# TLE4209G

Automotive Power

Never stop thinking

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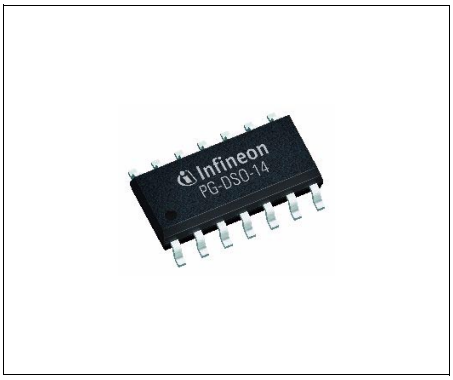
# 1 Overview




**PG-DSO-14-22**

### Features

- Optimized for manual headlight beam control applications
- Delivers up to 0.7 A continuous
- Low saturation voltage; typ.1.6 V total @ 25 °C; 0.7 A
- Output protected against short circuit
- Over temperature protection with hysteresis
- Over- and under voltage lockout
- Internal clamp diodes
- Enhanced SMD power package
- Green Product (RoHS compliant)
- AEC Qualified

### Description

The TLE4209G is a protected H-Bridge Driver designed specifically for automotive manual headlight beam control and industrial servo control applications with DC-brush motor loads.

The part is built using the bipolar high voltage power technology DOPL.

The standard enhanced power PG-DSO-14-22 package meets the application requirements and saves PCB-board space and costs. The package is lead- and halogen-free.

The servo-loop-parameter pos.- and neg. Hysteresis, pos.- and neg. deadband and angle-amplification are programmable with external resistors.

An internal window-comparator controls the input line. In the case of a fault condition, like short circuit to GND, short circuit to supply-voltage, and broken wire, the TLE4209G stops the motor immediately (brake condition).

Furthermore the built in features like over- and under voltage-lockout, short-circuit-protection and over-temperature-protection will open a wide range of automotive- and industrial applications.

| Type | Package | Marking |
|---|---|---|
| TLE4209G | PG-DSO-14-22 | TLE4209G |

# 2 Block Diagram

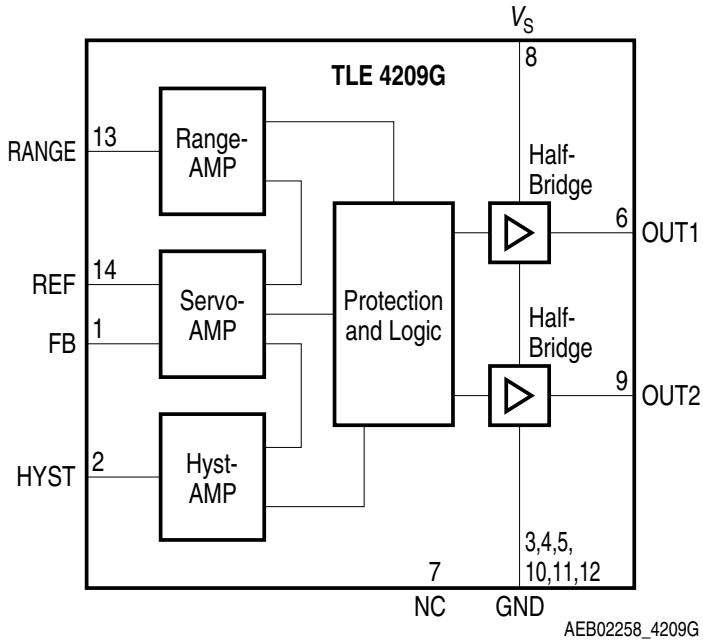



**Figure 1 Block Diagram**

# 3 Pin Configuration

## 3.1 Pin Assignment

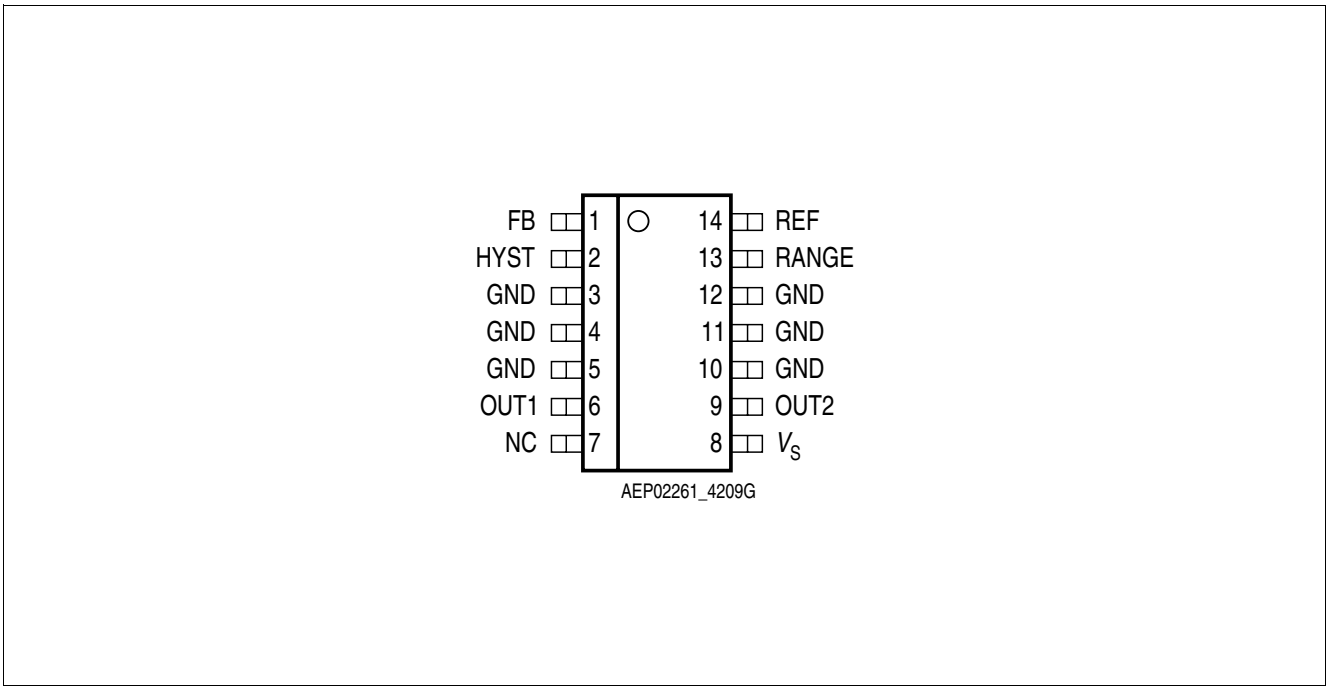



**Figure 2 Pin Configuration**

## 3.2 Pin Definitions and Functions

| Pin | Symbol | Function |
|---|---|---|
| 1 | FB | **Feedback Input** |
| 2 | HYST | **Hysteresis I/O** |
| 3, 4, 5, 10, 11, 12 | GND | **Ground** |
| 6 | OUT1 | **Power Output 1** |
| 7 | NC | **Not Connected** |
| 8 | $V_S$ | **Power Supply Voltage** |
| 9 | OUT2 | **Power Output 2** |
| 13 | RANGE | **Range Input** |
| 14 | REF | **Reference Input** |

# 4 General Product Characteristics

## 4.1 Absolute Maximum Ratings

**Absolute Maximum Ratings** [1)]

$T_j$ = -40 °C to +150 °C; all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

| Pos. | Parameter | Symbol | Limit Values | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | | Min. | Max. | | |
| **Voltages** | | | | | | |
| 4.1.1 | Supply voltage | $V_S$ | -0.3 | 45 | V | – |
| 4.1.2 | Supply voltage | $V_S$ | -1 | – | V | $t$ < 0.5 s; $I_S$ > -2 A |
| 4.1.3 | Logic input voltages (FB, REF, RANGE, HYST) | $V_I$ | -0.3 | 20 | V | – |
| **Currents** | | | | | | |
| 4.1.4 | Output current (OUT1, OUT2) | $I_{OUT}$ | – | – | A | internally limited |
| 4.1.5 | Output current (Diode) | $I_{OUT}$ | -0.9 | 0.9 | A | – |
| 4.1.6 | Input current<br>(FB, REF, RANGE, HYST) | $I_{IN}$ | -2<br>-6 | 2<br>6 | mA<br>mA | <br>$t$ < 2 ms; $t$/T < 0.1 |
| **Temperatures** | | | | | | |
| 4.1.7 | Junction temperature | $T_j$ | -40 | 150 | °C | – |
| 4.1.8 | Storage temperature | $T_{stg}$ | -50 | 150 | °C | – |

1) Not subject to production test, specified by design.

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

*Note: Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.*

## 4.2 Operating Range

| Pos. | Parameter | Symbol | Limit Values | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | | Min. | Max. | | |
| 4.2.1 | Supply voltage | $V_S$ | 8 | 18 | V | After $V_S$ rising above $V_{UV\ ON}$ |
| 4.2.2 | Supply voltage increasing | $V_S$ | -0.3 | $V_{UV\ ON}$ | V | Outputs in tristate |
| 4.2.3 | Supply voltage decreasing | $V_S$ | -0.3 | $V_{UV\ OFF}$ | V | Outputs in tristate |
| 4.2.4 | Output current | $I_{OUT1-2}$ | -0.7 | 0.7 | A | – |
| 4.2.5 | Input current (FB, REF) | $I_{IN}$ | -50 | 500 | µA | – |
| 4.2.6 | Junction temperature | $T_j$ | -40 | 150 | °C | – |

*Note: Within the functional range the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the related electrical characteristics table.*

## 4.3 Thermal Resistance

*Note: This thermal data was generated in accordance with JEDEC JESD51 standards. For more information, go to **www.jedec.org**.*

| Pos. | Parameter | Symbol | Limit Values | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| 4.3.1 | Junction to Soldeering Point[1)] | $R_{thJSP}$ | – | – | 25 | K/W | measured to pin 5 |
| 4.3.2 | Junction to Ambient[1)] minimal-footprint | $R_{thJA}$ | – | 130 | – | K/W | [2)] |
| 4.3.3 | Junction to Ambient[1)] additional 600 mm$^2$ CU area | $R_{thJA}$ | – | 65 | – | K/W | [3)] |

1) Not subject to production test, specified by design.

2) JESD 51-2, 51-3, FR4 76.2 mm × 114.3 mm × 1.5 mm, 70 µm Cu, minimal footprint

3) JESD 51-2, 51-3, FR4 76.2 mm × 114.3 mm × 1.5 mm, 70 µm Cu, 600 mm$^2$ CU cooling area connected to Pins: 3, 4, 5, 10, 11, 12

## 4.4 Electrical Characteristics

**Electrical Characteristics**

$V_S$ = 8 V to 18 V, $T_j$ = -40 °C to +150 °C, $I_{OUT1-2}$ = 0 A, all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

| Pos. | Parameter | Symbol | Limit Values | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| **Current Consumption** | | | | | | | |
| 4.4.1 | Supply current | $I_S$ | – | 12 | 20 | mA | – |
| 4.4.2 | Supply current | $I_S$ | – | 20 | 30 | mA | $I_{OUT1}$ = 0.3 A<br>$I_{OUT2}$ = -0.3 A |
| 4.4.3 | Supply current | $I_S$ | – | 30 | 50 | mA | $I_{OUT1}$ = 0.7 A<br>$I_{OUT2}$ = -0.7 A |
| **Over- and Under Voltage Lockout** | | | | | | | |
| 4.4.4 | UV Switch ON voltage | $V_{UV\ ON}$ | – | 7.4 | 8 | V | $V_S$ increasing |
| 4.4.5 | UV Switch OFF voltage | $V_{UV\ OFF}$ | 6.3 | 6.9 | – | V | $V_S$ decreasing |
| 4.4.6 | UV ON/OFF Hysteresis | $V_{UVHY}$ | – | 0.5 | – | V | $V_{UV\ ON}$ - $V_{UV\ OFF}$ |
| 4.4.7 | OV Switch OFF voltage | $V_{OV\ OFF}$ | – | 20.5 | 23 | V | $V_S$ increasing |
| 4.4.8 | OV Switch ON voltage | $V_{OV\ ON}$ | 17.5 | 20 | – | V | $V_S$ decreasing |
| 4.4.9 | OV ON/OFF Hysteresis | $V_{OVHY}$ | – | 0.5 | – | V | $V_{OV\ OFF}$ - $V_{OV\ ON}$ |
| **Outputs OUT1-2, Saturation Voltages** | | | | | | | |
| 4.4.10 | Source (upper)<br>$I_{OUT}$ = -0.3 A | $V_{SAT\ U}$ | – | 0.90 | 1.20 | V | $T_j$ = 25 °C |
| 4.4.11 | Sink (upper)<br>$I_{OUT}$ = -0.7 A | $V_{SAT\ U}$ | – | 1.10 | 1.50 | V | $T_j$ = 25 °C |
| 4.4.12 | Sink (lower)<br>$I_{OUT}$ = 0.3 A | $V_{SAT\ L}$ | – | 0.25 | 0.40 | V | $T_j$ = 25 °C |
| 4.4.13 | Sink (lower)<br>$I_{OUT}$ = 0.7 A | $V_{SAT\ L}$ | – | 0.45 | 0.75 | V | $T_j$ = 25 °C |

**Electrical Characteristics** (cont'd)

$V_S$ = 8 V to 18 V, $T_j$ = -40 °C to +150 °C, $I_{OUT1-2}$ = 0 A, all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

| Pos. | Parameter | Symbol | Limit Values | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| 4.4.14 | Total drop<br>$I_{OUT}$ = 0.3 A | $V_{SAT}$ | – | 1.2 | 1.7 | V | $V_{SAT} = V_{SAT\,U} + V_{SAT\,L}$ |
| 4.4.15 | Total drop<br>$I_{OUT}$ = 0.7 A | $V_{SAT}$ | – | 1.6 | 2.5 | V | $V_{SAT} = V_{SAT\,U} + V_{SAT\,L}$ |
| **Outputs OUT1-2, Clamp Diodes** | | | | | | | |
| 4.4.16 | Forward voltage; upper | $V_{FU}$ | – | 1 | 1.5 | V | $I_F$ = 0.3 A |
| 4.4.17 | Upper leakage current | $I_{LKU}$ | – | – | 5 | mA | $I_F$ = 0.3 A |
| 4.4.18 | Forward voltage; lower | $V_{FL}$ | – | 0.9 | 1.4 | V | $I_F$ = 0.3 A |
| **Input-Interface, Input REF** | | | | | | | |
| 4.4.19 | Quiescent voltage | $V_{REFq}$ | – | 200 | – | mV | $I_{REF}$ = 0 µA |
| 4.4.20 | Input resistance | $R_{REF}$ | – | 6 | – | kΩ | 0 V < $V_{REF}$ < 0.5 V |
| **Input-Interface, Input FB** | | | | | | | |
| 4.4.21 | Quiescent voltage | $V_{FBq}$ | – | 200 | – | mV | $I_{FB}$ = 0 µA |
| 4.4.22 | Input resistance | $R_{FB}$ | – | 6 | – | kΩ | 0 V < $V_{FB}$ < 0.5 V |
| **Input-Interface, Input/Output HYST** | | | | | | | |
| 4.4.23 | Current Amplification<br>$A_{HYST} = I_{HYST} / (I_{REF} - I_{FB})$ | $A_{HYST}$ | 0.8 | 0.95 | 1.1 | – | -20 µA < $I_{HYST}$ < -10 µA;<br>10 µA < $I_{HYST}$ < 20 µA;<br>$I_{REF}$ = 250 µA;<br>$V_{HYST} = V_S / 2$ |
| 4.4.24 | Current Offset | $I_{HYSTIO}$ | -2 | 0.35 | 3 | µA | $I_{REF} = I_{FB}$ = 250 µA;<br>$V_{HYST} = V_S / 2$ |
| 4.4.25 | Threshold voltage High | $V_{HYH} / V_S$ | – | 52 | – | % | – |
| 4.4.26 | Deadband voltage High | $V_{DBH} / V_S$ | – | 50.4 | – | % | – |
| 4.4.27 | Deadband voltage Low | $V_{DBL} / V_S$ | – | 49.6 | – | % | – |
| 4.4.28 | Threshold voltage Low | $V_{HYL} / V_S$ | – | 48 | – | % | – |
| 4.4.29 | Hysteresis Window | $V_{HYW} / V_S$ | 3 | 4 | 5 | % | $(V_{HYH} - V_{HYL}) / V_S$ |
| 4.4.30 | Deadband Window | $V_{DBW} / V_S$ | 0.4 | 0.8 | 1.2 | % | $(V_{DBH} - V_{DBL}) / V_S$ |
| **Input-Interface, Input RANGE** | | | | | | | |
| 4.4.31 | Input current | $I_{RANGE}$ | -1 | – | 1 | µA | 0 V < $V_{RANGE}$ < $V_S$ |
| 4.4.32 | Switch-OFF voltage High | $V_{OFFH}$ | -25 | 0 | 100 | mV | refer to $V_S$ |
| 4.4.33 | Switch-OFF voltage Low | $V_{OFFL}$ | 300 | 400 | 500 | mV | refer to GND |

**Electrical Characteristics** (cont'd)

$V_S$ = 8 V to 18 V, $T_j$ = -40 °C to +150 °C, $I_{OUT1-2}$ = 0 A, all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

| Pos. | Parameter | Symbol | Limit Values | | | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| **Thermal Shutdown** | | | | | | | |
| 4.4.34 | Thermal shutdown junction temperature[1)] | $T_{jSD}$ | 150 | 175 | 200 | °C | – |
| 4.4.35 | Thermal switch-on junction temperature[1)] | $T_{jSO}$ | 120 | – | 170 | °C | – |
| 4.4.36 | Temperature hysteresis | $\Delta T$ | – | 30 | – | K | – |

1) Not subject to production test, specified by design.

# 5 Application Information

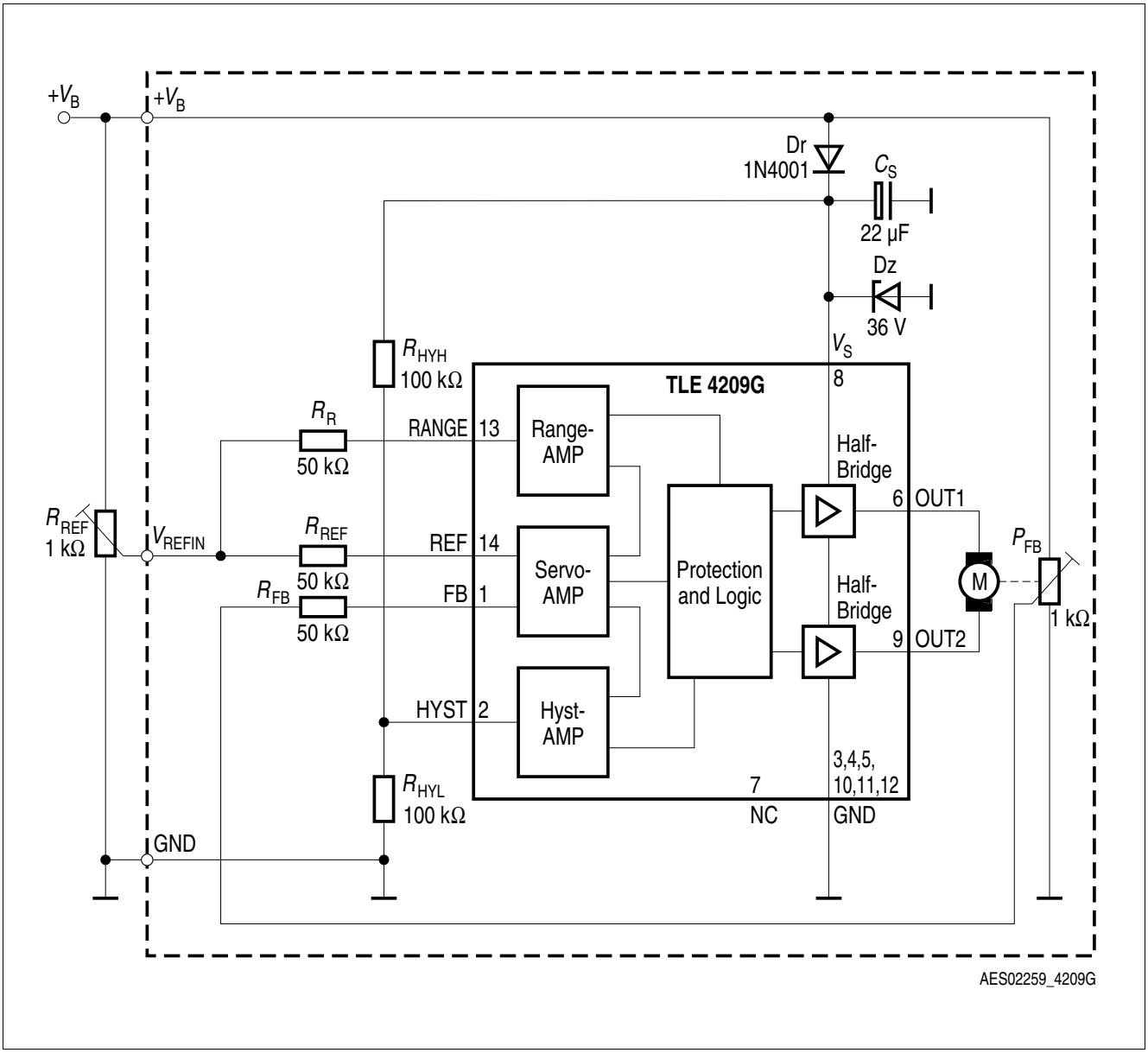



**Figure 3 Application Diagram**

*Note: In the application the PIN 7 can remain not connected.*

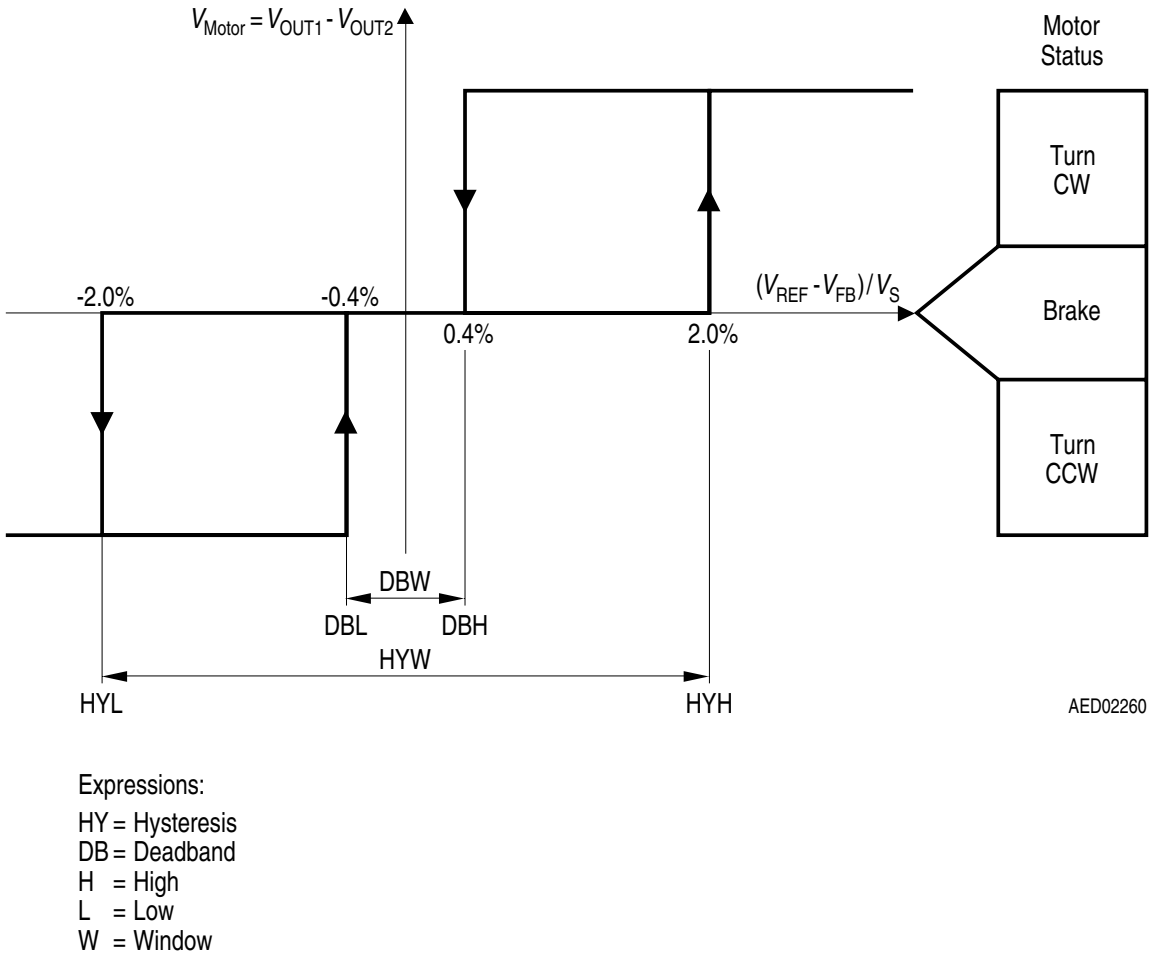



**Figure 4 Hysteresis, Phaselag and Deadband-Definitions**

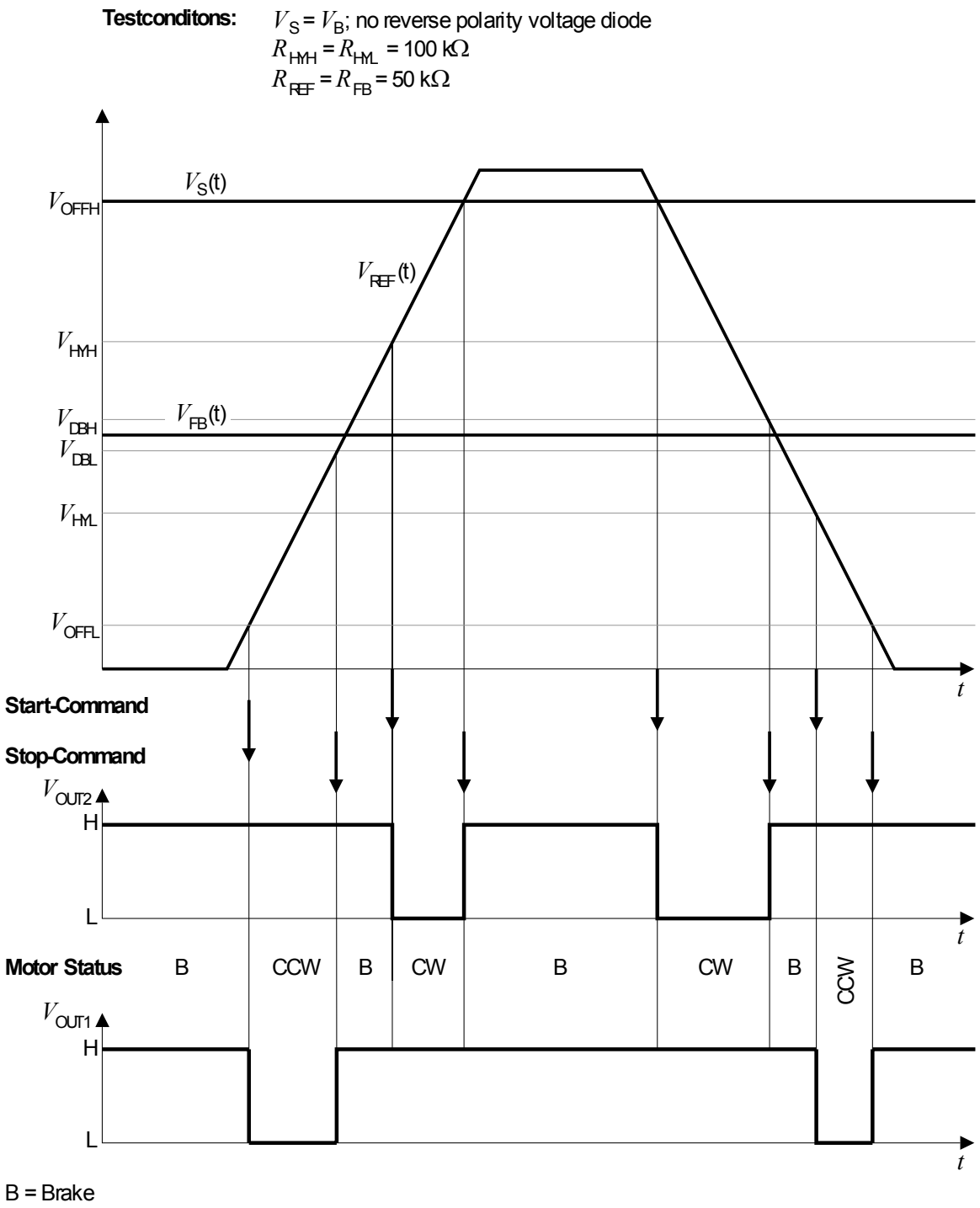



**Figure 5 Timing and Phaselag**

# 6 Package Outlines

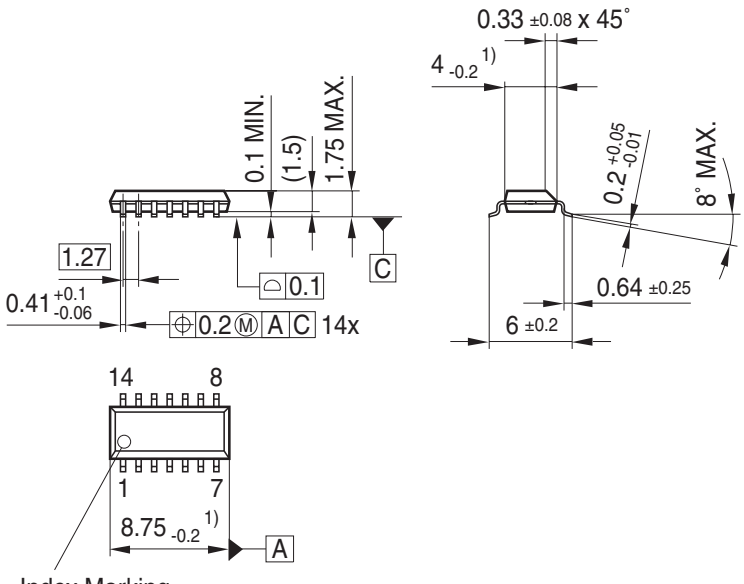



**Figure 6** **PG-DSO-14-22** (Plastic Green - Dual Small Outline Package)

**Green Product (RoHS compliant)**

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

You can find all of our packages, sorts of packing and others in our Infineon Internet Page “Products”: **http://www.infineon.com/products**.

Dimensions in mm

# 7 Revision History

| Revision | Date | Changes |
|---|---|---|
| 1.1 | 2007-04-11 | RoHS-compliant DSO package version of the TLE 4209<br>All pages: Infineon logo updated<br>Page 1:<br>“AEC qualified” and “RoHS” logo added, “Green Product (RoHS compliant)” and “AEC qualified” statement added to feature list, package names changed to RoHS compliant versions, package pictures updated<br>Page 13:<br>Package names changed to RoHS compliant versions, “Green Product” description added<br>Revision History added<br>Legal Disclaimer added |
| 1.2 | 2007-08-10 | Package name changed to PG-DSO-14-22 |
| 1.3 | 2008-02-04 | Page 1: Editorial change: deleted "fully" (The term "fully protected" often leads to misunderstandings as it is unclear with respect to which parameters). |

**Edition 2008-02-04**

**Published by**
**Infineon Technologies AG**
**81726 Munich, Germany**



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