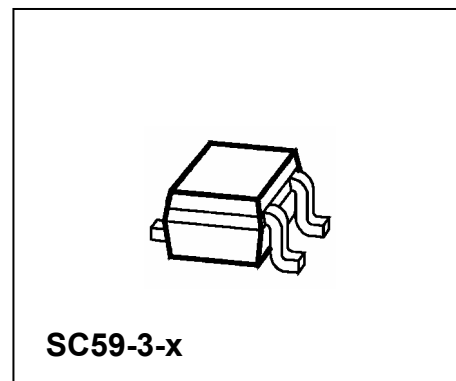


## Low Power Hall Switch

**TLE 4913**

### Features

- Micro power design
- 2.4 V to 5.5 V battery operation
- High sensitivity and high stability of the magnetic switching points
- High resistance to mechanical stress
- Digital output signal
- Switching for both poles of a magnet (omnipolar)



### Functional Description

The TLE4913 is an Integrated Hall-Effect Sensor designed specifically to meet the requirements of low-power devices. e.g. as an On/Off switch in Cellular Flip-Phones, with battery operating voltages of 2.4V – 5.5V.

Precise magnetic switching points and high temperature stability are achieved through the unique design of the internal circuit.

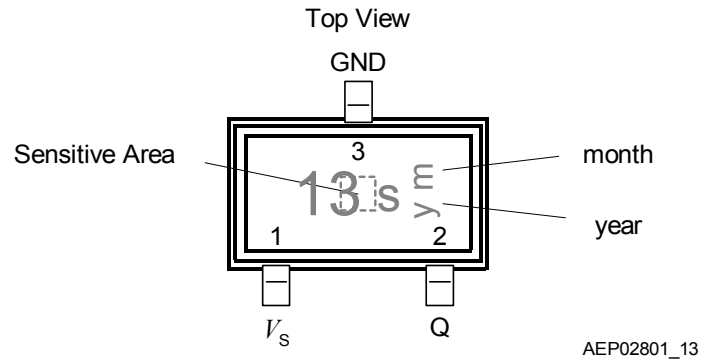
An onboard clock scheme is used to reduce the average operating current of the IC.

During the operate phase the IC compares the actual magnetic field detected with the internally compensated switching points. The output Q is switched at the end of each operating phase.

During the Stand-by phase the output stage is latched and the current consumption of the device reduced to some  $\mu\text{A}$ .

The IC switching behaviour is Omnipolar, i.e. it can be switched on with either the North or South pole of a magnet.

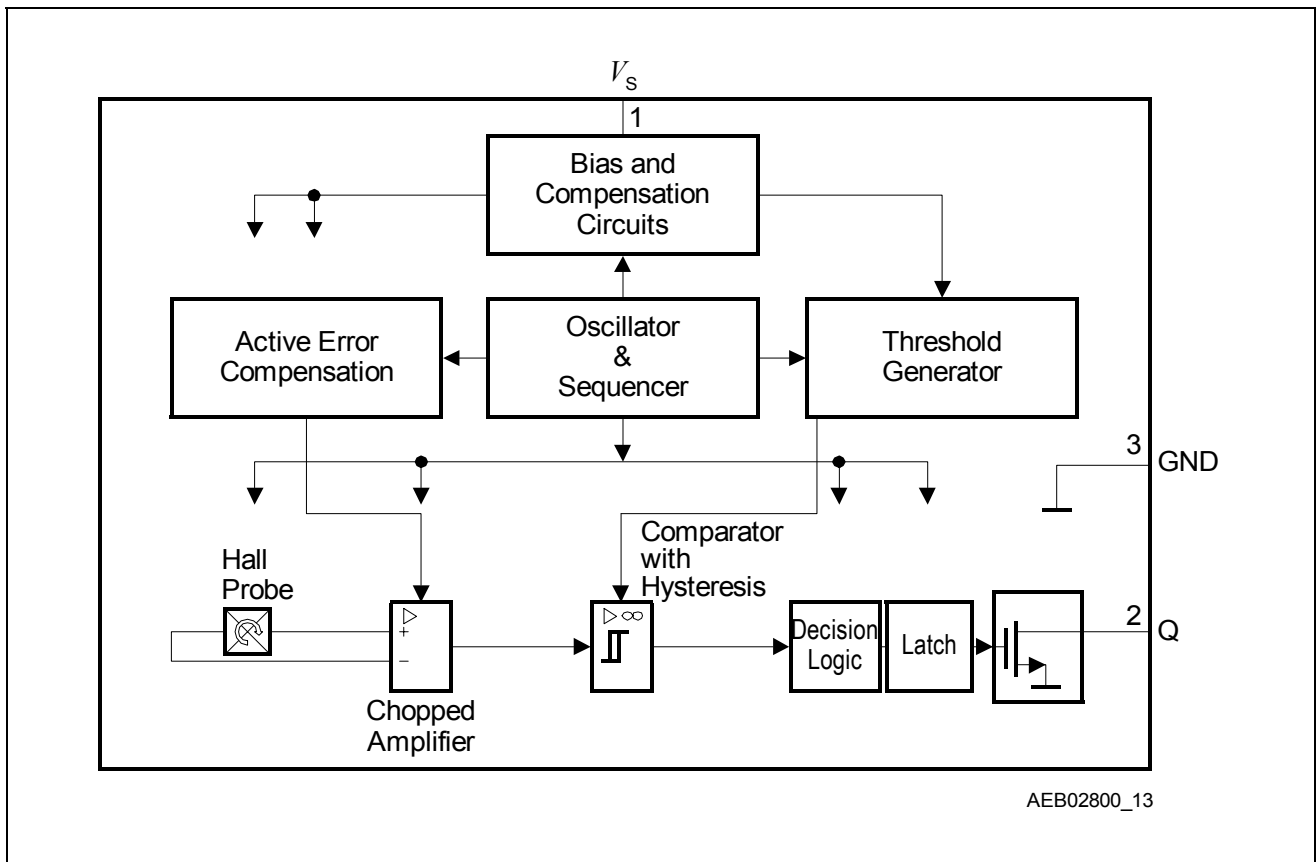
| Type     | Marking    | Ordering Code | Package   |
|----------|------------|---------------|-----------|
| TLE 4913 | 13s<br>013 | Q62705K 619   | SC 59-3-x |



**Figure 1 Pin Configuration (top view)**

### Pin Definitions and Functions

| Pin | Symbol | Function         |
|-----|--------|------------------|
| 1   | $V_S$  | Supply Voltage   |
| 2   | $Q$    | Open Drain Input |
| 3   | $Gnd$  | Ground           |



**Figure 2 Block Diagram**

## Circuit Description

The Low Power Hall IC Switch comprises a Hall probe, bias generator, compensation circuits, oscillator, output latch and an n-channel open drain output transistor.

The bias generator provides currents for the Hall probe and the active circuits. Compensation circuits stabilize the temperature behavior and reduce technology variations.

The Active Error Compensation rejects offsets in signal stages and the influence of mechanical stress to the Hall probe caused by molding and soldering processes and other thermal stresses in the package. This chopper technique together with the threshold generator and the comparator ensures high accurate magnetic switching points.

Very low power consumption is achieved with a timing scheme controlled by an oscillator and a sequencer. This circuitry activates the sensor for 50  $\mu\text{s}$  (typical operating time) sets the output state after sequential questioning of the switch points and latches it with the beginning of the following standby phase (max. 200 ms). In the standby phase the average current is reduced to typical 4  $\mu\text{A}$ . Because of the long standby time compared to the operating time the overall averaged current is only slightly higher than the standby current.

The output transistor can sink up to 1 mA with a maximal saturation voltage  $V_{\text{QSAT}}$ .

## Absolute Maximum Ratings

| Parameter                        | Symbol      | Limit Values |           | Unit | Notes |
|----------------------------------|-------------|--------------|-----------|------|-------|
|                                  |             | min.         | max.      |      |       |
| Supply Voltage                   | $V_S$       | – 0.3        | 5.5       | V    |       |
| Supply Current                   | $I_S$       | – 1          | 2.5       | mA   |       |
| Output Voltage                   | $V_Q$       | – 0.3        | 5.5       | V    |       |
| Output Current                   | $I_Q$       | – 1          | 2         | mA   |       |
| Junction temperature             | $T_j$       | – 40         | 150       | °C   |       |
| Storage temperature              | $T_S$       | – 40         | 150       | °C   |       |
| Magnetic Flux Density            | $B$         | –            | unlimited | mT   |       |
| Thermal Resistance<br>P-SC59-3-x | $R_{th JA}$ | –            | 35        | K/W  |       |

*Note: Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ESD Protection

Human Body Model (HBM) tests according to:  
EOS/ESD Association Standard S5.1-1993 and Mil. Std. 883D method 3015.7

| Parameter   | Symbol    | Limit Values |      | Unit | Notes                                                                                    |
|-------------|-----------|--------------|------|------|------------------------------------------------------------------------------------------|
|             |           | Min.         | Max. |      |                                                                                          |
| ESD Voltage | $V_{ESD}$ |              | ± 4  | kV   | $R = 1.5 \text{ k}\Omega$ ,<br>$C = 100 \text{ pF}$ ;<br>$T = 25 \text{ }^\circ\text{C}$ |

## Operating Range

| Parameter           | Symbol | Limit Values |      |      | Unit | Notes         |
|---------------------|--------|--------------|------|------|------|---------------|
|                     |        | Min.         | typ. | max. |      |               |
| Supply voltage      | $V_S$  | 2.4          | 2.7  | 5.5  | V    | <sup>1)</sup> |
| Output voltage      | $V_Q$  | – 0.3        | 2.7  | 5.5  | V    |               |
| Ambient Temperature | $T_A$  | – 40         | 25   | 85   | °C   |               |

<sup>1)</sup> A Ceramic Bypass Capacitor of 100 nF at  $V_S$  to GND is highly recommended.

## AC/DC Characteristics

| Parameter                                           | Symbol             | Limit Values |       |                     | Unit | Notes                                                  |
|-----------------------------------------------------|--------------------|--------------|-------|---------------------|------|--------------------------------------------------------|
|                                                     |                    | Min.         | typ.  | Max.                |      |                                                        |
| Averaged Supply Current                             | $I_{SAVG}$         | 1            | 4     | 20                  | μA   |                                                        |
| Averaged Supply Current during Operating Time       | $I_{SOPAVG}$       | 0.5          | 1.1   | 2.5                 | mA   |                                                        |
| Transient Peak Supply Current during Operating Time | $I_{SOPT}$         | –            | –     | 2.5                 | mA   | $t < 100 \text{ ns}$                                   |
| Supply Current during Standby Time                  | $I_{SSTB}$         | 1            | 3.5   | 20                  | μA   |                                                        |
| Output Saturation Voltage                           | $V_{QSAT}$         | –            | 0.13  | 0.4                 | V    | $I_Q = 1 \text{ mA}$                                   |
| Output Leakage Current                              | $I_{QLEAK}$        | –            | 0.01  | 1                   | μA   |                                                        |
| Output Rise Time                                    | $t_r$              | –            | 0.5   | 1                   | μs   | $R_L = 2.7 \text{ k}\Omega$ ;<br>$C_L = 10 \text{ pF}$ |
| Output Fall Time                                    | $t_f$              | –            | 0.1   | 1                   | μs   | $R_L = 2.7 \text{ k}\Omega$ ;<br>$C_L = 10 \text{ pF}$ |
| Operating Time                                      | $t_{op}$           | 15           | 50    | 93 <sup>1) 2)</sup> | μs   |                                                        |
| Standby Time                                        | $t_{stb}$          | –            | 130   | 240 <sup>3)</sup>   | ms   |                                                        |
| Duty Cycle                                          | $t_{op} / t_{stb}$ | –            | 0.039 | –                   | %    |                                                        |
| Start-up Time of IC                                 | $t_{stu}$          | –            | 6     | 12                  | μs   | <sup>4)</sup>                                          |

<sup>1)</sup> for  $V_S=3.5\text{V}$  the max. Operating Time  $t_{op \text{ max}} = 85\mu\text{s}$

<sup>2)</sup> includes the Start-up Time  $t_{stu}$

<sup>3)</sup> for  $V_S=3.5\text{V}$  the max. Standby Time  $t_{stb \text{ max}} = 220\text{ms}$

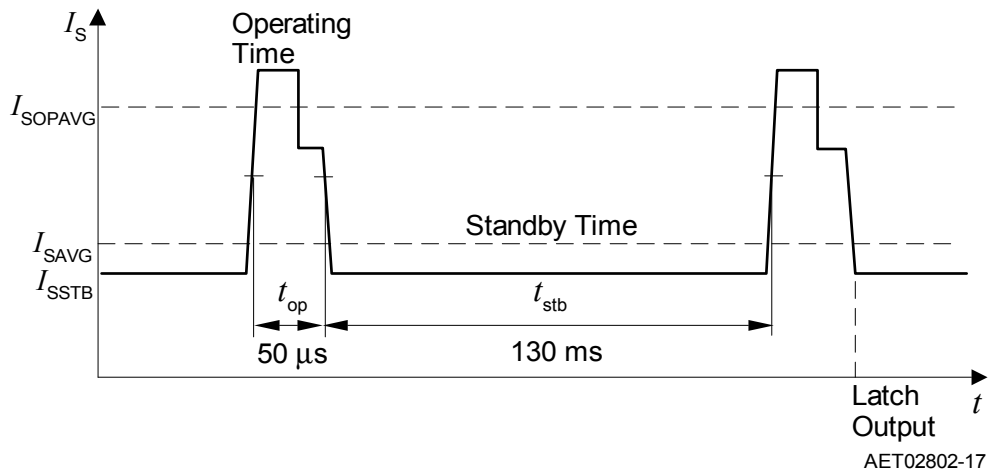
<sup>4)</sup> initial power on time.  $V_S$  must be applied in this time ( typ. 6μs to max. 12μs ) to get already a valid output state after the first operating phase (typ. 56μs). For rise times of  $V_S > 12\mu\text{s}$ , the output state is valid after the second operating phase (includes one standby phase), e.g. happens only when the battery in flip phones is changed.

## Magnetic Characteristics

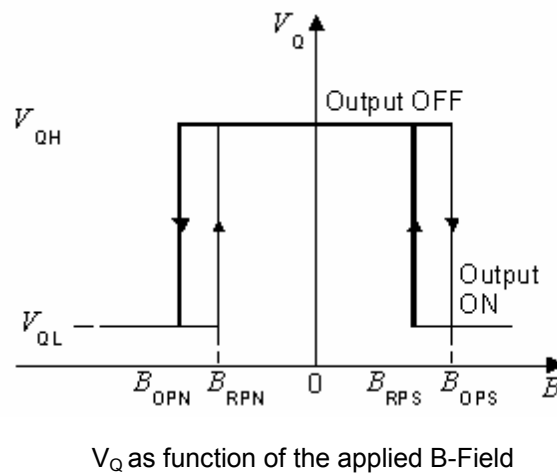
| Parameter                      | Symbol           | Limit Values |       |       | Unit | Notes         |
|--------------------------------|------------------|--------------|-------|-------|------|---------------|
|                                |                  | min.         | typ.  | max.  |      |               |
| Operate Points<br>(Output on)  | B <sub>OPS</sub> | 2            | 3.5   | 5     | mT   | <sup>1)</sup> |
|                                | B <sub>OPN</sub> | - 5          | - 3.5 | - 2   | mT   |               |
| Release Points<br>(Output off) | B <sub>RPS</sub> | 1,2          | 2.7   | 4.2   | mT   | <sup>1)</sup> |
|                                | B <sub>RPN</sub> | - 4.2        | - 2.6 | - 1,2 | mT   |               |
| Hysteresis                     | B <sub>HYS</sub> | 0.2          | 0.8   | 1,6   | mT   |               |

<sup>1)</sup> Positive magnetic fields are related to the approach of a magnetic south pole to the branded side of package

*Note: The listed AC/DC and magnetic characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not other specified, typical characteristics apply at  $T_j = 25\text{ °C}$  and  $V_S = 2.7\text{ V}$*



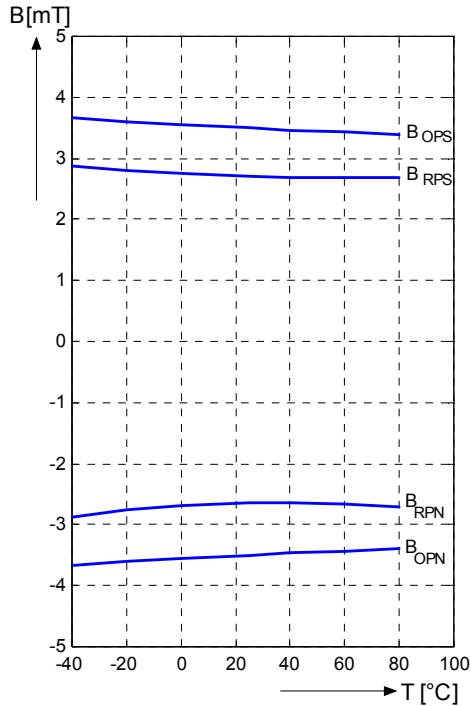
**Figure 3 Timing Diagram**



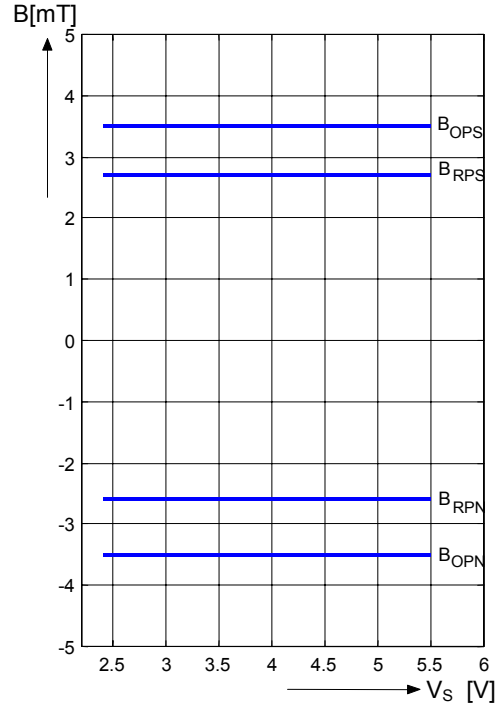
**Figure 4 Output – Signal TLE 4913**

All curves reflect typical values at the given parameters for  $T_A$  in  $^{\circ}\text{C}$  and  $V_S$  in V.

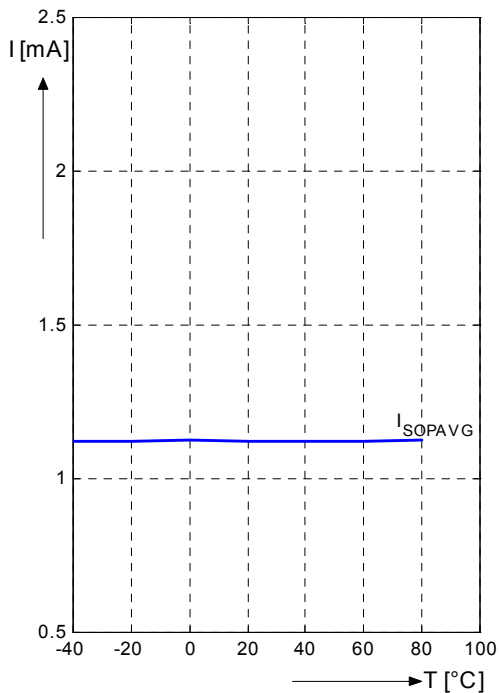
**Magnetic Switching Points versus Temperature ( $V_S=2.7\text{V}$ )**



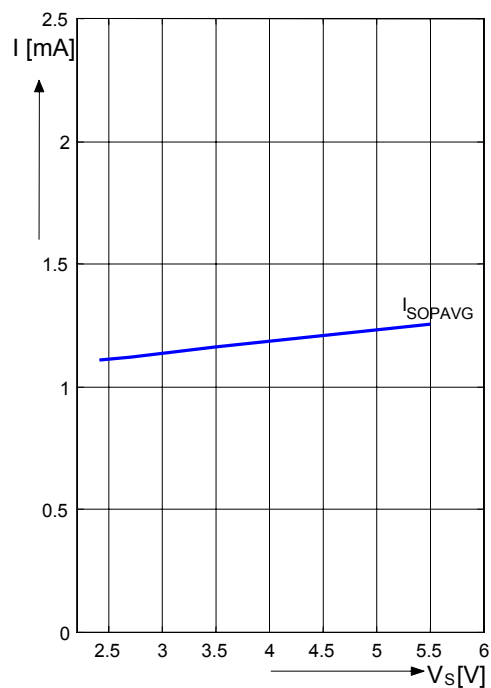
**Magnetic Switching Points versus Supply Voltage  $V_S$  ( $T_A=20^{\circ}\text{C}$ )**



**Supply current  $I_{SOPAVG}$  during Operating Time versus Temperature ( $V_S=2.7\text{V}$ )**

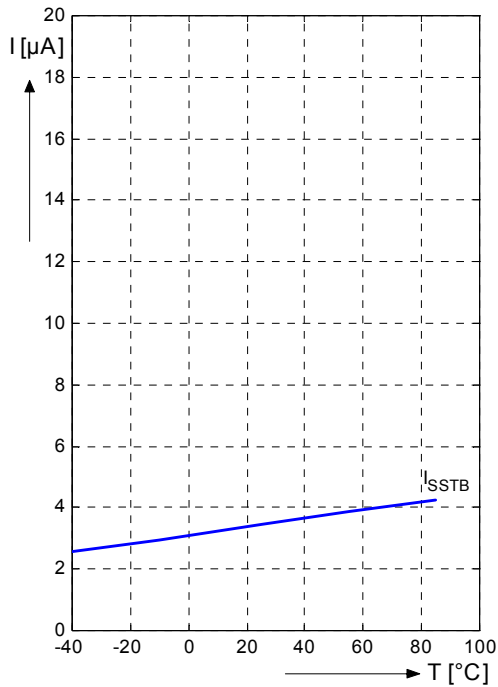


**Supply current  $I_{SOPAVG}$  during Operating Time versus Supply Voltage  $V_S$  ( $T_A=20^{\circ}\text{C}$ )**

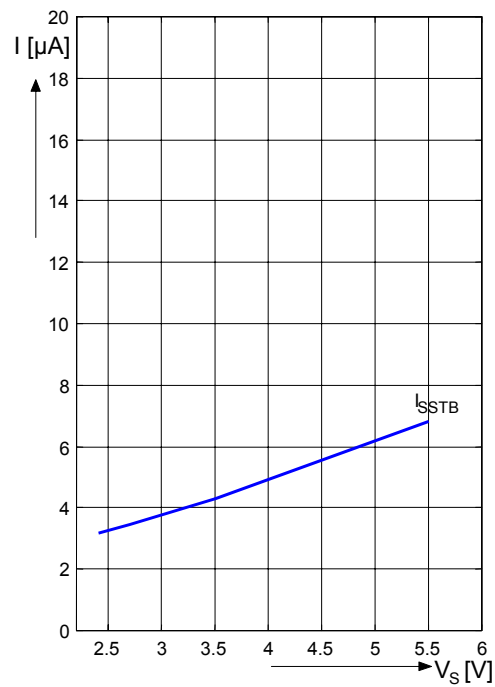




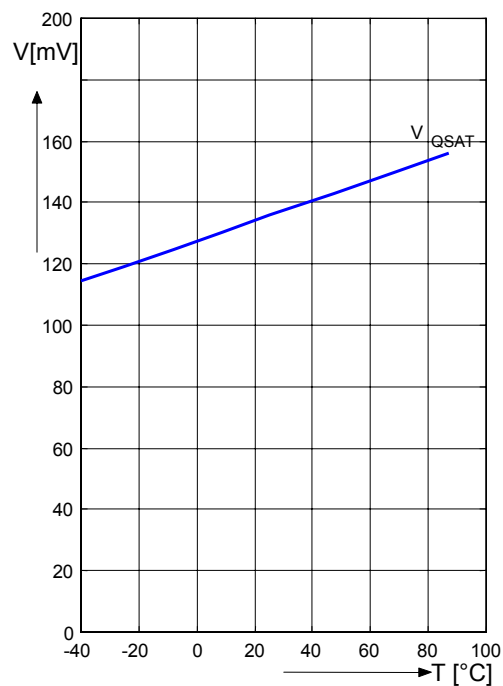
**Supply current  $I_{SSTB}$  during Standby  
Time versus Temperature ( $V_S=2.7V$ )**



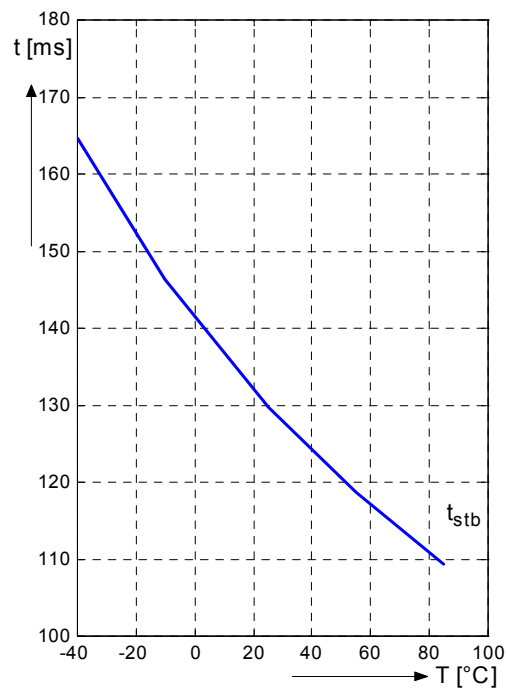
**Supply current  $I_{SSTB}$  during Standby  
Time versus Supply Voltage  $V_S$  ( $T_A=20^{\circ}C$ )**

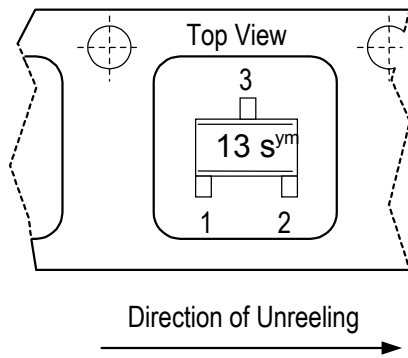


**Output Saturation voltage  $V_{QSAT}$   
versus Temperature ( $I_Q=1mA$ )**



**Standby Time  $t_{stb}$  versus Temperature  
( $V_S = 2.7V$ )**



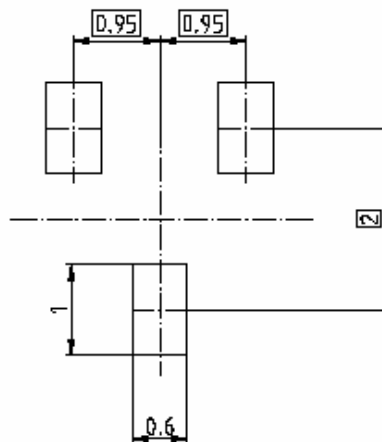


Marking on P-SC 59-3-x package corresponds to pin 1 of device

Position in Tape: pin 1 opposite of feed hole side

| <u>Package</u> | <u>Pieces / Reel</u> | <u>ØReel</u> |
|----------------|----------------------|--------------|
| P-SC59-3-x     | 3.000                | 180 mm       |

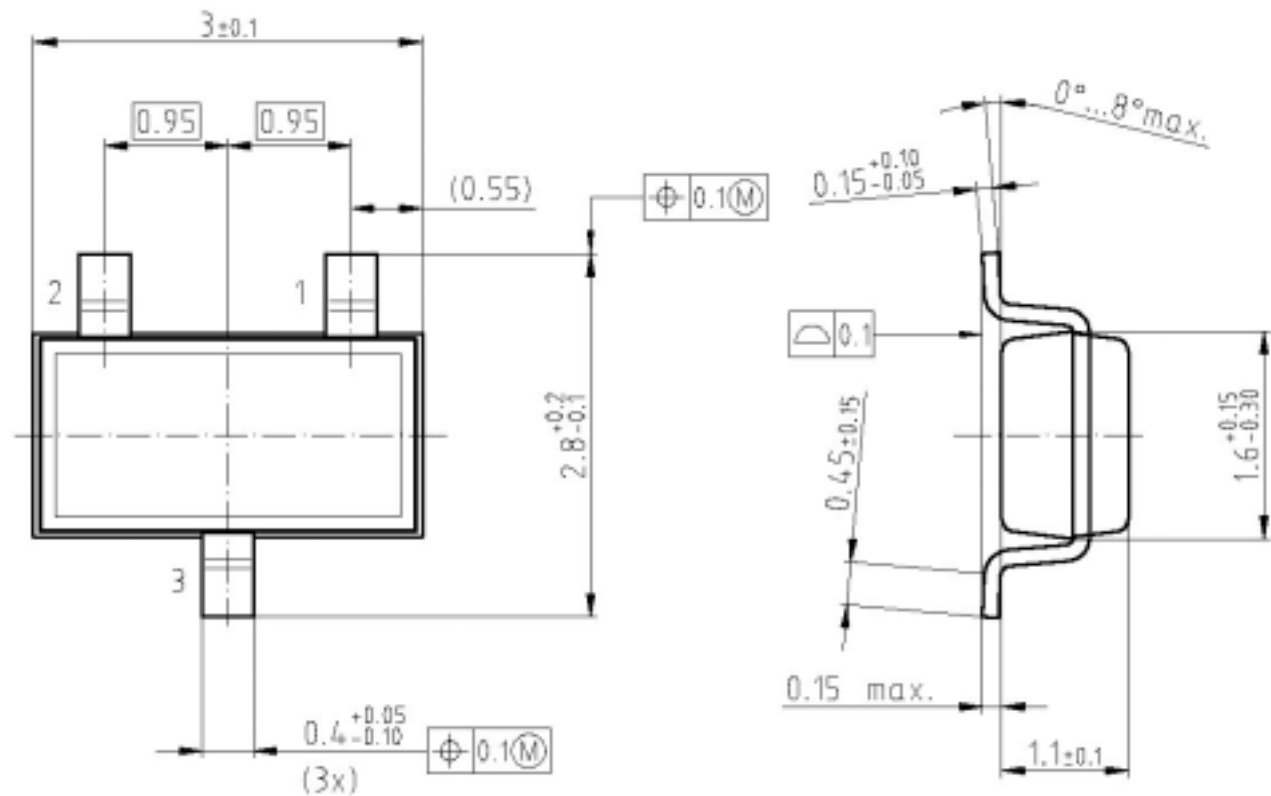
**Figure 5 Marking and Tape Loading Orientation**



**Figure 6 Foot Print Reflow Soldering**

## Package Dimensions

### P-SC 59-3-x - Package



coplanarity : 0.10mm

### Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

|                              |                                              |
|------------------------------|----------------------------------------------|
| <b>TLE4913</b>               |                                              |
| <b>Revision History:</b>     | <b>2004-03-09</b>                            |
| <b>V 2.2</b>                 |                                              |
| Previous Version: 2003-07-16 |                                              |
| Page                         | Subjects (major changes since last revision) |
| 4                            | ESD Level adapted to $\pm 4$ kV              |
|                              |                                              |
|                              |                                              |
|                              |                                              |

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Edition 2002-08-22

Published by Infineon Technologies AG

St.-Martin-Strasse 53

D-81541 München

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