

## Ultrafast recovery diode

### Main product characteristics

|                |         |
|----------------|---------|
| $I_{F(AV)}$    | 2 X 8 A |
| $V_{RRM}$      | 400 V   |
| $T_j$          | 175° C  |
| $V_F$ (typ)    | 0.9 V   |
| $t_{rr}$ (typ) | 25 ns   |

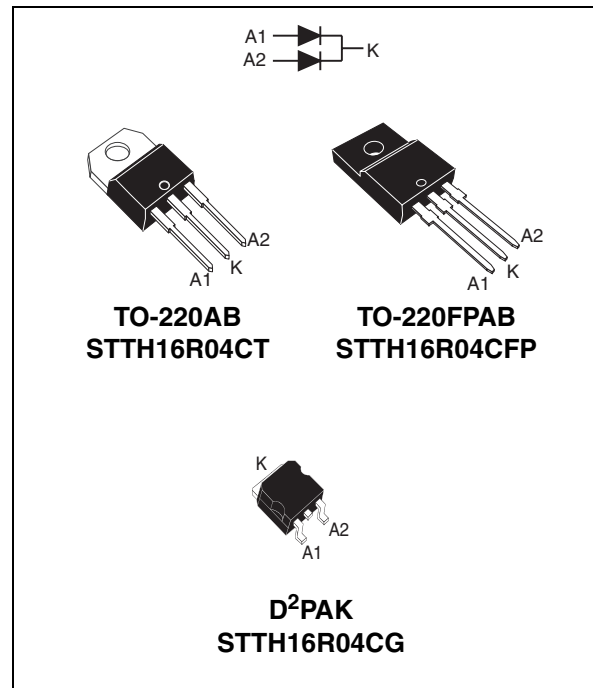
### Features and benefits

- Very low switching losses
- High frequency and/or high pulsed current operation
- High junction temperature
- Insulated package:
  - TO-220FPAB  
Electrical insulation = 1500 V<sub>RMS</sub>  
Capacitance = 12 pF

### Description

The STTH16R04C series uses ST's new 400 V planar Pt doping technology. The STTH16R04C is specially suited for switching mode base drive and transistor circuits.

Packaged in through-the-hole and surface mount packages, this device is intended for use in low voltage, high frequency inverters, free wheeling and polarity protection.



### Order codes

| Part Number    | Marking      |
|----------------|--------------|
| STTH16R04CT    | STTH16R04CT  |
| STTH16R04CG    | STTH16R04CG  |
| STTH16R04CG-TR | STTH16R04CG  |
| STTH16R04CFP   | STTH16R04CFP |

# 1 Characteristics

**Table 1. Absolute ratings (limiting values at 25° C, unless otherwise specified)**

| Symbol              | Parameter                                    |                                   | Value                              | Unit |   |
|---------------------|--|-----------------------------------|------------------------------------|------|---|
| V <sub>RRM</sub>    | Repetitive peak reverse voltage              |                                   | 400                                | V    |   |
| I <sub>F(RMS)</sub> | RMS forward current                          |                                   | 30                                 | A    |   |
| I <sub>F(AV)</sub>  | Average forward current, δ = 0.5             | TO-220AB / D <sup>2</sup> PAK     | Per diode T <sub>c</sub> = 150° C  | 8    | A |
|                     |  |                                   | Per device T <sub>c</sub> = 145° C | 16   |   |
|                     |  | TO-220FPAB                        | Per diode T <sub>c</sub> = 125° C  | 8    |   |
|                     |  |                                   | Per device T <sub>c</sub> = 90° C  | 16   |   |
| I <sub>FSM</sub>    | Surge non repetitive forward current         | t <sub>p</sub> = 10 ms Sinusoidal | 120                                | A    |   |
| T <sub>stg</sub>    | Storage temperature range                    |                                   | -65 to +175                        | ° C  |   |
| T <sub>j</sub>      | Maximum operating junction temperature range |                                   | -40 to +175                        | ° C  |   |

**Table 2. Thermal parameters**

| Symbol               | Parameter        |                               | Value      | Unit |      |
|----------------------|------------------|-------------------------------|------------|------|------|
| R <sub>th(j-c)</sub> | Junction to case | TO-220AC / D <sup>2</sup> PAK | Per diode  | 2    | °C/W |
|                      |                  |                               | Per device | 1.15 |      |
|                      |                  | TO-220FPAB                    | Per diode  | 4.6  |      |
|                      |                  |                               | per device | 3.8  |      |
| R <sub>th(c)</sub>   | Coupling         | TO-220AC / D <sup>2</sup> PAK | Per device | 0.3  | °C/W |
|                      |                  | TO-220FPAB                    | per device | 3    |      |

When the diodes are used simultaneously:

$$\Delta T_{j(\text{diode } 1)} = P_{(\text{diode } 1)} \times R_{th(j-c)(\text{Per diode})} + P_{(\text{diode } 2)} \times R_{th(c)}$$

**Table 3. Static electrical characteristics**

| Symbol      | Parameter               | Test conditions            |                      | Min | Typ  | Max  | Unit          |
|-------------|-------------------------|----------------------------|----------------------|-----|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25^\circ \text{C}$  | $V_R = V_{RRM}$      |     |      | 10   | $\mu\text{A}$ |
|             |                         | $T_j = 125^\circ \text{C}$ |                      |     | 10   | 100  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25^\circ \text{C}$  | $I_F = 8 \text{ A}$  |     |      | 1.5  | V             |
|             |                         | $T_j = 100^\circ \text{C}$ |                      |     | 1.05 | 1.3  |               |
|             |                         | $T_j = 150^\circ \text{C}$ |                      |     | 0.9  | 1.1  |               |
|             |                         | $T_j = 25^\circ \text{C}$  | $I_F = 16 \text{ A}$ |     |      | 1.75 |               |
|             |                         | $T_j = 100^\circ \text{C}$ |                      |     | 1.25 | 1.55 |               |
|             |                         | $T_j = 150^\circ \text{C}$ |                      |     | 1.12 | 1.37 |               |

1. Pulse test:  $t_p = 5 \text{ ms}$ ,  $\delta < 2 \%$

2. Pulse test:  $t_p = 380 \mu\text{s}$ ,  $\delta < 2 \%$

To evaluate the conduction losses use the following equation:

$$P = 0.83 \times I_{F(AV)} + 0.034 \times I_{F(RMS)}^2$$

**Table 4. Dynamic characteristics**

| Symbol   | Parameter                | Test conditions   | Min | Typ | Max | Unit |
|----------|--------------------------|---|-----|-----|-----|------|
| $t_{rr}$ | Reverse recovery time    | $I_F = 1 \text{ A}$ , $di_F/dt = -50 \text{ A}/\mu\text{s}$ ,<br>$V_R = 30 \text{ V}$ , $T_j = 25^\circ \text{C}$         |     | 35  | 50  | ns   |
|          |                          | $I_F = 1 \text{ A}$ , $di_F/dt = -100 \text{ A}/\mu\text{s}$ ,<br>$V_R = 30 \text{ V}$ , $T_j = 25^\circ \text{C}$        |     | 25  | 35  |      |
| $I_{RM}$ | Reverse recovery current | $I_F = 8 \text{ A}$ , $di_F/dt = -200 \text{ A}/\mu\text{s}$ ,<br>$V_R = 320 \text{ V}$ , $T_j = 125^\circ \text{C}$      |     | 5.5 | 8   | A    |
| S        | Softness factor          | $I_F = 8 \text{ A}$ , $di_F/dt = -200 \text{ A}/\mu\text{s}$ ,<br>$V_R = 320 \text{ V}$ , $T_j = 125^\circ \text{C}$      |     | 0.4 |     |      |
| $t_{fr}$ | Forward recovery time    | $I_F = 8 \text{ A}$ , $di_F/dt = 100 \text{ A}/\mu\text{s}$<br>$V_{FR} = 1.1 \times V_{Fmax}$ , $T_j = 25^\circ \text{C}$ |     |     | 150 | ns   |
| $V_{FP}$ | Forward recovery voltage | $I_F = 8 \text{ A}$ , $di_F/dt = 100 \text{ A}/\mu\text{s}$<br>$T_j = 25^\circ \text{C}$                                  |     | 2.9 |     | V    |

Figure 1. Conduction losses versus average current

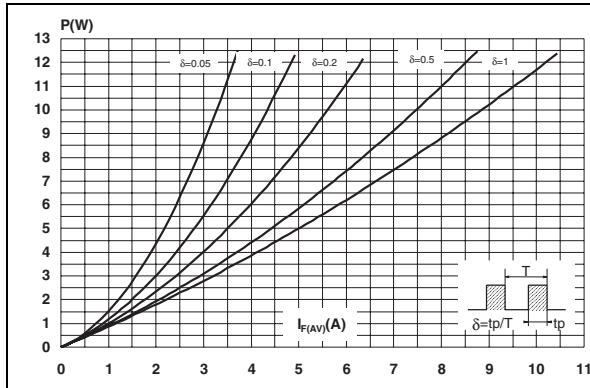


Figure 2. Forward voltage drop versus forward current

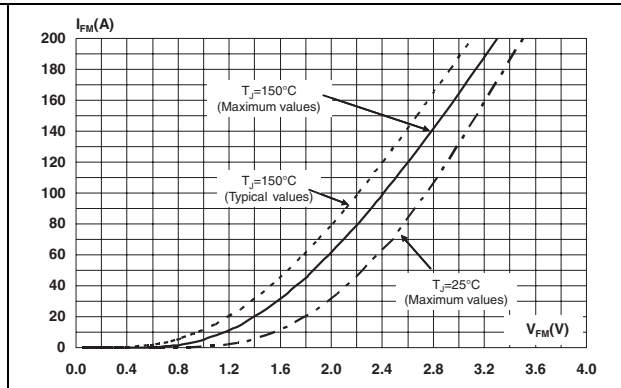


Figure 3. Relative variation of thermal impedance junction to case versus pulse duration

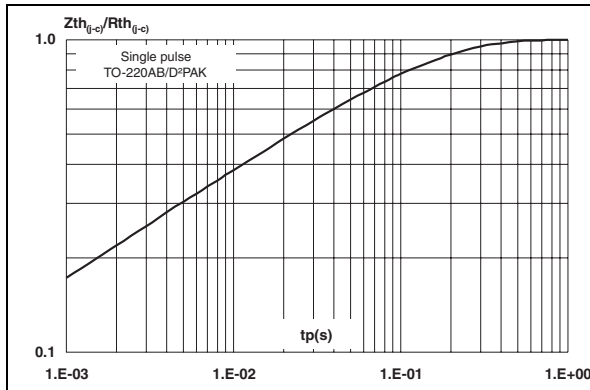


Figure 4. Relative variation of thermal impedance junction to case versus pulse duration TO-220FPAB

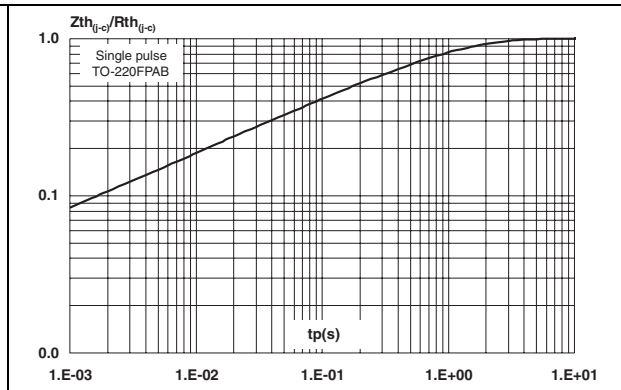


Figure 5. Peak reverse recovery current versus di\_F/dt (typical values)

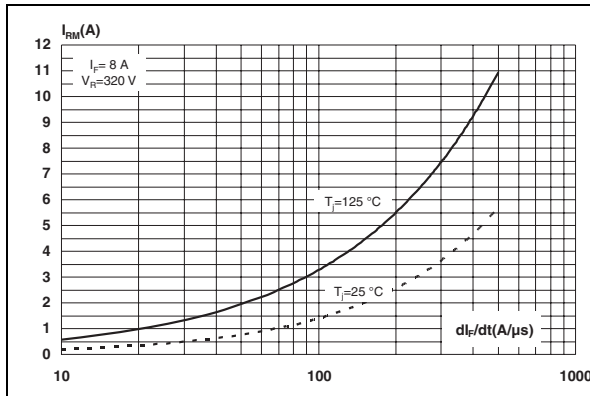


Figure 6. Reverse recovery time versus di\_F/dt (typical values)

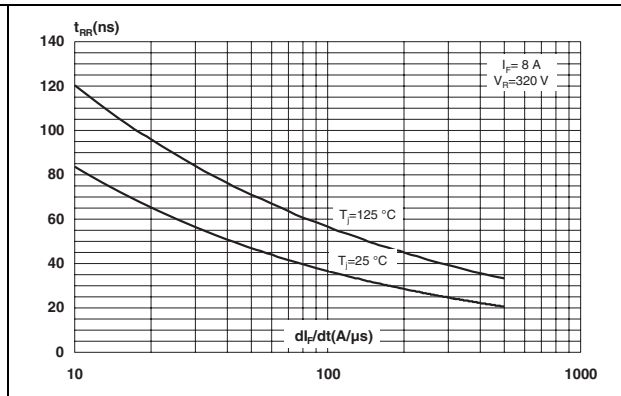


Figure 7. Reverse recovery charges versus  $di_F/dt$  (typical values)

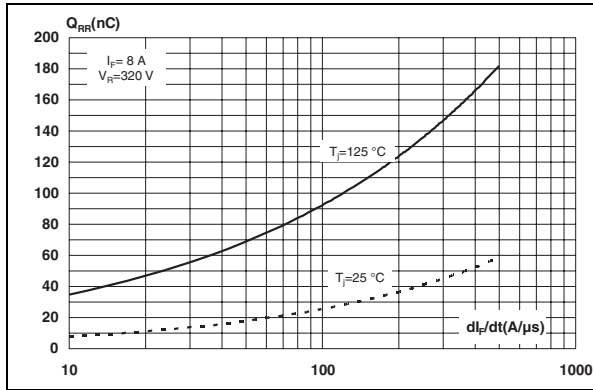


Figure 8. Thermal resistance junction to ambient versus copper surface under tab (Epoxy printed circuit board FR4,  $\epsilon_{CU} = 35 \mu m$ )

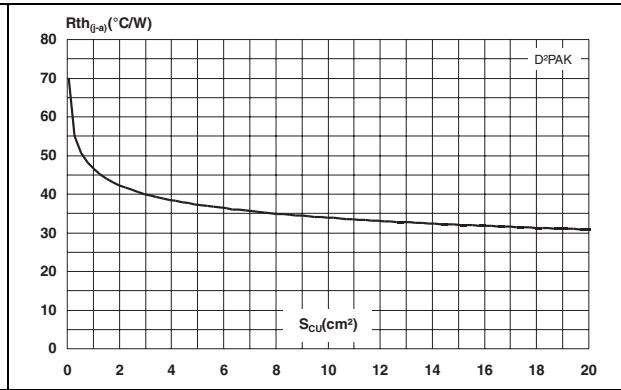


Figure 9. Relative variations of dynamic parameters versus junction temperature

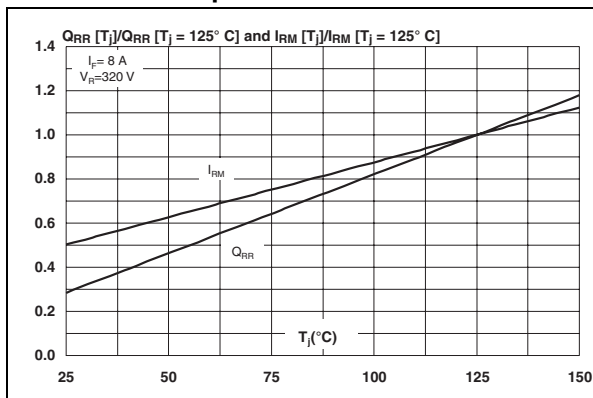


Figure 10. Transient peak forward voltage versus  $di_F/dt$  (typical values)

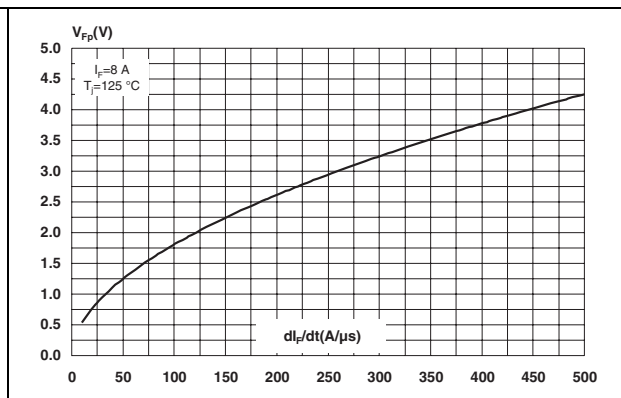


Figure 11. Forward recovery time versus  $di_F/dt$  (typical values)

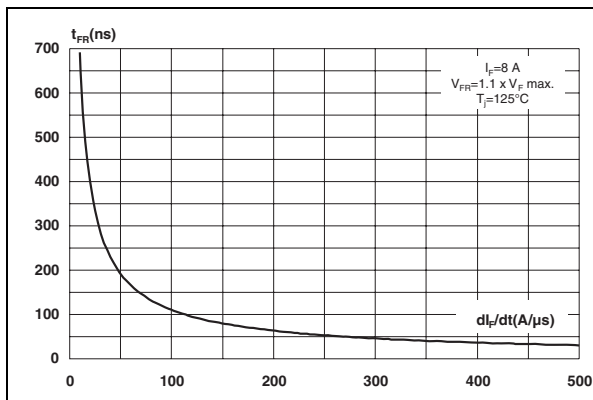
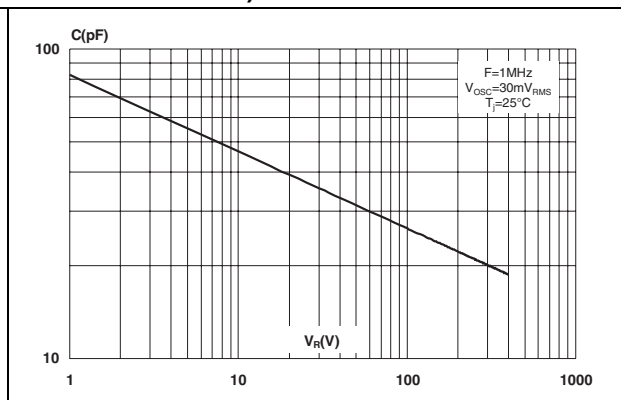


Figure 12. Junction capacitance versus reverse voltage applied (typical values)



## 2 Package information

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.8 Nm (TO-220FPAB) / 0.55 Nm (TO-220AB)
- Maximum torque value: 1.0 Nm (TO-220FPAB) / 0.70 Nm (TO-220AB)

Table 5. D<sup>2</sup>PAK dimensions

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 4.40        | 4.60  | 0.173      | 0.181 |
| A1   | 2.49        | 2.69  | 0.098      | 0.106 |
| A2   | 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      | 0.054 |
| D    | 8.95        | 9.35  | 0.352      | 0.368 |
| E    | 10.00       | 10.40 | 0.393      | 0.409 |
| G    | 4.88        | 5.28  | 0.192      | 0.208 |
| L    | 15.00       | 15.85 | 0.590      | 0.624 |
| L2   | 1.27        | 1.40  | 0.050      | 0.055 |
| L3   | 1.40        | 1.75  | 0.055      | 0.069 |
| M    | 2.40        | 3.20  | 0.094      | 0.126 |
| R    | 0.40 typ.   |       | 0.016 typ. |       |
| V2   | 0°          | 8°    | 0°         | 8°    |

Figure 13. D<sup>2</sup>PAK footprint (dimensions in mm)

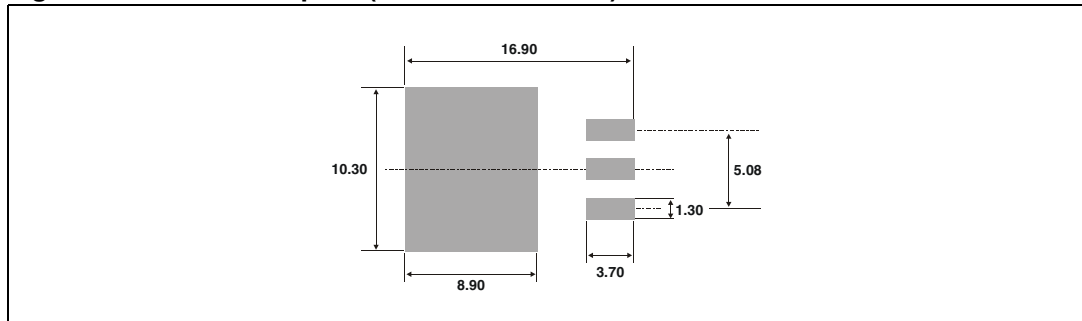
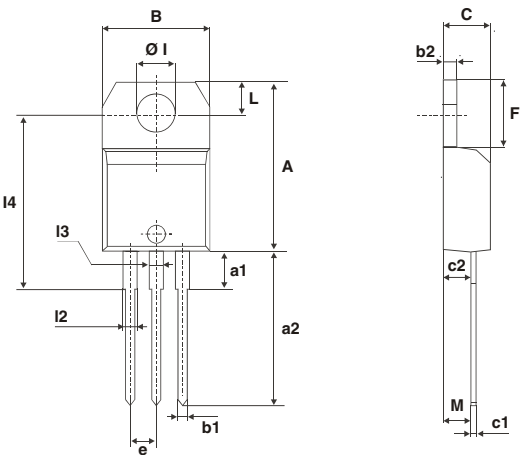


Table 6. TO-220AB dimensions



| Ref. | Dimensions  |       |       |        |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | Millimeters |       |       | Inches |       |       |
|      | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A    | 15.20       |       | 15.90 | 0.598  |       | 0.625 |
| a1   |             | 3.75  |       |        | 0.147 |       |
| a2   | 13.00       |       | 14.00 | 0.511  |       | 0.551 |
| B    | 10.00       |       | 10.40 | 0.393  |       | 0.409 |
| b1   | 0.61        |       | 0.88  | 0.024  |       | 0.034 |
| b2   | 1.23        |       | 1.32  | 0.048  |       | 0.051 |
| C    | 4.40        |       | 4.60  | 0.173  |       | 0.181 |
| c1   | 0.49        |       | 0.70  | 0.019  |       | 0.027 |
| c2   | 2.40        |       | 2.72  | 0.094  |       | 0.107 |
| e    | 2.40        |       | 2.70  | 0.094  |       | 0.106 |
| F    | 6.20        |       | 6.60  | 0.244  |       | 0.259 |
| ØI   | 3.75        |       | 3.85  | 0.147  |       | 0.151 |
| I4   | 15.80       | 16.40 | 16.80 | 0.622  | 0.646 | 0.661 |
| L    | 2.65        |       | 2.95  | 0.104  |       | 0.116 |
| I2   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| I3   | 1.14        |       | 1.70  | 0.044  |       | 0.066 |
| M    |             | 2.60  |       |        | 0.102 |       |

Table 7. TO-220FPAB dimensions

| Ref. | Dimensions  |      |           |       |
|------|-------------|------|-----------|-------|
|      | Millimeters |      | Inches    |       |
|      | Min.        | Max. | Min.      | Max.  |
| A    | 4.4         | 4.6  | 0.173     | 0.181 |
| B    | 2.5         | 2.7  | 0.098     | 0.106 |
| D    | 2.5         | 2.75 | 0.098     | 0.108 |
| E    | 0.45        | 0.70 | 0.018     | 0.027 |
| F    | 0.75        | 1    | 0.030     | 0.039 |
| F1   | 1.15        | 1.70 | 0.045     | 0.067 |
| F2   | 1.15        | 1.70 | 0.045     | 0.067 |
| G    | 4.95        | 5.20 | 0.195     | 0.205 |
| G1   | 2.4         | 2.7  | 0.094     | 0.106 |
| H    | 10          | 10.4 | 0.393     | 0.409 |
| L2   | 16 Typ.     |      | 0.63 Typ. |       |
| L3   | 28.6        | 30.6 | 1.126     | 1.205 |
| L4   | 9.8         | 10.6 | 0.386     | 0.417 |
| L5   | 2.9         | 3.6  | 0.114     | 0.142 |
| L6   | 15.9        | 16.4 | 0.626     | 0.646 |
| L7   | 9.00        | 9.30 | 0.354     | 0.366 |
| Dia. | 3.00        | 3.20 | 0.118     | 0.126 |

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).



### 3 Ordering information

| Part Number    | Marking      | Package            | Weight | Base qty | Delivery mode |
|----------------|--------------|--------------------|--------|----------|---------------|
| STTH16R04CT    | STTH16R04CT  | TO-220AB           | 1.92 g | 50       | Tube          |
| STTH16R04CG    | STTH16R04CG  | D <sup>2</sup> PAK | 1.48 g | 50       | Tube          |
| STTH16R04CG-TR | STTH16R04CG  | D <sup>2</sup> PAK | 1.48 g | 1000     | Tape and reel |
| STTH16R04CFP   | STTH16R04CFP | TO-220FPAB         | 1.69 g | 50       | Tube          |

### 4 Revision history

| Date        | Revision | Description of Changes |
|-------------|----------|------------------------|
| 31-Mar-2007 | 1        | First issue            |

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