



# STB12NM50ND STD12NM50ND, STF12NM50ND

N-channel 500 V, 0.29  $\Omega$ , 11 A, FDmesh™ II Power MOSFET  
(with fast diode) in D<sup>2</sup>PAK, DPAK, TO-220FP

## Features

| Type        | V <sub>DSS</sub> (@T <sub>jmax</sub> ) | R <sub>DS(on)</sub> max | I <sub>D</sub> |
|-------------|----------------------------------------|-------------------------|----------------|
| STB12NM50ND | 550 V                                  | 0.38 $\Omega$           | 11 A           |
| STD12NM50ND | 550 V                                  | 0.38 $\Omega$           | 11 A           |
| STF12NM50ND | 550 V                                  | 0.38 $\Omega$           | 11 A           |

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Application

- Switching applications

## Description

FDmesh™ technology combines the MDmesh™ features with an intrinsic fast-recovery body diode. The resulting product has reduced on-resistance and fast switching commutations, making it especially suitable for bridge topologies where low  $t_{rr}$  is required.

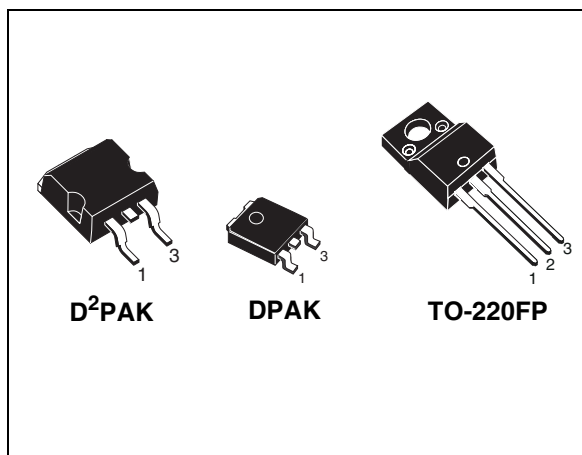
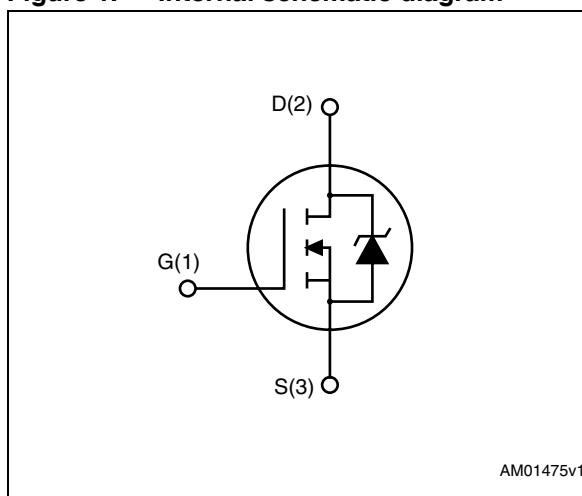


Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

| Order codes | Marking  | Package            | Packaging     |
|-------------|----------|--------------------|---------------|
| STB12NM50ND | 12NM50ND | D <sup>2</sup> PAK | Tape and reel |
| STD12NM50ND | 12NM50ND | DPAK               | Tape and reel |
| STF12NM50ND | 12NM50ND | TO-220FP           | Tube          |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                         | Parameter                                                                                                    | Value              |      |                    | Unit |
|--------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------|------|--------------------|------|
|                                |                                                                                                              | D <sup>2</sup> PAK | DPAK | TO-220FP           |      |
| V <sub>DS</sub>                | Drain-source voltage (V <sub>GS</sub> =0)                                                                    | 500                |      |                    | V    |
| V <sub>GS</sub>                | Gate-source voltage                                                                                          | ± 25               |      |                    | V    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 25 °C                                                         | 11                 |      | 11 <sup>(1)</sup>  | A    |
| I <sub>D</sub>                 | Drain current (continuous) at T <sub>C</sub> = 100 °C                                                        | 6.9                |      | 6.9 <sup>(1)</sup> | A    |
| I <sub>DM</sub> <sup>(2)</sup> | Drain current (pulsed)                                                                                       | 44                 |      | 44 <sup>(1)</sup>  | A    |
| P <sub>TOT</sub>               | Total dissipation at T <sub>C</sub> = 25 °C                                                                  | 100                |      | 25                 | W    |
| V <sub>ISO</sub>               | Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> =25 °C) |                    |      | 2500               | V    |
| dv/dt <sup>(3)</sup>           | Peak diode recovery voltage slope                                                                            | 40                 |      |                    | V/ns |
| T <sub>stg</sub>               | Storage temperature                                                                                          | -55 to 150         |      |                    | °C   |
| T <sub>j</sub>                 | Operating junction temperature                                                                               | 150                |      |                    | °C   |

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. I<sub>SD</sub> ≤ 11 A, di/dt ≤ 600 A/μs, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>

**Table 3. Thermal data**

| Symbol                | Parameter                                       | Value              |      |          | Unit |
|-----------------------|-------------------------------------------------|--------------------|------|----------|------|
|                       |                                                 | D <sup>2</sup> PAK | DPAK | TO-220FP |      |
| R <sub>thj-case</sub> | Thermal resistance junction-case max            | 1.25               |      |          | °C/W |
| R <sub>thj-pcb</sub>  | Thermal resistance junction-pcb max             | 30                 | 50   |          | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-amb max             | 62.5               |      |          | °C/W |
| T <sub>l</sub>        | Maximum lead temperature for soldering purposes | 300                |      |          | °C   |

**Table 4. Avalanche characteristics**

| Symbol          | Parameter                                                                                                                  | Max value | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|-----------|------|
| I <sub>AS</sub> | Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>j</sub> max)                                | 5         | A    |
| E <sub>AS</sub> | Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AS</sub> , V <sub>DD</sub> = 50 V) | 350       | mJ   |

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

**Table 5. On/off states**

| Symbol        | Parameter                                        | Test conditions                                                                                  | Min. | Typ. | Max.     | Unit                           |
|---------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------|------|------|----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage                   | $I_D = 1\text{ mA}$ , $V_{GS} = 0$                                                               | 500  |      |          | V                              |
| $dv/dt^{(1)}$ | Drain-source voltage slope                       | $V_{DD} = 400\text{ V}$ , $I_D = 11\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$                        | 44   |      |          | V/ns                           |
| $I_{DSS}$     | Zero gate voltage drain current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max rating}$ ,<br>$V_{DS} = \text{Max rating}$ , @ $125\text{ }^{\circ}\text{C}$ |      |      | 1<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate body leakage current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                       |      |      | 100      | nA                             |
| $V_{GS(th)}$  | Gate threshold voltage                           | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                               | 3    | 4    | 5        | V                              |
| $R_{DS(on)}$  | Static drain-source on resistance                | $V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$                                                    |      | 0.29 | 0.38     | $\Omega$                       |

1. Value measured at turn off under inductive load

**Table 6. Dynamic**

| Symbol                              | Parameter                                                               | Test conditions                                                                                      | Min. | Typ.           | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------|----------------|------|----------------|
| $g_{fs}^{(1)}$                      | Forward transconductance                                                | $V_{DS} = 15\text{ V}$ , $I_D = 5.5\text{ A}$                                                        | -    | 8              | -    | S              |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ ,<br>$V_{GS} = 0$                                        | -    | 850<br>48<br>5 | -    | pF<br>pF<br>pF |
| $C_{oss\text{ eq.}}^{(2)}$          | Equivalent output capacitance                                           | $V_{GS} = 0$ , $V_{DS} = 0\text{ to }400\text{ V}$                                                   | -    | 100            | -    | pF             |
| $R_g$                               | Gate input resistance                                                   | $f = 1\text{ MHz}$ Gate DC Bias=0<br>Test signal level=20 mV<br>open drain                           | -    | 4.5            | -    | $\Omega$       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$       | Total gate charge<br>Gate-source charge<br>Gate-drain charge            | $V_{DD} = 400\text{ V}$ , $I_D = 11\text{ A}$<br>$V_{GS} = 10\text{ V}$<br><a href="#">Figure 19</a> | -    | 30<br>6<br>17  | -    | nC<br>nC<br>nC |

1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

2.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 7. Switching times**

| Symbol       | Parameter           | Test conditions                                                                                                      | Min. | Typ. | Max. | Unit |
|--------------|---------------------|----------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $t_{d(on)}$  | Turn-on delay time  | $V_{DD} = 250\text{ V}$ , $I_D = 5.5\text{ A}$ ,<br>$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$<br><i>Figure 18</i> | -    | 12   | -    | ns   |
| $t_r$        | Rise time           |                                                                                                                      |      | 15   |      | ns   |
| $t_{d(off)}$ | Turn-off delay time |                                                                                                                      |      | 40   |      | ns   |
| $t_f$        | Fall time           |                                                                                                                      |      | 17   |      | ns   |

**Table 8. Source drain diode**

| Symbol          | Parameter                     | Test conditions                                                                                                                                | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $I_{SD}$        | Source-drain current          |                                                                                                                                                | -    |      | 11   | A    |
| $I_{SDM}^{(1)}$ | Source-drain current (pulsed) |                                                                                                                                                |      |      | 44   | A    |
| $V_{SD}^{(2)}$  | Forward on voltage            | $I_{SD} = 11\text{ A}$ , $V_{GS}=0$                                                                                                            | -    |      | 1.6  | V    |
| $t_{rr}$        | Reverse recovery time         | $I_{SD} = 11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 100\text{ V}$<br><i>Figure 20</i>                                   | -    | 122  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                |      | 650  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                |      | 11   |      | A    |
| $t_{rr}$        | Reverse recovery time         | $V_{DD} = 100\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$ , $I_{SD} = 11\text{ A}$<br>$T_j = 150\text{ }^\circ\text{C}$ , <i>Figure 20</i> | -    | 160  |      | ns   |
| $Q_{rr}$        | Reverse recovery charge       |                                                                                                                                                |      | 940  |      | nC   |
| $I_{RRM}$       | Reverse recovery current      |                                                                                                                                                |      | 12   |      | A    |

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

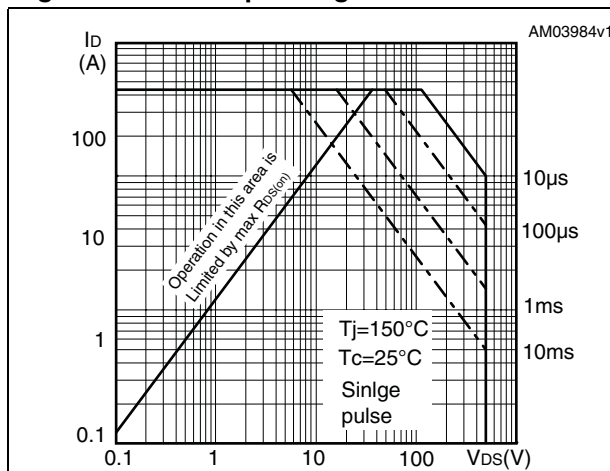
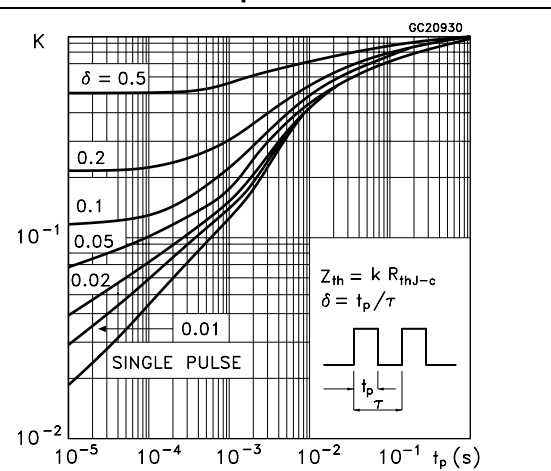
Figure 2. Safe operating area for D<sup>2</sup>PAKFigure 3. Thermal impedance for D<sup>2</sup>PAK

Figure 4. Safe operating area for TO-220FP

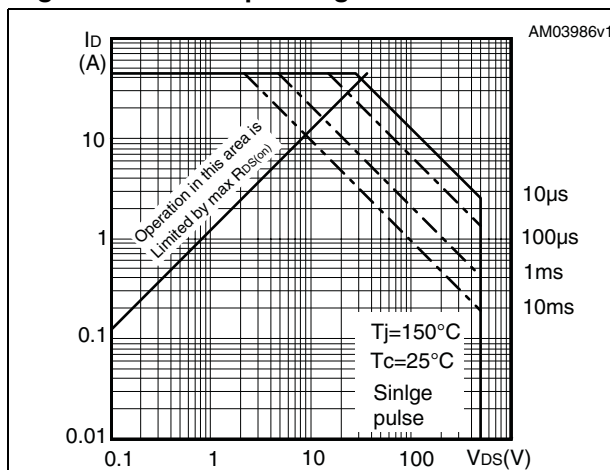


Figure 5. Thermal impedance for TO-220FP

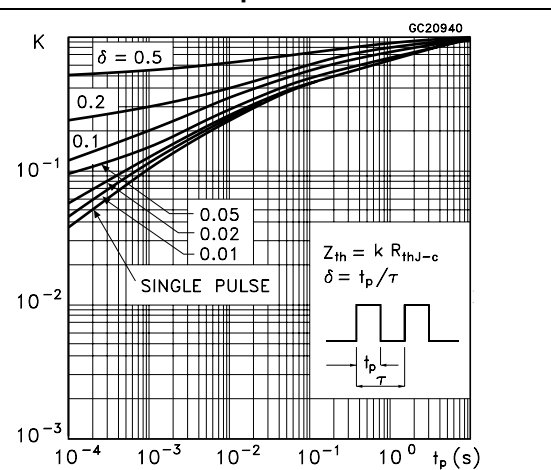


Figure 6. Safe operating area for DPAK

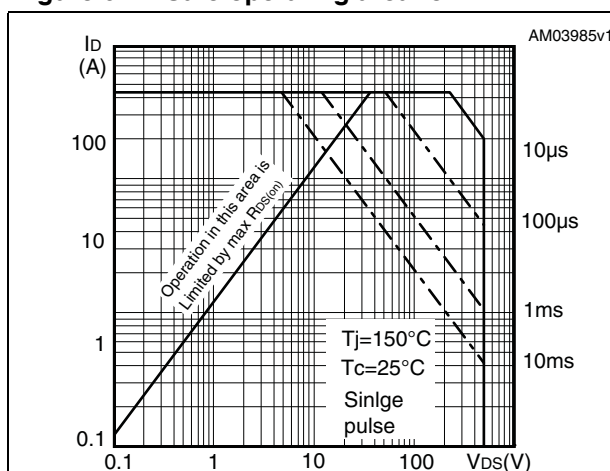


Figure 7. Thermal impedance for DPAK

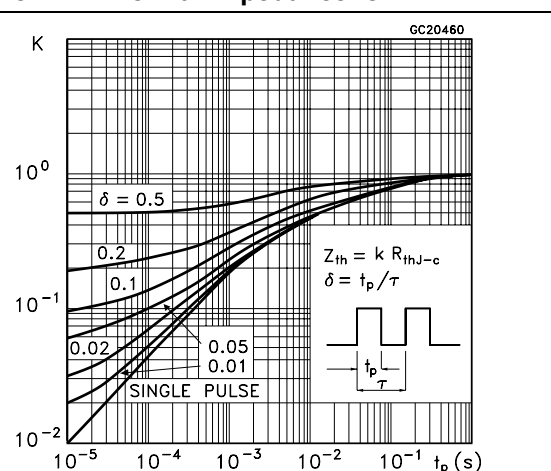


Figure 8. Output characteristics

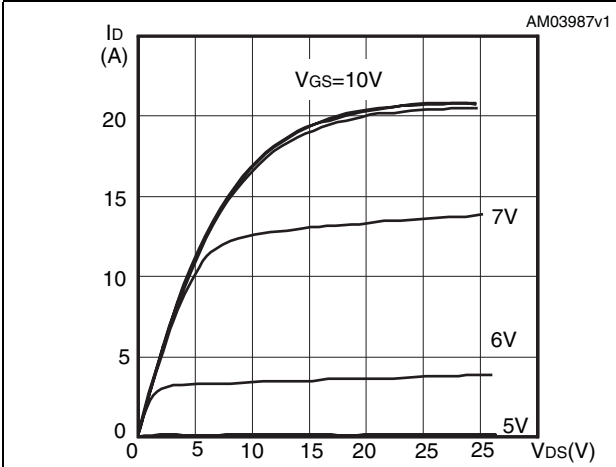


Figure 9. Transfer characteristics

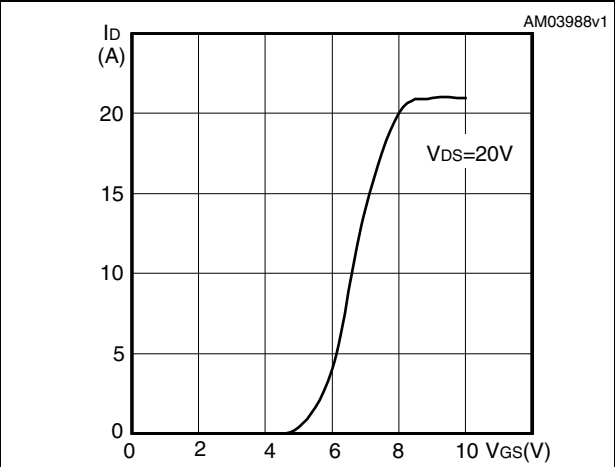


Figure 10. Transconductance

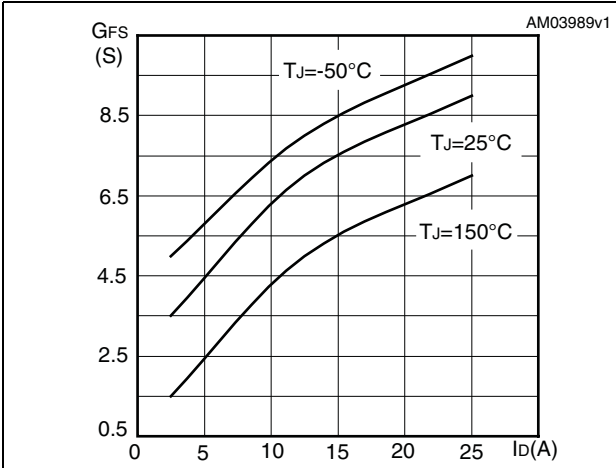


Figure 11. Static drain-source on resistance

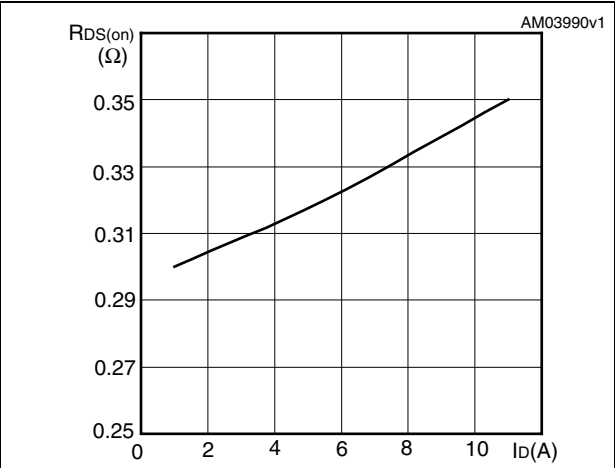


Figure 12. Gate charge vs gate-source voltage

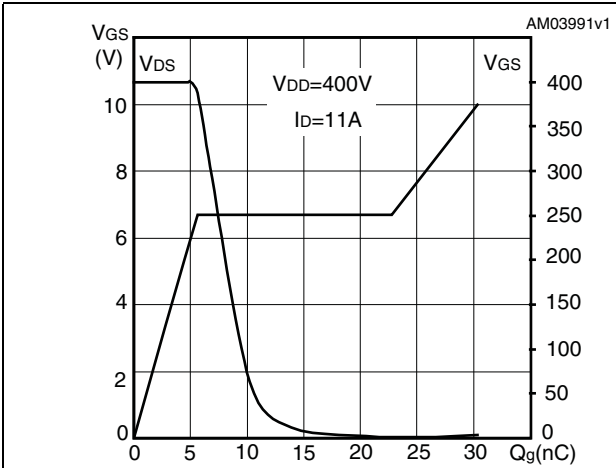


Figure 13. Capacitance variations

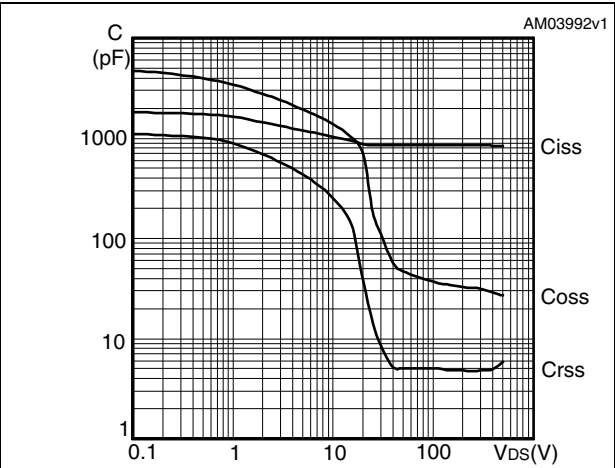


Figure 14. Normalized gate threshold voltage vs temperature

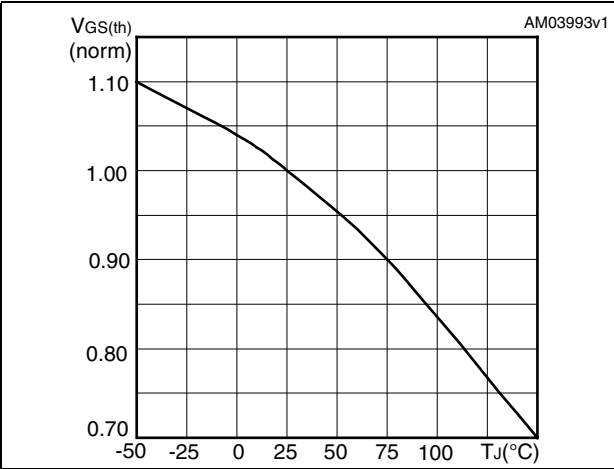


Figure 15. Normalized on resistance vs temperature

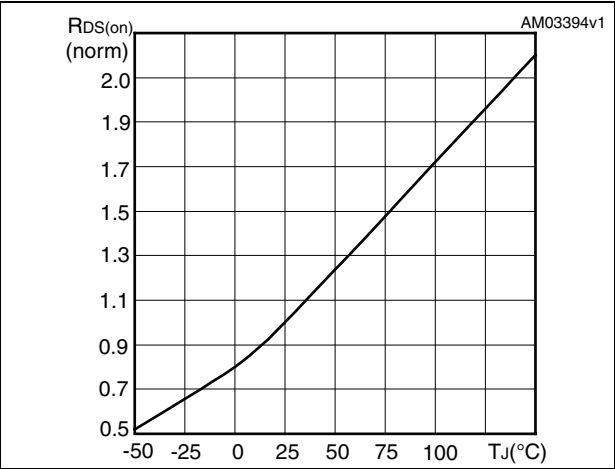


Figure 16. Source-drain diode forward characteristics

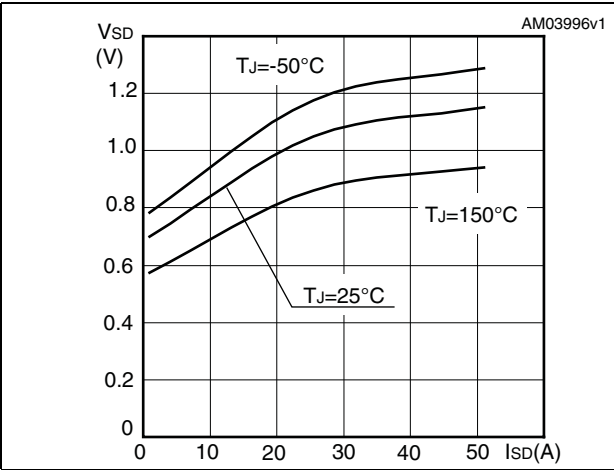
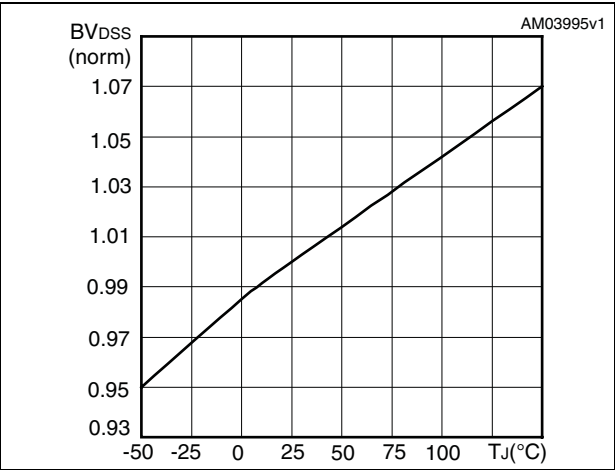


Figure 17. Normalized BV<sub>DSS</sub> vs temperature



### 3 Test circuits

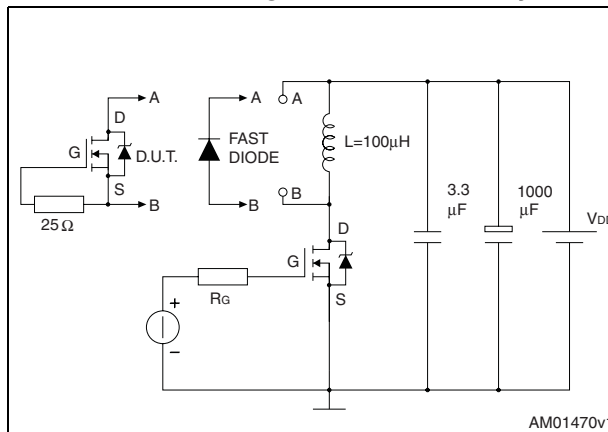
**Figure 18. Switching times test circuit for resistive load**



**Figure 19. Gate charge test circuit**



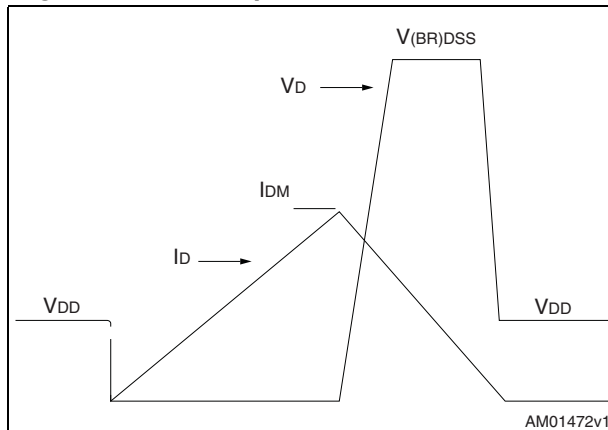
**Figure 20. Test circuit for inductive load switching and diode recovery times**



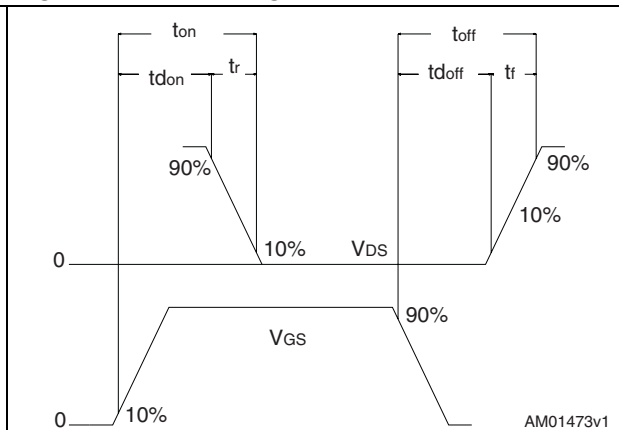
**Figure 21. Unclamped inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. Switching time waveform**

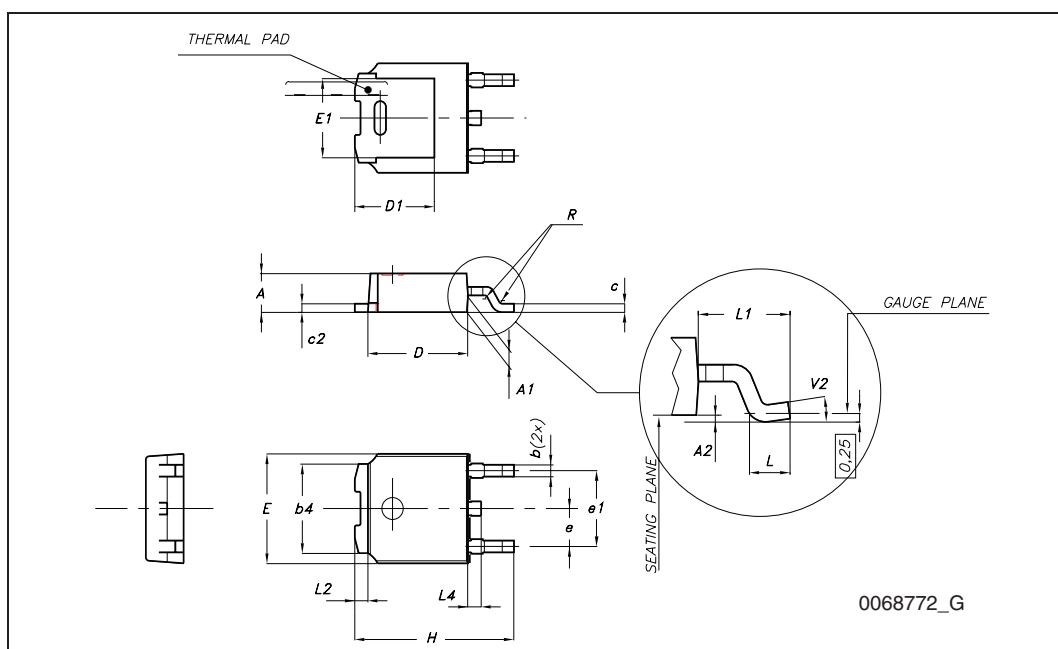


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

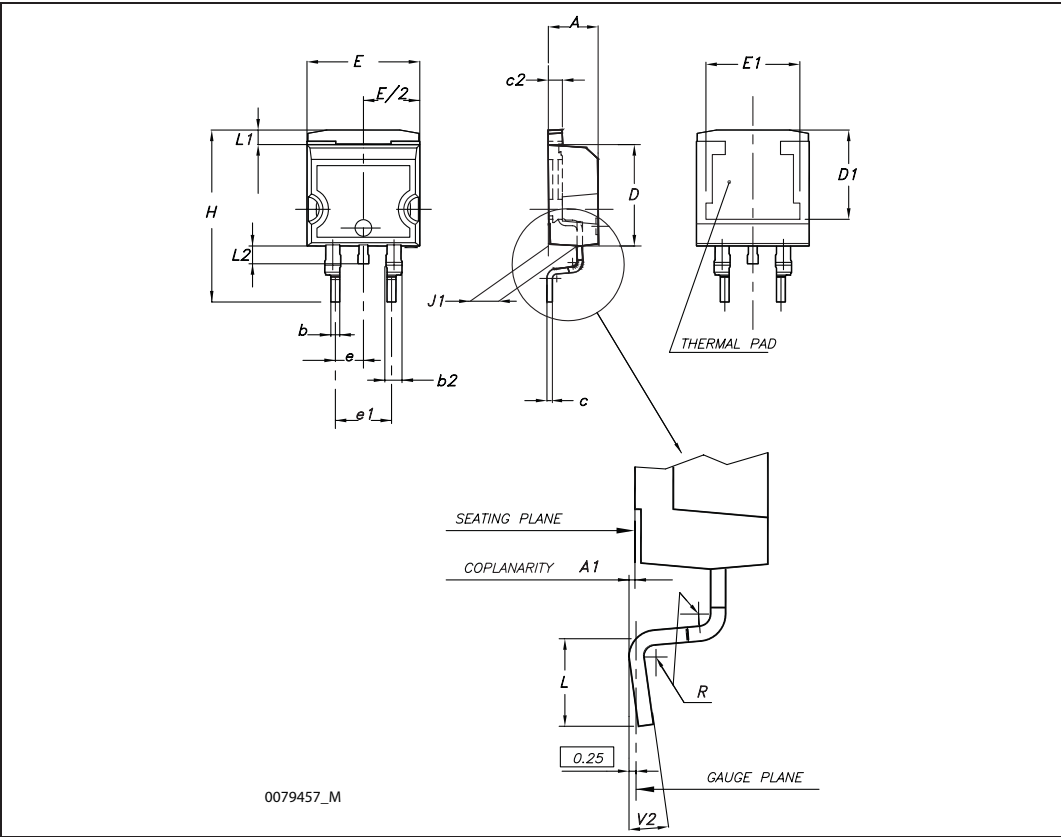
### TO-252 (DPAK) mechanical data

| DIM. | mm.  |      |       |
|------|------|------|-------|
|      | min. | typ  | max.  |
| A    | 2.20 |      | 2.40  |
| A1   | 0.90 |      | 1.10  |
| A2   | 0.03 |      | 0.23  |
| b    | 0.64 |      | 0.90  |
| b4   | 5.20 |      | 5.40  |
| c    | 0.45 |      | 0.60  |
| c2   | 0.48 |      | 0.60  |
| D    | 6.00 |      | 6.20  |
| D1   |      | 5.10 |       |
| E    | 6.40 |      | 6.60  |
| E1   |      | 4.70 |       |
| e    |      | 2.28 |       |
| e1   | 4.40 |      | 4.60  |
| H    | 9.35 |      | 10.10 |
| L    | 1    |      |       |
| L1   |      | 2.80 |       |
| L2   |      | 0.80 |       |
| L4   | 0.60 |      | 1     |
| R    |      | 0.20 |       |
| V2   | 0 °  |      | 8 °   |



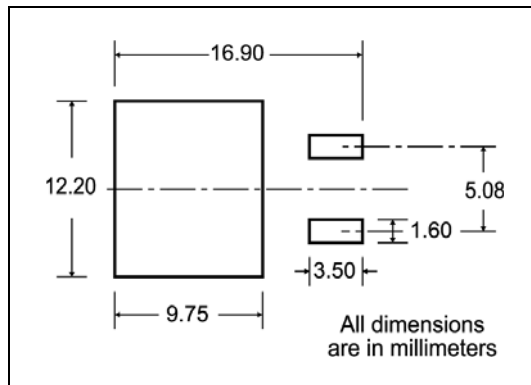
D<sup>2</sup>PAK (TO-263) mechanical data

| Dim | mm   |      |       | inch  |       |       |
|-----|------|------|-------|-------|-------|-------|
|     | Min  | Typ  | Max   | Min   | Typ   | Max   |
| A   | 4.40 |      | 4.60  | 0.173 |       | 0.181 |
| A1  | 0.03 |      | 0.23  | 0.001 |       | 0.009 |
| b   | 0.70 |      | 0.93  | 0.027 |       | 0.037 |
| b2  | 1.14 |      | 1.70  | 0.045 |       | 0.067 |
| c   | 0.45 |      | 0.60  | 0.017 |       | 0.024 |
| c2  | 1.23 |      | 1.36  | 0.048 |       | 0.053 |
| D   | 8.95 |      | 9.35  | 0.352 |       | 0.368 |
| D1  | 7.50 |      |       | 0.295 |       |       |
| E   | 10   |      | 10.40 | 0.394 |       | 0.409 |
| E1  | 8.50 |      |       | 0.334 |       |       |
| e   |      | 2.54 |       |       | 0.1   |       |
| e1  | 4.88 |      | 5.28  | 0.192 |       | 0.208 |
| H   | 15   |      | 15.85 | 0.590 |       | 0.624 |
| J1  | 2.49 |      | 2.69  | 0.099 |       | 0.106 |
| L   | 2.29 |      | 2.79  | 0.090 |       | 0.110 |
| L1  | 1.27 |      | 1.40  | 0.05  |       | 0.055 |
| L2  | 1.30 |      | 1.75  | 0.051 |       | 0.069 |
| R   |      | 0.4  |       |       | 0.016 |       |
| V2  | 0°   |      | 8°    | 0°    |       | 8°    |

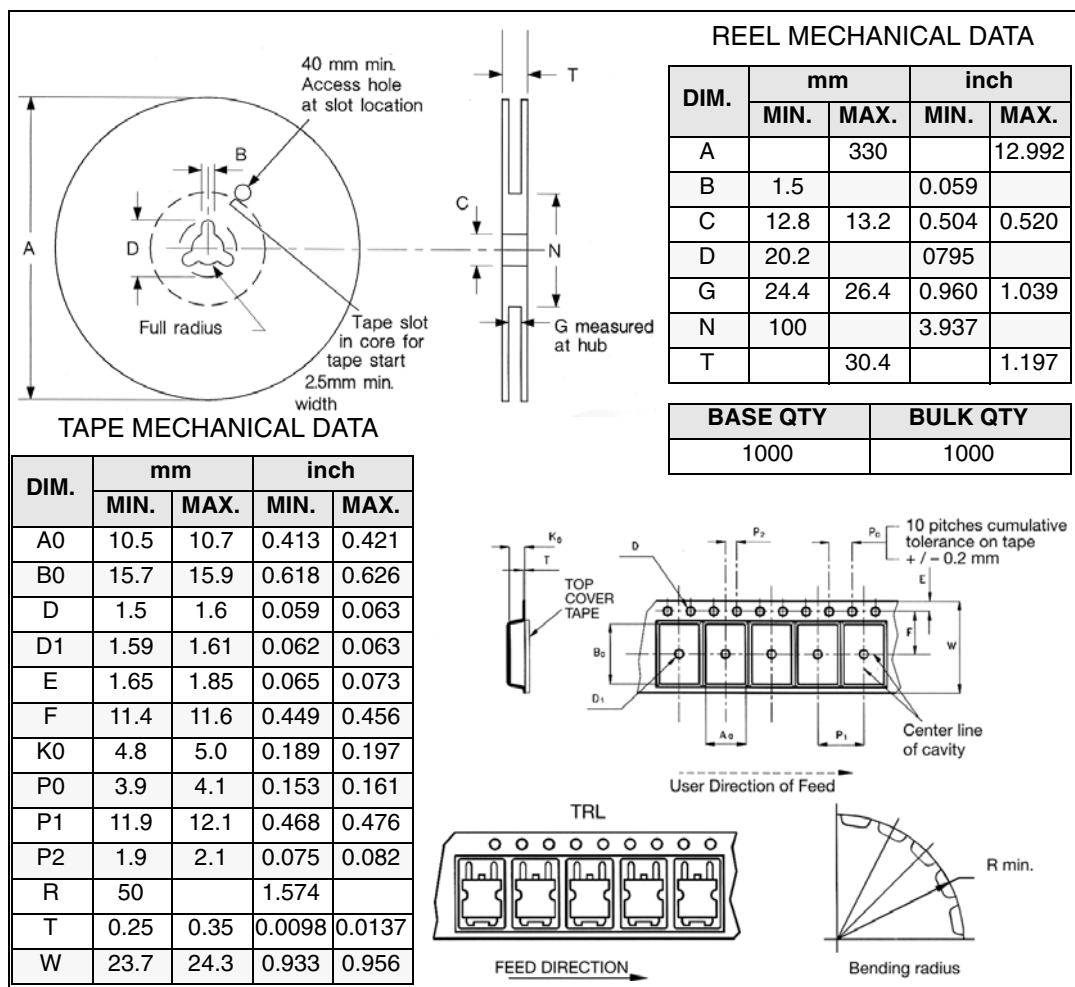


## 5 Packaging mechanical data

### D<sup>2</sup>PAK FOOTPRINT

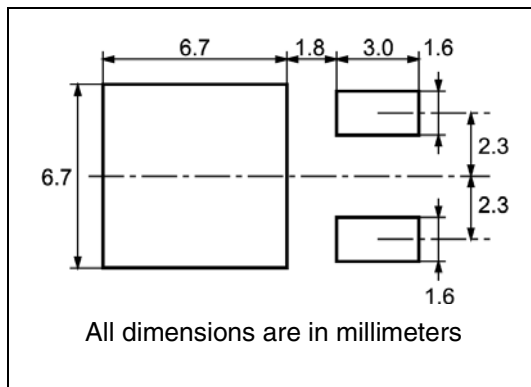


### TAPE AND REEL SHIPMENT

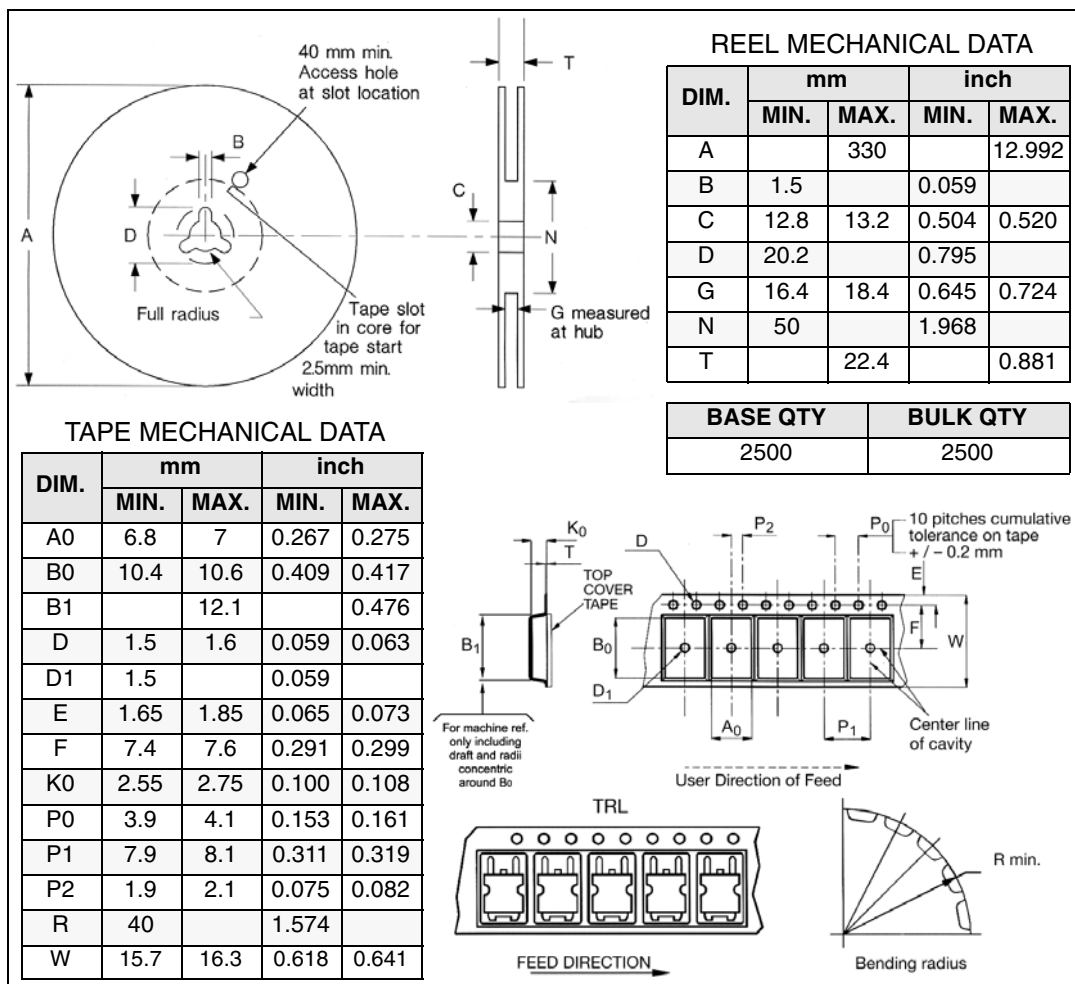


\* on sales type

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes                                      |
|-------------|----------|----------------------------------------------|
| 23-Sep-2008 | 1        | First release                                |
| 10-Jun-2009 | 2        | Added new package, mechanical data: TO-220FP |

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- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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