



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

STK984-091A-E — Thick-Film Hybrid IC 3-phase Blush-less DC Motor Driver IC

Overview

The STK984-091A-E is a hybrid IC designed to be used in Blush-less DC Motor.

Application

- Industrial – Motor Drive

Features

- FET can be driven (built-in pre-driver IC) by microcontroller output (logic system).
- Various protections (Overcurrent Protection, Over Temperature Protection, Low Voltage Protection, Over Voltage Protection) are incorporated.
- Intelligent DIAG Function that externally outputs each protection status, such as Overcurrent Protection, Over Temperature Protection.
- Protection functions can be reset by external inputs.

Series model

	STK984-091A-E	STK984-090A-E
VB max	40V	40V
Id max	20A	20A
IOC	91-170A	68-160A
ISD	48-90A	22-65A
TSD	135-145°C	126-136°C

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STK984-091A-E

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$, $T_c = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V+B1	+B1 to PG	-0.3 to 40	V
	V+B2	+B2 to SG		
Control input voltage	V_{IN} max	UT, VT, WT, UB, VB, WB to SG	-0.3 to 6	V
DIAG terminal voltage	VDIAG	DIAG1, DIAG2 to SG	-0.3 to 6	V
Drain current	I_d max	DC	20	A
		Pulse (Single-Shot within 10 μ s)	180	A
Junction temperature	T_j max	Semiconductor device	150	$^\circ\text{C}$
Storage temperature	T_{stg}		-40 to +125	$^\circ\text{C}$

Recommended Operating Conditions at $-40^\circ\text{C} \leq T_c \leq 125^\circ\text{C}$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Supply voltage	V+B1	+B1 to PG	8	13.5	18	V
	V+B2	+B2 to SG				
Output current	I_O	$I_O \propto$ ON duty, ON duty100% 120deg excitation method			20	A
Operating substrate temperature	T_c	Thick film IC substrate temperature	-40		125	$^\circ\text{C}$
Drive PWM frequency	FO	ONDuty: 10 to 90%, 100%			20	kHz

Thermal Resistance

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Chip-case resistance	θ_{jc}	Junction -to- backside of the substrate MOSFET/ch		4.5		$^\circ\text{C}/\text{W}$

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V+B1$ ($V+B2$) = 13.5V unless otherwise specified

Parameter	Symbol	Test Conditions	min	typ	max	Unit	
Current consumption (Control system)	I_{CC}	$V+B1=V+B2=16\text{V}$		10	15	mA	
Output saturation voltage	$V_{DS}(\text{sat})$	$I_O=20\text{A}$	+B1 to U, V, W	0.3	0.5	V	
			U, V, W to PG	0.2	0.4		
Current sensing resistor	R_s		2.91	3.00	3.09	m Ω	
Time delay (ON)	$t_{d(\text{on})}$	20A	U, V, W	0.9	1.8	2.8	μs
			U-, V-, W-	0.9	1.9	3.0	
Rise time	t_r	20A		0.3		μs	
Time delay (OFF)	$t_{d(\text{off})}$	20A	U, V, W	1.3	2.9	4.5	μs
			U-, V-, W-	0.8	2.2	3.5	
Fall time	t_f	20A		0.3		μs	

Motor Control Input Terminal at $8\text{V} \leq V+B1$ ($V+B2$) $\leq 18\text{V}$, $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Input ON voltage	$V_{IN}(\text{on})$	Output on UT, VT, WT, UB, VB, WB to SG	3.5			V
Input OFF voltage	$V_{IN}(\text{off})$	Output off UT, VT, WT, UB, VB, WB to SG			1.5	V

Reset Input Terminal at $8\text{V} \leq V+B1$ ($V+B2$) $\leq 18\text{V}$, $-40^\circ\text{C} \leq T_a \leq 125^\circ\text{C}$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Reset high voltage	$V_{\text{reset}}(\text{Hi})$	Output ON	3.5			V
Reset low voltage	$V_{\text{reset}}(\text{Lo})$	Output OFF			1.5	V
Output delay time (ON)	$t_{\text{reset}}(\text{on})$	From reset input terminal (RESET=Hi) to output ON		0.25		ms
Output delay time (OFF)	$t_{\text{reset}}(\text{off})$	From reset input terminal (RESET=Lo) to output OFF		2		μs

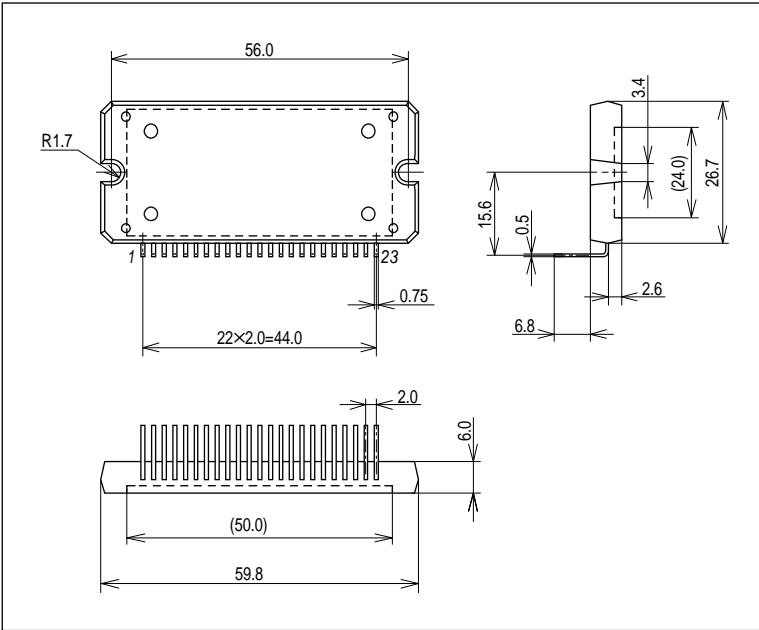
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Protective Function at $T_a = 25^\circ\text{C}$, V_{+B1} (V_{+B2}) = 13.5V unless otherwise specified

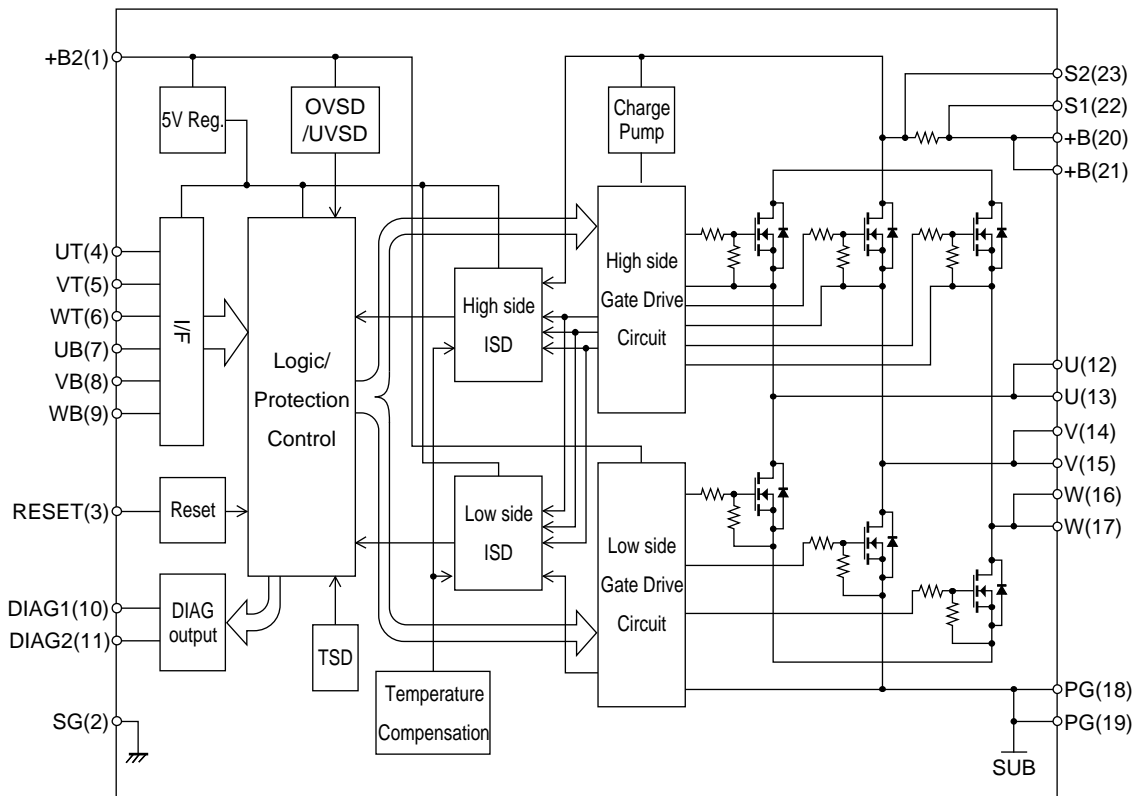
Parameter	Symbol	Test Conditions	min	typ	max	Unit
Low voltage protection threshold	Vuv		4.45	4.75	5.1	V
Low voltage protection hysteresis	Vuv(hy)		0.07	0.2	0.3	V
Low voltage shutdown output delay	Tuvoff			1.0		μs
Over current threshold	ISD	Automatic recovery	48	68	90	A
Over current DIAG output delay time	Tocdgoff			4.3		μs
Over current shutdown interval	tint			1		ms
Over current shutdown output delay	Tocoff			4.3		μs
Ground fault short-circuit protection	IOC	Power-cycle	91	134	170	A
Ground fault short-circuit detection DIAG output delay time	Tspdgoft			3.0		ms
Ground fault short-circuit shutdown output delay time	Tspoff			3.0		ms
Temperature protection shutdown	Tst	Thick film IC substrate temperature, automatic restoration	135	140	145	$^\circ\text{C}$
Temperature protection recovery	Tst(hy)	Thick film IC substrate temperature	115	120	125	$^\circ\text{C}$
Over temperature DIAG output delay time	Tthdgoff			3.4		ms
Over temperature shutdown output delay	Tthoff			3.4		μs
Over voltage threshold	Vov		24			V
Over voltage protection hysteresis width	Vov(hy)			0.5		V
Over voltage shutdown output delay	Tovoff			1.0		μs

Package Dimensions

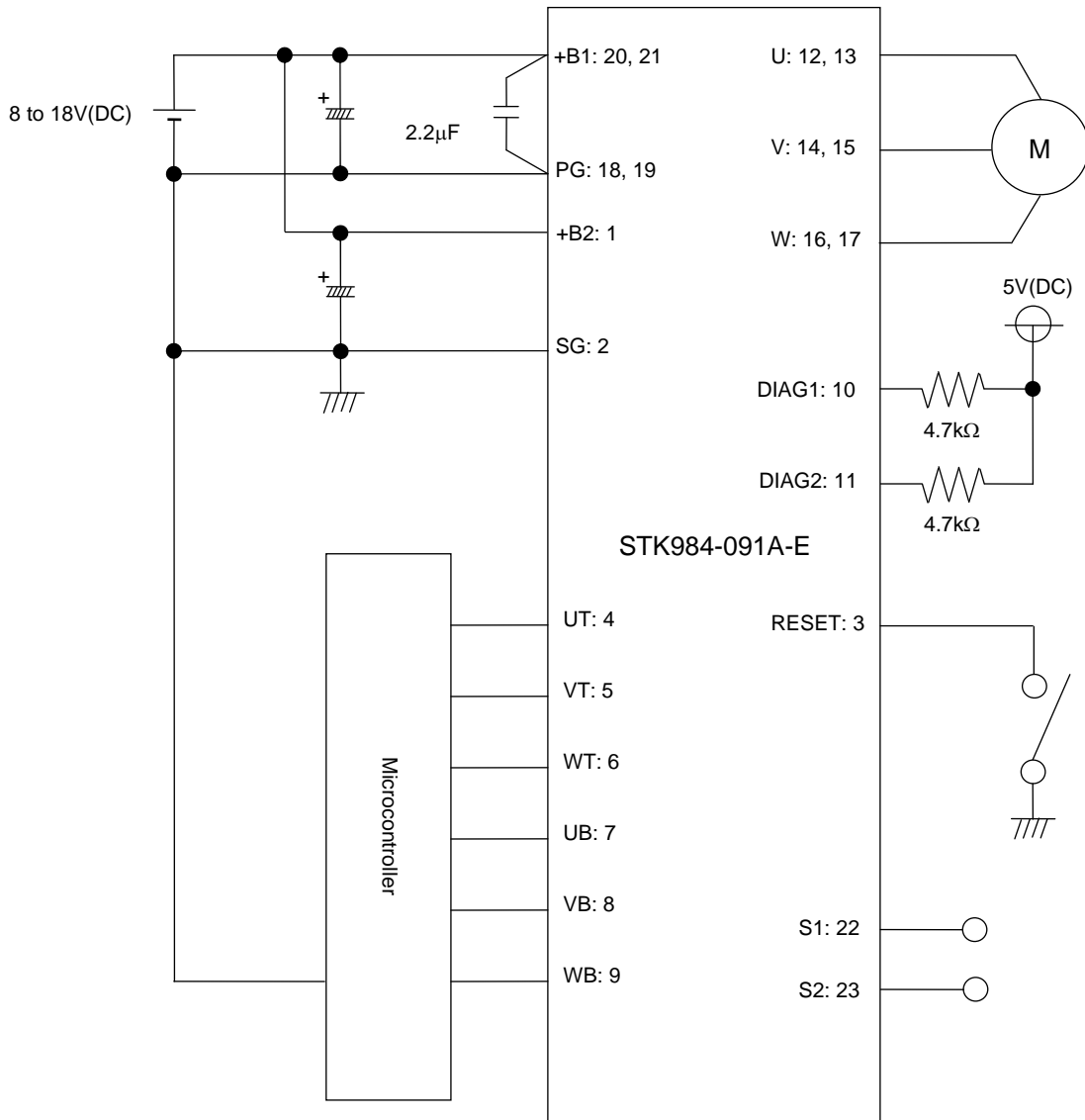
unit : mm (typ)



Internal Block Diagram



Application Circuit



NOTE

1. A voltage overshoot with vibration will be occurred during a switching operation due to floating inductance of the power source wiring connected between terminal +B1 and PG. In order that the voltage overshoot between +B1 and PG, +B1 and each -UBW, each UVW and PG will not exceed its rating, please minimize wiring inductance by shortening the wiring, also connect a snubber circuit close to between +B1 and PG terminals.
2. With the object of the overcurrent protection circuit fail-safe design, inserting a fuse in +B1 line is recommended.
3. There is a 100kΩ (Typ) pull-down resistor connected inside of the signal input terminal. However, in the case of mounting a resistor externally to reduce noise due to wiring, please satisfy the input voltage threshold of this Hybrid-IC.
4. Terminal DIAG 1 and DIAG 2 are the open drain output configuration. Please pull up with 4.7kΩ resistor to 5V power supply.
5. There is a 100kΩ (Typ) pull-up resistor connected inside of the RESET terminal. It operates normally in the open-state. When the short-circuit protection operates and latches the output OFF, the latched output OFF can be released by making RESET terminal Low and re-opened.

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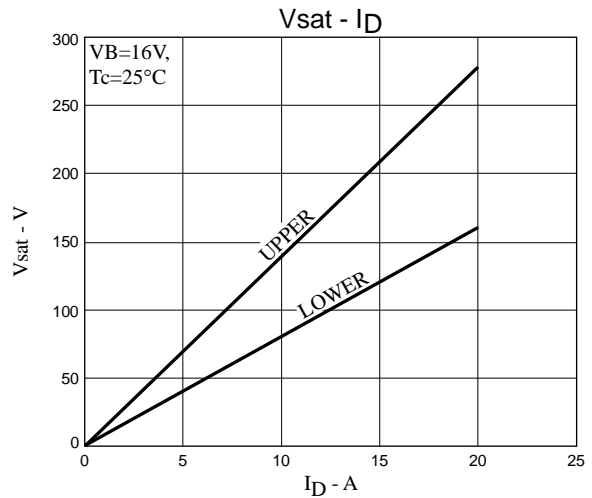
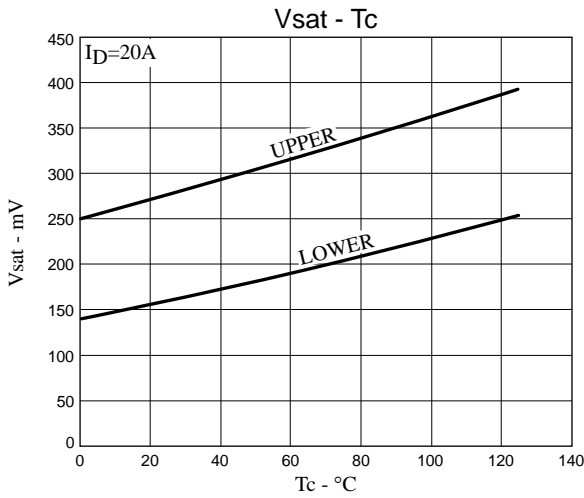
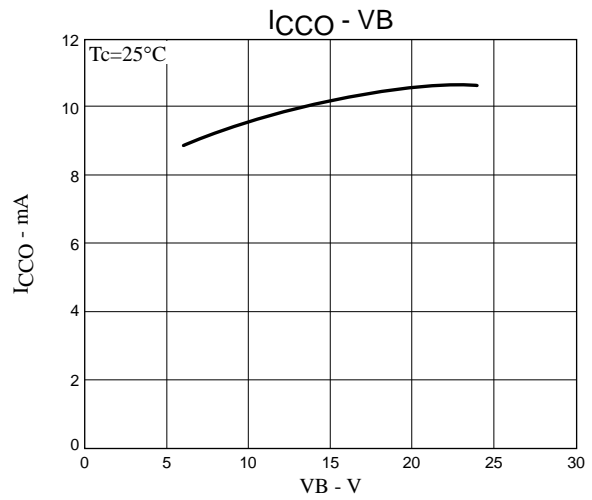
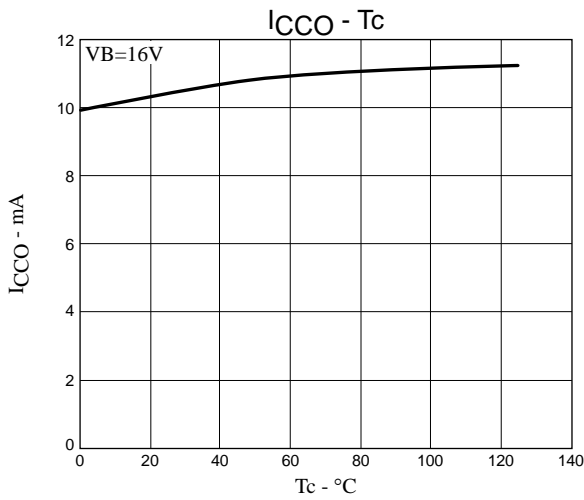
Pin Function Description

Pin No.	Pin Name	Description	Pin*
1	+B2	Control System Power	S
2	SG	Control System GND	S
3	RESET	RESET Terminal Normal operating in RESET = H or Open-State The Gate Output will be Lo-state for both Hi/Lo sides with RESET = L (Output OFF) Output OFF Latch Release terminal of Short-circuit Protection	S
4	UT	Driving Signal Input Upper U-phase	S
5	VT	Driving Signal Input Upper V-phase	S
6	WT	Driving Signal Input Upper W-phase	S
7	UB	Driving Signal Input Lower U-phase	S
8	VB	Driving Signal Input Lower V-phase	S
9	WB	Driving Signal Input Lower W-phase	S
10	DIAG1	Fault Diagnosis Output 1 (Overcurrent) Normal Operation: Lo Abnormal Operation: Hi	S
11	DIAG2	Fault Diagnosis Output 2 (Over Temperature) Normal Operation: Lo Abnormal Operation: Hi	S
12	U	U-phase Output	P
13	U	U-phase Output	P
14	V	V-phase Output	P
15	V	V-phase Output	P
16	W	W-phase Output	P
17	W	W-phase Output	P
18	PG	Power System GND	P
19	PG	Power System GND	P
20	+B1	Power System Supply	P
21	+B1	Power System Supply	P
22	S1	Current Sense Resistor Sensing (+) terminal	S
23	S2	Current Sense Resistor Sensing (-) terminal	S

*

S: Signal terminal

P: Power terminal



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