

## Turbo 2 ultrafast - high voltage rectifier

### Main product characteristics

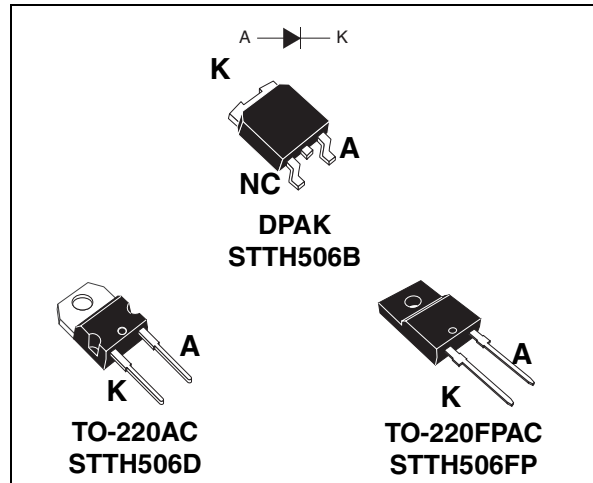
|                |        |
|----------------|--------|
| $I_{F(AV)}$    | 5 A    |
| $V_{RRM}$      | 600 V  |
| $T_j$          | 175° C |
| $V_F$ (typ)    | 1.1 V  |
| $t_{rr}$ (max) | 30 ns  |

### Features and benefits

- Ultrafast switching
- Low reverse current
- Low thermal resistance
- Reduces conduction and switching losses
- Insulated package TO-220FPAC
  - Insulated voltage: 2500 V<sub>RMS</sub>
  - Typical package capacitance: 12 pF

### Description

The STTH506 uses ST Turbo2 600V technology. This device is specially suited for use in switching power supplies, and industrial applications.



### Order codes

| Part Number | Marking   |
|-------------|-----------|
| STTH506B    | STTH506B  |
| STTH506B-TR | STTH506B  |
| STTH506D    | STTH506D  |
| STTH506FP   | STTH506FP |

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

| Symbol       | Parameter                                             |                                                            | Value        | Unit |
|--------------|-------------------------------------------------------|------------------------------------------------------------|--------------|------|
| $V_{RRM}$    | Repetitive peak reverse voltage                       |                                                            | 600          | V    |
| $I_{F(RMS)}$ | RMS forward current                                   | TO-220AC, TO220FPAC                                        | 20           | A    |
|              |                                                       | DPAK                                                       | 10           | A    |
| $I_{F(AV)}$  | Average forward current, $\delta = 0.5$               | $T_c = 145^\circ \text{C}$<br>TO-220AC, DPAK               | 5            | A    |
|              |                                                       | $T_c = 120^\circ \text{C}$<br>TO-220FPAC                   | 5            | A    |
| $I_{FSM}$    | Surge non repetitive forward current                  | $t_p = 10 \text{ ms}$<br>Sinusoidal<br>TO-220AC, TO220FPAC | 70           | A    |
|              |                                                       | DPAK                                                       | 55           | A    |
| $T_{stg}$    | Storage temperature range                             |                                                            | -65 to + 175 | °C   |
| $T_j$        | Maximum operating junction temperature <sup>(1)</sup> |                                                            | 175          | °C   |

1.  $\frac{dP_{tot}}{dT_j} < \frac{1}{R_{th(j-a)}}$  thermal runaway condition for a diode on its own heatsink

# 1 Characteristics

**Table 2. Thermal parameters**

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

**Table 3. Static electrical characteristics**

| Symbol      | Parameter               | Test conditions           |                    | Min. | Typ  | Max. | Unit          |
|-------------|-------------------------|---------------------------|--------------------|------|------|------|---------------|
| $I_R^{(1)}$ | Reverse leakage current | $T_j = 25^\circ\text{C}$  | $V_R = V_{RRM}$    |      |      | 5    | $\mu\text{A}$ |
|             |                         | $T_j = 150^\circ\text{C}$ |                    |      | 13   | 130  |               |
| $V_F^{(2)}$ | Forward voltage drop    | $T_j = 25^\circ\text{C}$  | $I_F = 5\text{ A}$ |      |      | 1.85 | V             |
|             |                         | $T_j = 150^\circ\text{C}$ |                    |      | 1.10 | 1.40 |               |

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

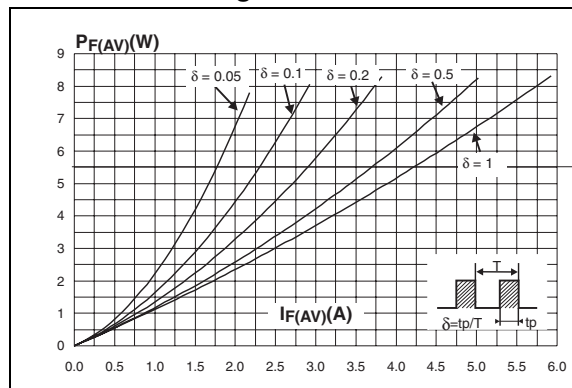
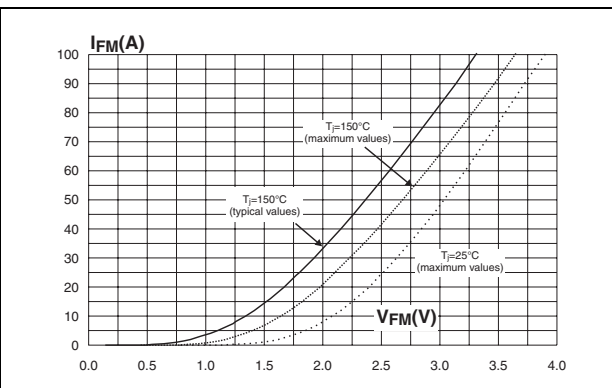
2. Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:

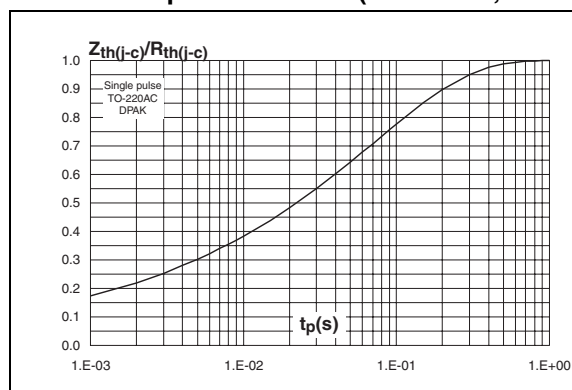
$$P = 1.07 \times I_{F(AV)} + 0.066 I_{F(RMS)}^2$$

**Table 4. Dynamic characteristics**

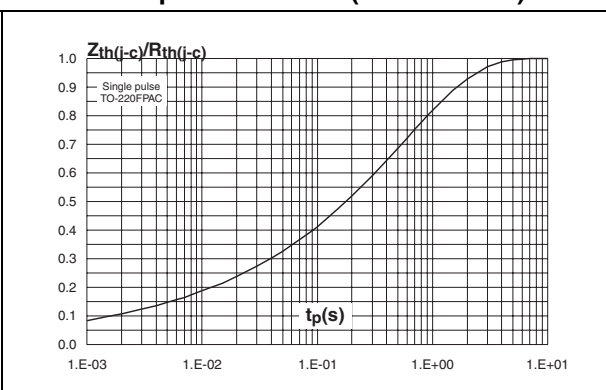
| Symbol   | Parameter                | Test conditions                                                                                                      | Min. | Typ | Max. | Unit |
|----------|--------------------------|----------------------------------------------------------------------------------------------------------------------|------|-----|------|------|
| $t_{rr}$ | Reverse recovery time    | $I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ , $I_R = 1\text{ A}$ ,<br>$T_j = 25^\circ\text{C}$                   |      |     | 30   | ns   |
|          |                          | $I_F = 1\text{ A}$ , $dI_F/dt = -50\text{ A}/\mu\text{s}$ ,<br>$V_R = 30\text{ V}$ , $T_j = 25^\circ\text{C}$        |      | 35  | 50   |      |
| $I_{RM}$ | Reverse recovery current | $I_F = 5\text{ A}$ , $dI_F/dt = -100\text{ A}/\mu\text{s}$ ,<br>$V_R = 400\text{ V}$ , $T_j = 25^\circ\text{C}$      |      | 3.5 | 5    |      |
| $t_{fr}$ | Forward recovery time    | $I_F = 5\text{ A}$ $dI_F/dt = 100\text{ A}/\mu\text{s}$<br>$V_{FR} = 1.1 \times V_{Fmax}$ , $T_j = 25^\circ\text{C}$ |      |     | 180  | ns   |
| $V_{FP}$ | Forward recovery voltage | $I_F = 5\text{ A}$ $dI_F/dt = 100\text{ A}/\mu\text{s}$<br>$V_{FR} = 1.1 \times V_{Fmax}$ , $T_j = 25^\circ\text{C}$ |      | 4   |      | V    |

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

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


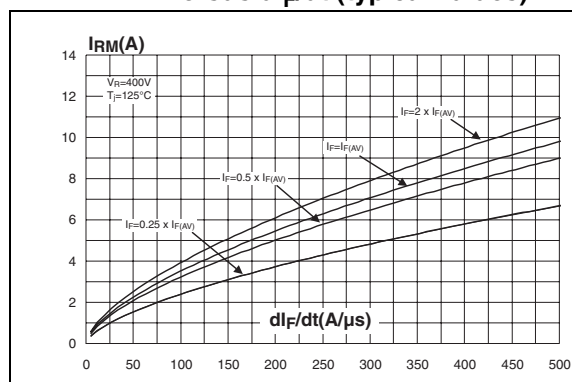
**Figure 3. Relative variation of thermal impedance junction to case versus pulse duration (TO-220AC, DPAK)**



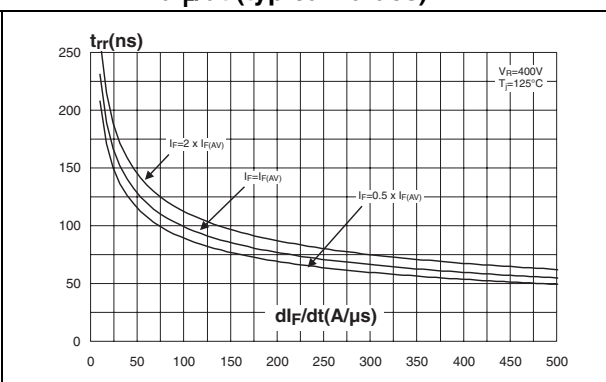
**Figure 4. Relative variation of thermal impedance junction to case versus pulse duration (TO-220FPAC)**



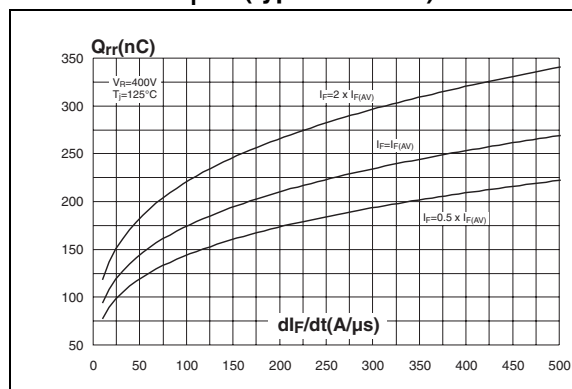
**Figure 5. Peak reverse recovery current versus  $dl_F/dt$  (typical values)**



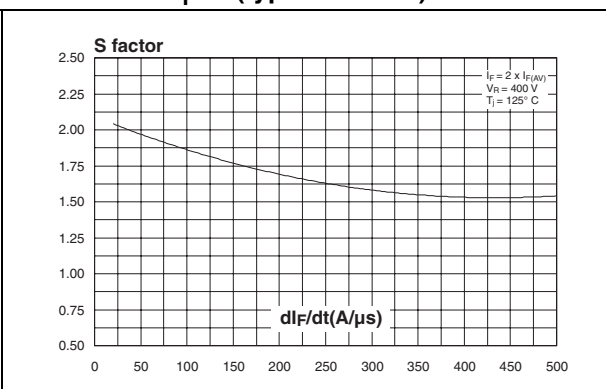
**Figure 6. Reverse recovery time versus  $dl_F/dt$  (typical values)**



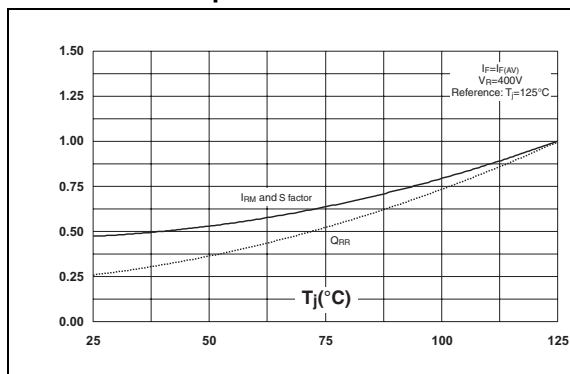
**Figure 7. Reverse recovery charges versus  $dl_F/dt$  (typical values)**



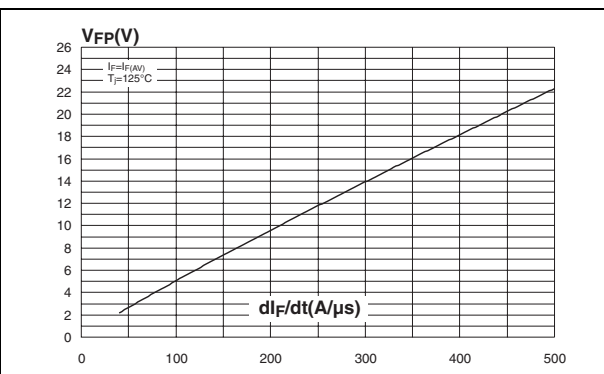
**Figure 8. Softness factor versus  $dl_F/dt$  (typical values)**



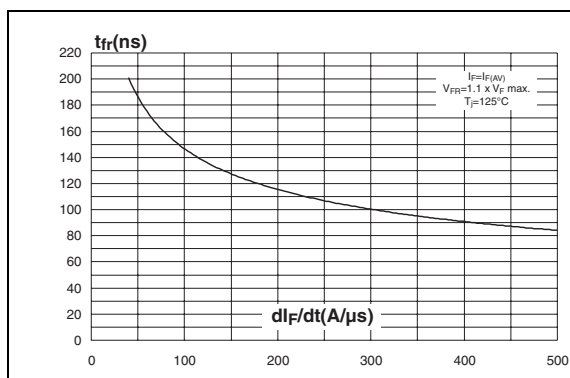
**Figure 9. Relative variations of dynamic parameters versus junction temperature**



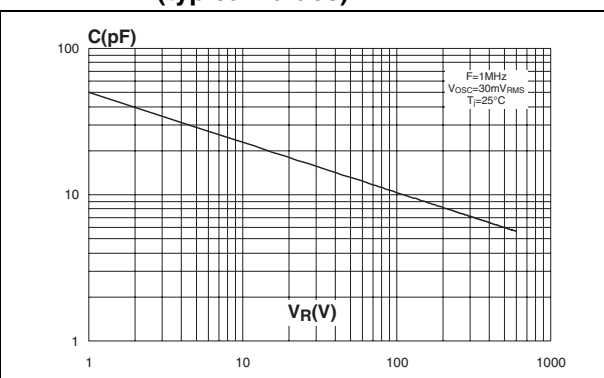
**Figure 10. Transient peak forward voltage versus  $di_F/dt$  (typical values)**



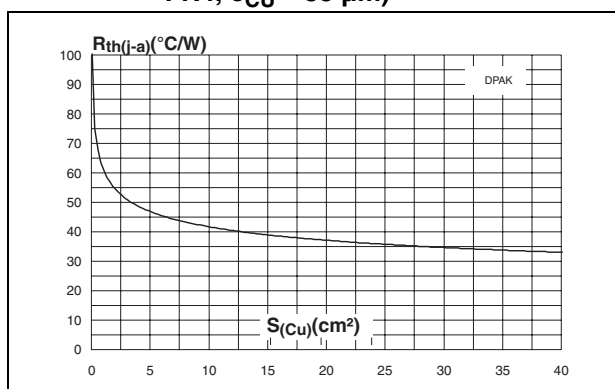
**Figure 11. Forward recovery time versus  $di_F/dt$  (typical values)**



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



**Figure 13. Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4,  $e_{CU} = 35 \mu m$ )**



# 2 Package mechanical data

Epoxy meets UL94, V0

Cooling method: by conduction (C)

Recommended torque value: 0.80 Nm

Maximum torque value: 1.0 Nm

Table 5. DPAK Dimensions

| 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°    |

Figure 14. DPAK Footprint dimensions (in mm)

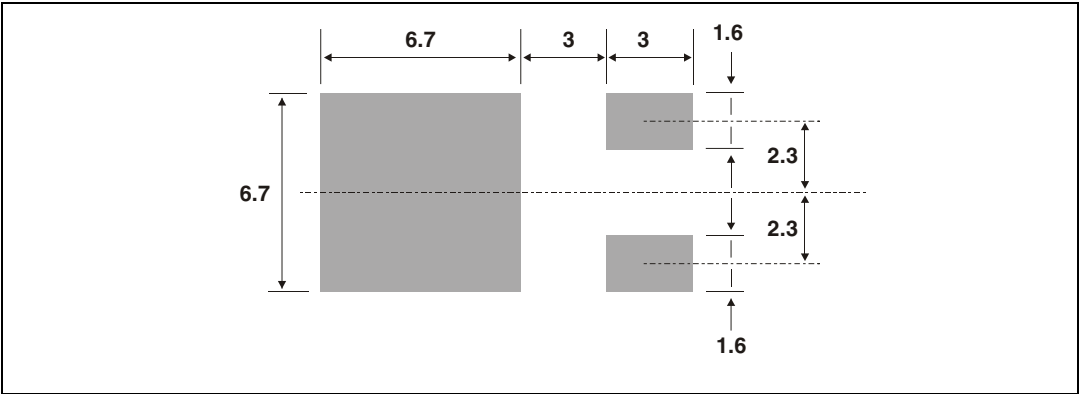


Table 6. TO-220AC Dimensions

| 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 |

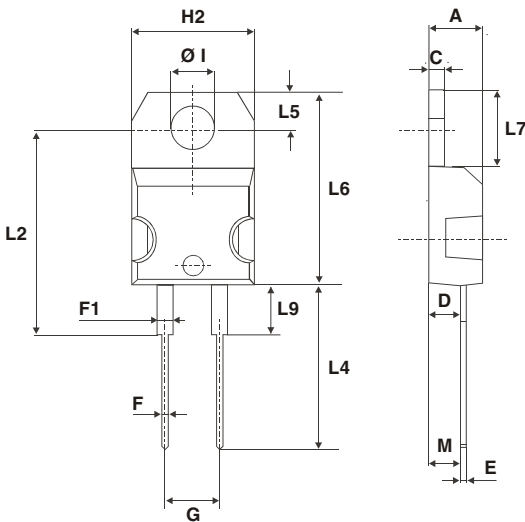


Table 7. TO-220FPAC Dimensions

| 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 |

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 |
|-------------|-----------|------------|--------|----------|---------------|
| STTH506B    | STTH506B  | DPAK       | 0.3 g  | 75       | Tube          |
| STTH506B-TR | STTH506B  | DPAK       | 0.3 g  | 2500     | Tape and reel |
| STTH506D    | STTH506D  | TO-220AC   | 1.86   | 50       | Tube          |
| STTH506FP   | STTH506FP | TO-220FPAC | 1.8 g  | 50       | Tube          |

### 4 Revision history

| Date        | Revision | Description of Changes |
|-------------|----------|------------------------|
| 18-May-2006 | 1        | First issue.           |

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