SIEMENS

3-A Motor Driver

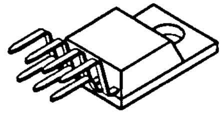
TLE 4204

Preliminary Data

Bipolar IC

Features

- Max. output current 4 A
- Outputs short-circuit proof to ± V_S
- Thermal overload protection
- Integrated free-wheeling diodes to ± V_S
- Max. supply voltage 45 V
- Suitable for automotive applications



P-TO220-7-1

Type	Ordering Code	Package
■ S TLE 4204	Q67000-A8182	P-TO220-7-1

■ Not for new design

Integrated 3 A full-bridge DC motor driver with temperature protection, fully protected output stages and integrated free-wheeling diodes. The case temperature range is – 40°C to 125°C. The IC is also especially suitable for application in automotive electronics.

Application Description

In industrial and automotive electronics full-bridge DC motor drivers are mostly applied in bidirectional motor drives. Both of the differential control inputs act on the outputs as follows:

State	Differential input voltage 1	Differential input voltage 2	Output 1	Output 2
1	< 0	< 0	V_{QL}	V_{QL}
2	< 0	> 0	V_{QL}	V_{QH}
3	> 0	< 0	V_{QH}	V_{QL}
4	> 0	> 0	V_{QH}	V_{QH}

V_{QL} means: Lower power unit conducts; upper power unit is blocked
V_{QH} means: Upper power unit conducts; lower power unit is blocked

Examples:
State 1: Motor is slowed down
State 2: Motor turns right
State 3: Motor turns left
State 4: Motor is slowed down

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Circuit Description

Input Circuit

The input stages are designed as differential inputs with an open-loop gain of typ. 80 dB and a common-mode input voltage range to 0 V.

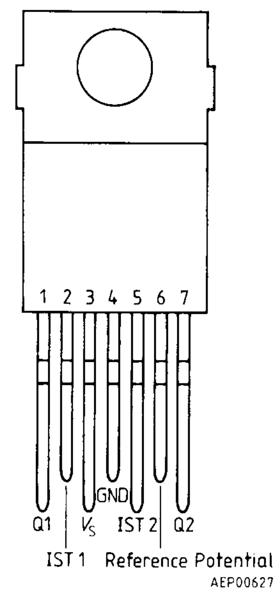
Output Stages

The output stages consist of two push-pull C stages. Using the protective circuits for limiting the power dissipation makes the outputs short-circuit proof to ground and to supply voltage throughout the entire operating range. Positive and negative voltage peaks which occur during switching of inductive loads, are limited by integrated diodes.

Monitoring and Protecting Functions

The IC is protected against thermal overload by a temperature protecting unit.

The power units are controlled by a protection circuit. At low voltages (up to 8 V) only the current is limited in order to protect the bond leads. At higher voltages the protection circuit controls the power dissipation in the power unit.



Pin Configuration
(top view)

Pin Definitions and Functions

Pin	Symbol	Function
1	Q1	**Output of channel 1** Short-circuit proof push-pull C output channel 1 for rated currents up to 3 A. Free-wheeling diodes to $+V_S$ and to ground are integrated.
2	IST1	**Control input for channel 1** Differential input referred to pin 6; of non-inverting effect on output channel 1. The common-mode range is specified from V_S – 2.5 V to ground.
3	V_S	**Supply voltage** Block against ground (pin 4) with a ceramic capacitor of 220 nF min. close to pin 3. For longer connections a low-inductance circuit-proof supporting electrolytic capacitor of at least 10 µF between pin 3 and 4 is to be supplied. The connection is to be designed for the maximum short-circuit current (2 × 4 A).
4	GND	**Ground** Design the connection for the maximum short-circuit current (2 × 4 A).
5	IST2	**Control input channel 2** Differential input referred to pin 6; of non-inverting effect on output 2. The common-mode range is specified from V_S – 2.5 V to ground.
6	Reference potential	**Input reference potential for channel 1 and 2** The user can individually determine the switching threshold with this input. The common-mode range is specified from V_S – 2.5 V to ground.
7	Q2	**Output of channel 2** Short-circuit proof push-pull C output channel 2 for rated currents up to 3 A. Free-wheeling diodes to $+V_S$ and to ground are integrated.

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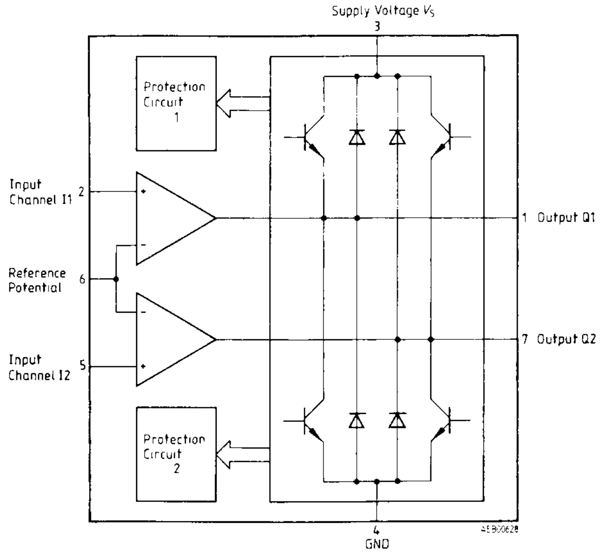

Block Diagram

Absolute Maximum Ratings

T_C = – 40 to 125 °C

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Voltages				
Supply voltage	V_S	– 0.3	45	V
Input voltages Pin 2, 5 and 6	V_I	– 0.3	+ V_S	V
Currents				
Supply current $T_C \leq 85$ °C	I_S	– 3	8	A
Output current $T_C \leq 85$ °C	$I_{Q1,2}$	– 4	4	A
Ground current $T_C \leq 85$ °C	I_{GND}	– 8	8	A
Diode peak currents				
to + V_S	I_{F+}	–	1.5	A
to ground	I_{F-}	–	4	A

Absolute Maximum Ratings (cont'd)
T_C = – 40 to 125 °C

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Temperatures				
Junction temperature	T_j	–	150	°C
Storage temperature range	T_{stg}	– 50	150	°C
Operating Range				
Supply voltage	V_S	8	24	V
Case temperature $T_j \leq 150$ °C	T_C	– 40	125	°C
Thermal resistance				
system - case	$R_{th\,SC}$	–	4	K/W
system - ambient	$R_{th\,SA}$	–	65	K/W

Characteristics
V_S = 12 V; T_C = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
General Ratings						
Quiescent current	I_1	–	15	30	mA	$V_{2,5}$ = 12 V; V_6 = 0 V
Control Inputs						
Input offset voltage	V_{IO}	– 10	–	10	mV	–
Input offset current	I_{IO}	– 100	–	100	nA	–
Input current	$-I_{I\,2,5}$	–	1	2	µA	$V_{2,5}$ = 0 V V_6 = 12 V
Input current	$-I_{I\,6}$	–	2	4	µA	$V_{2,5}$ = 12 V V_6 = 0 V
Common-mode input voltage ranges						
to + V_S	V_{C+}	–	2.5	3	V	Difference to + V_S
to ground	V_{C-}	–	– 0.5	0	V	to ground

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Characteristics (cont'd)
V_S = 12 V; T_C = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Output Stages						
Saturation voltages						
to + V_S	V_{QSato}	–	1.0	1.3	V	$V_{I6} < V_{I2,5}$; $I_Q = -1$ A[1]
to + V_S	V_{QSato}	–	2.0	2.5	V	$V_{I6} < V_{I2,5}$; $I_Q = -3$ A[1]
to ground	V_{QSatu}	–	1.0	1.3	V	$V_{I6} < V_{I2,5}$; $I_Q = 1$ A
to ground	V_{QSatu}	–	2.0	2.5	V	$V_{I6} < V_{I2,5}$; $I_Q = 3$ A
Forward voltages						
to + V_S	V_{Fo}	–	1.2	1.4	V	$V_{I6} < V_{I2,5}$; $I_Q = 1$ A[1]
to ground	V_{Fu}	–	– 1	– 1.2	V	$V_{I6} > V_{I2,5}$; $I_Q = -1$ A
to ground	V_{Fu}	–	– 1.4	– 1.6	V	$V_{I6} > V_{I2,5}$; $I_Q = -3$ A
Short-circuit currents						
at short-circuit to + V_S						S 1P, 2P closed
						$V_6 > V_{I2,5}$
	$I_{QP1,7}$	–	2.5	3.5	A	V_S = 12 V
	$I_{QP1,7}$	–	1.0	–	–	V_S = 24 V
at short-circuit						S 1M, 2M closed
to ground						$V_6 > V_{I2,5}$
	$-I_{QM1,7}$	–	2.5	–	A	V_S = 12 V
	$-I_{QM1,7}$	–	1.5	3.5	A	V_S = 24 V
Switching Times						
Turn-ON time	$t_{D\,ON}$	–	2	4	μs	**see figure 2**
Turn-OFF time	$t_{D\,OFF}$	–	3	6	μs	**see figure 2**

1) measured to + V_S

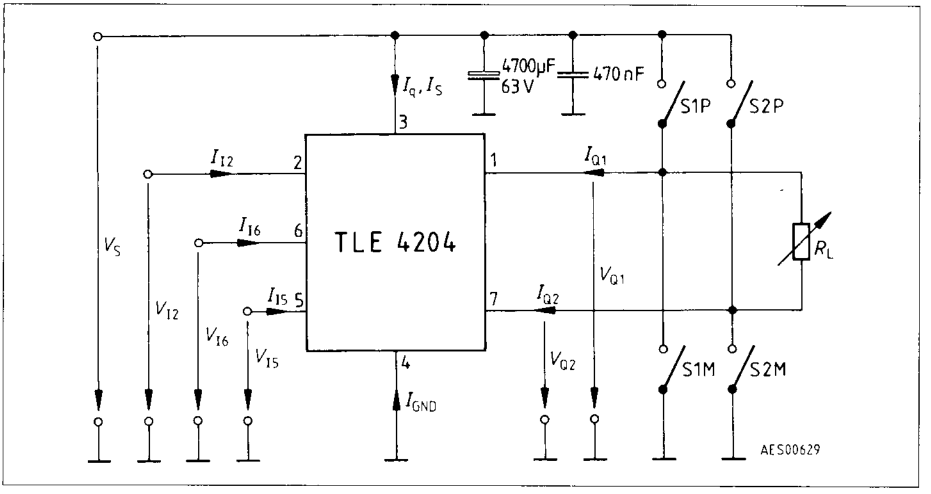


Figure 1
Test Circuit

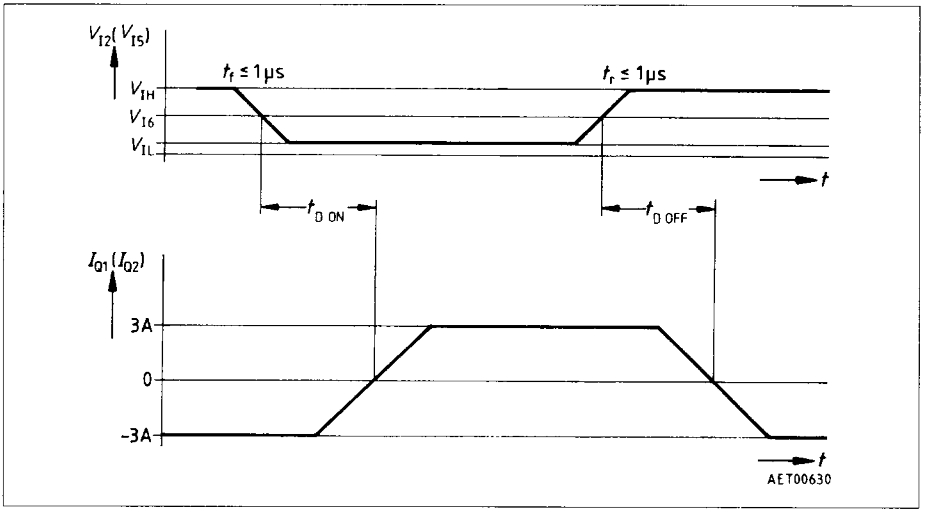


Figure 2
Timing Diagram

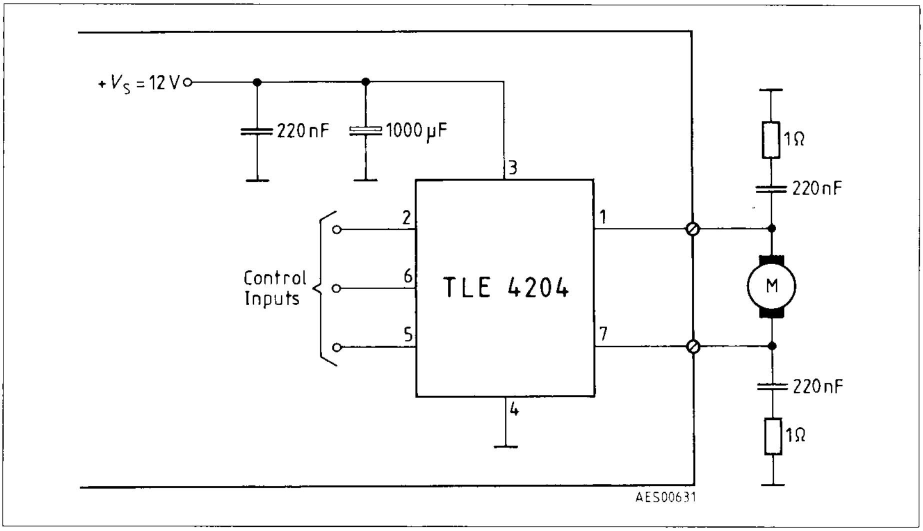
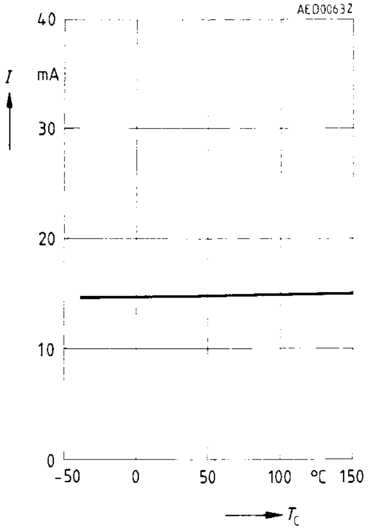
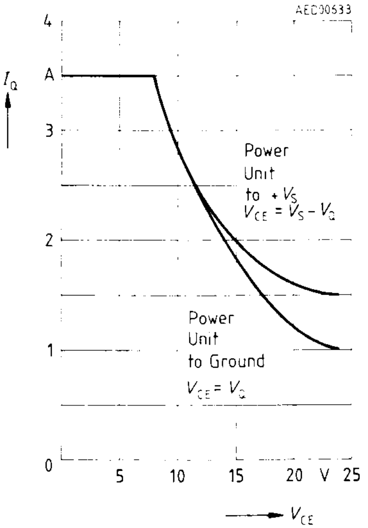


Figure 3
Application Circuit

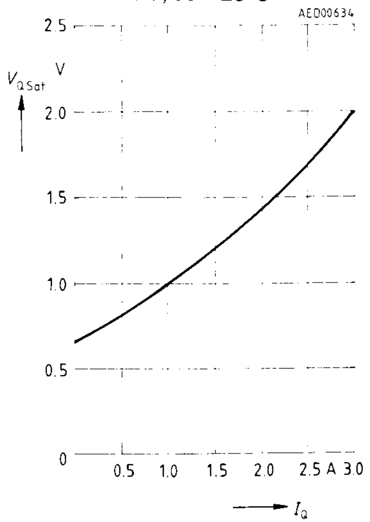
Quiescent Current versus Case Temperature T_C
V_S = 12 V; $V_{I\,2/5}$ = V_S; $V_{I\,6}$ = 0 V



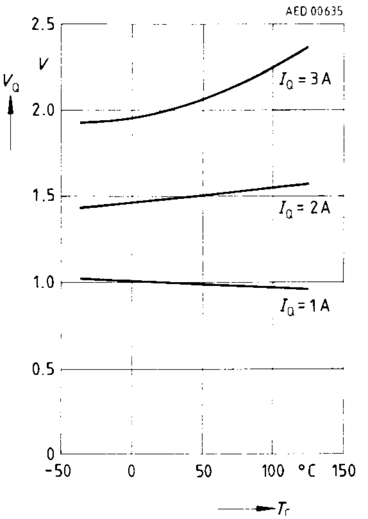
Short-Circuit Current versus Voltage V_{CE} of Power Unit
T_C = 25 °C



Saturation Voltage V_{QSat} versus Output Current I_Q
V_S = 12 V; T_C = 25 °C



Saturation Voltage versus Case Temperature T_C
V_S = 12 V; P_D ≤ 6 W



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