SIEMENS

Motor Driver

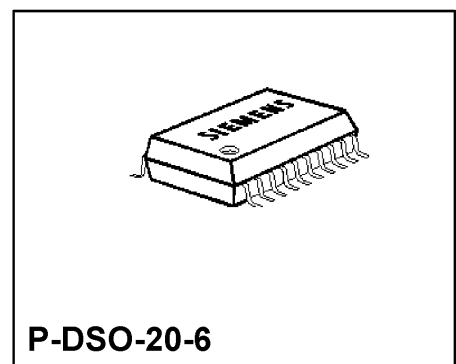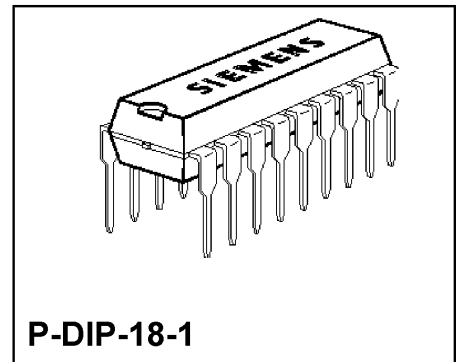<div align="right">

TLE 4205

Bipolar IC

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Features

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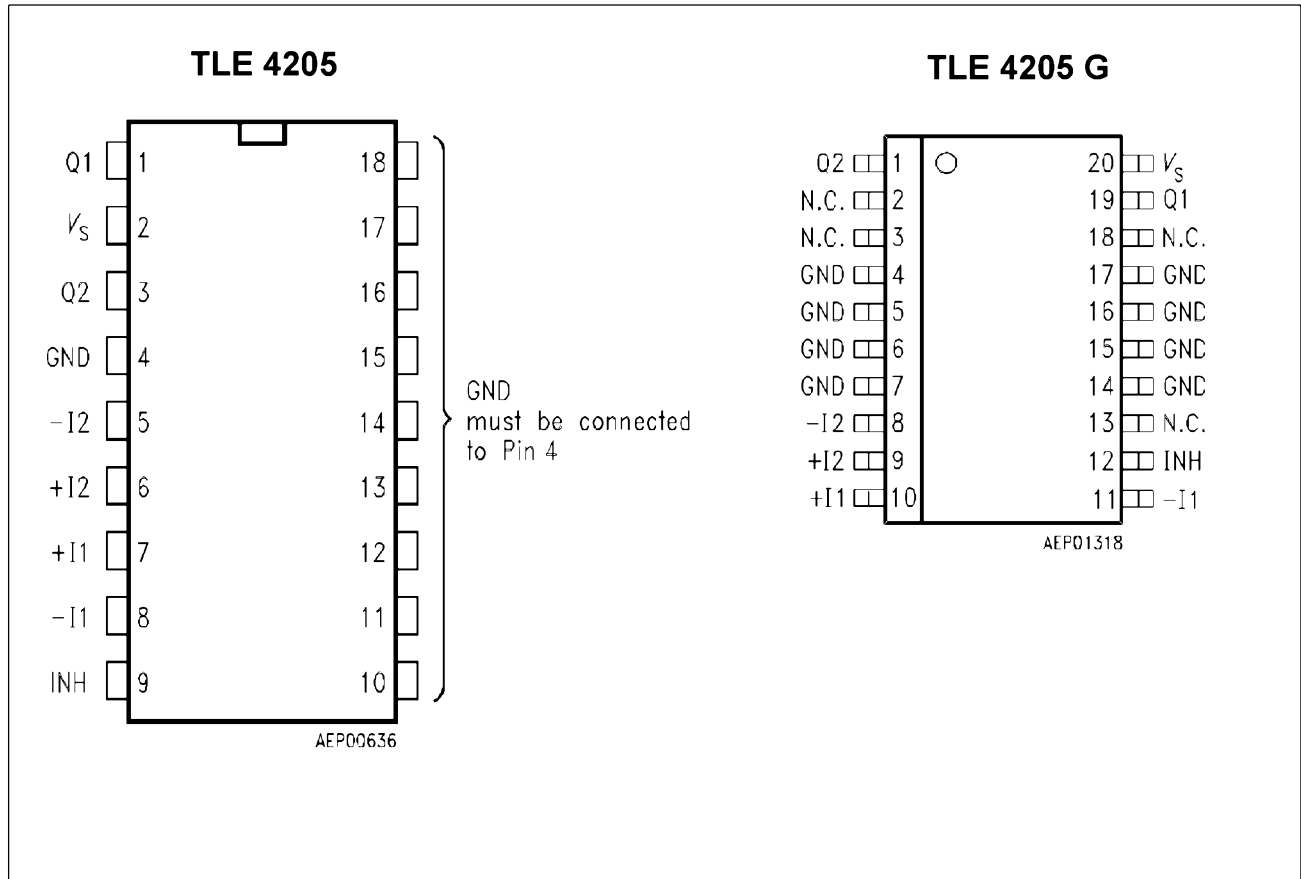- Temperature range – 40 °C $\leq T_j \leq$ 150 °C

P-DIP-18-1

P-DSO-20-6

Type	Ordering Code	Package
TLE 4205	Q67000-A9025	P-DIP-18-1
▼ TLE 4205 G	Q67000-A9114	P-DSO-20-6 (SMD)

▼ New type

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 from 18 V to ground and turn-OFF when overtemperature occurs. This IC is especially suitable for headlight-beam adjustment in automobiles.
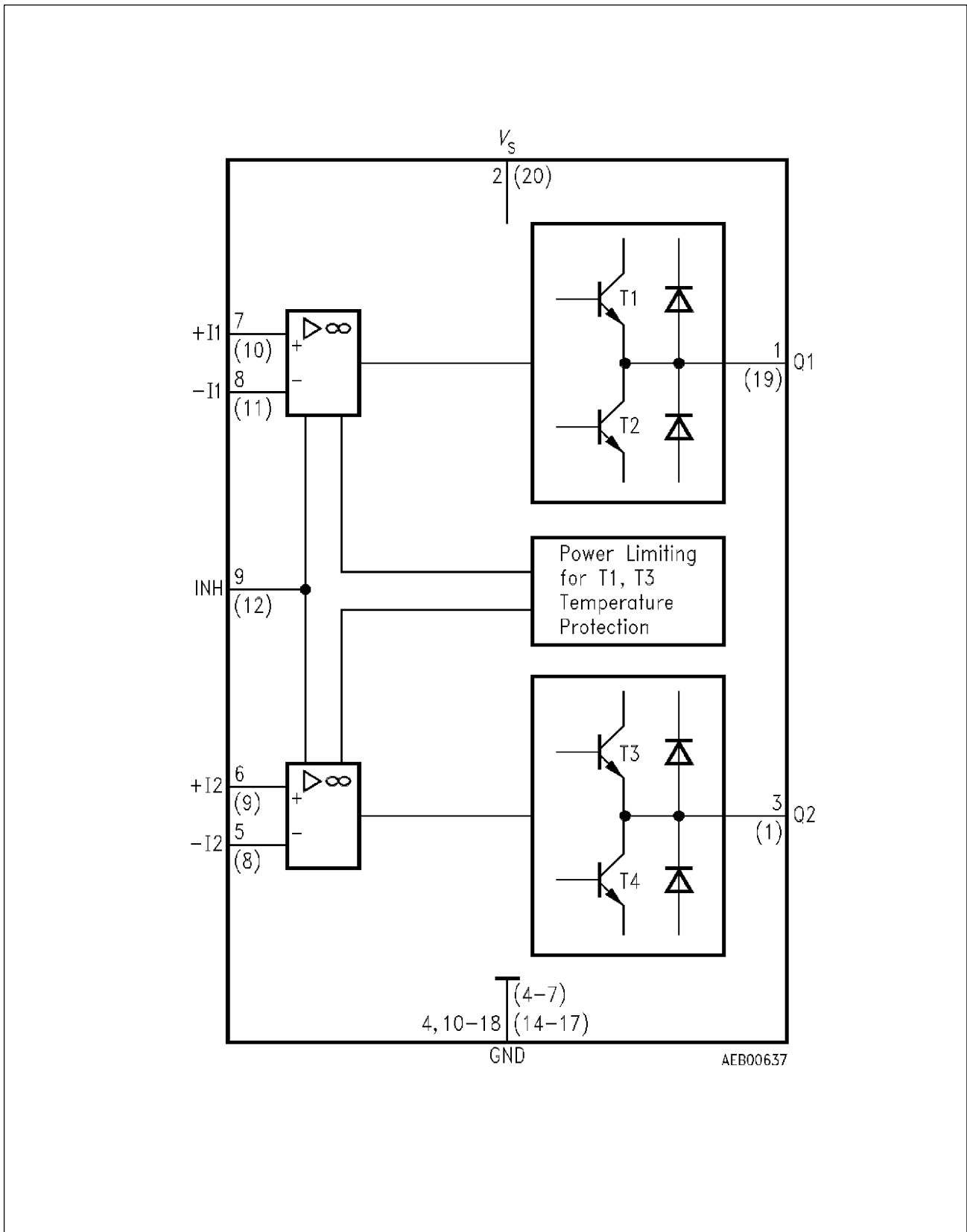
Pin Configuration
(top view)

TLE 4205

Q1	1 ... 18
V_S	2 ... 17
Q2	3 ... 16
GND	4 ... 15
–I2	5 ... 14
+I2	6 ... 13
+I1	7 ... 12
–I1	8 ... 11
INH	9 ... 10

GND must be connected to Pin 4

AEP00636

TLE 4205 G

Left	Right
Q2 — 1	20 — V_S
N.C. — 2	19 — Q1
N.C. — 3	18 — N.C.
GND — 4	17 — GND
GND — 5	16 — GND
GND — 6	15 — GND
GND — 7	14 — GND
–I2 — 8	13 — N.C.
+I2 — 9	12 — INH
+I1 — 10	11 — –I1

AEP01318

Pin Definitions and Functions (TLE 4205)

Pin	Symbol	Function
1	Q1	**Output Q1 of channel 1;** push-pull B output with DC short-circuit protection to ground. Integrated free-wheeling diodes to ground and the supply voltage.
2	V_S	**Supply voltage** V_S; must be blocked to ground with a ceramic capacitor of at least 100 nF directly on the pins of the IC.
3	Q2	**Output Q2 of channel 2;** see pin 1.
4	GND	**Ground**
5	− I2	**Inverting input channel 2;** to be wired according to general rules.
6	+ I2	**Non-inverting input channel 2;** to be wired according to general rules.
7	+ I1	**Non-inverting input channel 1;** see pin 6.
8	− I1	**Inverting input channel 1;** see pin 5.
9	INH	**Inhibit;** the IC is passive when this pin is open or connected to ground.
10-18	GND	**Ground;** must be connected to pin 4.

Pin Definitions and Functions (TLE 4205 G)

Pin	Symbol	Function
1	Q2	**Output 2 of channel 2**; 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	**Inverting input channel 2**; to be wired according to general rules.
9	+ I2	**Non-inverting input channel 2**; to be wired according to general rules.
10	+ I1	**Non-inverting input channel 1**; see pin 6.
11	– I1	**Inverting input channel 1**; see pin 5.
12	INH	**Inhibit**; 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**; must be connected to pin 4.
20	V_S	**Supply voltage**; must be connected to pin 4.

V_S

2 (20)

+I1 7
     (10) + ▷∞

−I1 8
     (11) −

T1

T2

1
(19) Q1

Power Limiting
for T1, T3
Temperature
Protection

INH 9
     (12)

+I2 6
     (9) + ▷∞

−I2 5
     (8) −

T3

T4

3
(1) Q2

(4−7)
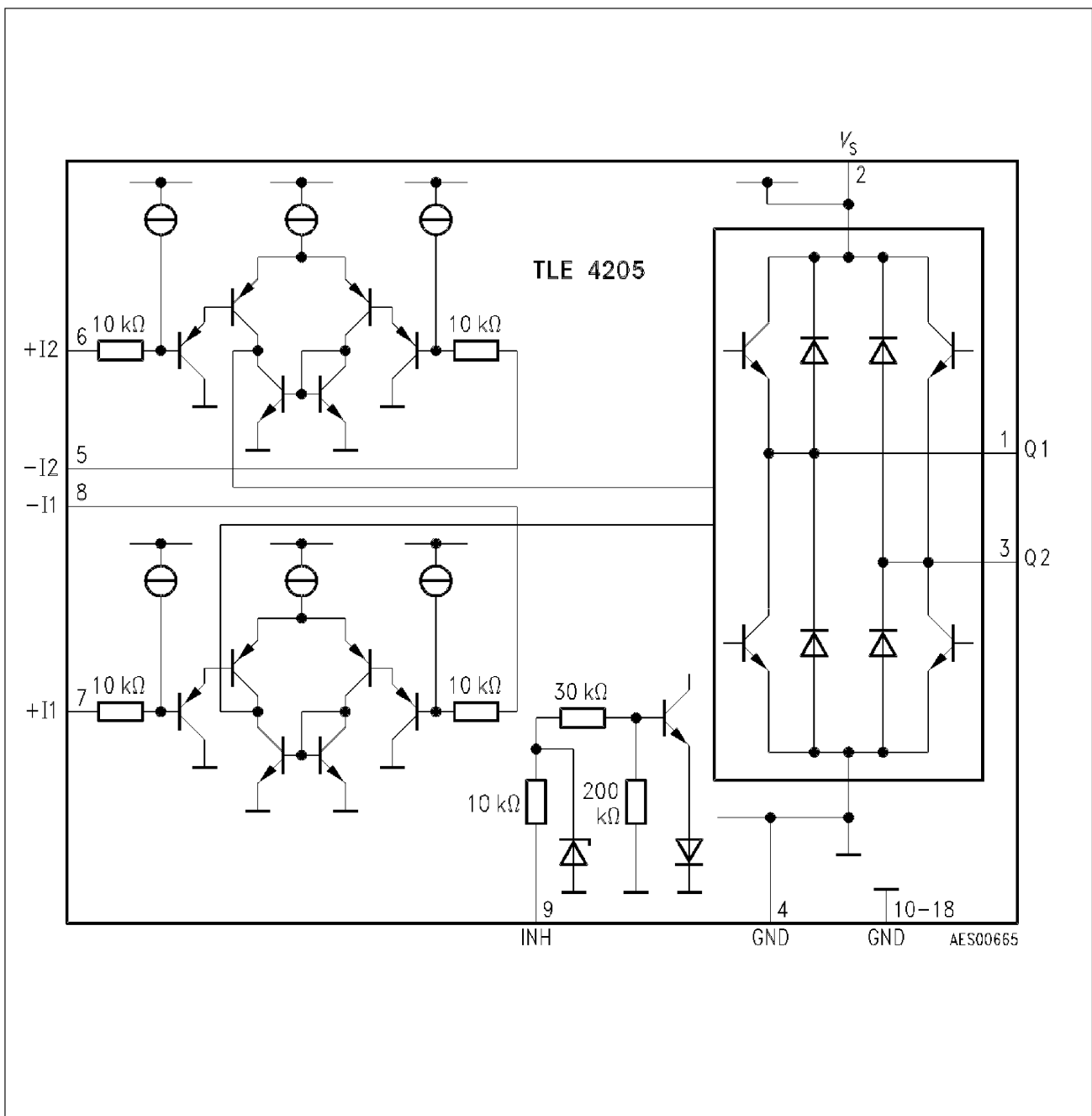4,10−18 (14−17)
GND

AEB00637

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.

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	$\Delta V_{6\text{-}5}$ or $\Delta V_{7\text{-}8}$ TLE 4205 $\Delta V_{8\text{-}9}$ or $\Delta V_{10\text{-}11}$ 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_9	-15	$+V_S$	V	
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	$°C$	$P_{Dmax} = 3\ W$
Thermal resistance junction - ambient junction - case	$R_{th\ JA}$ $R_{th\ JC}$		60 15	K/W K/W	TLE 4205 TLE 4205
Thermal resistance junction - ambient junction - case	$R_{th\ JA}$ $R_{th\ JC}$		65 3	K/W K/W	TLE 4205 G TLE 4205 G

Outputs pin 1 and pin 3 short-circuit proof to GND at $V_S \leq 18\ V$

Characteristics

V_S = 13.5 V; T_j = 25 °C

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

General

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Open-circuit current consumption	I_S		10	30	mA	active
Open-circuit current consumption	I_S		10	100	µA	inhibit
Turn-ON dead time ref. to $V_{9\ OFF/ON}$	$t_{d\ ON}$		10	20	µs	$\lvert I_{1,3} \rvert$ < 1 A TLE 4205 $\lvert I_{1,19} \rvert$ < 1 A TLE 4205 G
Turn-OFF dead time ref. to $V_{9\ OFF/ON}$	$t_{d\ OFF}$		10	20	µs	$\lvert I_{1,3} \rvert$ < 1 A TLE 4205 $\lvert I_{1,19} \rvert$ < 1 A TLE 4205 G
Open-loop gain	G_{VO}	50	80		dB	f = 500 Hz

Inputs

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Input zero voltage	V_{IO}	− 7.5		7.5	mV	R_S = 10 kΩ; − 40 °C ≤ T_j ≤ 85 °C
Input-voltage drift	$\Delta V_{IO}/\Delta T$		20	30	µV/K	− 40 °C ≤ T_j ≤ 85 °C
Input zero current	I_{IO}	− 75		75	mA	− 40 °C ≤ T_j ≤ 85 °C
Input current	I_I	− 300		300	nA	− 40 °C ≤ T_j ≤ 85 °C
Input-current drift	$\Delta I_I/\Delta T$			5	nA/K	− 40 °C ≤ T_j ≤ 85 °C
Input common-mode range, positive	V_{IC}			$V_S - 2$	V	
Input common-mode range, negative	V_{IC}			− 0.5	V	

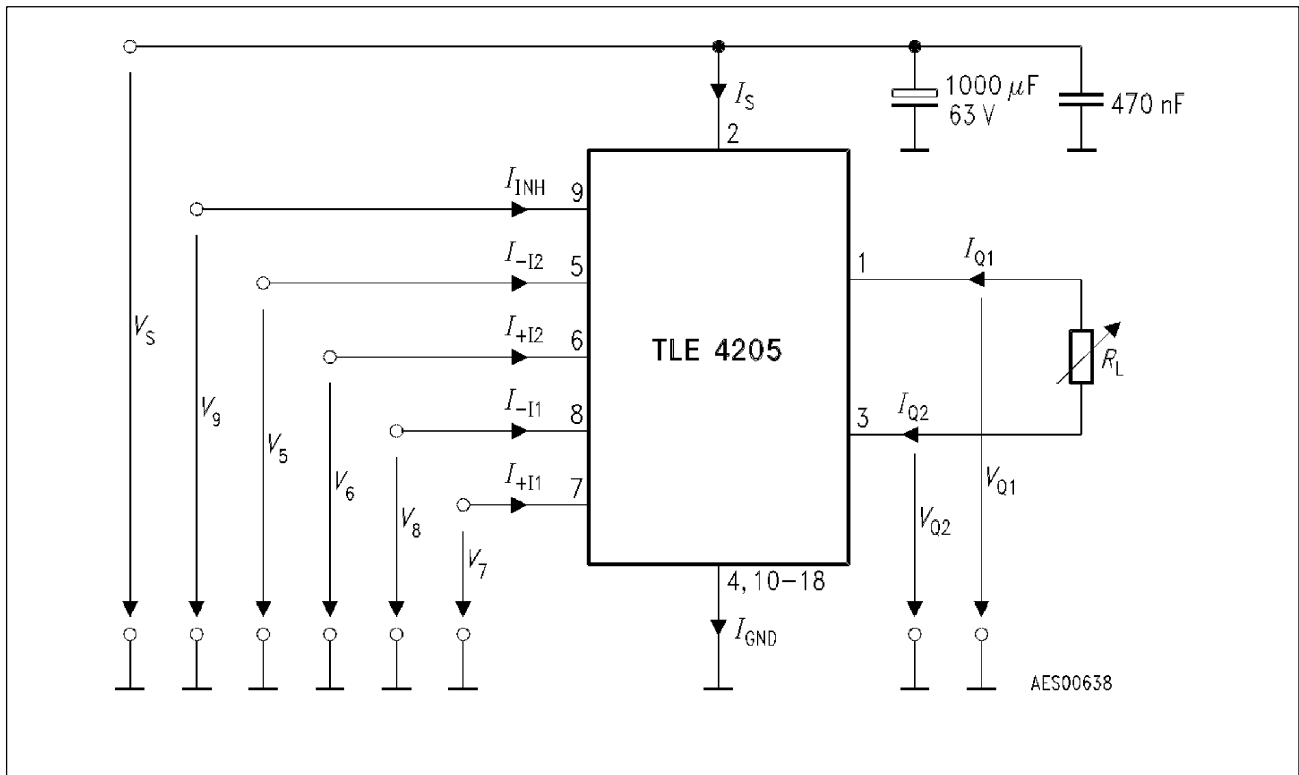## Characteristics (cont'd)

$V_S = 13.5 \text{ V}; T_j = 25 \text{ °C}$

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Power-supply rejection ratio	$PSSR$			200	µV/V	$R_S = 10 \text{ k}\Omega;$ $-40 \text{ °C} \le T_j \le 85 \text{ °C}$
Common-mode rejection ratio	$CMRR$	70	80		dB	

Outputs

Saturation voltage	V_{Satu}		1.0	1.5	V	$I_Q = 0.6 \text{ A};$ $-40 \text{ °C} \le T_j \le 85 \text{ °C}$
Saturation voltage	V_{Sat1}		1.0	1.5	V	$I_Q = 0.6 \text{ A};$ $-40 \text{ °C} \le T_j \le 85 \text{ °C}$
Forward voltage of free-wheeling diode	V_{Fu}		1.0	1.5	V	$I_Q = 0.6 \text{ A};$ $-40 \text{ °C} \le T_j \le 85 \text{ °C}$
Forward voltage of free-wheeling diode	V_{F1}		1.0	1.5	V	$I_Q = 0.6 \text{ A};$ $-40 \text{ °C} \le T_j \le 85 \text{ °C}$
Slew rate of V_Q	$\mathrm{d}V_q\mathrm{d}t_r$		0.5		V/µs	

Inhibit Input

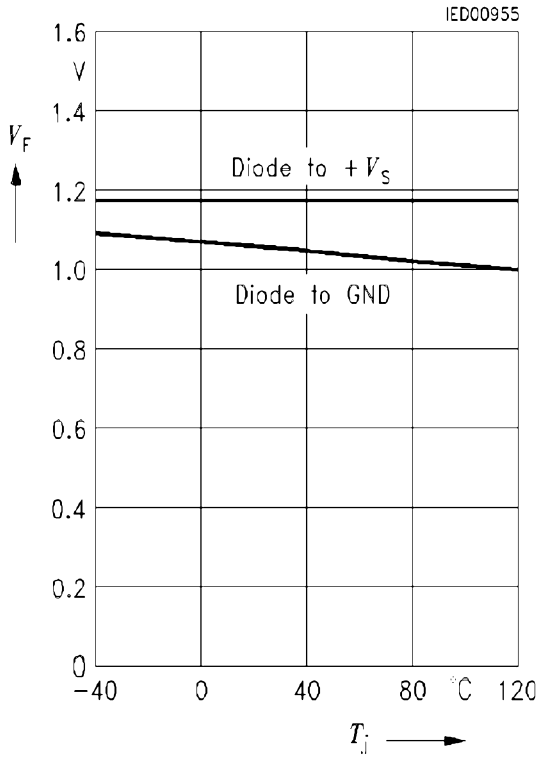|						
Switching threshold high	V_{IH}	2			V	
Switching threshold low	V_{IL}			0.8	V	
H-input current	I_{IH}		100		µA	$V_9 = 5 \text{ V}$
L-input current	I_{IH}		0		µA	$V_9 = 0 \text{ V}$

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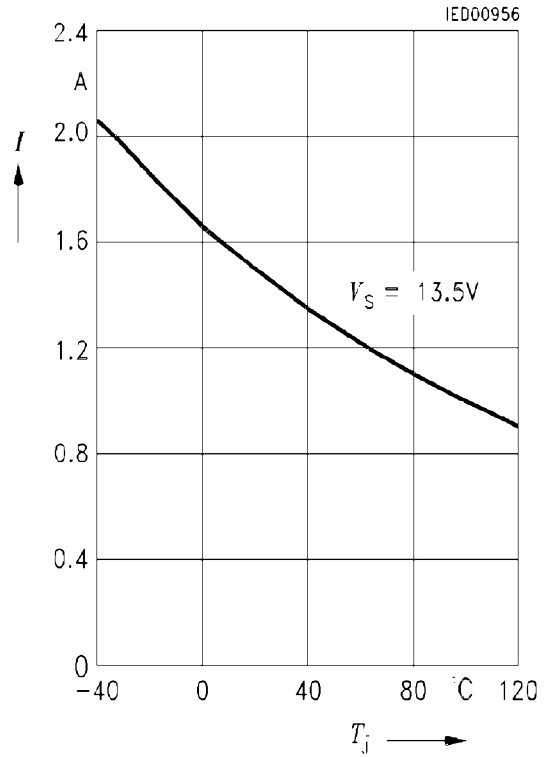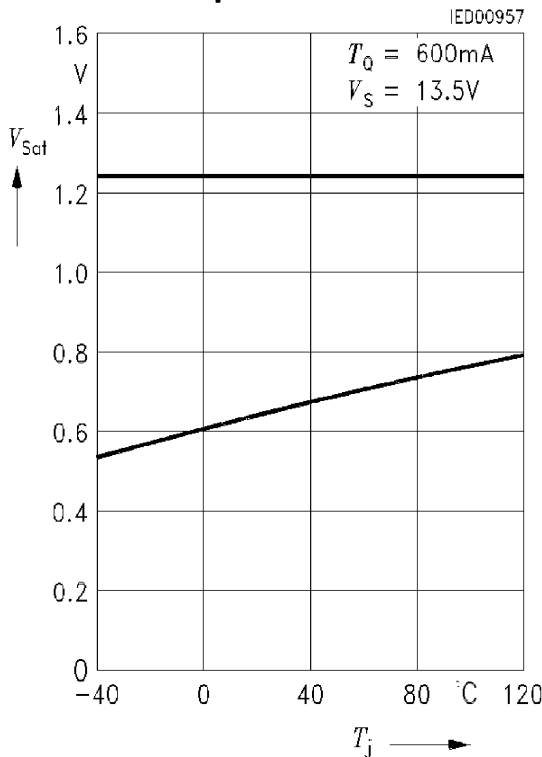**Test Circuit**

AES00639

Application Circuit

Forward Voltage of the Free-Wheeling Diodes versus Junction Temperature

IED00955

Start Point of the SOA-Protection Circuit versus Junction Temperature

IED00956

Saturation Voltage versus Junction Temperature

IED00957

Current Consumption versus Junction Temperature

IED00958