

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

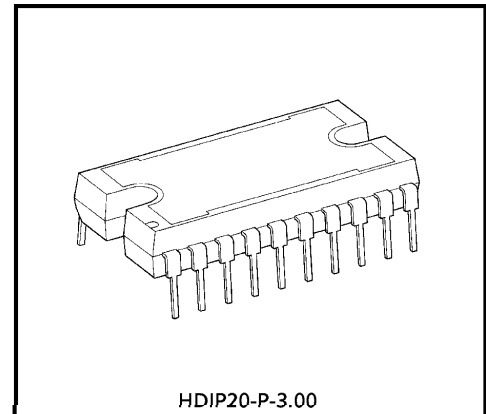
TA7247AP

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.



Weight : 8.19 g (Typ.)

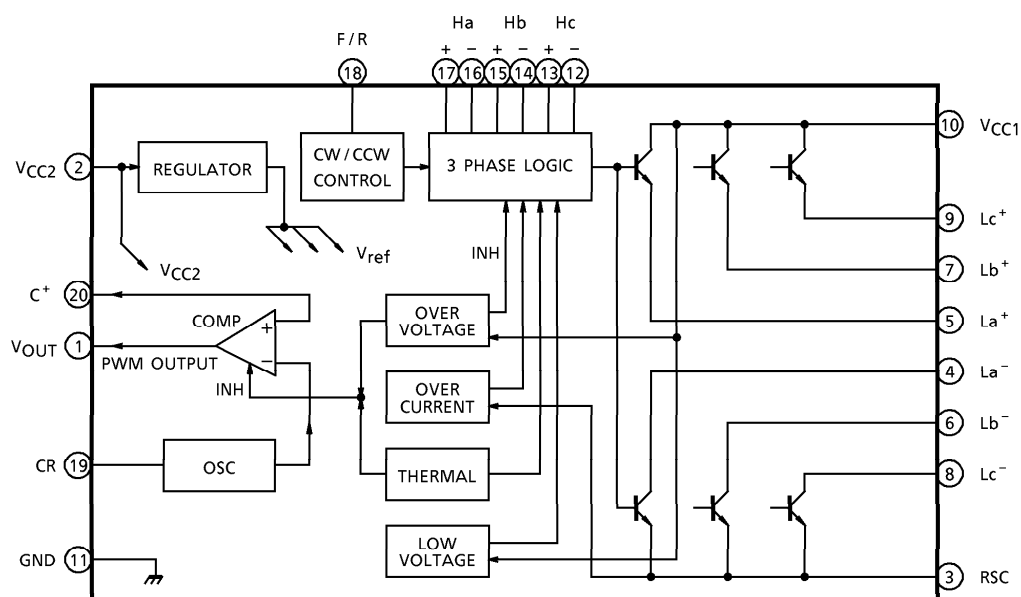
FEATURES

- Voltage Controlled 3 Phase Bi-Directional Motor Power Driver.
- Output Current Up to 1.5 A.
- High Sensitivity of Position Sensing Inputs : $V_H = 40 \text{ mV (Typ.)}$
- Built in Over Current, Over Voltage, Low Voltage and Thermal Protect Circuit.
- More Power-up Applications with Additional Power Transistors.
- Recommended Supply Voltage : $V_{CC1} \text{ (opr.)} = 0 \sim 30 \text{ V}$
 $V_{CC2} \text{ (opr.)} = 4.5 \sim 5.5 \text{ V}$

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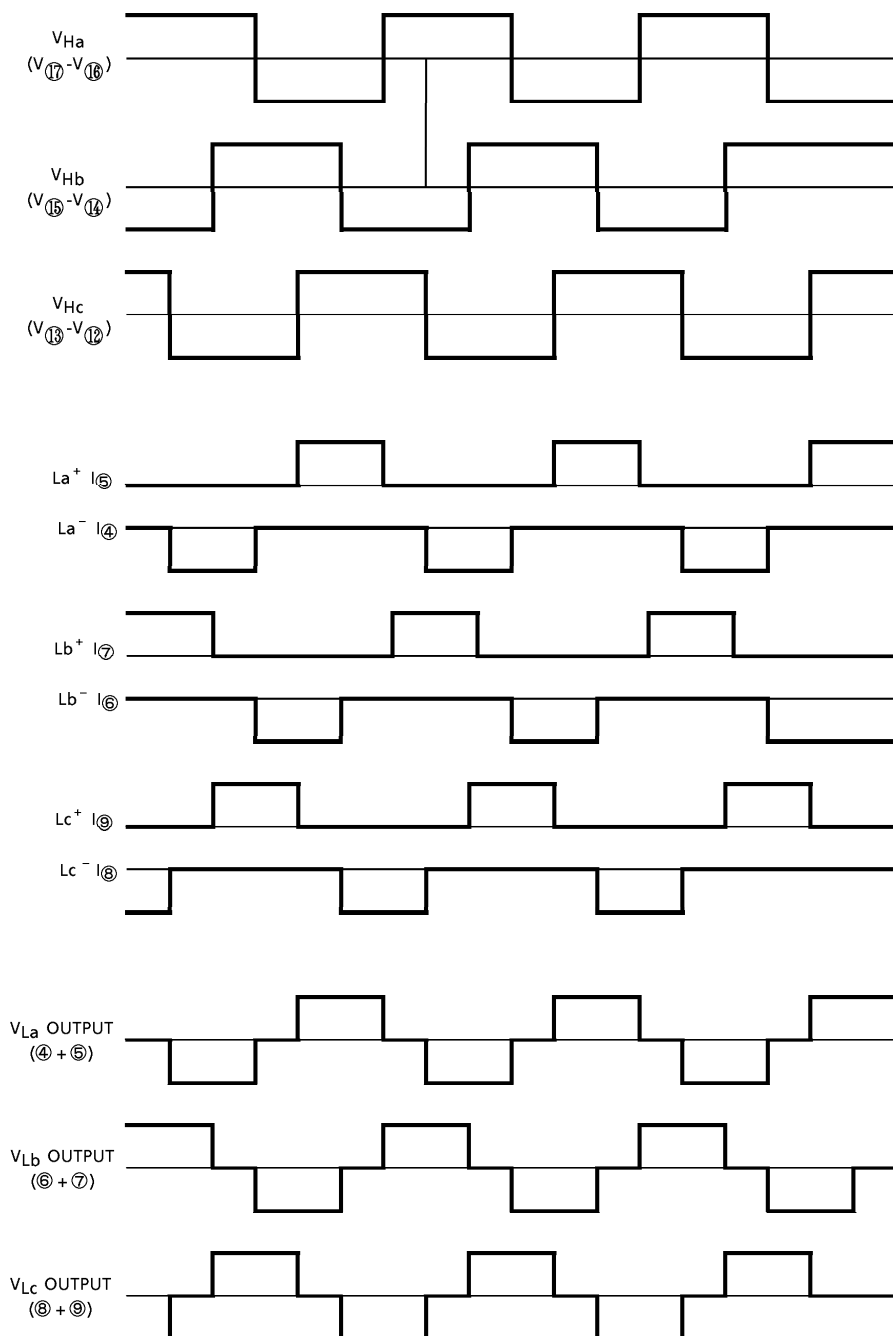
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BLOCK DIAGRAM

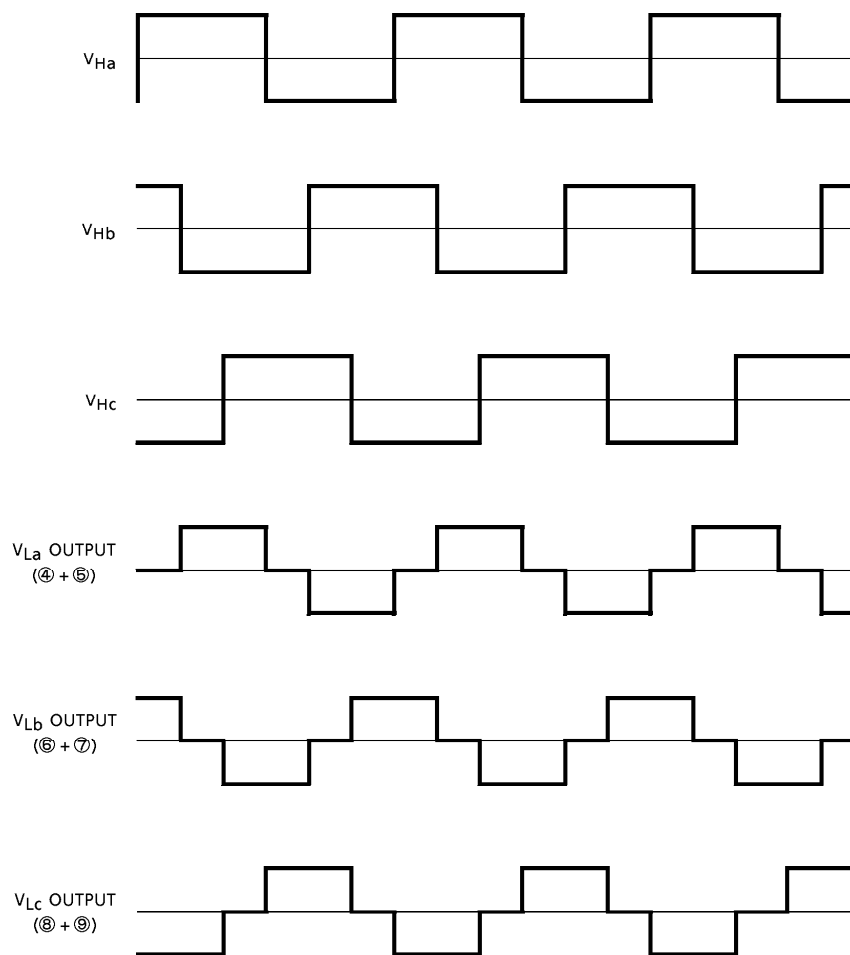


PIN FUNCTION

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

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

b) Reverse rotation mode (Pin¹⁸ GND or 0.4 V 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 ($\cong 5V$) 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 :

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

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

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 .

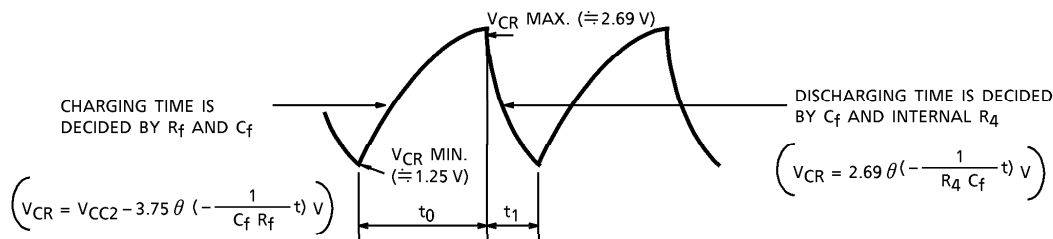


Fig.1 Triangular waveform generating circuit output waveform (Pin19)

Further, oscillation periods t_0 and t_1 are decided by the following equations :

$$t_0 \cong 0.4845 \cdot C_f \cdot R_f \text{ (s)}$$

$$t_1 \cong 0.7664 \cdot C_f \cdot R_4 \text{ (s)}$$

Where, R_4 is an internal resistor ($\cong 1.3 k\Omega$)

Further, as resistance of the resistor R_4 in IC varies by about $\pm 20\%$, 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.

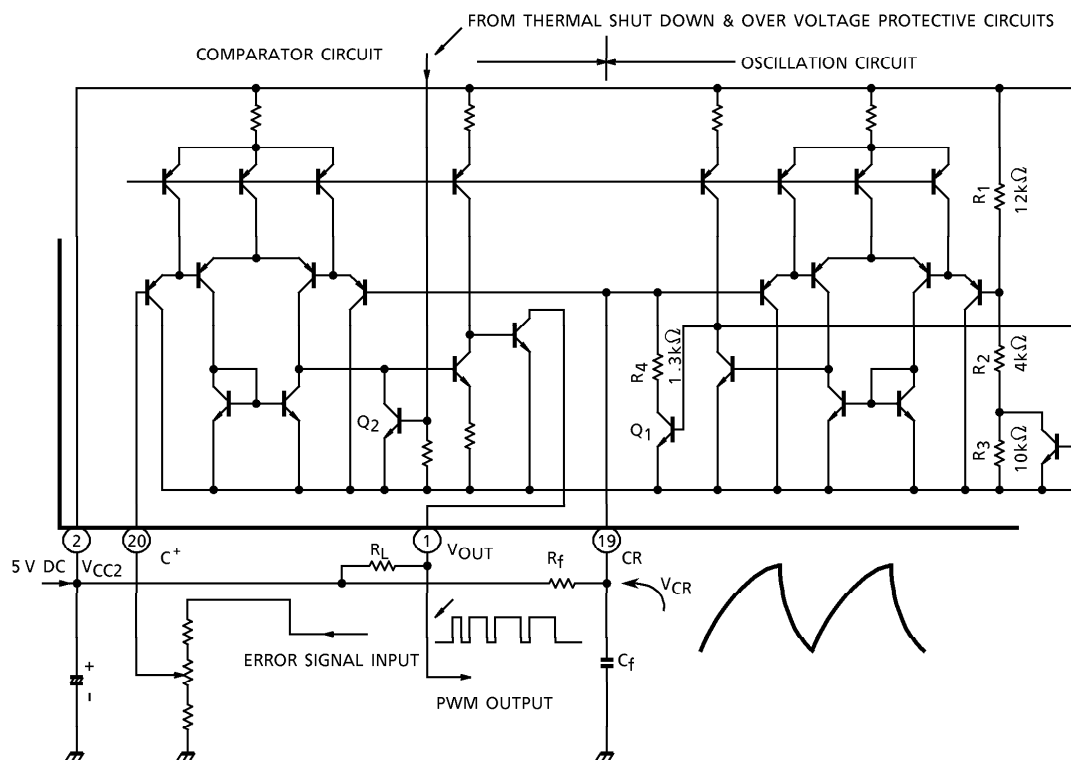


Fig.2 PWM waveform generating circuit

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 (pin⑱) and required duty ratio.

As DC level at the CR terminal is 1.25~2.67 V 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.

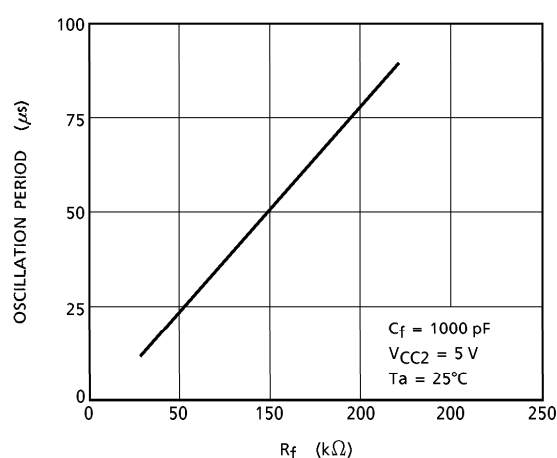


Fig.3 R_f – Oscillation period characteristic

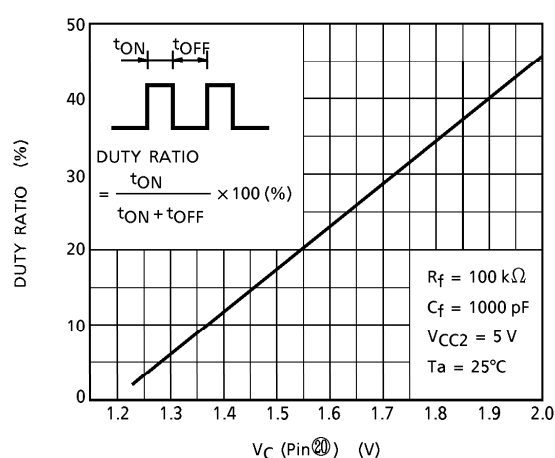


Fig.4 DUTY RATIO – V_C characteristics

(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 (≈ 20 mV, Typ.).

As operating DC level (CMR) is about 1.5 V at the lower side and $V_{CC} - 1.8$ V 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 (60~70 mV_{p-p}).

If the hall element is removed during the rotation, IC can be destructed.

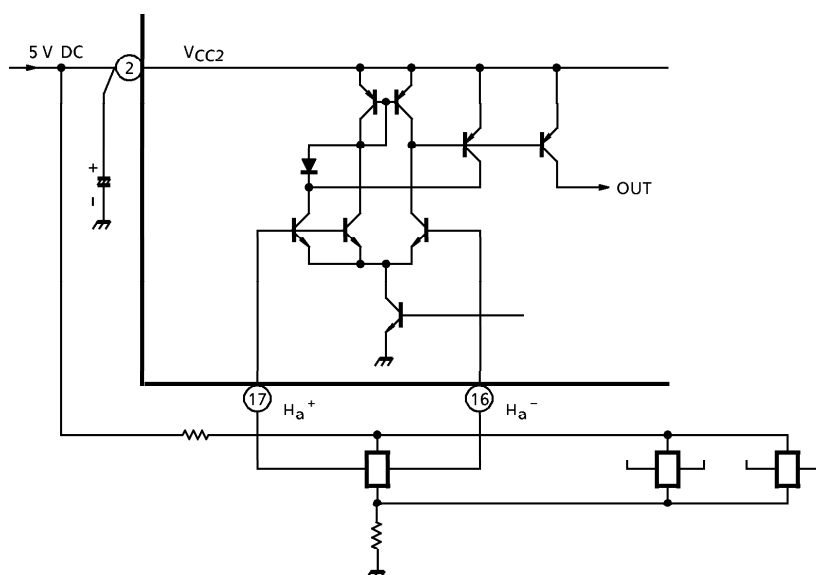


Fig.5 Position detecting circuit (Hall element input)

(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 2.5 V or above), while the reverse rotation (or forward rotation) is resulted at GND (or at 0.4 V or below).

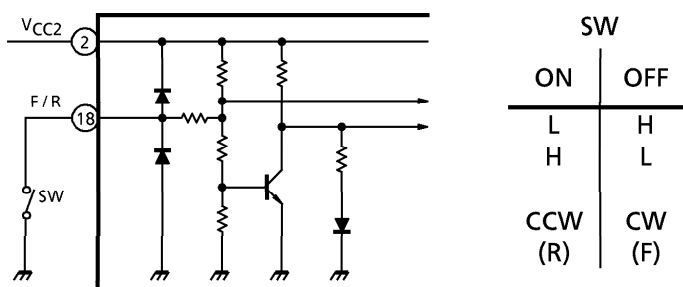


Fig.6 Forward /reverse rotation selector circuit

(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, while 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.

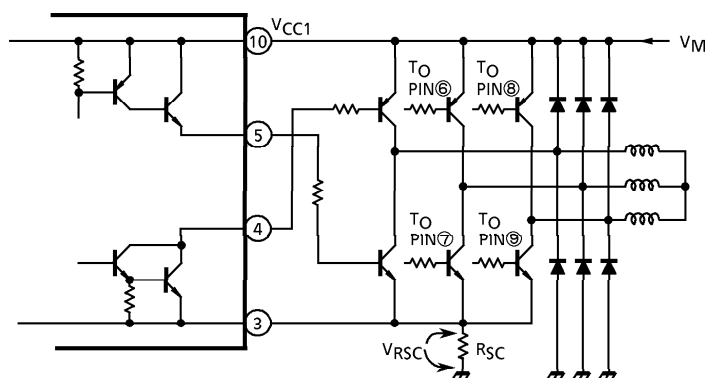


Fig.7 Output circuit

(5) Protective circuits

a) Over voltage protective circuit

If voltage at V_{CC1} terminal exceeds normal voltage (38 V), 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.

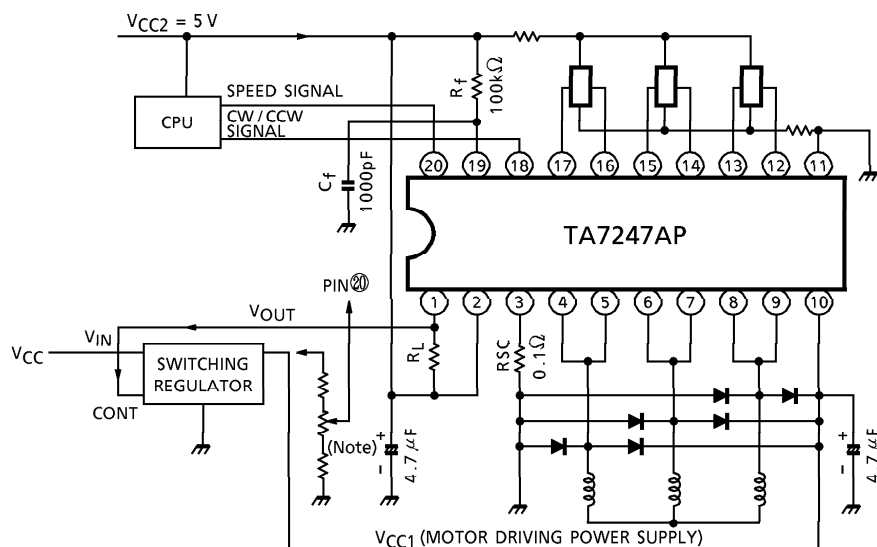
MAXIMUM RATINGS (Ta = 25°C)

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) T_c = 75°CELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC2} = 5 V, Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Quiescent Current		I _{CC}	—	I _O = 0.75 A	—	15	20	mA	
Saturation Voltage	Upper Side	V _{SAT1}	—	I _O = 0.75 A	—	1.5	2.1	V	
				I _O = 0.9 A	—	1.7	2.4		
				I _O = 1.2 A	—	1.9	—		
	Lower Side	V _{SAT2}		I _O = 0.75 A	—	1.4	2.0		
				I _O = 0.9 A	—	1.5	2.3		
				I _O = 1.2 A	—	1.7	—		
Leak Current	Upper Side	I _{LU}	—		—	—	100	μA	
	Lower Side	I _{LL}	—		—	—	100	μA	
Current Limiter Sensitivity		V _{RSC}	—	RSC = 0.2 Ω	180	220	300	mV	
Over Voltage Protector Operating Voltage		V _{H·SE}	—		38	—	—	V	
Thermal Shut-down Operating Temperature		T _{TSD}	—		150	—	—	°C	
Low Voltage Protector Operating Voltage		V _{L·SE}	—		—	5.7	—	V	
Position Sensing Input Sensitivity		V _{th}	—	Sine wave (100 mV _{p-p} , 30 Hz)	—	20	—	mV	
Oscillator	Frequency	f _O	—	R _f = 68 kΩ, C _f = 1000 pF	—	30	—	kHz	
	Amplitude	A _O	—		—	1.2		V _{p-p}	
	Temperature- Coefficient	T _{CV0} f _O	—		—	0		Hz / °C	
Comparator	Output Current	I _{COM}	—		—	—		mA	
	Saturation Voltage	V _{SAT COM}	—	V ₍₂₀₎ = 0 V	—	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₎ = 2 V	—	50	—	%	
	Duty Ratio Temperature Coefficient	T _{CV0} D _y	—		—	0	—	% / °C	

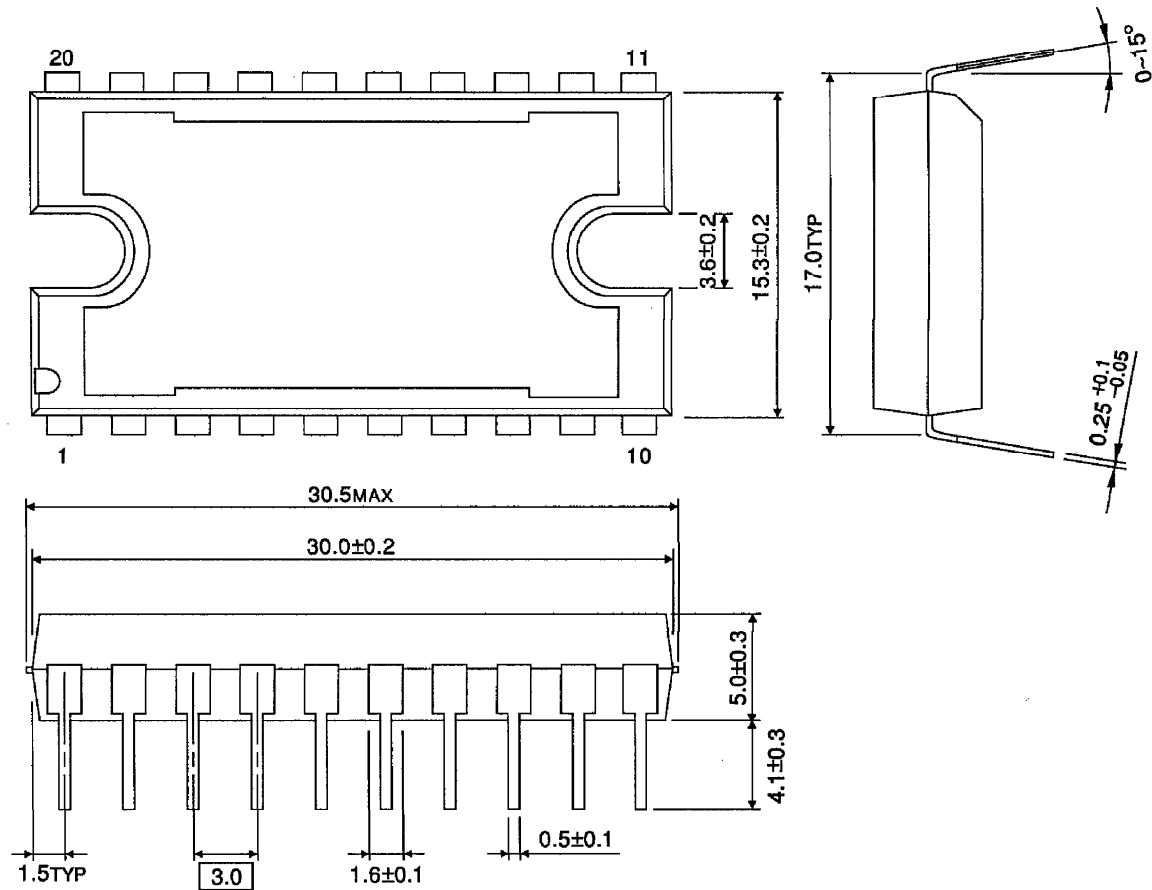
APPLICATION CIRCUIT



(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 : 8.19 g (Typ.)