

# Uni- and Bipolar Hall IC Switches for Magnetic Field Applications

TLE4905G  
TLE4935G  
TLE4935-2G  
TLE4945-2G

Sensors



Never stop thinking.

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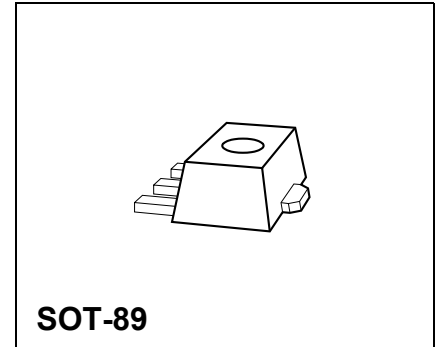
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## Uni- and Bipolar Hall IC Switches for Magnetic Field Applications

**TLE4905G; TLE4935G;  
TLE4935-2G; TLE4945-2G**

### Features

- Digital output signal
- For unipolar and alternating magnetic fields
- Large temperature range
- Temperature compensated magnetic performance
- Protection against reversed polarity
- Output protection against electrical disturbances



| Type       | Marking | Ordering Code | Package |
|------------|---------|---------------|---------|
| TLE4905G   | 05      | Q62705-K402   | SOT-89  |
| TLE4935G   | 35      | Q62705-K404   | SOT-89  |
| TLE4935-2G | 35 2    | Q62705-K405   | SOT-89  |
| TLE4945-2G | 45 2    | Q62705-K403   | SOT-89  |

TLE4905/35/35-2/45-2 (Unipolar/Bipolar Magnetic Field Switches) have been designed specifically for automotive and industrial applications. Reverse polarity protection is included on-chip as is output protection against negative voltage transients.

Typical applications are position/proximity indicators, brushless DC motor commutation, rotational indexing etc.

## Pin Configuration

(view on branded side of component)

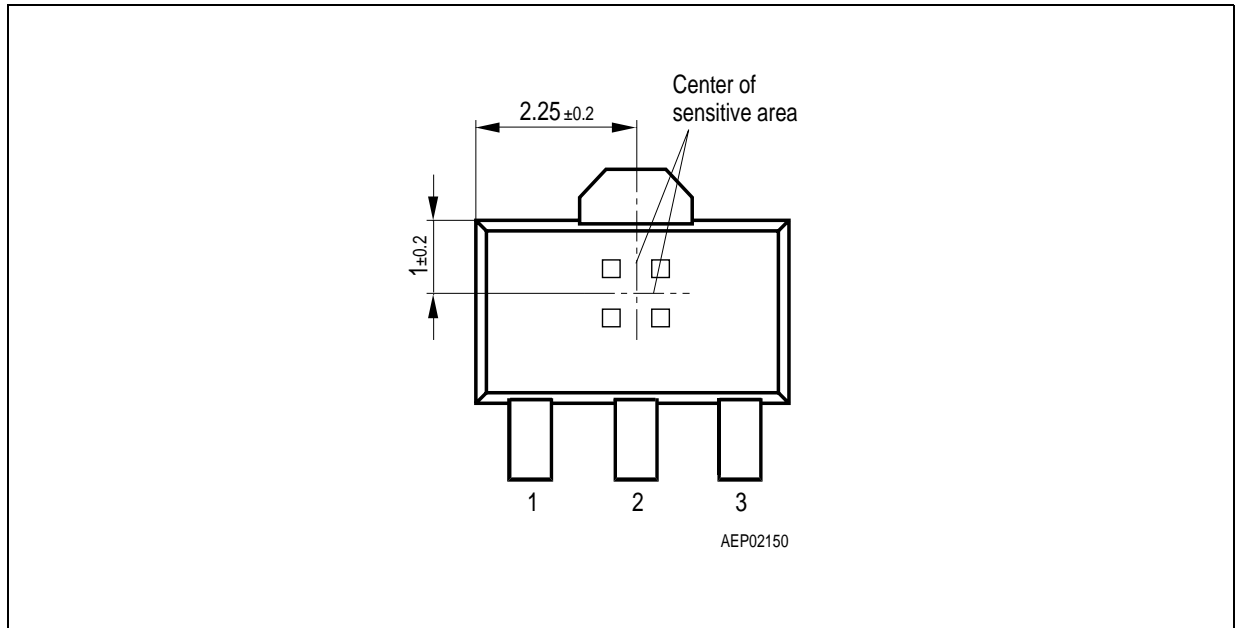


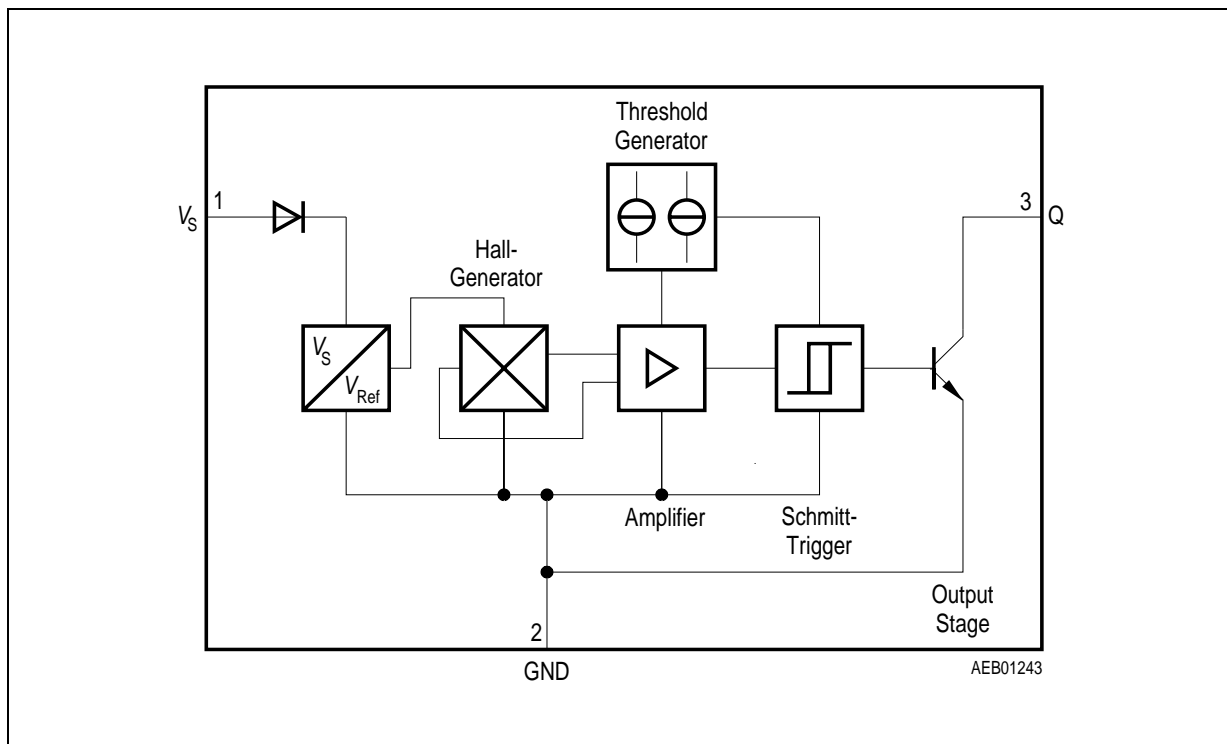
Figure 1

## Pin Definitions and Functions

| Pin No. | Symbol | Function       |
|---------|--------|----------------|
| 1       | $V_S$  | Supply voltage |
| 2       | GND    | Ground         |
| 3       | Q      | Output         |

### Circuit Description

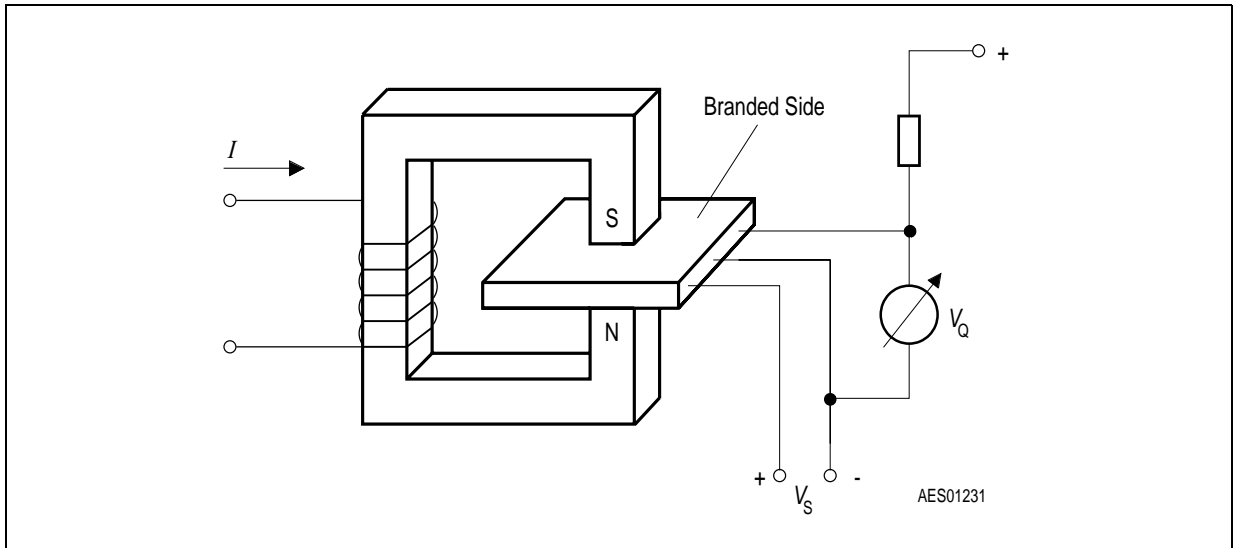
The circuit includes Hall generator, amplifier and Schmitt-Trigger on one chip. The internal reference provides the supply voltage for the components. A magnetic field perpendicular to the chip surface induces a voltage at the hall probe. This voltage is amplified and switches a Schmitt-trigger with open-collector output. A protection diode against reverse power supply is integrated. The output is protected against electrical disturbances.



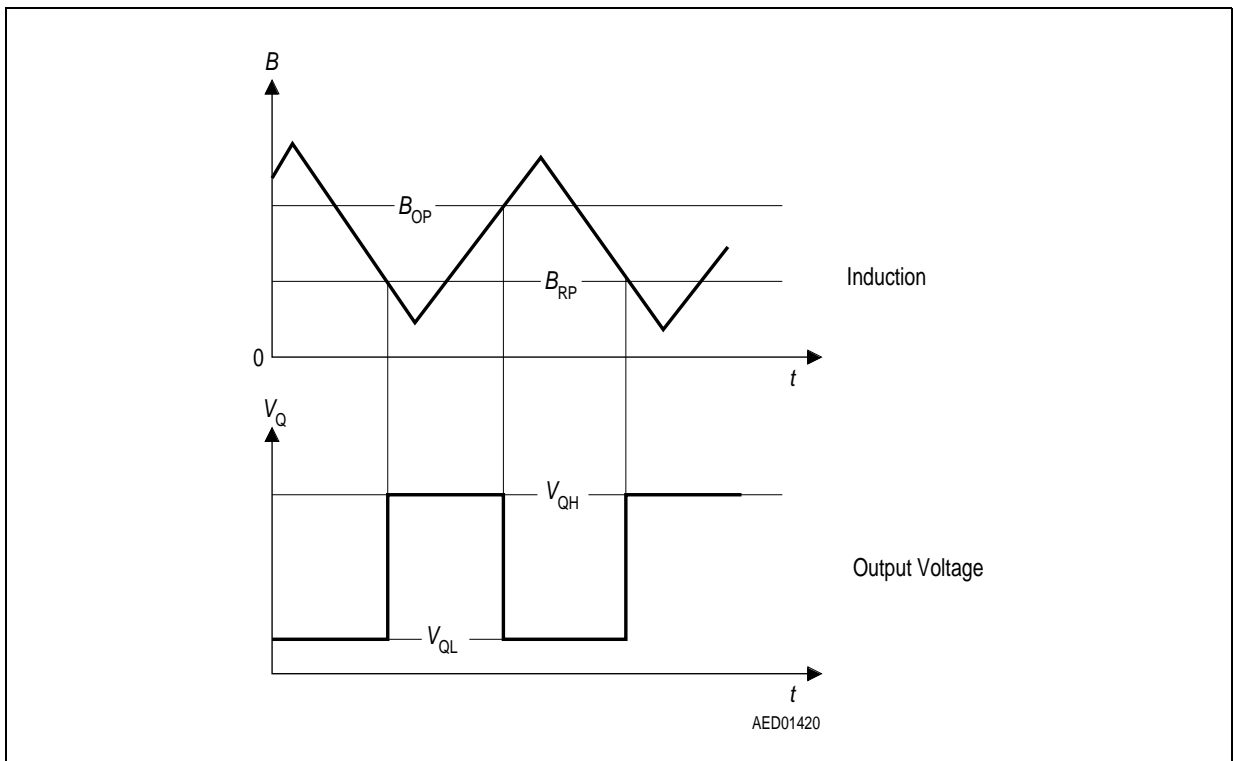
**Figure 2 Block Diagram**

### Functional Description Unipolar Type TLE4905 (Figure 3 and 4)

When a positive magnetic field is applied in the indicated direction (**Figure 3**) and the turn-on magnetic induction  $B_{OP}$  is exceeded, the output of the Hall-effect IC will conduct (Operate Point). When the magnetic field is reduced to a value smaller than the release point, the output of the IC turns off (Release Point; **Figure 4**).



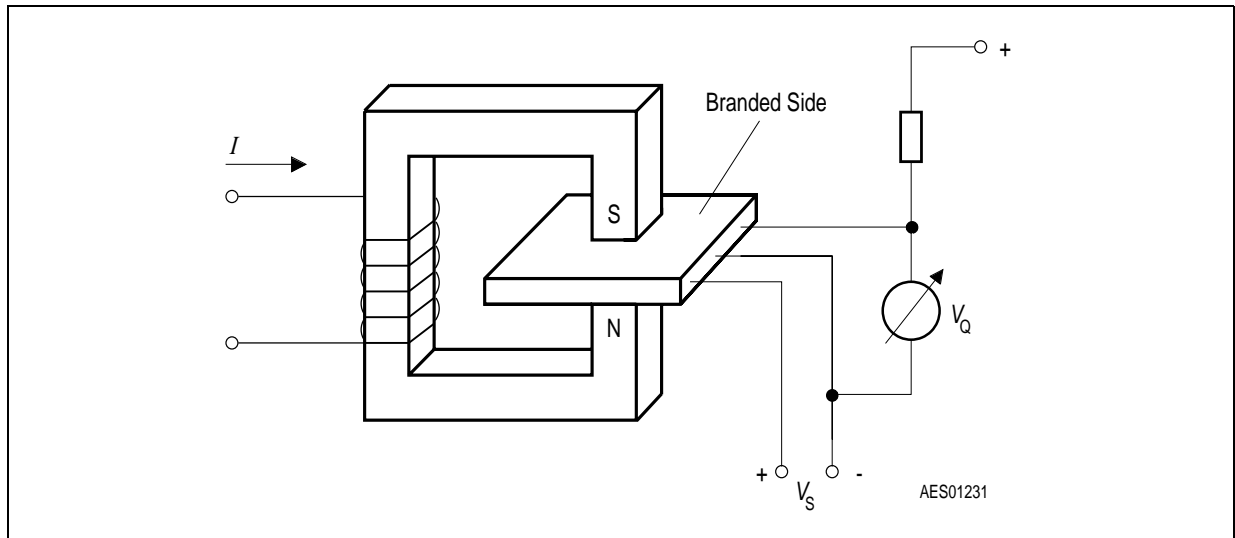
**Figure 3 Sensor/Magnetic-Field Configuration**



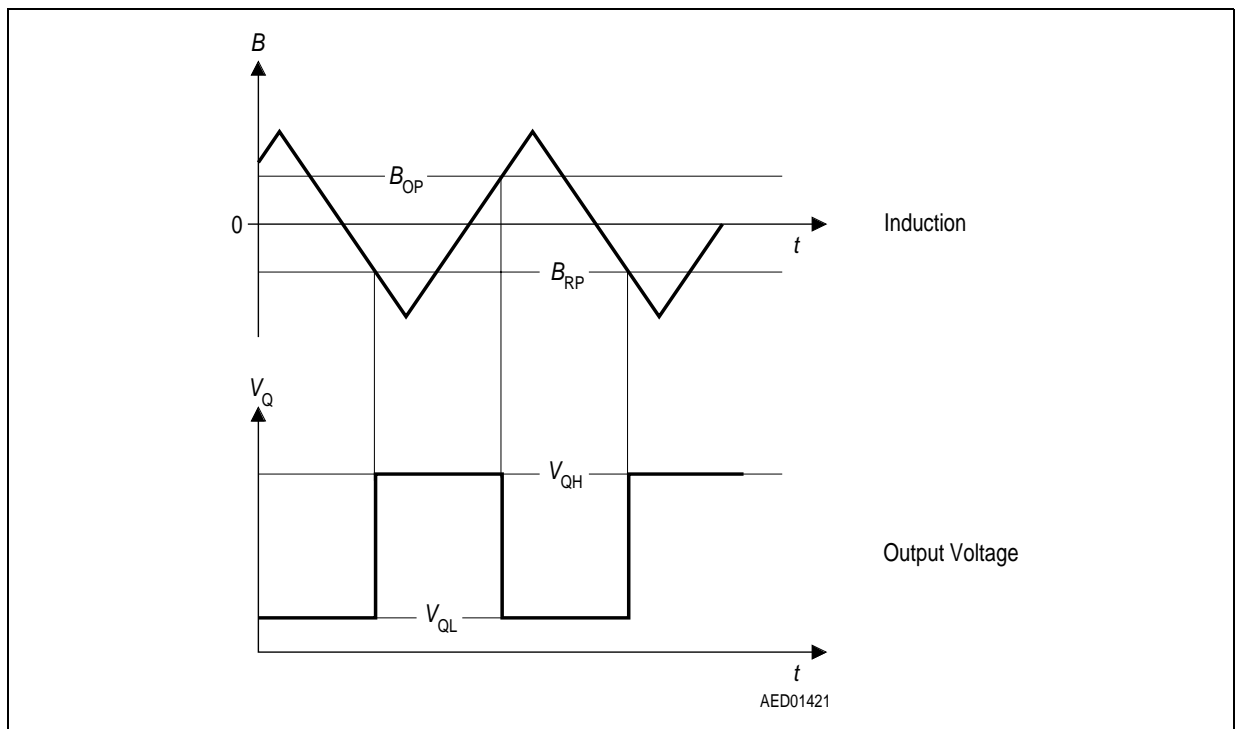
**Figure 4 Switching Characteristics Unipolar Type**

### Functional Description Bipolar Type TLE4935/35-2/45-2 (Figure 5 and 6)

When a positive magnetic field is applied in the indicated direction (**Figure 5**) and the turn-on magnetic induction  $B_{OP}$  is exceeded, the output of the Hall-effect IC will conduct (Operate Point). The output state does not change unless a reverse magnetic field exceeding the turn-off magnetic induction  $|B_{RP}|$  is exceeded. In this case the output will turn off (Release Point; **Figure 6**).



**Figure 5** Sensor/Magnetic-Field Configuration



**Figure 6** Switching Characteristics Bipolar Type

### Absolute Maximum Ratings

$T_j = -40$  to  $150$  °C

| Parameter              | Symbol      | Limit Values |      | Unit | Remarks                 |
|------------------------|-------------|--------------|------|------|-------------------------|
|                        |             | min.         | max. |      |                         |
| Supply voltage         | $V_S$       | -40          | 32   | V    | -                       |
| Supply voltage         | $V_S$       | -            | 40   | V    | $t < 400$ ms; $v = 0.1$ |
| Output voltage         | $V_Q$       | -            | 32   | V    | -                       |
| Output current         | $I_Q$       | -            | 100  | mA   | -                       |
| Output reverse current | $-I_Q$      | -            | 100  | mA   | -                       |
| Junction temperature   | $T_j$       | -40          | 150  | °C   | -                       |
| Storage temperature    | $T_{stg}$   | -50          | 150  | °C   | -                       |
| Thermal resistance     | $R_{th JA}$ | -            | 100  | 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.*

### Operating Range

| Parameter            | Symbol | Limit Values |      | Unit | Remarks |
|----------------------|--------|--------------|------|------|---------|
|                      |        | min.         | max. |      |         |
| Supply voltage       | $V_S$  | 4.0          | 24   | V    | -       |
| Junction temperature | $T_j$  | -40          | 150  | °C   | -       |

*Note: In the operating range the functions given in the circuit description are fulfilled.*



### AC/DC Characteristics

$4.0\text{ V} \leq V_S \leq 24\text{ V}$ ;  $-40\text{ }^\circ\text{C} \leq T_j \leq 150\text{ }^\circ\text{C}$

| Parameter                 | Symbol             | Limit Values |      |      | Unit          | Test Condition  | Test Circuit |
|---------------------------|--------------------|--------------|------|------|---------------|---|--------------|
|                           |                    | min.         | typ. | max. |               |   |              |
| Supply current            | $I$                | 1.6          | –    | 5.0  | mA            |   | 1            |
|                           | $I_{\text{SHigh}}$ | –            | 2.5  | –    | mA            | $B < B_{\text{RP}}$                                   | 1            |
|                           | $I_{\text{SLow}}$  | –            | 3.5  | –    | mA            | $B > B_{\text{OP}}$                                   | 1            |
| Output saturation voltage | $V_{\text{QSat}}$  | –            | 0.25 | 0.5  | V             | $I_{\text{Q}} = 40\text{ mA}$                         | 1            |
| Output leakage current    | $I_{\text{QL}}$    | –            | –    | 10   | $\mu\text{A}$ | $V_{\text{Q}} = 18\text{ V}$                          | 1            |
| Rise/fall time            | $t_r / t_f$        | –            | –    | 1    | $\mu\text{s}$ | $R_L = 1.2\text{ k}\Omega$<br>$C_L \leq 33\text{ pF}$ | 1            |

*Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at  $T_j = 25^\circ\text{C}$  and the given supply voltage.*

**Magnetic Characteristics**

$4.0 \text{ V} \leq V_S \leq 24 \text{ V}$

| Parameter | Symbol | Limit Values     |      |                       |      |                         |      |                          |      | Unit |
|-----------|--------|------------------|------|-----------------------|------|-------------------------|------|--------------------------|------|------|
|           |        | TLE4905 unipolar |      | TLE4935 bipolar latch |      | TLE4935-2 bipolar latch |      | TLE4945-2 bipolar switch |      |      |
|           |        | min.             | max. | min.                  | max. | min.                    | max. | min.                     | max. |      |

**Junction Temperature  $T_j = -40 \text{ }^\circ\text{C}$** 

|                                |              |     |     |     |     |     |     |    |   |    |
|--------------------------------|--------------|-----|-----|-----|-----|-----|-----|----|---|----|
| Turn-ON induction              | $B_{OP}$     | 7.5 | 19  | 10  | 20  | 15  | 27  | -3 | 6 | mT |
| Turn-OFF induction             | $B_{RP}$     | 5.5 | 17  | -20 | -10 | -27 | -15 | -6 | 3 | mT |
| Hysteresis ( $B_{OP}-B_{RP}$ ) | $\Delta B_H$ | 2   | 6.5 | 20  | 40  | 30  | 54  | 1  | 5 | mT |

**Junction Temperature  $T_j = 25 \text{ }^\circ\text{C}$** 

|                                |              |   |    |     |     |     |     |    |   |    |
|--------------------------------|--------------|---|----|-----|-----|-----|-----|----|---|----|
| Turn-ON induction              | $B_{OP}$     | 7 | 18 | 10  | 20  | 14  | 26  | -3 | 6 | mT |
| Turn-OFF induction             | $B_{RP}$     | 5 | 16 | -20 | -10 | -26 | -14 | -6 | 3 | mT |
| Hysteresis ( $B_{OP}-B_{RP}$ ) | $\Delta B_H$ | 2 | 6  | 20  | 40  | 28  | 52  | 1  | 5 | mT |

**Junction Temperature  $T_j = 85 \text{ }^\circ\text{C}$** 

|                                |              |     |      |     |     |     |     |    |   |    |
|--------------------------------|--------------|-----|------|-----|-----|-----|-----|----|---|----|
| Turn-ON induction              | $B_{OP}$     | 6.5 | 17.5 | 10  | 20  | 13  | 26  | -3 | 6 | mT |
| Turn-OFF induction             | $B_{RP}$     | 4.5 | 15   | -20 | -10 | -26 | -13 | -6 | 3 | mT |
| Hysteresis ( $B_{OP}-B_{RP}$ ) | $\Delta B_H$ | 2   | 5.5  | 20  | 40  | 26  | 52  | 1  | 5 | mT |

**Junction Temperature  $T_j = 150 \text{ }^\circ\text{C}$** 

|                                |              |   |    |     |     |     |     |    |   |    |
|--------------------------------|--------------|---|----|-----|-----|-----|-----|----|---|----|
| Turn-ON induction              | $B_{OP}$     | 6 | 17 | 10  | 20  | 12  | 25  | -3 | 6 | mT |
| Turn-OFF induction             | $B_{RP}$     | 4 | 14 | -20 | -10 | -25 | -12 | -6 | 3 | mT |
| Hysteresis ( $B_{OP}-B_{RP}$ ) | $\Delta B_H$ | 2 | 5  | 20  | 40  | 24  | 50  | 1  | 5 | mT |

*Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at  $T_j = 25 \text{ }^\circ\text{C}$  and the given supply voltage.*

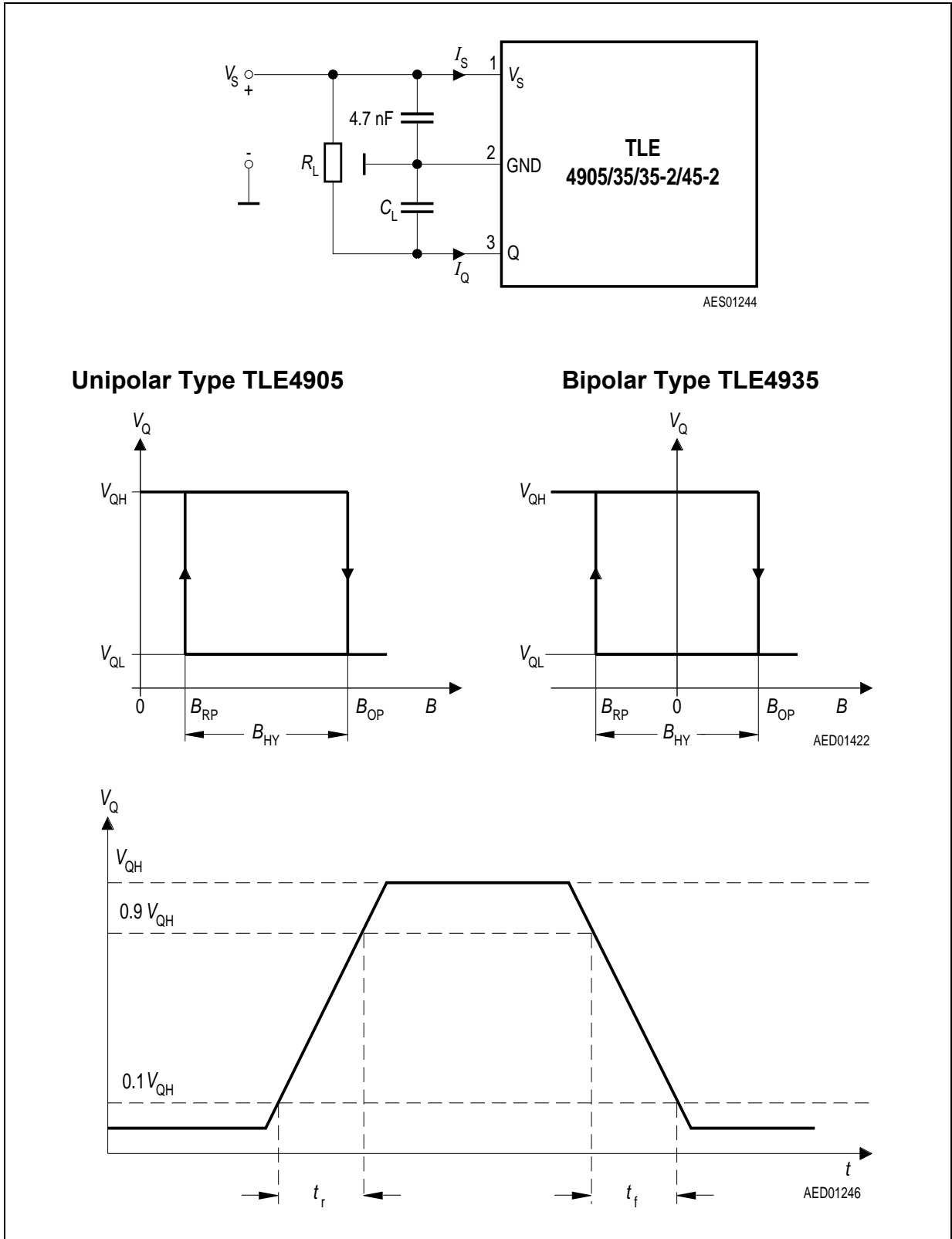
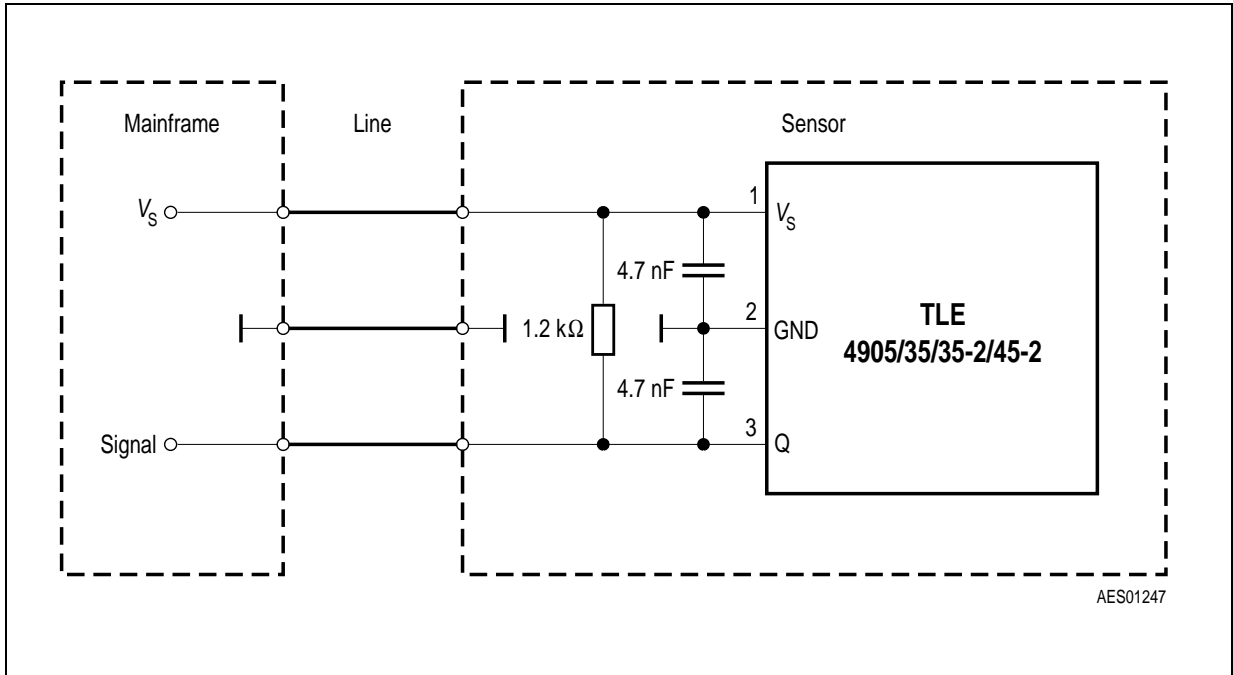


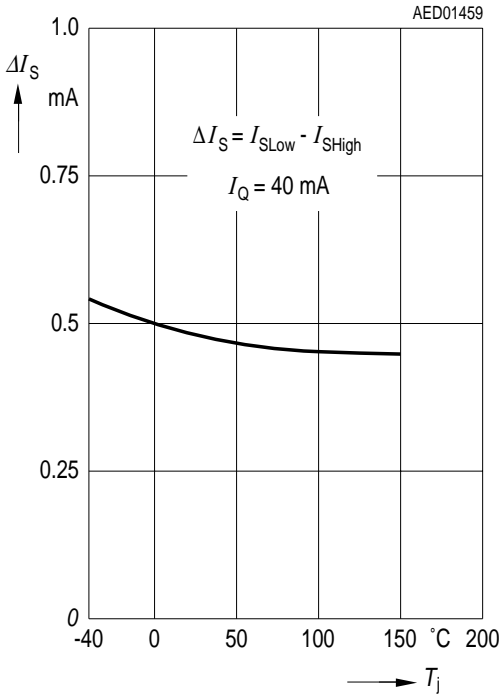
Figure 7 Test Circuit 1



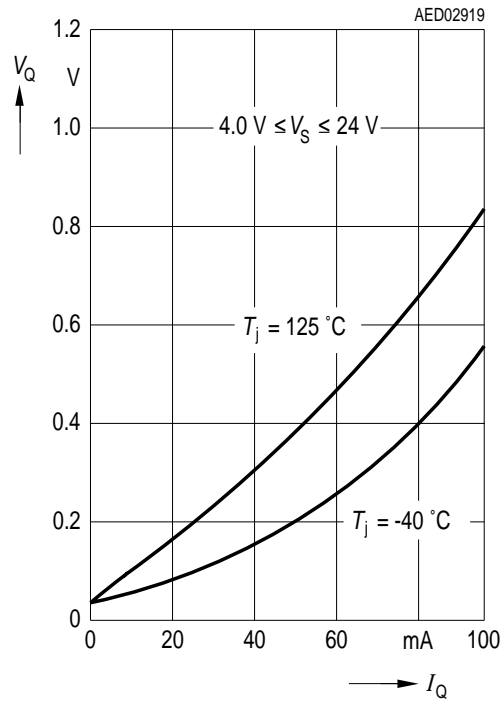
**Figure 8 Application Circuit**

If not otherwise specified, all curves reflect typical values at  $T_j = 25\text{ }^\circ\text{C}$  and  $V_S = 12\text{ V}$

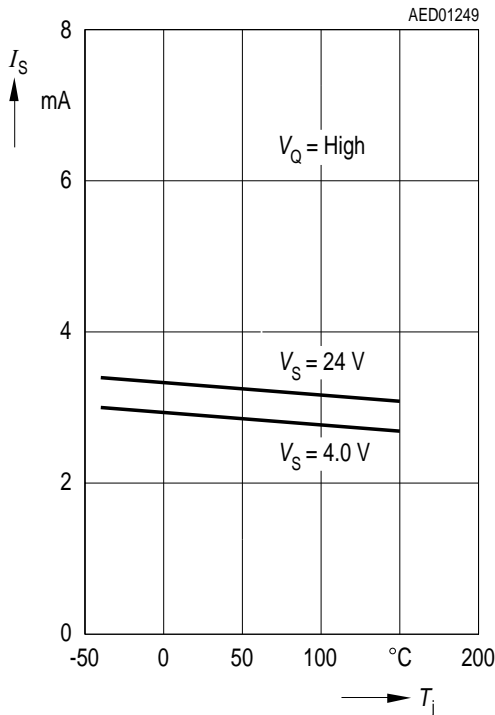
### Quiescent Current Difference versus Temperature



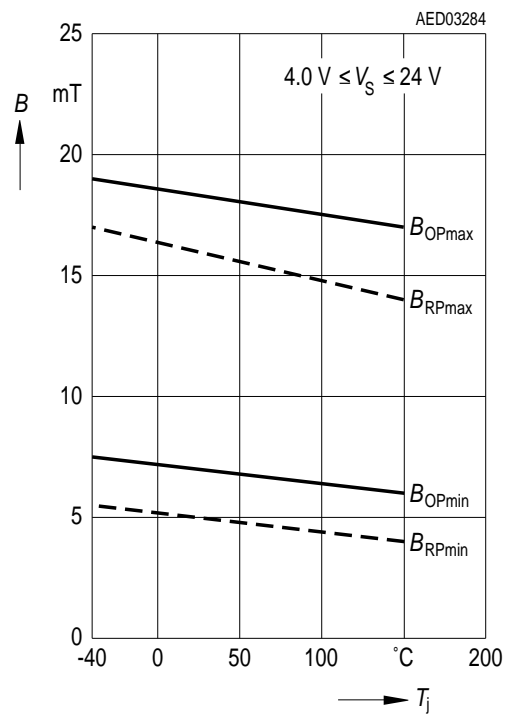
### Saturation Voltage versus Output Current



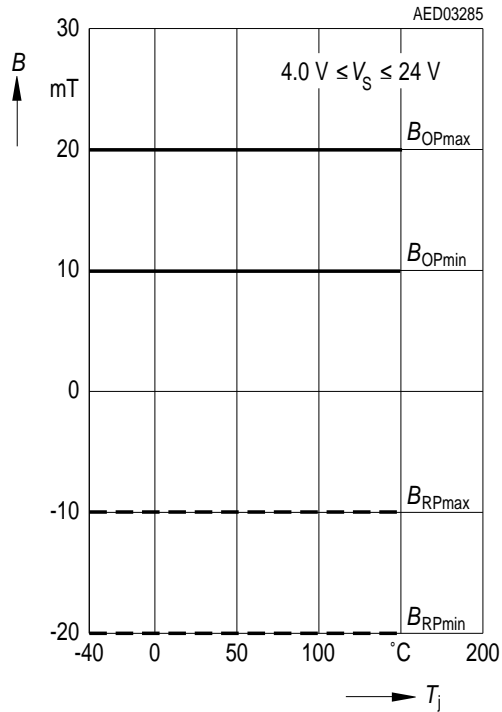
### Quiescent Current versus Junction Temperature



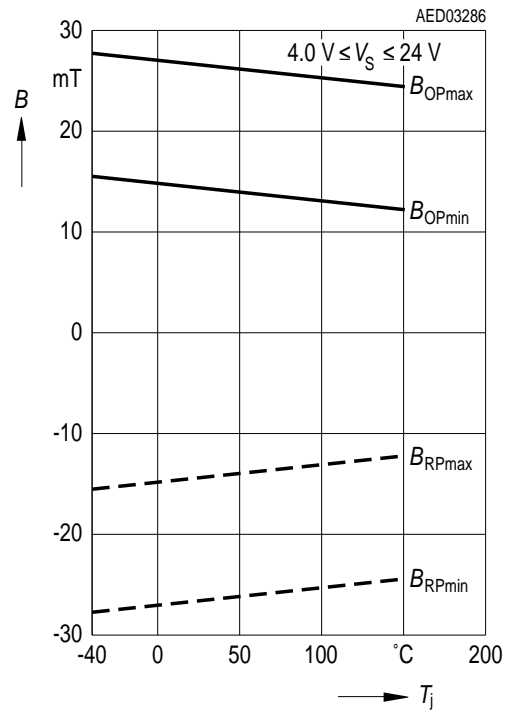
### TLE4905 Operate-and Release-Point versus Junction Temperature



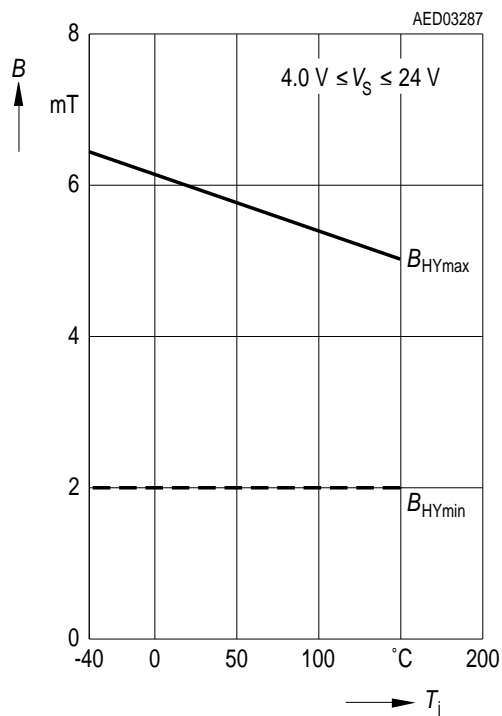
**TLE4935 Operate-and Release-Point versus Junction Temperature**



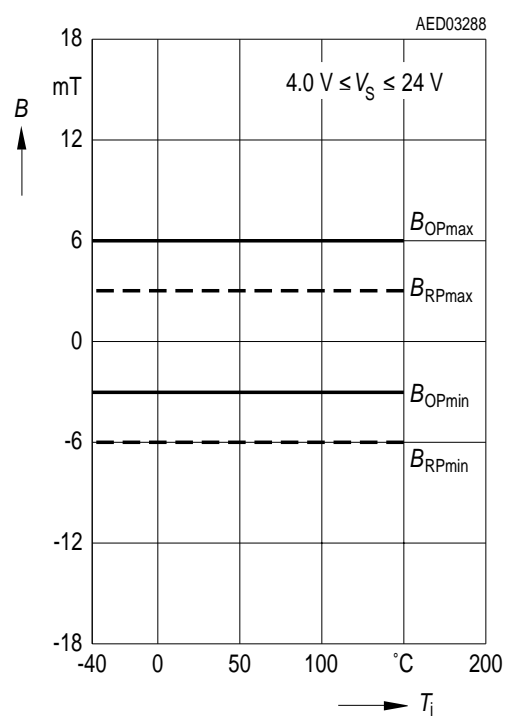
**TLE4935-2 Operate-and Release-Point versus Junction Temperature**



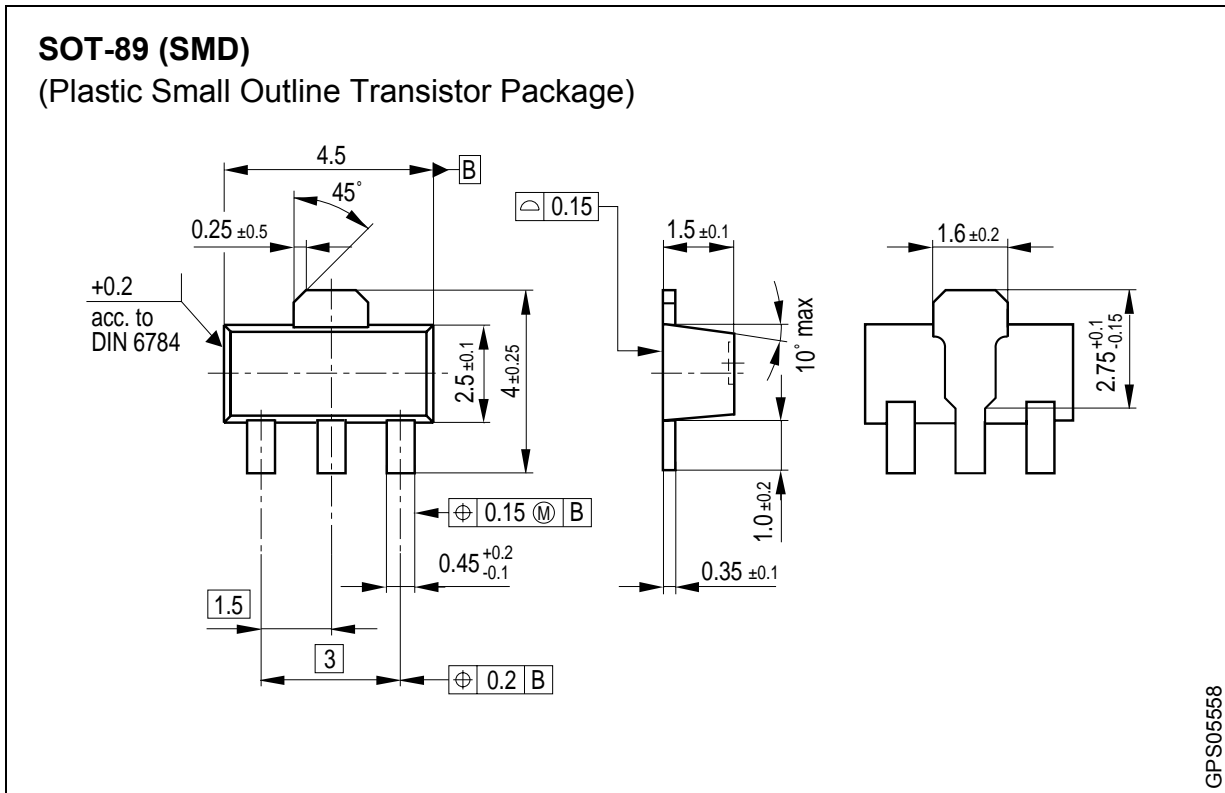
**TLE4905 Hysteresis versus Junction Temperature**



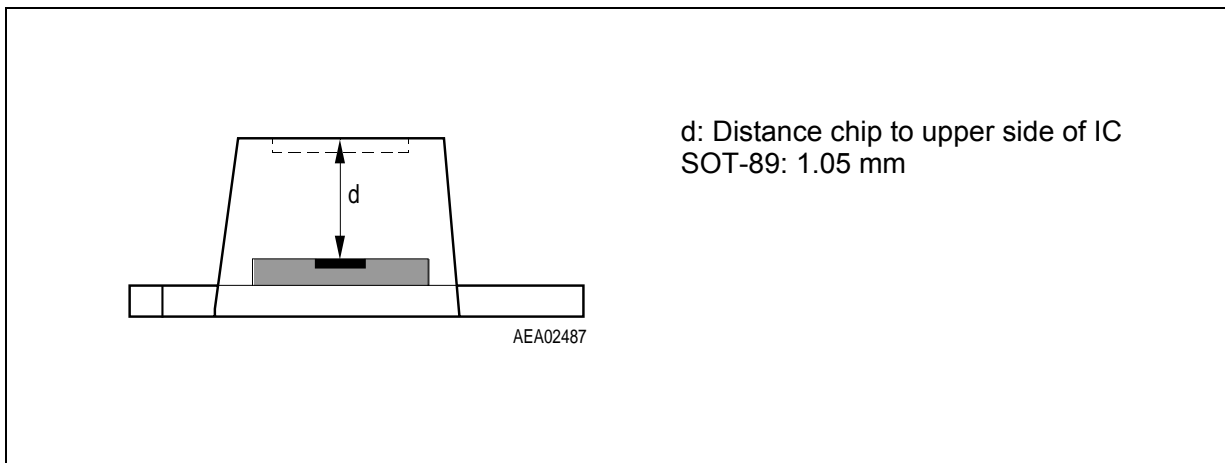
**TLE4945-2 Operate-and Release-Point versus Junction Temperature**



## Package Outlines



## Package Information



## Sorts of Packing

Package outlines for tubes, trays etc. are contained in our data book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm

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**Revision History:2004-06-07, V1.2**

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Previous Version: 2004-03-19, V1.1

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| Page  | Subjects (major changes since last revision) |
|-------|--|
| 13,14 | typical curves removed                       |
| -     | new format of data sheet                     |
|       |  |
|       |  |
|       |  |
|       |  |

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