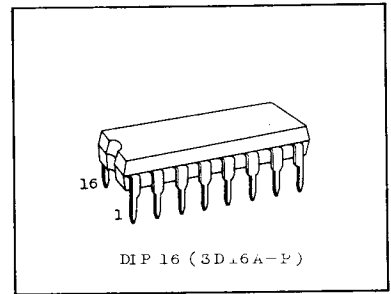


## TC5002BP, TC5022BP BCD TO 7-SEGMENT DECODER/DRIVER

TC5002BP and TC5022BP are decoders to convert BCD code input to the driving signal for 7-segment display element and equipped with NPN transistors as the output buffers enabling direct driving of common cathode type LED.

When BI input is set at "H" level, all the segment outputs are turned "OFF" (not illumination) regardless of other inputs.

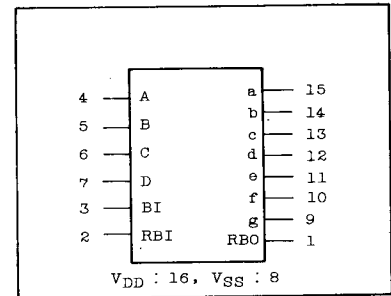
RBI input is to turn the output "OFF" and RBO output is to generate "H" level output only for "0" code input and these are used for leading zero suppress when connected in cascade.



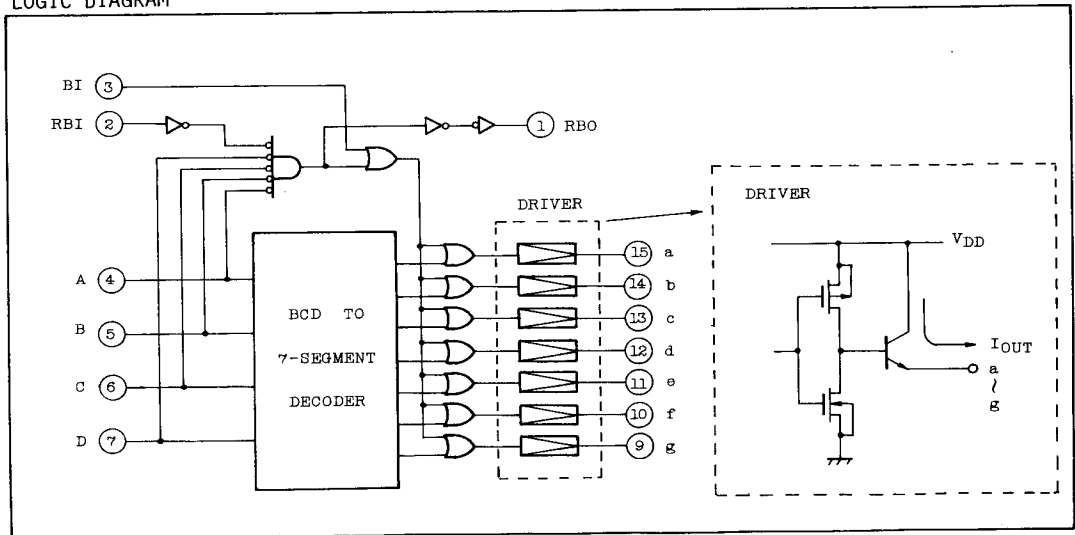
### ABSOLUTE MAXIMUM RATINGS

| CHARACTERISTIC            | SYMBOL           | RATING                                      | UNIT |
|---------------------------|------------------|---|------|
| DC Supply Voltage         | V <sub>DD</sub>  | V <sub>SS</sub> -0.5 ~ V <sub>SS</sub> +20  | V    |
| Input Voltage             | V <sub>IN</sub>  | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| Output Voltage            | V <sub>OUT</sub> | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| DC Input Current          | I <sub>IN</sub>  | ±10   | mA   |
| Power Dissipation         | P <sub>D</sub>   | 300   | mW   |
| Storage Temperature Range | T <sub>stg</sub> | -65 ~ 150                                   | °C   |
| Lead Temp./Time           | T <sub>sol</sub> | 260°C · 10sec                               |      |

### PIN ASSIGNMENT



### LOGIC DIAGRAM



# TC5002BP, TC5022BP

## TRUTH TABLE

(TC5002BP)

|    |     | INPUT |   |   |   | OUTPUT |   |   |   |   |   |   |     |      |
|----|-----|-------|---|---|---|--------|---|---|---|---|---|---|-----|------|
| BI | RBI | A     | B | C | D | a      | b | c | d | e | f | g | RBO | NOTE |
| H  | *   | *     | * | * | * | L      | L | L | L | L | L | L | ☆   |      |
| L  | H   | L     | L | L | L | L      | L | L | L | L | L | L | H   |      |
| L  | L   | L     | L | L | L | H      | H | H | H | H | H | H | L   |      |
| L  | *   | H     | L | L | L | L      | H | H | L | L | L | L | L   |      |
| L  | *   | L     | H | L | L | H      | H | L | H | H | L | H | L   |      |
| L  | *   | H     | H | L | L | H      | H | H | H | L | L | H | L   |      |
| L  | *   | L     | L | H | L | L      | H | H | L | L | H | H | L   |      |
| L  | *   | H     | L | H | L | H      | L | H | H | L | H | H | L   |      |
| L  | *   | L     | H | H | L | L      | L | H | H | H | H | H | L   | 1    |
| L  | *   | H     | H | H | L | H      | H | H | L | L | L | L | L   | 2    |
| L  | *   | L     | L | L | H | H      | H | H | H | H | H | H | L   |      |
| L  | *   | H     | L | L | H | H      | H | H | L | L | H | H | L   | 3    |
| L  | *   | L     | H | L | H | H      | H | H | H | H | H | L | L   |      |
| L  | *   | H     | H | L | H | L      | H | H | L | L | L | L | L   |      |
| L  | *   | L     | L | H | H | H      | H | L | H | H | L | H | L   |      |
| L  | *   | H     | L | H | H | H      | H | H | L | L | H | H | L   |      |
| L  | *   | L     | H | H | H | L      | H | H | L | L | H | H | L   |      |
| L  | *   | H     | H | H | H | H      | L | H | H | L | H | H | L   |      |

NOTE 1 : TC5022BP,  $\longrightarrow$  a = "H"

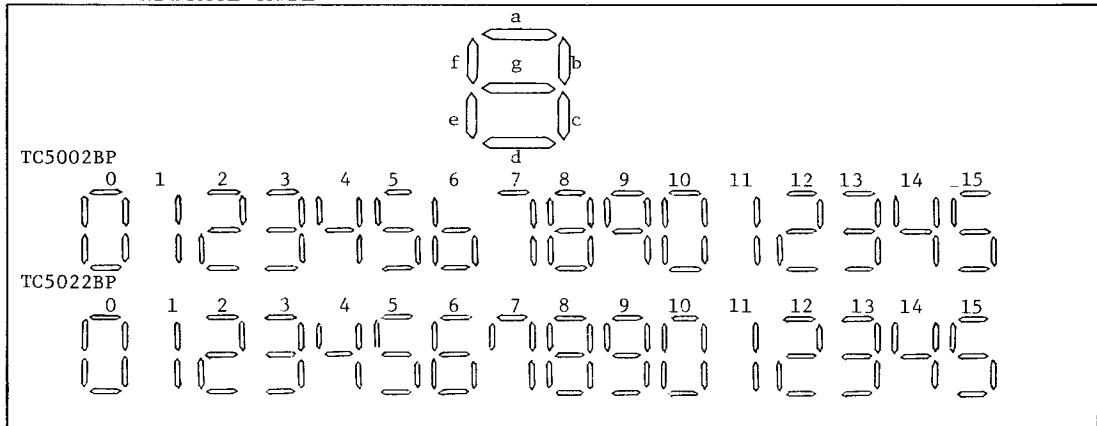
2 : TC5022BP,  $\longrightarrow$  f = "H"

3 : TC5022BP,  $\longrightarrow$  d = "H"

☆ : Undetermined

\* : Don't Care

## DISPLAY INDICATE MODE



RECOMMENDED OPERATING CONDITIONS (VSS= 0V)

| CHARACTERISTIC  | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-----------------|--------|------|------|------|------|
| Supply Voltage  | VDD    | 3    | -    | 18   | V    |
| Input Voltage   | VIN    | 0    | -    | VDD  | V    |
| Operating Temp. | Topr   | -40  | -    | 85   | °C   |

ELECTRICAL CHARACTERISTICS (VSS=0V)

| CHARACTERISTIC                    | SYMBOL          | TEST CONDITIONS  | VDD (V) | -40°C |      | 25°C  |                   |      | 85°C  |      | UNIT |
|-----------------------------------|-----------------|--|---------|-------|------|-------|-------------------|------|-------|------|------|
|                                   |                 |  |         | MIN.  | MAX. | MIN.  | TYP.              | MAX. | MIN.  | MAX. |      |
| High Level Output Voltage (RBO)   | VOH             | IOUT  < 1μA<br>VIN=VSS, VDD  | 5       | 4.95  | -    | 4.95  | 5.00              | -    | 4.95  | -    | V    |
|                                   |                 |  | 10      | 9.95  | -    | 9.95  | 10.00             | -    | 9.95  | -    |      |
|                                   |                 |  | 15      | 14.95 | -    | 14.95 | 15.00             | -    | 14.95 | -    |      |
| Low Level Output Voltage (RBO)    | VOL             | IOUT  < 1μA<br>VIN=VSS, VDD  | 5       | -     | 0.05 | -     | 0.00              | 0.05 | -     | 0.05 | V    |
|                                   |                 |  | 10      | -     | 0.05 | -     | 0.00              | 0.05 | -     | 0.05 |      |
|                                   |                 |  | 15      | -     | 0.05 | -     | 0.00              | 0.05 | -     | 0.05 |      |
| High Level Output Voltage (a - g) | VOH             | IOUT  < 1μA<br>VIN=VSS, VDD  | 5       | 4.0   | -    | 4.0   | 4.5               | -    | 4.0   | -    | V    |
|                                   |                 |  | 10      | 9.0   | -    | 9.0   | 9.5               | -    | 9.0   | -    |      |
|                                   |                 |  | 15      | 14.0  | -    | 14.0  | 14.5              | -    | 14.0  | -    |      |
| High Level Output Current (RBO)   | IOH             | VOH=4.6V<br>VOH=9.5V<br>VOH=13.5V<br>VIN=VSS, VDD                      | 5       | -0.2  | -    | -0.16 | -                 | -    | -0.12 | -    | mA   |
|                                   |                 |  | 10      | -0.5  | -    | -0.4  | -                 | -    | -0.3  | -    |      |
|                                   |                 |  | 15      | -1.4  | -    | -1.2  | -                 | -    | -1.0  | -    |      |
|                                   |                 |  | 5       | 0.52  | -    | 0.44  | -                 | -    | 0.36  | -    |      |
| Low Level Output Current (RBO)    | IOL             | VOL=0.4V<br>VOL=0.5V<br>VOL=1.5V<br>VIN=VSS, VDD                       | 10      | 1.3   | -    | 1.1   | -                 | -    | 0.9   | -    | mA   |
|                                   |                 |  | 15      | 3.6   | -    | 3.0   | -                 | -    | 2.4   | -    |      |
|                                   |                 |  | 5       | -20   | -    | -20   | -                 | -    | -15   | -    |      |
|                                   |                 |  | 10      | -25   | -    | -25   | -                 | -    | -20   | -    |      |
| High Level Output Current (a - g) | IOH             | VOH=3.5V<br>VOH=8.5V<br>VOH=13.5V<br>VIN=VSS, VDD                      | 15      | -30   | -    | -30   | -                 | -    | -25   | -    | mA   |
|                                   |                 |  | 5       | 3.5   | -    | 3.5   | 2.75              | -    | 3.5   | -    |      |
|                                   |                 |  | 10      | 7.0   | -    | 7.0   | 5.5               | -    | 7.0   | -    |      |
| High Level Input Voltage          | VIH<br>**       | VOUT=0.5V, 4.0V<br>VOUT=1.0V, 9.0V<br>VOUT=1.5V, 13.5V<br> IOUT  < 1μA | 5       | 11.0  | -    | 11.0  | 8.25              | -    | 11.0  | -    | V    |
|                                   |                 |  | 10      | 7.0   | -    | 7.0   | 5.5               | -    | 7.0   | -    |      |
|                                   |                 |  | 15      | 11.0  | -    | 11.0  | 8.25              | -    | 11.0  | -    |      |
| Low Level Input Voltage           | VIL<br>**       | VOUT=0.5V, 4.0V<br>VOUT=1.0V, 9.0V<br>VOUT=1.5V, 13.5V<br> IOUT  < 1μA | 5       | -     | 1.5  | -     | 2.25              | 1.5  | -     | 1.5  | V    |
|                                   |                 |  | 10      | -     | 3.0  | -     | 4.5               | 3.0  | -     | 3.0  |      |
|                                   |                 |  | 15      | -     | 4.0  | -     | 6.75              | 4.0  | -     | 4.0  |      |
| Disable Current (a - g)           | IDL             | VOL=0V   | 18      | -     | -3.0 | -     | -10 <sup>-4</sup> | -3.0 | -     | -30  | μA   |
| Input 'H' Level Current           | I <sub>IH</sub> | V <sub>IH</sub> =18V   | 18      | -     | 0.3  | -     | 10 <sup>-5</sup>  | 0.3  | -     | 1.0  | μA   |
|                                   | I <sub>IL</sub> | V <sub>IL</sub> =0V  | 18      | -     | -0.3 | -     | -10 <sup>-5</sup> | -0.3 | -     | -1.0 |      |
| Quiescent Current Consumption     | IDD             | VIN=VSS, VDD<br>*  | 5       | -     | 20   | -     | 0.005             | 20   | -     | 150  | μA   |
|                                   |                 |  | 10      | -     | 40   | -     | 0.010             | 40   | -     | 300  |      |
|                                   |                 |  | 15      | -     | 80   | -     | 0.015             | 80   | -     | 600  |      |

\* All valid input combinations. Outputs open.

\*\* Required pull down register RL = 20 kΩ (a ~ g outputs).

# TC5002BP, TC5022BP

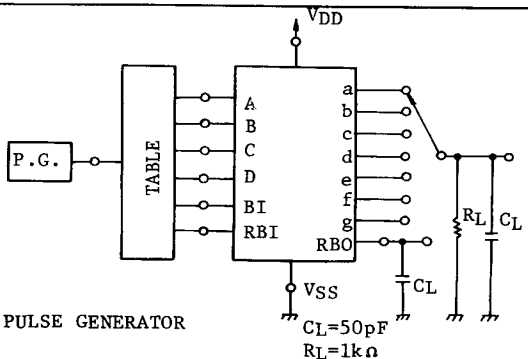
SWITCHING CHARACTERISTICS (Ta=25°C, VSS=0V, CL=50pF)

| CHARACTERISTIC  | SYMBOL                               | TEST CONDITIONS      | VDD (V) | MIN. | TYP. | MAX. | UNIT |
|---|--------------------------------------|----------------------|---------|------|------|------|------|
|   |                                      |                      | 5       |      |      |      |      |
| Output Rise Time<br>(SEGMENT OUT)                             | t <sub>TLH</sub>                     | R <sub>L</sub> =1 kΩ | 5       | -    | 100  | 200  | ns   |
|   |                                      |                      | 10      | -    | 50   | 100  |      |
|   |                                      |                      | 15      | -    | 40   | 80   |      |
| Output Rise Time<br>(RBO)                                     | t <sub>TLH</sub>                     |                      | 5       | -    | 130  | 400  | ns   |
|   |                                      |                      | 10      | -    | 65   | 200  |      |
|   |                                      |                      | 15      | -    | 50   | 160  |      |
| Output Fall Time<br>(RBO)                                     | t <sub>THL</sub>                     |                      | 5       | -    | 100  | 200  | ns   |
|   |                                      |                      | 10      | -    | 50   | 100  |      |
|   |                                      |                      | 15      | -    | 40   | 80   |      |
| (LOW-HIGH)<br>Propagation Delay Time<br>(A,B,C,D-SEGMENT OUT) | t <sub>pLH</sub>                     | R <sub>L</sub> =1 kΩ | 5       | -    | 500  | 1000 | ns   |
|   |                                      |                      | 10      | -    | 150  | 400  |      |
|   |                                      |                      | 15      | -    | 120  | 300  |      |
| (HIGH-LOW)<br>Propagation Delay Time<br>(A,B,C,D-SEGMENT OUT) | t <sub>pHL</sub>                     | R <sub>L</sub> =1 kΩ | 5       | -    | 1000 | 2000 | ns   |
|   |                                      |                      | 10      | -    | 450  | 1000 |      |
|   |                                      |                      | 15      | -    | 320  | 700  |      |
| (LOW-HIGH)<br>Propagation Delay Time<br>(A,B,C,D - RBO)       | t <sub>pLH</sub>                     |                      | 5       | -    | 1000 | 2000 | ns   |
|   |                                      |                      | 10      | -    | 370  | 1000 |      |
|   |                                      |                      | 15      | -    | 250  | 750  |      |
| (HIGH-LOW)<br>Propagation Delay Time<br>(A,B,C,D - RBO)       | t <sub>pHL</sub>                     |                      | 5       | -    | 500  | 1000 | ns   |
|   |                                      |                      | 10      | -    | 200  | 500  |      |
|   |                                      |                      | 15      | -    | 140  | 300  |      |
| (LOW-HIGH)<br>Propagation Delay Time<br>(RBI - RBO)           | t <sub>pLH</sub>                     |                      | 5       | -    | 800  | 1600 | ns   |
|   |                                      |                      | 10      | -    | 270  | 700  |      |
|   |                                      |                      | 15      | -    | 190  | 500  |      |
| (HIGH-LOW)<br>Propagation Delay Time<br>(RBI - RBO)           | t <sub>pHL</sub>                     |                      | 5       | -    | 180  | 700  | ns   |
|   |                                      |                      | 10      | -    | 70   | 350  |      |
|   |                                      |                      | 15      | -    | 50   | 250  |      |
| Propagation Delay Time<br>(BI - SEGMENT OUT)                  | t <sub>pLH</sub><br>t <sub>pHL</sub> | R <sub>L</sub> =1 kΩ | 5       | -    | 500  | 1500 | ns   |
|   |                                      |                      | 10      | -    | 200  | 600  |      |
|   |                                      |                      | 15      | -    | 150  | 500  |      |
| Input Capacity  | C <sub>IN</sub>                      |                      |         | -    | 5    | 7.5  | pF   |

## SWITCHING TIME TEST CIRCUIT

TABLE (t<sub>pLH</sub>, t<sub>pHL</sub> Test Condition)

| TEST                     | P.G. | "H" | "L"             | OUTPUT | Wave-<br>form |
|--------------------------|------|-----|-----------------|--------|---------------|
| A,B,C,D -<br>SEGMENT OUT | A    | -   | Other<br>Inputs | a      | 1             |
| A,B,C,D -<br>RBO         | A    | RBI | Other<br>Inputs | RBO    | 2             |
| RBI - RBO                | RBI  | -   | Other<br>Inputs | RBO    | 3             |
| BI -<br>SEGMENT OUT      | BI   | A,B | Other<br>Inputs | a      | 4             |



SWITCHING TIME TEST WAVEFORMS

