SINGLE PHASE FULL WAVE DIRECT PWM MOTOR DRIVER AM4961

General Description

The AM4961 is a full wave driver IC with PWM control function. It is used for single phase motor and is capable of speed control by changing output duty cycle.

The AM4961 is available in TSSOP-20(EDP) and HTSSOP-14 packages.

Features

- Built-in Hall Bias Circuit
- Built-in PWM Speed Control Circuit
- Built-in Minimal Speed Setup Circuit
- Rotation Speed Indication (FG)
- Rotation or Lock State Indication (RD)
- Built-in Thermal Shutdown Circuit
- Lock Protection
- Output Current Limit

Application

- CPU Cooler Fan in PC
- Brushless DC Motor Driver

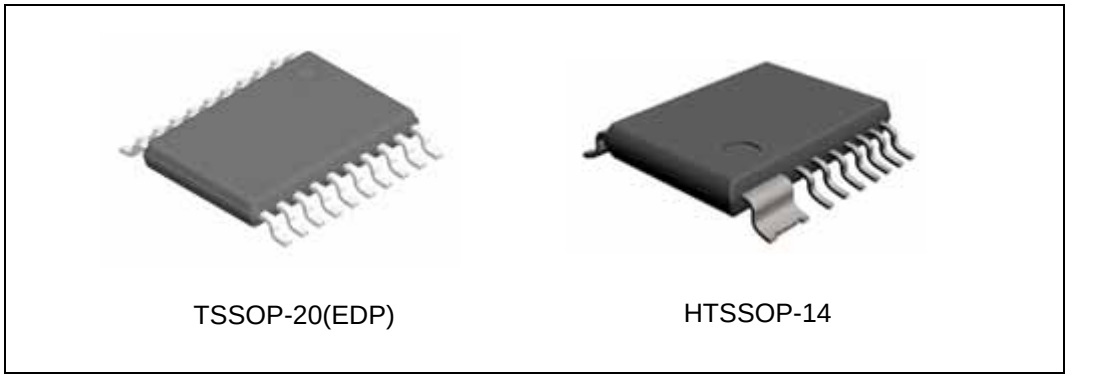
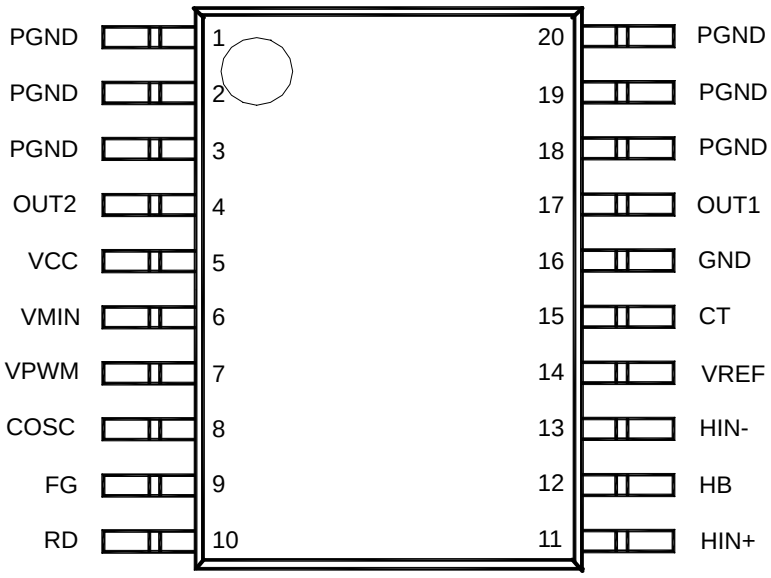


Figure 1. Package Types of AM4961

Pin Configuration

G Package
(TSSOP-20(EDP))



Pin Configuration (Continued)

GH Package
(HTSSOP-14)

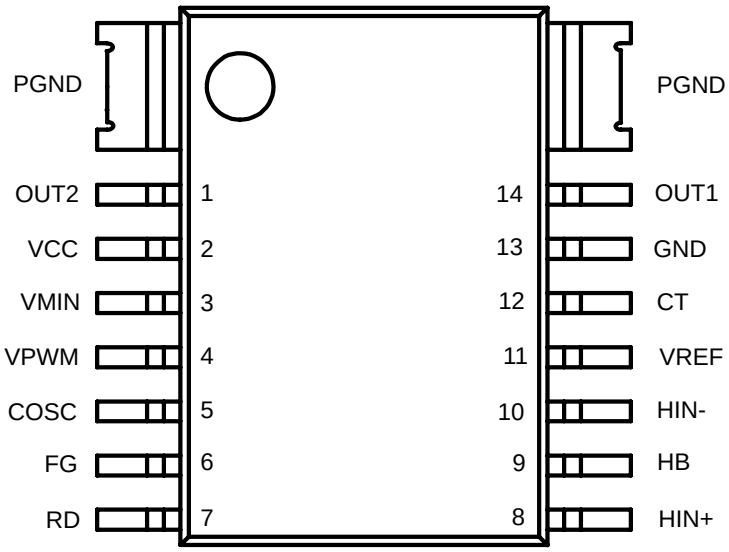
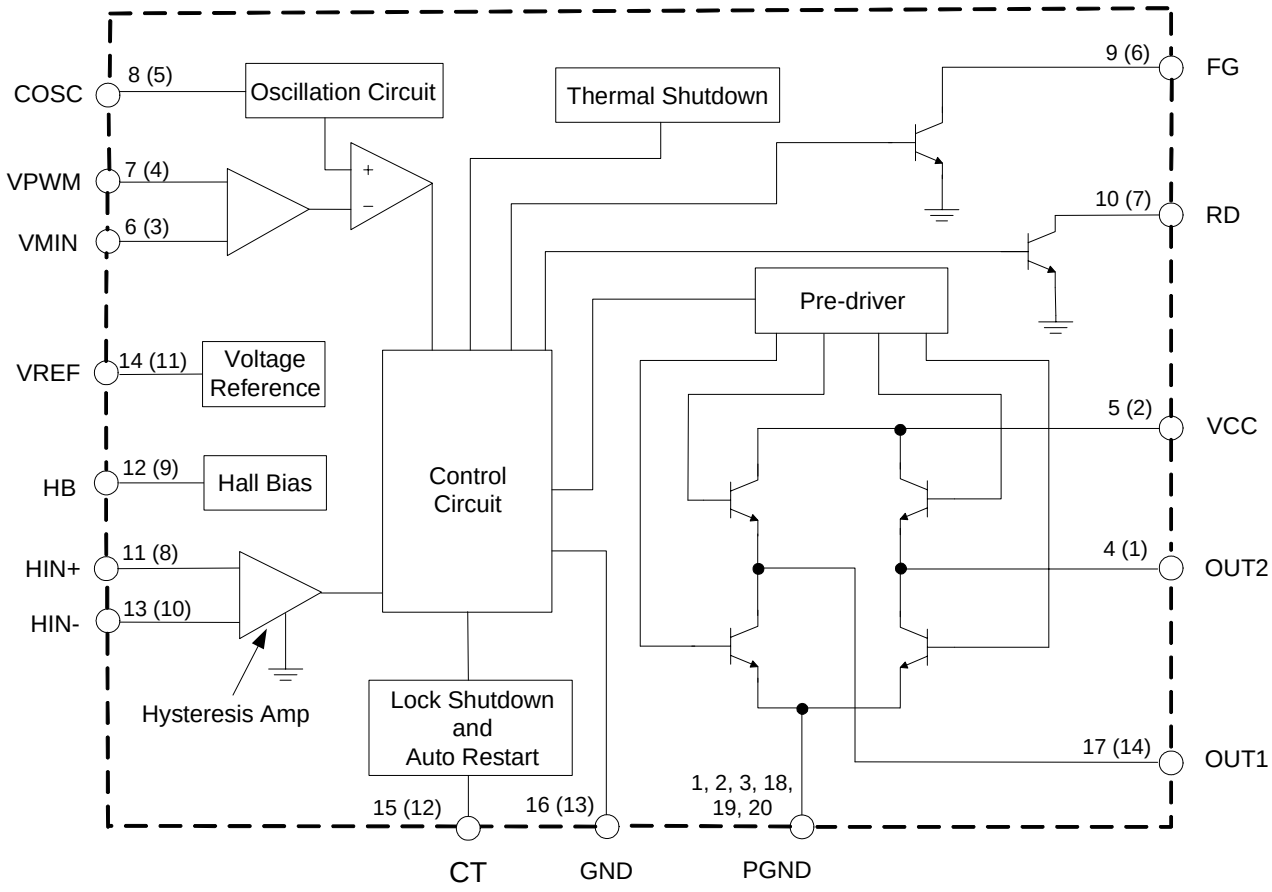


Figure 2. Pin Configuration of AM4961 (Top View)

Pin Description

Pin Number		Pin Name	Function
TSSOP-20(EDP)	HTSSOP-14		
1		PGND	Power ground
2		PGND	Power ground
3		PGND	Power ground
4	1	OUT2	Driver output 2
5	2	VCC	Power supply
6	3	VMIN	Minimum duty setting
7	4	VPWM	Adjustable Input
8	5	COSC	Oscillator capacitor
9	6	FG	Rotation speed indicator
10	7	RD	Rotation/lock state indicator
11	8	HIN+	Hall sensor input +
12	9	HB	Hall sensor bias regulator
13	10	HIN-	Hall sensor input -
14	11	VREF	Reference voltage regulator
15	12	CT	Lock and rotation setting capacitor terminal
16	13	GND	Ground for control circuit
17	14	OUT1	Driver output 1
18		PGND	Power ground
19		PGND	Power ground
20		PGND	Power ground

Functional Block Diagram



A (B)
A for 20-pin B for 14-pin

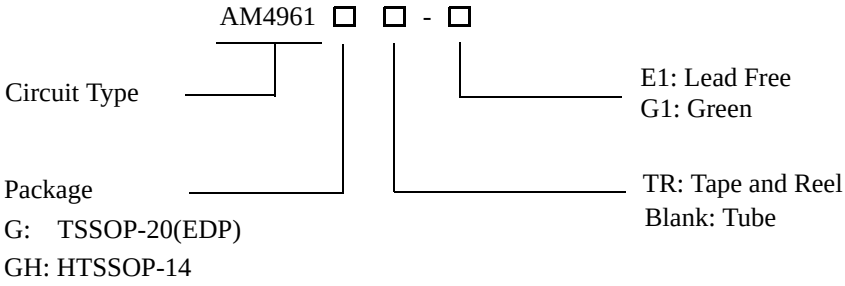
Figure 3. Functional Block Diagram of AM4961

Truth Table

HIN-	HIN+	COSC (Note 1)	CT	OUT1	OUT2	FG	RD	Mode
H	L	H	L	H	L	L	L	Rotation (Drive)
L	H			L	H	OFF		
H	L	L		OFF	L	L		Rotation (Recirculate)
L	H			L	OFF	OFF		
H	L	H	H	H	OFF	L	OFF	Lock Protection
L	H			OFF	H	OFF		
H	L	L		OFF	OFF	L		
L	H			OFF	OFF	OFF		

Note 1: V_{OSC} (H) $>V_{PWM}$, V_{OSC} (L) $<V_{PWM}$.

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
TSSOP-20 (EDP)	-30 to 105°C	AM4961G-E1	AM4961G-G1	AM4961G	AM4961G-G1	Tube
		AM4961GTR-E1	AM4961GTR-G1	AM4961G	AM4961G-G1	Tape & Reel
HTSSOP-14	-30 to 90°C	AM4961GH-E1	AM4961GH-G1	AM4961GH	AM4961GH-G1	Tube
		AM4961GHTR-E1	AM4961GHTR-G1	AM4961GH	AM4961GH-G1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

Absolute Maximum Ratings (Note 2)

Parameter	Symbol	Value		Unit
Supply Voltage	V_{CC}	18		V
Output Current	I_{OUT}	1.2		A
Output Voltage	V_{OUT}	18		V
HB Output Current	I_{HB}	10		mA
VPWM Input Voltage	V_{PWM}	6		V
RD Output Voltage	V_{RD}	18		V
FG Output Voltage	V_{FG}	18		V
RD Output Current	I_{RD}	10		mA
FG Output Current	I_{FG}	10		mA
Power Dissipation (Note 3)	P_D	TSSOP-20(EDP)	1.5	W
		HTSSOP-14	1.1	W
Storage Temperature Range	T_{STG}	-55 to 150		^oC
ESD (Human Body Model)	ESD	2000		V
ESD (Machine Model)	ESD	250		V

Note 2: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Note 3: T_A=25^{o}C, no external heatsink.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	3.5	12	16	V
Hall Input Voltage + (Note 4)	V_{IN+}	0.2		3	V
Hall Input Voltage - (Note 4)	V_{IN-}	0.2		3	V
Ambient Temperature (Note 5)	T_A	-30		105	^oC

Note 4: Hall input voltage range includes the amplitude of signal.

Note 5: For TSSOP-20(EDP) package only. External heatsink shall larger than 15.24mm*3.81mm to ensure the IC is available at T_A=105^{o}C.

Electrical Characteristics

(V_{CC}=12V, T_A=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Quiescent Current	I_{Q1}	Lock off	11.24	15	18.76	mA
	I_{Q2}	Lock on	6.25	8	10.55	
VREF Voltage	V_{REF}	I_{REF}=5mA	5.8	6	6.2	V
Output Saturation Voltage at High Side	V_{SATH}	I_{SOURCE}=200mA		1.0	1.17	V
Output Saturation Voltage at Low Side	V_{SATL}	I_{SINK}=200mA		0.2	0.3	V
COSC Frequency	f_{OSC}	C_{OSC}=100pF	18	25	32	KHz
COSC High Level Voltage	V_{OSCH}		3.45	3.6	3.75	V
COSC Low Level Voltage	V_{OSCL}		1.83	1.95	2.07	V
Hall Input Hysteresis	V_{HYS}			±10	±20	mV
Hall Bias Voltage	V_{HB}	I_{HB}=5mA	1.1	1.25	1.4	V
CT High Level Voltage	V_{CTH}		3.55	3.7	3.88	V
CT Low Level Voltage	V_{CTL}		1.55	1.7	1.85	V
CT Charge Current	I_{CHG}		1.5	2	2.55	μA
CT Discharge Current	I_{DHG}		0.14	0.2	0.255	μA
CT Charge and Discharge Ratio	R_{CD}	I_{CHG}/I_{DHG}	8.5	10	14.5	
FG Output Low Level Voltage	V_{FGL}	I_{FG}=5mA		0.2	0.3	V
FG Leakage Current	I_{LFG}	V_{FG}=12V			30	μA
RD Output Low Level Voltage	V_{RDL}	I_{RD}=5mA		0.2	0.3	V
RD Leakage Current	I_{LRD}	V_{RD}=12V			30	μA

Typical Performance Characteristics

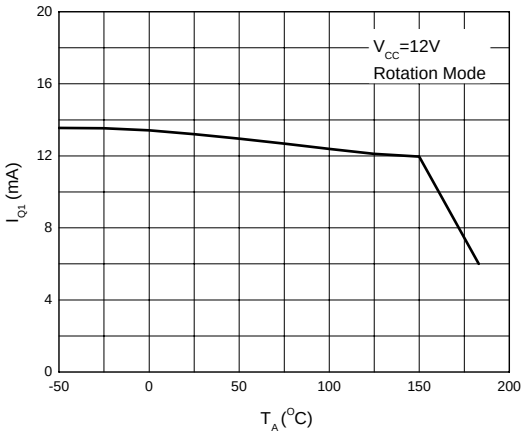


Figure 4.Quiescent Current vs. Ambient Temperature

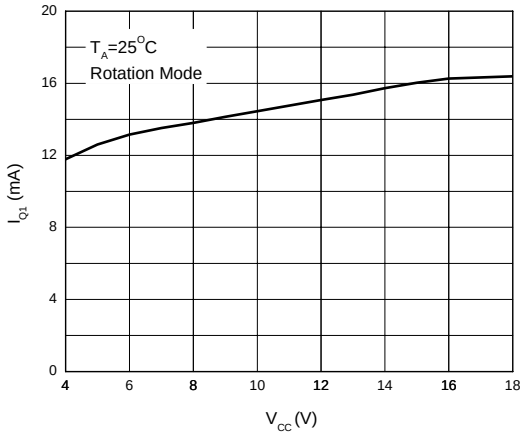


Figure 5. Quiescent Current vs. Supply Voltage

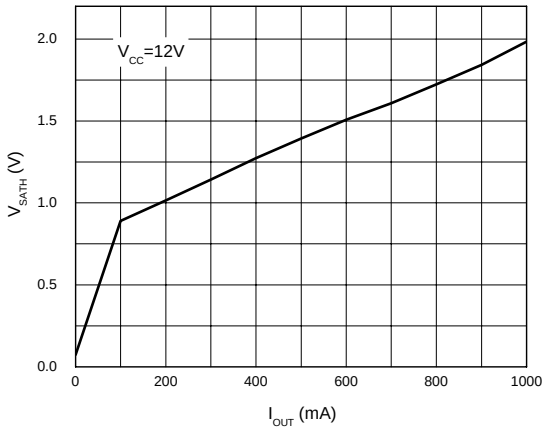


Figure 6. Output Saturation Voltage (High) vs. Output Current

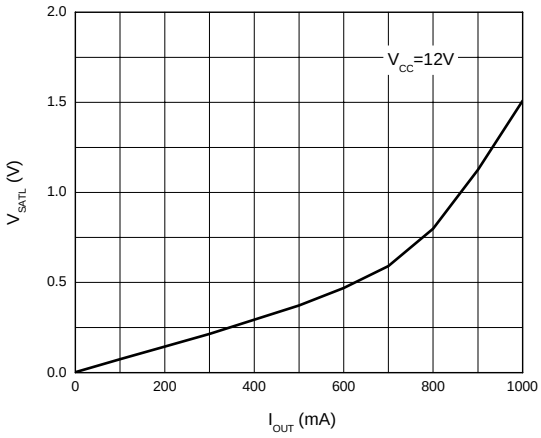


Figure 7. Output Saturation Voltage (Low) vs. Output Current

Typical Performance Characteristics (Continued)

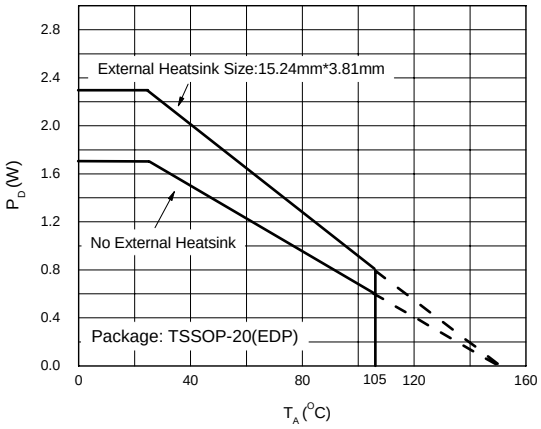


Figure 8. Power Dissipation vs. Ambient Temperature

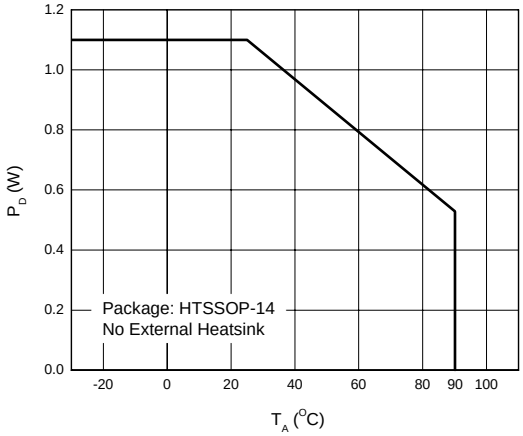


Figure 9. Power Dissipation vs. Ambient Temperature

Operating Diagram

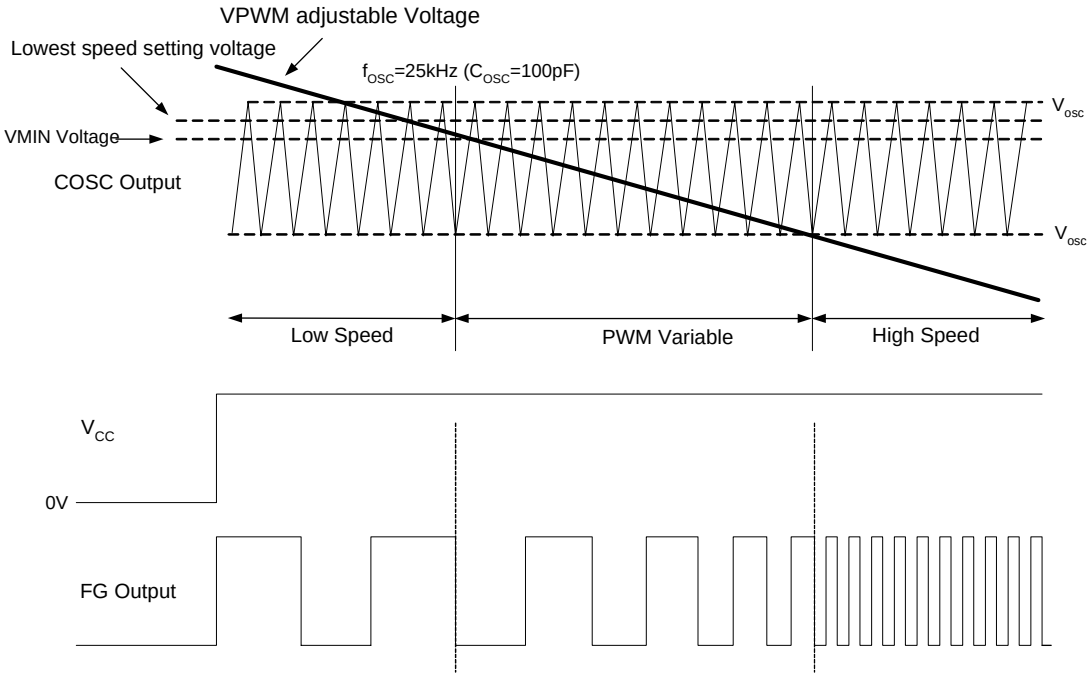


Figure 10. Operating Diagram of AM4961 (Note 6)

Note 6:

1. Low Speed Setting Mode

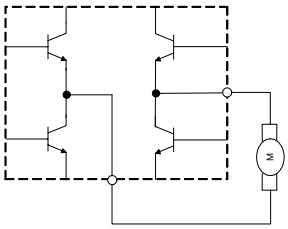
When VPWM voltage is higher than VMIN pin voltage, motor speed is settable by VMIN pin voltage. The minimum drive duty cycle is settable by comparing COSC oscillating voltage and VMIN pin voltage.

VPWM voltage is decided by variation of PWM duty.

2. Variable Speed Setting Mode

When VPWM voltage is lower than VMIN pin voltage, PWM control system works by comparing VPWM voltage and COSC voltage. If VPWM voltage is higher, the ON duty cycle of the upper side transistors will be minimized and motor speed becomes lower. Vice versa.

3. Full Speed Rotation Mode



At a certain PWN duty, when VPWM voltage is lower than the low side of COSC output voltage, the motor will run at full speed.

Typical Application

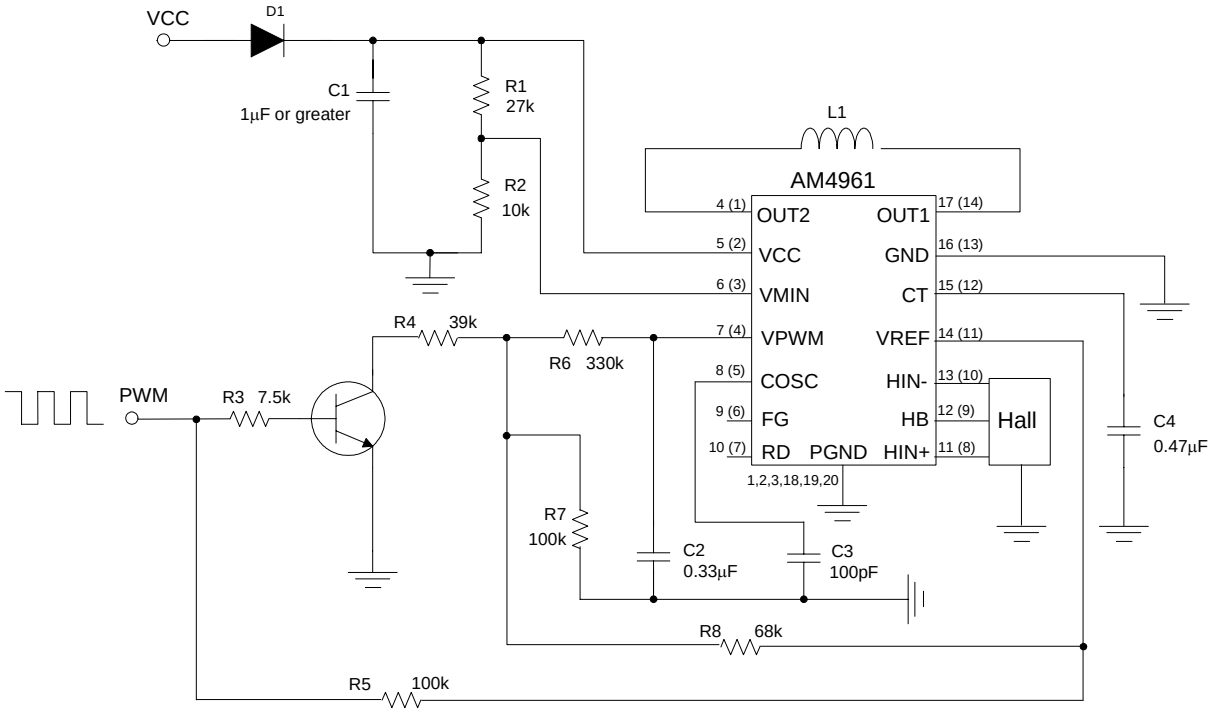


Figure 11. Typical Application of AM4961 (Note 7)

Typical Application (Continued)

Note 7:

*1. Ground Line Layout

PGND is connected to motor supply stage and GND is connected to control stage. All ground lines from control stage are connected to GND.

*2. Stability of Power Supply

C1 is employed to stabilize V_{CC}. Its capacitance is no less than 1μF.

*3. Hall Input

To avoid noise, the shortest line is recommended to connect with Hall stage which has about 20mV hysteresis. Thus, the ideal Hall input is 50mV or over.

*4. COSC Capacitor

When C_{CP} is 100pF, the COSC frequency will be 25kHz.

*5. FG Output

FG output terminal is open collector output which varies with phase change.

*6. RD Output

RD output terminal is open collector output. It is low at rotation mode and high when stopped.

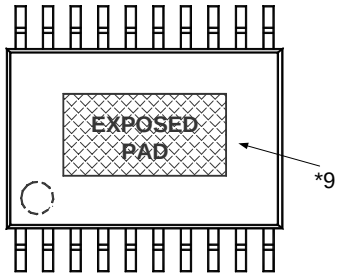
*7. HB Pin

This pin is available to output a 1.25V Hall bias voltage.

*8. VMIN Pin

If this pin is disused, connect it directly with VPWM, the minimum duty cycle will be 10%.

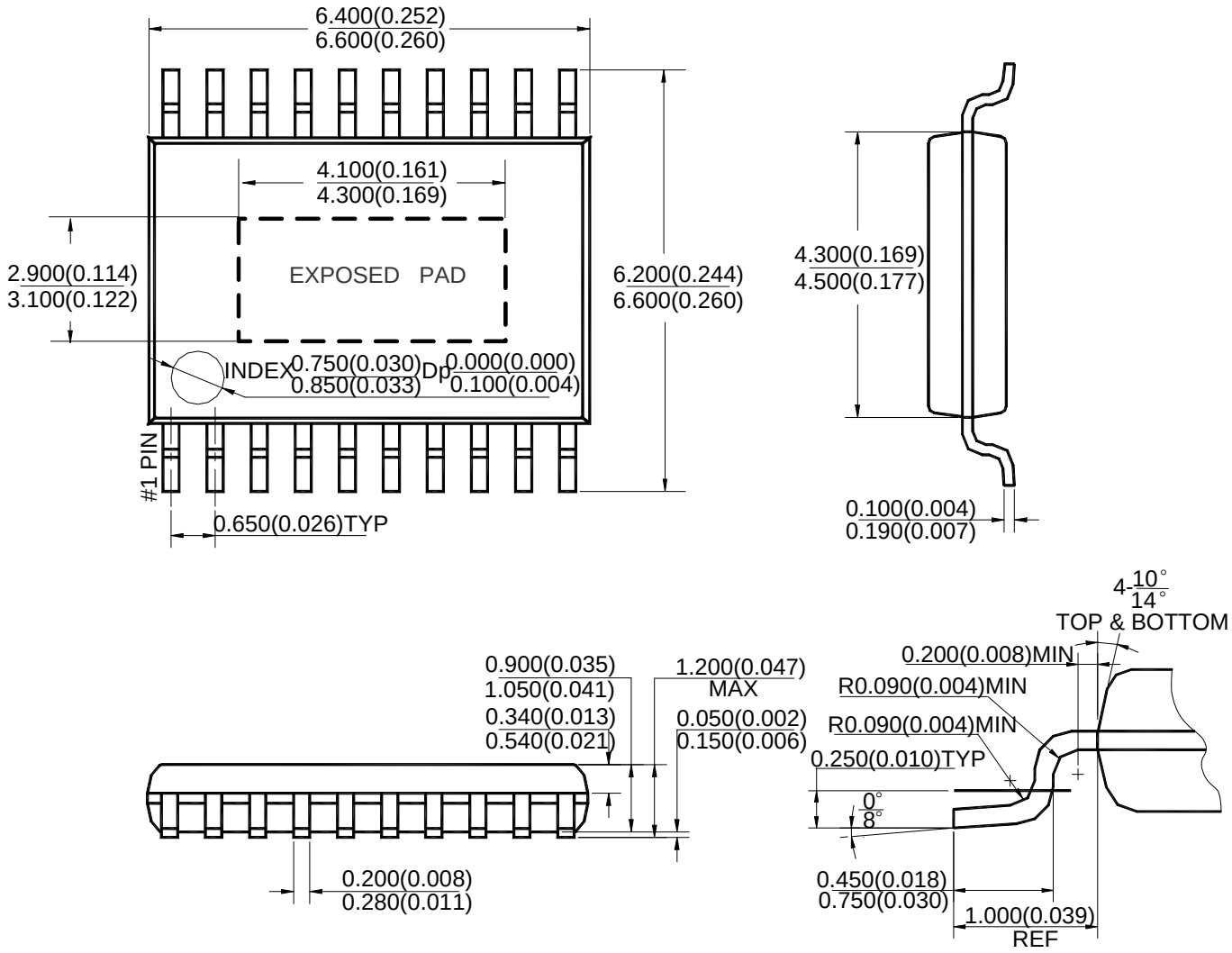
*9. Exposed Pad (For TSSOP-20(EDP) package only)



There is an exposed pad at the bottom of IC. If operating current is high, it is recommended to solder external heatsink closely with this pad by tin to ensure better temperature characteristics.

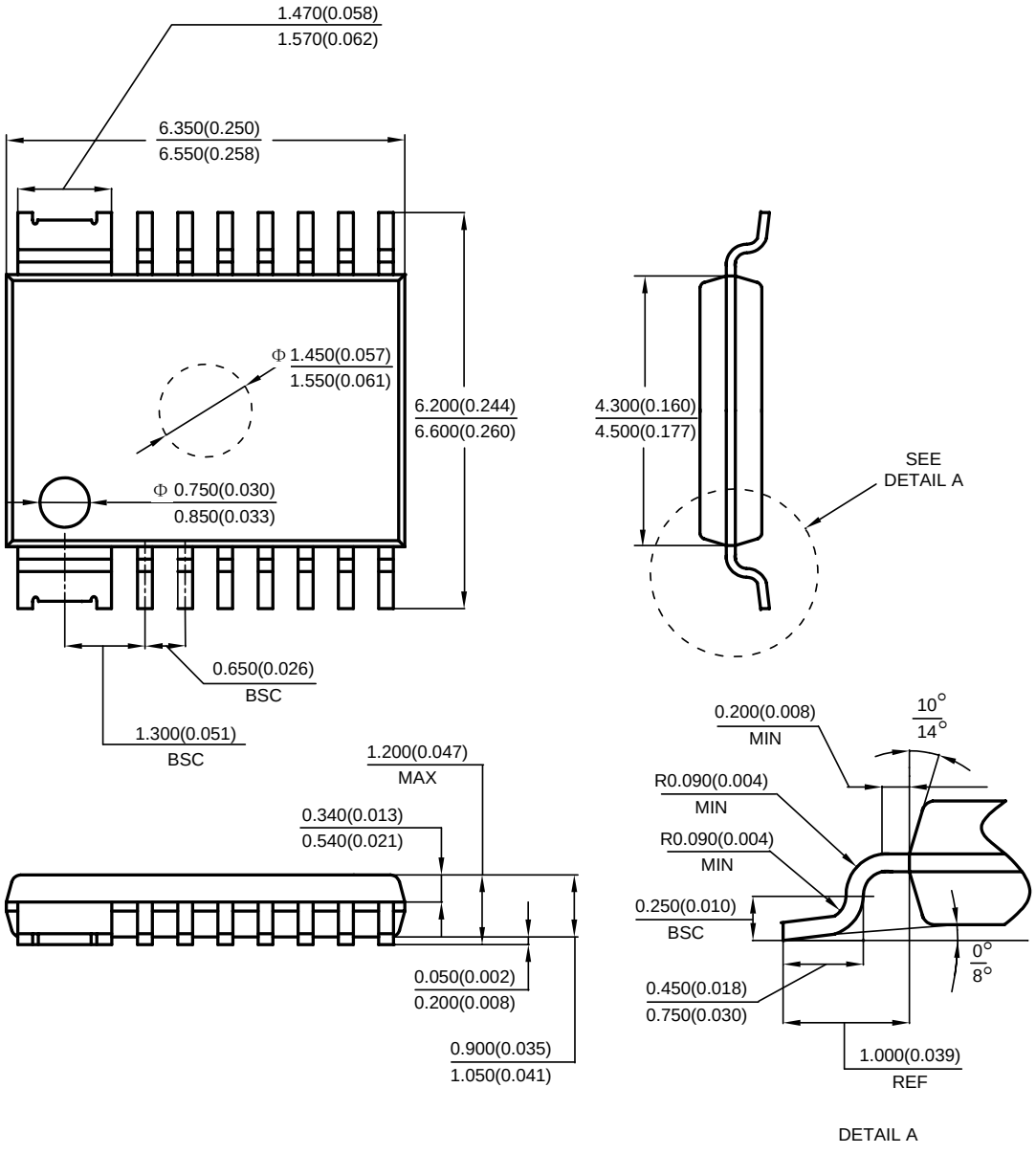
Mechanical Dimensions

TSSOP-20(EDP) **Unit: mm(inch)**



Mechanical Dimensions (Continued)

HTSSOP-14 **Unit: mm(inch)**



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