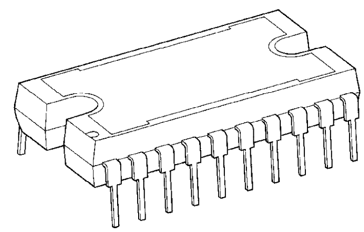
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA7247AP

DC MOTOR DRIVER

The TA7247AP is a 3 phase Bi-directional supply-voltage-controlled motor driver IC providing all the active functions necessary for switching-regulator-controlled FAN MOTOR of electrical Air conditioner.
It's designed for especially energy saving air conditioner applications and suitable for use any other motor driver applications.
It contains 3 phase Bi-directional power driver, CW / CCW control circuit, comparator and oscillator for switching regulator, and protect circuits.



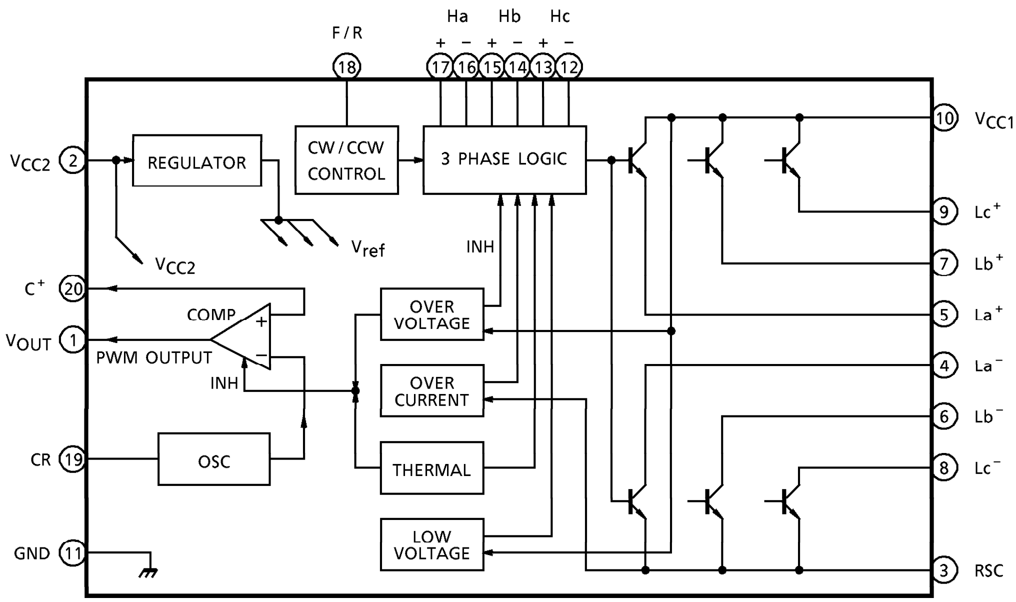
HDIP20-P-3.00

Weight : 8.19g (Typ.)

FEATURES

- Voltage Controlled 3 Phase Bi-Directional Motor Power Driver.
- Output Current Up to 1.5A.
- High Sensitivity of Position Sensing Inputs : $V_H = 40mV$ (Typ.)
- Built in Over Current, Over Voltage, Low Voltage and Thermal Protect Circuit.
- More Power-up Applications with Additional Power Transistors.
- Recommended Supply Voltage : $V_{CC1\,(opr.)} = 0\sim30V$
  $V_{CC2\,(opr.)} = 4.5\sim5.5V$

BLOCK DIAGRAM

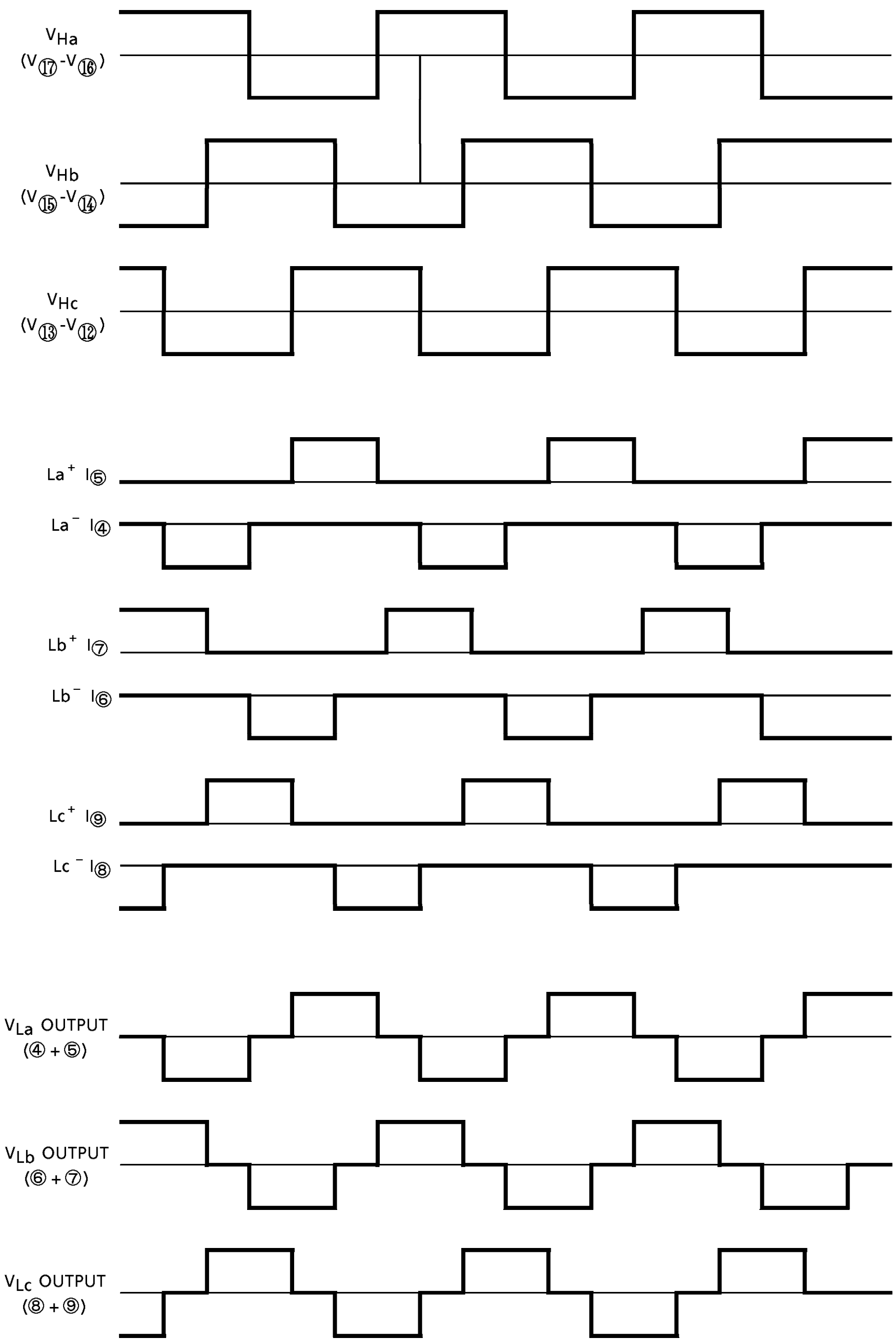


PIN FUNCTION

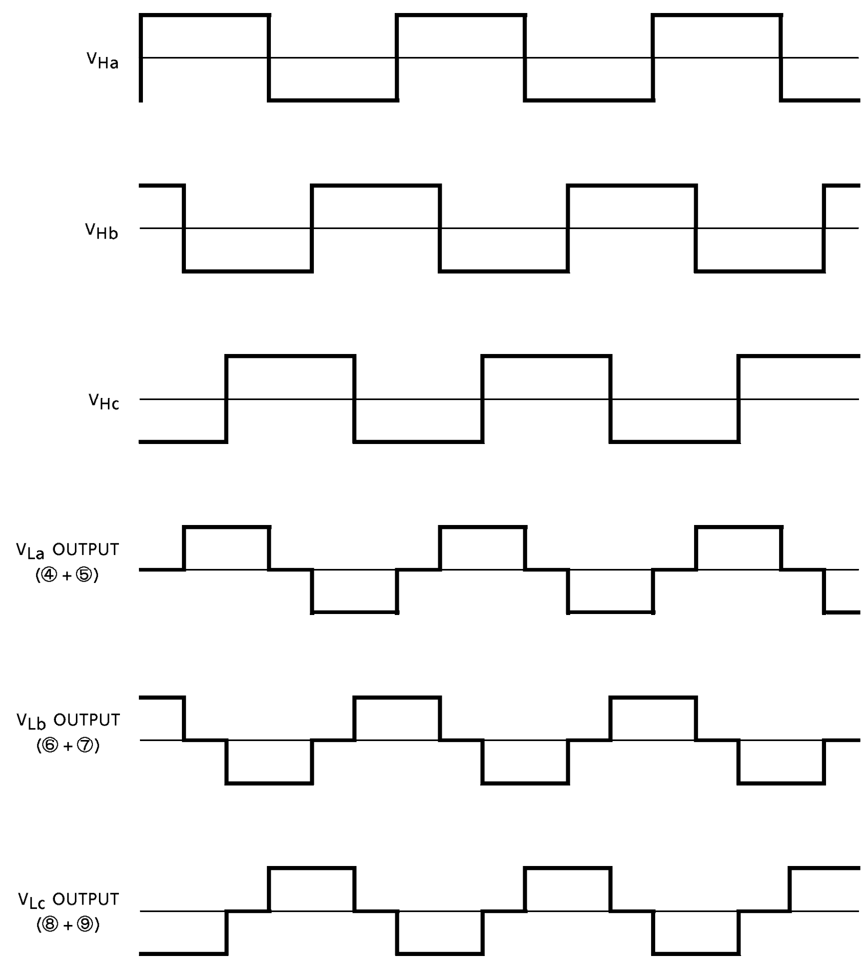
PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
1	V_{OUT}	PWM Output terminal
2	V_{CC2}	Power supply input terminal
3	RSC	Output current detection terminal
4	La^-	a-phase lower drive output terminal
5	La^+	a-phase upper drive output terminal
6	Lb^-	b-phase lower drive output terminal
7	Lb^+	b-phase upper drive output terminal
8	Lc^-	c-phase lower drive output terminal
9	Lc^+	c-phase upper drive output terminal
10	V_{CC1}	Drive power supply input terminal
11	GND	GND terminal
12	Hc^-	c-phase Hall amp negative input terminal
13	Hc^+	c-phase Hall amp positive input terminal
14	Hb^-	b-phase Hall amp negative input terminal
15	Hb^+	b-phase Hall amp positive input terminal
16	Ha^-	a-phase Hall amp negative input terminal
17	Ha^+	a-phase Hall amp positive input terminal
18	F / R	Normal rotation / reverse rotation switch terminal
19	CR	Capacitor connection terminal for reference oscillation
20	C^+	Comparator reference voltage input terminal

FUNCTION

a) Forward rotation mode (Pin⑱ open or 2.5V Min.)



b) Reverse rotation mode (Pin⑯ GND or 0.4V Max.)



APPLICATION OF TA7247AP

(1) Design method of switching regulator oscillation circuit (PWM generating circuit)

The PWM wave generating circuit that controls the switching regulator output switching transistors is shown in Fig.2.
The circuit consists of a triangular waveform generating circuit that generates a comparison signal and a comparator that compares the comparison signal from the triangular waveform generating circuit with output voltage from the switching regulator. (In the example shown in Fig.2, output level is such that "H" level is at V_{CC2} level (≒5V) and "L" level is typically at 0.5V as specified in the standard.)
In this oscillation circuit, positive feedback is added to the differential comparator to provide hysteresis. "H" and "L" levels of triangular waveform output are expressed, respectively, by the following equations :

$$V_{CR}\ \mathrm{MAX.} = \frac{R_2 + R_3}{R_1 + R_2 + R_3} \cdot V_{CC2} \fallingdotseq 2.69\mathrm{V}$$

$$V_{CR}\ \mathrm{MIN.} = \frac{R_2}{R_1 + R_2} \cdot V_{CC2} \fallingdotseq 1.25\mathrm{V}$$

Q_1 shown in Fig.2 is for a discharge path and R_4 decides discharging time constant together with an external capacitor C_f.

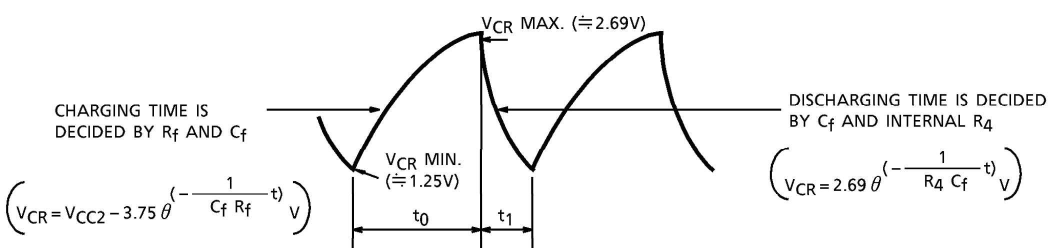


Fig.1 Triangular waveform generating circuit output waveform (Pin⑲)

Further, oscillation periods to and t_1 are decided by the following equations :

$t_0 \fallingdotseq 0.4845 \cdot C_f \cdot R_f$ (s)
$t_1 \fallingdotseq 0.7664 \cdot C_f \cdot R_4$ (s)
Where, R_4 is an internal resistor (≒1.3kΩ)

Further, as resistance of the resistor R_4 in IC varies by about ±20%, it is recommended to use R_4 in actual application at $R_f \gg R_4$ to suppress internal fluctuation of resistance in IC at the minimum level.

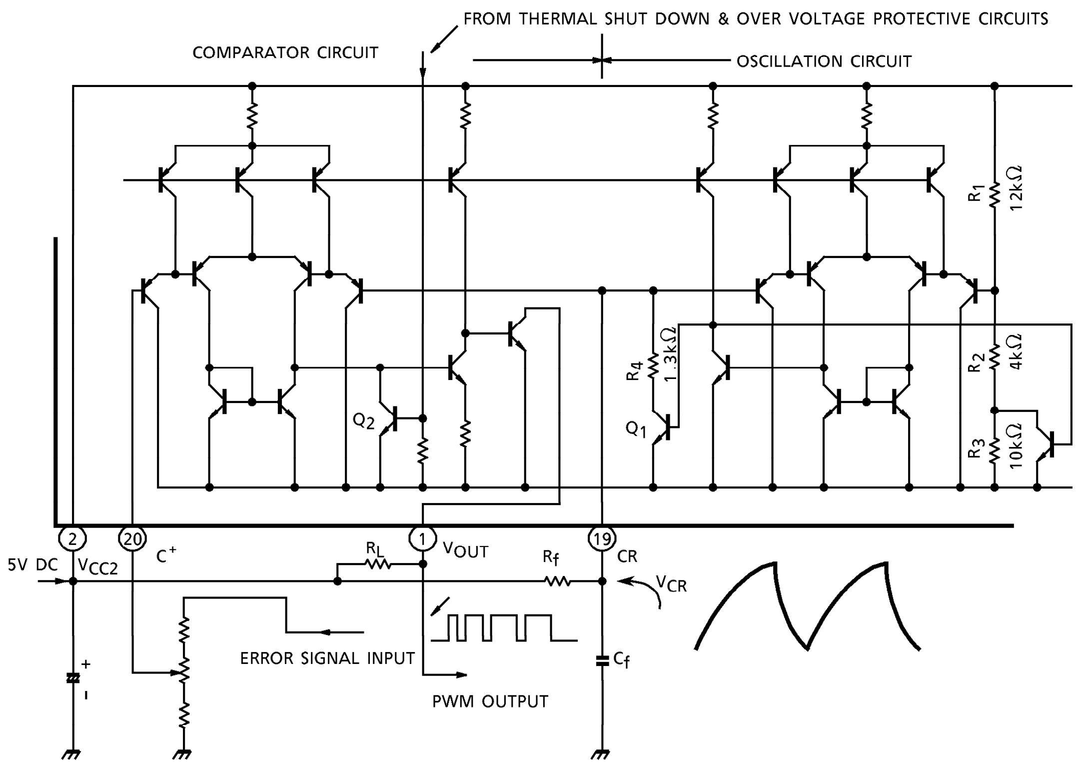


Fig.2 PWM waveform generating circuit

The comparator circuit consists of a differential amplifier which is operated by PNP differential input.
DC level to the C⁺ terminal is decided by DC level at the CR terminal (pin⑲) and required duty ratio.
As DC level at the CR terminal is 1.25~2.67V as shown in Fig.1, it is recommended to input DC at a level corresponding to DC level at the CR terminal.
Further, R_f and Triangular waveform oscillation period characteristic is shown in Fig.3 and PWM output waveform duty ratio vs. pin⑳ voltage characteristic in Fig.4.

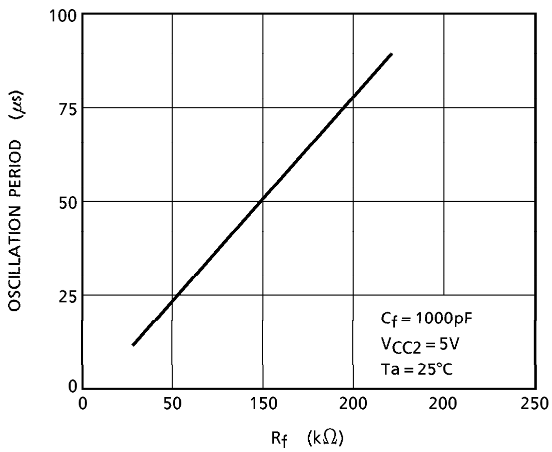


Fig.3 R_f – Oscillation period characteristic

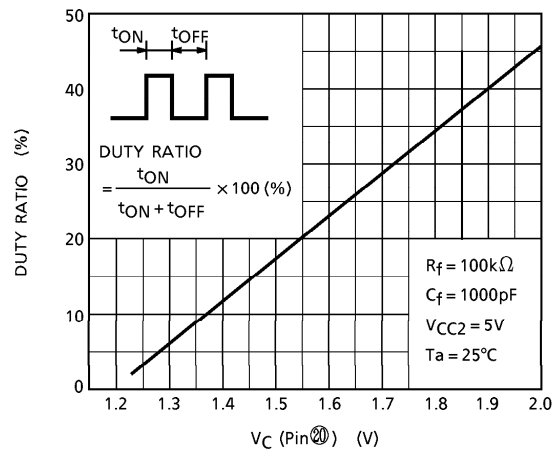


Fig.4 DUTY RATIO – V_C characteristics

(2) Position detecting circuit (Hall element input circuit)

The Position detecting circuit is shown in Fig.5.
This circuit consists of a differential amplifier having hysteresis (≒20mV, Typ.).
As operating DC level (CMR) is about 1.5V at the lower side and V_{CC} – 1.8V at the upper side, it is recommended to input constant voltage drive from V_{CC2} at level higher than hysteresis by 3 times or more (60~70m$V_{p\text{-}p}$).
If the hall element is removed during the rotation, IC can be destructed.

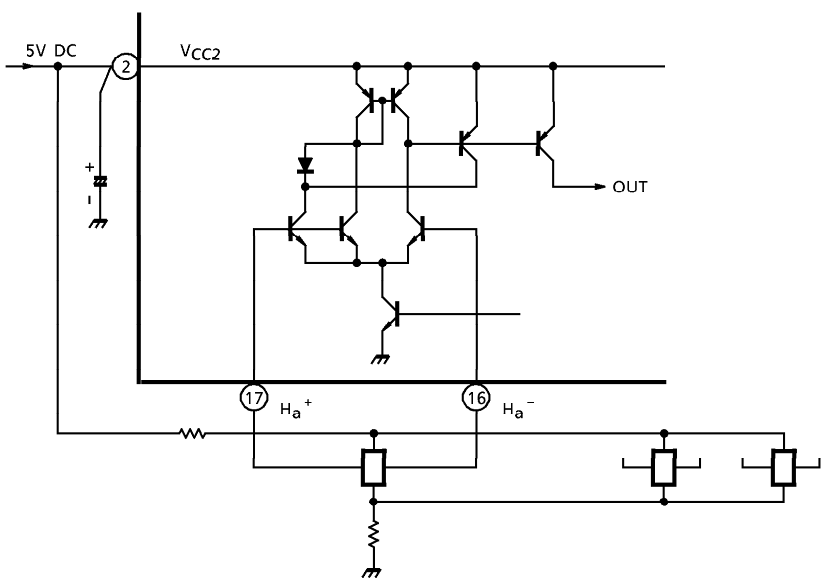
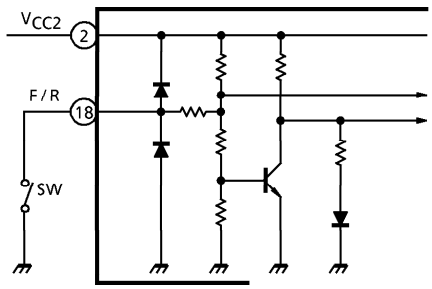


Fig.5 Position detecting circuit (Hall element input)

(3) Forward / reverse rotation selector circuit

The forward / reverse rotation selector circuit is shown in Fig.6.
The forward rotation (or reverse rotation) is resulted when pin⑱ is opened (or at 2.5V or above), while the reverse rotation (or forward rotation) is resulted at GND (or at 0.4V or below).



SW: ON	SW: OFF
L	H
H	L
CCW (R)	CW (F)

Fig.6 Forward / reverse rotation selector circuit

(4) Output circuit

The output circuit is shown in Fig.7. The upper side of the circuit (pins ⑤, ⑦ and ⑨) is for outlet, whichle the lower side (pins ④, ⑥ and ⑧) is for intake. When the built-in output transistors are used, pins ④ and ⑤, ⑥ and ⑦, and ⑧ and ⑨ shall be shorted, respectively.
When transistors are externally mounted for increasing the capacity largely, they shall be connected as shown in Fig.7.

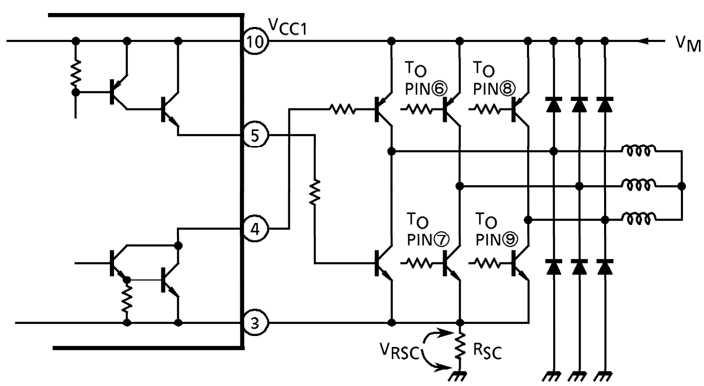


Fig.7 Output circuit

(5) Protective circuits

a) Over voltage protective circuit

If voltage at V_{CC1} terminal exceeds normal voltage (38V), Q_2 in Fig.2 is ON to inhibit PWM output and at the same time, the output circuit is OFF.

b) Thermal shut down circuit

If temperature at the junction point exceeds specified temperature (150°C), similar to a), above, Q_2 in Fig.2 in ON to inhibit PWM output and at the same time, the output circuit is OFF.

c) Over current protective circuit

If V_{RSC} in Fig.7 exceeds specified voltage ($V_{RSC} = R_{SC} \cdot I_{SC}$), the output circuit is OFF.

d) Excessively low voltage protective circuit

If voltage at V_{CC1}, terminal drops below specified voltage, the output circuit is OFF.
Further, this circuit is a malfunction preventive circuit.

MAXIMUM RATINGS (Ta = 25°C)

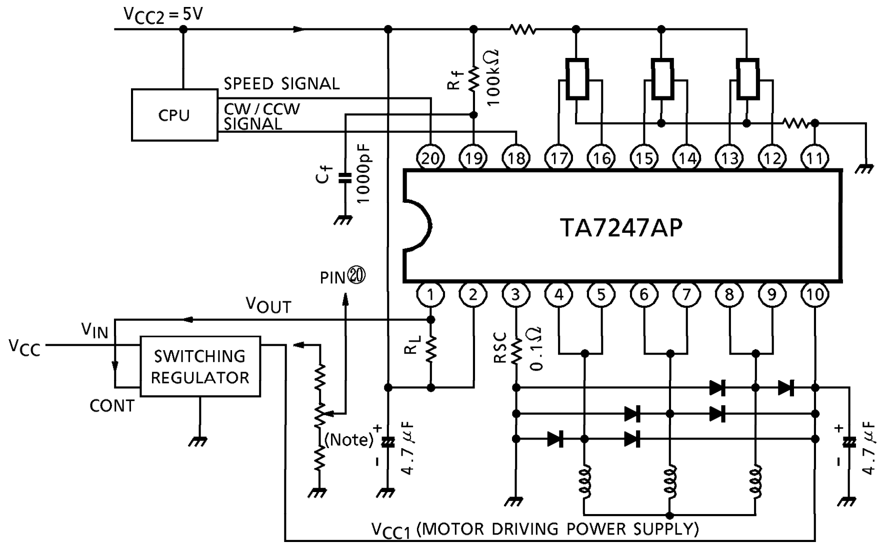
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage (Motor)	V_{CC1}	38	V
Supply Voltage (Control)	V_{CC2}	7	V
Output Current	I_O	1.5	A
Power Dissipation	P_D (Note)	25	W
Operating Temperature	T_{opr}	−30~70	°C
Storage Temperature	T_{stg}	−55~150	°C

(Note) Tc = 75°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC2} = 5V, Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current		I_{CC}	—	I_O = 0.75A	—	15	20	mA
Saturation Voltage	Upper Side	V_{SAT1}	—	I_O = 0.75A	—	1.5	2.1	V
				I_O = 0.9A	—	1.7	2.4	
				I_O = 1.2A	—	1.9	—	
	Lower Side	V_{SAT2}		I_O = 0.75A	—	1.4	2.0	
				I_O = 0.9A	—	1.5	2.3	
				I_O = 1.2A	—	1.7	—	
Leak Current	Upper Side	I_{LU}	—		—	—	100	μA
	Lower Side	I_{LL}	—		—	—	100	μA
Current Limiter Sensitivity		V_{RSC}	—	RSC = 0.2Ω	180	220	300	mV
Over Voltage Protector Operating Voltage		$V_{H \cdot SE}$	—		38	—	—	V
Thermal Shut-down Operating Temperature		T_{TSD}	—		150	—	—	°C
Low Voltage Protector Operating Voltage		$V_{L \cdot SE}$	—		—	5.7	—	V
Position Sensing Input Sensitivity		V_{th}	—	Sine wave (100mV$_{p-p}$, 30Hz)	—	20	—	mV
Oscillator	Frequency	f_O	—	R_f = 68kΩ, C_f = 1000pF	—	30	—	kHz
	Amplitude	A_O	—		—	1.2		V_{p-p}
	Temperature-Coefficient	$T_{CVO}\ f_O$	—		—	0		Hz / °C
Comparator	Output Current	I_{COM}	—		—	—		mA
	Saturation Voltage	$V_{SAT\ COM}$	—	$V_{⑳}$ = 0V	—	0.5	—	V
	Turn-ON Time	t_r	—		—	0.5	—	μs
	Turn-OFF Time	t_f	—		—	0.5	—	μs
	Duty Ratio	D_y	—	$V_{⑳}$ = 2V	—	50	—	%
	Duty Ratio Temperature Coefficient	$T_{CVO}\ D_y$	—		—	0	—	% / °C

APPLICATION CIRCUIT

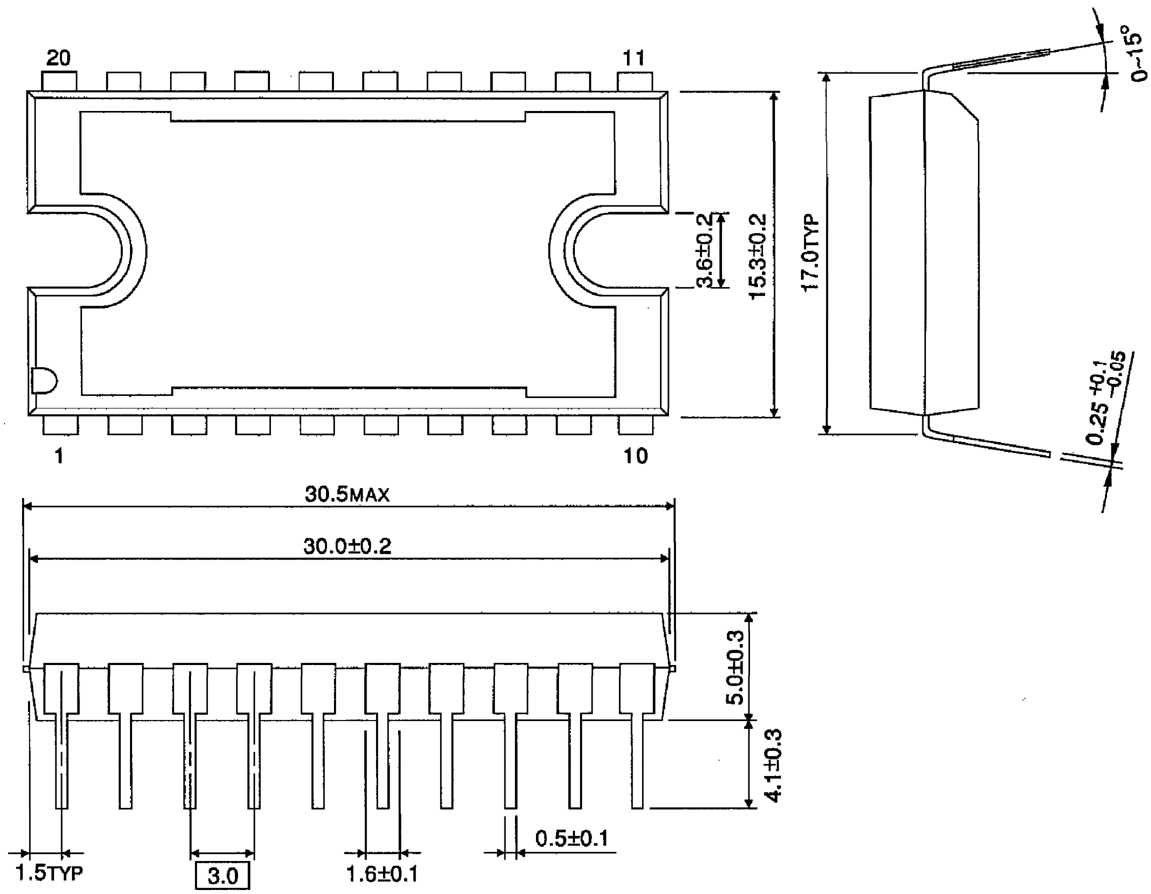


(Note) In case of the open-loop control by CPU, rotating speed is controlled by the rotation control signal (analog output) from CPU. However, the closed-loop control by the feedback signal taken from the switching regulator output is also possible.
In this case, the connection shall be made as shown in the above circuit diagram.

OUTLINE DRAWING

HDIP20-P-3.00

Unit : mm



Weight : 8.19g (Typ.)