

## 1-A DC Motor Driver

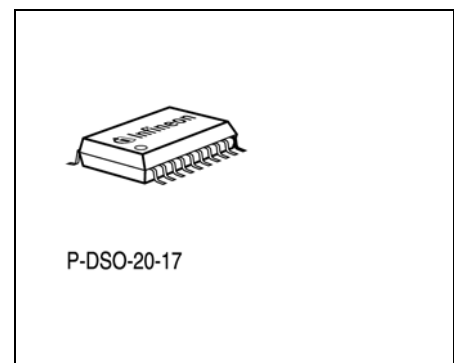
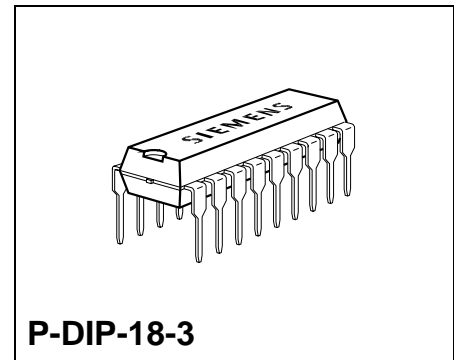
**TLE 4205**

### Overview

**Bipolar IC**

### Features

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



Type	Ordering Code	Package
TLE 4205	Q67000-A9025	P-DIP-18-3
TLE 4205 G	Q67006-A9114	P-DSO-20-17

### Description

TLE 4205 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.

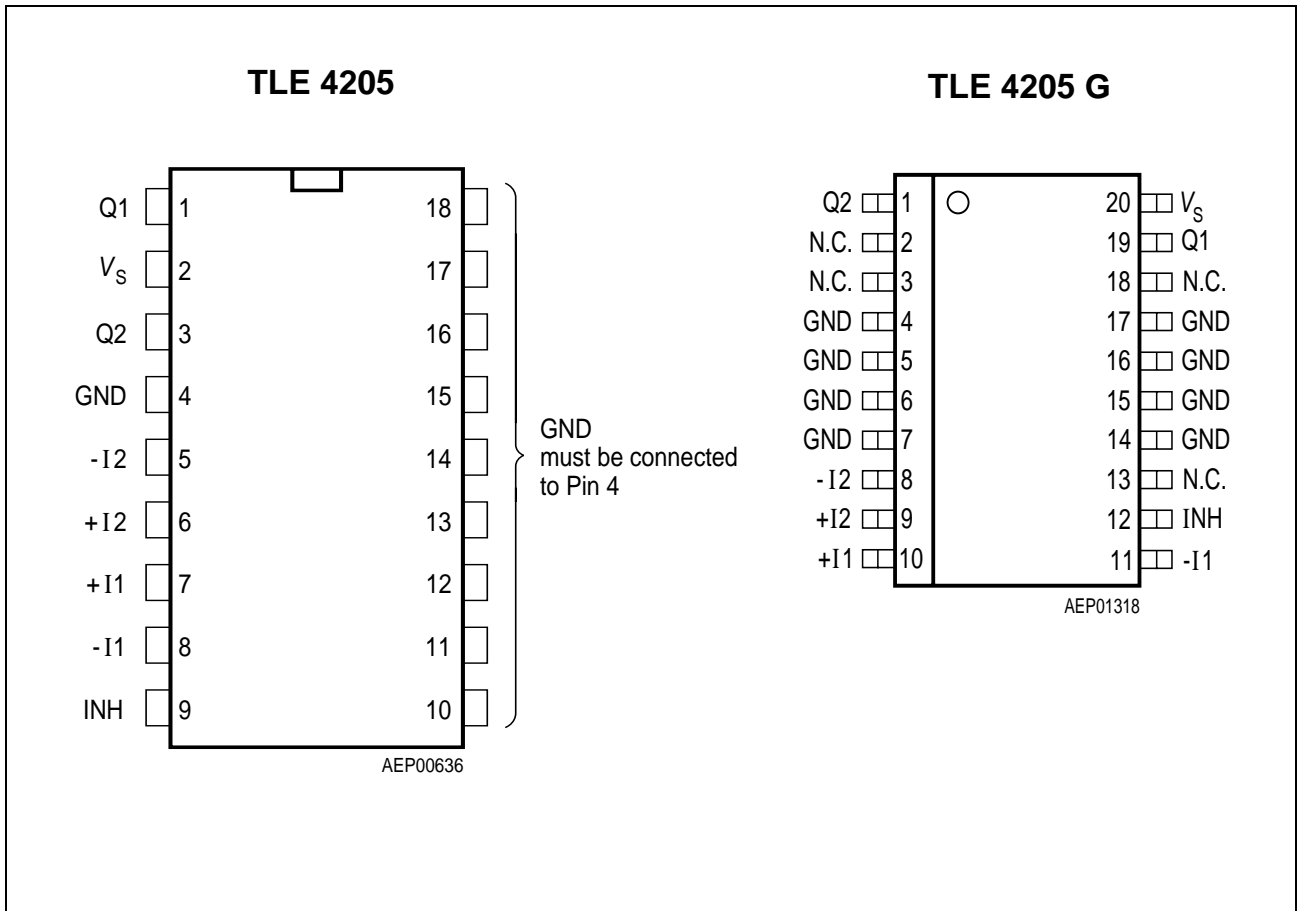


Figure 1 Pin Configuration (top view)

**Pin Definitions and Functions**

Pin No.	Symbol	Function
1	Q1	<b>Output Q1 of channel 1;</b> push-pull B output with DC short-circuit protection to ground. Integrated free-wheeling diodes to ground and the supply voltage.
2	$V_S$	<b>Supply voltage <math>V_S</math>;</b> must be blocked to ground with a ceramic capacitor of at least 100 nF directly on the pins of the IC.
3	Q2	<b>Output Q2 of channel 2;</b> see pin 1.
4	GND	Ground
5	- I2	<b>Inverting input channel 2;</b> to be wired according to general rules.
6	+ I2	<b>Non-inverting input channel 2;</b> to be wired according to general rules.
7	+ I1	<b>Non-inverting input channel 1;</b> see pin 6.
8	- I1	<b>Inverting input channel 1;</b> see pin 5.
9	INH	<b>Inhibit;</b> the IC is passive when this pin is open or connected to ground.
10-18	GND	<b>Ground;</b> must be connected to pin 4.

**Pin Definitions and Functions (TLE 4205 G)**

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.

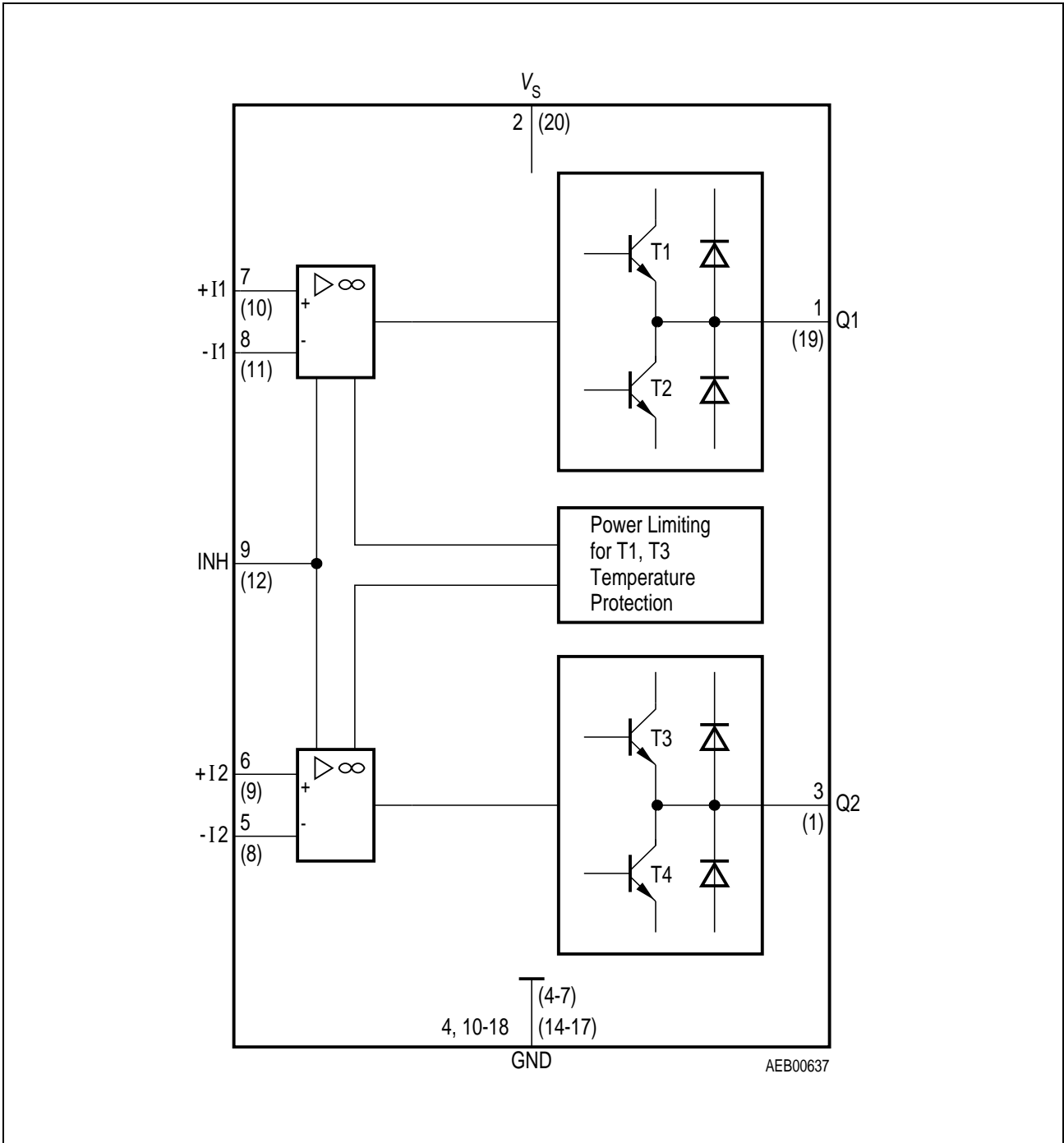


Figure 2 Block Diagram

### 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.

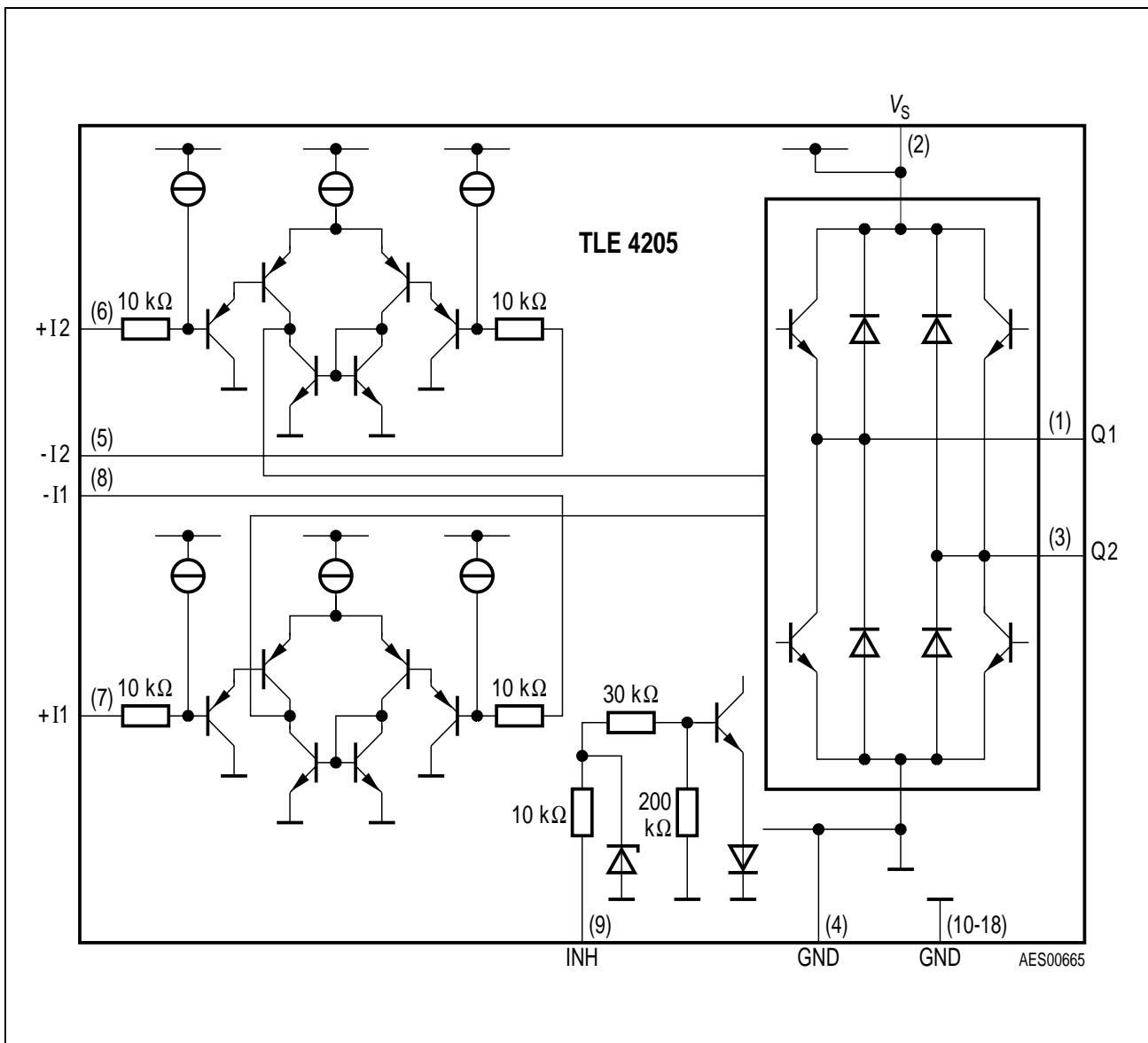


Figure 3 Circuit Diagram

**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	$\Delta V_{6-5}$ or $\Delta V_{7-8}$ TLE 4205 $\Delta V_{8-9}$ or $\Delta V_{10-11}$ TLE 4205 G
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	$V_5; V_6; V_7; V_8$ TLE 4205 $V_8; V_9; V_{10}; V_{11}$ TLE 4205 G
Inhibit input	$V_{Inh}$	- 15	$V_S$	V	$V_9$ TLE 4205 $V_{12}$ TLE 4205G
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	105	°C	$P_{Dmax} = 3$ W; DIP
Case temperature	$T_C$	- 40	95	°C	$P_{Dmax} = 3$ W; SO
Thermal resistance junction - ambient	$R_{th JA}$	-	60	K/W	TLE 4205
junction - case	$R_{th JC}$	-	15	K/W	TLE 4205
Thermal resistance junction - ambient	$R_{th JA}$	-	65	K/W	TLE 4205 G
junction - case	$R_{th JC}$	-	20	K/W	TLE 4205 G

Outputs pin 1 (19) and pin 3 (1) short-circuit proof to GND at  $V_S \leq 18$  V for TLE 4205 (TLE 4205G)

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

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

**General**

Open-circuit current consumption	$I_S$	–	10	30	mA	active, both outputs high
Open-circuit current consumption	$I_S$	–	10	100	$\mu\text{A}$	inhibit
Turn-ON dead time ref. to $V_{9\text{ OFF/ON}}$	$t_{d\text{ ON}}$	–	10	20	$\mu\text{s}$	$ I_{1,3}  < 1\text{ A}$ TLE 4205 $ I_{1,19}  < 1\text{ A}$ TLE 4205 G
Turn-OFF dead time ref. to $V_{9\text{ OFF/ON}}$	$t_{d\text{ OFF}}$	–	10	20	$\mu\text{s}$	$ I_{1,3}  < 1\text{ A}$ TLE 4205 $ I_{1,19}  < 1\text{ A}$ TLE 4205 G
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	–	$\mu\text{A}$	$V_9 = 5\text{ V}$
L-input current	$I_{\text{IH}}$	–	0	–	$\mu\text{A}$	$V_9 = 0\text{ V}$

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

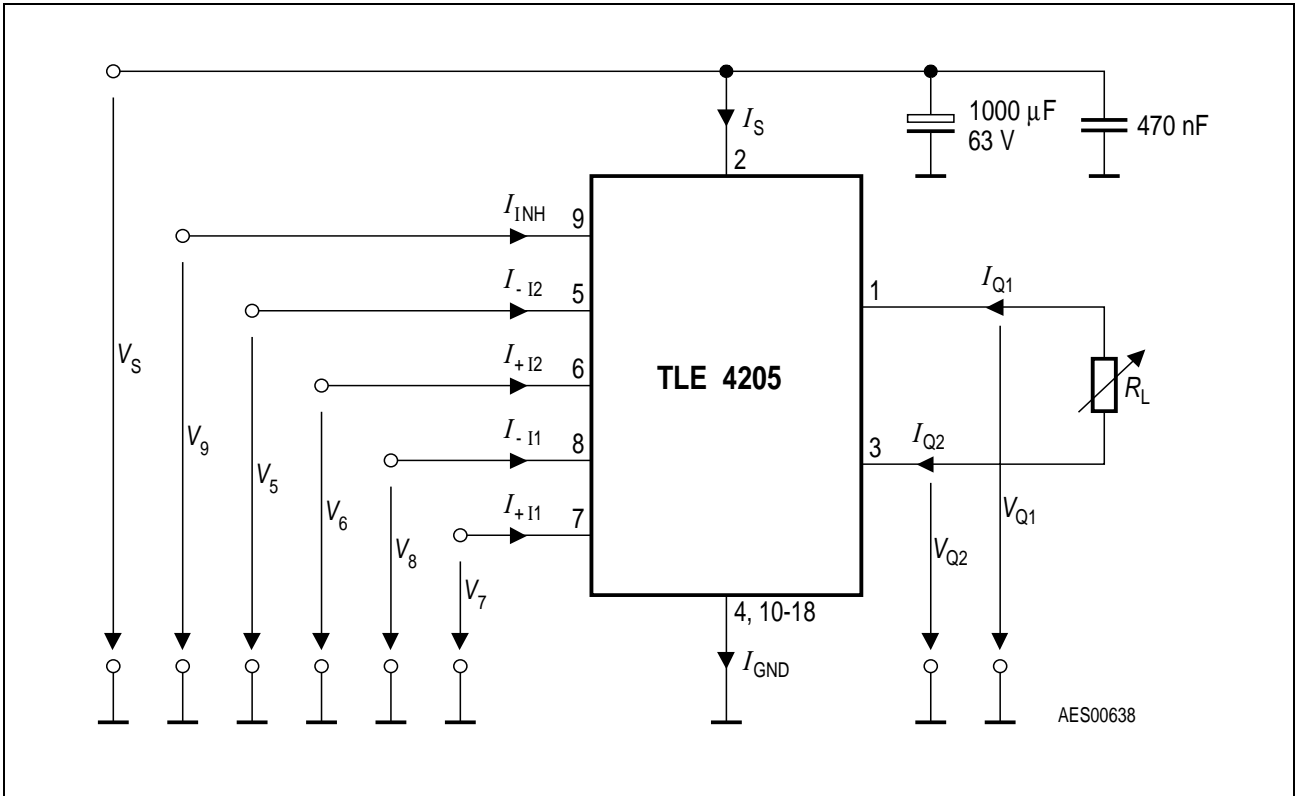


Figure 4 Test Circuit

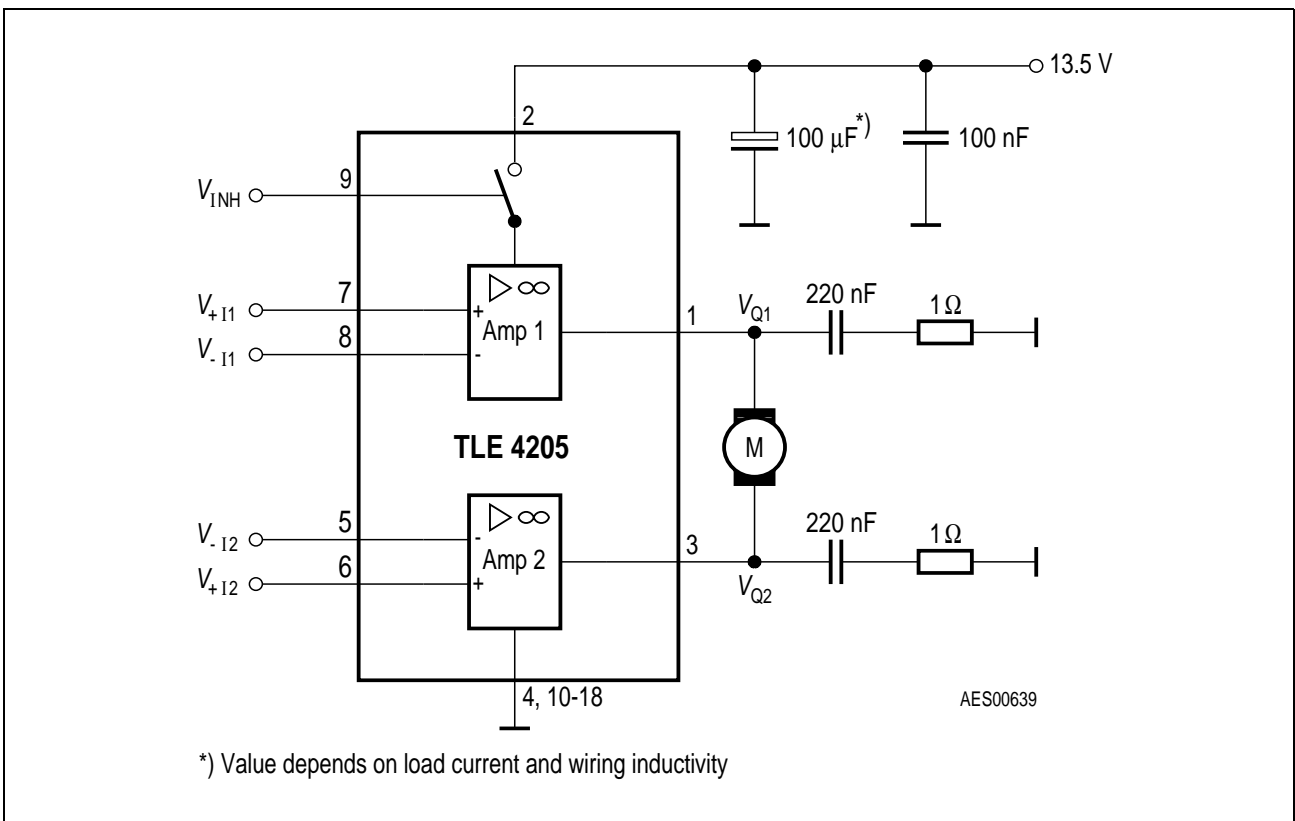
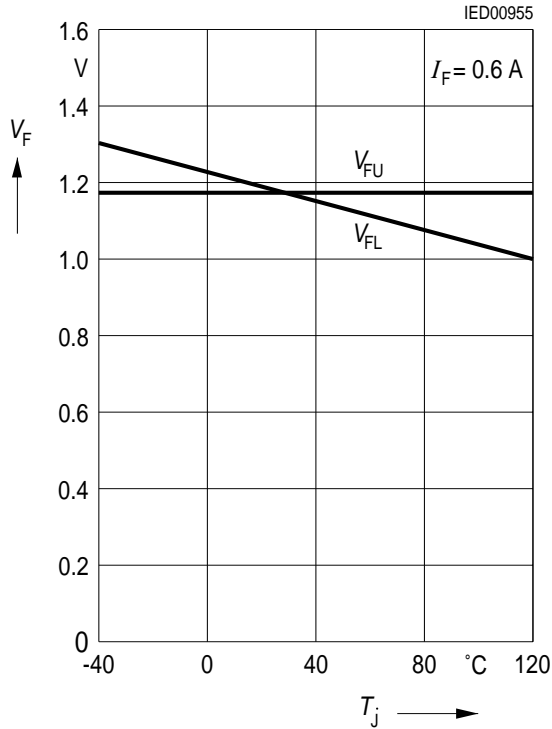
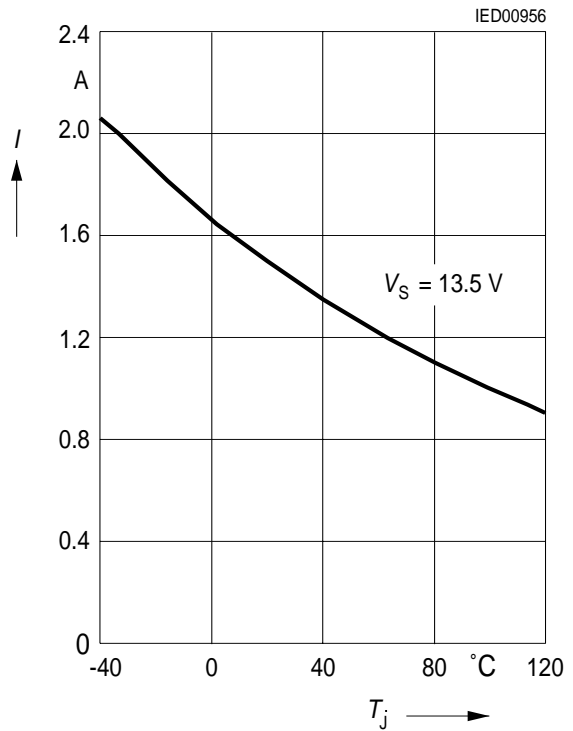


Figure 5 Application Circuit

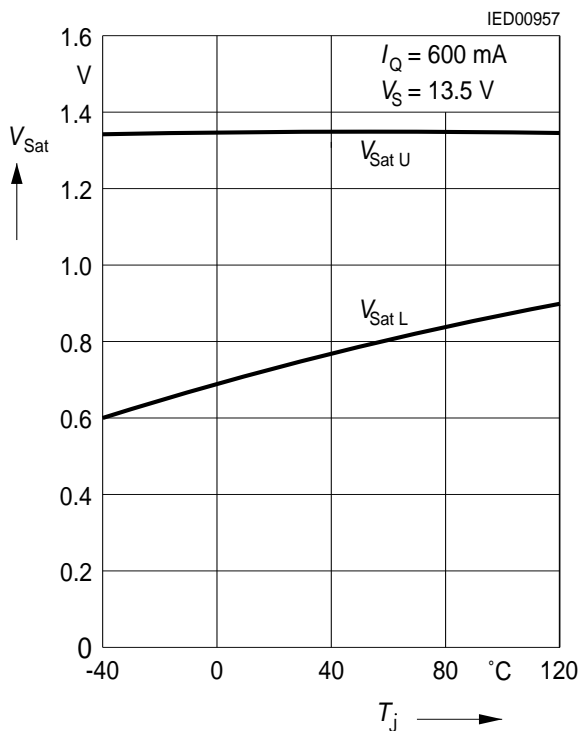
**Forward Voltage of the Free-Wheeling Diodes versus Junction Temperature**



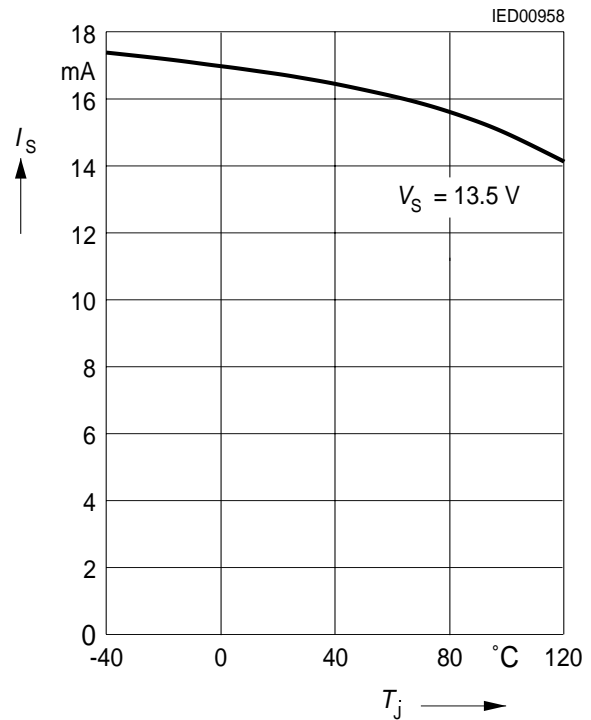
**Start Point of the SOA-Protection Circuit versus Junction Temperature**



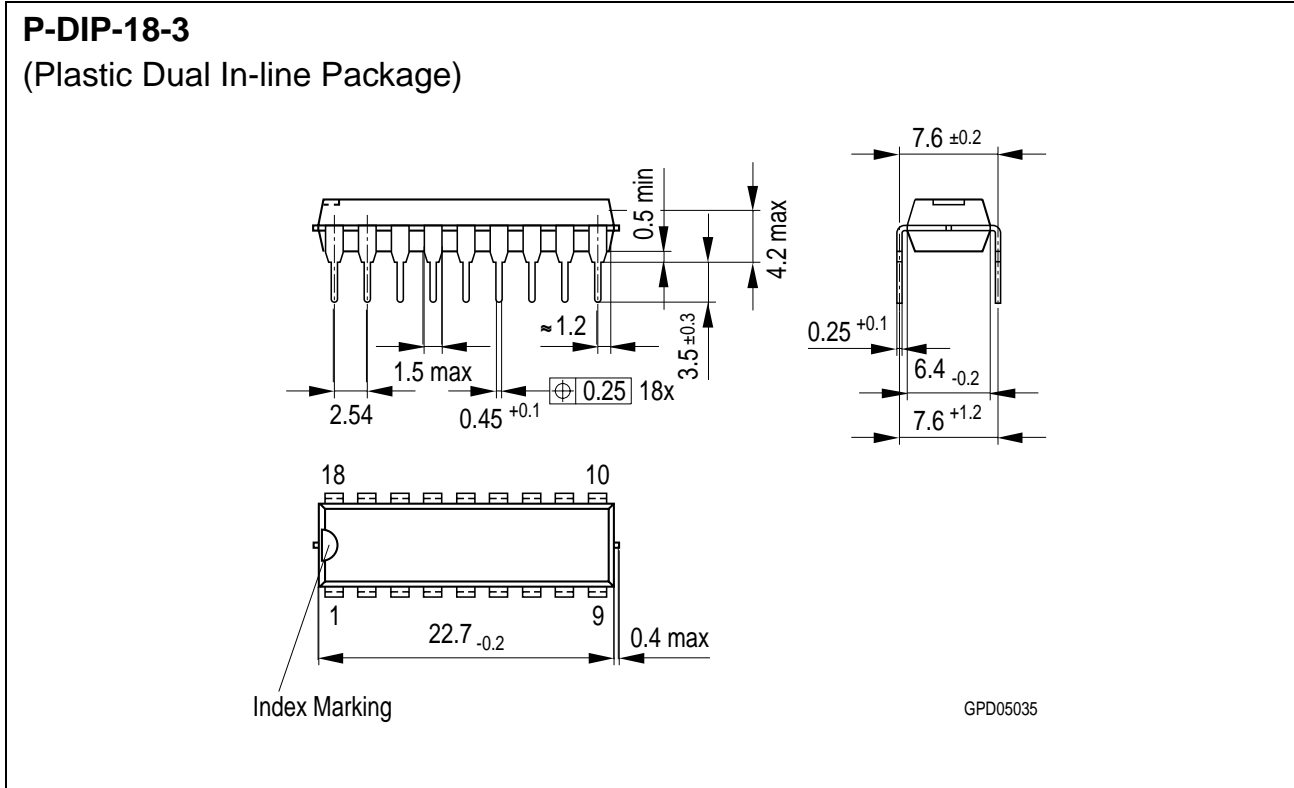
**Saturation Voltage versus Junction Temperature**



**Current Consumption versus Junction Temperature**



**Package Outlines**

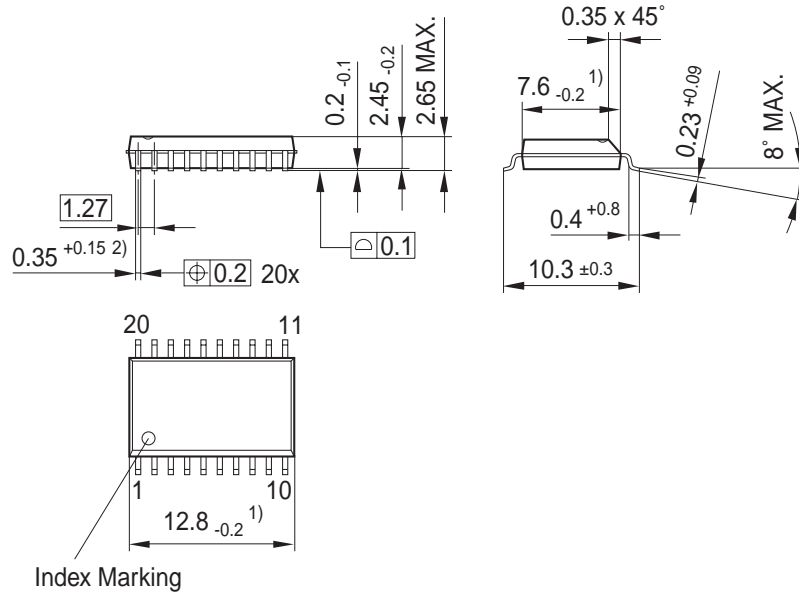


**Sorts of Packing**

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

Dimensions in mm

**P-DSO-20-17**  
(Plastic Dual Small Outline Package)



- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Does not include dambar protrusion of 0.05 max. per side

**Sorts of Packing**

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SMD = Surface Mounted Device

Dimensions in mm