STK681-310N-E

Forward / Reverse DC Motor Driver Intelligent Power Module (IPM)

ON Semiconductor®

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Overview
Reversible direction DC brush motor driver with current control function

Application
Copying machine, printer, etc. for office use

Features
- Forward, reverse, and braking operations can be controlled with external input signals.
- Provides a startup output current of 4.2 A and supports a peak braking output current of 8 A.
- Built-in current detection resistor (0.1 Ω) and supports constant-current control.
- Does not require design of a dead time period in which the high and low side devices are turned off when switching between the forward and reverse directions.

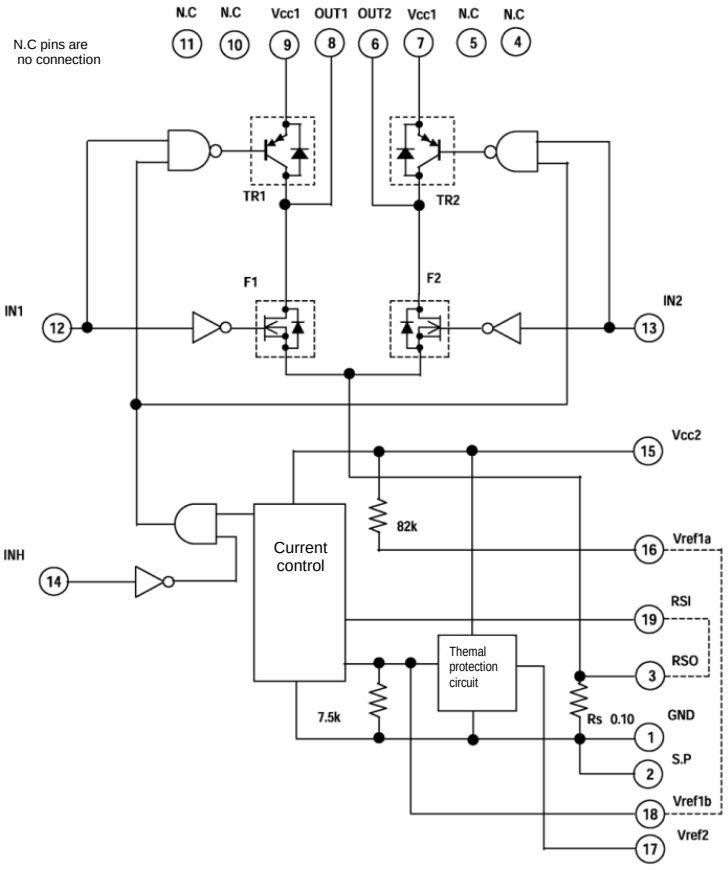
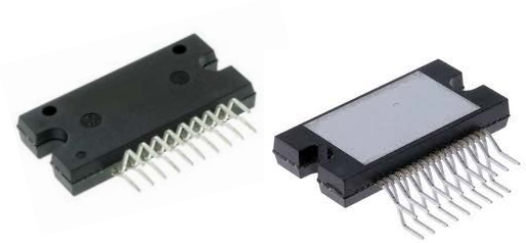
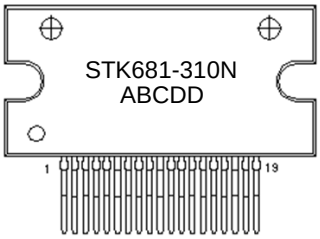


Figure 1 : Functional Diagram

PACKAGE PICTURE

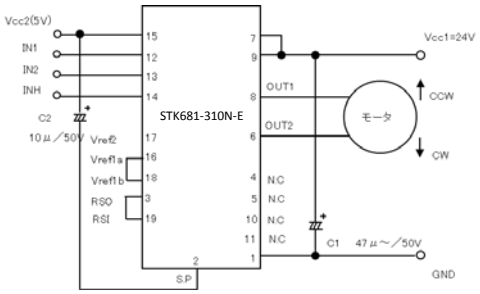


MARKING DIAGRAM



STK681-310N = Type name
A =Production Plant
B = Production Year
C = Production Month
DD = Production Day
Device marking is on package top side

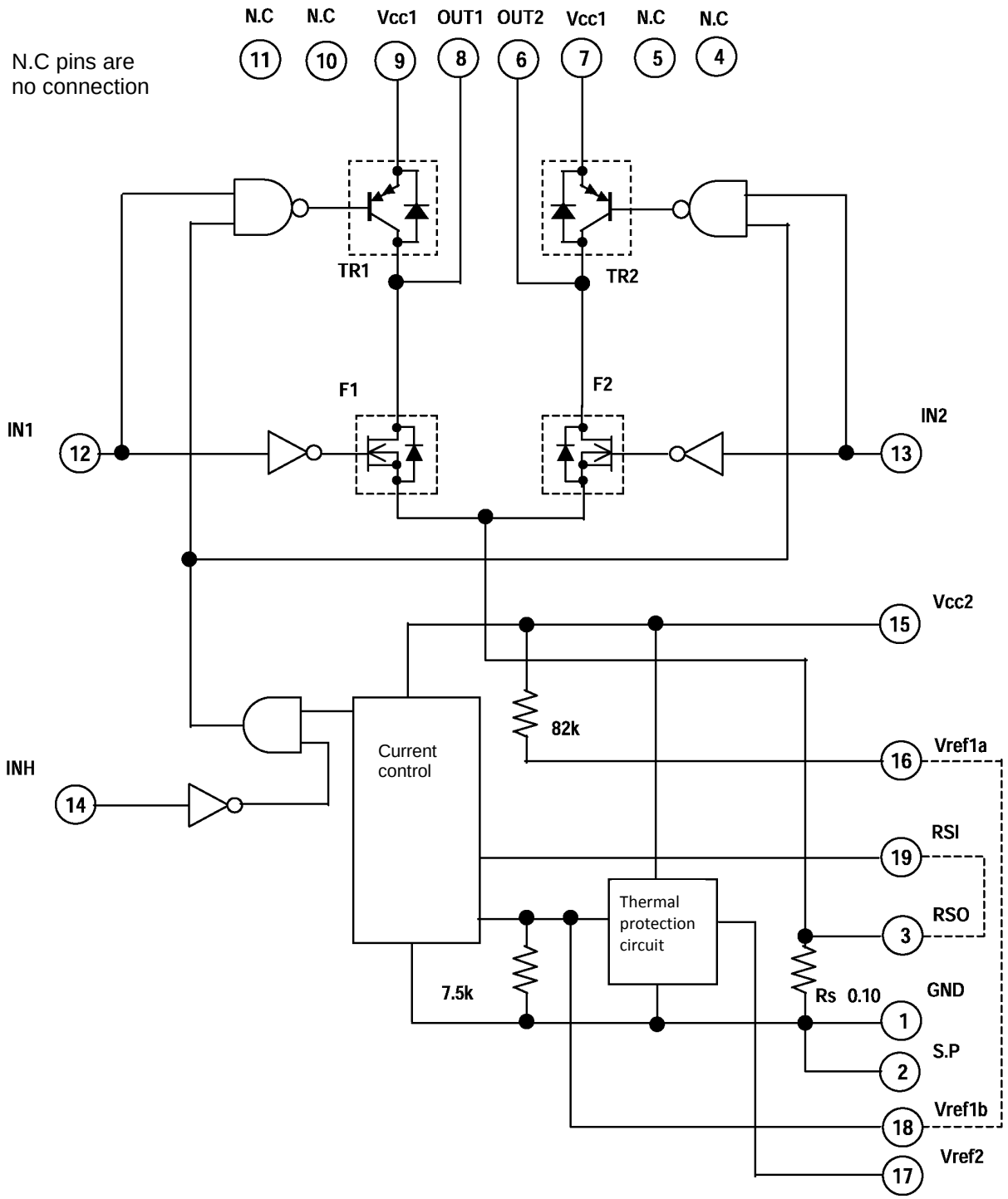
PIN CONNECTIONS



ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
STK681-310N-E	SIP19 29.2x14.4 (Pb-Free)	15 / Tube

Block Diagram



Absolutely Maximum Ratings at Ta = 25°C, Tc = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	V_{CC}1 max	V_{CC}2 = 0 V	52	V
Maximum supply voltage 2	V_{CC}2 max	No signal	−0.3 to +7.0	V
Input voltage	Vin max	At logic input pin	−0.3 to +7.0	V
Output current 1	IO max	V_{CC}2 = 5.0 V, DC current	4.2	A
Braking current	IOB max	V_{CC}2 = 5.0 V, V_{CC}2 = 5.0 V, square wave	8	A
Power Dissipation	PdPK max	Without a heat sink	3.1	W
Operating substrate	Tc max	Package of metal surface temperature	105	°C
Junction temperature	Tj max		150	°C
Storage temperature	Tstg		−40 to +125	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Allowable Operating Range at Ta = 25℃

Parameter	Symbol	Conditions	Ratings	Uint
Supply voltage 1	V_{CC}1	With signals applied	10 to 42	V
Supply voltage 2	V_{CC}2	With signals applied	5.0 ±5%	V
Input voltage	Vin	10,11,12,13,14,15,17 pin	0 to Vcc2	V
Output current 1 *1, *2	Io1	V_{CC}2 = 5.0 V, DC current, Tc ≤ 70°C	4.2	A
Output current 2 *1, *2	Io2	V_{CC}2 = 5.0 V, DC current, Tc = 90°C	3.2	A
Output current 3 *1, *2	Io3	V_{CC}2 = 5.0 V, DC current, Tc = 105°C	2.5	A
Braking current *1	IoB	V_{CC}2 = 5.0 V, square wave current waveform, operating time : 3.6 ms, Tc = 105°C	8	A

Remarks : See the allowable operating ranges graphs for details on the output current and braking current when the IC is powered.
*1 : Refer to the graph for each conduction-period tolerance range for the output current and brake current.
*2 : Io1, Io2, Io3 connect Vref2 pin to GND and a current value when over-heating current control does not work

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

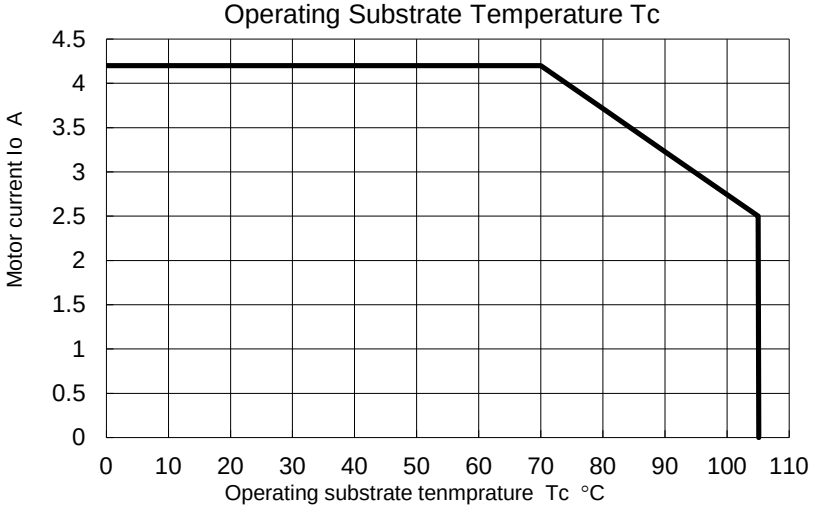
Electrical Characteristics at Tc = 25℃, V_{CC} = 24 V, V_{CC} = 5 V

Parameter	Symbol	Conditions	min	typ	max	unit
V_{CC}2 Supply current	Icco	During forward or reverse operation		1.7	4	mA
Diode forward voltage	Vdf	If = 1 A (RL = 23 Ω)		1.0	1.6	V
Output saturation voltage 1	Vsat1	RL = 23 Ω, TR1, TR2		0.8	1.1	V
Output saturation voltage 2	Vsat2	RL = 23 Ω, F1, F2 + current detection resistor		0.19	0.26	V
Output leakage current	IOL	When TR1, TR2, F1, and F2 are operating in the off state			50	μA
High-level input voltage 1	VIH1	The IN1 and IN2 pins	4.5			V
High-level input voltage 2	VIH2	The INH pin	2.5			V
Low-level input voltage	VIL	The IN1, IN2, and INH pins			0.6	V
Input current 1	IIH1	The IN1 and IN2 pins	0.1	0.2	0.4	mA
Input current 2	IIH2	The INH pin, VIH = 5 V	0.3	0.6	1.2	mA
Current setting voltage	Vref1	Between the Vref1 and S.P pins		0.42		V

Remarks : Constant-voltage power supply is used.

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

STK681-310N-E Motor Current Derating Curve for the Operating Substrate Temperature Tc

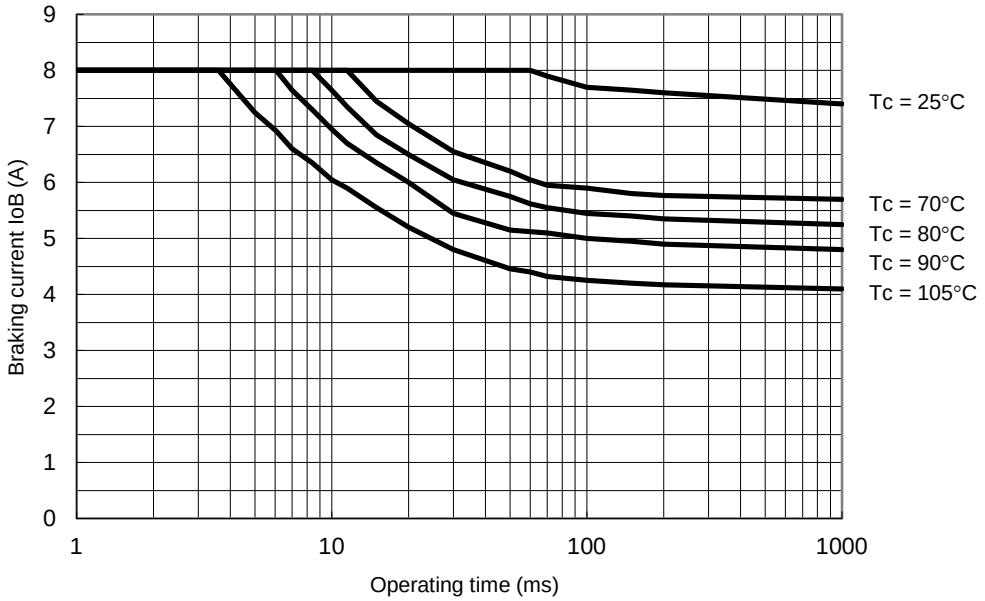


DC operating current range is within both the allowable $V_{CC}1$ operating range and the derating curve shown in the figure.

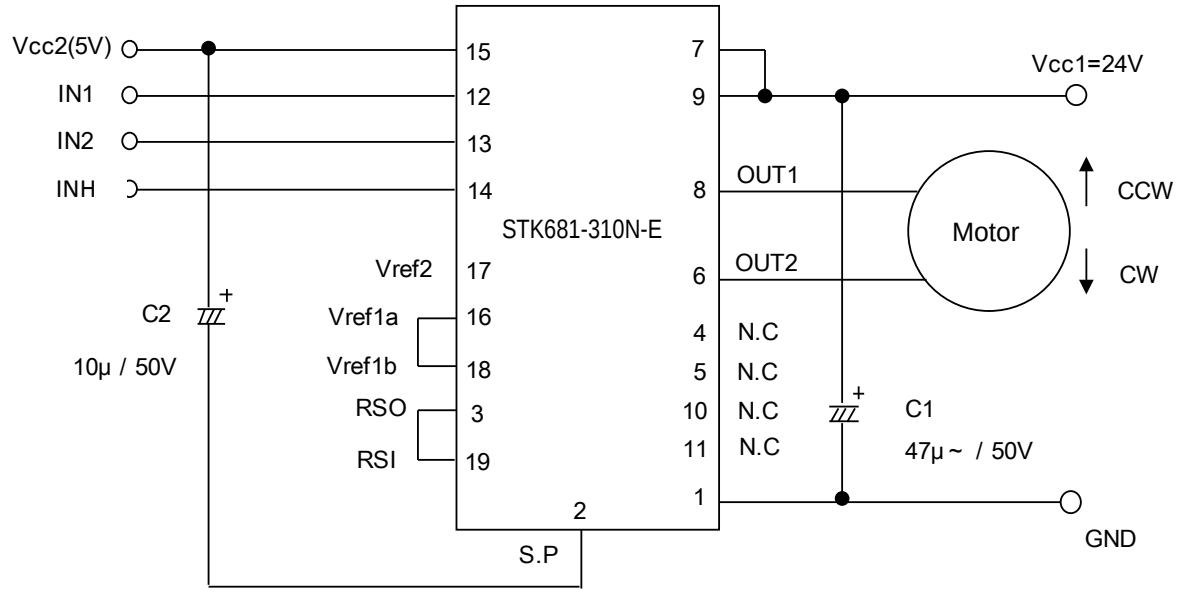
Coution

- Motor current Io shown above is the range for chopping operation when $V_{CC}1$ is under 28 V
- Substrate temperatures in the figure above are values measured when the motor is operating.
  The temperature Tc varies with the ambient temperature Ta, the motor drive current, and whether the motor current is continuous or the state of its intermittent operation. Therefore Tc must be verified in an actual end product system.

Allowable STK681-310N-E braking current ranges



Application Circuit



Motor Drive Conditions (H : high-level input, L : low-level input)

	IN1	IN2	INH	Comment
Stop 1 (Standby)	H	H	H or L	The state where the motor is not turning
Stop 2 (Power supply to the motor is off due to an input during motor operation)	H	H	H	Power supply to the motor was turned off due to a stop signal being applied during motor operation.
	H	L	H	
	L	H	H	
Forward (CW)	H	L	L	An input signal that turns off the high and low side drive elements during forward/reverse switching is not required
Reverse (CCW)	L	H	L	
Brake	L	L	L or H	The ground side MOSFET is in the on state

* : The state IN1 = IN2 = high, INH = L is illegal during motor operation.

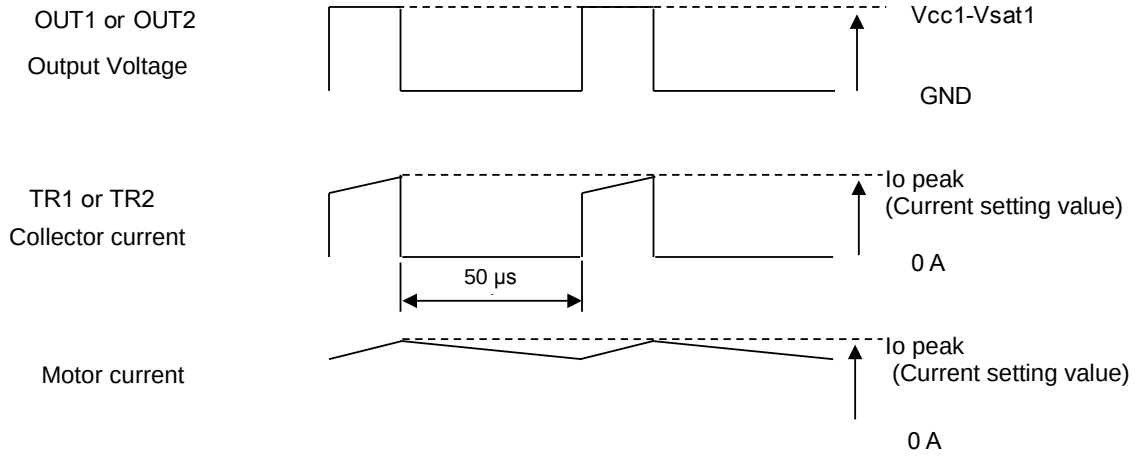
Notes

(1) The value of the power supply bypass capacitor C1 must be set so that the capacitor ripple current, which changes with the motor current, remains within the allowable range.

(2) While the Vref2 pin is normally handled by being left open, note that the thermal protection circuit will no longer operate if this pin is connected to ground or the P.S pin.

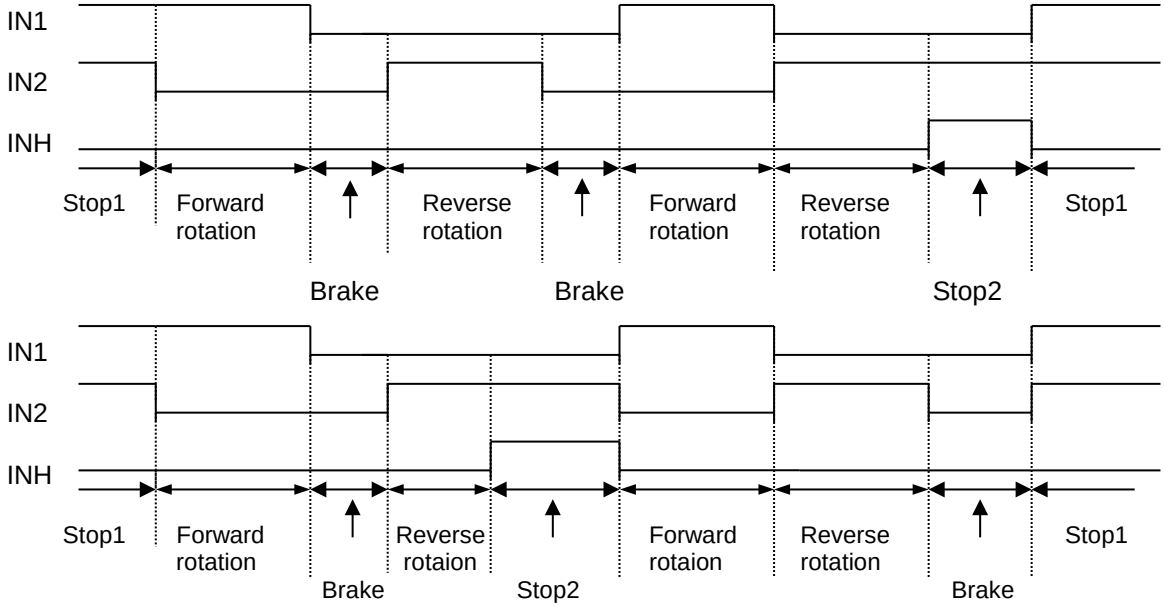
(3) Current is controlled by a constant-current chopping operation by transistors TR1 and TR2. The timing for the OUT1 or OUT2 output voltage and the TR1 or TR2 collector current is shown below.

(4) Do not connect or wire any of the NC (unused) pins that appear in either the block diagram or the application circuit examples to the circuit pattern on the PCB.



(5) Since the response time of the ground side drive element during forward/reverse direction switching is a few tens of microseconds, this product is not appropriate for H bridge applications. This device should only be used as a DC motor driver.

(6) Timing Charts



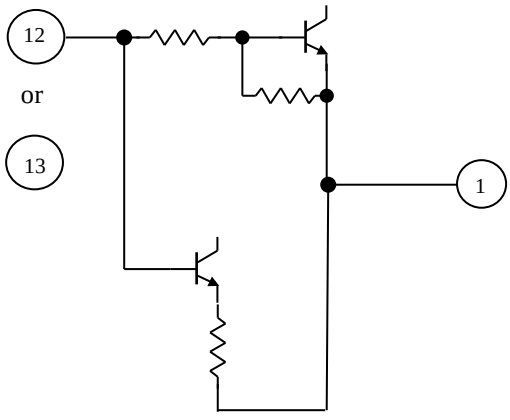
(7) Smoke Emission precautions : There is a possibillty of smoke emission if the IPM is subjected to physical or electrical damage as the result of being used without compliance with specifications.

Pin Functions

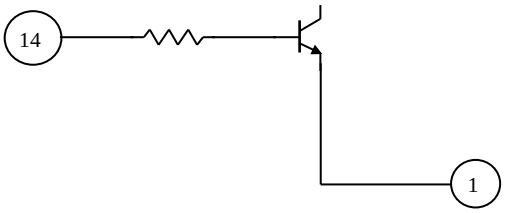
Pin Name	Pin Number	Functiuon
IN1	12	Input pin for turming TR1 and F1 ON/OFF at high level,TR1 : ON and F1 : OFF ; at low level TR1 : OFF and F1 : ON.
IN2	13	Input pin for turming TR2 and F2 ON/OFF at high level, TR2 : ON and F2 : OFF ; at low level TR2 : OFF and F2 : ON.
INH	14	Pin for turning TR1 and TR2 OFF ; at high level TR1 and TR2 : OFF This pin is usualy low or open
OUT1	8	This pin connects to the motor and outputs source/sync current depending on conditions at IN1 and IN2.
OUT2	6	This pin connects to the motor and outputs source/sync current depending on conditions at IN1 and IN2.
Vref1a Vref1b	16 18	This pin is used for current setting for constant-current operation performed with the Vrefa and Vrefb pins connected. A voltage of 0.42 V at Tc = 25℃ results for Vref1. 0.42 V is set by connecting 82 kΩ and 7.5 kΩ in series. Current detection resistance is Rs = 0.10 Ω. set using IO peak = Vref1 ÷ Rs It is to be noted, there is a CR time constant delay in RSI input. Io peak load conditions (load specs and power supply specifications) will vary (increase). Please check with the actual machine.
Vref2	17	Be sure to usually leave this pin open. The overheating control curcut can be made to stop operating by connecting this pin to Gnd or S.P pin.
S.P	2	Vref1 voltage can be reduced by connecting a resistor between Vref1 and the S.P pin.
RSO	3	This pin can be used to monitor the voltage across the current detection resistor Rs and is connected to the RSI pin.
RSI	19	This pin is connected to the RSO pin and serves as an input to the circuit that compares the input with Vref1.

Equivalent circuit

<IN1, IN2>

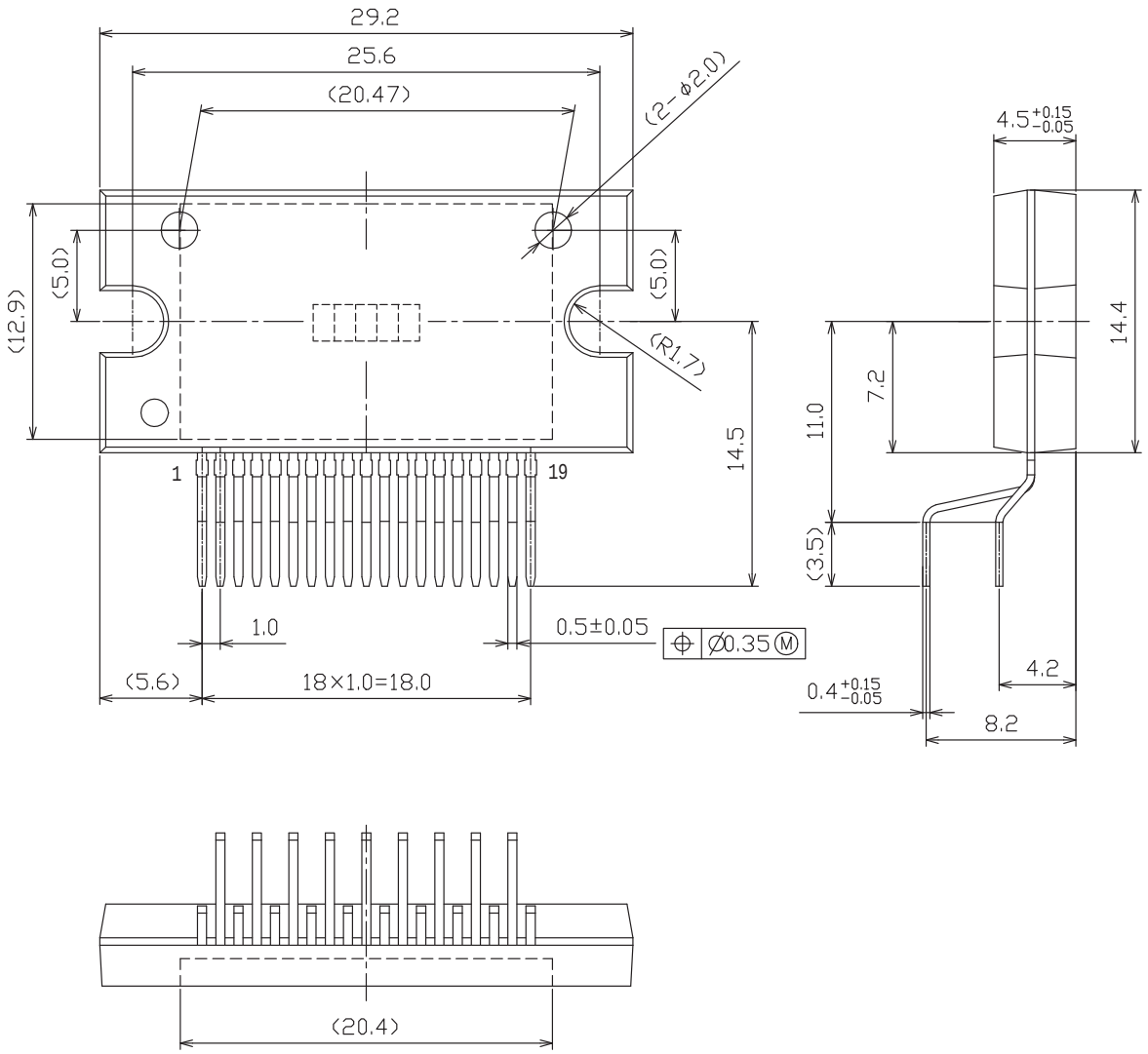


<INH>



Package Dimensions
unit : mm

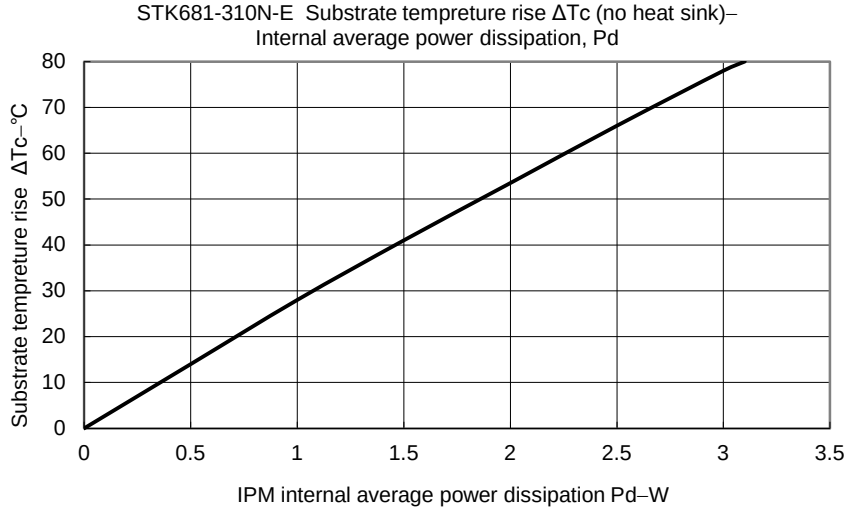
SIP19 29.2x14.4
CASE 127CF
ISSUE O



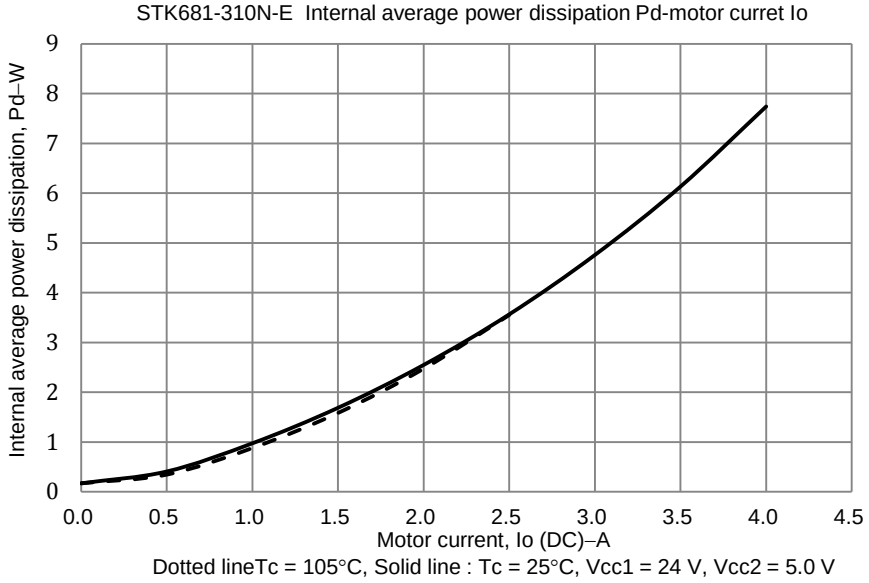
Technical data

1. Substrate temperature rise,ΔTc(no heat sink) – Internal average power dissipation, PD
2. Internal average power dissipation, Pd,in the DC current-motor current, Io, characterristics
3. Overheating current control characterristics
4. Allowable power dissipation,PdPK(no heat sink) – Ambient temperature,Ta
5. Electrical characteristics
    - Vdf vs If
    - Vsat1・Vsat2 vs Io
    - Vsat1 vs VIH1
    - VOUT vs VIH1
    - VOUT vs VIH2
    - IIH1 vs VIH1
    - IIH2 vs VIH2
6. TR1, TR2 A.S.O, F1, F2 A.S.O

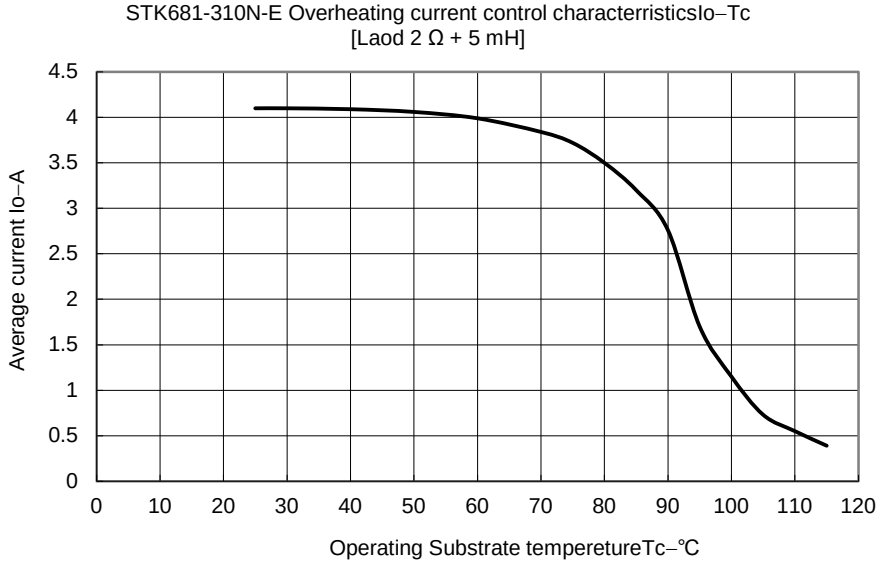
1. Substrate temperature rise, ΔTc(no heat sink) – Internal average power dissipation, PD



2. Internal average power dissipation, Pd,in the DC current-motor current,Io,characterristics



3. Overheating current control characterristics



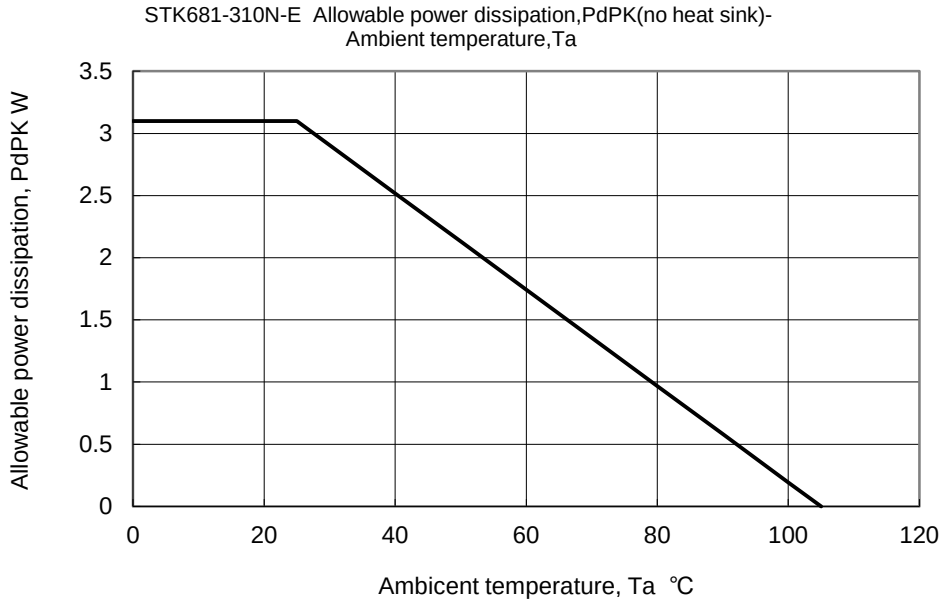
Overheating current control is a driver corruption prevention function when the motor lock occurs is abnormal behavior.

4. Allowable power dissipation, PdPK (no heat sink) – Ambient temperature, Ta

Package power loss, PdPK, refers to theaverage internal power loss, PdAV, allowable without a heat sink.
The figure below represents the allowable power loss, PdPK, vs. fluctuations in the ambient temperatire, Ta.

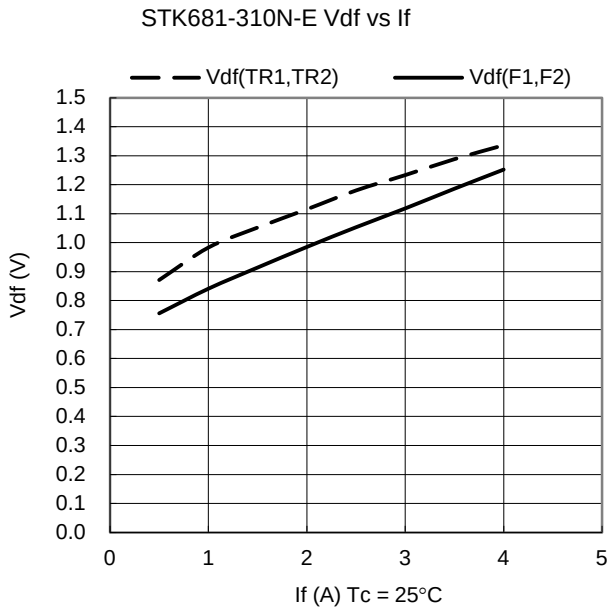
Power loss of up to 3.1 W is allowable at Ta = 25℃, and of up to 1.75 W at Ta = 60℃.

* Thermal resistance θc-a of the package is the 25.8℃/W.

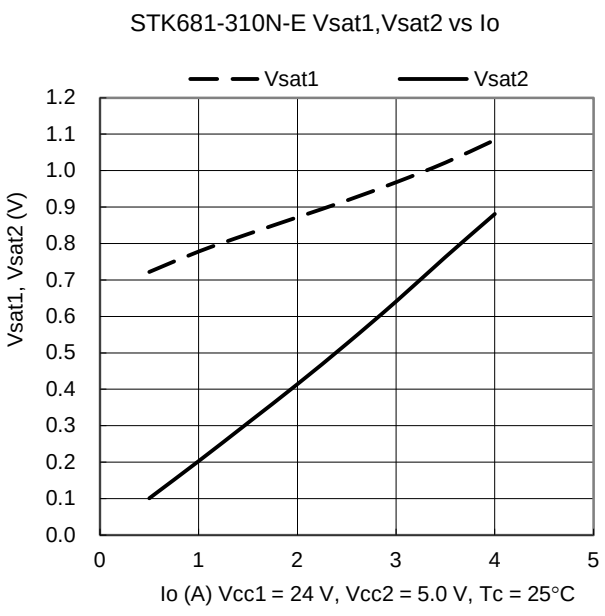


5. Electrical characteristics

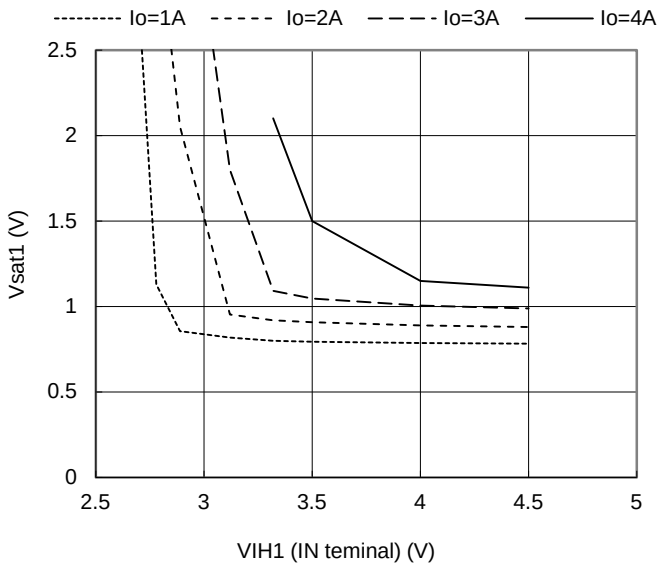
<Vdf vs If>



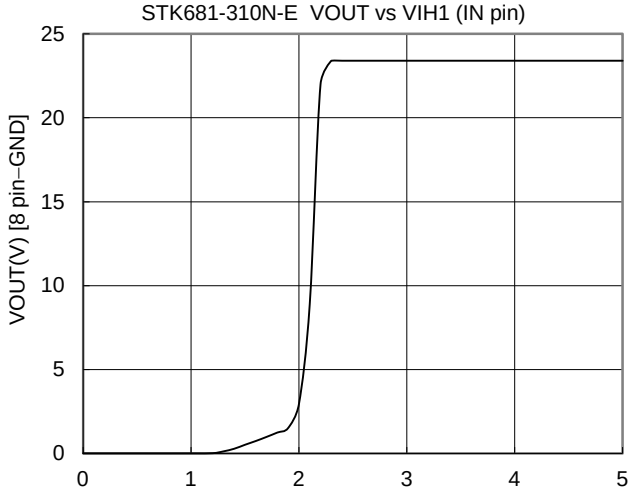
<Vsat1・Vsat2 vs Io>



STK681-310N-E Vsat1 vs VIH1

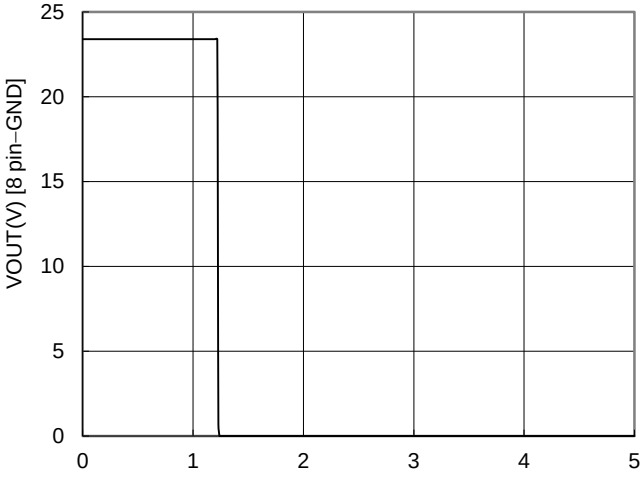


STK681-310N-E VOUT vs VIH1 (IN pin)



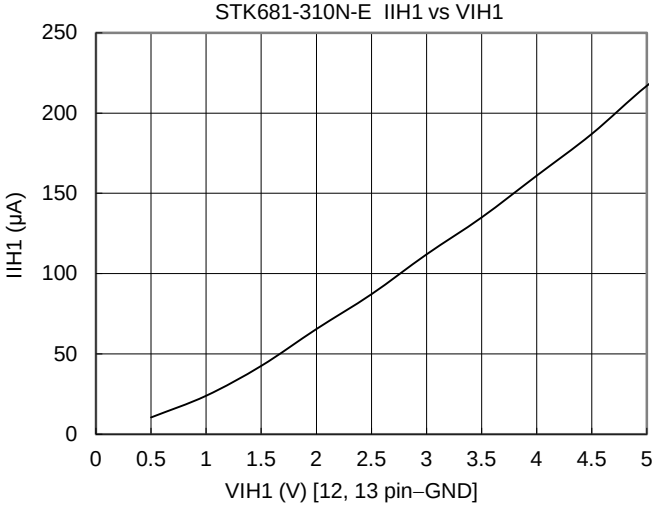
Vcc1 = 24 V, Vcc2 = 5.0 V, Tc = 25°C,
OUT1−OUT2 = 1 kΩ, 14 pin = Low

STK681-310N-E VOUT vs VIH2 (INH pin)



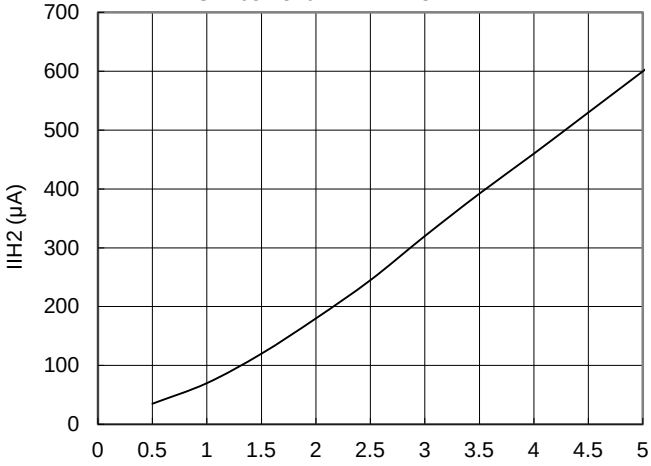
Vcc1 = 24 V, Vcc2 = 5.0 V, Tc = 25°C,
OUT1−OUT2 = 1 kΩ,12 pin = High

STK681-310N-E IIH1 vs VIH1



Vcc1 = 24 V, Vcc2 = 5.0 V, Tc = 25°C

STK681-310N-E IIH2 vs VIH2



Vcc1 = 24 V, Vcc2 = 5.0 V, Tc=25°C

6. TR1, TR2 A.S.O, F1, F2 A.S.O