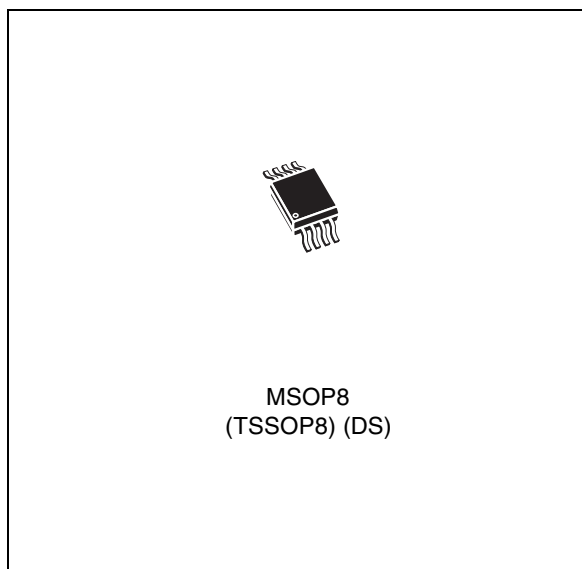


### Features

- Quad voltage monitoring
- Accurate  $\pm 1.8\%$  across temperature voltage threshold ( $\pm 1\%$  at 25 °C)
- Primary supply ( $V_{CC}$ ) monitor. Fixed (factory-programmed) reset thresholds: 3.078 to 2.188 V
- Second fixed ( $V_{2IN}$ ) monitor. Fixed (factory-programmed) reset thresholds: 2.333 to 1.110 V
- Two additional adjustable supply monitor inputs (externally adjustable)
- 0.6 V internal reference
- $\overline{RST}$  output (open drain)
- Output guaranteed for  $V_{CC} \geq 0.8$  V
- Reset delay time ( $t_{REC}$ ) pin selectable
- Manual reset input ( $\overline{MR}$ )
- Low supply current of 12  $\mu A$  (typ)
- Power supply voltage 0.8 to 5.5 V
- RoHS compliant (green package)
- 8-pin MSOP/TSSOP
- Operating temperature:  $-40$  to 85 °C (industrial grade)



### Applications

- Set-top boxes
- Multi-voltage systems
- Cable/satellite applications
- Computer systems
- Data storage equipment

**Table 1. Device summary<sup>(1)</sup>**

| Order code     | $V_{RST1}$ (V) | $V_{RST2}$ (V) | $t_{REC}$ (ms) | Package       |
|----------------|----------------|----------------|----------------|---------------|
| STM6904TZEDS6F | 3.078          | 2.333          | 210            | MSOP8(TSSOP8) |
| STM6904TWEDS6F | 3.078          | 1.683          | 210            | MSOP8(TSSOP8) |
| STM6904TGEDS6F | 3.078          | 1.110          | 210            | MSOP8(TSSOP8) |
| STM6904SYEDS6F | 2.955          | 2.188          | 210            | MSOP8(TSSOP8) |
| STM6904SFEDS6F | 2.955          | 1.050          | 210            | MSOP8(TSSOP8) |
| STM6904PWEDS6F | 2.866          | 1.683          | 210            | MSOP8(TSSOP8) |

1. Other reset threshold voltages and  $t_{REC}$  timeout periods are offered. Minimum order quantities may apply. Contact local ST sales office for availability.

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# 1 Description

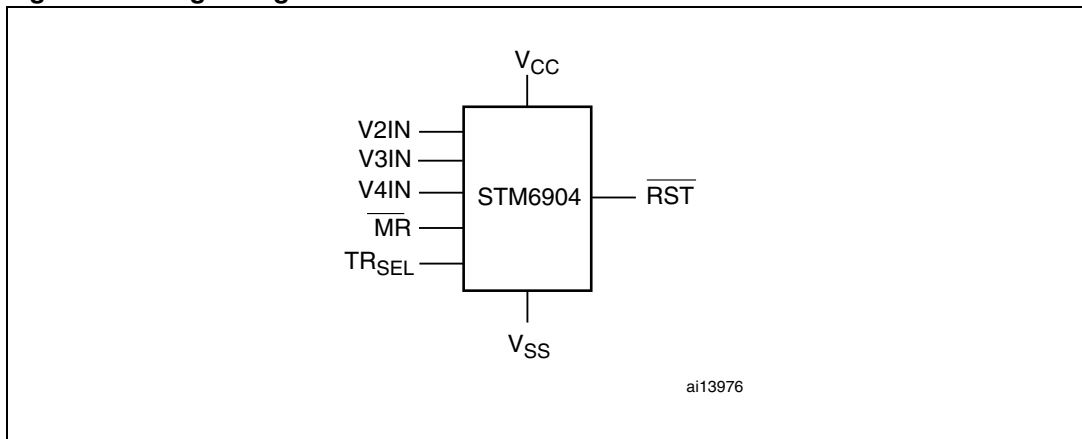
The STM6904 supervisor is a low voltage/low supply current processor supervisor, designed to monitor up to four system power supply voltages. This device is targeted at applications such as “Set-Top Boxes” (STBs), portable, battery-powered systems, networking and communication systems.

The device supports a push-button type manual reset input ( $\overline{MR}$ ). Two of the four supply monitors ( $V_{CC}$  and  $V2IN$ ) have fixed (customer-selectable, factory-trimmed) thresholds ( $V_{RST1}$  and  $V_{RST2}$ ). The other two voltage monitor inputs ( $V3IN$  and  $V4IN$ ) are monitored using externally adjustable threshold (0.600 V internal reference) to meet specific level requirements.

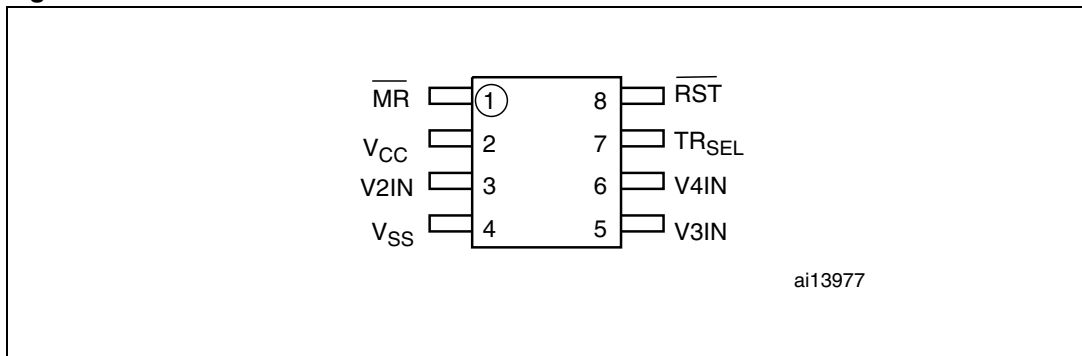
If any of the four monitored voltages drops below its factory-trimmed or adjustable thresholds, or if the  $\overline{MR}$  is asserted to logic low, the reset output  $\overline{RST}$  is asserted (driven low). Once asserted,  $\overline{RST}$  is maintained low for a minimum delay period ( $t_{REC}$ ) after ALL monitored supplies rise above their respective thresholds and  $\overline{MR}$  returns to high. This device is in the correct reset output logic state when  $V_{CC}$  greater than 0.8 V.

The STM6904 is available in a standard 8-lead MSOP (TSSOP) package.

**Figure 1. Logic diagram**



**Figure 2. MSOP/TSSOP-8 connections**



**Table 2. Signal names and functions**

| Pin | Name                    | Type   | Function   |
|-----|-------------------------|--------|--|
| 1   | $\overline{\text{MR}}$  | Input  | Active-low manual reset input with internal pull-up resistor   |
| 2   | $V_{\text{CC}}$         | Supply | Primary supply voltage input and integrated fixed threshold under-voltage monitor  |
| 3   | V2IN                    | Input  | Second fixed threshold input monitor   |
| 4   | $V_{\text{SS}}$         | Supply | Ground   |
| 5   | V3IN                    | Input  | Adjustable third reset comparator input  |
| 6   | V4IN                    | Input  | Adjustable fourth reset comparator input   |
| 7   | TRSEL                   | Input  | Controls selectable $t_{\text{REC}}$ . Two $t_{\text{REC}}$ options available.<br>If pin is tied high ( $V_{\text{CC}}$ ), $t_{\text{REC}} = 420$ ms<br>If pin is tied low ( $V_{\text{SS}}$ ), $t_{\text{REC}} = 210$ ms<br>Note: Pin must be tied to $V_{\text{CC}}$ or $V_{\text{SS}}$ (do not float) |
| 8   | $\overline{\text{RST}}$ | Output | Active-low open drain reset output (10 k $\Omega$ internal pull-up)  |

## 2 Pin descriptions

### 2.1 Push-button reset input ( $\overline{MR}$ )

When  $\overline{MR}$  goes low the  $\overline{RST}$  output is driven low,  $\overline{RST}$  remains low as long as  $\overline{MR}$  is low and for  $t_{REC}$  after  $\overline{MR}$  returns to high. The active-low input has an internal 10 k $\Omega$  pull-up resistor to  $V_{CC}$ . It can be driven from a TTL or CMOS logic line, or with open drain/collector outputs, or connected to  $V_{SS}$  through a switch. If unused, leave this pin open or connect it to  $V_{CC}$ .

Connect a normally open momentary switch from  $\overline{MR}$  to  $V_{SS}$ ; external debounce circuitry is not required. (If  $\overline{MR}$  is driven from long cables or if the device is used in noisy environments, connecting a 0.1  $\mu$ F capacitor from  $\overline{MR}$  to  $V_{SS}$  provides additional noise immunity).

### 2.2 $V_{CC}$ primary supply voltage monitoring input

The  $V_{CC}$  pin is also the input for the primary reset threshold monitor. Fixed (customer-selectable, factory programmed) reset thresholds include 3.078 to 2.866 V.

### 2.3 $V2IN$ second fixed voltage monitoring input

The  $V2IN$  input is the second fixed-voltage input for reset threshold monitoring. Available fixed (customer-selectable, factory programmed) reset thresholds include 2.333 to 1.050 V.

### 2.4 $V_{SS}$

This pin is the ground pin for the power supply.

### 2.5 $V3IN$ and $V4IN$

The  $V3IN$  and  $V4IN$  are high impedance inputs.  $\overline{RST}$  is driven low when the voltage ( $V_{TRIP}$ ) at the pin falls below 600 mV (internal reference voltage at their respective comparators). The monitored voltage reset threshold is set with an external resistor divider network.

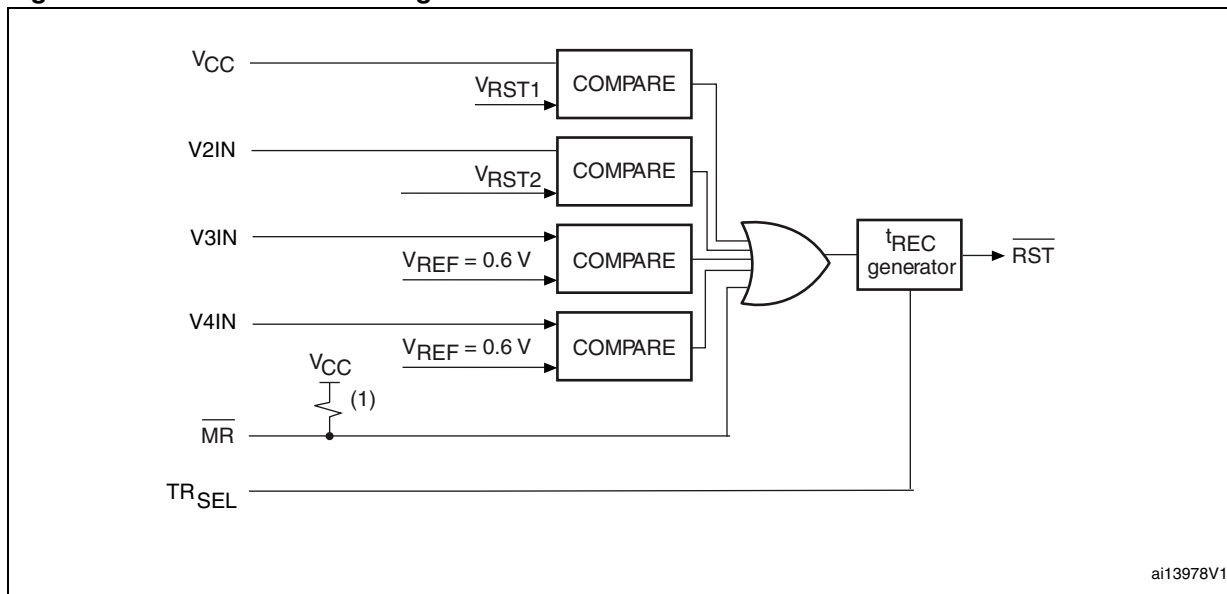
### 2.6 $\overline{RST}$ active-low, open drain reset output

The reset output ( $\overline{RST}$ ) pin is driven low and stays low whenever  $V_{CC}$  or  $V2IN$ , or  $V3IN$ , or  $V4IN$  falls below its factory-trimmed or adjustable reset threshold or when  $\overline{MR}$  goes to logic low. It remains low for  $t_{REC}$  after all supply voltages being monitored rise above their reset thresholds and  $\overline{MR}$  goes from low to high. Connect an external pull-up resistor to  $V_{CC}$ . A 10 k $\Omega$  pull-up resistor should be sufficient for most applications.

### 2.7 $TR_{SEL}$ input

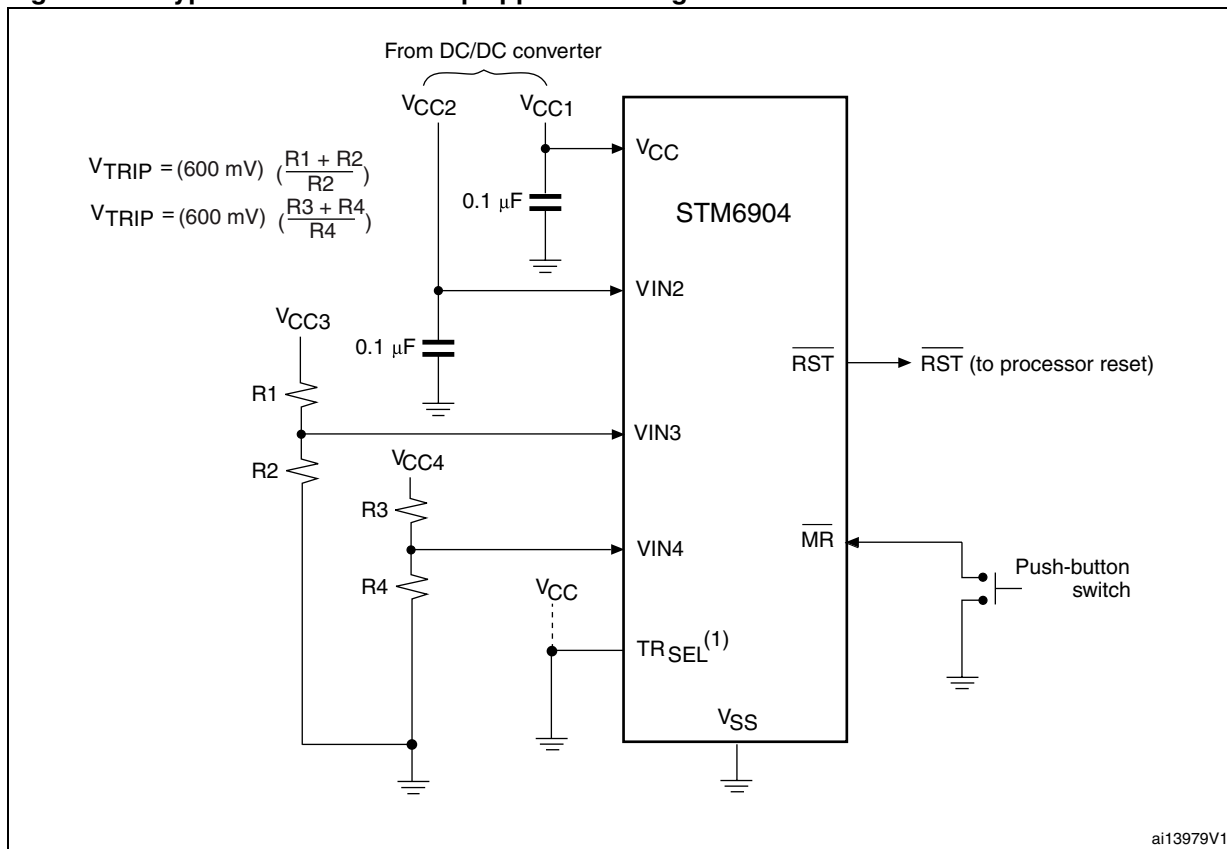
Allows user to select between two values of  $t_{REC}$  timing (210 or 420 ms). Pin must be tied to  $V_{SS}$  (210 ms) or  $V_{CC}$  (420 ms).

Figure 3. Functional block diagram



1. Internal pull-up on MR input of 10 kΩ (typ.).

Figure 4. Typical hardware hookup application diagram



1. TRSEL must be tied to VCC (tREC = 420 ms) or to VSS (tREC = 210 ms).



## 3 Operation

The STM6904 provides the ability to monitor critical voltages such as power-supply and battery voltage levels, while interfacing easily to the system controllers/microprocessors.

*Figure 4* shows typical hardware hookup for monitoring four voltages; two fixed thresholds (customer-selectable, factory-programmed) and two adjustable monitor inputs.  $\overline{\text{RST}}$  output is open drain and requires a 10 k $\Omega$  pull-up resistor tied to  $V_{\text{CC}}$ .

### 3.1 Setting the adjustable voltage levels for V3IN and V4IN inputs

The user can customize the minimum voltage levels for the two adjustable voltage inputs by connecting an external resistor divider network to the V3IN and V4IN pins in order to set the trip point at some voltage above the 600 mV ( $V_{\text{REF}}$ ) according to the following formula:

$$V_{\text{TRIP}} = 0.6\text{V} \times \frac{R1 + R2}{R2}$$

During normal operation, the STM6904 monitors the voltage levels at all four pins ( $V_{\text{CC}}$ , V2IN, V3IN, and V4IN).

### 3.2 Power on reset ( $t_{\text{REC}}$ )

On power up, the STM6904 activates a power on reset circuit which asserts the reset pin (i.e.  $\overline{\text{RST}}$  goes low). The  $\overline{\text{RST}}$  signal remains active until  $V_{\text{CC}}$  (and V2IN, V3IN, V4IN and  $\overline{\text{MR}}$ ) rises above the minimum voltage level for the time period  $t_{\text{REC}}$  thereby ensuring that the supply voltage has stabilized to sufficient operating levels.

## 4 Voltage monitoring

Figure 5.  $\overline{\text{MR}}$  timing waveforms

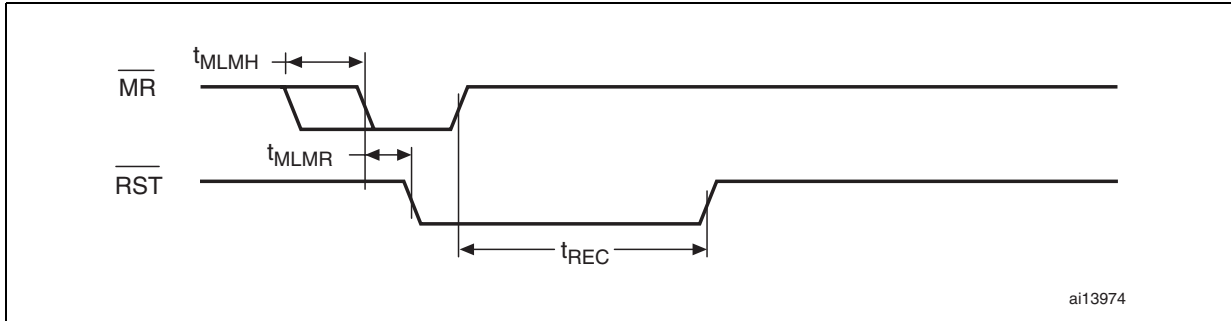
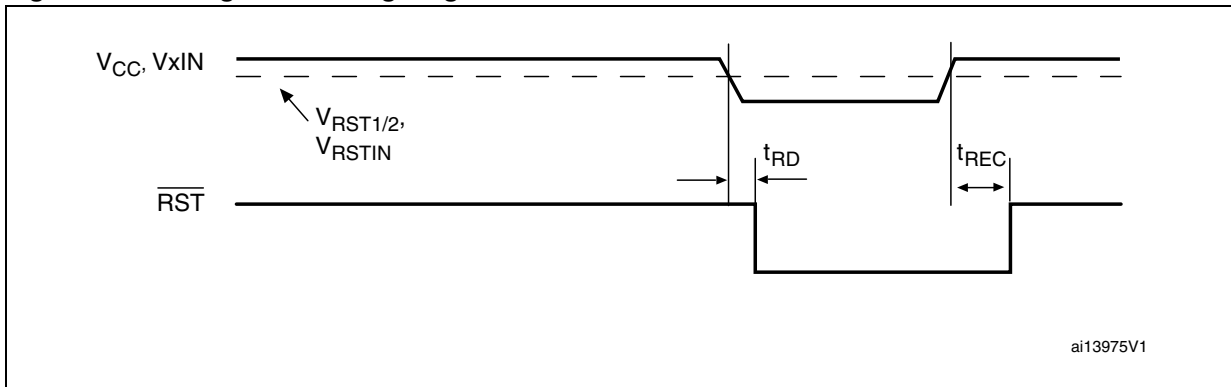


Figure 6. Voltage monitoring diagram



## 5 Maximum rating

Stressing the device above the rating listed in [Table 3: Absolute maximum ratings](#) may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in [Section 6: DC and AC parameters](#) of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics™ SURE Program and other relevant quality documents.

**Table 3. Absolute maximum ratings**

| Symbol          | Parameter                                | Value                  | Unit |
|-----------------|--|------------------------|------|
| $T_{STG}$       | Storage temperature ( $V_{CC}$ off)      | -55 to +150            | °C   |
| $T_{SLD}^{(1)}$ | Lead solder temperature for 10 seconds   | 260                    | °C   |
| $V_{IO}$        | Input or output voltage                  | -0.3 to $V_{CC} + 0.3$ | V    |
| $V_{CC}$        | Supply voltage                           | -0.3 to 7.0            | V    |
| $I_O$           | Output current                           | 20                     | mA   |
| $\theta_{JA}$   | Thermal resistance (junction to ambient) | 146                    | °C/W |

1. Reflow at peak temperature of 255 to 260 °C for < 30 seconds (total thermal budget not to exceed 180 °C for between 90 to 150 seconds).

## 6 DC and AC parameters

This section summarizes the operating measurement conditions and the DC and AC characteristics of the device. Designers should check that the operating conditions in their circuit match the operating conditions when relying on the quoted parameters.

**Table 4. DC and AC characteristics**

| Sym-<br>bol                      | Alter-<br>native | Description   | Test condition <sup>(1)</sup>  | Min.         | Typ.  | Max.  | Unit  |   |
|----------------------------------|------------------|---|--|--------------|-------|-------|-------|---|
| V <sub>CC</sub>                  |                  | Operating voltage   |  | 0.8          |       | 5.5   | V     |   |
| I <sub>CC</sub>                  |                  | V <sub>CC</sub> supply current                                | V <sub>CC</sub> < 5.5 V  |              | 10    | 14    | μA    |   |
|                                  |                  |   | V <sub>CC</sub> = 3.3 V  |              | 9     | 13    |       |   |
| I <sub>2IN</sub>                 |                  | V <sub>2IN</sub> supply current                               | V <sub>2IN</sub> = 3.3 V   |              | 3     | 5     | μA    |   |
| I <sub>LI</sub>                  |                  | Input leakage current -<br>(MR) <sup>(2)</sup>                | V <sub>IN</sub> = V <sub>SS</sub>  |              | 500   | 800   | μA    |   |
|                                  |                  | Input leakage current -<br>(TR <sub>SEL</sub> )               | V <sub>IN</sub> = V <sub>SS</sub> or V <sub>CC</sub>                         | -0.5         |       | +0.5  | μA    |   |
| I <sub>LO</sub> <sup>(3)</sup>   |                  | Open drain $\overline{\text{RST}}$ output<br>leakage current  | V <sub>CC</sub> > V <sub>RST</sub> ;<br>$\overline{\text{RST}}$ not asserted | -0.5         |       | +0.5  | μA    |   |
| V <sub>OL</sub>                  |                  | Output low voltage<br>( $\overline{\text{RST}}$ ; open drain) | V <sub>CC</sub> ≥ 0.8 V, I <sub>SINK</sub> = 1 μA                            |              |       | 0.3   | V     |   |
|                                  |                  |   | V <sub>CC</sub> ≥ 1.0 V, I <sub>SINK</sub> = 50 μA                           |              |       | 0.3   | V     |   |
|                                  |                  |   | V <sub>CC</sub> ≥ 1.2 V, I <sub>SINK</sub> = 100 μA                          |              |       | 0.3   | V     |   |
|                                  |                  |   | V <sub>CC</sub> ≥ 2.7 V, I <sub>SINK</sub> = 1.2 mA                          |              |       | 0.3   | V     |   |
|                                  |                  |   | V <sub>CC</sub> ≥ 4.5 V, I <sub>SINK</sub> = 3.2 mA                          |              |       | 0.4   | V     |   |
| V <sub>RST1</sub> <sup>(4)</sup> | V <sub>TH1</sub> | V <sub>CC</sub> reset threshold                               | T (falling)  | 25 °C        | 3.047 | 3.078 | 3.109 | V |
|                                  |                  |   |  | -40 to 85 °C | 3.023 |       | 3.133 |   |
|                                  |                  |   | S (falling)  | 25 °C        | 2.925 | 2.955 | 2.985 | V |
|                                  |                  |   |  | -40 to 85 °C | 2.902 |       | 3.008 |   |
|                                  |                  |   | P (falling)  | 25 °C        | 2.837 | 2.866 | 2.895 | V |
|                                  |                  |   |  | -40 to 85 °C | 2.814 |       | 2.918 |   |

Table 4. DC and AC characteristics (continued)

| Symbol  | Alternative      | Description  | Test condition <sup>(1)</sup>                      | Min.         | Typ.   | Max.   | Unit  |     |  |    |
|---|------------------|--|--|--------------|--|--|-------|-----|--|----|
| V <sub>RST2</sub> <sup>(4)</sup>                                  | V <sub>TH2</sub> | V2IN reset threshold   | Z (falling)  | 25 °C        | 2.310  | 2.333  | 2.356 | V   |  |    |
|   |                  |  |  | -40 to 85 °C | 2.291  |  | 2.375 |     |  |    |
|   |                  |  | Y (falling)  | 25 °C        | 2.166  | 2.188  | 2.210 | V   |  |    |
|   |                  |  |  | -40 to 85 °C | 2.149  |  | 2.227 |     |  |    |
|   |                  |  | W (falling)  | 25 °C        | 1.666  | 1.683  | 1.700 | V   |  |    |
|   |                  |  |  | -40 to 85 °C | 1.653  |  | 1.713 |     |  |    |
|   |                  |  | G (falling)  | 25 °C        | 1.099  | 1.110  | 1.121 | V   |  |    |
|   |                  |  |  | -40 to 85 °C | 1.090  |  | 1.130 |     |  |    |
|   |                  |  | F (falling)  | 25 °C        | 1.040  | 1.050  | 1.061 | V   |  |    |
|   |                  |  |  | -40 to 85 °C | 1.031  |  | 1.069 |     |  |    |
|   |                  |  | V <sub>HYST</sub>                                  |              | Reset threshold hysteresis                       | Referenced to V <sub>RST1</sub> /V <sub>RST2</sub> typical                     |       | 0.5 |  | %  |
|   |                  |  | t <sub>RD</sub>                                    |              | V <sub>CC</sub> to $\overline{\text{RST}}$ delay | V <sub>CC</sub> = (V <sub>RST1</sub> + 100 mV) to (V <sub>RST1</sub> - 100 mV) |       | 20  |  | µs |
| V2IN = (V <sub>RST2</sub> + 75 mV) to (V <sub>RST2</sub> - 75 mV) |                  | 20   |  |              |  |  | µs    |     |  |    |
| t <sub>REC</sub> <sup>(5)</sup>                                   | t <sub>RP</sub>  | $\overline{\text{RST}}$ timeout period                         | TR <sub>SEL</sub> = LOW (V <sub>SS</sub> )         | 140          | 210  | 280  | ms    |     |  |    |
|   |                  |  | TR <sub>SEL</sub> = HIGH (V <sub>CC</sub> )        | 280          | 420  | 560  | ms    |     |  |    |
| <b>Adjustable reset comparator input (V3IN and V4IN)</b>          |                  |  |  |              |  |  |       |     |  |    |
| V <sub>RSTIN</sub>  |                  | V3IN, V4IN input threshold                                     |  | 589          | 600  | 611  | mV    |     |  |    |
| I3IN, I4IN  |                  | V3IN, V4IN input current                                       | V3IN, V4IN > 0.8 V                                 | -25          |  | +25  | nA    |     |  |    |
|   |                  | V3IN, V4IN hysteresis  |  |              | 3  |  | mV    |     |  |    |
| t <sub>RSTIND</sub>   |                  | V3IN, V4IN to $\overline{\text{RST}}$ output delay             | V <sub>RSTIN</sub> to (V <sub>RSTIN</sub> - 30 mV) |              | 22   |  | µs    |     |  |    |
| <b>Manual (push-button) reset input</b>                           |                  |  |  |              |  |  |       |     |  |    |
| V <sub>IL</sub>   |                  | $\overline{\text{MR}}$ input voltage                           |  |              |  | 0.3 x V <sub>CC</sub>  | V     |     |  |    |
| V <sub>IH</sub>   |                  |  |  |              | 0.7 x V <sub>CC</sub>                            |  |       | V   |  |    |
| t <sub>MLMH</sub>   | t <sub>MR</sub>  | $\overline{\text{MR}}$ minimum pulse width                     |  | 1            |  |  | µs    |     |  |    |
| t <sub>MLRL</sub>   | t <sub>MRD</sub> | $\overline{\text{MR}}$ to $\overline{\text{RST}}$ output delay |  |              | 200  |  | ns    |     |  |    |

Table 4. DC and AC characteristics (continued)

| Symbol | Alternative | Description                               | Test condition <sup>(1)</sup> | Min. | Typ. | Max. | Unit       |
|--------|-------------|---|-------------------------------|------|------|------|------------|
|        |             | $\overline{\text{MR}}$ glitch immunity    |                               |      | 100  |      | ns         |
|        |             | $\overline{\text{MR}}$ pull-up resistance |                               |      | 10   |      | k $\Omega$ |

- Valid for ambient operating temperature:  $T_A = -40$  to  $+85$  °C;  $V_{CC} = 0.8$  to  $5.5$  V (except where noted).
- 10 k $\Omega$  (typ) internal pull-up resistor.
- The leakage current measured on the  $\overline{\text{RST}}$  pin is tested with the reset de-asserted (output high impedance).
- Other reset threshold voltages are offered. Minimum order quantities may apply. Contact local sales office for availability.
- Other  $t_{\text{REC}}$  timeout periods are offered. Minimum order quantities may apply. Contact local sales office for availability.

## 7 Package mechanical data

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

**Figure 7. TSSOP8, 3 x 3mm, package mechanical outline**

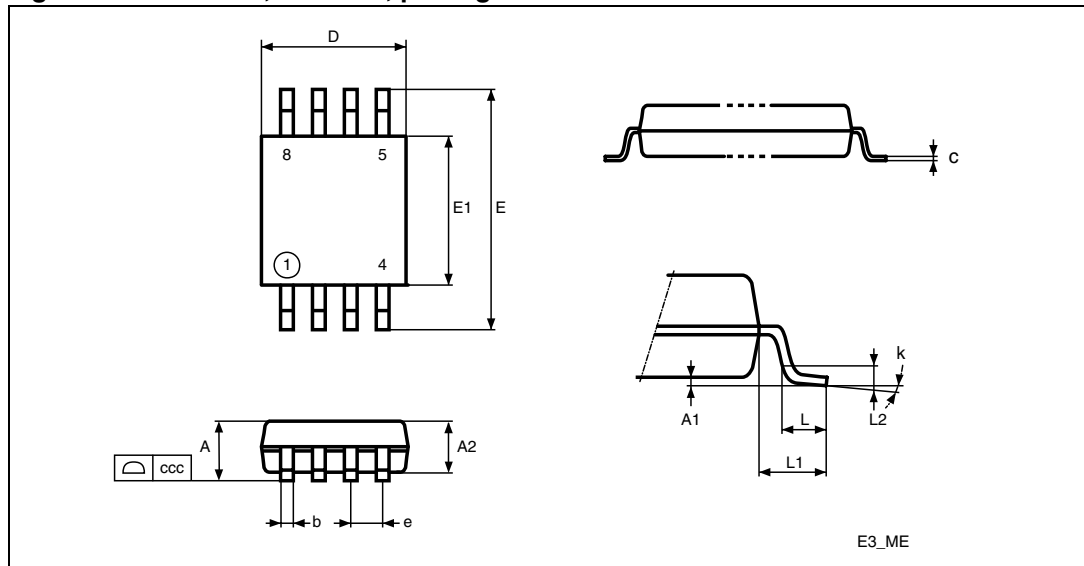


Table 5. TSSOP 8-lead package mechanical data

| Symbol | mm   |      |      | inches |       |       |
|--------|------|------|------|--------|-------|-------|
|        | Min. | Typ. | Max. | Min.   | Typ.  | Max.  |
| A      |      |      | 1.10 |        |       | 0.043 |
| A1     | 0.00 |      | 0.15 | 0.000  |       | 0.006 |
| A2     | 0.75 | 0.85 | 0.95 | 0.030  | 0.034 | 0.037 |
| b      | 0.22 |      | 0.40 | 0.009  |       | 0.016 |
| c      | 0.08 |      | 0.23 | 0.003  |       | 0.009 |
| ccc    |      |      | 0.10 |        |       | 0.004 |
| D      | 2.80 | 3.00 | 3.20 | 0.110  | 0.118 | 0.126 |
| e      |      | 0.65 |      |        | 0.026 |       |
| E      | 4.65 | 4.90 | 5.15 | 0.183  | 0.193 | 0.203 |
| E1     | 2.80 | 3.00 | 3.10 | 0.110  | 0.118 | 0.122 |
| L      | 0.40 | 0.60 | 0.80 | 0.016  | 0.024 | 0.032 |
| L1     |      | 0.95 |      |        | 0.037 |       |
| L2     |      | 0.25 |      |        | 0.010 |       |
| k      | 0°   | 4    | 6°   | 0°     | 4     | 6°    |
| N      | 8    |      |      | 8      |       |       |



# 8 Part numbering

**Table 6. Ordering information scheme**

|   |                         |                         |   |    |   |   |
|---|-------------------------|-------------------------|---|----|---|---|
| Example:                                      | STM6904                 | TZ                      | E | DS | 6 | F |
| <b>Device type</b>                            |                         |                         |   |    |   |   |
| STM6904                                       |                         |                         |   |    |   |   |
| <b>Reset threshold voltages<sup>(1)</sup></b> |                         |                         |   |    |   |   |
| <b>Suffix</b>                                 | <b>V<sub>RST1</sub></b> | <b>V<sub>RST2</sub></b> |   |    |   |   |
| TZ  | 3.078                   | 2.333                   |   |    |   |   |
| TW  | 3.078                   | 1.683                   |   |    |   |   |
| TG  | 3.078                   | 1.110                   |   |    |   |   |
| SY  | 2.955                   | 2.188                   |   |    |   |   |
| SF  | 2.955                   | 1.050                   |   |    |   |   |
| PW  | 2.866                   | 1.683                   |   |    |   |   |
| <b>t<sub>REC</sub><sup>(1)</sup></b>          |                         |                         |   |    |   |   |
| E = 210 or 420 ms                             |                         |                         |   |    |   |   |
| <b>Package</b>                                |                         |                         |   |    |   |   |
| DS = MSOP8 (TSSOP8)                           |                         |                         |   |    |   |   |
| <b>Temperature range</b>                      |                         |                         |   |    |   |   |
| 6: -40 to 85 °C                               |                         |                         |   |    |   |   |
| <b>Shipping method</b>                        |                         |                         |   |    |   |   |
| E = ECOPACK® package, tubes                   |                         |                         |   |    |   |   |
| F = ECOPACK® package, tape and reel           |                         |                         |   |    |   |   |

1. Other reset threshold voltages and t<sub>REC</sub> timeout periods are offered. Minimum order quantities may apply. Contact local sales office for availability.

## 9 Package marking information

**Table 7. Marking description**

| Part marking   | $V_{RST1}$ (V) | $V_{RST2}$ (V) | Package       | Topside marking |
|----------------|----------------|----------------|---------------|-----------------|
| STM6904TZEDS6F | 3.078          | 2.333          | MSOP (TSSOP8) | STZ4            |
| STM6904TWEDS6F | 3.078          | 1.683          | MSOP (TSSOP8) | STW4            |
| STM6904TGEDS6F | 3.078          | 1.110          | MSOP (TSSOP8) | STG4            |
| STM6904SFEDS6F | 2.955          | 1.050          | MSOP (TSSOP8) | SSF4            |
| STM6904SYEDS6F | 2.955          | 2.188          | MSOP (TSSOP8) | SSY4            |
| STM6904PWEDS6F | 2.866          | 1.683          | MSOP (TSSOP8) | SPW4            |

## 10 Revision history

**Table 8. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 19-Dec-2007 | 1        | Initial release.   |
| 28-Jan-2008 | 2        | Updated cover page, <a href="#">Figure 6</a> and <a href="#">Table 4</a> .   |
| 16-Dec-2011 | 3        | Removed label "Preliminary Data", document reformatted, minor text corrections throughout document, updated <a href="#">Section 6</a> , ECOPACK <sup>®</sup> and Disclaimer. |

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