

### Features

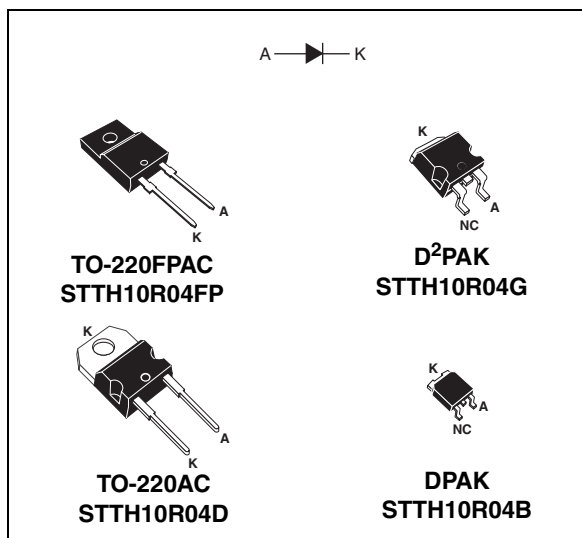
- Ultrafast recovery
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature

### Description

The **STTH10R04** is an ultrafast recovery power rectifier dedicated to **energy recovery in PDP application**.

It is especially designed for clamping function in energy recovery block.

The compromise between forward voltage drop and recovery time offers optimized performances.



**Table 1. Device summary**

|                |        |
|----------------|--------|
| $I_{F(peak)}$  | 10 A   |
| $V_{RRM}$      | 400 V  |
| $t_{rr}$ (typ) | 15 ns  |
| $T_j$          | 175 °C |
| $V_F$ (typ)    | 1.15 V |

# 1 Characteristics

**Table 2. Absolute ratings (limiting values)**

| Symbol               | Parameter                              |                                    |                                                    | Value        | Unit |
|----------------------|----------------------------------------|------------------------------------|----------------------------------------------------|--------------|------|
| V <sub>RRM</sub>     | Repetitive peak reverse voltage        |                                    |                                                    | 400          | V    |
| I <sub>F(RMS)</sub>  | Forward current (rms)                  |                                    |                                                    | 20           | A    |
| I <sub>F(peak)</sub> | Peak working forward current           | DPAK, TO-220AC, D <sup>2</sup> PAK | T <sub>c</sub> = 135 °C   δ = 0.5<br>Square signal | 10           | A    |
|                      |                                        | TO-220FPAC                         | T <sub>c</sub> = 130 °C   δ = 0.5<br>Square signal |              |      |
| I <sub>FSM</sub>     | Surge non-repetitive forward current   |                                    | t <sub>p</sub> = 10 ms sinusoidal                  | 100          | A    |
| T <sub>stg</sub>     | Storage temperature range              |                                    |                                                    | -65 to + 175 | °C   |
| T <sub>j</sub>       | Maximum operating junction temperature |                                    |                                                    | 175          | °C   |

**Table 3. Thermal parameters**

| Symbol        | Parameter        |                                    | Value | Unit |
|---------------|------------------|------------------------------------|-------|------|
| $R_{th(j-c)}$ | Junction to case | DPAK, TO-220AC, D <sup>2</sup> PAK | 3.5   | °C/W |
|               |                  | TO-220FPAC                         | 6     |      |

**Table 4. Static electrical characteristics**

| Symbol      | Parameter               | Test conditions       |                     | Min | Typ  | Max  | Unit          |
|-------------|-------------------------|-----------------------|---------------------|-----|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25\text{ °C}$  | $V_R = V_{RRM}$     |     |      | 10   | $\mu\text{A}$ |
|             |                         | $T_j = 125\text{ °C}$ |                     |     | 10   | 100  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25\text{ °C}$  | $I_F = 10\text{ A}$ |     | 1.5  | 1.7  | V             |
|             |                         | $T_j = 125\text{ °C}$ |                     |     | 1.15 | 1.35 |               |

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

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

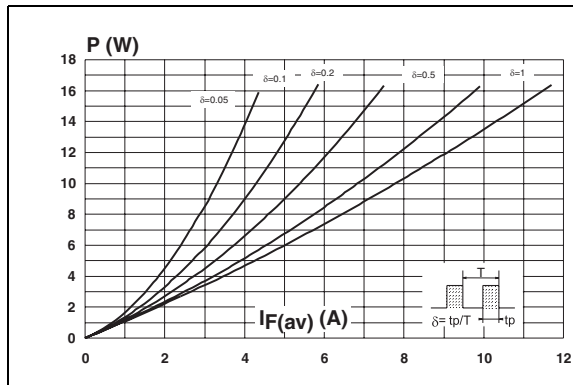
To evaluate the conduction losses use the following equation:

$$P = 1.05 \times I_{F(AV)} + 0.03 I_{F(RMS)}^2$$

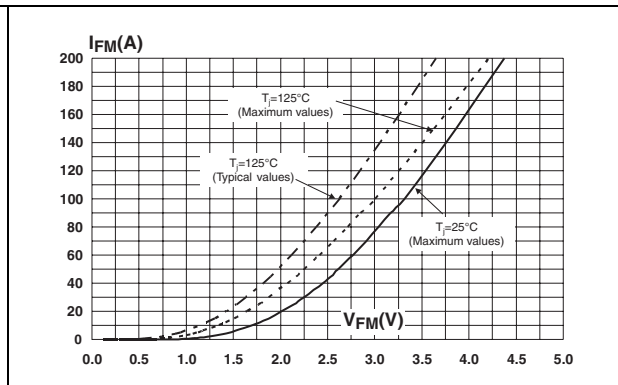
**Table 5. Recovery characteristics**

| Symbol       | Parameter                | Test conditions       |                                                                                              | Min | Typ | Max | Unit |
|--------------|--------------------------|-----------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $t_{rr}$     | Reverse recovery time    | $T_j = 25\text{ °C}$  | $I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ , $I_R = 1\text{ A}$                         |     | 15  | 20  | ns   |
|              |                          |                       | $I_F = 1\text{ A}$ , $V_R = 30\text{ V}$ , $dI_F/dt = -50\text{ A}/\mu\text{s}$              |     |     | 40  |      |
| $t_{fr}$     | Forward recovery time    | $T_j = 25\text{ °C}$  | $I_F = 10\text{ A}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$<br>$V_{FR} = 1.1 \times V_{Fmax}$ |     |     | 140 | ns   |
| $V_{FP}$     | Peak forward voltage     | $T_j = 25\text{ °C}$  | $I_F = 10\text{ A}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$                                   |     |     | 3   | V    |
| $I_{RM}$     | Reverse recovery current | $T_j = 125\text{ °C}$ | $I_F = 10\text{ A}$ , $V_{CC} = 200\text{ V}$<br>$dI_F/dt = 200\text{ A}/\mu\text{s}$        |     | 6.2 | 8   | A    |
| $S_{factor}$ | Softness factor          |                       |                                                                                              |     | 0.3 |     |      |

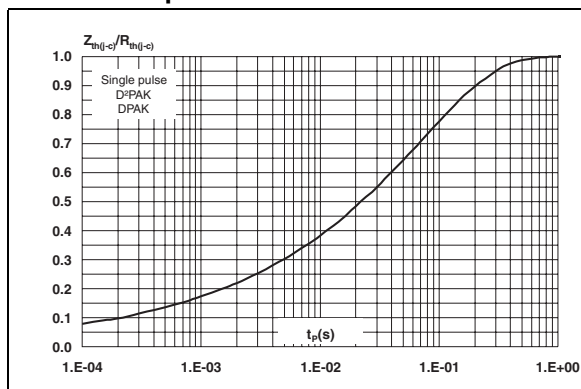
**Figure 1. Conduction losses versus average forward current**



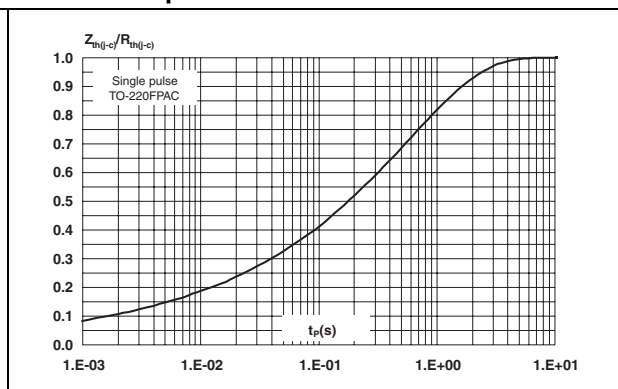
**Figure 2. Forward voltage drop versus forward current**



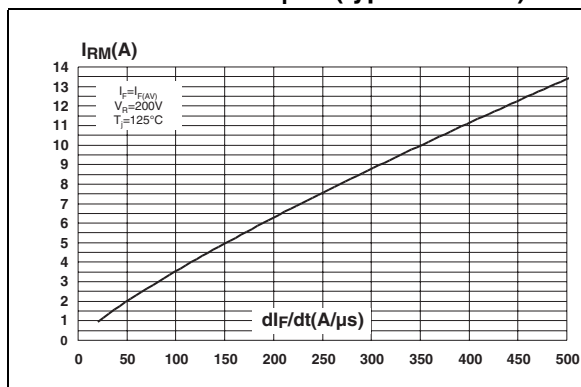
**Figure 3. Relative variation of thermal impedance junction to case versus pulse duration**



**Figure 4. Relative variation of thermal impedance junction to case versus pulse duration**



**Figure 5. Peak reverse recovery current versus  $dI_F/dt$  (typical values)**



**Figure 6. Reverse recovery time versus  $dI_F/dt$  (typical values)**

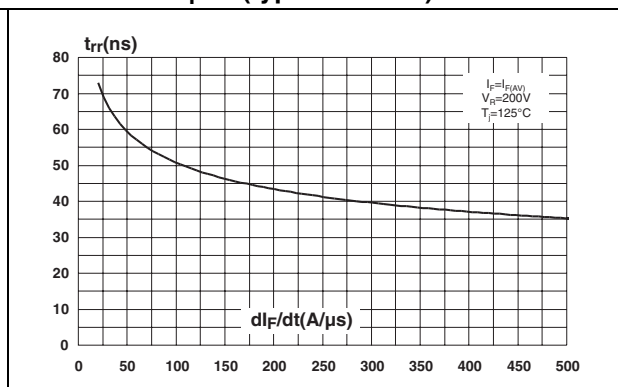


Figure 7. Reverse recovery charges versus  $dl_F/dt$  (typical values)

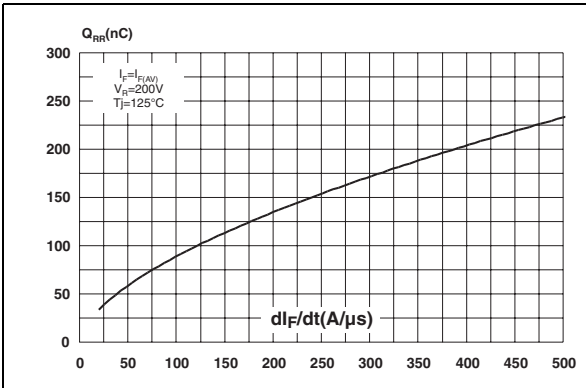


Figure 8. Reverse recovery softness factor versus  $dl_F/dt$  (typical values)

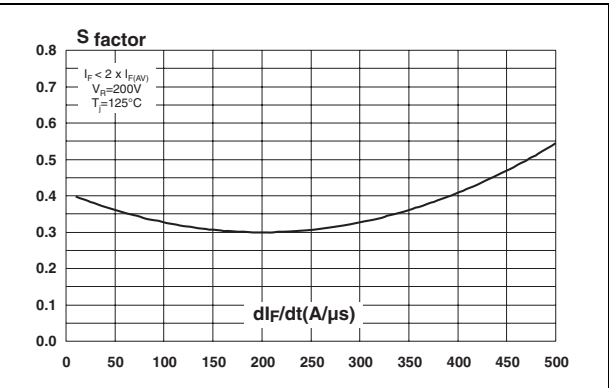


Figure 9. Relative variations of dynamic parameters versus junction temperature

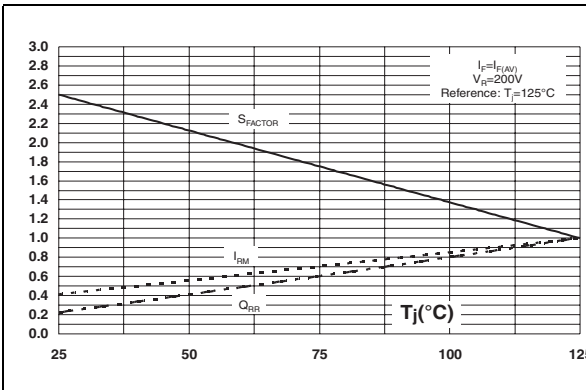


Figure 10. Transient peak forward voltage versus  $dl_F/dt$  (typical values)

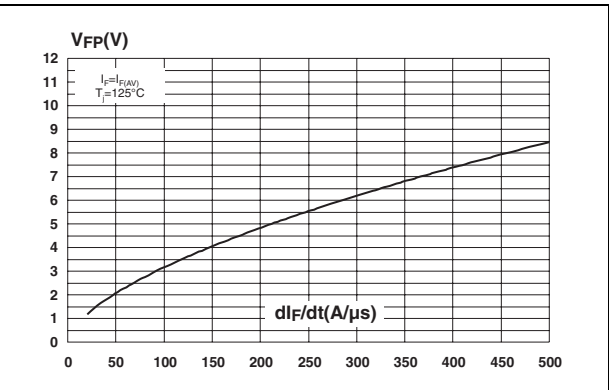


Figure 11. Forward recovery time versus  $di_F/dt$  (typical values)

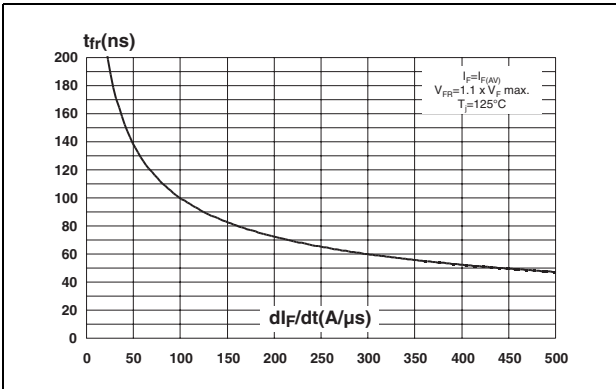


Figure 12. Junction capacitance versus reverse voltage applied (typical values)

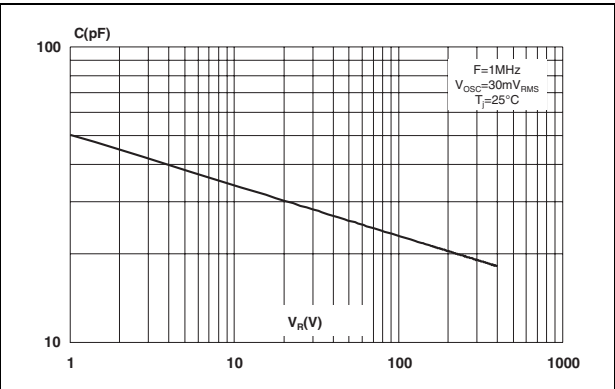


Figure 13. Thermal resistance, junction to ambient, versus copper surface under tab (epoxy printed board FR4, copper thickness = 35 μm) D<sup>2</sup>PAK

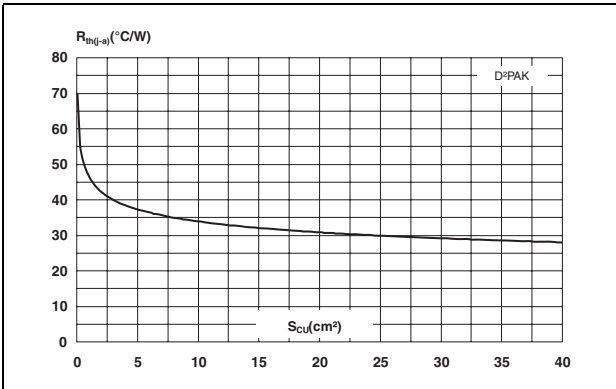
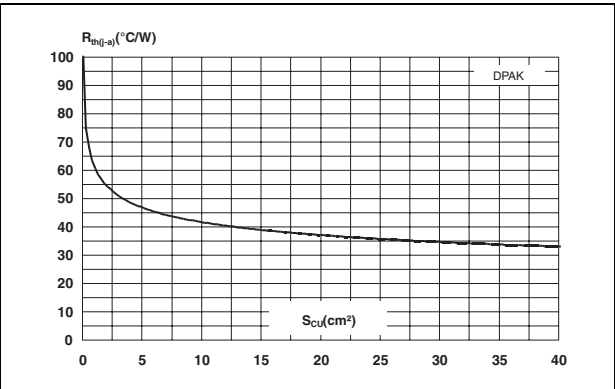


Figure 14. Thermal resistance, junction to ambient, versus copper surface under tab (epoxy printed board FR4, copper thickness = 35 μm) DPAK



## 2 Package information

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.8 N·m
- Maximum torque value: 1.0 N·m

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).

**Table 6. TO-220AC dimensions**

| Ref.    | Dimensions  |       |            |       |
|---------|-------------|-------|------------|-------|
|         | Millimeters |       | Inches     |       |
|         | Min.        | Max.  | Min.       | Max.  |
| A       | 4.40        | 4.60  | 0.173      | 0.181 |
| C       | 1.23        | 1.32  | 0.048      | 0.051 |
| D       | 2.40        | 2.72  | 0.094      | 0.107 |
| E       | 0.49        | 0.70  | 0.019      | 0.027 |
| F       | 0.61        | 0.88  | 0.024      | 0.034 |
| F1      | 1.14        | 1.70  | 0.044      | 0.066 |
| G       | 4.95        | 5.15  | 0.194      | 0.202 |
| H2      | 10.00       | 10.40 | 0.393      | 0.409 |
| L2      | 16.40 typ.  |       | 0.645 typ. |       |
| L4      | 13.00       | 14.00 | 0.511      | 0.551 |
| L5      | 2.65        | 2.95  | 0.104      | 0.116 |
| L6      | 15.25       | 15.75 | 0.600      | 0.620 |
| L7      | 6.20        | 6.60  | 0.244      | 0.259 |
| L9      | 3.50        | 3.93  | 0.137      | 0.154 |
| M       | 2.6 typ.    |       | 0.102 typ. |       |
| Diam. I | 3.75        | 3.85  | 0.147      | 0.151 |

Table 7. TO-220FPAC 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 |
| 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 |

Technical drawing of a mechanical part showing three views: a top view, a front view, and a side view. The dimensions are labeled as follows:

- Top View:** Dimensions E (total width), B2 (inner width), L2 (height), L4 (height), and G (width).
- Front View:** Dimensions A (total width), C2 (inner width), D (height), and R (radius).
- Side View:** Dimensions A1 (width), A2 (width), V2 (angle), and 0.60 MIN. (minimum thickness).

| Ref. | Dimensions  |       |            |       |
|------|-------------|-------|------------|-------|
|      | Millimeters |       | Inches     |       |
|      | Min.        | Max.  | Min.       | Max.  |
| A    | 2.20        | 2.40  | 0.086      | 0.094 |
| A1   | 0.90        | 1.10  | 0.035      | 0.043 |
| A2   | 0.03        | 0.23  | 0.001      | 0.009 |
| B    | 0.64        | 0.90  | 0.025      | 0.035 |
| B2   | 5.20        | 5.40  | 0.204      | 0.212 |
| C    | 0.45        | 0.60  | 0.017      | 0.023 |
| C2   | 0.48        | 0.60  | 0.018      | 0.023 |
| D    | 6.00        | 6.20  | 0.236      | 0.244 |
| E    | 6.40        | 6.60  | 0.251      | 0.259 |
| G    | 4.40        | 4.60  | 0.173      | 0.181 |
| H    | 9.35        | 10.10 | 0.368      | 0.397 |
| L2   | 0.80 typ.   |       | 0.031 typ. |       |
| L4   | 0.60        | 1.00  | 0.023      | 0.039 |
| V2   | 0°          | 8°    | 0°         | 8°    |

Technical drawing of a Tee fitting showing dimensions and a table of values.

**Dimensions:**

- A: Overall length of the Tee
- A1: Length of the Tee from the center of the branch to the end of the main run
- A2: Length of the Tee from the center of the branch to the end of the main run (alternative view)
- B: Diameter of the main run
- B2: Diameter of the branch
- C: Diameter of the branch
- C2: Diameter of the branch (alternative view)
- D: Height of the Tee from the center of the branch to the top of the main run
- E: Width of the Tee
- G: Distance from the center of the branch to the end of the main run
- L: Overall height of the Tee
- L2: Height of the Tee from the center of the branch to the top of the main run
- L3: Height of the Tee from the center of the branch to the bottom of the main run
- M: Distance from the center of the branch to the end of the main run (alternative view)
- R: Radius of the Tee
- V2: Angle of the Tee

**Table of Values:**

| 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°    |

\* FLAT ZONE NO LESS THAN 2mm

Technical drawing showing the front and side views of a mechanical part with the following dimensions:

- Overall width: 16.90
- Overall height: 10.30
- Width of the main body: 8.90
- Width of the side feature: 3.70
- Height of the side feature: 1.30
- Distance from the top of the side feature to the top of the main body: 5.08

### 3 Ordering information

**Table 10. Ordering information**

| Order code    | Marking     | Package            | Weight | Base qty | Delivery mode |
|---------------|-------------|--------------------|--------|----------|---------------|
| STTH10R04FP   | STTH10R04FP | TO-220FPAC         | 1.64 g | 50       | Tube          |
| STTH10R04B    | STTH10R04B  | DPAK               | 0.3g   | 75       | Tube          |
| STTH10R04B-TR | STTH10R04B  |                    |        | 2500     | Tape and reel |
| STTH10R04G    | STTH10R04G  | D <sup>2</sup> PAK | 1.48 g | 50       | Tube          |
| STTH10R04G-TR | STTH10R04G  |                    |        | 1000     | Tape and reel |
| STTH10R04D    | STTH10R04D  | TO-220AC           | 1.86 g | 50       | Tube          |

### 4 Revision history

**Table 11. Document revision history**

| Date        | Revision | Description of changes |
|-------------|----------|------------------------|
| 07-Nov-2007 | 1        | First issue            |

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