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SANYO Semiconductors

## DATA SHEET

# STK681-200-E — Thick-Film Hybrid IC Forward/Reverse Motor Driver

## Overview

The STK681-200-E is a hybrid IC for use in current control forward/reverse DC motor driver with brush.

## Applications

- Office photocopiers, printers, etc.

## Features

- Allows forward, reverse, and brake operations in accordance with the external input signal.
- 4.2A startup output current and 8A peak brake output current.
- Incorporating a current detection resistor (0.10Ω), fixed current control is possible.

## Specifications

**Absolute maximum ratings** at  $T_c = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	unit
Maximum supply voltage 1	$V_{CC1 \text{ max}}$	$V_{CC2}=0\text{V}$	52	V
Maximum supply voltage 2	$V_{CC2 \text{ max}}$	No signal	-0.3 to +7.0	V
Input voltage	$V_{IN \text{ max}}$	Logic input pins	-0.3 to +7.0	V
Output current	$I_O \text{ max}$	$V_{CC2}=5.0\text{V}$ , DC current	4.2	A
Brake current	$I_{OB \text{ max}}$	$V_{CC2}=5.0\text{V}$ , square wave current, operating time 60ms (single pulse)	8	A
Operating substrate temperature	$T_c \text{ max}$		105	$^\circ\text{C}$
Junction temperature	$T_j \text{ max}$		150	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 to +125	$^\circ\text{C}$

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## STK681-200-E

### Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	unit
Operating supply voltage 1	$V_{CC1}$	With signals applied	10 to 42	V
Operating supply voltage 2	$V_{CC2}$	With signals applied	5±5%	V
Input voltage	$V_{IN}$		0 to $V_{CC2}$	V
Output current 1	$I_{O1}$	$V_{CC2}=5.0\text{V}$ , DC current, $T_c \leq 70^\circ\text{C}$	4.2	A
Output current 2	$I_{O2}$	$V_{CC2}=5.0\text{V}$ , DC current, $T_c = 90^\circ\text{C}$	3.2	A
Output current 3	$I_{O3}$	$V_{CC2}=5.0\text{V}$ , DC current, $T_c = 105^\circ\text{C}$	2.5	A
Brake current	$I_{OB}$	$V_{CC2}=5.0\text{V}$ , square wave current, operating time 3.6ms, $T_c = 105^\circ\text{C}$	8	A

Refer to the graph for each conduction-period tolerance range for the output current and brake current.

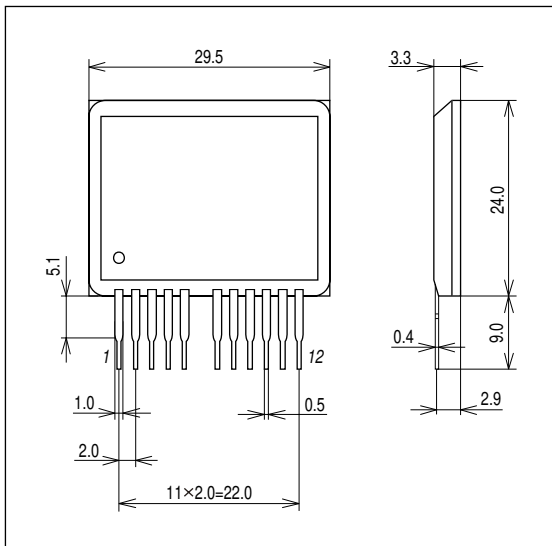
### Electrical Characteristics at $T_c = 25^\circ\text{C}$ , $V_{CC1} = 24\text{V}$ , $V_{CC2} = 5.0\text{V}$

Parameter	Symbol	Conditions	min	typ	max	unit
$V_{CC2}$ supply current	$I_{CCO}$	Forward or reverse operation		2.7	6	mA
FET diode forward voltage	$V_{df}$	$I_f = 1\text{A}$ ( $R_L = 23\Omega$ )		1.0	1.6	V
Output saturation voltage 1	$V_{sat1}$	$R_L = 23\Omega$ , TR1, TR2		0.80	1.1	V
Output saturation voltage 2	$V_{sat2}$	$R_L = 23\Omega$ , F1, F2+current detection resistance		0.22	0.30	V
Output leak current	$I_{OL}$	TR1, TR2, F1, and F2 OFF operation			50	$\mu\text{A}$
Input high voltage 1	$V_{IH1}$	IN1, IN2 pins	4.5			V
Input high voltage 2	$V_{IH2}$	INH pin	2.5			V
Input low voltage	$V_{IL}$	IN1, IN2, INH pins			0.6	V
Input current 1	$I_{IH1}$	IN1, IN2 pins, $V_{IH1} = 5\text{V}$	0.10	0.20	0.40	mA
Input current 2	$I_{IH2}$	INH pin, $V_{IH2} = 5\text{V}$	0.30	0.60	1.2	mA
Current setting voltage	$V_{ref1}$	Between pins $V_{ref1}$ and S.P		0.42		V

Note: A fixed-voltage power supply must be used.

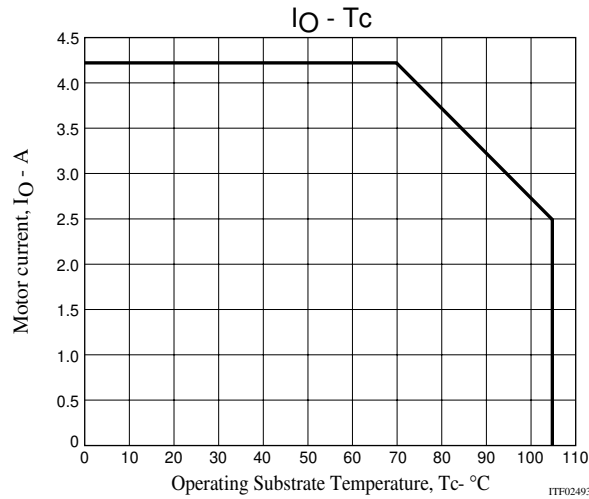
### Package Dimensions

unit:mm (typ)



**STK681-200-E**

Derating Curve of Motor Current,  $I_O$ , vs. STK681-200-E Operating Board Temperature,  $T_c$

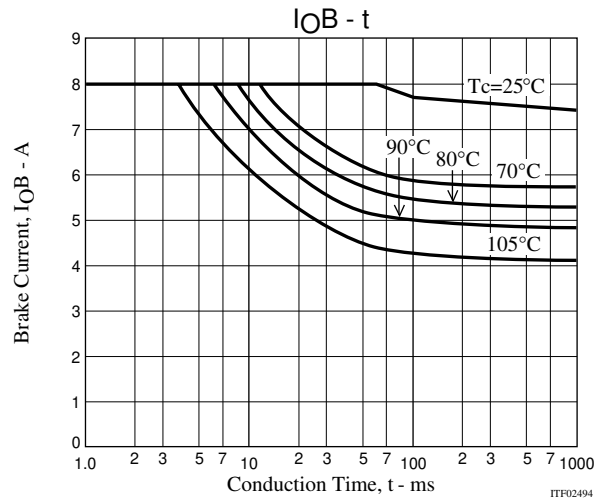


The motor current,  $I_O$ , shown above represents the range of DC operation and chopping operation.

The above graph shows performance when the overheating current control function (when pin 10 is connected to GND) is inoperational. For  $I_O$  characteristics when overheating current control is operational, see  $I_O$ - $T_c$  characteristics given in the Technical Information.

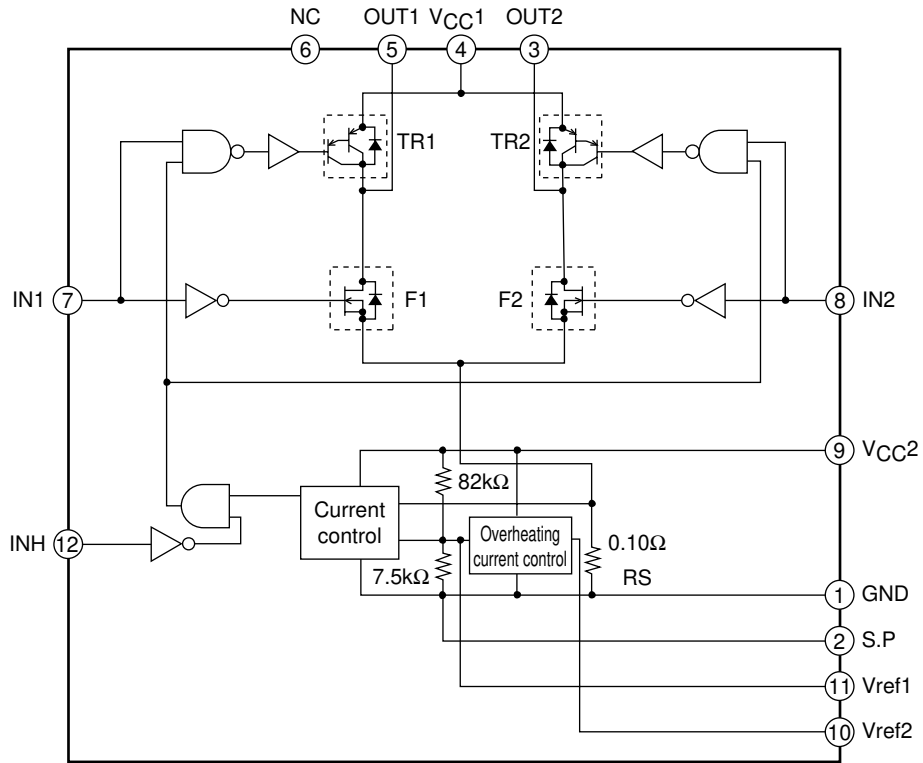
Since  $T_c$  fluctuates due to the ambient temperature,  $T_a$ , the motor current value, and continuous or intermittent operations of the motor current, always confirm this values using an actual set.

STK681-200-E Allowable Brake Current Range



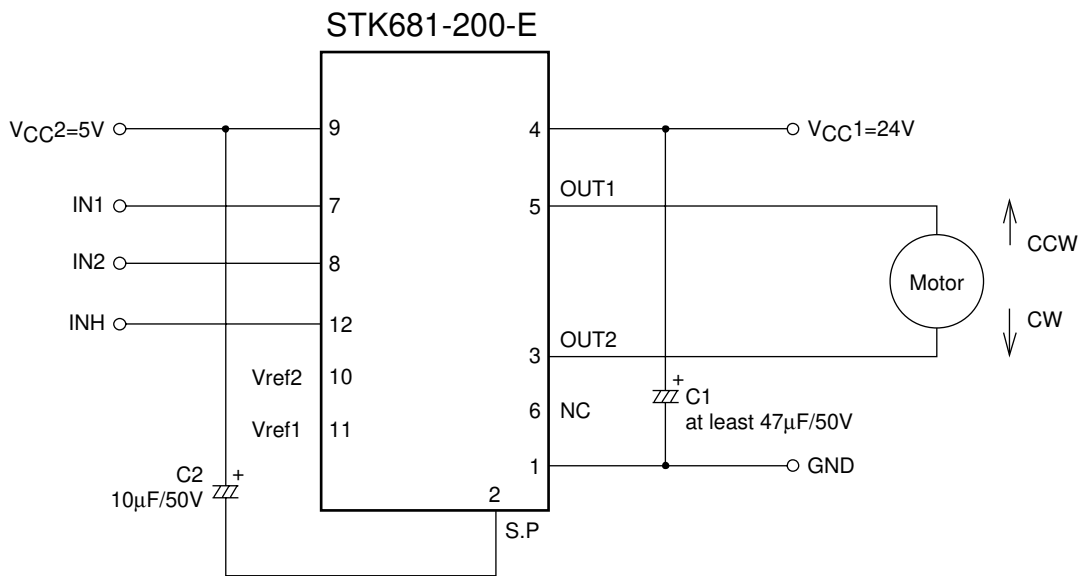
**STK681-200-E**

**Internal Block Diagram**



ITF02473

**Sample Application Circuit**



ITF02472

**STK681-200-E**

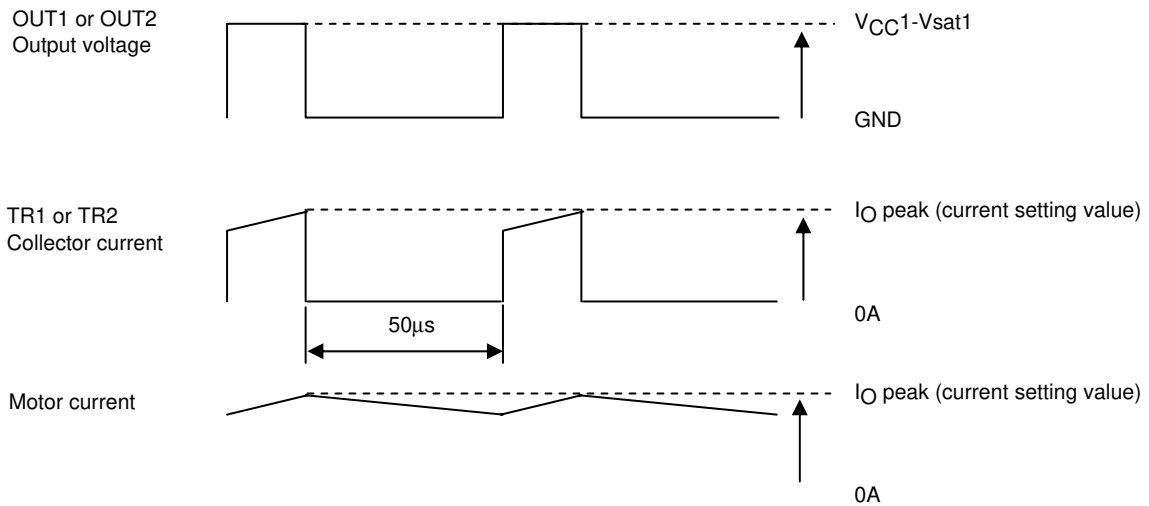
**Motor Drive Conditions** (H: High-level input; L: Low-Level Input)

	IN1	IN2	INH	Remarks
Stop 1 (standby)	H	H	H or L	When motor is not rotating
Stop 2 (supply power turned off by input during motor rotation)	H	H	H	IN=IN2=INH=H represents the dead time, Td, during which top and bottom drive devices are turned off when switching forward/reverse rotation. Input condition when making settings is Td=10μs or higher
	H	L	H	
	L	H	H	
Forward (CW)	H	L	L	Dead time, Td, design is recommended when switching forward/reverse rotation.
Reverse (CCW)	L	H	L	
Brake	L	L	L	GND side MOSFET ON

\* IN1=IN2=H and INH=L are prohibited during motor rotation.

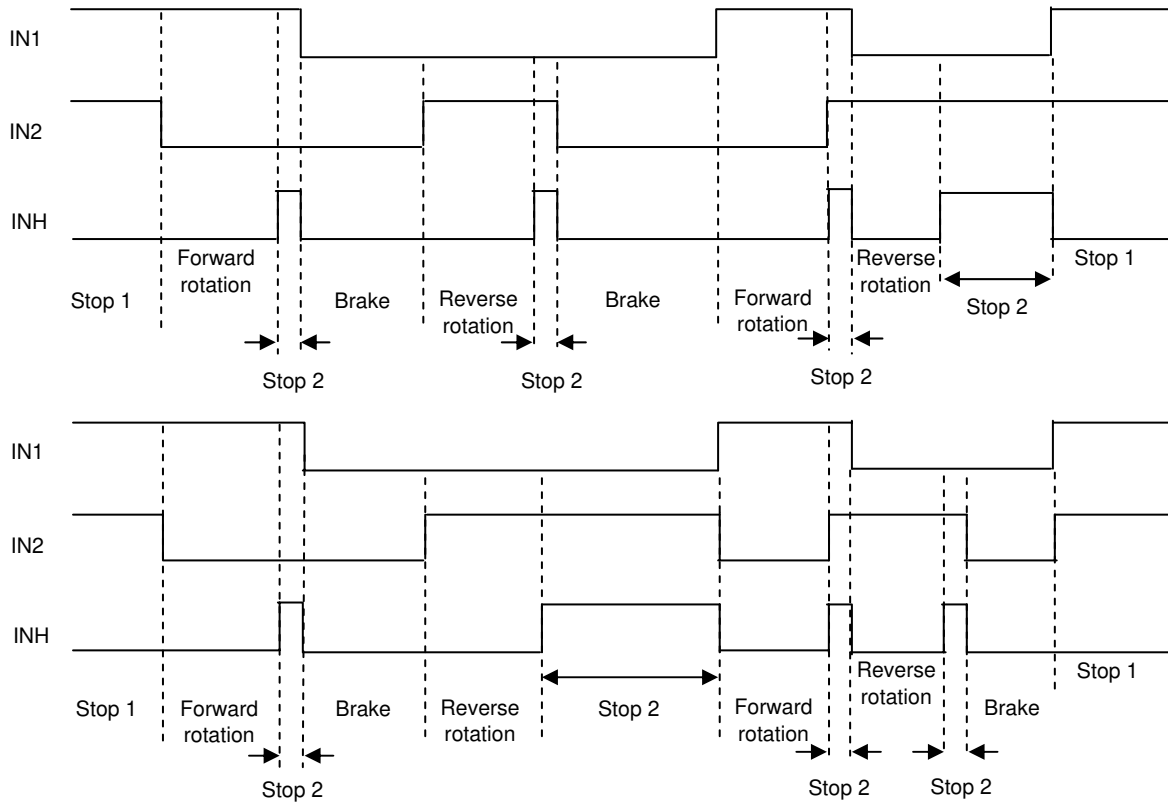
**Notes**

- (1) Be sure to set the capacitance of the power supply bypass capacitor, C1, so that the ripple current of the capacitor, which varies as motor current increases, falls within the allowed range.
- (2) Although the Vref 2 pin is kept open, if connected to the GND or S.P pin, the overheating current control circuit ceases to function.
- (3) Fixed current chopping operations based on TR1 and TR2 are used for current control. The timing given below is used for OUT1 or OUT2 voltage output and for TR1 or TR2 collector current.



**STK681-200-E**

(4) Sample Timing Diagram



- \* Dead time (INH High interval: Stop 2) is  $T_d=10\mu s$  or higher
- \* We recommend a dead time when switching from forward to reverse rotation, switching from reverse to forward rotation, and prior to braking operations.
- \* If the operation time between Stop 1 and Stop 2 or between Stop 2 and Stop 2 above is 100ms or higher, Stop 2 does not need to be set because the ratio of the short-circuit duration of the top and bottom devices is small.
- \* Because IN1 and IN2 form the base current for TR1 and TR2, a slow-rising signal may break TR1 and TR2 due to drive insufficiency. We recommend a drive signal from a CMOS IC.

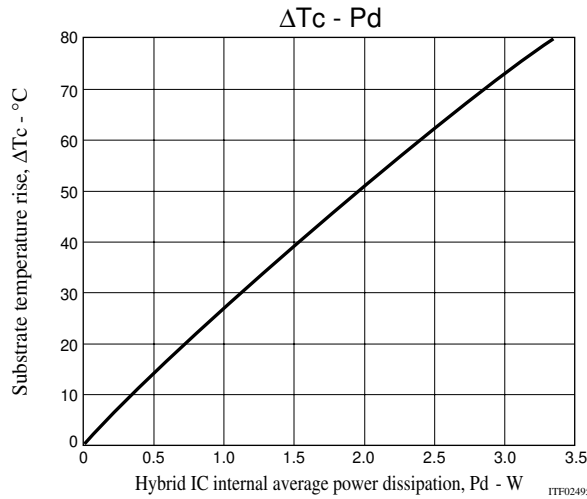
**I/O Functions of Each Pin**

Pin Name	Pin No.	Function
IN1	7	Input pin for turning TR1 and F1 ON and OFF At high level, TR1: ON and F1: OFF; at low level TR1: OFF and F1: ON
IN2	8	Input pin for turning TR2 and F2 ON and OFF At high level, TR2: ON and F2: OFF; at low level, TR2: OFF and F2: ON
INH	12	Pin for turning TR1 and TR2 OFF; At high level TR1 and TR2: OFF This pin is usually low or open.
OUT1	5	This pin connects to the motor and outputs source/sync current depending on conditions at IN1 and IN2.
OUT2	3	This pin connects to the motor and outputs source/sync current depending on conditions at IN1 and IN2.
Vref1	11	A voltage of 0.42V at $T_c=25^\circ C$ results for the current set voltage used in fixed current operations. A voltage of 0.42V at $T_c=25^\circ C$ results for Vref1. 0.42V is set by connecting 82k $\Omega$ and 7.5k $\Omega$ in series. Current detection resistance is $R_s=0.10\Omega$ . Set using $I_O \text{ peak}=V_{ref1} \div R_s$ .
Vref2	10	Be sure to usually leave this pin open. The overheating control circuit can be made to stop operating by connecting this pin to the GND or S.P pin.
S.P	2	Vref1 voltage can be lowered by connecting a resistor between the Vref1 and S.P pins.

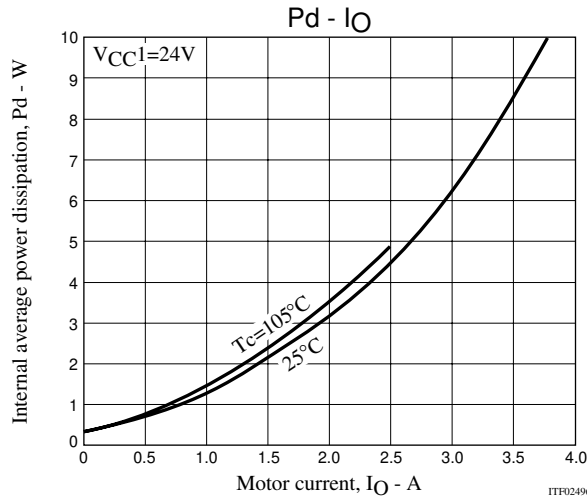
**STK681-200-E**

**Technical Information**

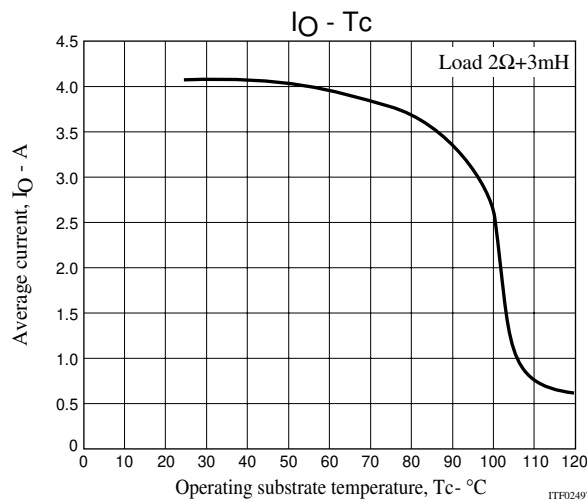
(1) Substrate temperature rise,  $\Delta T_c$  (no heat sink) - Internal average power dissipation, PdAV



(2) Internal average power dissipation, Pd, in the DC current-motor current,  $I_O$ , characteristics (typ values for Pd)



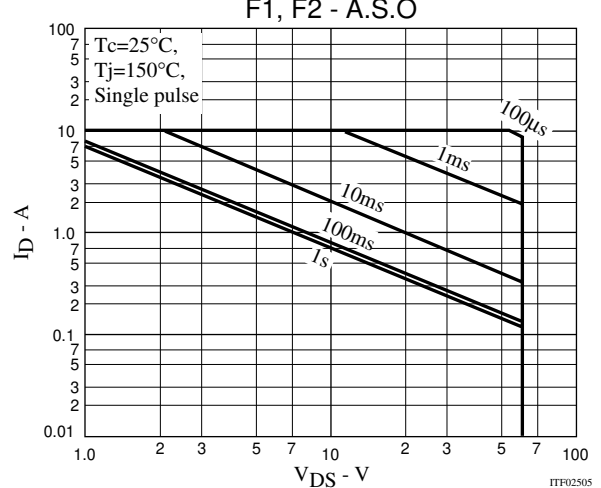
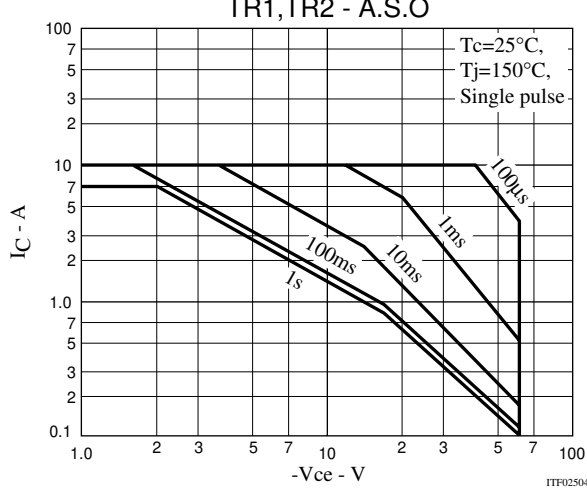
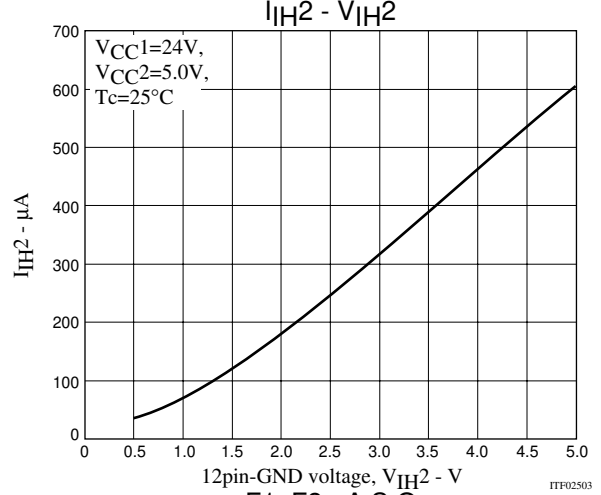
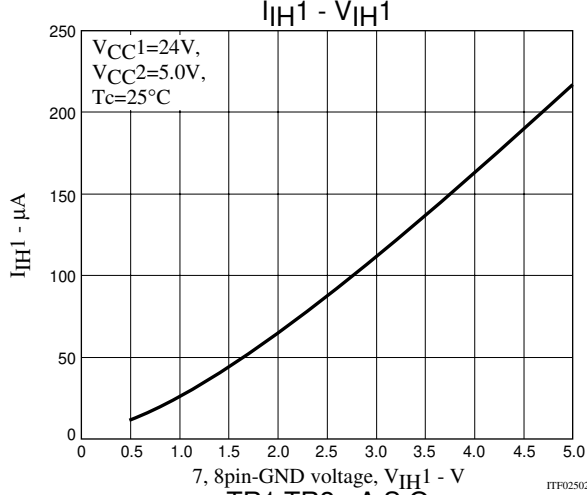
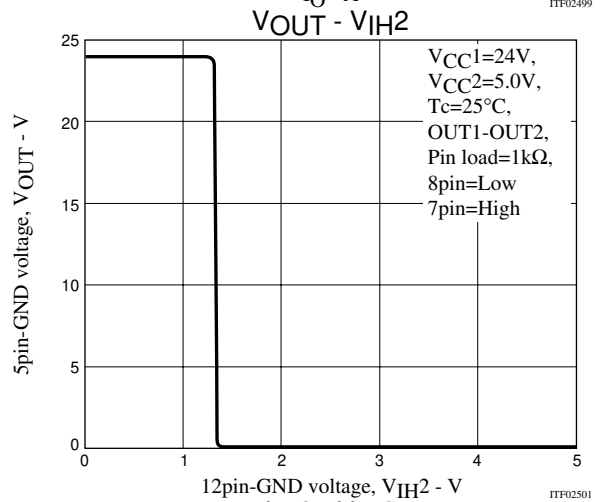
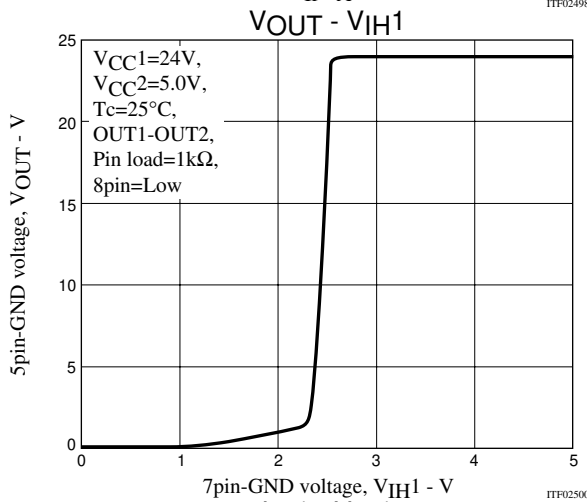
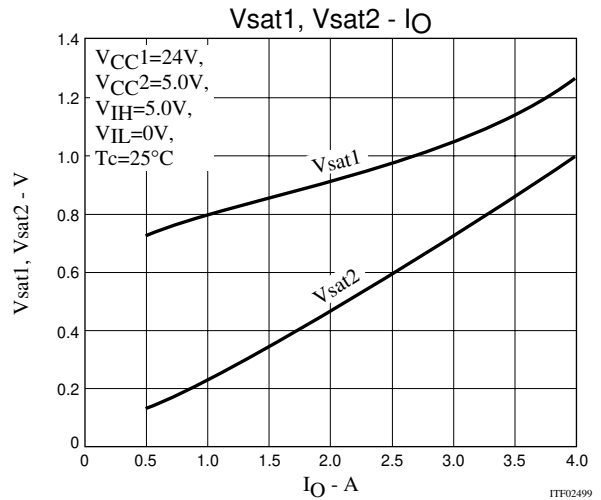
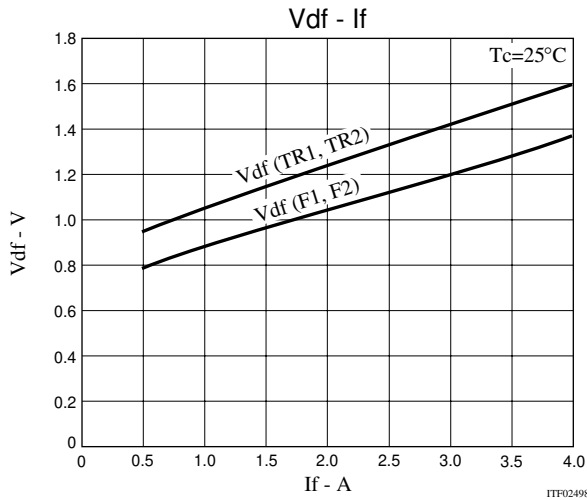
(3) Overheating current control characteristics



Overheating current control functions to prevent driver failure if a motor lock malfunction occurs.

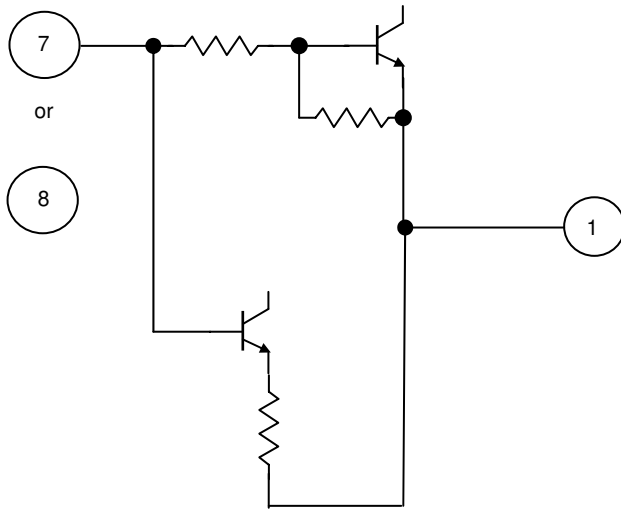


**STK681-200-E**

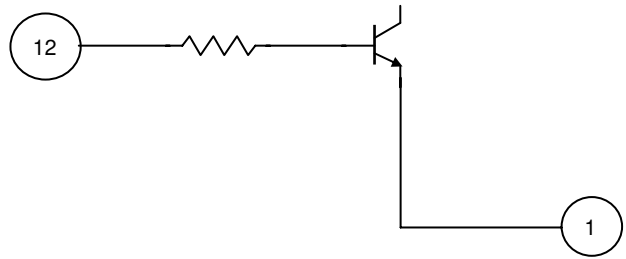


**Input Pin Configurations**

IN1, IN2



INH



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