# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

# CoolMOS™ C6 650V

650V CoolMOS™ C6 Power Transistor
IPD65R950C6

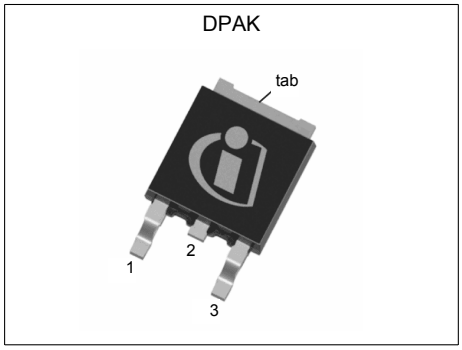
## Data Sheet

Rev. 2.0
Final

## Industrial & Multimarket

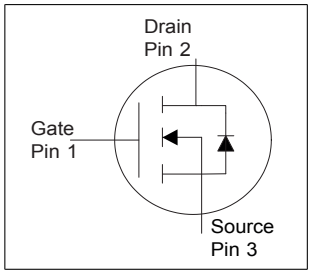
# 1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The resulting devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.




## Features

- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)




## Applications

Hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, Adapter, LCD & PDP TV and Lighting.

## Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ @ $T_{j\,max}$ | 700 | V |
| RDS(on),max | 0.95 | Ω |
| Qg,typ | 15.3 | nC |
| ID,pulse | 12 | A |
| Eoss @ 400V | 1.5 | µJ |
| Body diode di/dt | 500 | A/µs |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPD65R950C6 | PG-TO 252 | 65C6950 | see Appendix A |

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## 2 Maximum ratings

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

### Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current [1] | $I_D$ | | | 4.5 | A | $T_C$ = 25°C |
| | | | | 2.8 | | $T_C$ = 100°C |
| Pulsed drain current [2] | $I_{D,pulse}$ | | | 12 | A | $T_C$ = 25°C |
| Avalanche energy, single pulse | $E_{AS}$ | | | 50 | mJ | $I_D$ = 1.0A, $V_{DD}$ = 50V (see table 10) |
| Avalanche energy, repetitive | $E_{AR}$ | | | 0.15 | mJ | $I_D$ = 1.0A, $V_{DD}$ = 50V |
| Avalanche current, repetitive | $I_{AR}$ | | | 1.0 | A | |
| MOSFET dv/dt ruggedness | dv/dt | | | 50 | V/ns | $V_{DS}$ = 0 ... 480V |
| Gate source voltage | $V_{GS}$ | -20 | | 20 | V | static |
| | | -30 | | 30 | | AC (f > 1 Hz) |
| Operating and storage temperature | $T_j$,$T_{stg}$ | -55 | | 150 | °C | |
| Continuous diode forward current | $I_S$ | | | 3.9 | A | $T_C$ = 25°C |
| Diode pulse current | $I_{S,pulse}$ | | | 12 | A | $T_C$ = 25°C |
| Reverse diode dv/dt [3] | dv/dt | | | 15 | V/ns | $V_{DS}$ = 0 ... 400V, $I_{SD} \le I_D$, $T_j$ = 25°C (see table 8) |
| Maximum diode commutation speed | $di_f/dt$ | | | 500 | A/µs | |
| Power dissipation | $P_{tot}$ | | | 37 | W | $T_C$=25° |

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.75
[2] Pulse width $t_p$ limited by $T_{j\,max}$
[3] Identical low side and high side switch with identical $R_G$

# 3 Thermal characteristics

## Table 3 Thermal characteristics DPAK

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | | | 3.4 | °C/W | |
| Thermal resistance, junction - ambient [1)] | $R_{thJA}$ | | | 62 | °C/W | leaded |
| | | | 35 | | | SMD version, device on PCB, 6cm² cooling area |
| Soldering temperature, wave- & reflowsoldering allowed | $T_{sold}$ | | | 260 | °C | 1.6 mm (0.063 in.) from case for 10s |

[1)] Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

# 4 Electrical characteristics

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

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 650 | | | V | $V_{GS}$ = 0V, $I_D$ = 1mA |
| Gate threshold voltage | $V_{GS(th)}$ | 2.5 | 3 | 3.5 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 0.2mA |
| Zero gate voltage drain current | $I_{DSS}$ | | | 1 | µA | $V_{DS}$ = 650V, $V_{GS}$ = 0V, $T_j$ = 25°C |
| | | | 10 | | | $V_{DS}$ = 650V, $V_{GS}$ = 0V, $T_j$ = 150°C |
| Gate-source leakage current | $I_{GSS}$ | | | 100 | nA | $V_{GS}$ = 20V, $V_{DS}$ = 0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | | 0.855 | 0.95 | Ω | $V_{GS}$ = 10V, $I_D$ = 1.5A, $T_j$ = 25°C |
| | | | 2.223 | | | $V_{GS}$ = 10V, $I_D$ = 1.5A, $T_j$ = 150°C |
| Gate resistance | $R_G$ | | 5.5 | | Ω | $f$ = 1MHz, open drain |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | | 328 | | pF | $V_{GS}$ = 0V, $V_{DS}$ = 100V, $f$ = 1MHz |
| Output capacitance | $C_{oss}$ | | 23 | | pF | |
| Effective output capacitance, energy related [1] | $C_{o(er)}$ | | 14 | | pF | $V_{GS}$ = 0V, $V_{DS}$ = 0 ... 480V |
| Effective output capacitance, time related [2] | $C_{o(tr)}$ | | 58.5 | | pF | $I_D$ = constant, $V_{GS}$ = 0V, $V_{DS}$ = 0 ... 480V |
| Turn-on delay time | $t_{d(on)}$ | | 6.6 | | ns | $V_{DD}$ = 400V, $V_{GS}$ = 13V, $I_D$ = 2.2A, $R_G$ = 10.2Ω (see table 9) |
| Rise time | $t_r$ | | 5.2 | | ns | |
| Turn-off delay time | $t_{d(off)}$ | | 41 | | ns | |
| Fall time | $t_f$ | | 13.6 | | ns | |

## Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | | 1.8 | | nC | $V_{DD}$ = 480V, $I_D$ = 2.2A, $V_{GS}$ = 0 to 10V |
| Gate to drain charge | $Q_{gd}$ | | 8 | | nC | |
| Gate charge total | $Q_g$ | | 15.3 | | nC | |
| Gate plateau voltage | $V_{plateau}$ | | 5.1 | | V | |

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

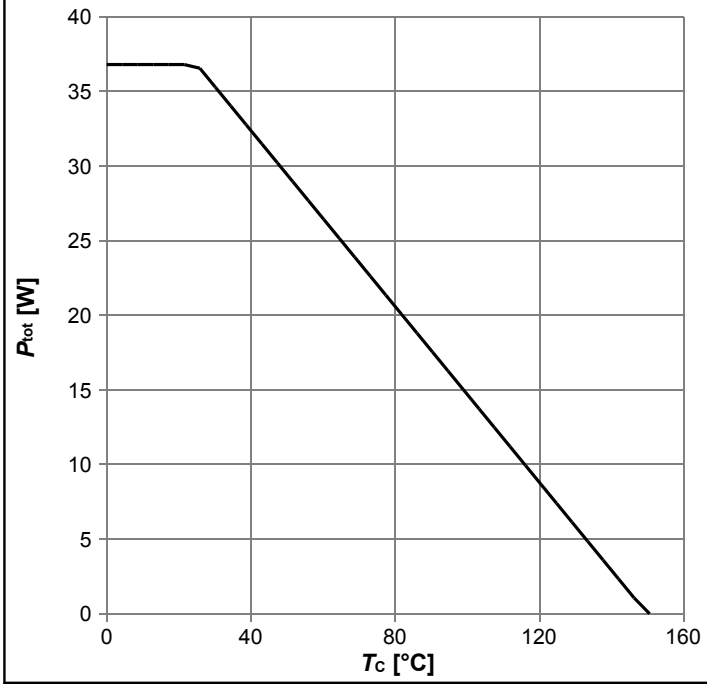
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$

**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, $I_F$ = 2.2A, $T_j$ = 25°C |
| Reverse recovery time | $t_{rr}$ | | 226 | | ns | $V_R$ = 400V, $I_F$ = 2.2A, $di_F/dt$ = 100A/µs (see table 8) |
| Reverse recovery charge | $Q_{rr}$ | | 1.3 | | µC | |
| Peak reverse recovery current | $I_{rrm}$ | | 9.9 | | A | |

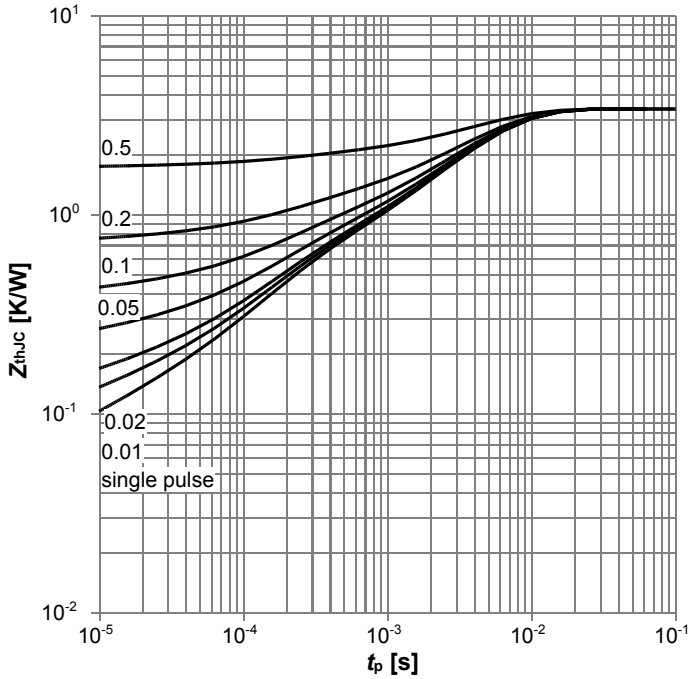
## 5 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



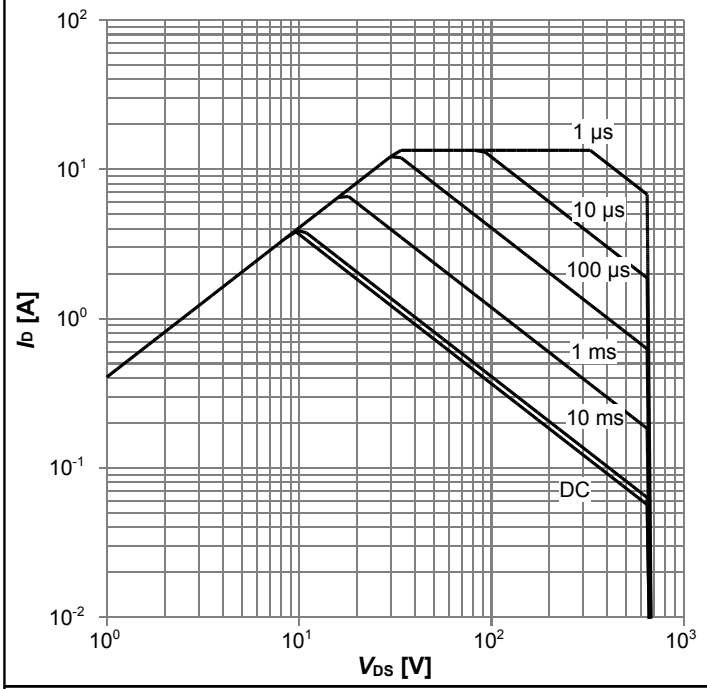

$P_{tot}=f(T_C)$

**Diagram 2: Max. transient thermal impedance**



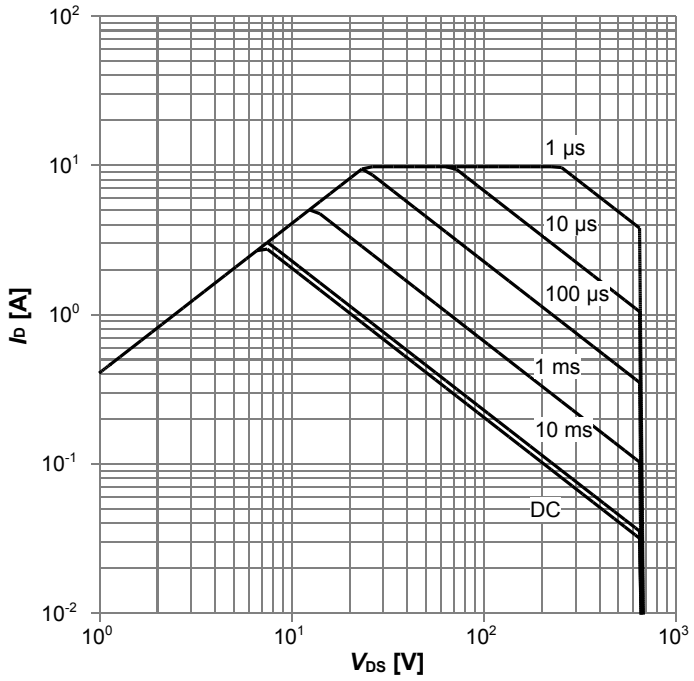

$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

**Diagram 3: Safe operating area**



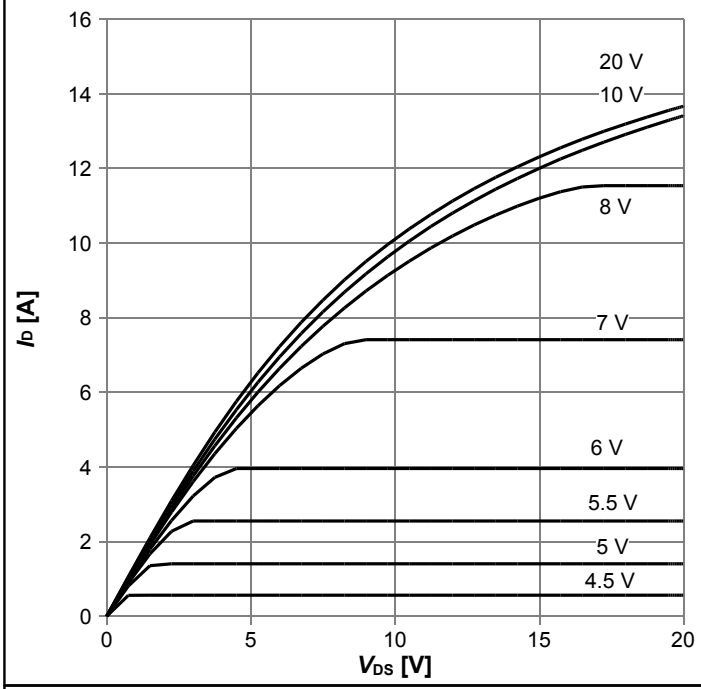

$I_D=f(V_{DS})$; VGS>7V; $T_C$=25°C; $D$=0; parameter: $t_p$

**Diagram 4: Safe operating area**



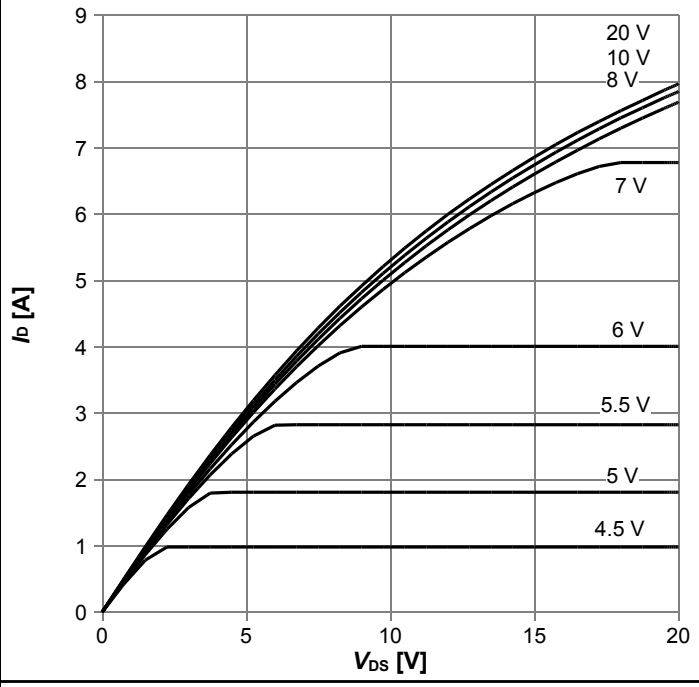

$I_D=f(V_{DS})$; VGS>7V; $T_C$=80°C; $D$=0; parameter: $t_p$

**Diagram 5: Typ. output characteristics**



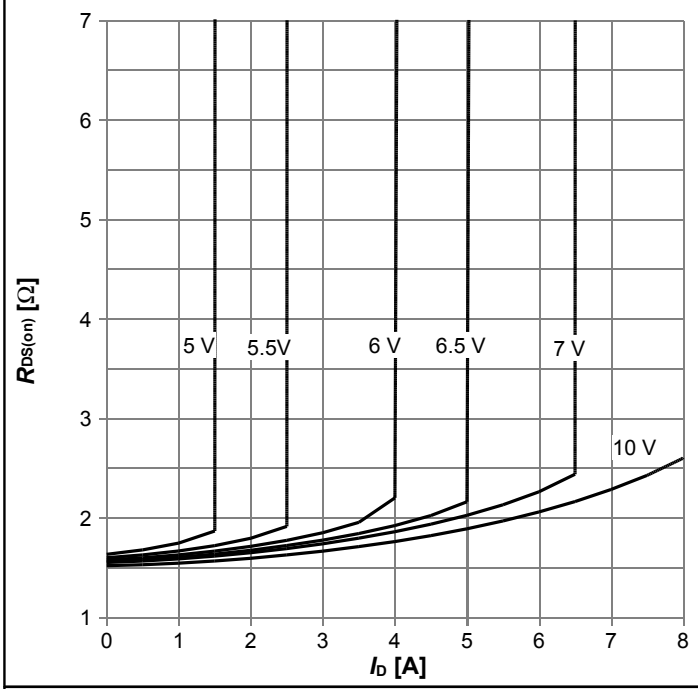

$I_D$=f($V_{DS}$); $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**



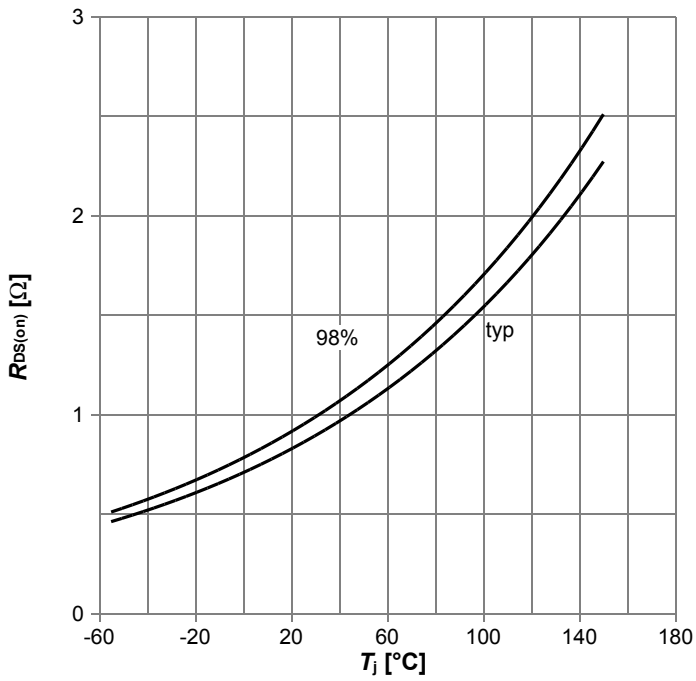

$I_D$=f($V_{DS}$); $T_j$=125 °C; parameter: $V_{GS}$

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



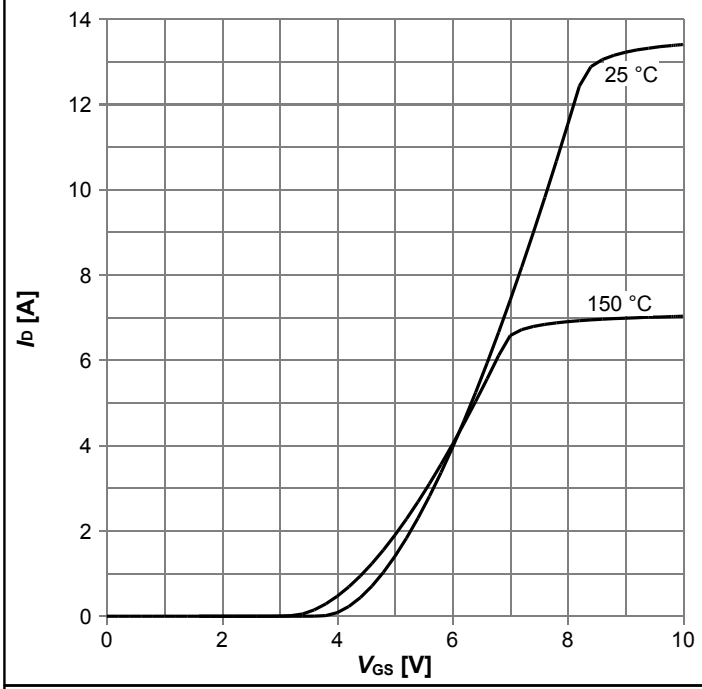

$R_{DS(on)}$=f($I_D$); $T_j$=125 °C; parameter: $V_{GS}$

**Diagram 8: Drain-source on-state resistance**



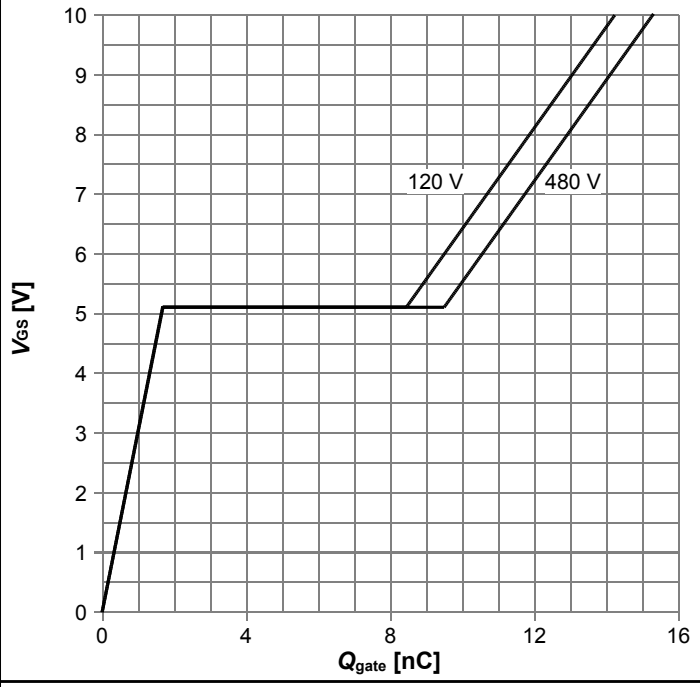

$R_{DS(on)}$=f($T_j$); $I_D$=1.5 A; $V_{GS}$=10 V

**Diagram 9: Typ. transfer characteristics**



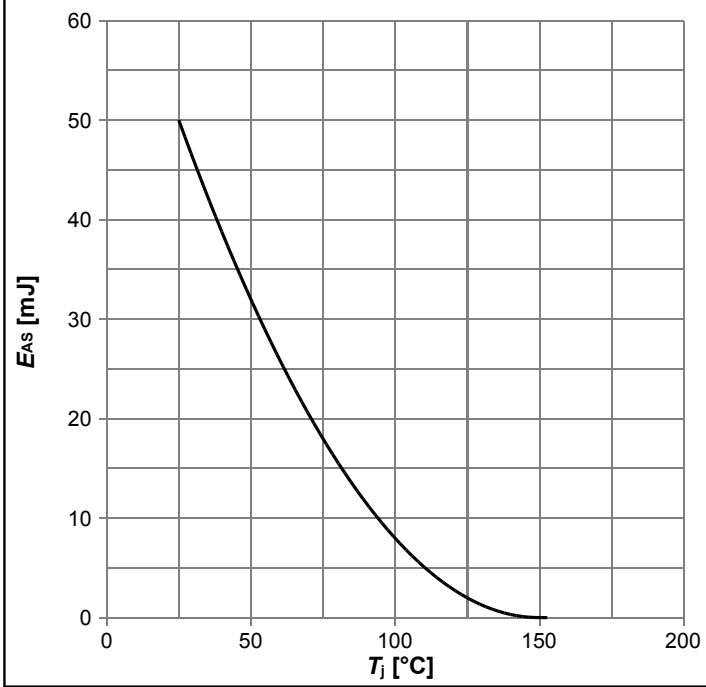

$I_D$=f($V_{GS}$); $V_{DS}$ = 20V; parameter: $T_j$

**Diagram 10: Typ. gate charge**



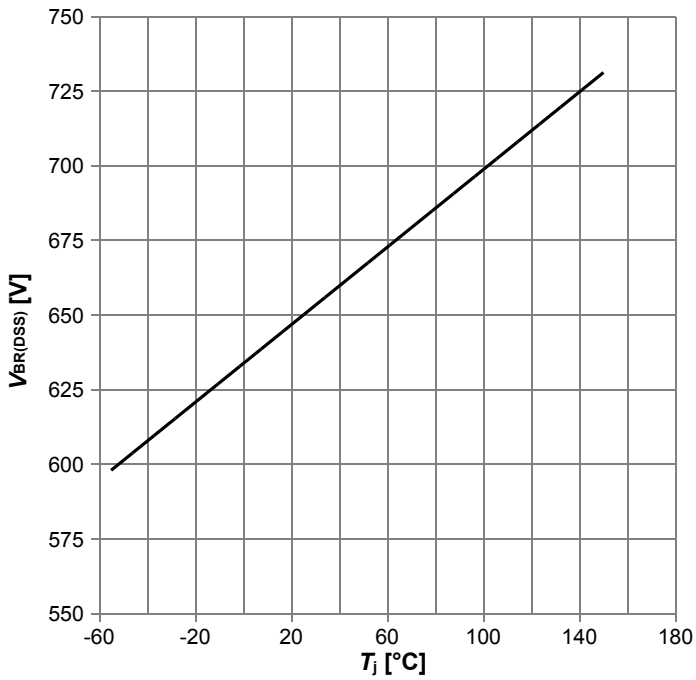

$V_{GS}$=f($Q_{gate}$); $I_D$=1.5 A pulsed; parameter: $V_{DD}$

**Diagram 11: Avalanche energy**



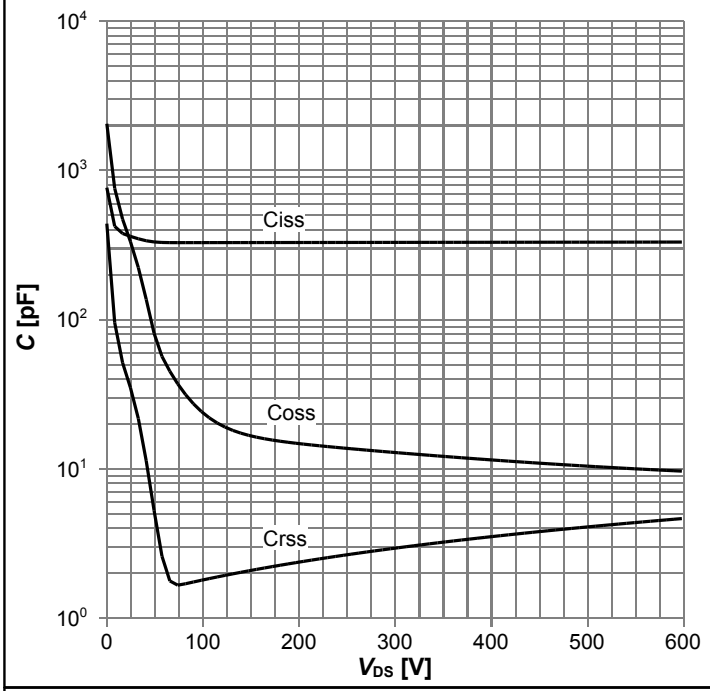

$E_{AS}$=f($T_j$); $I_D$=1.0 A; $V_{DD}$=50 V

**Diagram 12: Drain-source breakdown voltage**



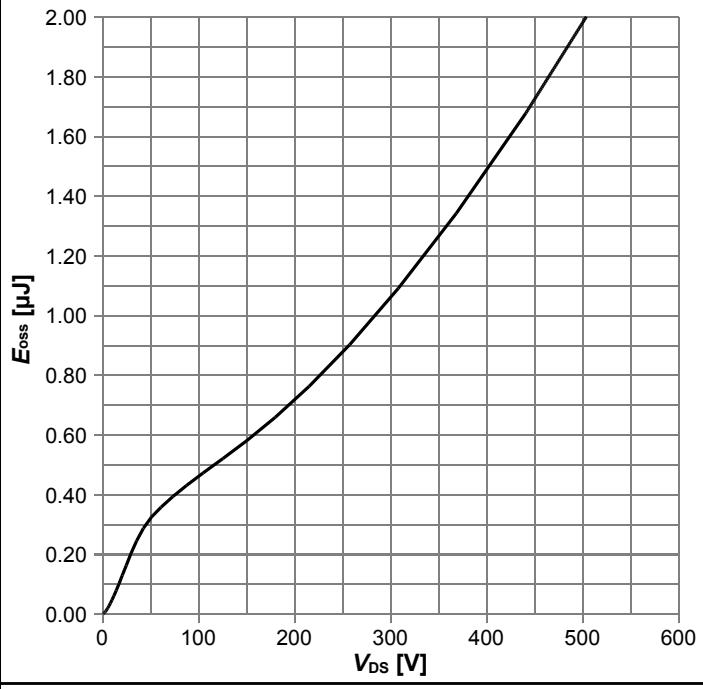

$V_{BR(DSS)}$=f($T_j$); $I_D$=1.0 mA

**Diagram 13: Typ. capacitances**



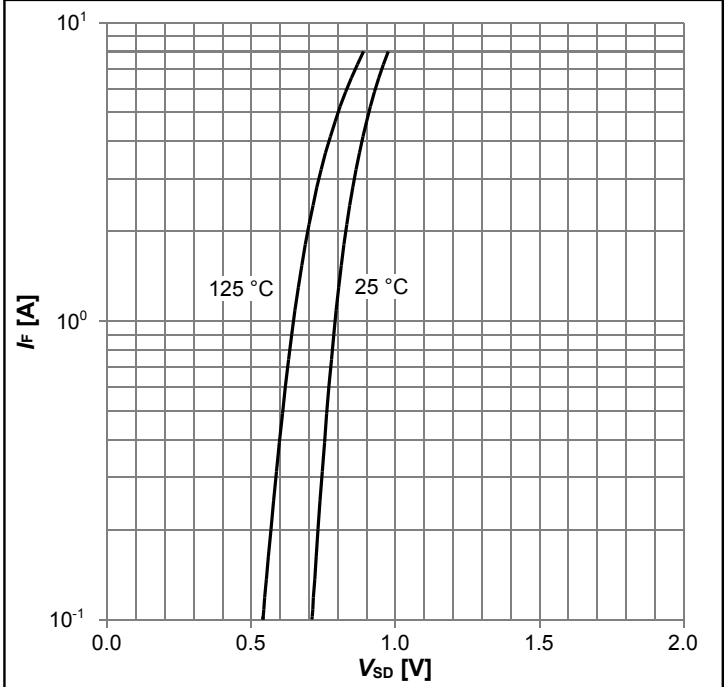

$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz

**Diagram 14: Typ. Coss stored energy**




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

**Diagram 15: Forward characteristics of reverse diode**




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

# 6 Test Circuits

**Table 8 Diode characteristics**

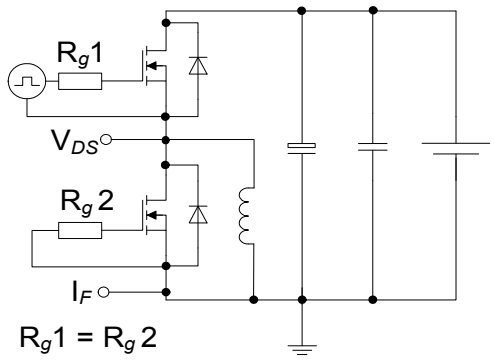
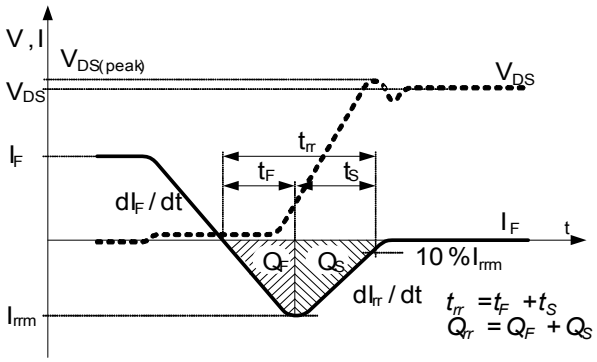
| Test circuit for diode characteristics | Diode recovery waveform |
|---|---|
|   |   |

**Table 9 Switching times**

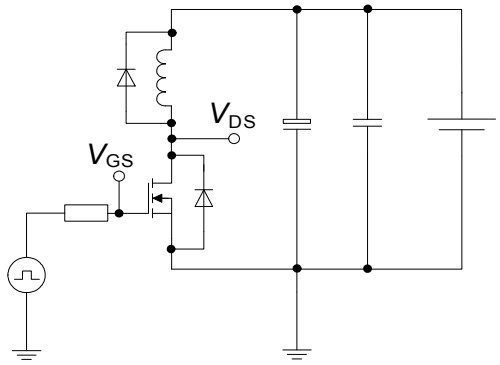
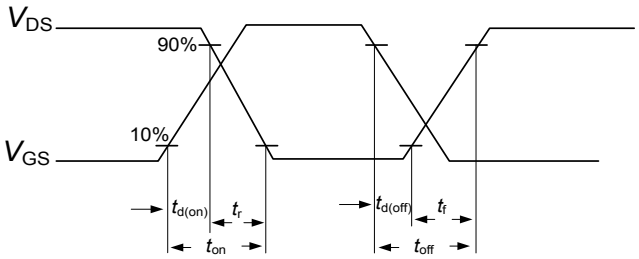
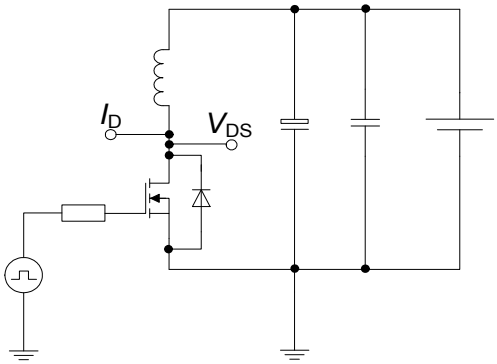
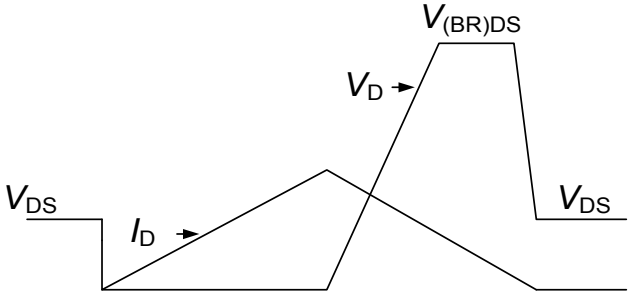
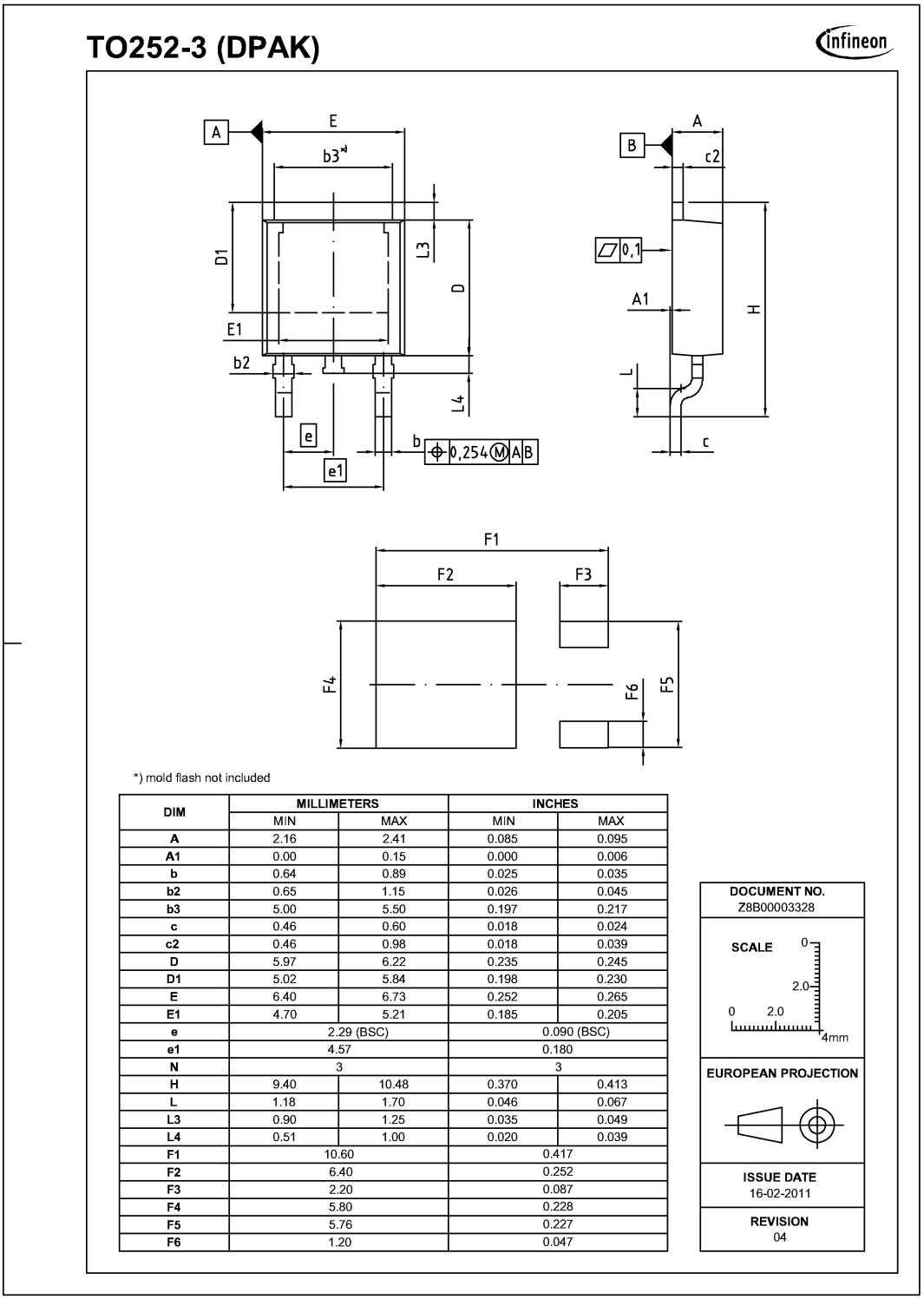
| Switching times test circuit for inductive load | Switching times waveform |
|---|---|
|   |   |

**Table 10 Unclamped inductive load**

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

# 7 Package Outlines




| 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 | 5.21 | 0.185 | 0.205 |
| e | 2.29 (BSC) | | 0.090 (BSC) | |
| e1 | 4.57 | | 0.180 | |
| 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 | |

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

# 8 Appendix A

**Table 11 Related Links**

- **IFX C6 Product Brief:** www.infineon.com
- **IFX C6 Portfolio:** www.infineon.com
- **IFX CoolMOS Webpage:** www.infineon.com
- **IFX Design Tools:** www.infineon.com

## Revision History

IPD65R950C6

**Revision: 2013-07-26, Rev. 2.0**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.0 | 2013-07-26 | Release of final version |

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**Edition 2011-08-01**
**Published by**
**Infineon Technologies AG**
**81726 München, Germany**
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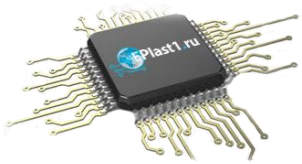
Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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