Signetics

TDA5040
Brushless DC Motor Driver

Objective Specification

Linear Products

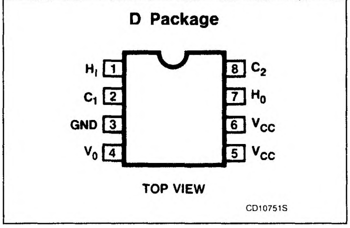
DESCRIPTION
The TDA5040 is designed to operate as a single-phase brushless motor driver in a voltage range of 5 to 16V. Thus a two-phase motor requires two TDA5040Ts and a 3-phase motor will require 3 such devices.

The device contains an internal Hall sensor element for controlling commutation. Motor direction is controlled by logic inputs to C_1 and C_2.

FEATURES
- **Thermal protection**

APPLICATIONS
- **Brushless DC motors**

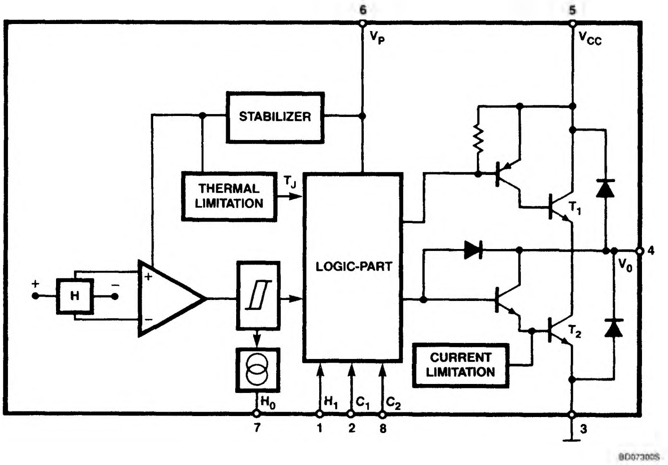
PIN CONFIGURATION



ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
8-Pin Plastic SO Package	0 to +70°C	TDA5040TD

BLOCK DIAGRAM



Brushless DC Motor Driver TDA5040

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	TEST CONDITIONS	RATING	UNIT
	Supply voltages			
V_{CC}	Low power stages		−0.5 to 16	V
V_{CC}	Output stage	Under resistance load	−0.5 to 16	V
V_{CC}	Output stage	Under inductive load	0 to 15	V
V_O	Voltage on output	With a maximum of 16V	−0.5 to V_{CC}+1	V
C_1, C_2	Voltage on inputs		−0.5 to 16	V
H_I, H_O	Voltage on Hall output		−0.5 to 16	V
$\pm I_O$	Output current		1.24	A
T_{STG}	Storage temperature		−55 to +150	°C
T_J	Junction temperature	Peak value up to 160°C during 5s	+150	°C

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DC ELECTRICAL CHARACTERISTICS Unless otherwise noted: $5V \leq V_{CC} \leq 16V$, $-15°C \leq T_A \leq 60°C$.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS Min	Typ	Max	UNIT
Supply voltage						
V_{CC}	Low power stage		5		16	V
V_{CC}	High power stage		0		15	V
Hall-element and trigger circuit						
M_O	Offset		$-15\ 10^{-3}$		$+15\ 10^{-3}$	Tesla
M_H	Hysteresis	Using output H_o or V_o	$2.5\ 10^{-3}$	$4.5\ 10^{-3}$	$6.5\ 10^{-3}$	Tesla
Hall output H_o						
		$V_p = 12V$ $T_A = 25°C$				
$-IH_oH$	Output current High	$VH_o \leq V_p - 0.25V$	10	15	20	μA
IH_oL	Output current Low	$0.7V \leq VH_o \leq V_p - 0.25V$	10	15	20	μA
$IHo/\Delta T°$	Temperature dependency			0.15		%/°C
$IHo/\Delta V_p$	Voltage dependency			4		%/V
Hall input H_I						
VH_{IH}	Input level High	$I_{HI} > 10\mu A$				
VH_{IL}	Low	$-I_{HI} > 10\mu A$	2.48	2.8	3.15	V
	Input switching level to drive					
VH_{IS}	Output V_O according to truth table	Referred to the calculated switching level $\frac{V_{HIH} + V_{HIL}}{2}$	TBD	0	TBD	mV
Logic inputs C_1 resp. C_2						
V_{IL}	Input voltage Low				1	V
V_{IH}	Input voltage High		2			V
I_{IL}	Input current Low	$V_c = 0.4V$	TBD	19	TBD	μA
I_{IH}	Input current High	$V_c = 16V$			2	μA
Power output stage						
		I_o = pulse of 1ms				
V_{OL}	Output voltage Low	I_o = 400mA duty cycle $\leq 1/10$		1	1.25	V
$\Delta V_{OL}/\Delta T°$	Temperature dependency			−0.93		mV/°C
V_{OH}	Output voltage High	$-I_o$ = 500mA duty cycle $\leq 1/10$	$V_{cc} - 1.35$	$V_{CC} - 1.1$		V
$\Delta V_{OH}/\Delta T°$	Temperature dependency			+3.6		mV/°C
I_{OL}	Output current Low internally limited		500		1200	mA
I_{OF}	Output current float	$V_o = V_{cc} = 16V$			1	mA
$-I_{OF}$	Output current float	$V_o = 0V$, $V_{cc} = 16V$			1	mA
R_L	Load resistance (across Pins 4 and 5)		6			Ω
Quiescent current						
I_p	Output Low or Float	$I_o = 0$, $V_p = V_{cc} = 16V$		6	TBD	mA
$I_p + I_{CC}$	Output High	$I_o = 0$, $V_p = V_{cc} = 16V$		9	TBD	
Thermal protection						
$T_{JSW-OFF}$	Switch-off temperature		130		160	°C
T_{JSW-ON}	Switch-on temperature		90		140	°C
T_{JSW}	Hysteresis		20	30	40	°C

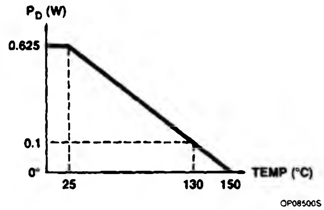


Figure 1. Operating Derating Curve

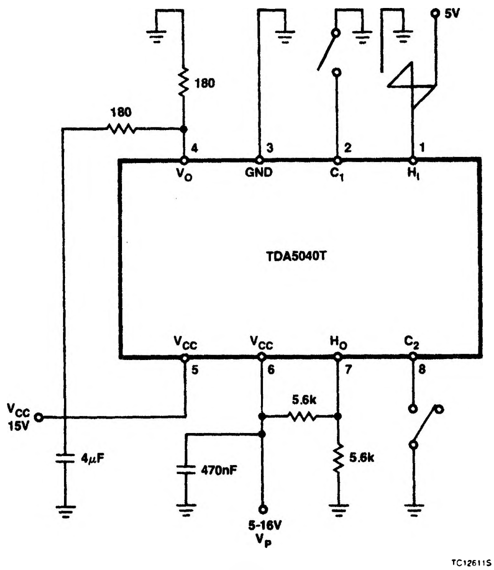


Figure 2

THEORY OF OPERATION

C_1 defines the motor rotation direction by connecting it to a high or low voltage level. A low voltage level on C_2 is a float command. Both C_1 and C_2 can be driven by a TTL, CMOS or LOCMOS circuit. Both input characteristics allow up to three inputs to be driven directly by one TTL, CMOS or LOCMOS circuit (e.g., a common float command line for all three ICs in the motor).

The circuit includes a thermal protection which switches the output in the floating state when the chip exceeds the limiting temperature. A hysteresis on this protection avoids degradation of the IC during constant short-circuit of the output. The output power current is limited by a current-limiter in the lower output stage.

A zener diode protects the lower output stage in case the supply voltage V_{CC} is disconnected and the output is inductively loaded. (See Block Diagram.)

TRUTH TABLE

INPUT					OUTPUT	
T_J	M	C_2	C_1	H_I	H_O	V_O
L	N	H	H	H	H	COMMON
L	S	H	H	H	L	H
L	N	H	H	L	H	L
L	S	H	H	L	L	COMMON
L	N	H	L	H	H	COMMON
L	S	H	L	H	L	L
L	N	H	L	L	H	H
L	S	H	L	L	L	COMMON

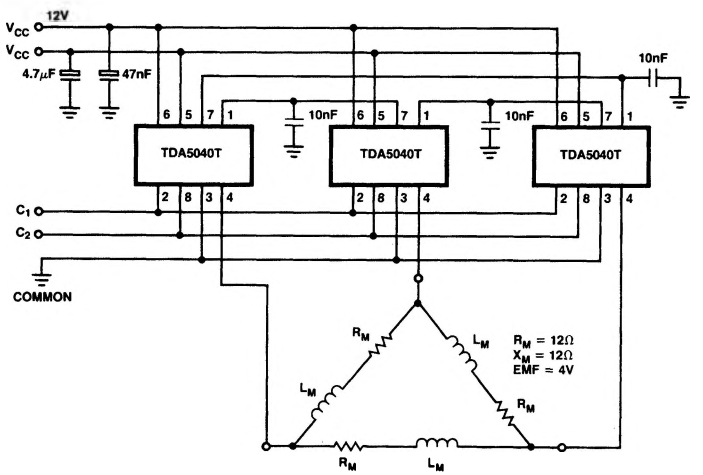
Remarks

T_J = "L" : junction temp. < min. switch on temp.

M = "N" : magnetic north above and south pole below the IC, magnetic field strength > max. offset + ½ max. hysteresis

M = "S" : magnetic south above and north pole below the IC, magnetic field strength > max. offset + ½ max. hysteresis

H_O is H_I compatible



NOTES:
N_{NOM} = 1500RPM
F_{NOM} = 200Hz
T_{NOM} = 2mNm
V_{CC} = 12V
$I_{CC\ NOM}$ = 80mA

Figure 3. Typical Application Circuit