

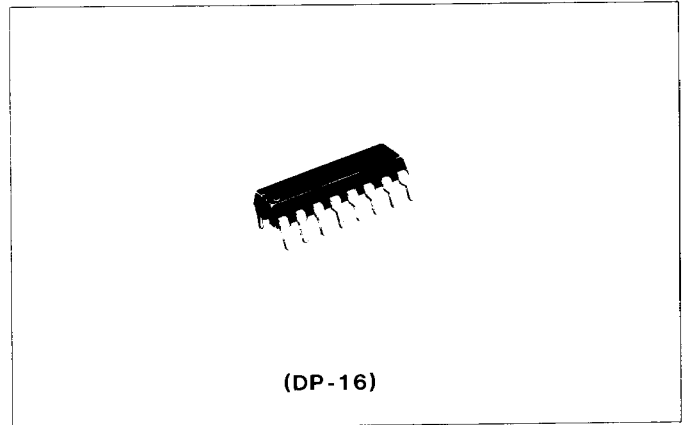
# HA12010

## Fluorescent Tube Driver for Bar Graph Display

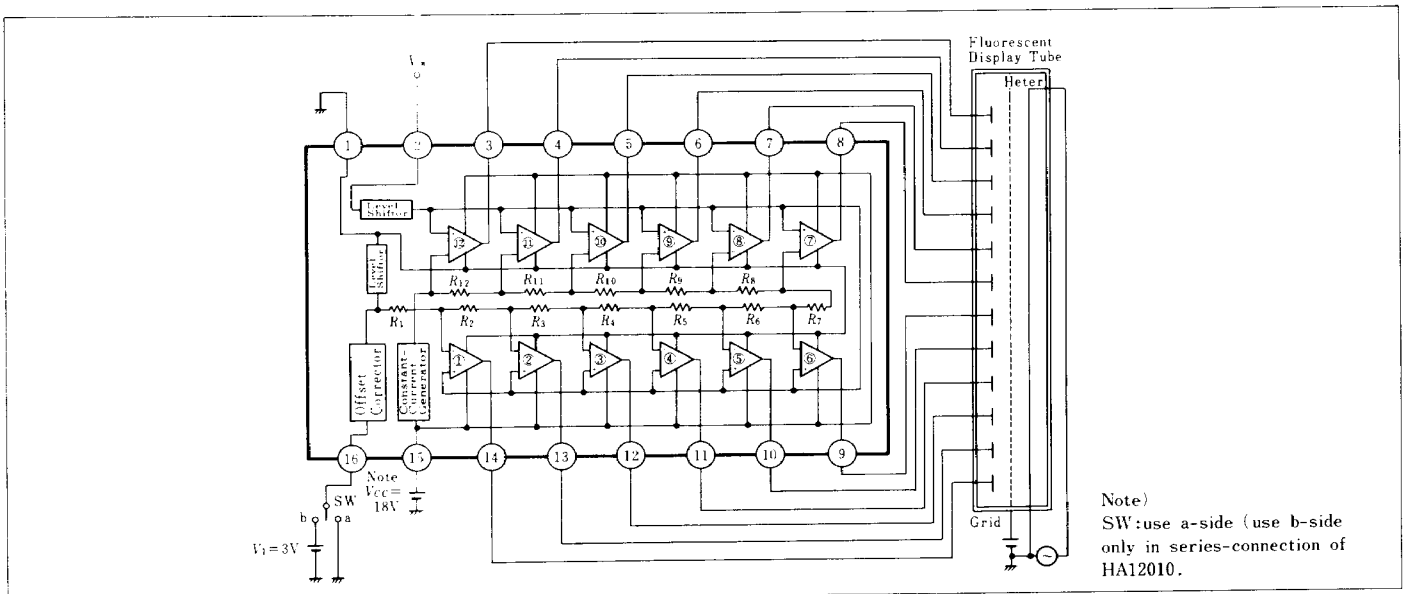
The Hitachi HA12010, encapsulated in 16-pin DIP, is a fluorescent display tube drivers specifically designed for linear-scale bar-graph display of VU-meters. Its features are as follows.

### FEATURES

- No external component and perfect automatic adjustment.
- 12-point bar-graph display, linearly corresponding to input DC voltage with accuracy.
- High input impedance facilitates the connection with other circuit-blocks.
- 5mA max. of output current ( $V_{CC} \leq 12V$ )
- Wide range of supply voltage ( $V_{CC} \cong 10$  to  $24V$ )
- 24-point bar-graph display available by using two HA12010's. (In the case of series-connection, the range of supply voltage is approx. 12 to 24V)



### BLOCK DIAGRAM & TYPICAL APPLICATION CIRCUIT



### ABSOLUTE MAXIMUM RATINGS (Unless otherwise specified, $T_a = 25^\circ C$ )

| Item                                | Symbol                    | Rating      | Unit       | Note |
|-------------------------------------|---------------------------|-------------|------------|------|
| Supply Voltage                      | $V_{CC}$                  | 24          | V          |      |
| Power Dissipation                   | $P_T$                     | 550         | mW         | (1)  |
| Operating Temperature Range         | $T_{opr}$                 | -20 to +70  | $^\circ C$ |      |
| Storage Temperature Range           | $T_{stg}$                 | -55 to +125 | $^\circ C$ |      |
| Max. Voltage at Pin-2               | $V_{2MAX}$                | 16          | V          | (2)  |
| Max. Voltage at Pin-16              | $V_{16MAX}$               | 16          | V          |      |
| Max. Voltage at Pins 3 to 14        | $V_{3MAX}$ to $V_{14MAX}$ | 23.5        | V          | (3)  |
| Max. Output Current at Pins 3 to 14 | $I_{3MAX}$ to $I_{14MAX}$ | 5           | mA         | (4)  |

Notes : (1) Value at  $T_a = 70^\circ C$

(2) Potential difference between pins 2 and 16: 7.0V or less.

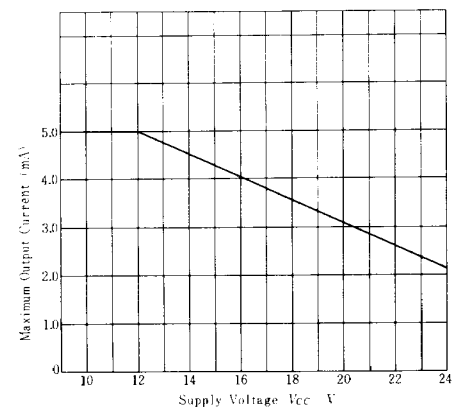
(3) Under  $V_{CC} = 24V$

Max. Voltage at Pins 3 to 14: ( $V_{CC} = 0.5V$ ) or less.

(4) Under  $V_{CC} \leq 12V$

See "Maximum Output Current vs. Supply Voltage".

### MAXIMUM OUTPUT CURRENT vs. SUPPLY VOLTAGE



Note: Maximum Output Current: the maximum current supplied from the output pins (pins 3-14).

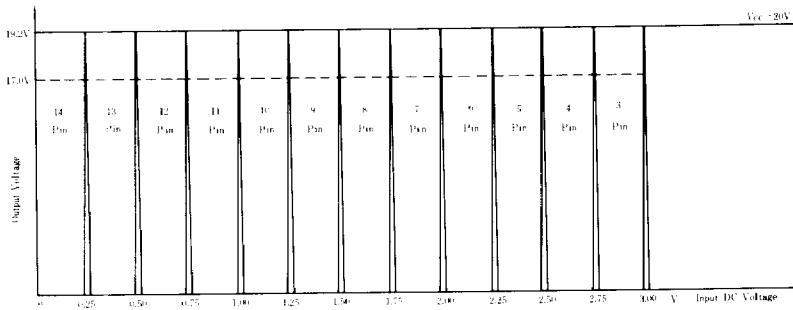
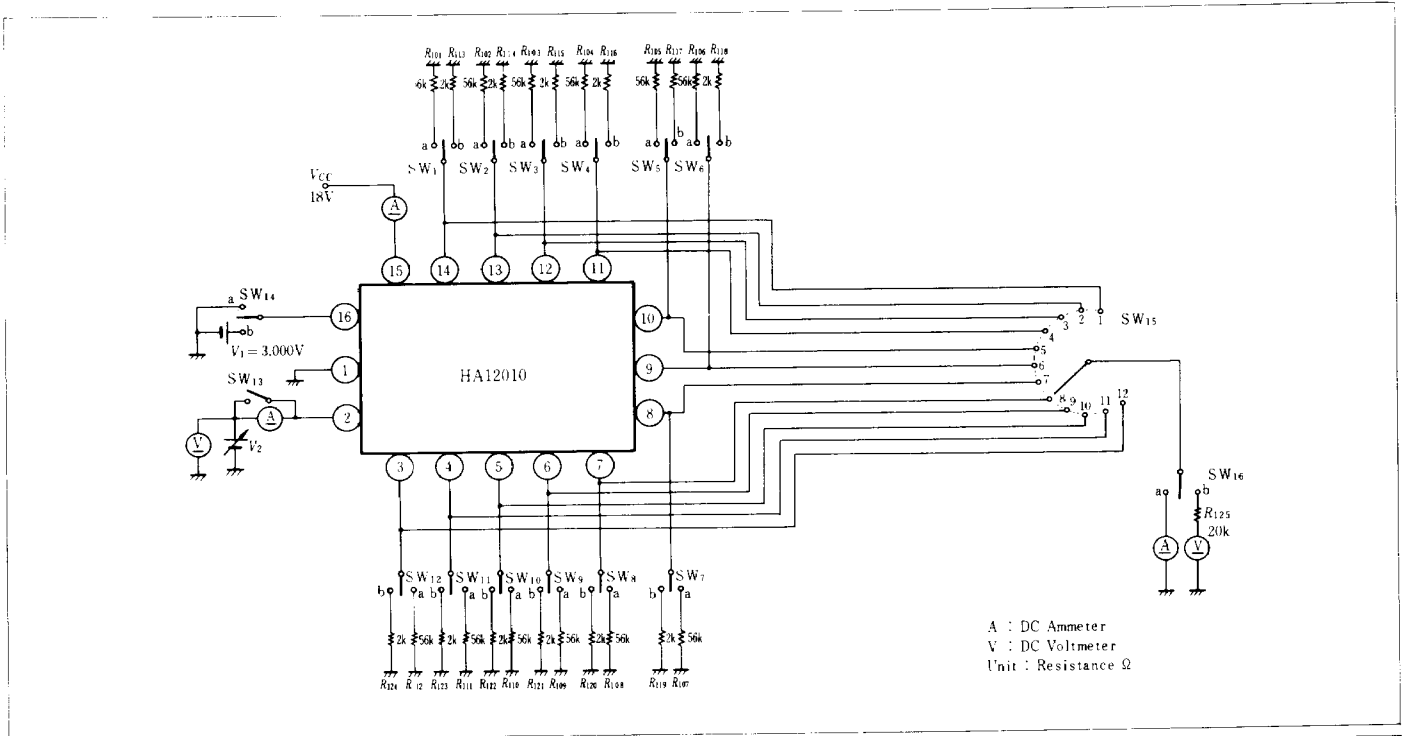


## ELECTRICAL CHARACTERISTICS

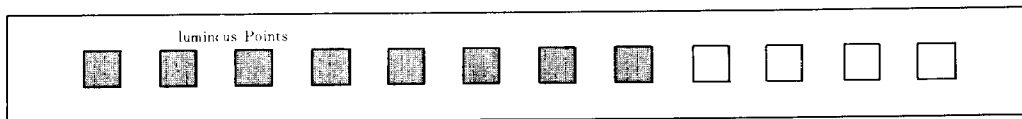
| Item   | Symbol             | Test Conditions   | min.  | typ.  | max.  | Unit    |
|--|--------------------|---|-------|-------|-------|---------|
| Input Voltage  | $I_{IL}$           | Measure outflow current at pin-2 (input terminal) under pin-2 grounded.   | —     | 2     | 300   | nA      |
| Pin-3 Threshold Voltage  | $V_{th 3}$         | $V_{in}$ under 15V of pin-3 voltage $R_L = 56k\Omega$   | —     | 3.00  | —     | V       |
| Pin-4 Threshold Voltage  | $V_{th 4}$         | $V_{in}$ under 15V of pin-4 voltage $R_L = 56k\Omega$   | —     | 2.75  | —     | V       |
| Pin-5 Threshold Voltage  | $V_{th 5}$         | $V_{in}$ under 15V of pin-5 voltage $R_L = 56k\Omega$   | —     | 2.50  | —     | V       |
| Pin-6 Threshold Voltage  | $V_{th 6}$         | $V_{in}$ under 15V of pin-6 voltage $R_L = 56k\Omega$   | —     | 2.25  | —     | V       |
| Pin-7 Threshold Voltage  | $V_{th 7}$         | $V_{in}$ under 15V of pin-7 voltage $R_L = 56k\Omega$   | —     | 2.00  | —     | V       |
| Pin-8 Threshold Voltage  | $V_{th 8}$         | $V_{in}$ under 15V of pin-8 voltage $R_L = 56k\Omega$   | —     | 1.75  | —     | V       |
| Pin-9 Threshold Voltage  | $V_{th 9}$         | $V_{in}$ under 15V of pin-9 voltage $R_L = 56k\Omega$   | —     | 1.50  | —     | V       |
| Pin-10 Threshold Voltage   | $V_{th 10}$        | $V_{in}$ under 15V of pin-10 voltage $R_L = 56k\Omega$  | —     | 1.25  | —     | V       |
| Pin-11 Threshold Voltage   | $V_{th 11}$        | $V_{in}$ under 15V of pin-11 voltage $R_L = 56k\Omega$  | —     | 1.00  | —     | V       |
| Pin-12 Threshold Voltage   | $V_{th 12}$        | $V_{in}$ under 15V of pin-12 voltage $R_L = 56k\Omega$  | —     | 0.75  | —     | V       |
| Pin-13 Threshold Voltage   | $V_{th 13}$        | $V_{in}$ under 15V of pin-13 voltage $R_L = 56k\Omega$  | —     | 0.50  | —     | V       |
| Voltage Difference between $V_{th 14}$ & GND                                     | $\Delta V_{th 1}$  | Measure the voltage difference between $V_{th 14}$ and Ground   | 0.220 | 0.250 | 0.280 | V       |
| Voltage Difference between $V_{th 13}$ & $V_{th 14}$ ( $V_{th 13} - V_{th 14}$ ) | $\Delta V_{th 2}$  | Measure the voltage difference between $V_{th 13}$ and $V_{th 14}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 12}$ & $V_{th 13}$ ( $V_{th 12} - V_{th 13}$ ) | $\Delta V_{th 3}$  | Measure the voltage difference between $V_{th 12}$ and $V_{th 13}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 11}$ & $V_{th 12}$ ( $V_{th 11} - V_{th 12}$ ) | $\Delta V_{th 4}$  | Measure the voltage difference between $V_{th 11}$ and $V_{th 12}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 10}$ & $V_{th 11}$ ( $V_{th 10} - V_{th 11}$ ) | $\Delta V_{th 5}$  | Measure the voltage difference between $V_{th 10}$ and $V_{th 11}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 9}$ & $V_{th 10}$ ( $V_{th 9} - V_{th 10}$ )   | $\Delta V_{th 6}$  | Measure the voltage difference between $V_{th 9}$ and $V_{th 10}$   | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 8}$ & $V_{th 9}$ ( $V_{th 8} - V_{th 9}$ )     | $\Delta V_{th 7}$  | Measure the voltage difference between $V_{th 8}$ and $V_{th 9}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 7}$ & $V_{th 8}$ ( $V_{th 7} - V_{th 8}$ )     | $\Delta V_{th 8}$  | Measure the voltage difference between $V_{th 7}$ and $V_{th 8}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 6}$ & $V_{th 7}$ ( $V_{th 6} - V_{th 7}$ )     | $\Delta V_{th 9}$  | Measure the voltage difference between $V_{th 6}$ and $V_{th 7}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 5}$ & $V_{th 6}$ ( $V_{th 5} - V_{th 6}$ )     | $\Delta V_{th 10}$ | Measure the voltage difference between $V_{th 5}$ and $V_{th 6}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 4}$ & $V_{th 5}$ ( $V_{th 4} - V_{th 5}$ )     | $\Delta V_{th 11}$ | Measure the voltage difference between $V_{th 4}$ and $V_{th 5}$  | 0.225 | 0.250 | 0.275 | V       |
| Voltage Difference between $V_{th 3}$ & $V_{th 4}$ ( $V_{th 3} - V_{th 4}$ )     | $\Delta V_{th 12}$ | Measure the voltage difference between $V_{th 3}$ and $V_{th 4}$  | 0.225 | 0.250 | 0.275 | V       |
| Operating Current  | $I_{CC}$           | Measure pin-15 inflow current under 0V of $V_{in}$ at pin-2   | —     | 8.0   | 14.3  | mA      |
| Output High-Voltage of pin-n   | $V_{OH n}$         | $V_{CC} = 12$ , $n = 14$ to $3$<br>4.0V is supplied to pin-2 (input terminal) under $R_L = 2.0k\Omega$          | 7.7   | 9.5   | —     | V       |
| Output Leak Current of pin-n   | $I_{OL n}$         | $n = 14$ to $3$ , $V_{in}(\text{pin-2}) = 0V$   | —     | 0.01  | 2     | $\mu A$ |
| Pin-14 Output Low-Voltage under 3V supplying to pin-16 (Referent terminal)       | $V_{OL 14}$        | 3.0V is supplied to pin-2 (input terminal) under 3.0V supplying to pin-16 (referent terminal) $R_L = 56k\Omega$ | —     | 0.56  | 112   | mV      |
| Pin-3 Output High-Voltage under 3V supplying to pin-16 (Referent terminal)       | $V_{OH 3}$         | 7.0V is supplied to pin-2 (input terminal) under 3.0V supplying to pin-16 (referent terminal)                   | 16.0  | 17.3  | —     | V       |
| Pin-16 Outflow Current   | $I_L 16$           | Measure pin-16 (referent terminal) outflow current  | —     | 2     | —     | $\mu A$ |

Note) Unless otherwise specified, testing conditions are :  $V_{CC} = 18.0V$ ,  
 $R_L$  (Load Resistance at pins 3 to 14) =  $56k\Omega$ , pin-1 = GND.

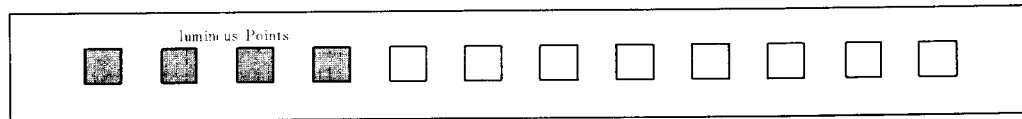
■ TEST CIRCUIT



Output Voltage vs. Input DC Voltage



Fluorescent Display Tube under 2V of Input Voltage



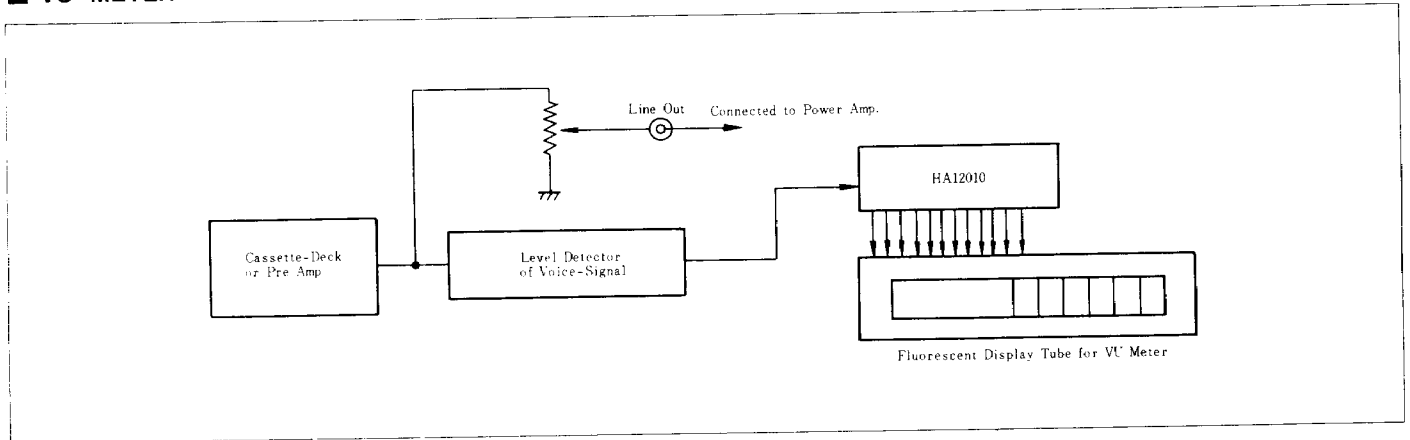
Fluorescent Display Tube under 1V of Input Voltage

HA12010 contains twelve voltage comparators as the diagram shows. Internal standard voltage which corresponds to each step is supplied to each comparator. When input DC voltage is higher than internal standard voltage, fluorescent display tube

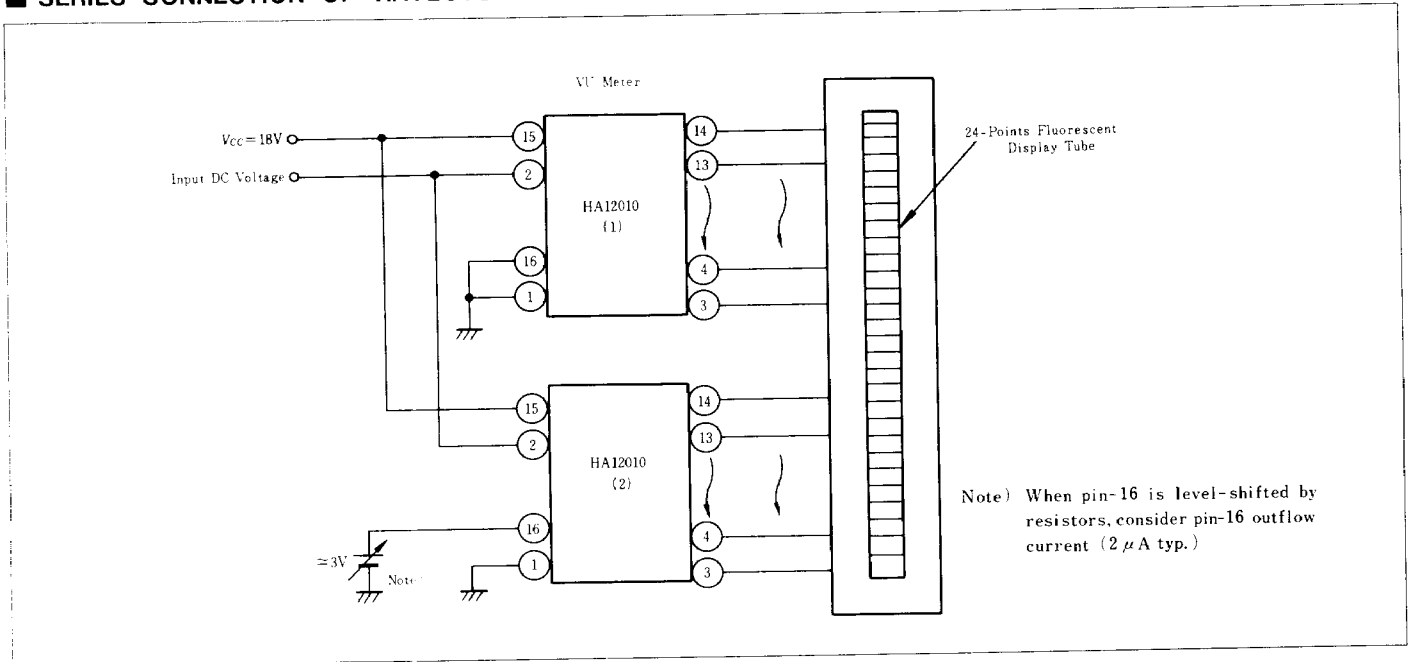
will operate with high level output of fluorescent display tube driver connected to voltage comparator output. For instance, fig. shows 'Output Voltage vs. Input DC Voltage'.



■ VU METER

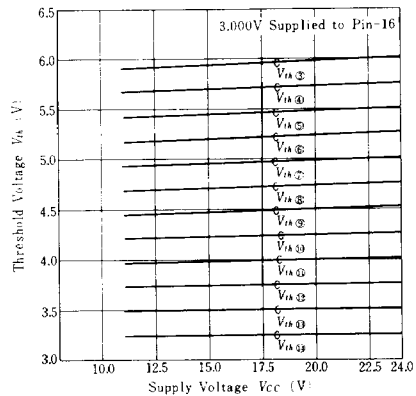
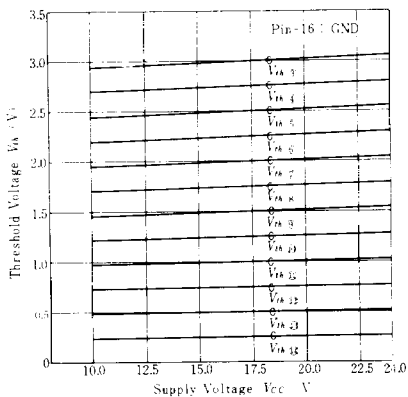


■ SERIES-CONNECTION OF HA12010

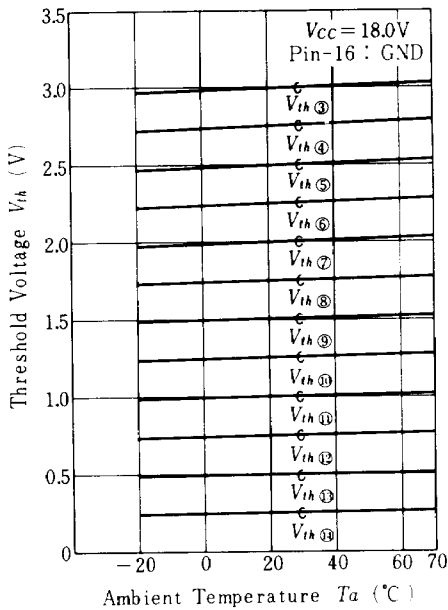


THRESHOLD VOLTAGE 14 TO 3 vs. SUPPLY VOLTAGE(1)

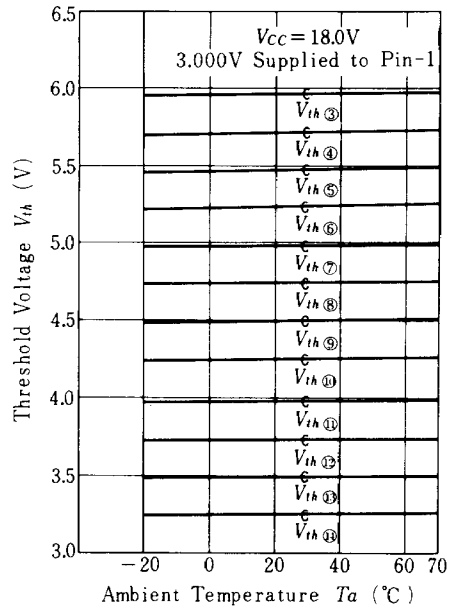
THRESHOLD VOLTAGE 14 TO 3 vs. SUPPLY VOLTAGE(2)



**THRESHOLD VOLTAGE 14 TO 3  
vs. AMBIENT TEMPERATURE(1)**



**THRESHOLD VOLTAGE 14 TO 3  
vs. AMBIENT TEMPERATURE(2)**



**OUTPUT HIGH-VOLTAGE  
& OPERATING CURRENT  
vs. AMBIENT TEMPERATURE**

