

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA7736P, TA7736F

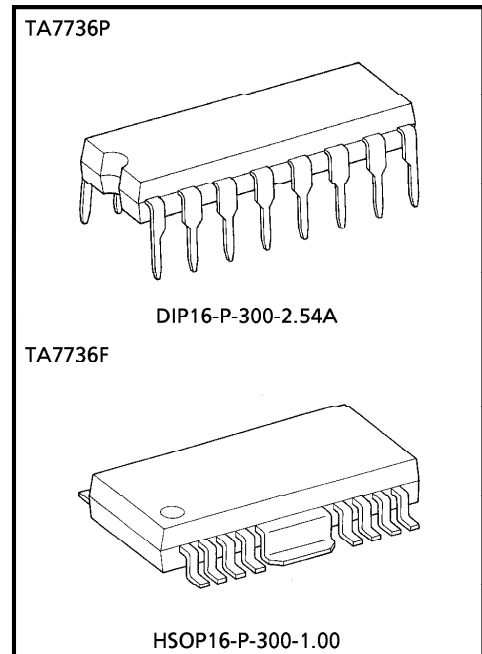
DC MOTOR DRIVER IC

The TA7736P is a 3 phase Bi-directional motor driver IC. It designed for use VCR, tape deck, floppy disk and record player motor drivers.

It contains output power drivers, position sensing circuits, control amplifier and CW/CCW control circuit.

FEATURES

- 3 Phase Bi-Directional Driver and Output Current Up to 1.0A.
- Few External Parts Required.
- Wide Operating Supply Voltage Range
: $V_{CC(opr)}$ (Min.) = 7~20V
- Forward and Reverse Rotation is Controlled Simply by Means of a CW/CCW Control Signal Fed Into 16PIN.
- High Sensitivity of Position Sensing Amplifier.
($V_H = 10mV_{p-p}$ (Typ.), Recommend to Use TOSHIBA Ga-As Hall Sensor "THS" Series.)
- Surge Protect Diode Connected for All Input Terminals.
(Position Sensing, Control, CW/CCW Control Inputs.)



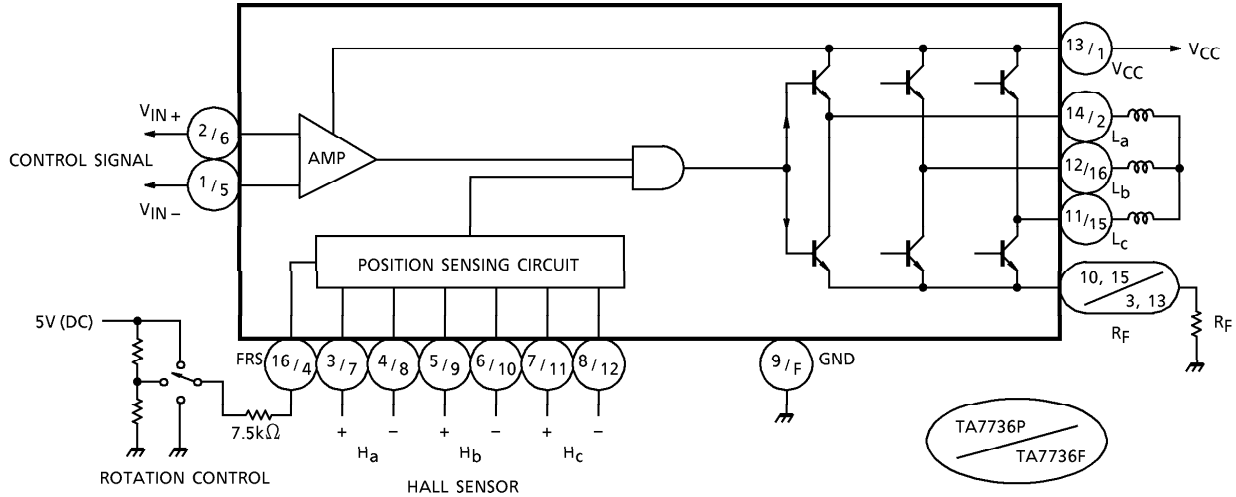
Weight

DIP16-P-300-2.54A : 1.11g (Typ.)
HSOP16-P-300-1.00 : 0.50g (Typ.)

961001EBA2

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to foreign exchange and foreign trade control laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

BLOCK DIAGRAM

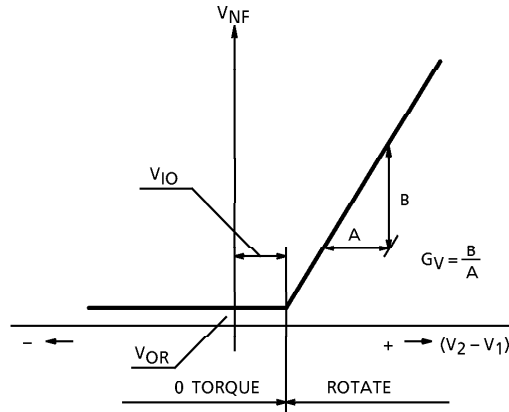


PIN FUNCTION

| PIN No. | | SYMBOL | FUNCTIONAL DESCRIPTION |
|---------|-----|-----------|---|
| P | F | | |
| 1 | 5 | V_{IN-} | Control Amp. negative terminal |
| 2 | 6 | V_{IN+} | Control Amp. positive terminal |
| 3 | 7 | H_a+ | a-phase Hall Amp. positive input terminal |
| 4 | 8 | H_a- | a-phase Hall Amp. negative input terminal |
| 5 | 9 | H_b+ | b-phase Hall Amp. positive input terminal |
| 6 | 10 | H_b- | b-phase Hall Amp. negative input terminal |
| 7 | 11 | H_c+ | c-phase Hall Amp. positive input terminal |
| 8 | 12 | H_c- | c-phase Hall Amp. negative input terminal |
| 9 | FIN | GND | GND terminal |
| 10 | 3 | R_F | Output current detection terminal |
| 11 | 15 | L_c | c-phase drive output terminal |
| 12 | 16 | L_b | b-phase drive output terminal |
| 13 | 1 | V_{CC} | power supply input terminal |
| 14 | 2 | L_a | a-phase drive output terminal |
| 15 | 13 | R_F | Output current detection terminal |
| 16 | 4 | FRS | Forward rotation / Reverse rotation switch terminal |

F : ⑭ Pin : No connection

INPUT VS OUTPUT

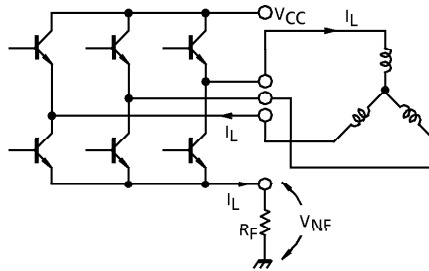


V_{NF} shows voltage drop at R_F .

This is in the case of star connection, when coil current is I_L

$$V_{NF} = R_F \cdot I_L$$

See the following circuit.



Further, if inputs (pin①, ⑤, pin②, ⑥) are shorted or $V_1 \geq V_2$, torque at the circuit, becomes zero. However, this zero torque state also can be obtained by setting FRS input (pin⑩, ④) to specified voltage or by placing the circuit in open state and this is rather advantageous as current consumption is less.

FUNCTION

| FRS (PIN⑩, ④) | POSITION SENSING INPUT | | | COIL OUTPUT | | |
|------------------|------------------------|----------------|----------------|----------------|----------------|----------------|
| | H _a | H _b | H _c | L _a | L _b | L _c |
| L | 1 | 0 | 1 | H | L | M |
| | 1 | 0 | 0 | H | M | L |
| | 1 | 1 | 0 | M | H | L |
| | 0 | 1 | 0 | L | H | M |
| | 0 | 1 | 1 | L | M | H |
| | 0 | 0 | 1 | M | L | H |
| H | 1 | 0 | 1 | L | H | M |
| | 1 | 0 | 0 | L | M | H |
| | 1 | 1 | 0 | M | L | H |
| | 0 | 1 | 0 | H | L | M |
| | 0 | 1 | 1 | H | M | L |
| | 0 | 0 | 1 | M | H | L |
| M | 1 | 0 | 1 | High Impedance | | |
| | 1 | 0 | 0 | | | |
| | 1 | 1 | 0 | | | |
| | 0 | 1 | 0 | | | |
| | 0 | 1 | 1 | | | |
| | 0 | 0 | 1 | | | |

(Note) "1" of Hole element input means that voltage above +10mV is applied to the positive side of each hall element from the negative side and "0" means that voltage above +10mV is applied to the negative side from the positive side. In this case, needless to say, DC potential must be within the specified common mode voltage range of hall element input.

Further, "H", "M" and "L" of output mean $V_{CC} - V_{SAT1} \doteq \frac{1}{2} V_{CC}$ and V_{SAT2} , respectively, and "L", "H" and "M" of FRS input mean application of voltage within specified values of V_F , V_R and V_S , respectively.

Further, by applying required voltage for control input (V_{IN+} , V_{IN-}), measure the circuit in operating state.

MAXIMUM RATINGS (Ta = 25°C)

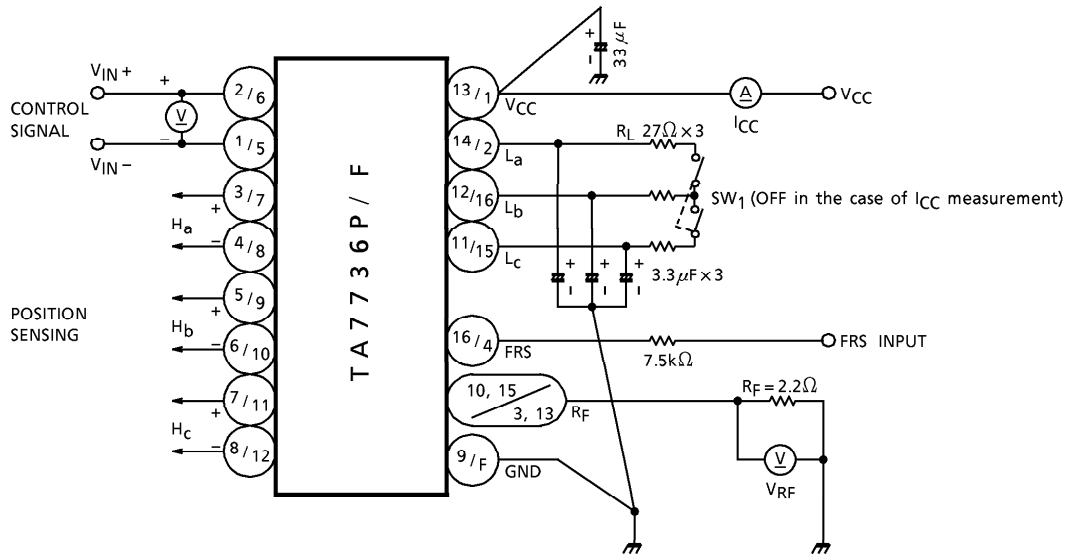
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------|-----------|--------------|------|
| Supply Voltage | V_{CC} | 26 | V |
| Output Current | I_O | 1.0 | A |
| Power Dissipation | TA7736P | P_D (Note) | W |
| | TA7736F | | |
| Operating Temperature | T_{opr} | -30~75 | °C |
| Storage Temperature | T_{stg} | -55~150 | °C |

(Note) No heat sink

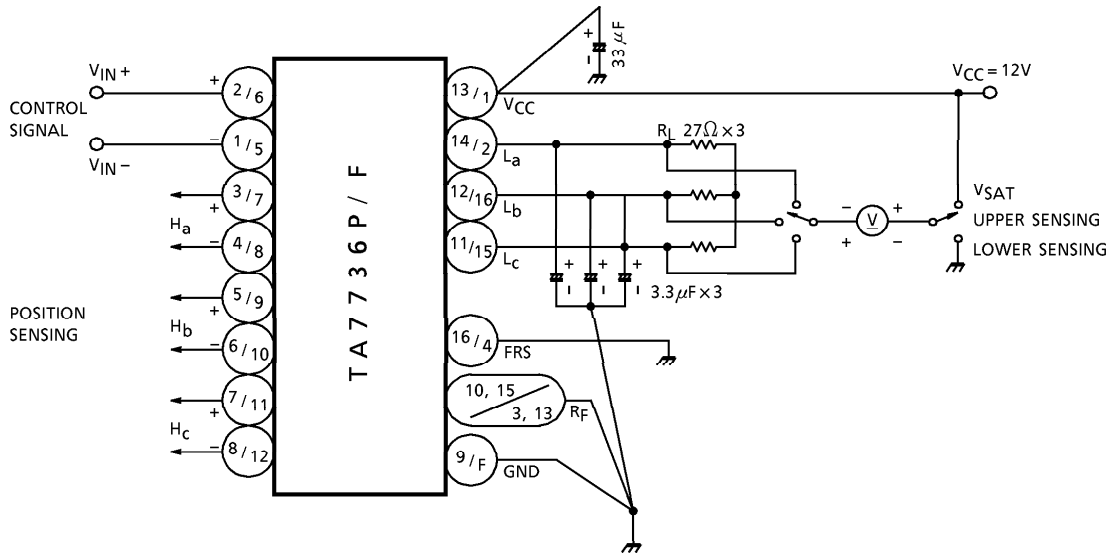
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $V_{CC} = 12V$, $T_a = 25^\circ C$)

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--|---------------------|--------------|----------------------------|------|------|----------------|---------|
| Quiescent Current | I_{CC1} | 1 | FRS = Open | 2 | 4 | 7 | mA |
| | I_{CC2} | | FRS = 5V | 2 | 5 | 9 | |
| | I_{CC3} | | $V_{CC} = 22V$, FRS = GND | 2 | 5 | 9 | |
| Input Offset Voltage | V_{IO} | 1 | | — | 40 | — | mV |
| Residual Output Voltage | V_{OR} | 1 | $V_1 = V_2 = 7V$ | — | 0 | 10 | mV |
| Voltage Gain | G_V | 1 | $R_{NF} = 2.2\Omega$ | — | 15.0 | — | |
| Saturation Voltage | Upper V_{SAT1} | 2 | $I_L = 400mA$ | — | 1.0 | 1.5 | V |
| | Lower V_{SAT2} | | | — | 0.4 | 1.0 | |
| Cut-off Current | Upper I_{OC1} | — | $V = 20V$ | — | — | 20 | μA |
| | Lower I_{OC2} | | | — | — | 20 | |
| Position Sensing Input Sensitivity | V_H | 1 | | — | 10 | — | mV |
| Maximum Position Sensing Input Voltage | V_H MAX. | 1 | | — | — | 400 | mV |
| Input Operating Voltage | Position CMR_H | 1 | | 2.0 | — | $V_{CC} - 2.5$ | V |
| | Control CMR_C | 1 | | 2.0 | — | $V_{CC} - 2.5$ | V |
| Rotation Control Input Voltage | CW V_F | 1 | | — | 0 | 0.4 | V |
| | STOP V_S | 1 | | 2.2 | 2.7 | 3.2 | V |
| | CCW V_R | 1 | | 4.8 | 5.0 | 5.8 | V |

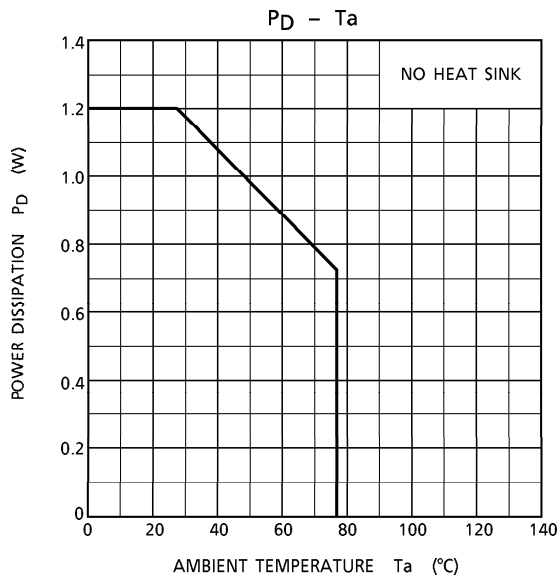
TEST CIRCUIT 1



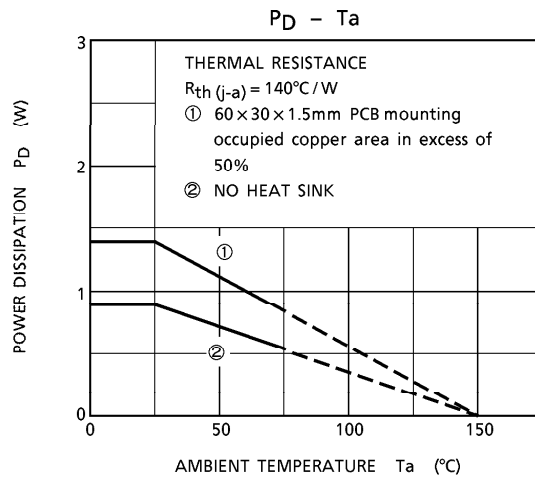
TEST CIRCUIT 2



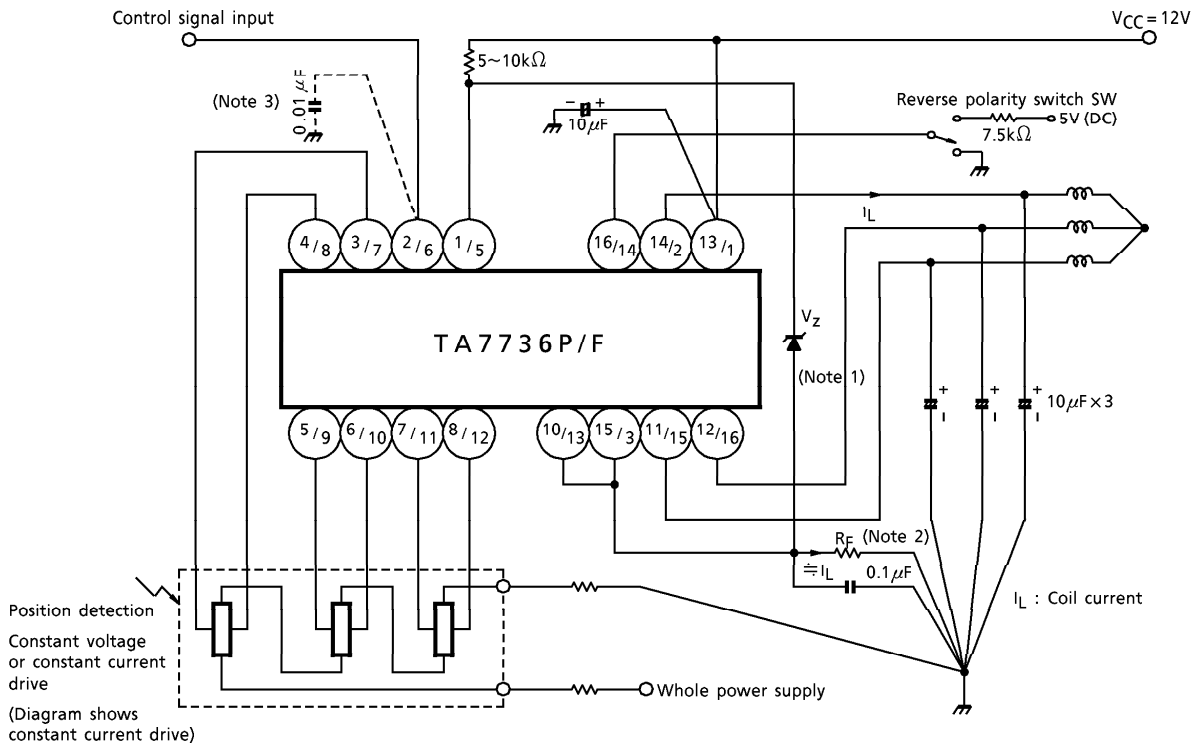
TA7736P



TA7736F



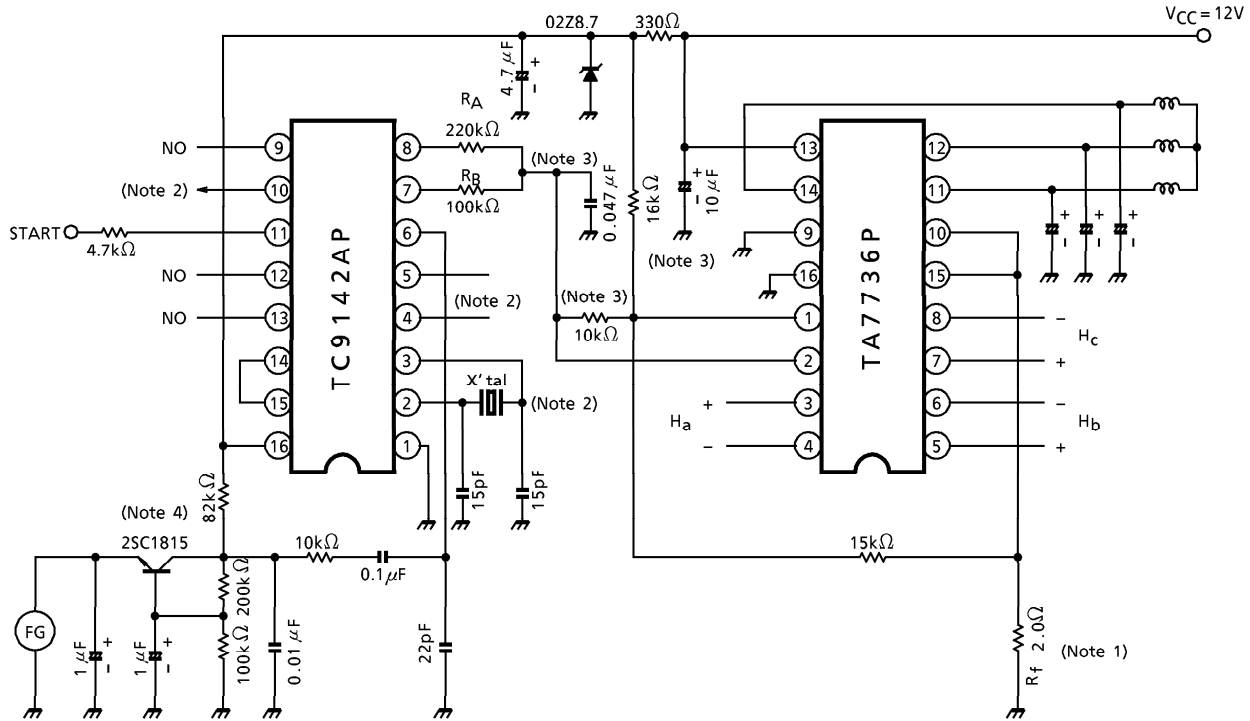
APPLICATION CIRCUIT 1
(Basic application circuit)



- (Note 1) Set the Zener diode V_Z to the control signal input DC level.
(V_Z setting recommended at 2.5 to 9.0V; 5.0V depending on temperature characteristics. With load control input pins (1) and (5), the DC electric potential becomes $V_Z + R_F \cdot I_L$.)
- (Note 2) R_F is set depending on the coil impedance, F/V transfer voltage (control input) and required starting torque. Set between 0.3 and 5Ω.
- (Note 3) Connect when dive to control input occurs.

APPLICATION CIRCUIT 2

(TC9142AP + TA7736P $3\frac{1}{2}$ PLL FDD)



(Note 1) R_f is a feed back Resistor that's voltage drop is equal to Input Voltage ($V_2 - V_1$) in this application with feed back by Zener Diode.

(Note 2) Required $X'tal$ frequency is calculated by following
 $f_X = (no \cdot a / 60) \cdot 128 \cdot 20 N = 42.6 no \cdot a \cdot N$ (at PIN⑩ "High" state)
 $f_X = (no \cdot a / 60) \cdot 128 \cdot 27 N = 57.6 no \cdot a \cdot N$ (at PIN⑩ "Low" state)

| PIN④ | PIN⑤ | N |
|------|------|-----|
| H | H | 32 |
| L | H | 128 |
| H | L | 4 |

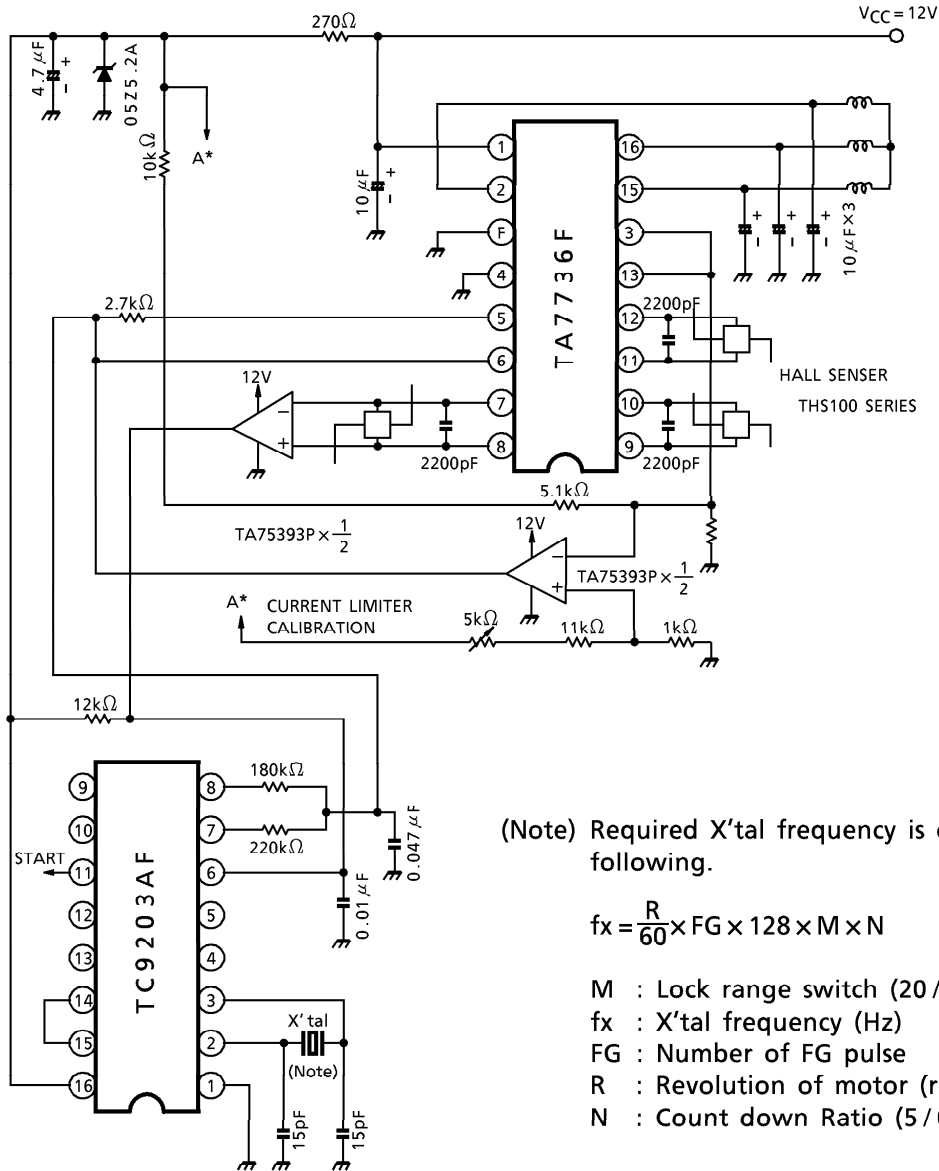
Where

- no : Required Rotation Speed (rpm)
- a : Number of FG pulse (pulse/rotation)
- N : Count Down Ratio (4.32 or 128)

(Note 3) Recommended value of R_A and R_B is $50k\Omega$ to $300k\Omega$
 The combination ratio of F/V and P/V output is designed by changing these value. For example, if you want more F/V conversion gain compare to P/V's one for fast system initial start up. Use a higher value of R_B compare to R_A .

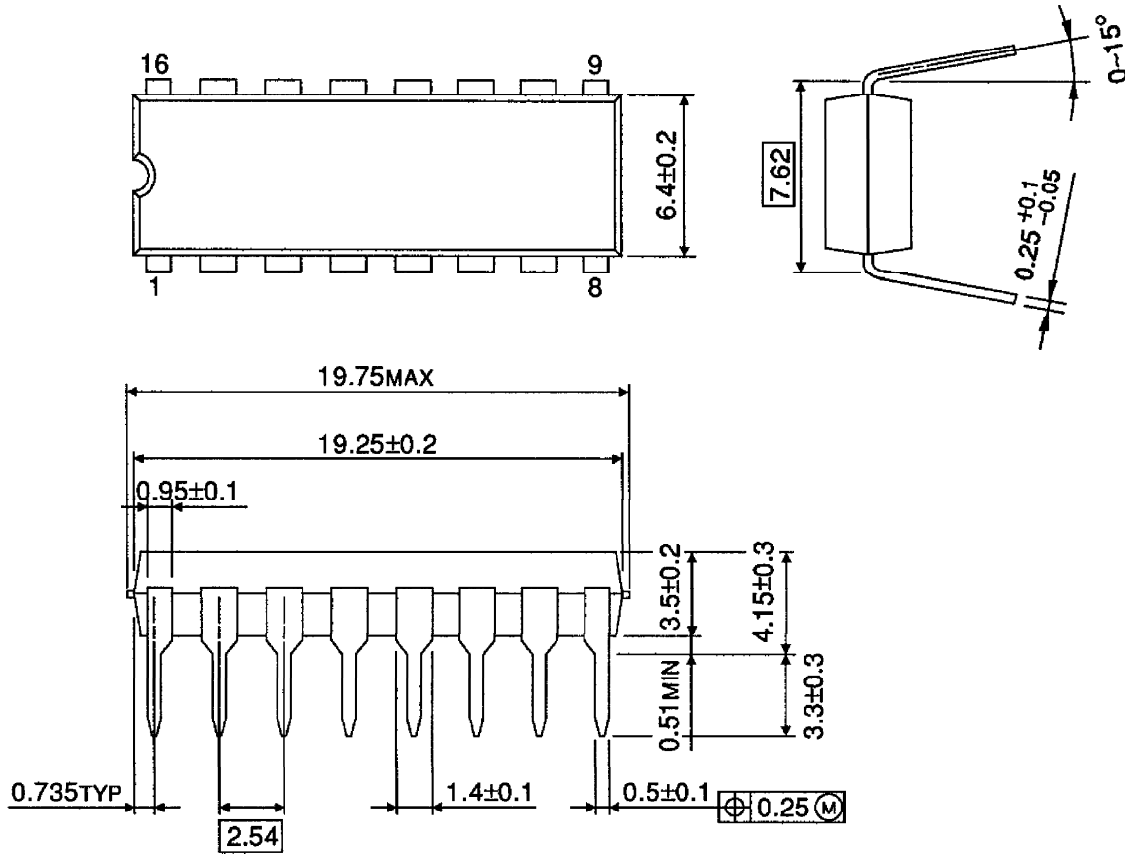
(Note 4) TC9142P's FG Amplifier gain is 30dB (Typ.) and required input signal is over $30mV_{rms}$.
 If the FG doesn't output over this value.
 Required a Front Amplifier.

APPLICATION CIRCUIT 3
(TC9203AF + TA7736F 3.5 PLL HDD)



OUTLINE DRAWING
DIP16-P-300-2.54A

Unit : mm

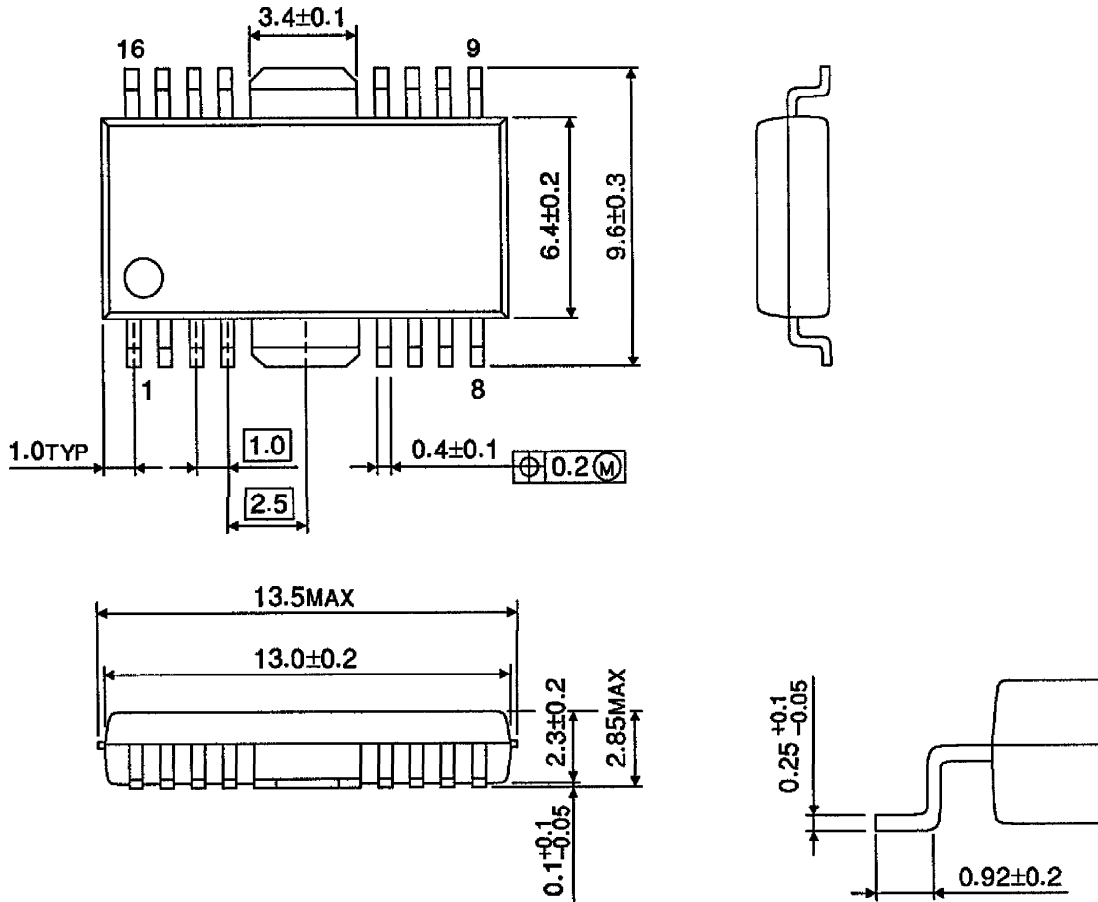


Weight : 1.11g (Typ.)

OUTLINE DRAWING

HSOP16-P-300-1.00

Unit : mm



Weight : 0.50g (Typ.)