

16 Channel Constant  
current output LED Driver

# **LD71D0016**

**Data Sheet**

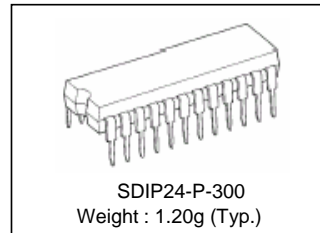
2004. 4

## DESCRIPTION

The LD71D0016 is specifically designed for LED and LED DISPLAY constant current drivers.

This constant current output circuit is able to set up external resistor (I<sub>OUT</sub> = 5mA to 90mA).

The devices consist of 16bit shift register, latch, and-gate and constant current driver.

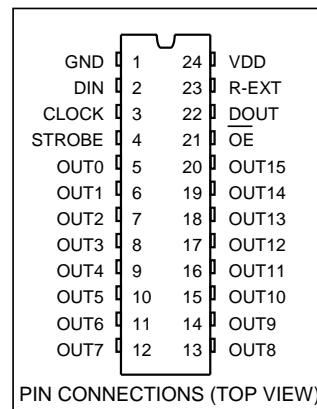


## FEATURES

- Output current : set-up at 5mA to 90mA with an external resistor
- A little change of output current

| OUT-GND VOLTAGE | A LITTLE CHANGE OF CHANNEL | I <sub>OUT</sub> (mA) |
|-----------------|----------------------------|-----------------------|
| ≥ 0.7V          | ± 6%                       | 5mA ~40mA             |
| ≥ 1.0V          |                            | 5mA ~90mA             |

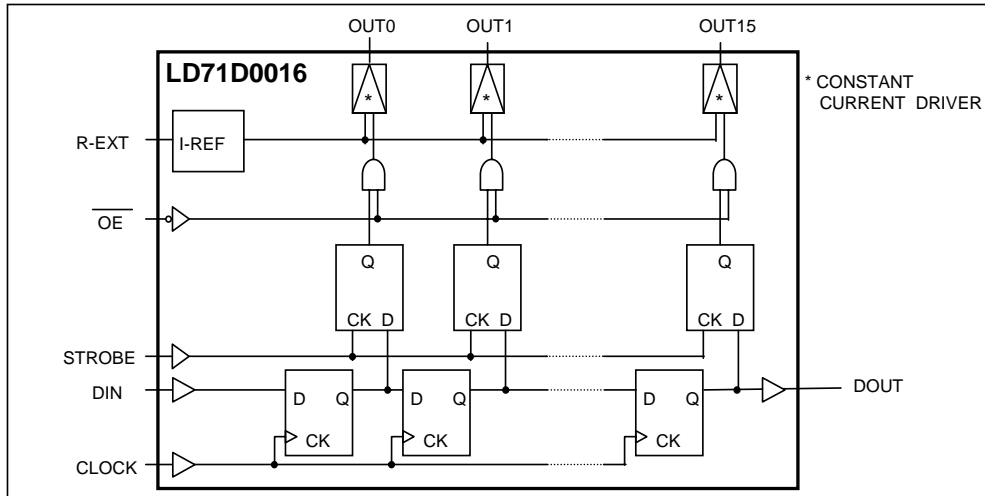
- 5V CMOS Compatible Input
- Package : SDIP-24, PDIP-24, SSOP-24, SOP-24
- Maximum Clock Frequency : f<sub>MAX</sub> = 25MHz



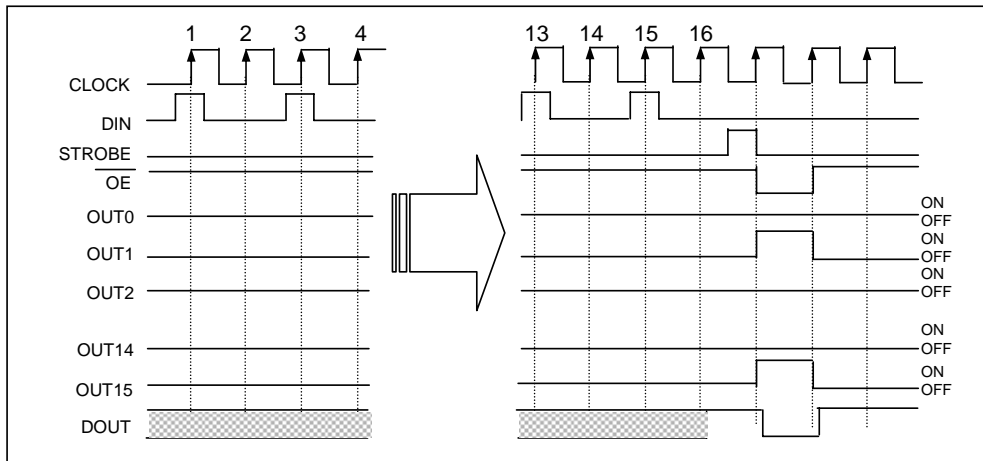
## PIN DESCRIPTION

| PIN NO.       | PIN NAME         | DESCRIPTION   |
|---------------|------------------|---|
| 1             | GND              | GND terminal for control logic driver   |
| 2             | DIN              | Serial data input terminal for shift register   |
| 3             | CLOCK            | Clock input terminal for data shift to up-edge  |
| 4             | STROBE           | "H" level : data through, "L" level : data hold   |
| 24            | VDD              | Supply voltage terminal   |
| 5-12<br>13-20 | OUT <sub>n</sub> | Output terminals  |
| 21            | OE               | "H" level output off, "L" level : latch data = "H" level then output on, latch data = "L" level then output off |
| 22            | DOUT             | Serial data output terminal for shift register  |
| 23            | R-EXT            | The resistor which connects between R-EXT and GND sets the constant output current.                             |

### BLOCK DIAGRAM



### TIMING DIAGRAM



### TRUTH TABLE

| INPUT |        |    |                | OUTPUT OUT <sub>n</sub> (t = n) |                  |                   |                   |
|-------|--------|----|----------------|---------------------------------|------------------|-------------------|-------------------|
| CLOCK | STROBE | OE | D <sub>n</sub> | OUT <sub>0</sub>                | OUT <sub>7</sub> | OUT <sub>15</sub> | DOUT              |
|       | H      | L  | D <sub>n</sub> | D <sub>n</sub>                  | D <sub>n-7</sub> | D <sub>n-15</sub> | D <sub>n-15</sub> |
|       | L      | L  | D <sub>n</sub> | No change                       |                  |                   | D <sub>n-15</sub> |
|       | *      | H  | D <sub>n</sub> | OFF                             | OFF              | OFF               | D <sub>n-15</sub> |
|       | *      | *  | D <sub>n</sub> | No change                       |                  |                   | No Change         |

(Note) D<sub>n</sub>-D<sub>n-15</sub> = "H" then OUT<sub>n</sub> is ON, "L" then OUT<sub>n</sub> is OFF

**ELECTRICAL CHARACTERISTICS****ABSOLUTE MAXIMUM RATINGS** (Ta = 25°C)

| PARAMETER             | SYMBOL           | RATING                    | UNIT |
|-----------------------|------------------|---------------------------|------|
| Supply Voltage        | V <sub>DD</sub>  | 0~7.0                     | V    |
| Output Voltage        | V <sub>OUT</sub> | -0.5~8.0                  | V    |
| Output current        | I <sub>OUT</sub> | 90                        | mA   |
| Input Voltage         | V <sub>IN</sub>  | -0.4~V <sub>DD</sub> +0.4 | V    |
| GND Terminal Current  | I <sub>GND</sub> | 1440                      | mA   |
| Clock Frequency       | f <sub>CK</sub>  | 25                        | MHz  |
| Power Dissipation     | P <sub>D</sub>   | 1.78                      | W    |
| Operating Temperature | T <sub>opr</sub> | -40~85                    | °C   |
| Storage Temperature   | T <sub>stg</sub> | -55~150                   | °C   |

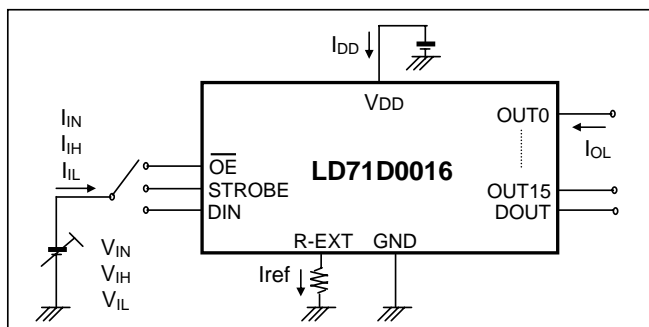
(Note ) Ambient temperature delated above 25°C in the proportion of 14.2mW/ °C

**RECOMMENDED OPERATING CONDITION** (Ta = 25°C unless otherwise noted)

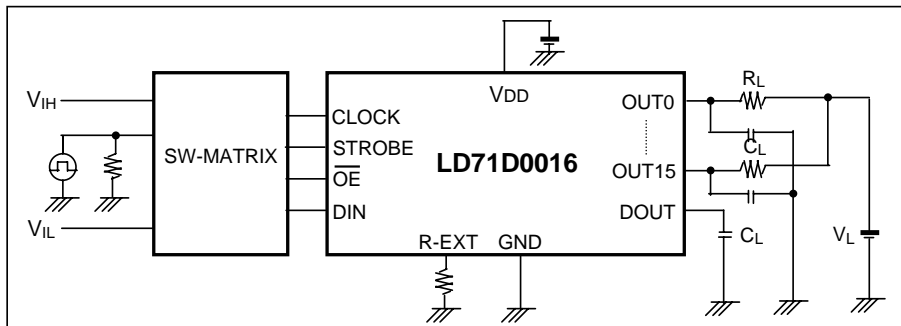
| PARAMETER          | SYMBOL                                 | CONDITION         | MIN. | TYP. | MAX.            | UNIT |
|--------------------|--|-------------------|------|------|-----------------|------|
| Supply Voltage     | V <sub>DD</sub>                        | -                 | 4.5  | 5.0  | 5.5             | V    |
| Output Voltage     | V <sub>OUT</sub>                       | -                 | -    | -    | 8.0             | -    |
| Output Voltage     | OUTn                                   | I <sub>OUT</sub>  | -    | -    | 90              | mA   |
|                    | DOUT                                   | I <sub>OH</sub>   | -    | -    | -1.0            |      |
|                    |  | I <sub>OL</sub>   | -    | -    | 1.0             |      |
| Input Voltage      | V <sub>IN</sub>                        | -                 | 0    | -    | V <sub>DD</sub> | V    |
| Data Set Up Time   | t <sub>setup</sub> (D)                 | -                 | 20   | -    | -               | ns   |
| Data Hold Time     | t <sub>hold</sub> (D)                  | -                 | 20   | -    | -               | ns   |
| STROBE Set UP Time | t <sub>setup</sub> (S)                 | -                 | 20   | -    | -               | ns   |
| STROBE Hold Time   | t <sub>hold</sub> (S)                  | -                 | 20   | -    | -               | ns   |
| Clock Pulse Width  | t <sub>w</sub> CLK                     | -                 | 15   | -    | -               | ns   |
|                    | t <sub>w</sub> $\overline{\text{CLK}}$ | -                 | 15   | -    | -               |      |
| Strobe Pulse Width | t <sub>w</sub> STB                     | -                 | 20   | -    | -               | ns   |
|                    | t <sub>w</sub> $\overline{\text{STB}}$ | -                 | 20   | -    | -               |      |
| Clock Pulse Width  | f <sub>CK</sub>                        | Cascade Operation | -    | -    | 25.0            | MHz  |
| Power Dissipation  | P <sub>D</sub>                         | Ta = 85°C         | -    | -    | 0.74            | W    |

**ELECTRICAL CHARACTERISTICS** ( $T_a = 25^\circ\text{C}$  unless otherwise noted) (continued)

| PARAMETER                 |           | SYMBOL                 | TEST CIRCUIT | TEST CONDITION   | MIN.        | TYP.      | MAX.        | UNIT          |
|---------------------------|-----------|------------------------|--------------|--|-------------|-----------|-------------|---------------|
| Input Voltage             | "H" Level | $V_{IH}$               | -            | -  | $0.7V_{DD}$ | -         | $V_{DD}$    | V             |
|                           | "L" Level | $V_{IL}$               | -            | -  | GND         | -         | $0.3V_{DD}$ |               |
| Output Leakage current    |           | $I_{OZ}$               | -            | $V_{OH} = 6.0V$  |             | -         | 1           | $\mu\text{A}$ |
| Output Voltage            | DOUT      | $V_{OL}$               | -            | -  | -           | -         | $0.2V_{DD}$ | V             |
|                           |           | $V_{OH}$               | -            | -  | $0.8V_{DD}$ | -         | -           |               |
| Output Current1           |           | $I_{OL1}$              | -            | $R_{EXT} = 14k$  | 37          | 40.0      | 43.0        | mA            |
| Delta IOUT                |           | $\Delta I_{OL1}$       | -            | $R_{EXT} = 14k$<br>$I_{OUT} = 40\text{mA}$ , $V_{OUT} = 1V$  | -           | $\pm 1.5$ | $\pm 6.0$   | %             |
| Output Current2           |           | $I_{OL2}$              | -            | $R_{EXT} = 7.0k$   | 70.0        | 75.0      | 80.0        | mA            |
| Delta IOUT                |           | $\Delta I_{OL2}$       | -            | $R_{EXT} = 7.0k$<br>$I_{OUT} = 75\text{mA}$ , $V_{OUT} = 1V$ | -           | $\pm 1.5$ | $\pm 6.0$   | %             |
| Supply Voltage Regulation |           | $\%V_{DD}$             | -            | $R_{EXT} = 14k$  | -           | 1.5       | 5.0         | $\%/V$        |
| Reference Voltage         |           | $V_{ref}$              | -            | $R_{EXT} = 14k$ , $T_a = -40\sim 85^\circ\text{C}$           | -           | 1.12      | -           | V             |
| Pull up resistor          |           | $R_{IN(up)}$           | -            | -  | 100         | 200       | 400         | kW            |
| Pull down resistor        |           | $R_{IN(down)}$         | -            | -  | 100         | 200       | 400         |               |
| Supply current            |           | $I_{DD}(\text{off}) 1$ | -            | $R_{EXT} = \text{OPEN}$ , $OUT_n = \text{OFF}$               | -           | 0.3       | 0.6         | mA            |
|                           |           | $I_{DD}(\text{off}) 2$ | -            | $R_{EXT} = 14k$ , $OUT_n = \text{OFF}$                       | 0.5         | 1.0       | 1.5         |               |
|                           |           | $I_{DD}(\text{off}) 3$ | -            | $R_{EXT} = 7.0k$ , $OUT_n = \text{OFF}$                      | 1.0         | 2.0       | 3.0         |               |

**DC CHARACTERISTIC TEST CIRCUIT**

## AC CHARACTERISTIC TEST CIRCUIT



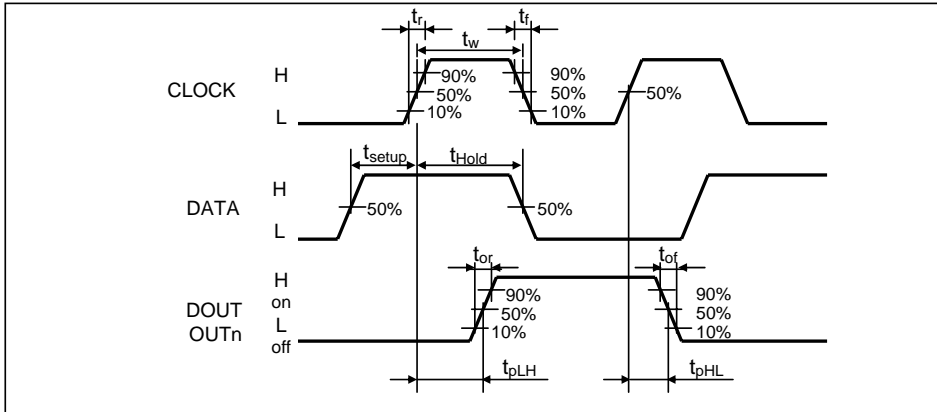
## SWITCHING CHARACTERISTICS (Ta = 25°C unless otherwise noted)

| PARAMETER                           |             | SYMBOL           | TEST CIRCUIT | TEST CONDITION  | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|-------------|------------------|--------------|---|------|------|------|------|
| Propagation Delay Time ("L" to "H") | CK-DOUT     | $t_{PLH}$        | -            | $V_{DD} = 5.0V$<br>$V_{OUT} = 1.0V$<br>$V_{IH} = V_{DD}$<br>$V_{IL} = GND$<br>$f_{CK} = 10MHz$<br>$R_{EXT} = 10k$<br>$I_{OUT} = 40mA$<br>$V_L = 3.0V$<br>$C_L = 10.0pF$<br>$R_L = 65$ | -    | 30   | 70   | ns   |
|                                     | CK-OUTn     |                  |              |   | -    | 600  | 1500 |      |
|                                     | STROBE-OUTn |                  |              |   | -    | 600  | 1500 |      |
|                                     | OE-OUTn     |                  |              |   | -    | 600  | 1500 |      |
| Propagation Delay Time ("H" to "L") | CK-DOUT     | $t_{PHL}$        | -            |   | -    | 30   | 70   | ns   |
|                                     | CK-OUTn     |                  |              |   | -    | 350  | 1000 |      |
|                                     | STROBE-OUTn |                  |              |   | -    | 350  | 1000 |      |
|                                     | OE-OUTn     |                  |              |   | -    | 350  | 1000 |      |
| Maximum Clock Frequency             |             | $f_{CKMAX} (*1)$ | -            |   | -    | 10   | 25   | MHz  |
| Propagation Delay Time ("H" to "L") | Clock       | $t_{WCK}$        | -            |   | -    | 20   | 50   | ns   |
|                                     | STROBE      | $t_{WSTB}$       | -            | -   | 10   | 40   |      |      |
| Data Set Up Time                    |             | $t_{setup(D)}$   | -            | -   | 10   | 30   | ns   |      |
| Data Hold Time                      |             | $t_{hold(D)}$    | -            | -   | 10   | 30   |      |      |
| STROBE Set up Time                  | LH          | $t_{STB\ setup}$ | -            | -   | 10   | 20   | ns   |      |
|                                     | HL          |                  |              | -   | 0    | 20   |      |      |
| STROBE Hold Time                    | LH          | $t_{STB\ hold}$  | -            | -   | 10   | 20   | ns   |      |
|                                     | HL          |                  |              | -   | 0    | 20   |      |      |
| Maximum Clock Rise Time             |             | $t_r$            | -            | -   | -    | 10   | ns   |      |
| Maximum Clock Fall Time             |             | $t_f$            | -            | -   | -    | 10   |      |      |
| Minimum Output Rise Time            |             | $t_{or}$         | -            | -   | 300  | 1000 | ns   |      |
| Minimum Output Rise Time            |             | $t_{of}$         | -            | -   | 150  | 600  |      |      |

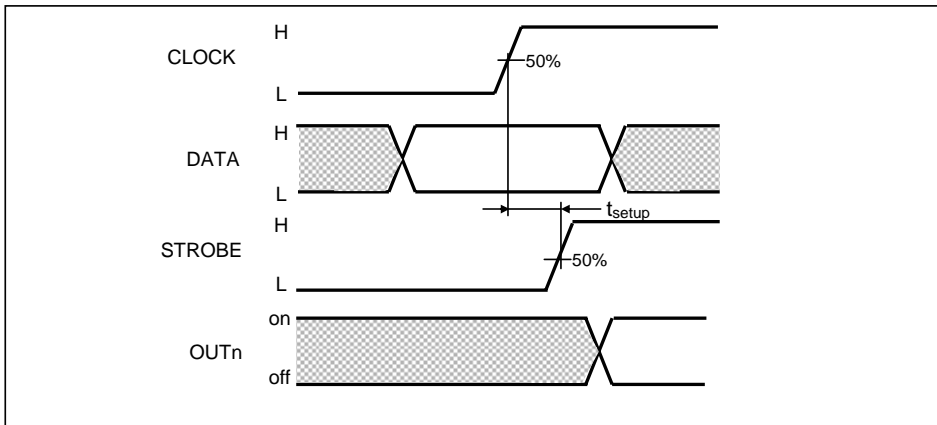
\*1 : Cascade Operation

## TIMING WAVE FORM

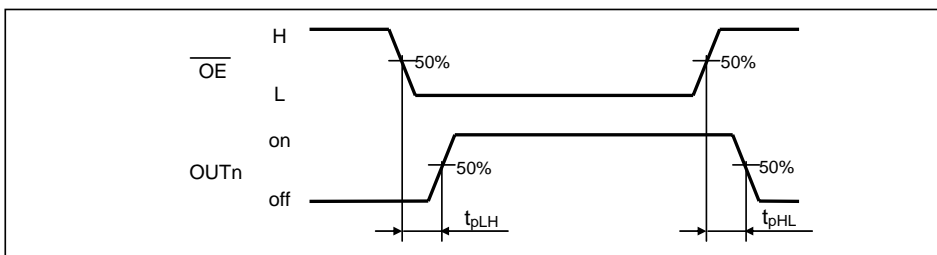
### CLOCK-DOUT, OUTn



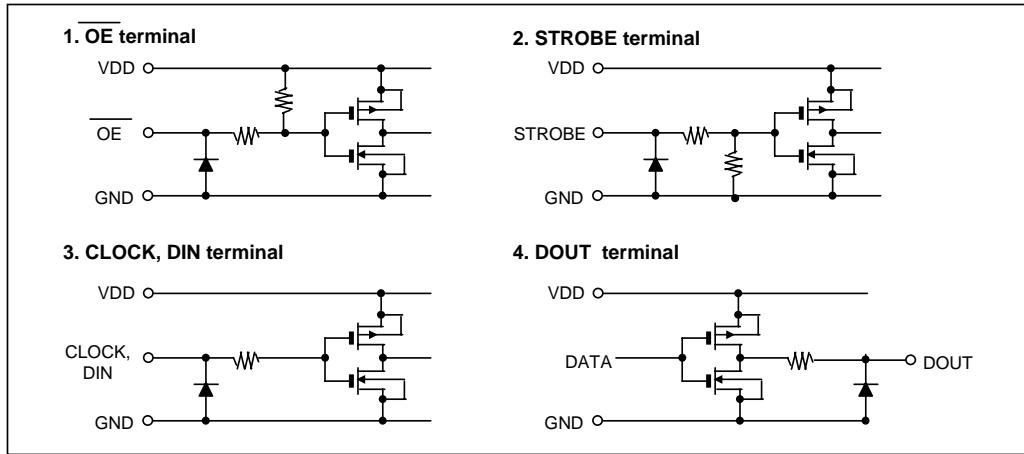
### CLOCK-STROBE



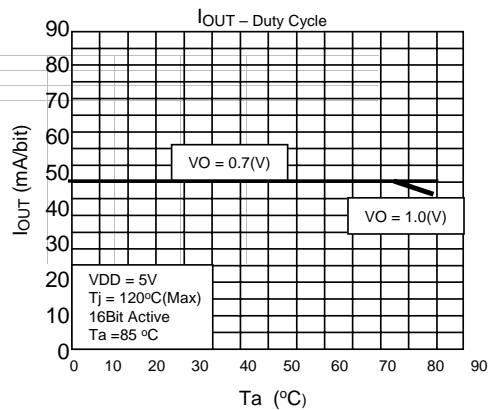
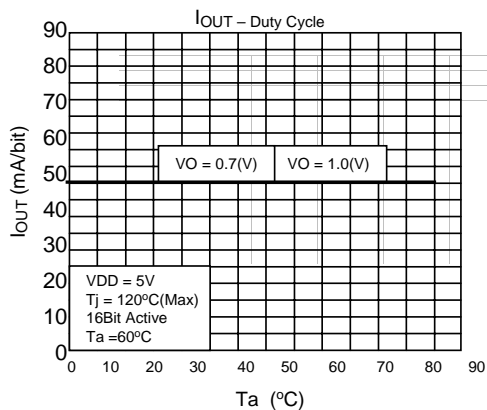
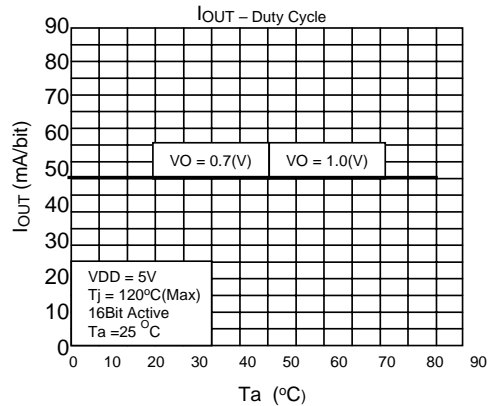
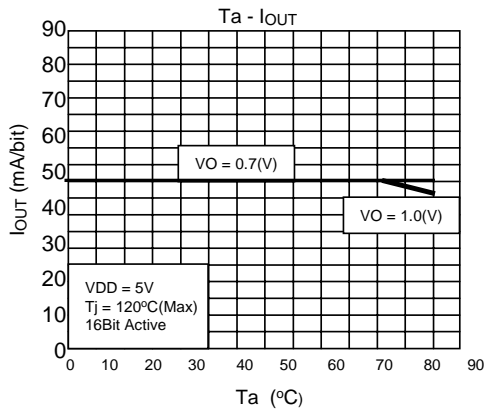
### $\overline{OE}$



## EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

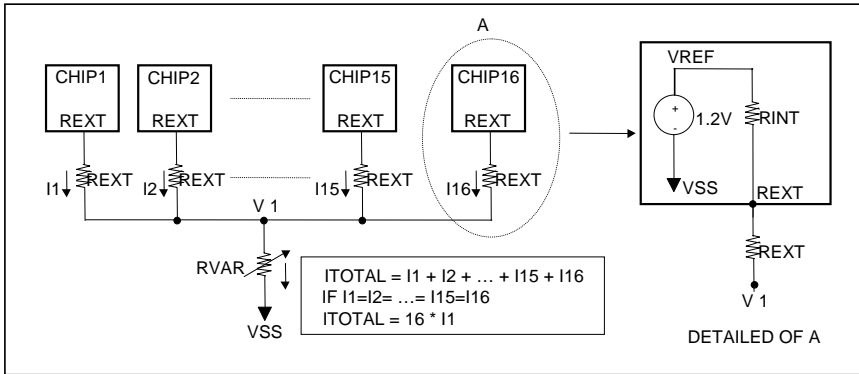


## OUTPUT CURRENT vs. AMBIENT TEMPERATURE





## OUTPUT CURRENT AND REXT



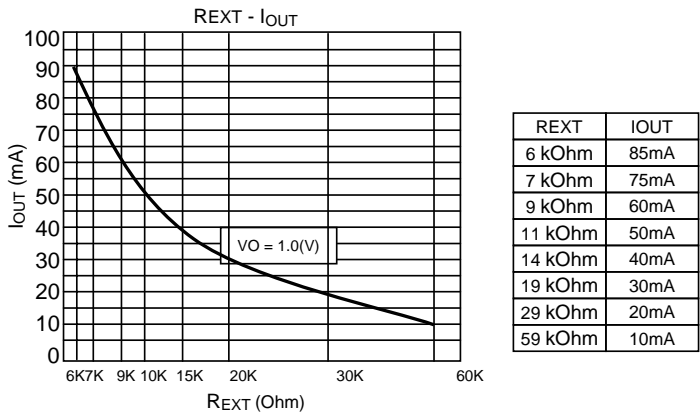
When RVAR is closing to 0 Ohm, the current through LED(ILED) reaches to maximum value then the Maximum Current Limitation(ILED\_MAX) value can be determined with REXT resistor. The LD71D0016 has RINT resistor(1 kOhm) internally to protect device from excessive current and RINT is connected to REXT port serially.

$$I_1 = (VREF - V1) / (RINT + REXT)$$

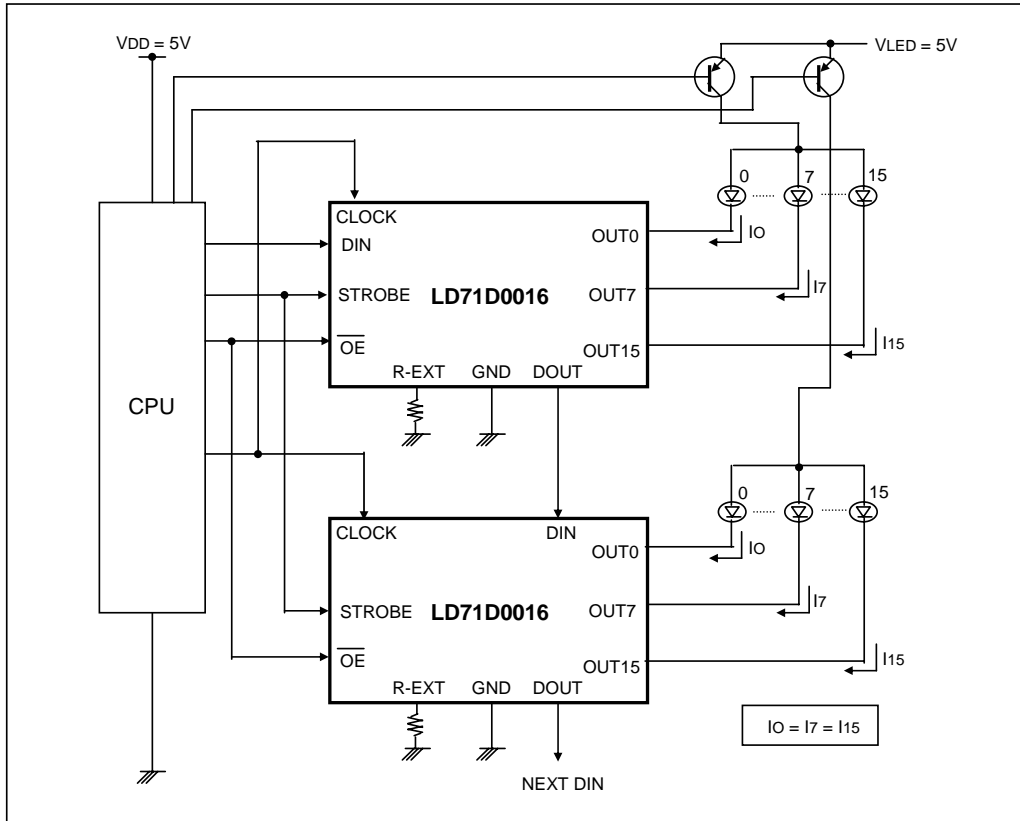
$$V1 = 16 * I_1 * RVAR = 16 * [(VREF - V1) / (RINT + REXT)] * RVAR$$

$$ILED = 500 * I_1 = 500 * (VREF - V1) / (RINT + REXT)$$

At RVAR is 0 Ohm(V1 voltage is 0 V), the ILED\_MAX value can be measured. Knowing the ILED\_MAX and ILED\_MIN, the REXT and the RVAR value are calculated using above formula and determined with taking the operating tolerance into considerations.

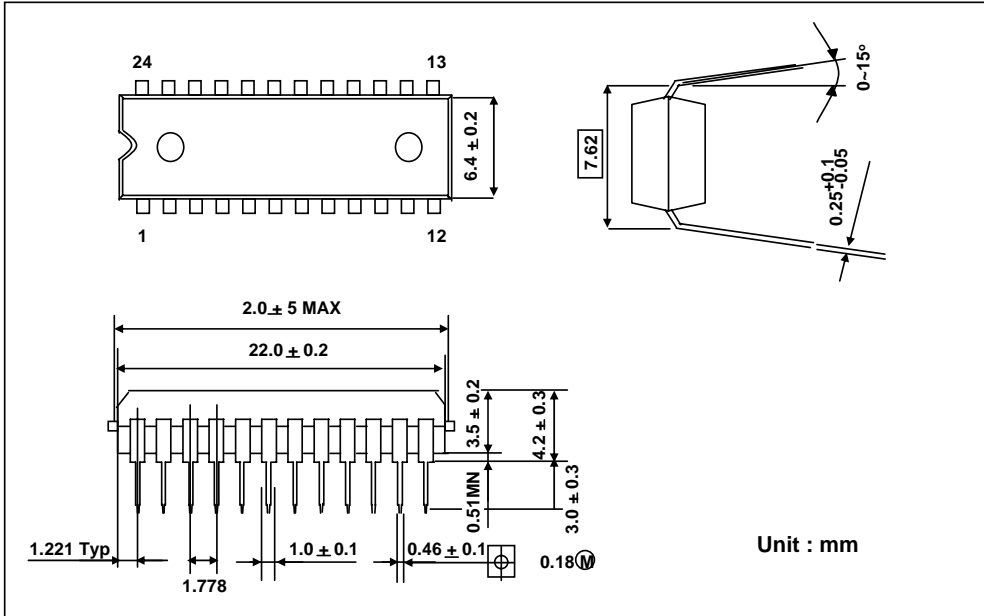


**TYPICAL APPLICATION**

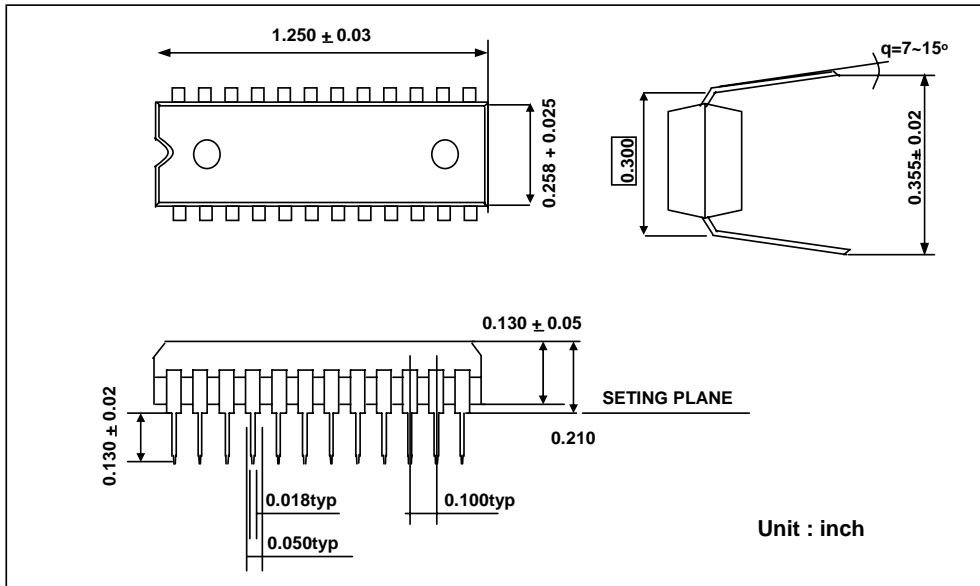


**PACKAGE INFORMATION**

**SDIP24-P-300-1.78**

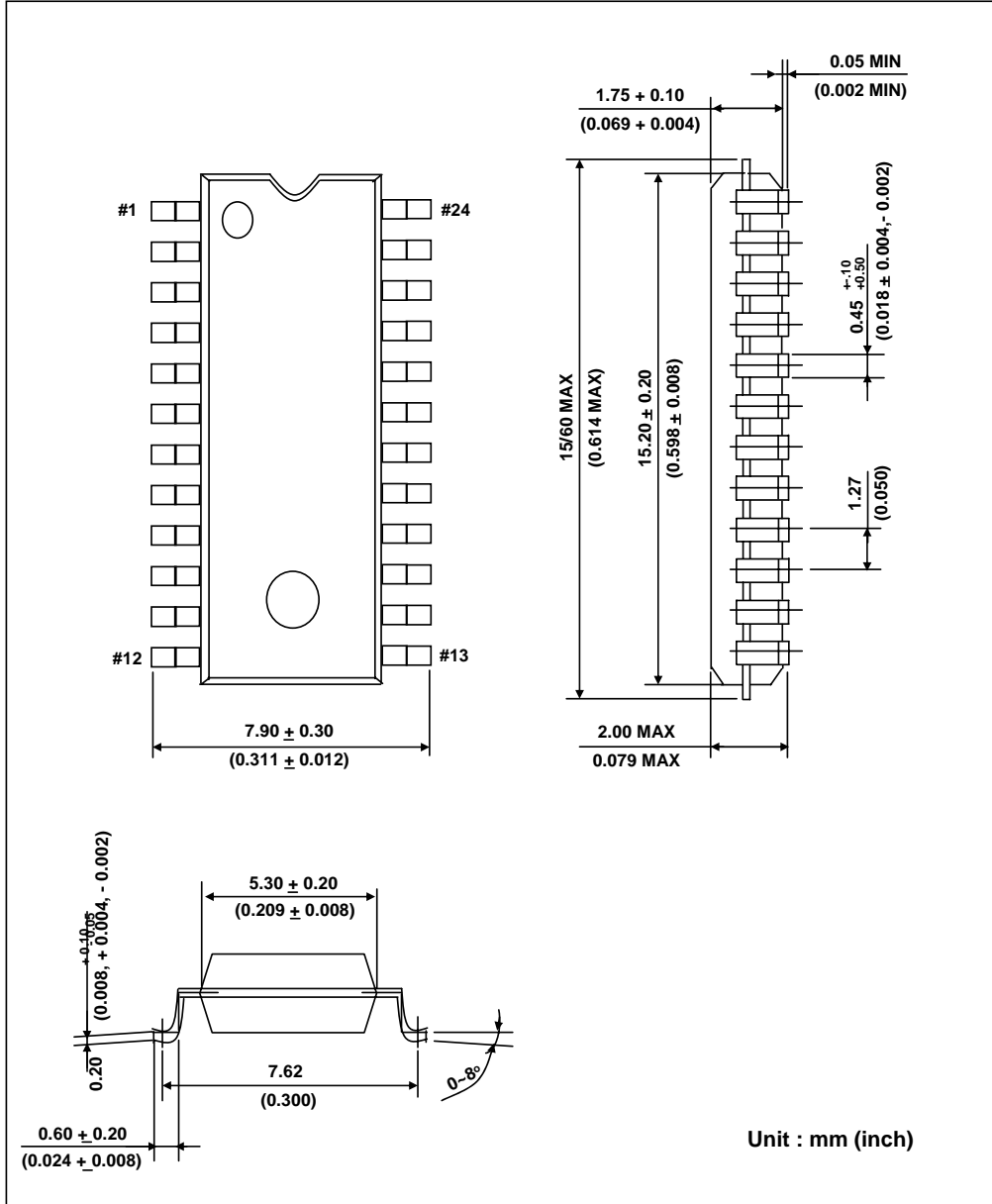


**P-DIP 24**



**PACKAGE INFORMATION** (continued)

**SSOP 24 - 300**



**PACKAGE INFORMATION** (continued)

**SOP 24**

