

# TLE4205G

1-A DC Motor Driver

Datasheet

Rev. 1.1, 2015-01-15

Automotive Power

## 1-A DC Motor Driver Overview

### Features

- Max. driver current 1 A
- Integrated free-wheeling diodes
- Short-circuit proof to ground
- Inhibit
- ESD protected inputs
- Temperature range  $-40\text{ °C} \leq T_j \leq 150\text{ °C}$
- Green Product (RoHS compliant)
- AEC Qualified

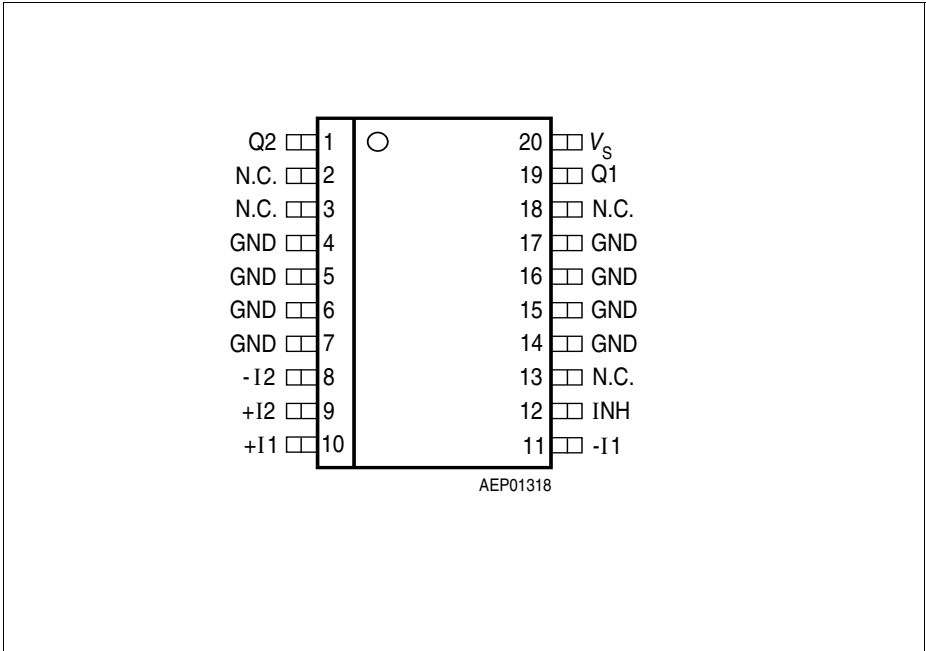


PG-DSO-20

| Type     | Marking  | Package   |
|----------|----------|-----------|
| TLE4205G | TLE4205G | PG-DSO-20 |

### Description

TLE 4205G is an integrated power full-bridge DC-motor driver for a wide temperature range, as required in automotive applications for example. The circuit contains two power comparators that can be combined to a full-bridge circuit. For inductive loads there are integrated free-wheeling diodes to  $+V_S$  and ground. The outputs are short-circuit proof up to 18 V supply voltage to ground and turn off when overtemperature occurs. This IC is especially suitable for headlight-beam adjustment in automobiles.



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

**Pin Definitions and Functions**

| Pin No. | Symbol | Function   |
|---------|--------|--|
| 1       | Q2     | <b>Output 2 of channel 2;</b> push-pull B output with DC short-circuit protection to ground. Integrated free-wheeling diodes to ground and the supply voltage. |
| 2       | N.C.   | Not connected  |
| 3       | N.C.   | Not connected  |
| 4-7     | GND    | Ground   |
| 8       | – I2   | <b>Inverting input channel 2;</b> to be wired according to general rules.  |
| 9       | + I2   | <b>Non-inverting input channel 2;</b> to be wired according to general rules.  |
| 10      | + I1   | <b>Non-inverting input channel 1;</b> see pin 9.   |
| 11      | – I1   | <b>Inverting input channel 1;</b> see pin 8.   |
| 12      | INH    | <b>Inhibit;</b> the IC is passive when this pin is open or connected to ground.  |
| 13      | N.C.   | Not connected  |
| 14-17   | GND    | Ground   |
| 18      | N.C.   | Not connected  |
| 19      | Q1     | Output Q1 of channel 1, see pin 1.   |
| 20      | $V_s$  | <b>Supply voltage <math>V_s</math>;</b> must be blocked with a ceramic capacitor of at least 100 nF directly on the pins of the IC.                            |

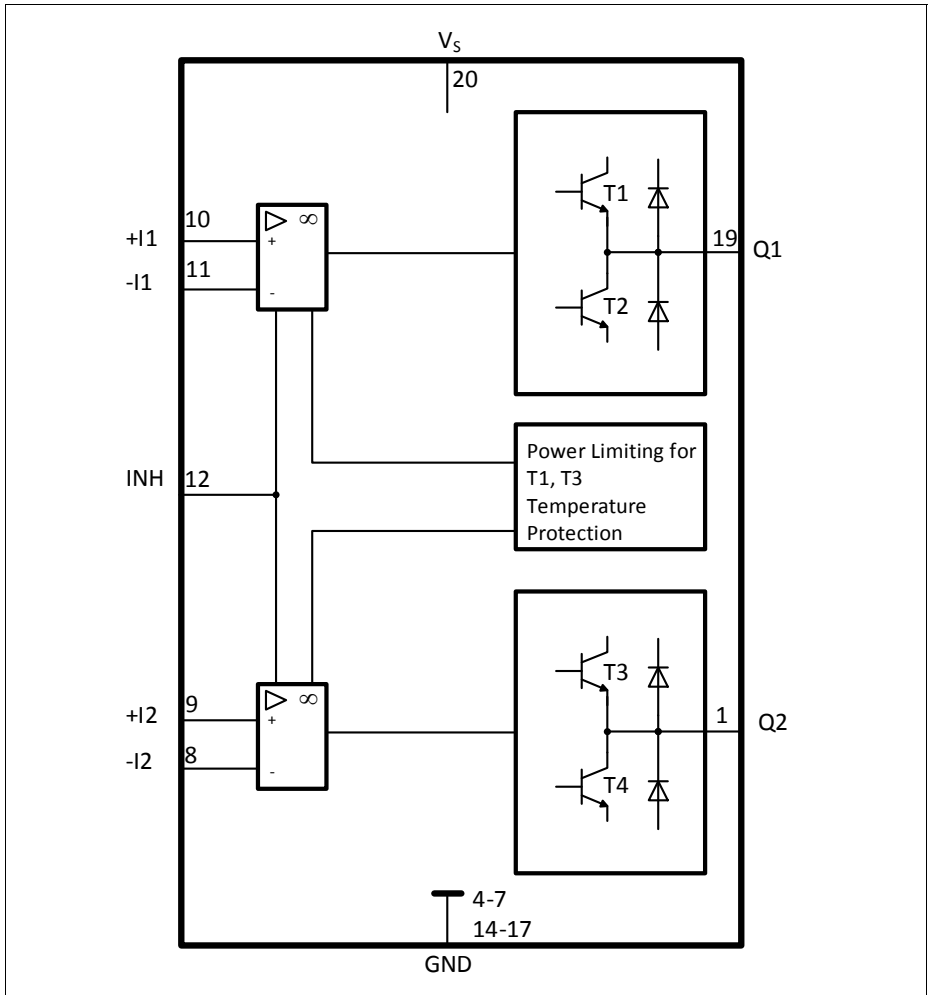
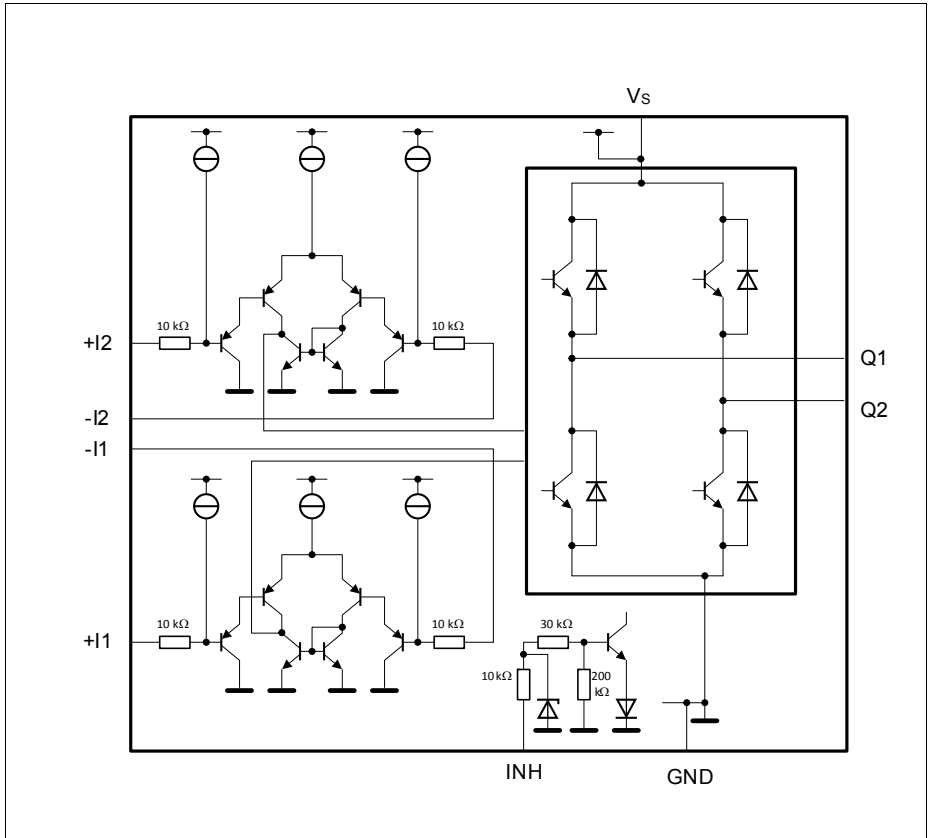


Figure 2 Block Diagram

**Circuit Description**

The IC contains two amplifiers with typical open-loop gain of 80 dB at 500 Hz.

The input stages consist of PNP-differential amplifiers. This produces a common-mode input range of 0 V to nearly  $V_S$  and a maximum differential input voltage of  $V_S$ . The IC is guarded against ground shorts by an SOA-protective circuit. The output transistors are turned off if the chip temperature exceeds approx. 160 °C. The IC can be turned off by an inhibit input, which very much reduces current consumption.



**Figure 3 Circuit Diagram**

**Absolute Maximum Ratings**
 $T_j = -40$  to  $150$  °C

| Parameter                  | Symbol    | Limit Values |           | Unit | Remarks                                |
|----------------------------|-----------|--------------|-----------|------|--|
|                            |           | min.         | max.      |      |  |
| Supply voltage             | $V_S$     | - 0.3        | 45        | V    | -                                      |
| Differential input voltage | $V_{ID}$  | -            | $\pm V_S$ | V    | $\Delta V_{8-9}$ or $\Delta V_{10-11}$ |
| Output current             | $I_Q$     | - 1          | 1         | A    | -                                      |
| Supply current             | $I_S$     | 2.5          | 3         | A    | -                                      |
| Ground current             | $I_{GND}$ | - 3          | 2.5       | A    | I2                                     |
| Input voltage              | $V_I$     | - 15         | $V_S$     | V    | $V_8; V_9; V_{10}; V_{11}$             |
| Inhibit input              | $V_{Inh}$ | - 15         | $V_S$     | V    | $V_{12}$                               |
| Junction temperature       | $T_j$     | -            | 150       | °C   | -                                      |
| Storage temperature        | $T_{stg}$ | - 50         | 150       | °C   | -                                      |

**Operating Range**

|  |            |      |    |     |                  |
|--|------------|------|----|-----|------------------|
| Supply voltage                           | $V_S$      | 6    | 32 | V   | -                |
| Case temperature                         | $T_C$      | - 40 | 95 | °C  | $P_{Dmax} = 3$ W |
| Thermal resistance<br>junction - ambient | $R_{thJA}$ | -    | 65 | K/W |                  |
| junction - case                          | $R_{thJC}$ | -    | 20 | K/W |                  |

 Outputs pin 1 and pin 19 short-circuit proof to GND at  $V_S \leq 18$  V

**Characteristics**
 $6$  V <  $V_S$  <  $18$  V;  $-40$  °C <  $T_j$  <  $150$  °C

| Parameter | Symbol | Limit Values |      |      | Unit | Test Condition |
|-----------|--------|--------------|------|------|------|----------------|
|           |        | min.         | typ. | max. |      |                |

**General**

|  |              |   |    |     |    |                           |
|--|--------------|---|----|-----|----|---------------------------|
| Open-circuit current consumption               | $I_S$        | - | 10 | 30  | mA | active, both outputs high |
| Open-circuit current consumption               | $I_S$        | - | 10 | 100 | μA | inhibit                   |
| Turn-ON dead time<br>ref. to $V_{12\ OFF/ON}$  | $t_{d\ ON}$  | - | 10 | 20  | μs | $ I_{1,19}  < 1$ A        |
| Turn-OFF dead time<br>ref. to $V_{12\ OFF/ON}$ | $t_{d\ OFF}$ | - | 10 | 20  | μs | $ I_{1,19}  < 1$ A        |

**Characteristics** (cont'd)

 $6\text{ V} < V_S < 18\text{ V}; -40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$ 

| Parameter      | Symbol   | Limit Values |      |      | Unit | Test Condition      |
|----------------|----------|--------------|------|------|------|---------------------|
|                |          | min.         | typ. | max. |      |                     |
| Open-loop gain | $G_{VO}$ | 50           | 80   | –    | dB   | $f = 500\text{ Hz}$ |

**Inputs**

|                                   |                          |       |    |           |                 |                            |
|-----------------------------------|--------------------------|-------|----|-----------|-----------------|----------------------------|
| Input zero voltage                | $V_{IO}$                 | – 7.5 | –  | 7.5       | mV              | $R_S = 10\text{ k}\Omega;$ |
| Input-voltage drift               | $\Delta V_{IO}/\Delta T$ | –     | 20 | 30        | $\mu\text{V/K}$ | –                          |
| Input zero current                | $I_{IO}$                 | – 75  | –  | 75        | mA              | –                          |
| Input current                     | $I_I$                    | – 300 | –  | 300       | nA              | –                          |
| Input-current drift               | $\Delta I_I/\Delta T$    | –     | –  | 5         | nA/K            | –                          |
| Input common-mode range, positive | $V_{IC}$                 | –     | –  | $V_S - 2$ | V               | –                          |
| Input common-mode range, negative | $V_{IC}$                 | –     | –  | – 0.5     | V               | –                          |
| Power-supply rejection ratio      | $PSSR$                   | –     | –  | 200       | $\mu\text{V/V}$ | $R_S = 10\text{ k}\Omega;$ |
| Common-mode rejection ratio       | $CMRR$                   | 70    | 80 | –         | dB              | –                          |



**Characteristics** (cont'd)

 $6\text{ V} < V_S < 18\text{ V}; -40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$ 

| Parameter | Symbol | Limit Values |      |      | Unit | Test Condition |
|-----------|--------|--------------|------|------|------|----------------|
|           |        | min.         | typ. | max. |      |                |

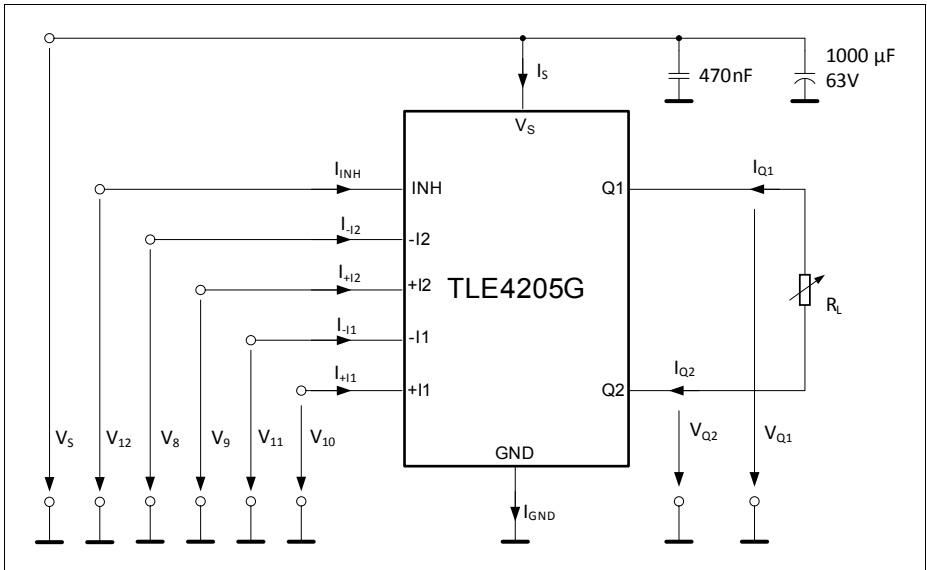
**Outputs**

|  |                    |   |      |     |                  |                       |
|--|--------------------|---|------|-----|------------------|-----------------------|
| Saturation voltage                     | $V_{\text{Sat U}}$ | – | 1.35 | 1.5 | V                | $I_Q = -0.6\text{ A}$ |
| Saturation voltage                     | $V_{\text{Sat L}}$ | – | 0.8  | 1.2 | V                | $I_Q = 0.6\text{ A}$  |
| Forward voltage of free-wheeling diode | $V_{\text{FU}}$    | – | 1    | 1.5 | V                | $I_F = 0.6\text{ A}$  |
| Forward voltage of free-wheeling diode | $V_{\text{FL}}$    | – | 1    | 1.5 | V                | $I_F = 0.6\text{ A}$  |
| Slew rate of $V_Q$                     | $dV_q/dt_r$        | – | 0.5  | –   | V/ $\mu\text{s}$ | –                     |

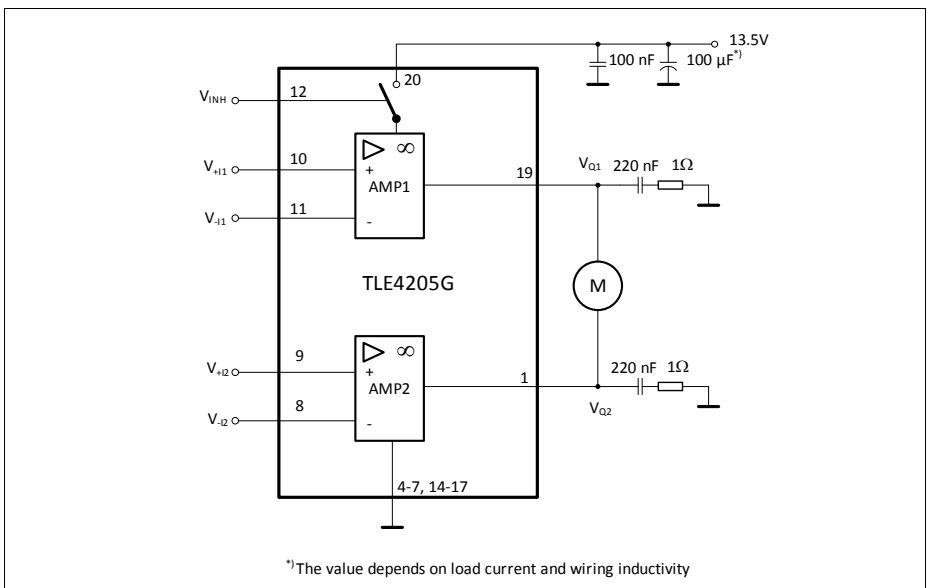
**Inhibit Input**

|                          |                 |   |     |     |               |                       |
|--------------------------|-----------------|---|-----|-----|---------------|-----------------------|
| Switching threshold high | $V_{\text{IH}}$ | 2 | –   | –   | V             | –                     |
| Switching threshold low  | $V_{\text{IL}}$ | – | –   | 0.8 | V             | –                     |
| H-input current          | $I_{\text{IH}}$ | – | 100 | –   | $\mu\text{A}$ | $V_{12} = 5\text{ V}$ |
| L-input current          | $I_{\text{IH}}$ | – | 0   | –   | $\mu\text{A}$ | $V_{12} = 0\text{ V}$ |

Note:  $V_{\text{Sat U}}$  = upper  
 $V_{\text{Sat L}}$  = lower



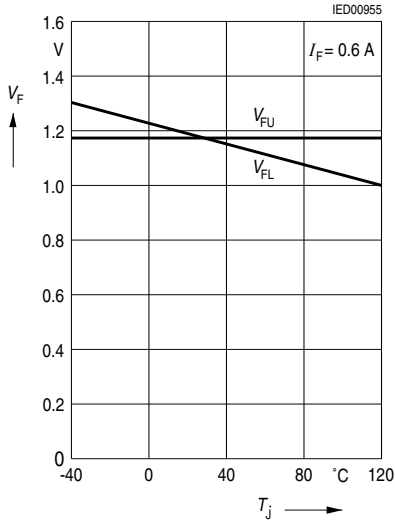
**Figure 4 Test Circuit**



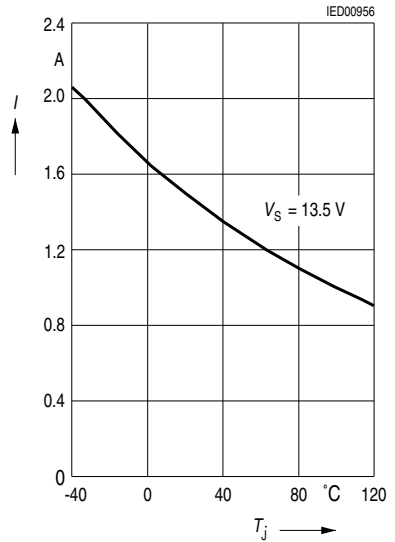
<sup>1)</sup>The value depends on load current and wiring inductivity

**Figure 5 Application Circuit**

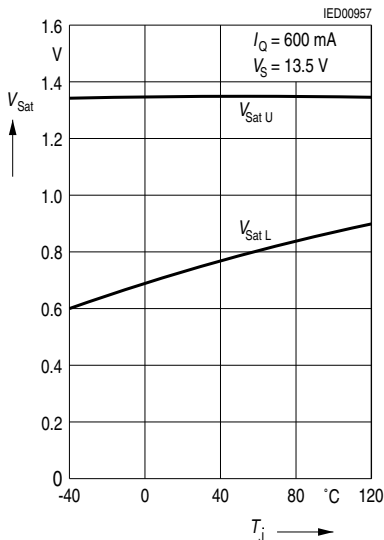
**Forward Voltage of the Free-Wheeling Diodes versus Junction Temperature**



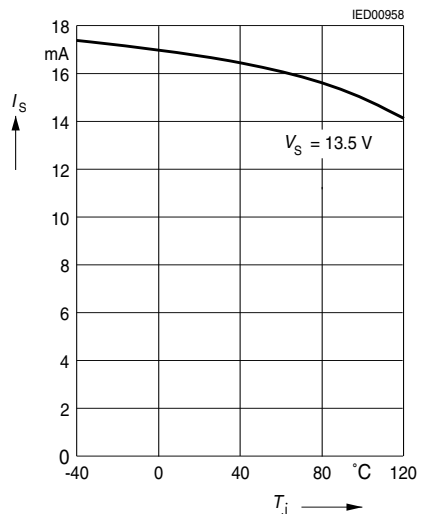
**Start Point of the SOA-Protection Circuit versus Junction Temperature**



**Saturation Voltage versus Junction Temperature**



**Current Consumption versus Junction Temperature**



Package Outlines

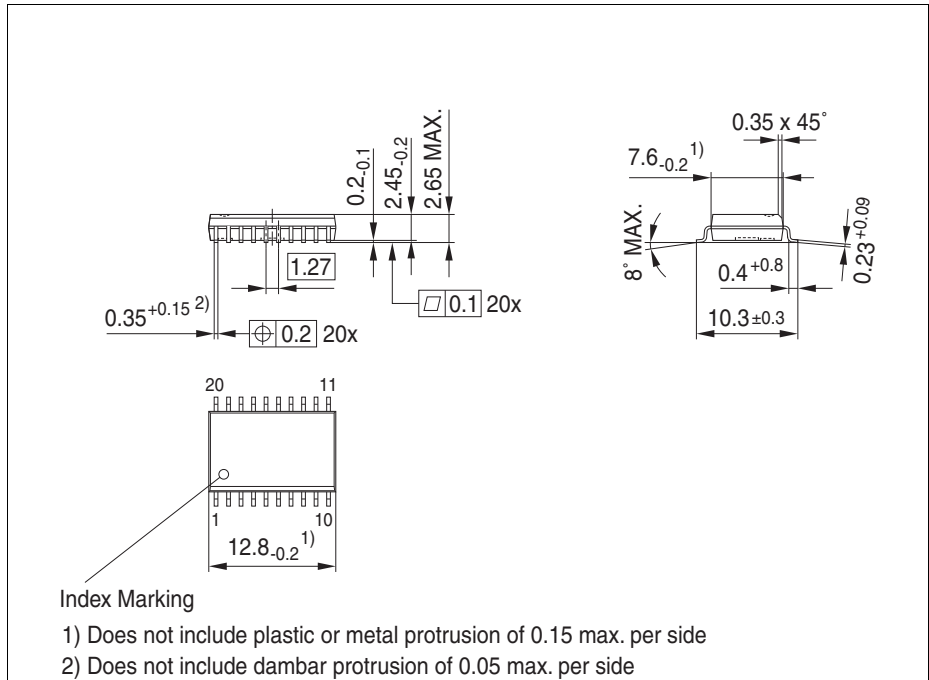


Figure 6 PG-DSO-20 (Plastic Dual Small Outline)

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).

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Dimensions in mm

## Revision History

| Revision | Date       | Changes  |
|----------|------------|--|
| 1.1      | 2015-01-19 | <p>Initial version of RoHS-compliant derivate of TLE 4205G</p> <ul style="list-style-type: none"><li>• Page 1: Added Coverpage,</li><li>• All pages: Infineon logo updated</li><li>• Page 2:<br/>“added AEC qualified” and “RoHS” logo, “Green Product (RoHS compliant)” and “AEC qualified” statement added to feature list, package name changed to RoHS compliant versions, package picture updated</li><li>• Page 12:<br/>Package name changed to RoHS compliant versions, “Green Product” description added</li><li>• Page 13: added Revision History</li><li>• Page 14: added Legal Disclaimer</li><li>• Page 7, Page 9: V9 designating the voltage at INH pin renamed V12</li></ul> |

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