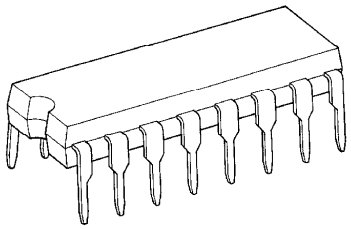
TENTATIVE TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB6520P

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.



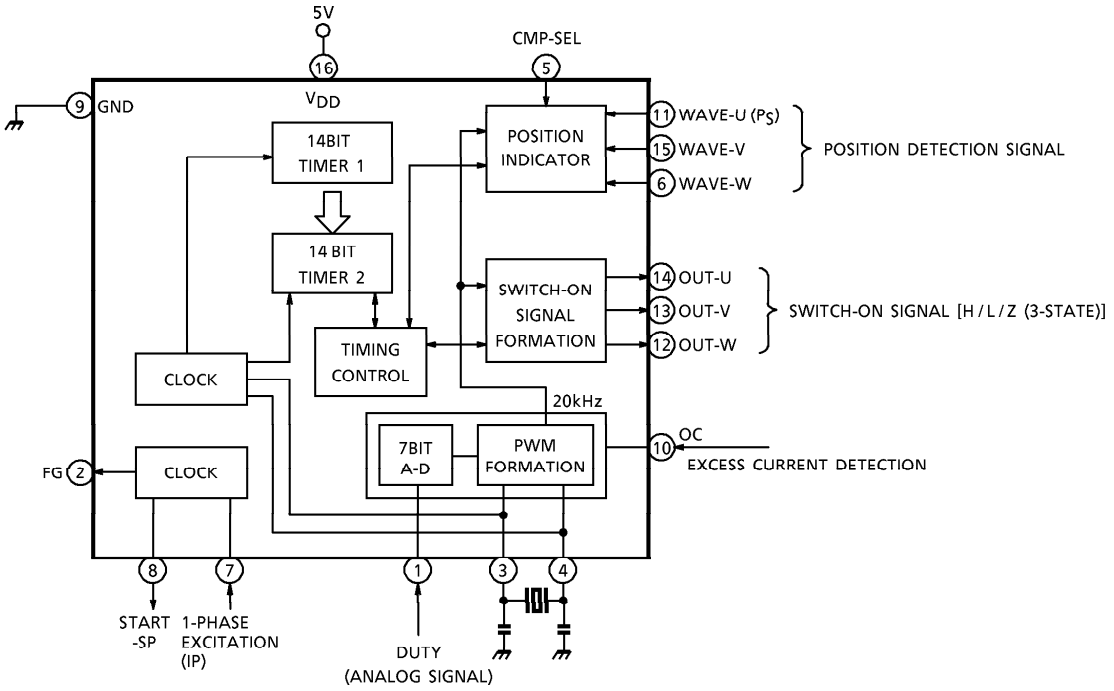
DIP16-P-300-2.54A

Weight : 1.11g (Typ.)

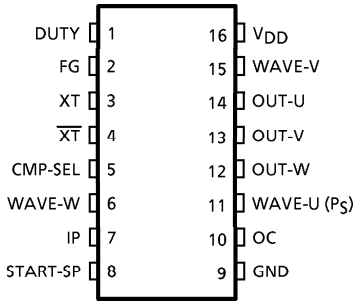
FEATURES

- 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

BLOCK DIAGRAM



PIN CONNECTION



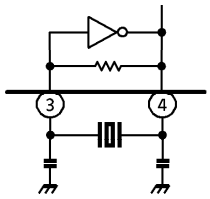
PIN FUNCTION

PIN No.	SYMBOL	I / O	FUNCTIONAL DESCRIPTION
1	DUTY	I	Analog input pin to control PWM duty ● $V_{DUTY} \leqq V_{AD\,(L)}$ ..... Duty 0% ● $V_{AD\,(L)} < V_{DUTY} < V_{AD\,(H)}$ .. Duty change by V_{DUTY} (1 / 128 to 127 / 128) ● $V_{DUTY} \geqq V_{AD\,(H)}$ ..... Duty 100% (127 / 128) (Note) Duty becomes 100% when duty pin is open.
2	FG	O	Rotational frequency detection output ● 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, $\overline{XT}$	I	Crystal oscillation pin Start transfer frequency fst, maximum transfer frequency fmx, and PWM frequency fp are determined by outer oscillator frequency. • $fst = fx / 2^{18}$ • $fmx = fx / 2^{10}$ • $fp = fx / 256$
5	CMP-SEL	I	Position detection signal 1-phase input mode / 3-phase input mode switching pin • 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 • 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 • LOW: output on • HIGH: output off
9	GND		Ground
10	OC	I	● 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	● 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	V_{DD}		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 fst and maximum transfer frequency fmx depend upon crystal oscillation frequency fx. Please make sure of the start operation in determining your frequency.

   $fst = fx / 2^{18}$

   $fmx = fx / 2^{10}$

   PWM chopping frequency fp is also determined as follows:

   $fp = fx / 256$

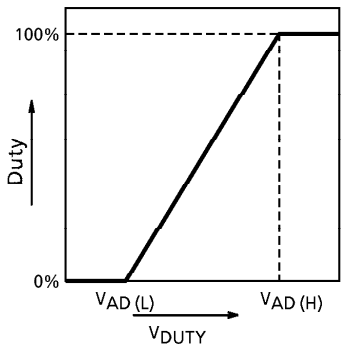
2. Lead angle control

   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.

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

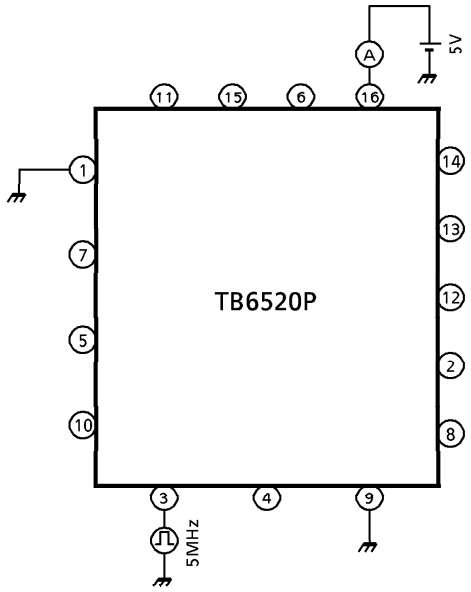
RECOMMENDED OPERATING CONDITIONS (Ta = −30 to 85°C)

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

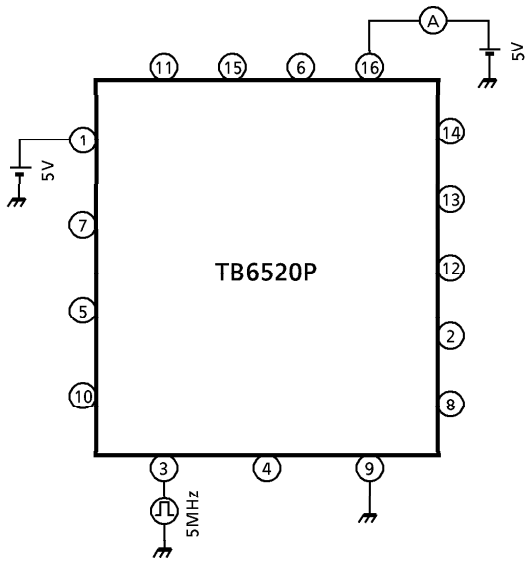
ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{DD} = 5V)

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	$I_{IN\text{-}1\ (H)}$	3	V_{IN} = 5V, WAVE-U, WAVE-V WAVE-W, OC	—	50	—	μA
	$I_{IN\text{-}1\ (L)}$	4	V_{IN} = 0V, WAVE-U, WAVE-V WAVE-W, OC	−1	0	—	
	$I_{IN\text{-}2\ (H)}$	3	V_{IN} = 5V, IP	—	0	1	
	$I_{IN\text{-}2\ (L)}$	4	V_{IN} = 0V, IP	−1	0	—	
	$I_{IN\text{-}3\ (H)}$	3	V_{IN} = 5V, CMP-SEL	—	0	1	
	$I_{IN\text{-}3\ (L)}$	4	V_{IN} = 0V, CMP-SEL	−75	−50	—	
	$I_{IN\text{-}4\ (H)}$	3	V_{IN} = 5V, DUTY	—	0	1	
	$I_{IN\text{-}4\ (L)}$	4	V_{IN} = 0V, DUTY	−3	−0.5	—	
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	

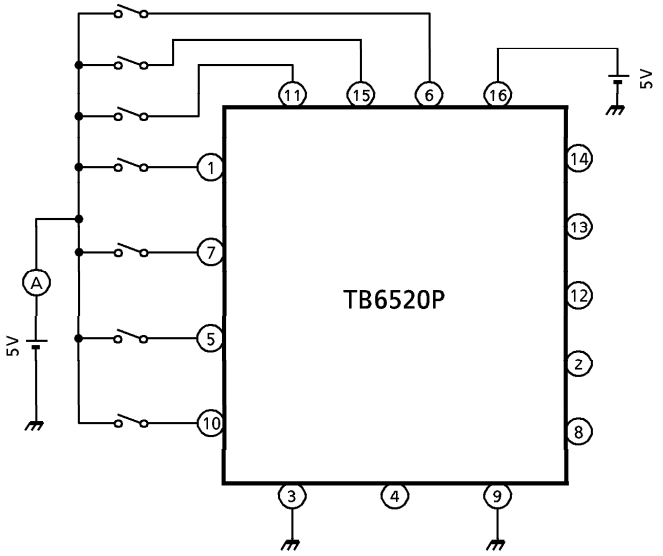
TEST CIRCUIT 1: I_{DD}



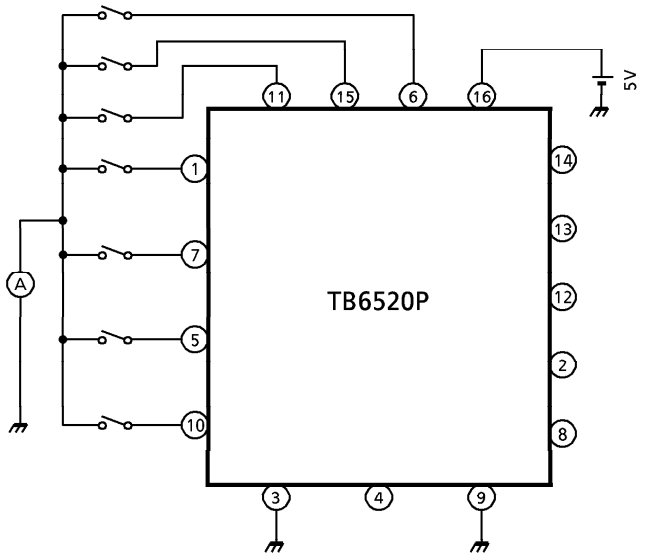
TEST CIRCUIT 2: I_{DD} (opr.)



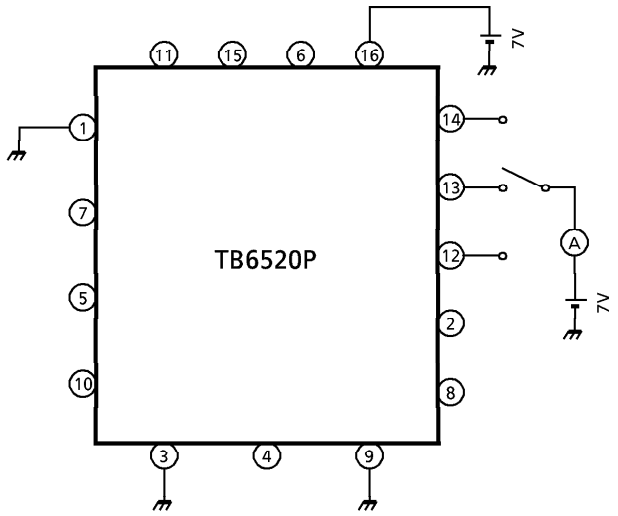
TEST CIRCUIT 3: I_{IN} (H)



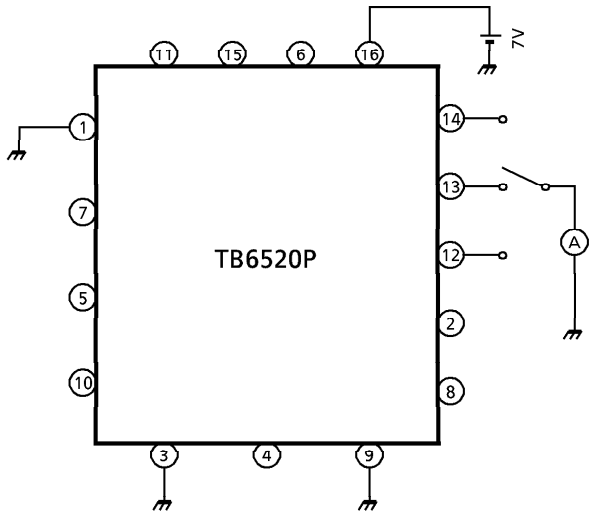
TEST CIRCUIT 4: I_{IN} (L)



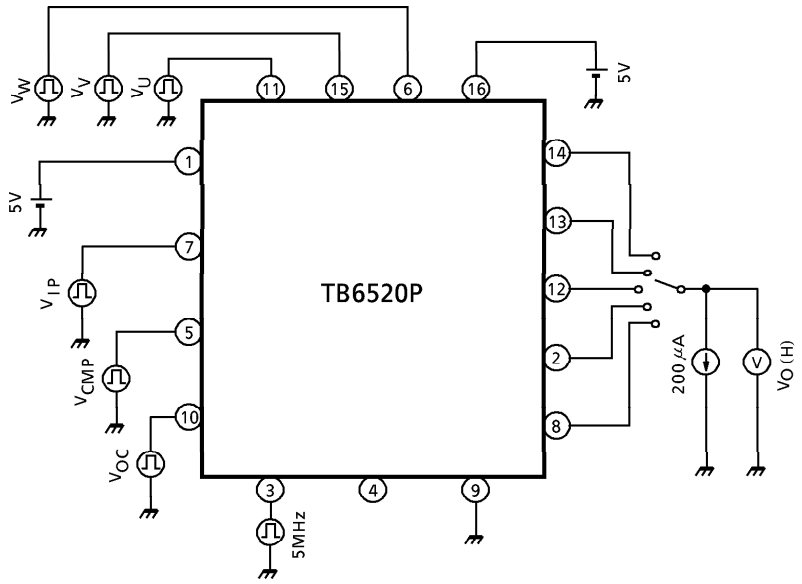
TEST CIRCUIT 5: $I_{L\,(L)}$



TEST CIRCUIT 6: $I_{L\,(H)}$

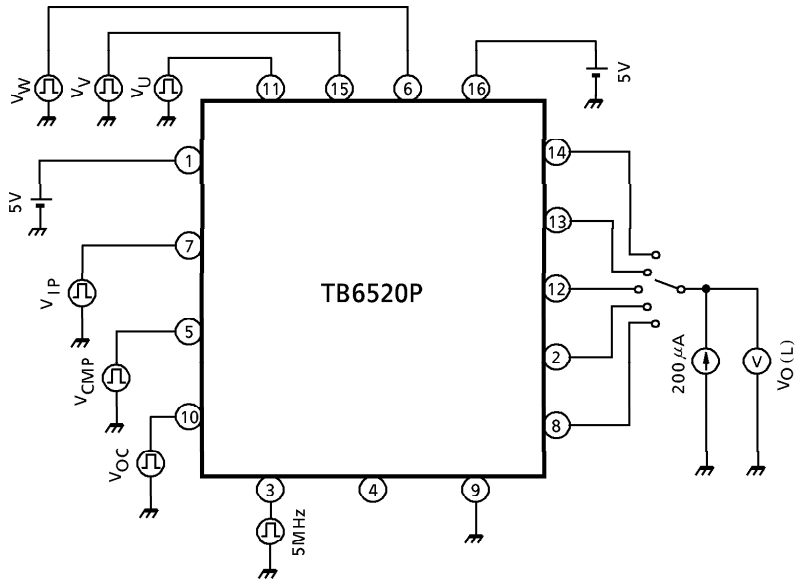


TEST CIRCUIT 7



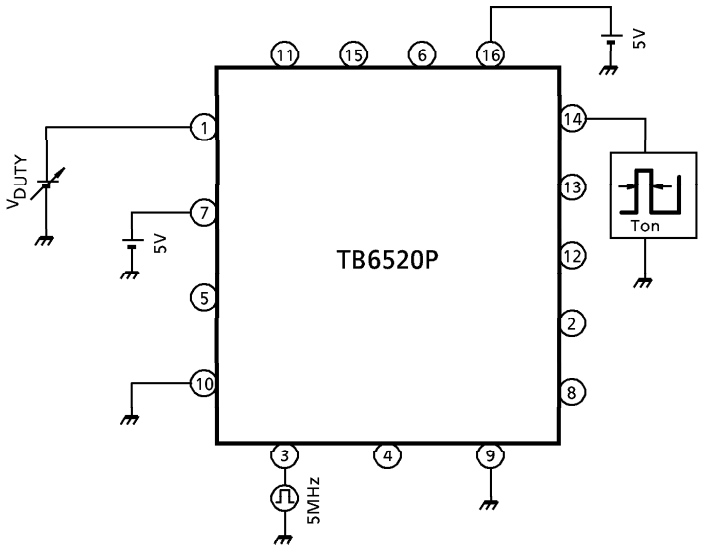
- Input amplitude 1.5 to 3.5V to V_U, V_V, V_W, V_{IP}, V_{CMP}, and V_{OC}, and causes the output to function.

TEST CIRCUIT 8



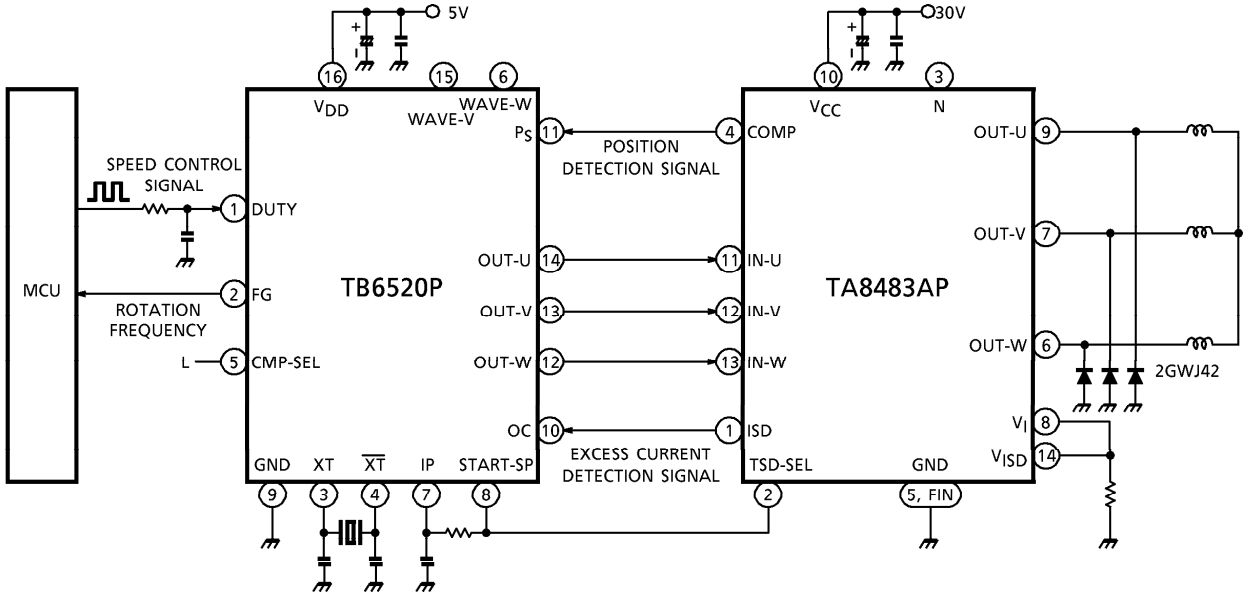
- Input amplitude 1.5 to 3.5V to V_U, V_V, V_W, V_{IP}, V_{CMP}, and V_{OC}, and cause the output to function.

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



- Change V_{DUTY} and measure Ton.

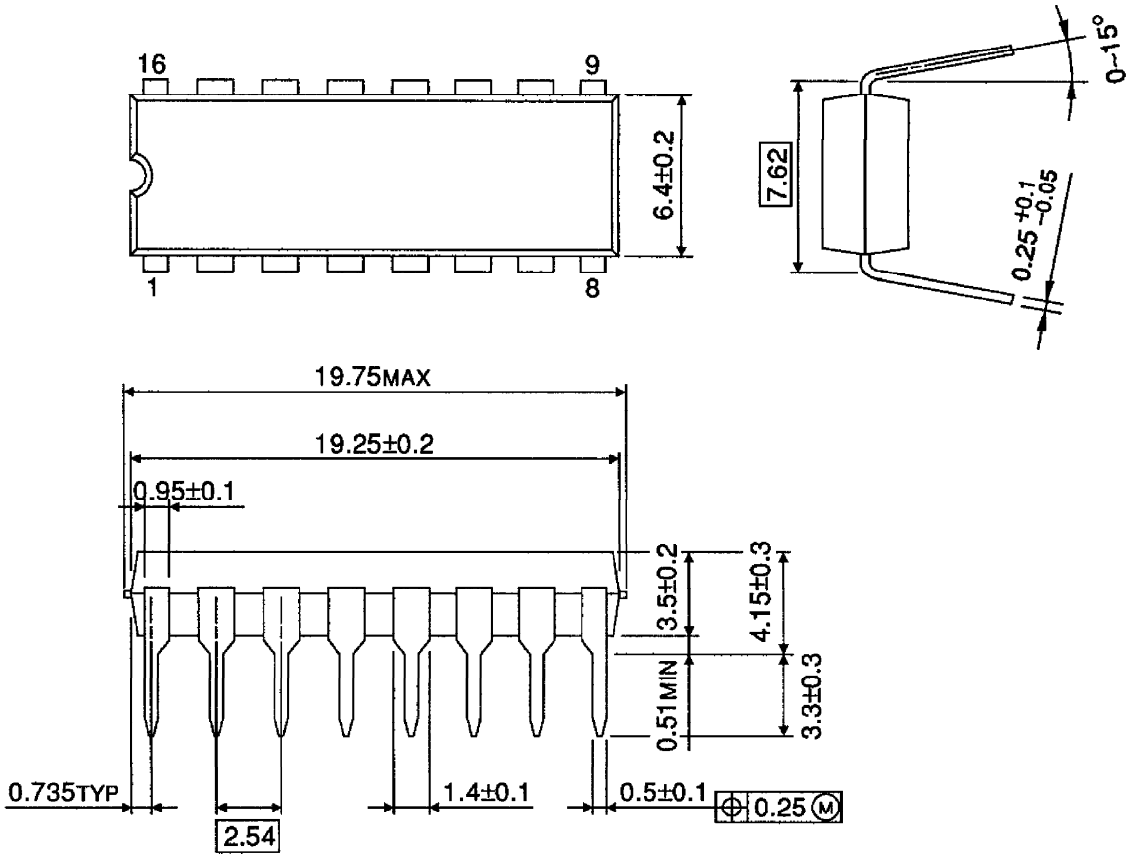
APPLICATION CIRCUIT (1-PHASE INPUT MODE)



OUTLINE DRAWING

DIP16-P-300-2.54A

Unit : mm



Weight : 1.11g (Typ.)