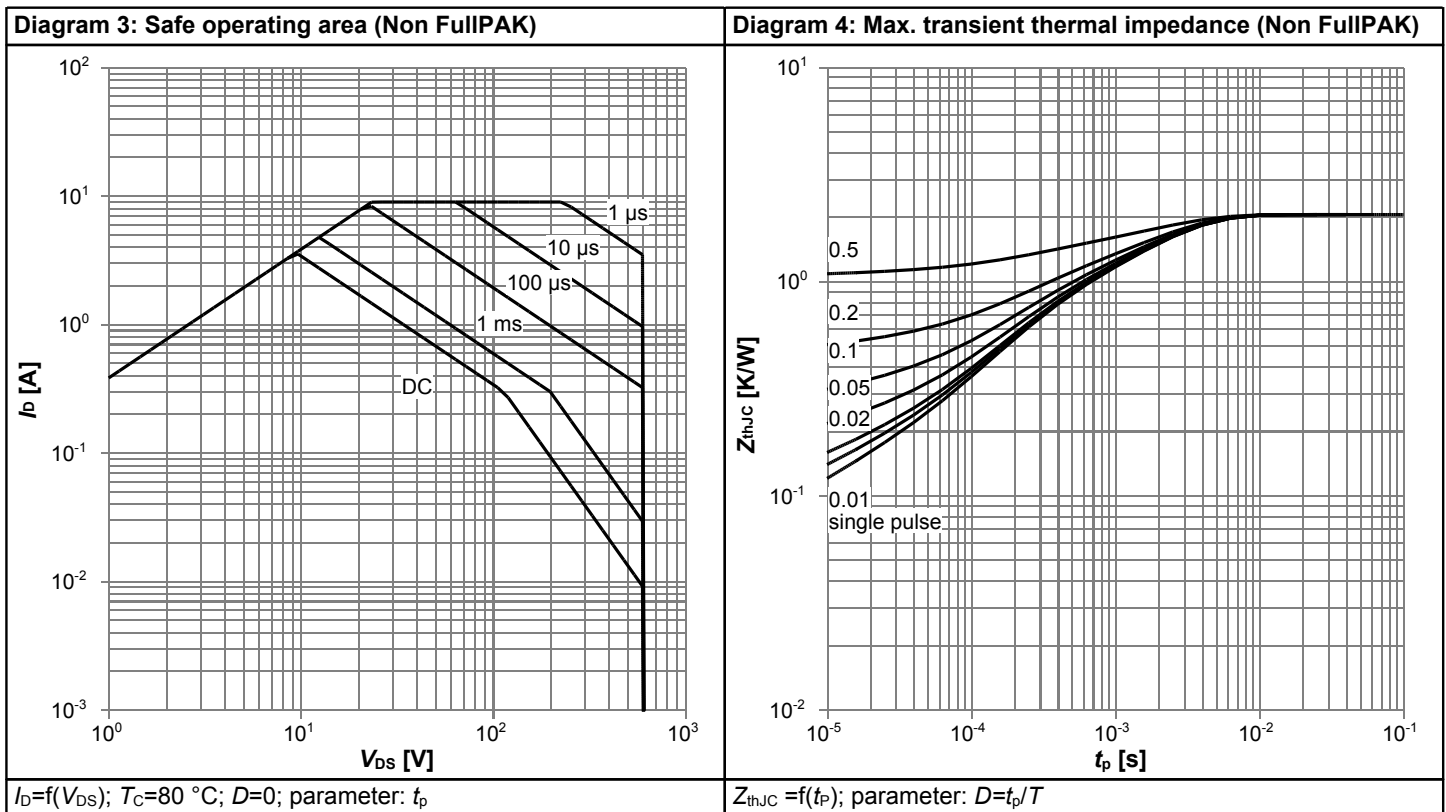
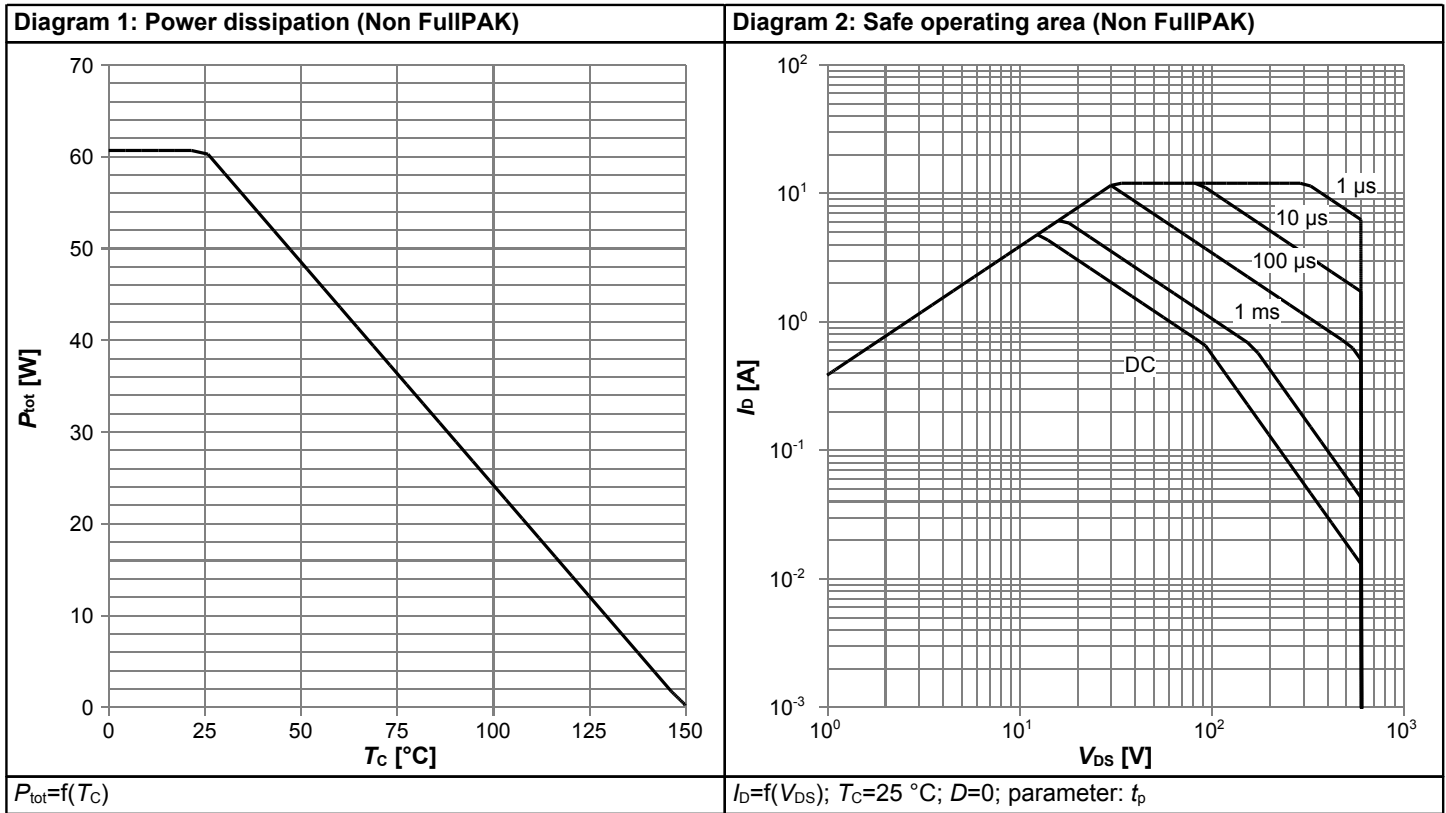
<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{(BR)DSS}$

<sup>2)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{(BR)DSS}$

**Table 7 Reverse diode characteristics**

| Parameter                     | Symbol    | Values |      |      | Unit    | Note / Test Condition                                     |
|-------------------------------|-----------|--------|------|------|---------|---|
|                               |           | Min.   | Typ. | Max. |         |   |
| Diode forward voltage         | $V_{SD}$  | -      | 0.9  | -    | V       | $V_{GS}=0V, I_F=1.9A, T_j=25^\circ C$                     |
| Reverse recovery time         | $t_{rr}$  | -      | 220  | -    | ns      | $V_R=400V, I_F=1.9A, di_F/dt=100A/\mu s$ ;<br>see table 9 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 1.5  | -    | $\mu C$ | $V_R=400V, I_F=1.9A, di_F/dt=100A/\mu s$ ;<br>see table 9 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 12   | -    | A       | $V_R=400V, I_F=1.9A, di_F/dt=100A/\mu s$ ;<br>see table 9 |

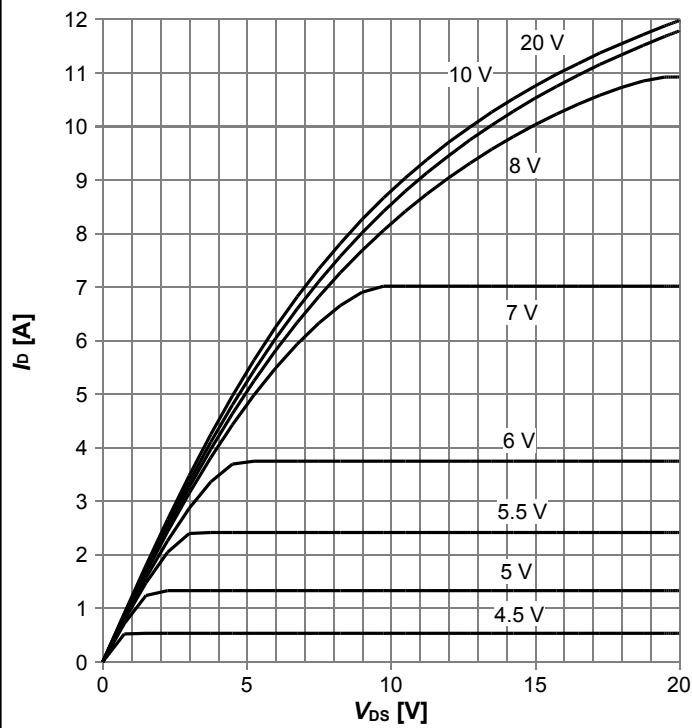
### 4 Electrical characteristics diagrams



# 600V CoolMOS™ CE Power Transistor

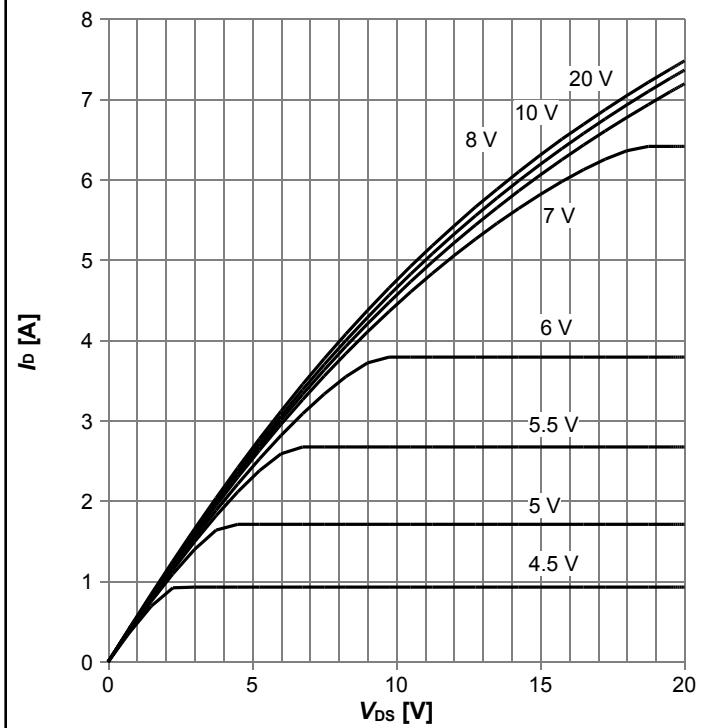
IPD60R1K0CE, IPU60R1K0CE

Diagram 5: Typ. output characteristics



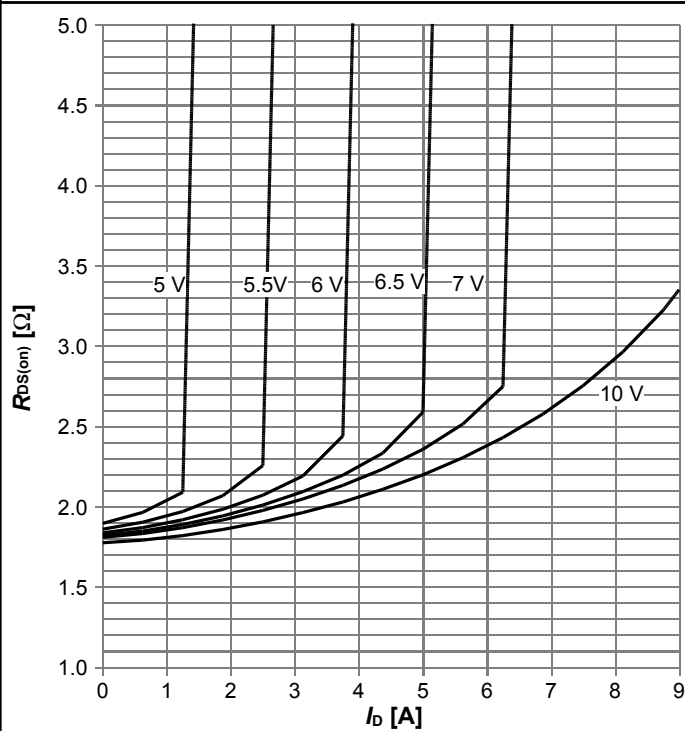
$I_D=f(V_{DS})$ ;  $T_j=25\text{ }^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



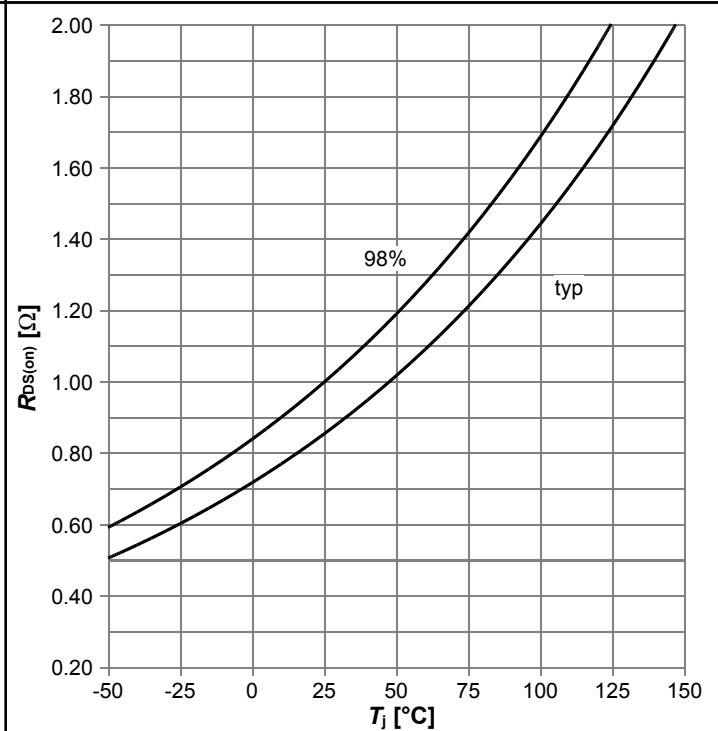
$I_D=f(V_{DS})$ ;  $T_j=125\text{ }^\circ\text{C}$ ; parameter:  $V_{GS}$

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



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

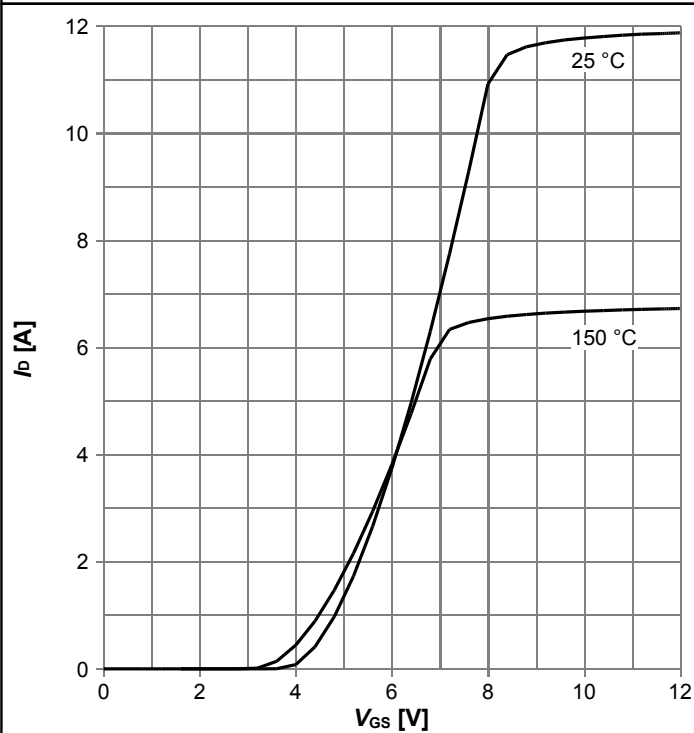
Diagram 8: Drain-source on-state resistance



$R_{DS(on)}=f(T_j)$ ;  $I_D=1.5\text{ A}$ ;  $V_{GS}=10\text{ V}$

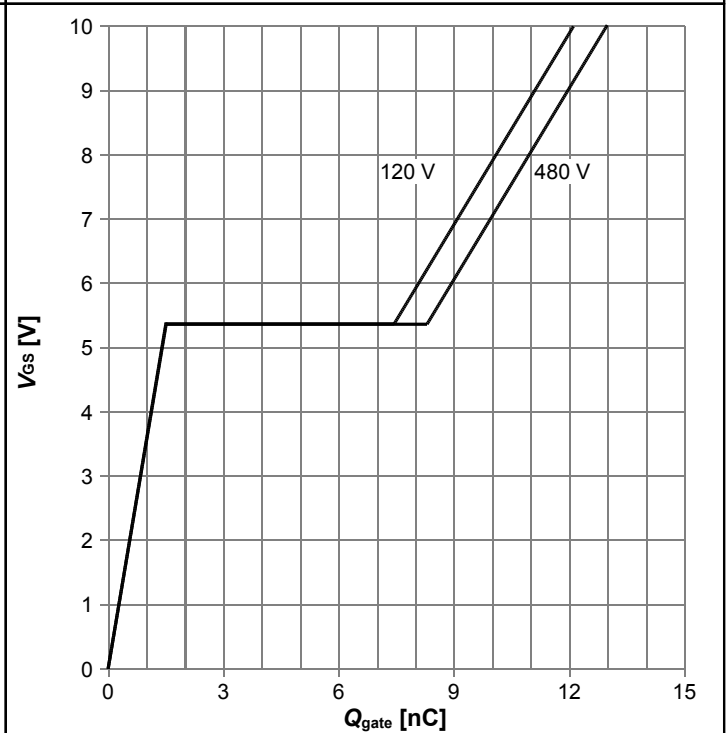
**600V CoolMOS™ CE Power Transistor**  
**IPD60R1K0CE, IPU60R1K0CE**

**Diagram 9: Typ. transfer characteristics**



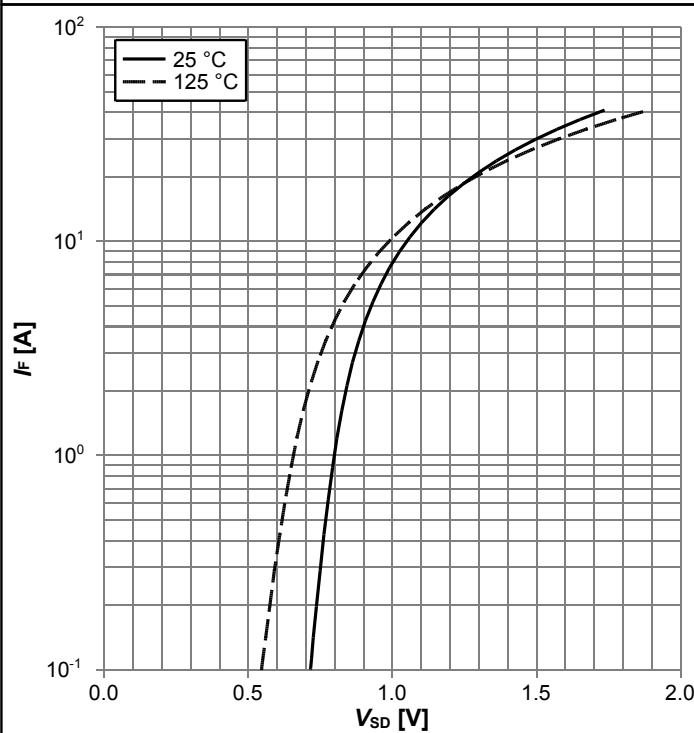
$I_D = f(V_{GS}); V_{DS} = 20V; \text{parameter: } T_j$

**Diagram 10: Typ. gate charge**



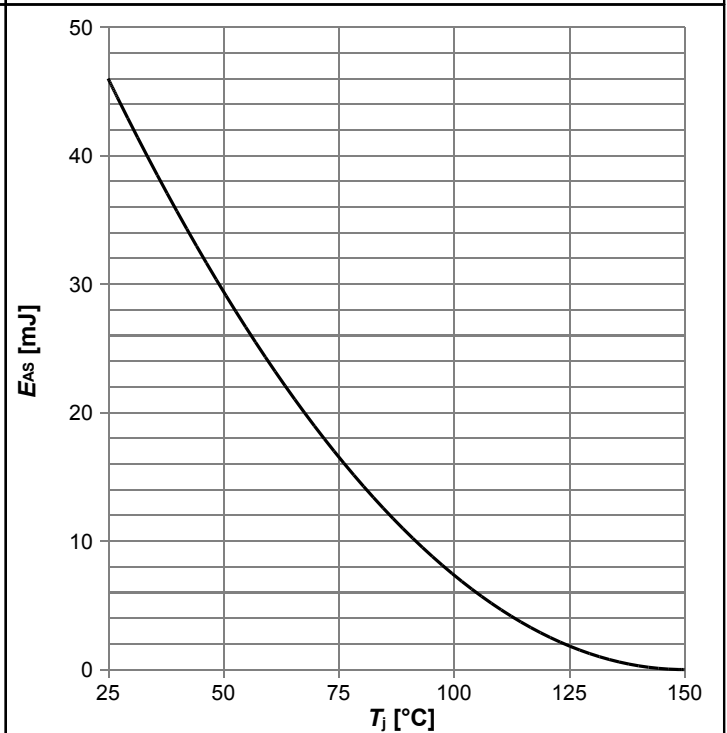
$V_{GS} = f(Q_{gate}); I_D = 1.9 \text{ A pulsed}; \text{parameter: } V_{DD}$

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



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

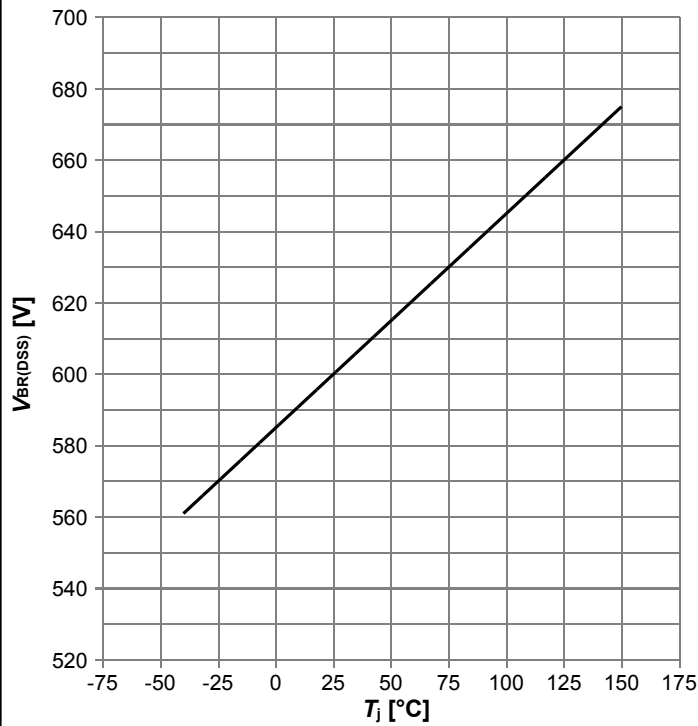
**Diagram 12: Avalanche energy**



$E_{AS} = f(T_j); I_D = 0.8 \text{ A}; V_{DD} = 50 \text{ V}$

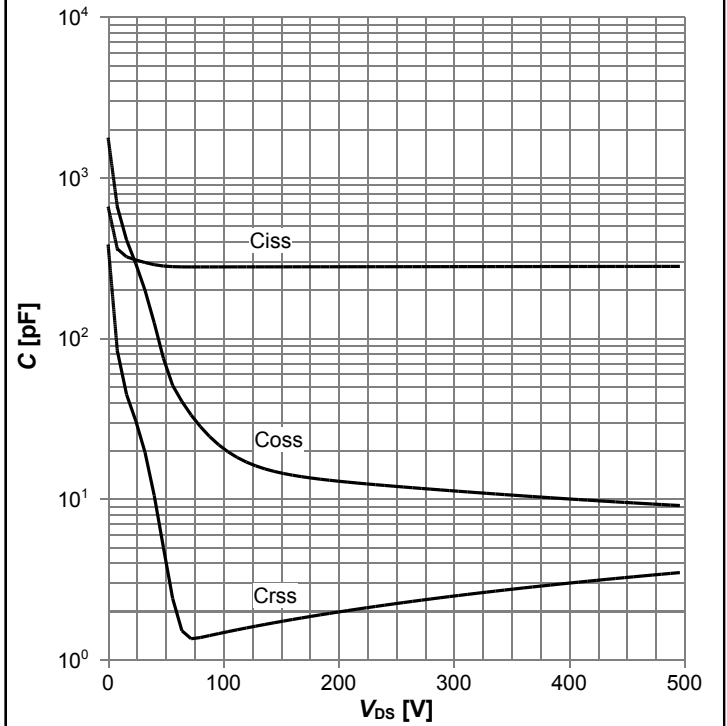
**600V CoolMOS™ CE Power Transistor**  
**IPD60R1K0CE, IPU60R1K0CE**

**Diagram 13: Drain-source breakdown voltage**



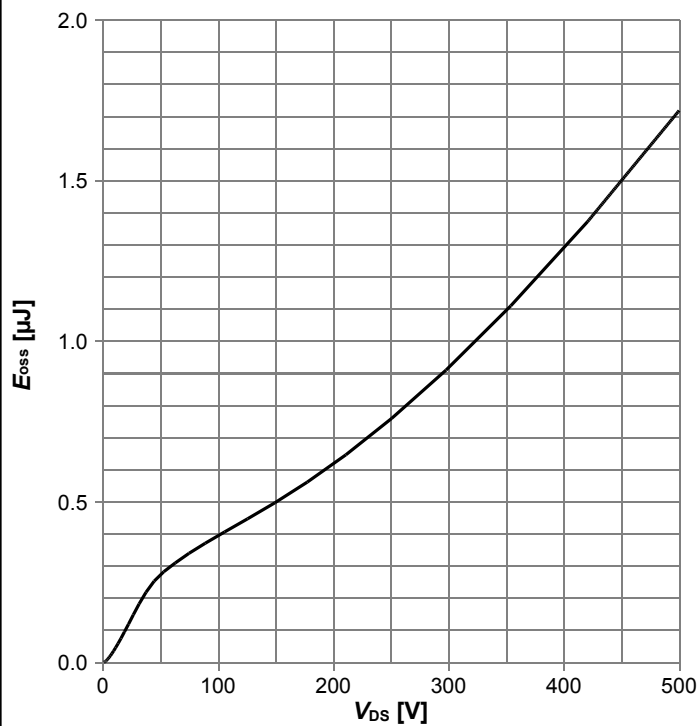
$V_{BR(DSS)}=f(T_j); I_D=0.25 \text{ mA}$

**Diagram 14: Typ. capacitances**



$C=f(V_{DS}); V_{GS}=0 \text{ V}; f=1 \text{ MHz}$

**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 |
|--|-------------------------|
|  |                         |

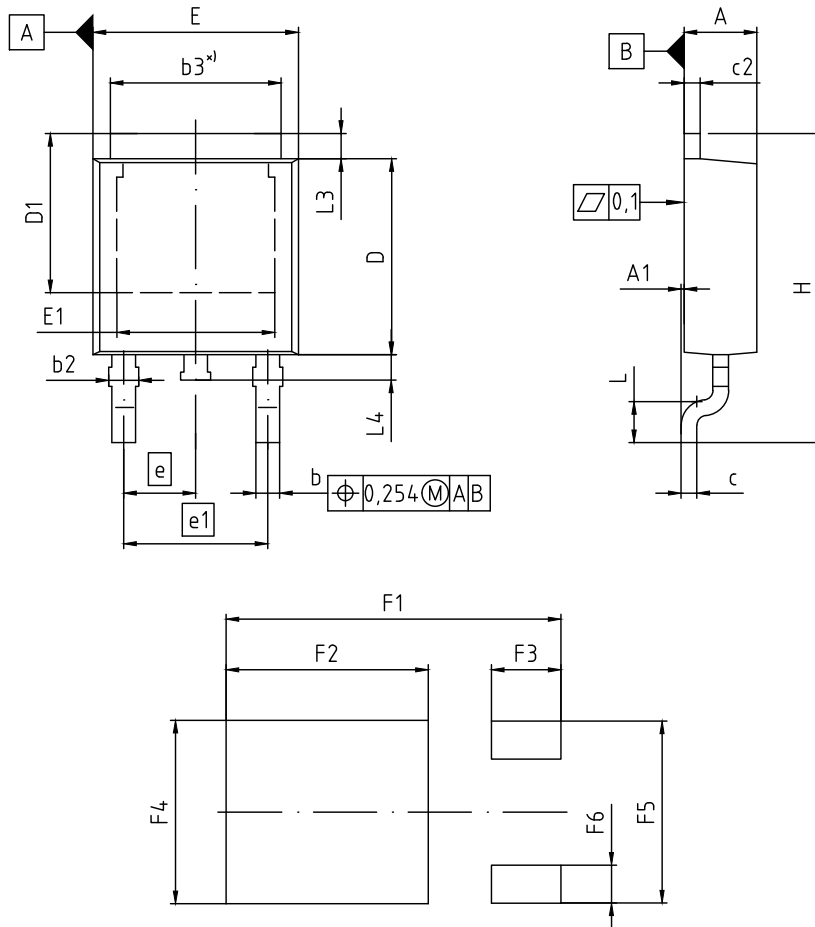
**Table 9 Switching times**

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

**Table 10 Unclamped inductive load**

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

## 6 Package Outlines



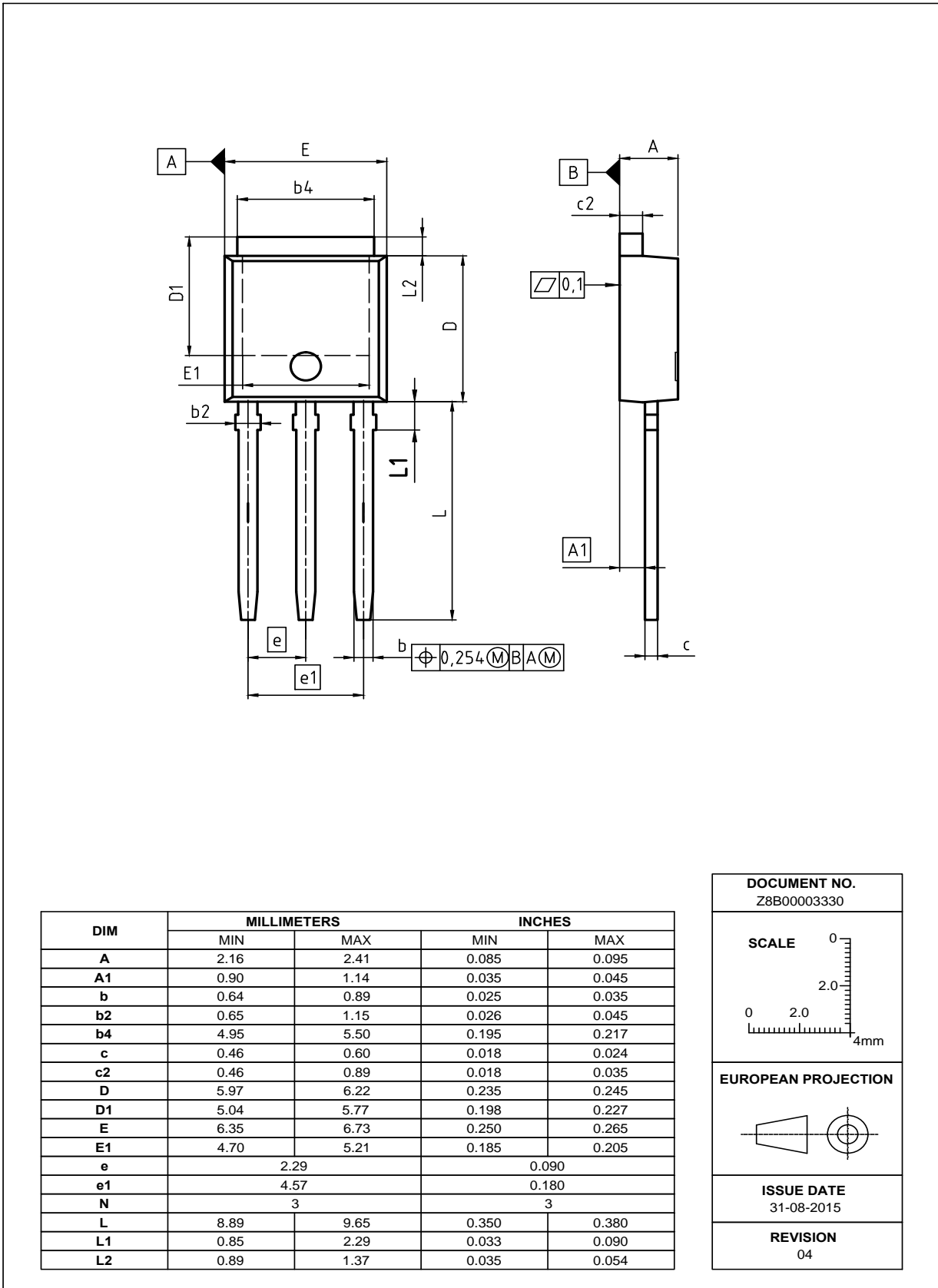
\*) mold flash not included

| DIM | MILLIMETERS |       | INCHES      |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | 2.16        | 2.41  | 0.085       | 0.095 |
| A1  | 0.00        | 0.15  | 0.000       | 0.006 |
| b   | 0.64        | 0.89  | 0.025       | 0.035 |
| b2  | 0.65        | 1.15  | 0.026       | 0.045 |
| b3  | 5.00        | 5.50  | 0.197       | 0.217 |
| c   | 0.46        | 0.60  | 0.018       | 0.024 |
| c2  | 0.46        | 0.98  | 0.018       | 0.039 |
| D   | 5.97        | 6.22  | 0.235       | 0.245 |
| D1  | 5.02        | 5.84  | 0.198       | 0.230 |
| E   | 6.40        | 6.73  | 0.252       | 0.265 |
| E1  | 4.70        | 5.60  | 0.185       | 0.220 |
| e   | 2.29 (BSC)  |       | 0.090 (BSC) |       |
| e1  | 4.57 (BSC)  |       | 0.180 (BSC) |       |
| N   | 3           |       | 3           |       |
| H   | 9.40        | 10.48 | 0.370       | 0.413 |
| L   | 1.18        | 1.70  | 0.046       | 0.067 |
| L3  | 0.90        | 1.25  | 0.035       | 0.049 |
| L4  | 0.51        | 1.00  | 0.020       | 0.039 |
| F1  | 10.60       |       | 0.417       |       |
| F2  | 6.40        |       | 0.252       |       |
| F3  | 2.20        |       | 0.087       |       |
| F4  | 5.80        |       | 0.228       |       |
| F5  | 5.76        |       | 0.227       |       |
| F6  | 1.20        |       | 0.047       |       |

|                                    |
|------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00003328 |
| <b>SCALE</b><br>0 2.0 4mm          |
| <b>EUROPEAN PROJECTION</b><br>     |
| <b>ISSUE DATE</b><br>01-09-2015    |
| <b>REVISION</b><br>05              |

**Figure 1 Outline PG-TO 252, dimensions in mm/inches**

**600V CoolMOS™ CE Power Transistor**  
**IPD60R1K0CE, IPU60R1K0CE**



**Figure 2 Outline PG-TO 251, dimensions in mm/inches**

## 7 Appendix A

### Table 11 Related Links

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

## Revision History

IPD60R1K0CE, IPU60R1K0CE

**Revision: 2016-03-31**

Previous Revision

| Date       | Subjects (major changes since last revision)                      |
|------------|---|
| 2014-09-25 | Release of final version  |
| 2015-11-17 | Updated to qualified for standard grade & updated package drawing |
| 2016-03-31 | Modified Id, Rthjc. Modified SOA, Zthjc curves                    |

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-  [Infineon Technologies Information](#)

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-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management