

TENTATIVE

TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

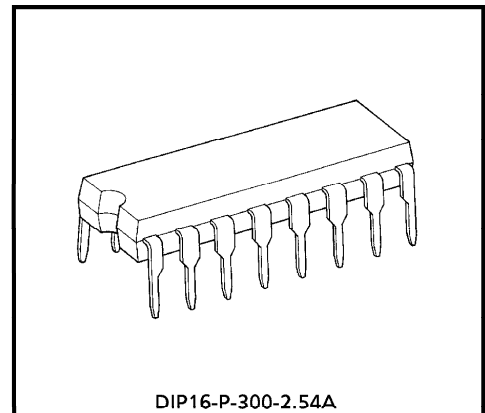
T B 6 5 2 0 P

PWM TYPE 3-PHASE FULL-WAVE SENSORLESS MOTOR CONTROLLER

The TB6520P is a PWM chopper type 3-phase full-wave sensorless motor controller. It is capable of PWM type sensorless driving when used in conjunction with TA8483AP.

FEATURES

- Three-phase sensorless driving type
- PWM chopper driving type
- PWM driving duty is controlled by analog input (built-in 7bit A-D converter)
- Three-state output as a switch-on signal
- Built-in function for rotation frequency detection output
- Built-in lead angle control function (15 degrees)
- Built-in one-phase excitation function to improve start property
- One-phase / three-phase input mode switching function



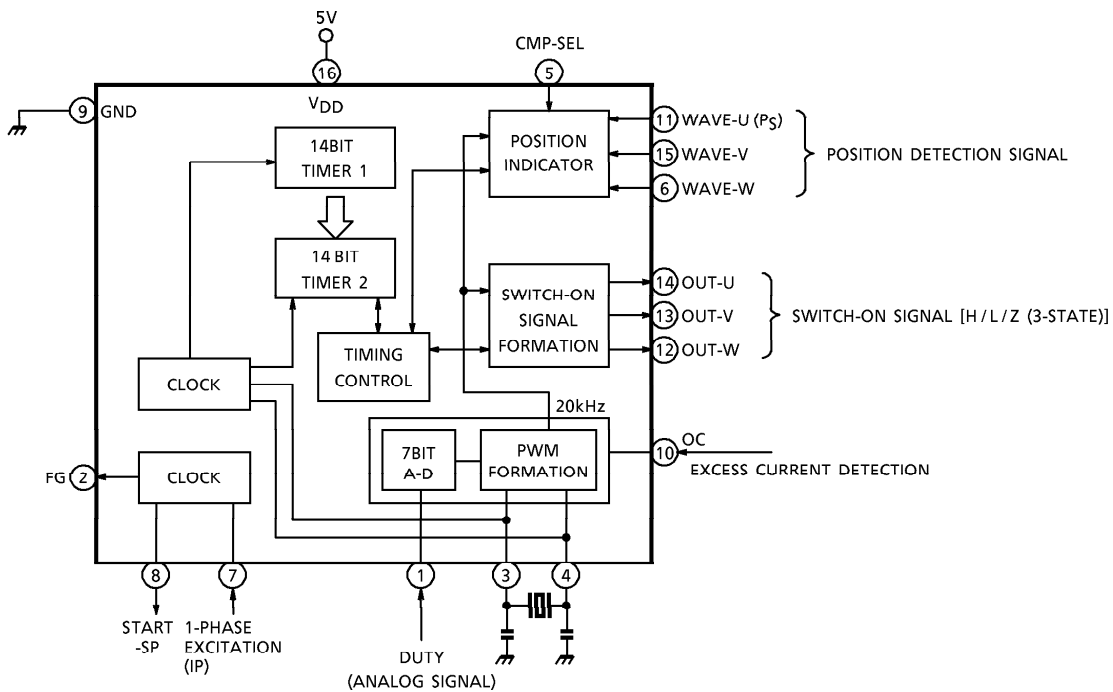
DIP16-P-300-2.54A

Weight : 1.11g (Typ.)

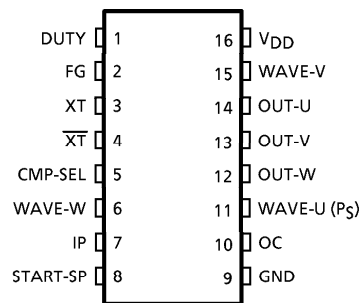
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BLOCK DIAGRAM



PIN CONNECTION



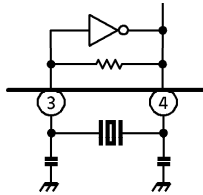
PIN FUNCTION

PIN No.	SYMBOL	I/O	FUNCTIONAL DESCRIPTION
1	DUTY	I	Analog input pin to control PWM duty <ul style="list-style-type: none"> • $V_{DUTY} \leq V_{AD(L)}$ Duty 0% • $V_{AD(L)} < V_{DUTY} < V_{AD(H)}$.. Duty change by V_{DUTY} (1/128 to 127/128) • $V_{DUTY} \geq V_{AD(H)}$ Duty 100% (127/128) (Note) Duty becomes 100% when duty pin is open.
2	FG	O	Rotational frequency detection output <ul style="list-style-type: none"> • When stopped: LOW • When start is forcibly transferred: LOW • When normally rotated : 1-pulse signal is output in one electric cycle. 4-polar motor .. 2 pulses/rotation 8-polar motor .. 4 pulses/rotation
3 4	XT, XT	I	Crystal oscillation pin Start transfer frequency f_{st} , maximum transfer frequency f_{mx} , and PWM frequency f_p are determined by outer oscillator frequency. <ul style="list-style-type: none"> • $f_{st} = f_x / 2^{18}$ • $f_{mx} = f_x / 2^{10}$ • $f_p = f_x / 256$
5	CMP-SEL	I	Position detection signal 1-phase input mode/3-phase input mode switching pin <ul style="list-style-type: none"> • HIGH or OPEN: 3-phase input mode • LOW: 1-phase input mode Pull-up resistor is built in
6	WAVE-W	I	W-phase position detection signal input. Used by 3-phase input mode. Pull-down resistor is built in.
7	IP	I	Start position determination input <ul style="list-style-type: none"> • HIGH: Internal timer stopped • LOW: Internal timer started Non-transfer operation when $V_{DUTY} > V_{AD(L)}$, IP = HIGH (1-phase excitation) Normal operation when $V_{DUTY} > V_{AD(L)}$, IP = LOW
8	START-SP	O	START, STOP detection output <ul style="list-style-type: none"> • LOW: output on • HIGH: output off
9	GND		Ground
10	OC	I	<ul style="list-style-type: none"> • Excess current detection signal input • When OC = "HIGH", turn off the HIGH output of the switch-on signal. • Pull-down resistor is built in.
11	WAVE-U	I	<ul style="list-style-type: none"> • At the time of 3-phase input mode: U-phase position detection signal. • At the time of 1-phase input mode: position detection signal. • Pull-down resistor is built in.
12	OUT-W	O	W-phase switch-on signal, 3-state output.
13	OUT-V	O	V-phase switch-on signal, 3-state output.
14	OUT-U	O	U-phase switch-on signal, 3-state output.
15	WAVE-V	I	V-phase position signal input. Used in 3-phase input mode. Pull-down resistor is built in.
16	VDD		5V supply pin

FUNCTIONAL DESCRIPTION

1. Crystal oscillator (XT, \overline{XT})

The crystal oscillator is connected as shown in the following diagram:



The start transfer frequency f_{st} and maximum transfer frequency f_{mx} depend upon crystal oscillation frequency f_x . Please make sure of the start operation in determining your frequency.

$$f_{st} = f_x / 2^{18}$$

$$f_{mx} = f_x / 2^{10}$$

PWM chopping frequency f_p is also determined as follows:

$$f_p = f_x / 256$$

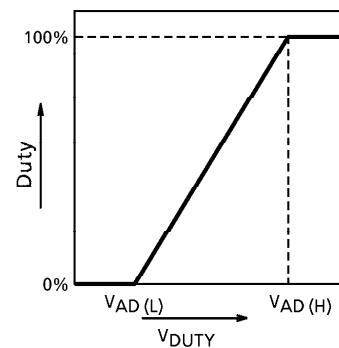
2. Lead angle control

Operated at 0 lead angle during forced start transfer, and automatically switched to 15 lead angle upon normal transfer.

3. PWM Duty Control

PWN duty is controlled through A-D conversion of the analog voltage that is input to the DUTY pin.

- $0 (V) \leq V_{DUTY} \leq V_{AD} (L)$ DUTY 0%
- $V_{AD} (L) < V_{DUTY} < V_{AD} (H)$ (1/128 to 127/128)
in the figure to the right
- $V_{AD} (H) \leq V_{DUTY} \leq V_{DD}$ DUTY 100% (127/128)



4. FG output

FG, which represents the frequency of motor rotation, is output from the position detection signal input.

- When stopped: LOW
- When start is forcibly transferred: LOW
- When normally rotated 1-pulse signal is output in one electric cycle.

4-polar motor	2 pulses/rotation
8-polar motor	4 pulses/rotation

MAXIMUM RATING

CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	7	V
Input Voltage	V _{IN}	V _{DD}	V
Power Dissipation	P _D	300	mW
Operating Temperature	T _{opr}	-30~85	°C
Storage Temperature	T _{stg}	-55~150	°C

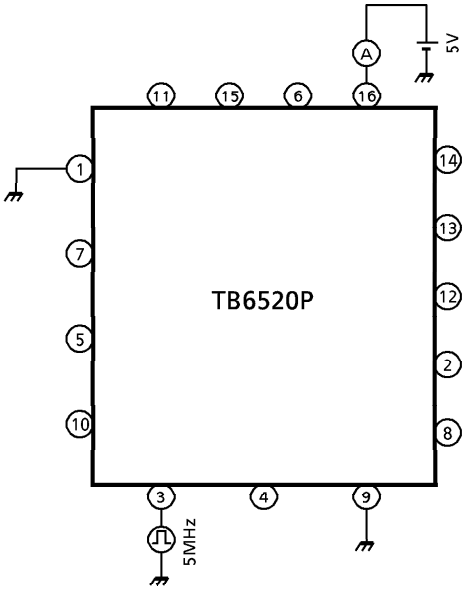
RECOMMENDED OPERATING CONDITIONS (Ta = -30 to 85°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Voltage	V _{DD}	—	4.5	5.0	5.5	V
Input Voltage	V _{IN}	—	GND	—	V _{DD}	V
OSC Frequency	f _{osc}	—	1.0	—	10	MHz

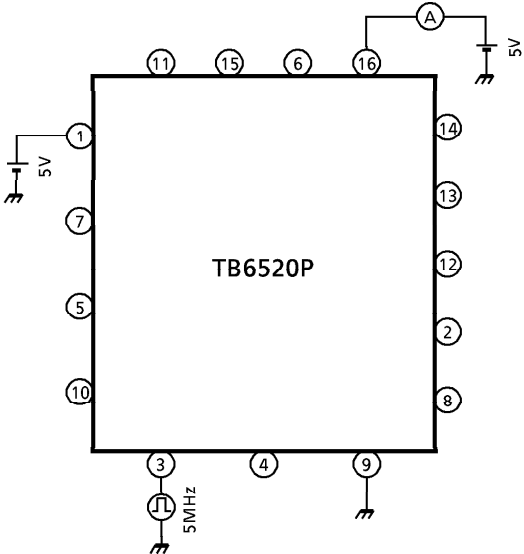
ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{DD} = 5V)

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Rest Supply Current	I _{DD}	1	DUTY = 0V	—	2	5	mA
Operating Supply Current	I _{DD (opr)}	2	DUTY = 5V	—	2	5	mA
Input Current	I _{IN-1 (H)}	3	V _{IN} = 5V, WAVE-U, WAVE-V WAVE-W, OC	—	50	—	μA
	I _{IN-1 (L)}	4	V _{IN} = 0V, WAVE-U, WAVE-V WAVE-W, OC	-1	0	—	
	I _{IN-2 (H)}	3	V _{IN} = 5V, IP	—	0	1	
	I _{IN-2 (L)}	4	V _{IN} = 0V, IP	-1	0	—	
	I _{IN-3 (H)}	3	V _{IN} = 5V, CMP-SEL	—	0	1	
	I _{IN-3 (L)}	4	V _{IN} = 0V, CMP-SEL	-75	-50	—	
	I _{IN-4 (H)}	3	V _{IN} = 5V, DUTY	—	0	1	
Output Leakage Current	I _{L (L)}	5	V _{DD} = 7V, V _{OUT} = 7V OUT-U, OUT-V, OUT-W	—	0	10	μA
	I _{L (H)}	6	V _{DD} = 7V, V _{OUT} = 0V OUT-U, OUT-V, OUT-W	—	0	10	
Output Voltage	V _{O (H)}	7	I _O = 200μA, OUT-U, OUT-V OUT-W, START-SP, FG	4.3	—	V _{DD}	V
	V _{O (L)}	8	I _O = 200μA, OUT-U, OUT-V OUT-W, START-SP, FG	GND	—	0.5	
Input Voltage	V _{IN (H)}	7	WAVE-U, WAVE-V, WAVE-W OC, IP, CMP-SEL	3.5	—	5.15	V
	V _{IN (L)}	8	WAVE-U, WAVE-V, WAVE-W OC, IP, CMP-SEL	GND	—	1.5	
Input Hysteresis Voltage	V _H	—	WAVE-U, WAVE-V, WAVE-W OC, IP	—	0.6	—	V
ADC Input Voltage Range	V _{AD (L)}	9	DUTY	0.44	0.49	0.54	V
	V _{AD (H)}	9	DUTY	4.1	4.3	4.5	

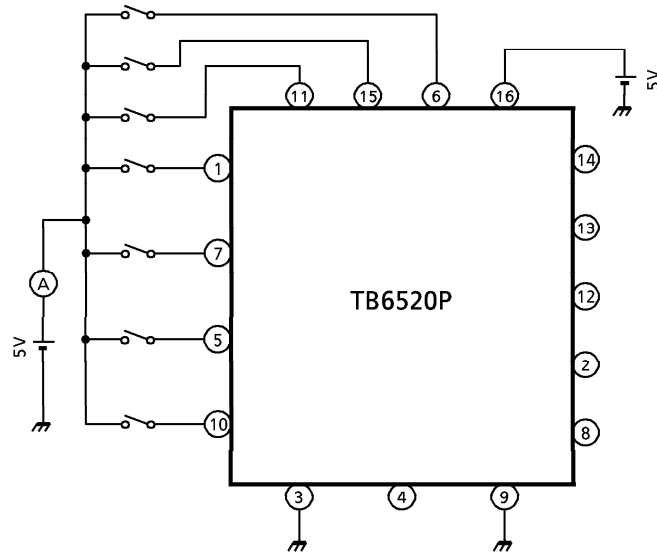
TEST CIRCUIT 1: I_{DD}



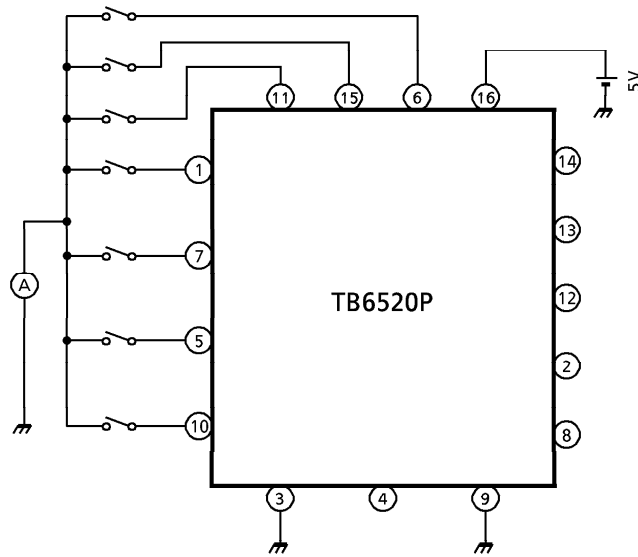
TEST CIRCUIT 2: I_{DD} (opr.)



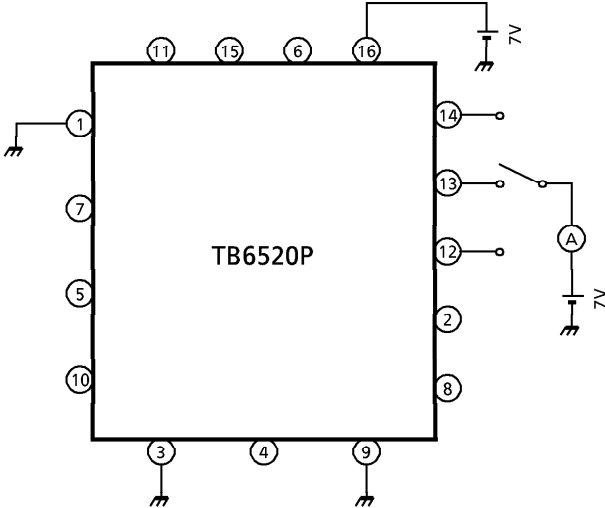
TEST CIRCUIT 3: $I_{IN}(H)$



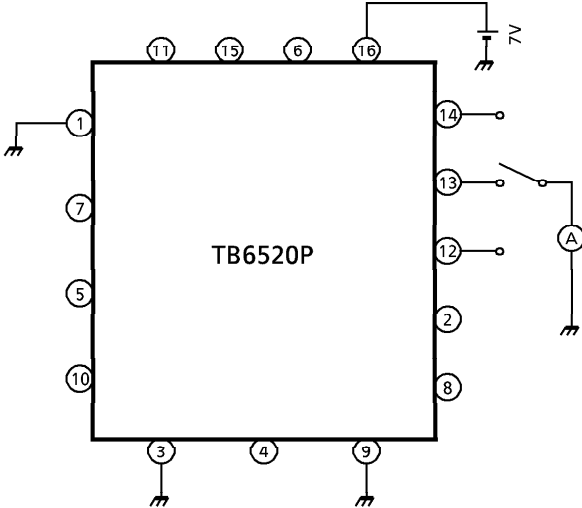
TEST CIRCUIT 4: $I_{IN}(L)$



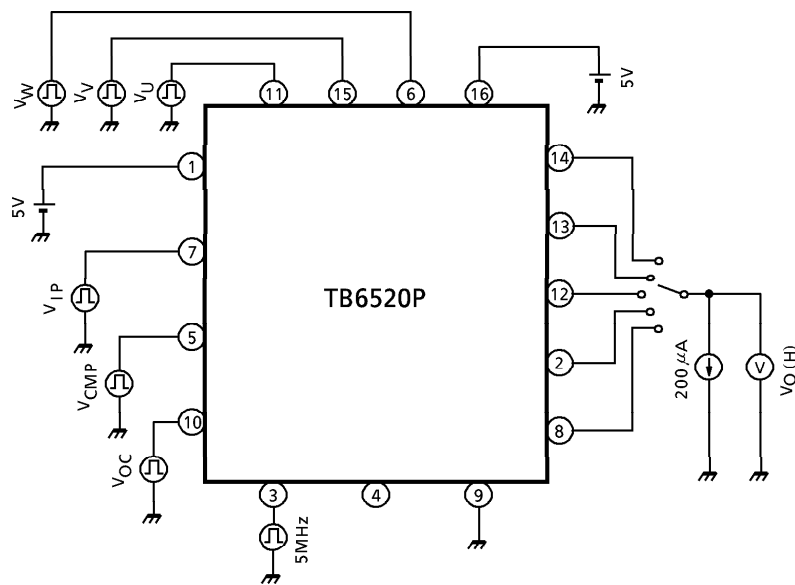
TEST CIRCUIT 5: $I_L(L)$



TEST CIRCUIT 6: $I_L(H)$

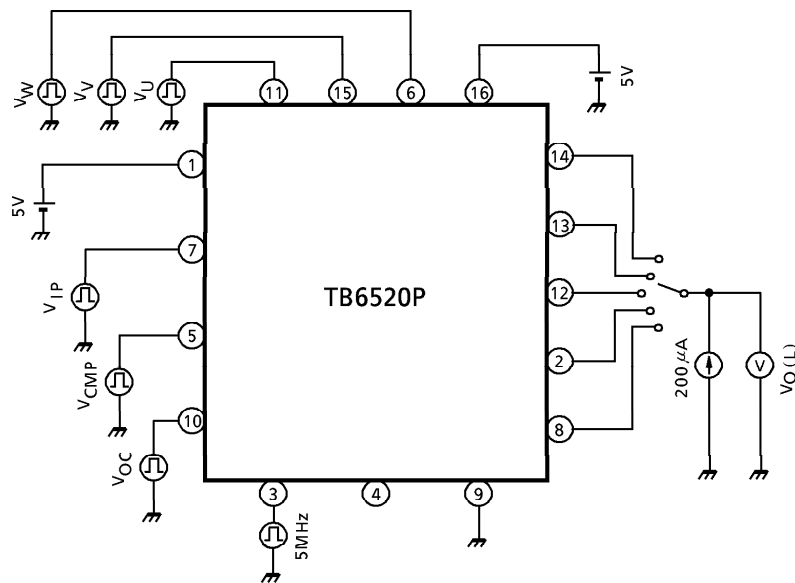


TEST CIRCUIT 7



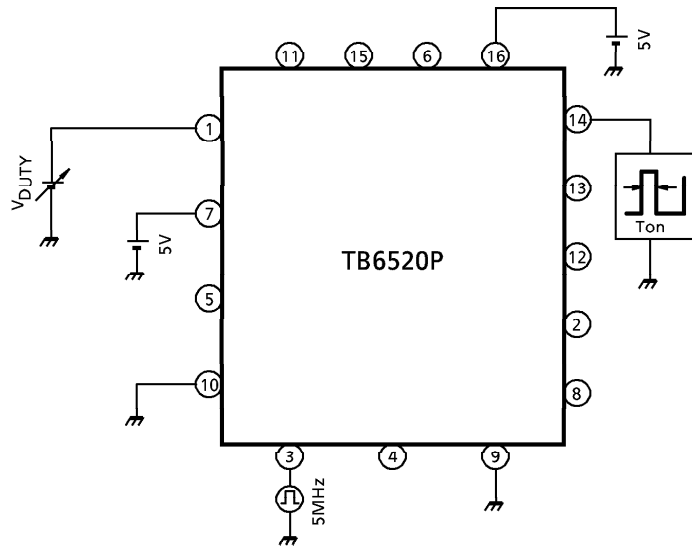
- Input amplitude 1.5 to 3.5V to V_U , V_V , V_W , V_{IP} , V_{CMP} , and V_{OC} , and causes the output to function.

TEST CIRCUIT 8



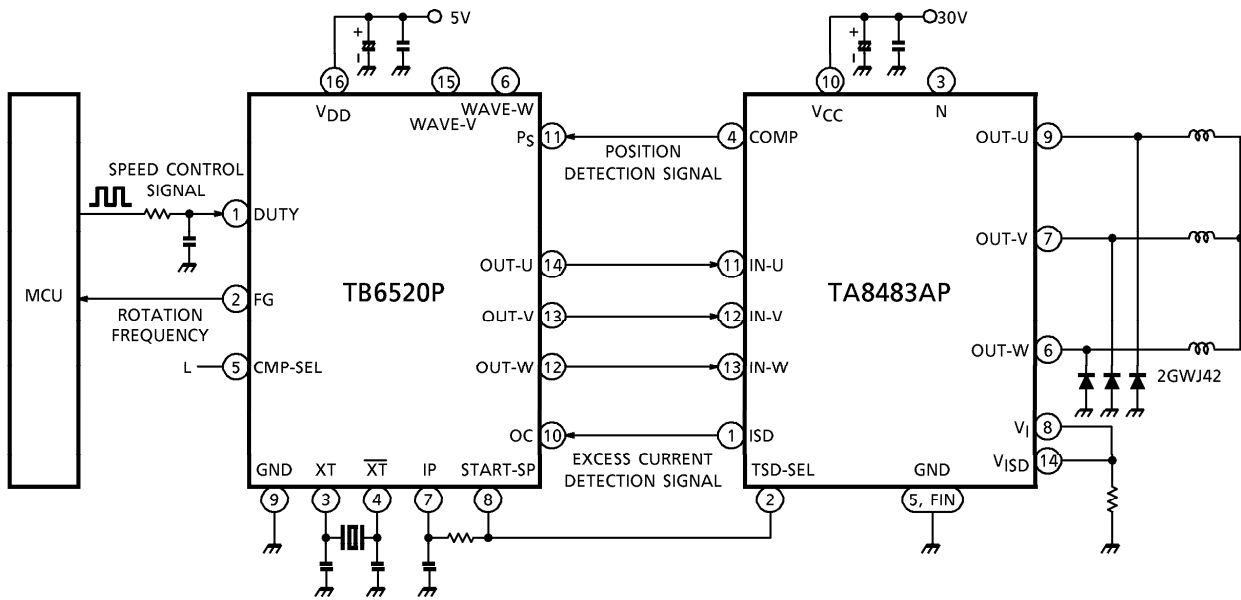
- Input amplitude 1.5 to 3.5V to V_U , V_V , V_W , V_{IP} , V_{CMP} , and V_{OC} , and cause the output to function.

TEST CIRCUIT 9: $V_{AD(L)}$, $V_{AD(H)}$



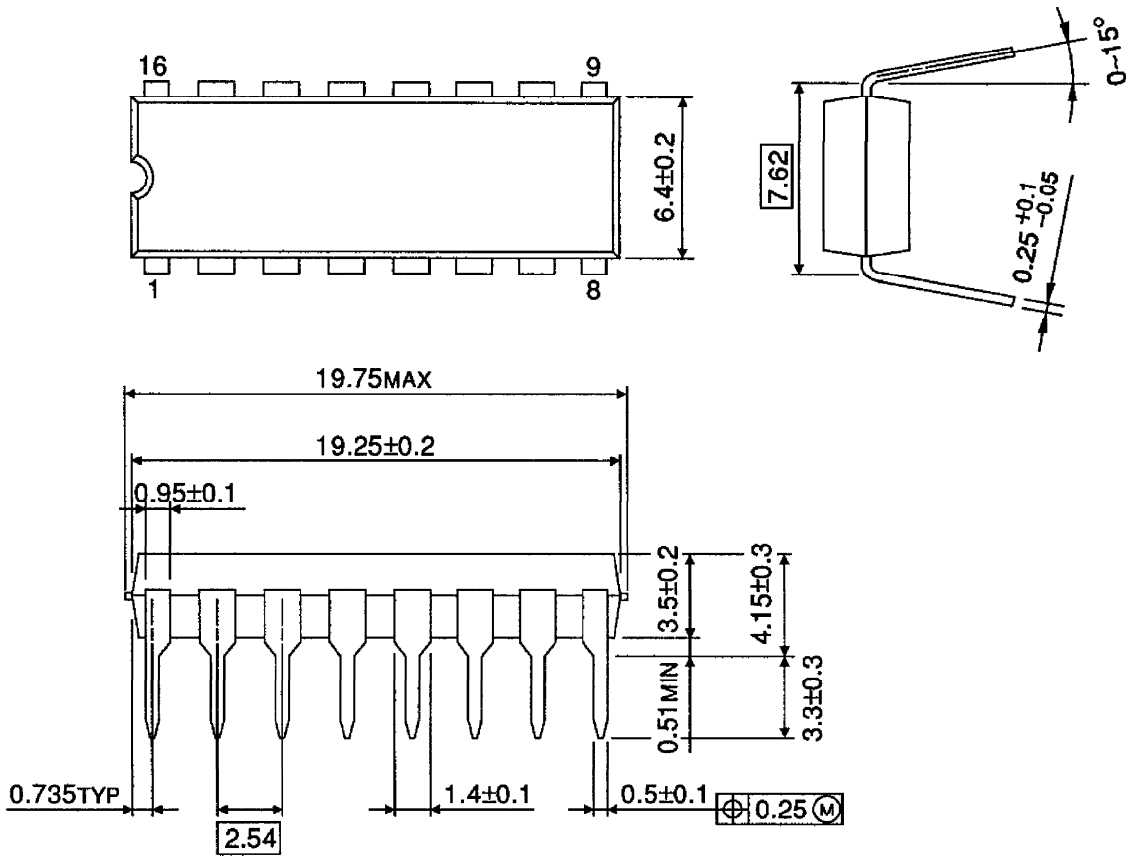
- Change V_{DUTY} and measure T_{on} .

APPLICATION CIRCUIT (1-PHASE INPUT MODE)



OUTLINE DRAWING
DIP16-P-300-2.54A

Unit : mm



Weight : 1.11g (Typ.)