**3-ch Constant-Current LED Drivers**

## FEATURES

- Up to 45mA LED Bias Current
- 6% LED Current Matching
- Simple LED Brightness Control
- 5V to 8V Supply Voltage Range
- Serial in Data Clock Frequency : 25MHz
- PWM Output Current Control
- Build in Thermal Protect 160 °C
- SOP-16 Package and Lead-free

## Applications

- LED/Display Back Light Driver
- Lightings
- LED Decorative Lighting

## GENERAL DESCRIPTION

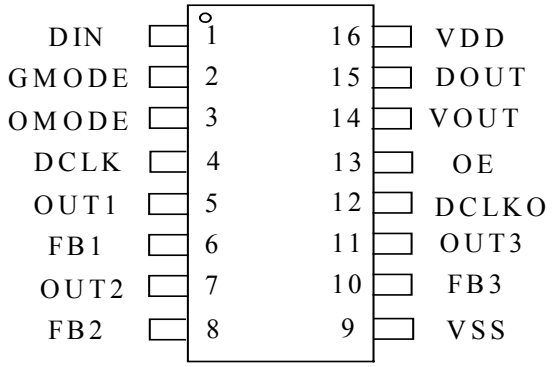
The T6506A is a 3-channel constant current LED drivers. The T6506A uses external resistors to set the output current for LEDs, which are matched to 6%. much lower bias variation with supply voltage variation, significantly lower dropout voltage, and in some applications, significantly improved efficiency.

The T6506A built in oscillator for PWM functioning, data and clock buffer output for cascading and data to next driver.

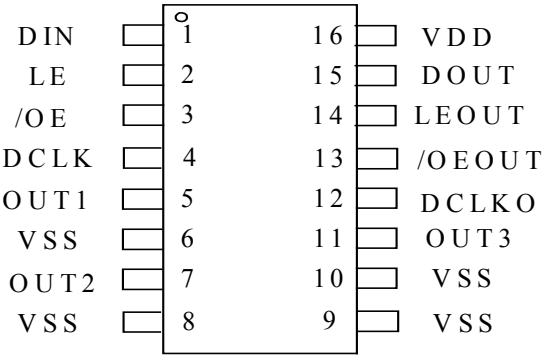
## PART NUMBER EXAMPLES

| PART NO. | Control mode | PACKAGE |
|---|---|---|
| T6506A-ADG | Mode1 | SOP-16 lead-free |
| T6506A-BDG | Mode2 | SOP-16 lead-free |

## PIN ARRANGEMENT
**(Top view)**SOP-16




mode1




mode2

## PIN DESCRIPTION

| SYMBOL | Pin no. | | DESCRIPTION |
|---|---|---|---|
| | Mode1 | Mode2 | |
| DIN | 1 | 1 | Serial data input, internal pull high |
| GMODE | 2 | | gray level adjustment, "1"=Linear modulation, "0"= 256 level none Linear modulation, internal pull high |
| LE | | 2 | Leach data, hight active |
| OMODE | 3 | | Output control mode, "1"= internal output constant voltage/current mode, "0"= external resistors set current mode, internal pull high |
| /OE | | 3 | Output enable, low active |
| DCLK | 4 | 4 | Serial clock input, internal pull high |
| OUT1 | 5 | 5 | Output port 1 |
| FB1 | 6 | | Output port 1 constant voltage/current mode, or external set resistors terminal |
| OUT2 | 7 | 7 | Output port 2 |
| FB2 | 8 | | Output port 2 constant voltage/current mode, or external set resistors terminal |
| VSS | 9 | 6,8,9,10 | ground |
| FB3 | 10 | | Output port 3 constant voltage/current mode, or external set resistors terminal |
| OUT3 | 11 | 11 | Output port 3 |
| DCLKO | 12 | 12 | Serial clock output |
| EN | 13 | | Chip enable, hight active |
| /OEOUT | | 13 | Output enable signle output, low active |
| VOUT | 14 | | 5V output, if VDD>5V, output=5V. if VDD<5V, output=VDD. Also is internal operation voltage, Suggestion connected a 0.1uF capacitor to ground. |
| LEOUT | | 14 | Leach data signle output |
| DOUT | 15 | 15 | Serial data output |
| VDD | 16 | 16 | Power supply |

## ABSOLUTE MAXIMUM RATINGS

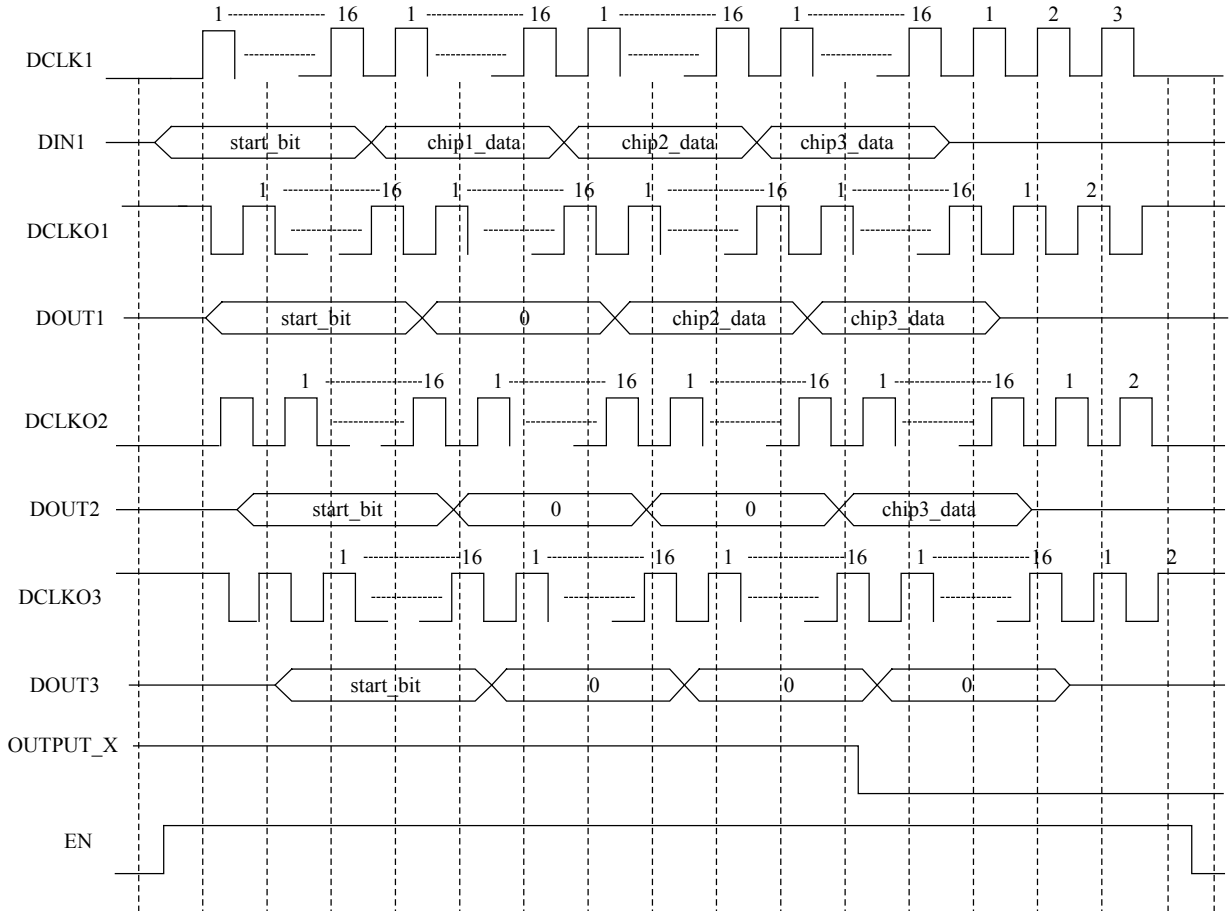
| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Voltage on any pin relative to GND | $V_{IN}$ | -0.3 to 8 | V |
| Operating Temperature Rang | $T_A$ | -40 to +85 | °C |
| Maximum Soldering Temperature (at leads, 10 sec) | $T_{LEAD}$ | 300 | °C |
| Storage Temperature Rang | $T_S$ | -65 to +150 | °C |
| Continuous Power Dissipation ( $T_A$ = +70°C ) | | 0.6 | W |

## Electrical Characteristics

(TA = -40 to 85°C unless otherwise noted. Typical values are at TA =25°C, VEN =3.3V, VOUT1 = VOUT2= VOUT3= 1V)

| Symbol | Description | Conditions | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Operating voltage range | | 5 | - | 7.5 | V |
| $V_{OUT}$ | $V_{OUT}$ output voltage | | 4.75 | 5 | 5.25 | V |
| $V_{OUTX}$ | LED output ports voltage | | - | - | 12 | V |
| $V_{IH}$ | Input voltage high level | | 2.0 | - | - | V |
| $V_{IL}$ | Input voltage low level | | - | - | 0.6 | V |
| $I_{LED}$ | Maximum LED sink current | constant voltage | - | - | 45 | mA |
| | | constant current | - | - | 30 | mA |
| $I_{DD}$ | Operating voltage current | | - | 1.5 | - | mA |
| $I_{OSH}$ | Serial data output high current | | - | - | 1.5 | mA |
| $I_{OSL}$ | Serial data output low current | | - | - | -10 | mA |
| $F_{CLK}$ | Input data clock frequency | | 0 | - | 25 | MHz |
| $t_{CKHW}$ | Clock high pulse width | | 30 | - | - | ns |
| $t_{CKLW}$ | Clock low pulse width | | 30 | - | - | ns |
| $t_{DS}$ | Input data setup time | | 10 | - | - | ns |
| $t_{HS}$ | Input data hold time | $C_L$=30pF, $R_L$=1K | 5 | - | - | ns |
| $t_{DONF}$ | Serial data output ON/OFF time | $I_{OUT}$=20mA | - | - | 80 | ns |
| $t_{PO}$ | PWM output ON pulse width | $I_{OUT}$=20mA | - | - | 200 | ns |

## Control mode 1 Timming Waveform (3 series connection IC)




notes :
1.DCLK and DCLKO is inverse.
2.start_bits is 16 bits Length "0"
3.Data Format:
The total data is 16 bits :

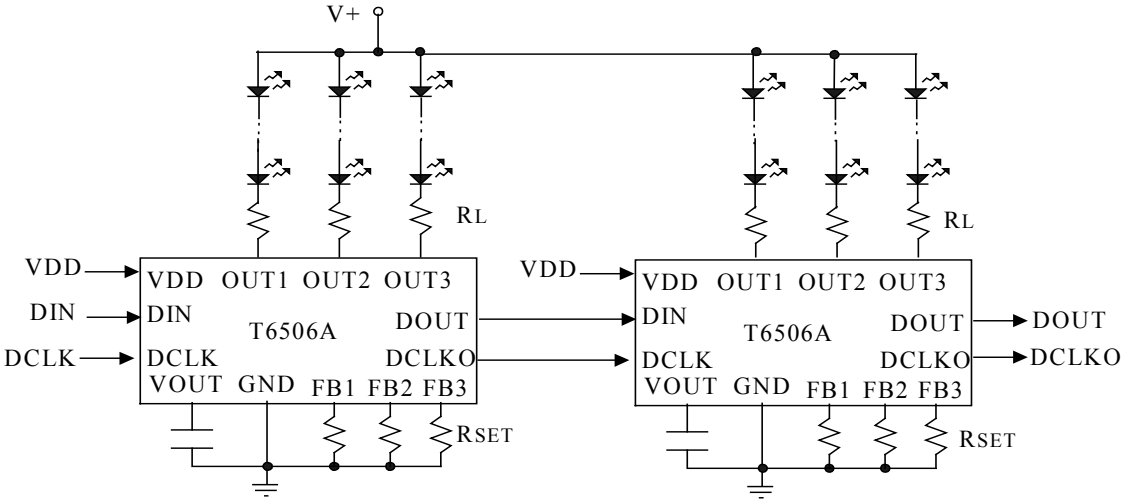
| bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F1 | Channel 1 data | | | | | Channel 2 data | | | | | Channel 3 data | | | | |

If after receives the 16bits length "0" start_bit, if has receives 1 bit again"0", pass through to output. if has receives 1 bit again "1", then regards as "F1", The "F1" bit0 is "1", leach follow the 15bits data, after "F1" and 15bits data all change to "0", then pass through 16 bits "0" data to output.

The channel data 00000~11111, May use Gmode pin control the 5bits value transformation to the 8bits inverse-gama value (256 steps), or the 7bits linear value(128 steps), again has the output afterwards by PWM.

## Control mode 1 Typical Application Circuits

**Internal constant current mode:**




This mode (OMODE= hight or floating) $I_{OUT} \approx 0.7V/R_{SET}$, The output voltage must be able to maintain constant current the condition between 1.1~6V.

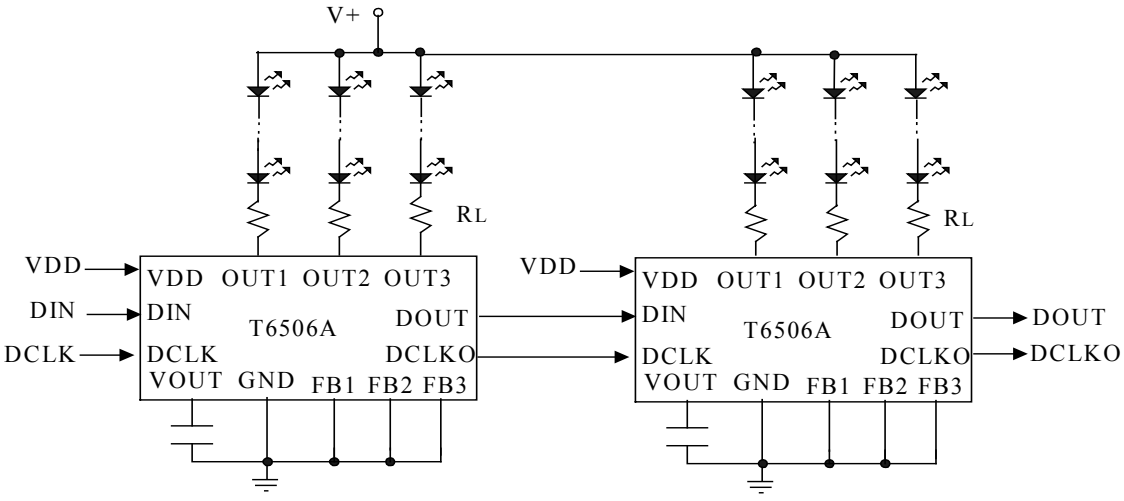
For condition example :

$V_{LED}+6V+I_{LED}*R_L \geq V+ \geq V_{LED}+1.1V+I_{LED}*R_L$

Maximum power consumed:

$P_D=I_{LED1}*(V_{OUT1}-0.7V)+ I_{LED2}*(V_{OUT2}-0.7V)+ I_{LED3}*(V_{OUT3}-0.7V)+ P_{IC}$

**Internal constant voltage mode :**

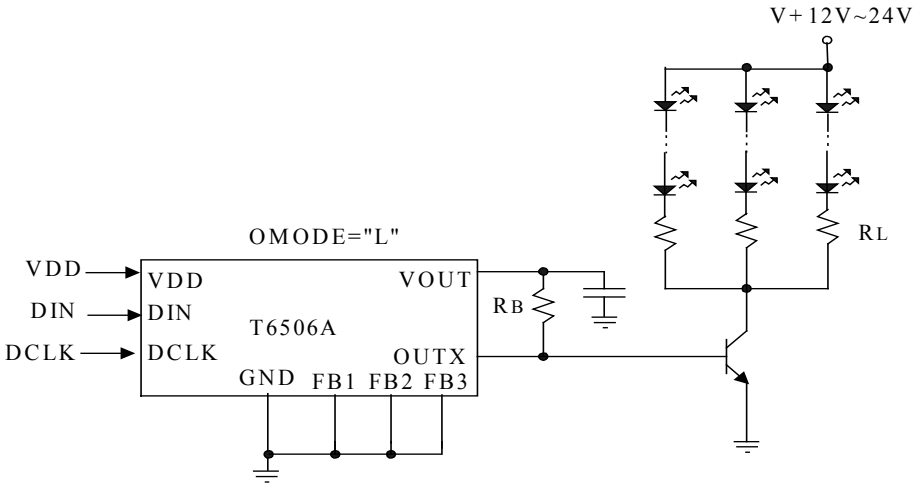



this mode (OMODE= hight or floating) $RL=(V+ - V_{LED} - V_{OUTX})/I_{LED}$

Maximum power consumed:

$P_D=I_{LED1}*V_{OUT1}+ I_{LED2}*V_{OUT2}+ I_{LED3}*V_{OUT3}+ P_{IC}$

**External constant voltage mode**

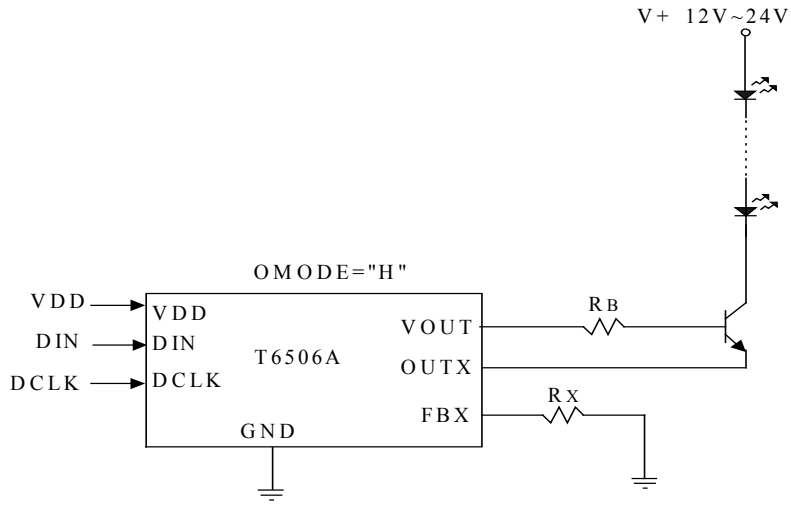



This mode is suitable for many LED or a higher voltage situation, is in fact the NPN transistor by the OUTX output voltage control more LED.
RL Resistance calculational avenue :

$R_L=(V+ - V_{LED} - V_{CE})/ 20mA$

Generally $V_{CE}$ = 0.5V~0.8V, $R_B$ = 2K~5K

**External constant current mode**

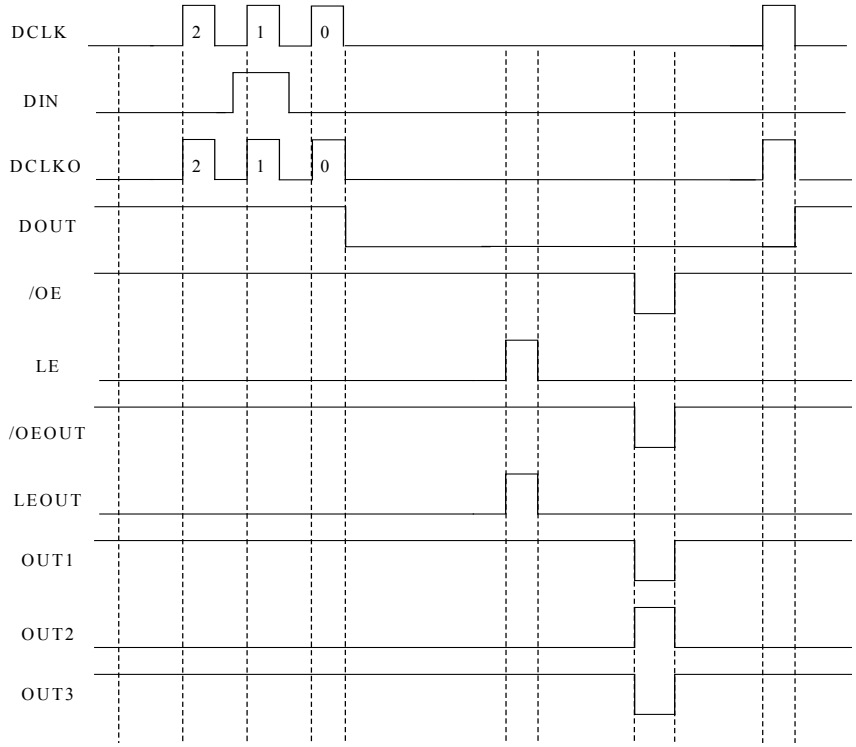



This mode is suitable to single series connects many LED , also V+ is over than 12V the situation, besides constant current and the augment driving with transistor
ILED current calculational avenue :

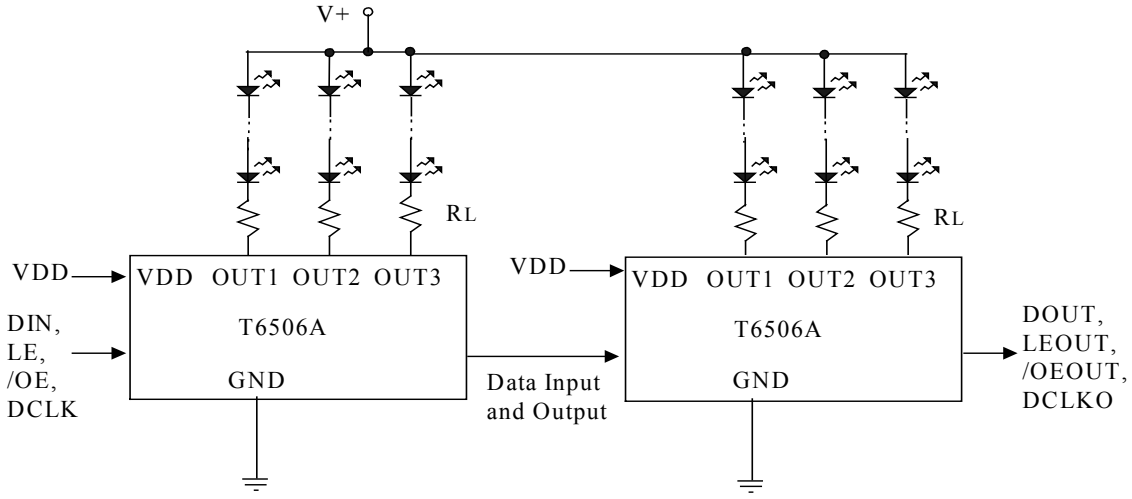
$I_{LED} = I_O * \beta / (\beta +1)$

The β is multiple which transistor enlargement, when β is bigger, the previous close to $I_{LED} = I_O$ with RB=5K.

## Control mode 2 Timming Waveform




## Control mode 2 Typical Application Circuits




RL=(V+ - VLED - VOUTX)/ILED

## PWM Duty Comparative table

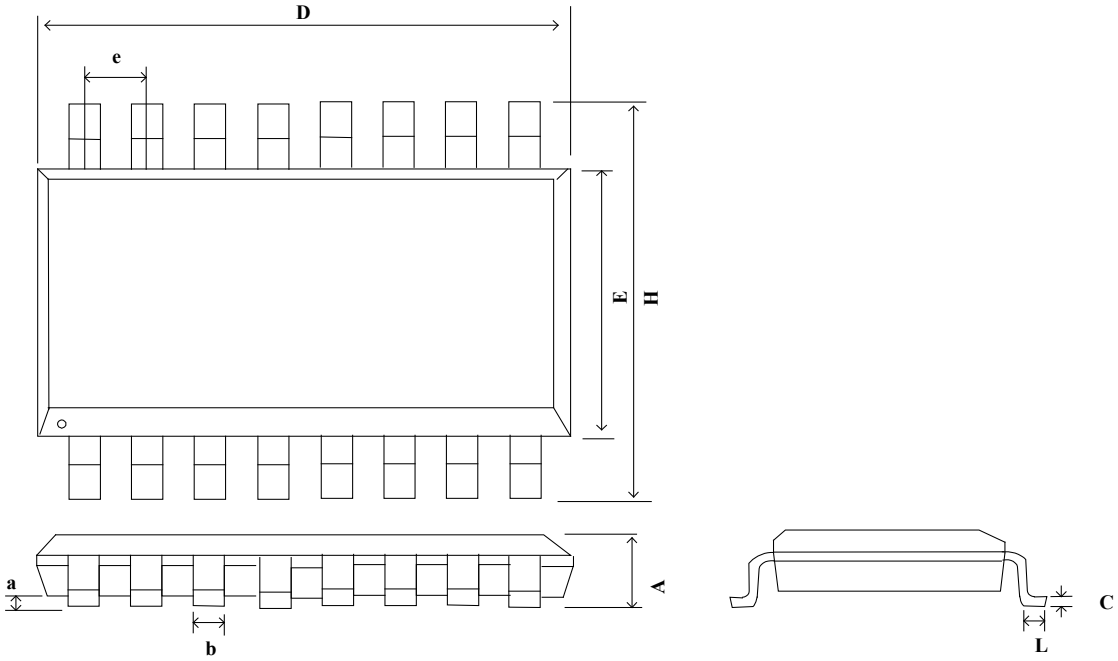
Non-linear gray level
(Correspondence with GAMMA=1.8, GMODE=0)

| Input data | Output Duty Ratio (unit:1/256) |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | 3 |
| 3 | 5 |
| 4 | 8 |
| 5 | 12 |
| 6 | 16 |
| 7 | 21 |
| 8 | 26 |
| 9 | 32 |
| 10 | 38 |
| 11 | 45 |
| 12 | 52 |
| 13 | 60 |
| 14 | 68 |
| 15 | 76 |
| 16 | 85 |
| 17 | 95 |
| 18 | 105 |
| 19 | 115 |
| 20 | 125 |
| 21 | 136 |
| 22 | 148 |
| 23 | 160 |
| 24 | 172 |
| 25 | 185 |
| 26 | 198 |
| 27 | 211 |
| 28 | 225 |
| 29 | 239 |
| 30 | 254 |
| 31 | 256 |

Linear gray level
(Correspondence with GMODE=1 )

| Input data | Output Duty Ratio (unit:1/128) |
|---|---|
| 0 | 0 |
| 1 | 4 |
| 2 | 8 |
| 3 | 12 |
| 4 | 16 |
| 5 | 20 |
| 6 | 24 |
| 7 | 28 |
| 8 | 32 |
| 9 | 36 |
| 10 | 40 |
| 11 | 44 |
| 12 | 48 |
| 13 | 52 |
| 14 | 56 |
| 15 | 60 |
| 16 | 64 |
| 17 | 68 |
| 18 | 72 |
| 19 | 76 |
| 20 | 80 |
| 21 | 84 |
| 22 | 88 |
| 23 | 92 |
| 24 | 96 |
| 25 | 100 |
| 26 | 104 |
| 27 | 108 |
| 28 | 112 |
| 29 | 116 |
| 30 | 120 |
| 31 | 128 |

## PACKAGE DIMENSIONS
## 16-LEAD SOP




| Symbol | Dimension in mm | | | Dimension in inch | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | - | 1.75 | - | - | 0.069 | - |
| a | - | 0.25 | - | - | 0.010 | - |
| b | 0.36 | - | 0.49 | 0.014 | - | 0.019 |
| C | 0.19 | - | 0.25 | 0.007 | - | 0.010 |
| D | 9.8 | - | 10 | 0.386 | - | 0.394 |
| E | 3.8 | - | 4.0 | 0.150 | - | 0.157 |
| e | - | 1.27 | - | - | 0.050 | - |
| L | 0.4 | - | 1.0 | 0.016 | - | 0.039 |