# 8-Bit Serial Input Constant-Current Latched LED Driver

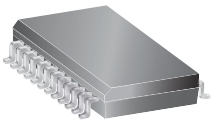
## Features and Benefits

- Up to 150 mA constant-current outputs
- Undervoltage lockout
- Low-power CMOS logic and latches
- High data input rate
- Similar to Toshiba TD62715FN
- High/low output current function
- Digital dimming control

## Packages

20-pin DIP
(A package)

20-pin SOICW
(LW package)



*Not to scale*

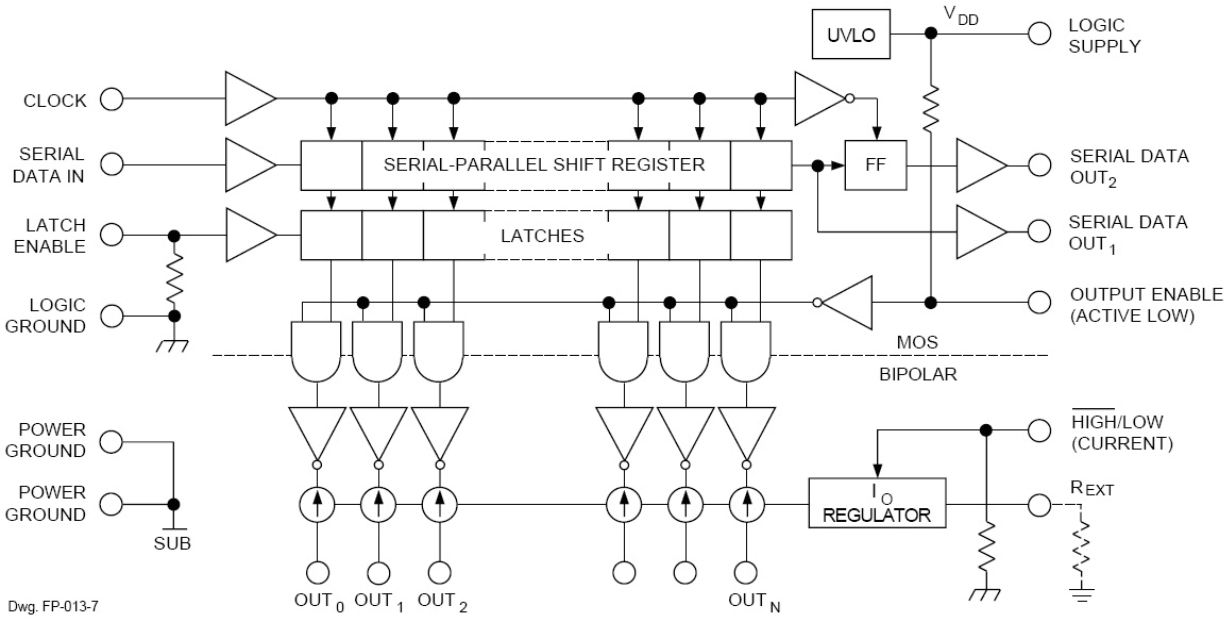
## Description

The A6277 is specifically designed for LED display applications. Each BiCMOS device includes an 8-bit CMOS shift register, accompanying data latches, and eight NPN constant-current sink drivers. Two package styles and two operating temperature ranges are available.

The CMOS shift register and latches allow direct interfacing with microprocessor-based systems. With a 5 V logic supply, typical serial data-input rates are up to 20 MHz. The LED drive current is determined by the user selection of a single resistor. A CMOS serial data output permits cascade connections in applications requiring additional drive lines. For inter-digit blanking, all output drivers can be disabled with an ENABLE input high. In addition, a HIGH/LOW function enables full selected current with the application of a logic low, or 50% selected current with the application of a logic high.

Two package styles are provided, a through-hole DIP (suffix A), and a surface-mount SOIC (LW). The copper leadframe and low logic-power dissipation allow the DIP to sink 122 mA through all outputs continuously over the operating temperature range (1.0 V drop, 85°C). Both packages are lead (Pb) free, with 100% matte-tin leadframe plating.

## Functional Block Diagram



## Selection Guide

| Part Number | Packing | Package |
|---|---|---|
| ~~A6277EA-T*~~ | 20-pin DIP | 18 per tube |
| A6277ELWTR-T | 20-pin SOICW | 1000 per reel |

*Variant is in production but has been determined to be LAST TIME BUY. This classification indicates that the variant is obsolete and notice has been given. Sale of the variant is currently restricted to existing customer applications. The variant should not be purchased for new design applications because of obsolescence in the near future. Samples are no longer available. Status date change November 2, 2009. Deadline for receipt of LAST TIME BUY orders is April 30, 2010.

## Absolute Maximum Ratings*

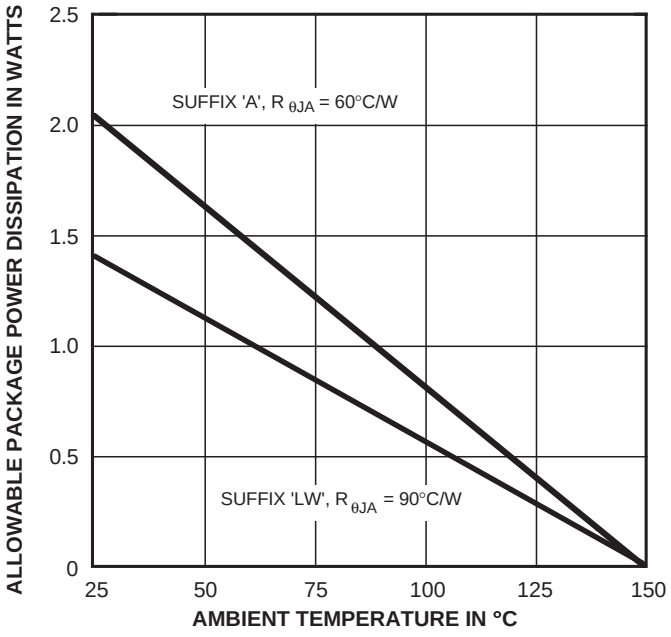
| Characteristic | Symbol | Notes | Rating | Units |
|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | | 7.0 | V |
| Output Voltage Range | $V_O$ | | –0.5 to 24 | V |
| Input Voltage Voltage | $V_I$ | | –0.4 to $V_{DD}$ + 0.4 | V |
| Output Current | $I_O$ | | 150 | mA |
| Operating Ambient Temperature | $T_A$ | Range E | –40 to 85 | ºC |
| Maximum Junction Temperature | $T_J$(max) | | 150 | ºC |
| Storage Temperature | $T_{stg}$ | | –55 to 150 | ºC |

* Caution: These CMOS devices have input static protection (Class 2) but are still susceptible to damage if exposed to extremely high static electrical charges.

**Thermal Characteristics** may require derating at maximum conditions, see application information

| Characteristic | Symbol | Test Conditions* | Value | Units |
|---|---|---|---|---|
| Package Thermal Resistance | $R_{\theta JA}$ | Package A, on 1-layer PCB | 60 | ºC/W |
| | | Package LW, 1-layer PCB | 90 | ºC/W |

*Additional thermal information available on the Allegro website.



**ELECTRICAL CHARACTERISTICS at $T_A$ = +25°C, $V_{H/L}$ = $V_{DD}$ = 5 V (unless otherwise noted).**

| Characteristic | Symbol | Test Conditions | Limits | | | |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Unit |
| Supply Voltage Range | $V_{DD}$ | Operating | 4.5 | 5.0 | 5.5 | V |
| Under-Voltage Lockout | $V_{DD(UV)}$ | $V_{DD}$ = 0 to 5 V | 3.4 | – | 4.0 | V |
| Output Current (any single output) | $I_O$ | $V_{CE}$ = 1.0 V, $R_{EXT}$ = 160 Ω | 100 | 120 | 140 | mA |
| | | $V_{CE}$ = 0.4 V, $R_{EXT}$ = 470 Ω | 34 | 42 | 48 | mA |
| Output Current Matching (difference between any two outputs at same $V_{CE}$) | $\Delta I_O$ | 0.4 V ≤ $V_{CE(A)}$ = $V_{CE(B)}$ ≤ 1.0 V: | | | | |
| | | $R_{EXT}$ = 160 Ω | – | ±1.5 | ±6.0 | % |
| | | $R_{EXT}$ = 470 Ω | – | ±1.5 | ±6.0 | % |
| Output Leakage Current | $I_{CEX}$ | $V_{OH}$ = 20 V | – | 1.0 | 5.0 | µA |
| Logic Input Voltage | $V_{IH}$ | | 0.7$V_{DD}$ | – | – | V |
| | $V_{IL}$ | | – | – | 0.3$V_{DD}$ | V |
| SERIAL DATA OUT Voltage ($SDO_1$ & $SDO_2$) | $V_{OL}$ | $I_{OL}$ = 1.0 mA | – | – | 0.4 | V |
| | $V_{OH}$ | $I_{OH}$ = -1.0 mA | 4.6 | – | – | V |
| Input Resistance | $R_I$ | ENABLE input, pull up | 150 | 300 | 600 | kΩ |
| | | LATCH & $\overline{\text{HIGH}}$/LOW inputs, pull down | 100 | 270 | 400 | kΩ |
| Supply Current | $I_{DD(OFF)}$ | $R_{EXT}$ = open, $V_{OE}$ = 5 V | – | 0.8 | 1.6 | mA |
| | | $R_{EXT}$ = 470 Ω, $V_{OE}$ = 5 V | 3.5 | 6.5 | 9.5 | mA |
| | | $R_{EXT}$ = 160 Ω, $V_{OE}$ = 5 V | 14 | 17 | 22 | mA |
| | $I_{DD(ON)}$ | $R_{EXT}$ = 470 Ω, $V_{OE}$ = 0 V | 5.0 | 10 | 15 | mA |
| | | $R_{EXT}$ = 160 Ω, $V_{OE}$ = 0 V | 20 | 27 | 40 | mA |

Typical Data is at $V_{DD}$ = 5 V and is for design information only.

**SWITCHING CHARACTERISTICS at $T_A$ = 25°C, $V_{DD}$ = $V_{IH}$ = 5 V, $V_{CE}$ = 0.4 V, $V_{IL}$ = 0 V, $R_{EXT}$ = 470 Ω, $I_O$ = 40 mA, $V_L$ = 3 V, $R_L$ = 65 Ω, $C_L$ = 10.5 pF.**

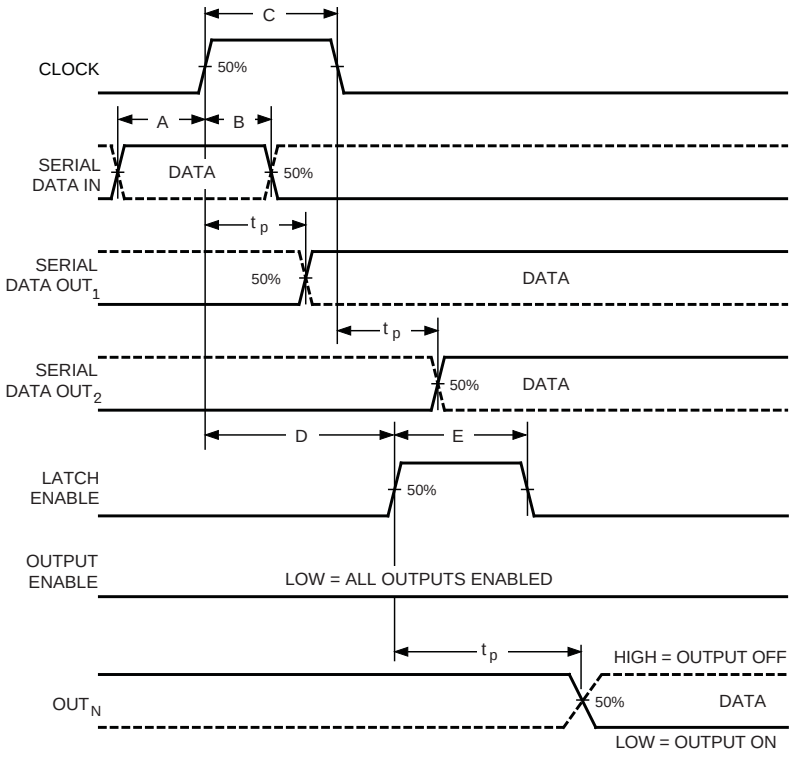
| Characteristic | Symbol | Test Conditions | Limits | | | |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Unit |
| Propagation Delay Time | $t_{pHL}$ | CLOCK-$OUT_n$ | – | 350 | 1000 | ns |
| | | LATCH-$OUT_n$ | – | 350 | 1000 | ns |
| | | ENABLE-$OUT_n$ | – | 350 | 1000 | ns |
| | | CLOCK-SERIAL DATA $OUT_1$ | – | 40 | – | ns |
| Propagation Delay Time | $t_{pLH}$ | CLOCK-$OUT_n$ | – | 300 | 1000 | ns |
| | | LATCH-$OUT_n$ | – | 400 | 1000 | ns |
| | | ENABLE-$OUT_n$ | – | 380 | 1000 | ns |
| | | CLOCK-SERIAL DATA $OUT_2$ | – | 40 | – | ns |
| Output Fall Time | $t_f$ | 90% to 10% voltage | 150 | 250 | 1000 | ns |
| Output Rise Time | $t_r$ | 10% to 90% voltage | 150 | 250 | 600 | ns |

## RECOMMENDED OPERATING CONDITIONS

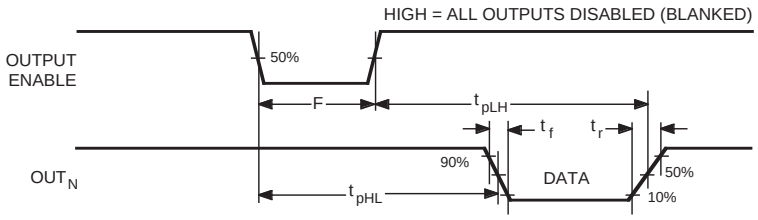
| Characteristic | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | | 4.5 | 5.0 | 5.5 | V |
| Output Voltage | $V_O$ | | – | 1.0 | 4.0 | V |
| Output Current | $I_O$ | Continuous, any one output | – | – | 150 | mA |
| | $I_{OH}$ | SERIAL DATA OUT | – | – | -1.0 | mA |
| | $I_{OL}$ | SERIAL DATA OUT | – | – | 1.0 | mA |
| Logic Input Voltage | $V_{IH}$ | | $0.7V_{DD}$ | – | – | V |
| | $V_{IL}$ | | – | – | $0.3V_{DD}$ | V |
| Clock Frequency | $f_{CK}$ | Cascade operation | – | – | 10 | MHz |

## TIMING REQUIREMENTS and SPECIFICATIONS

(Logic Levels are $V_{DD}$ and Ground)




Dwg. WP-029-3




Dwg. WP-030-1A

**A.** Data Active Time Before Clock Pulse (Data Set-Up Time), $t_{su(D)}$ ..... **60 ns**

**B.** Data Active Time After Clock Pulse (Data Hold Time), $t_{h(D)}$ ..... **20 ns**

**C.** Clock Pulse Width, $t_{w(CK)}$ ..... **50 ns**

**D.** Time Between Clock Activation and Latch Enable, $t_{su(L)}$ ..... **100 ns**

**E.** Latch Enable Pulse Width, $t_{w(L)}$ ..... **100 ns**

**F.** Output Enable Pulse Width, $t_{w(OE)}$ ..... **4.5 µs**

NOTE – Timing is representative of a 10 MHz clock. Significantly higher speeds are attainable.

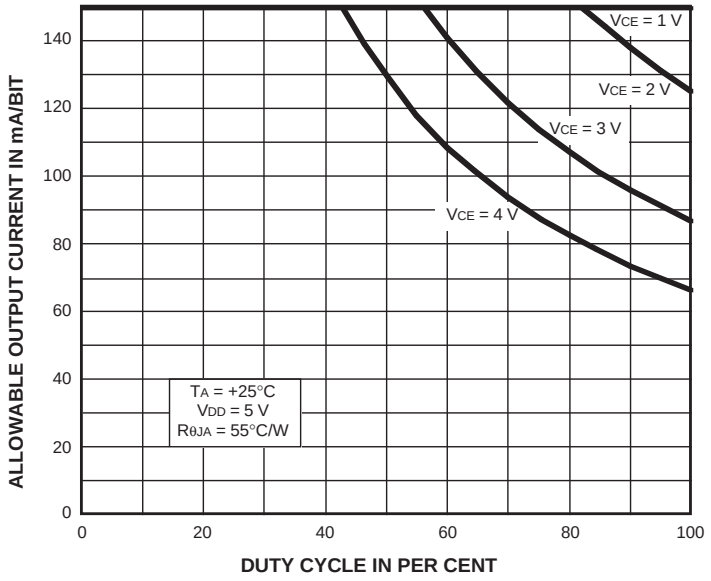
— Max. Clock Transition Time, $t_r$ or $t_f$ ..... **10 µs**

Information present at any register is transferred to the respective latch when the LATCH ENABLE is high (serial-to-parallel conversion). The latches will continue to accept new data as long as the LATCH ENABLE is held high. Applications where the latches are bypassed (LATCH ENABLE tied high) will require that the OUTPUT ENABLE input be high during serial data entry.

When the OUTPUT ENABLE input is high, the output source drivers are disabled (OFF). The information stored in the latches is not affected by the OUTPUT ENABLE input. With the OUTPUT ENABLE input low, the outputs are controlled by the state of their respective latches.

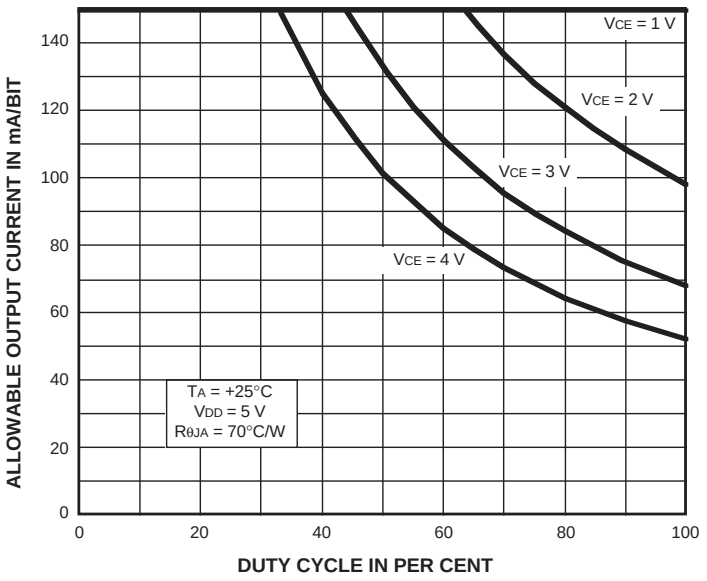
## ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE

### Package A

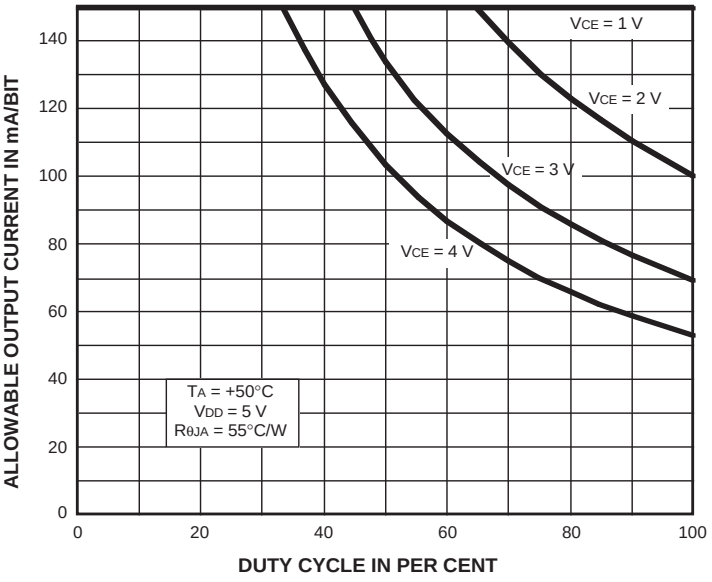



Dwg. GP-062-17

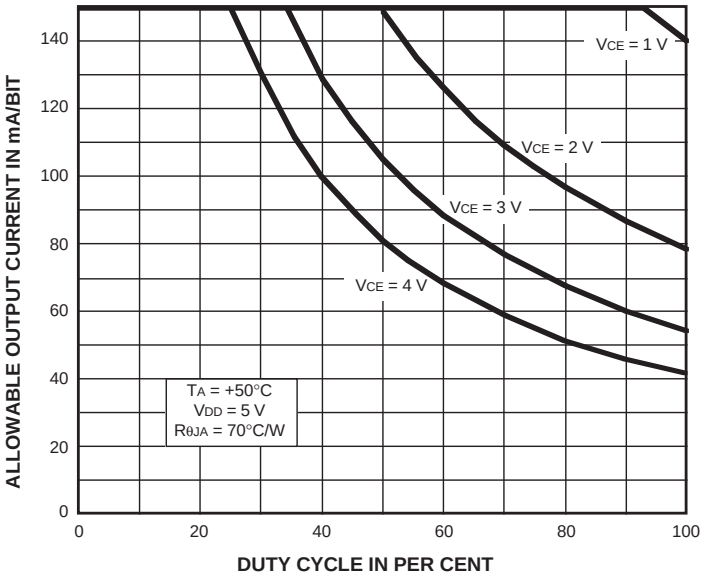
### Package LW




Dwg. GP-062-16



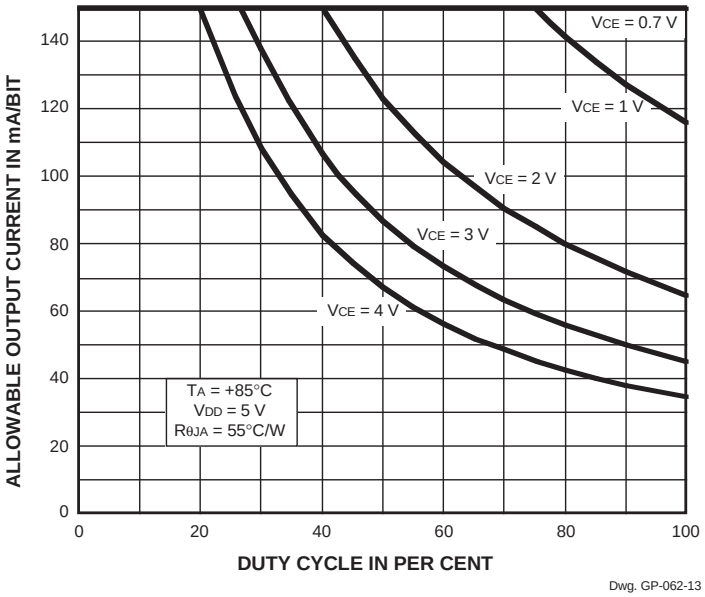

Dwg. GP-062-15




Dwg. GP-062-14

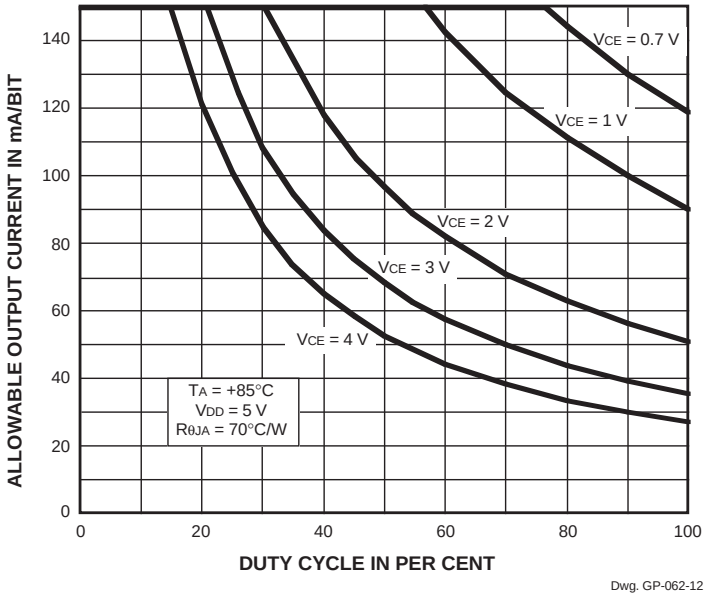
## ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE (cont.)

### Package A



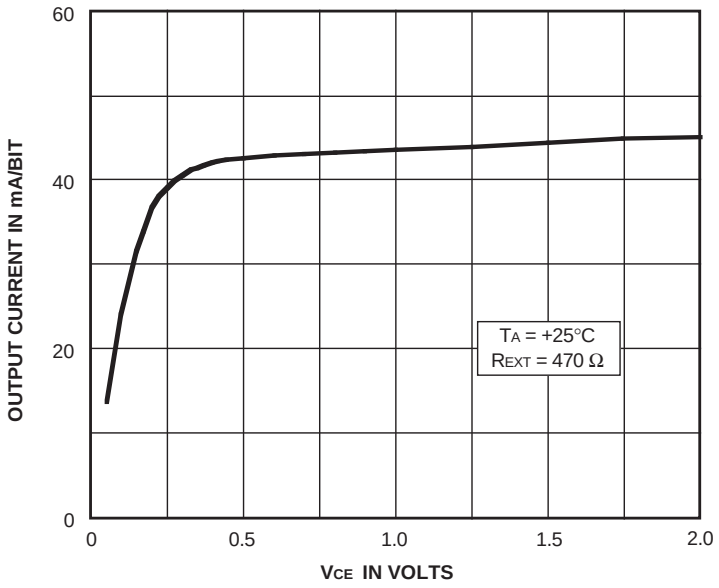

Dwg. GP-062-13

### Package LW

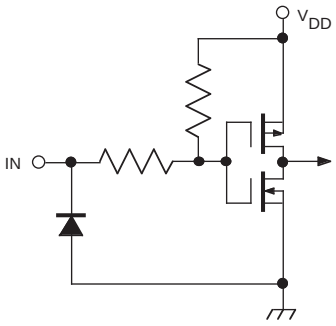



Dwg. GP-062-12

## TYPICAL CHARACTERISTICS

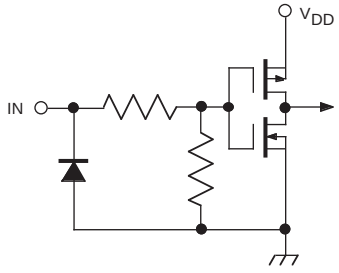



Dwg. GP-063-1



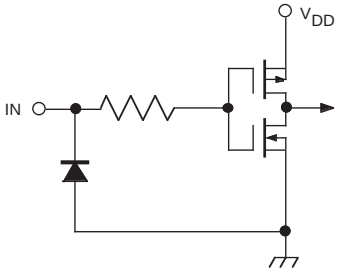

Dwg. EP-010-11

OUTPUT ENABLE (active low)



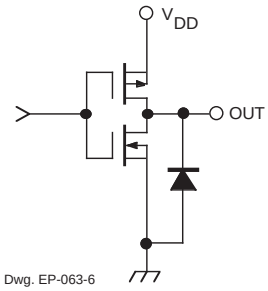

Dwg. EP-010-12

LATCH ENABLE and $\overline{\text{HIGH/LOW}}$




Dwg. EP-010-13

CLOCK and SERIAL DATA IN




Dwg. EP-063-6

SERIAL DATA OUT

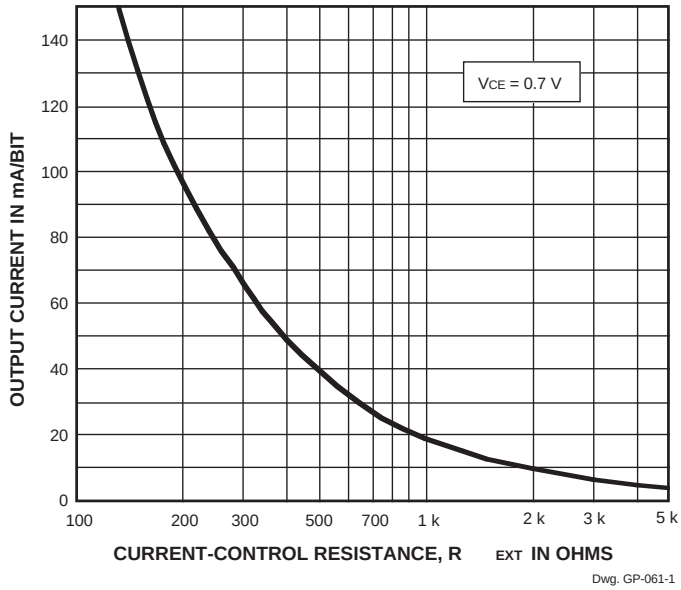
## TRUTH TABLE

| Serial Data Input | Clock Input | Shift Register Contents | Serial Data Output | Latch Enable Input | Latch Contents | Output Enable Input | Output Contents |
|---|---|---|---|---|---|---|---|
| | | $I_1$ $I_2$ $I_3$ ... $I_{N-1}$ $I_N$ | | | $I_1$ $I_2$ $I_3$ ... $I_{N-1}$ $I_N$ | | $I_1$ $I_2$ $I_3$ ... $I_{N-1}$ $I_N$ |
| H | ⌐ | H $R_1$ $R_2$ ... $R_{N-2}$ $R_{N-1}$ | $R_{N-1}$ | | | | |
| L | ⌐ | L $R_1$ $R_2$ ... $R_{N-2}$ $R_{N-1}$ | $R_{N-1}$ | | | | |
| X | ¬ | $R_1$ $R_2$ $R_3$ ... $R_{N-1}$ $R_N$ | $R_N$ | | | | |
| | | X X X ... X X | X | L | $R_1$ $R_2$ $R_3$ ... $R_{N-1}$ $R_N$ | | |
| | | $P_1$ $P_2$ $P_3$ ... $P_{N-1}$ $P_N$ | $P_N$ | H | $P_1$ $P_2$ $P_3$ ... $P_{N-1}$ $P_N$ | L | $P_1$ $P_2$ $P_3$ ... $P_{N-1}$ $P_N$ |
| | | | | | X X X ... X X | H | H H H ... H H |

L = Low Logic (Voltage) Level H = High Logic (Voltage) Level X = Irrelevant P = Present State R = Previous State

## Applications Information

The load current per bit ($I_O$) is set by the external resistor ($R_{EXT}$) as shown in the figure below.




**Package Power Dissipation ($P_D$).** The maximum allowable package power dissipation is determined as

$$P_D(max) = (150 - T_A)/R_{\theta JA}.$$

The actual package power dissipation is

$$P_D(act) = dc(V_{CE} \bullet I_O \bullet 8) + (V_{DD} \bullet I_{DD}).$$

When the load supply voltage is greater than 3 V to 5 V, considering the package power dissipating limits of these devices, or if $P_D(act) > P_D(max)$, an external voltage reducer ($V_{DROP}$) should be used.

**Load Supply Voltage ($V_{LED}$).** These devices are designed to operate with driver voltage drops ($V_{CE}$) of 0.4 V to 0.7 V with LED forward voltages ($V_F$) of 1.2 V to 4.0 V. If higher voltages are dropped across the driver, package power dissipation will be increased significantly. To minimize package power dissipation, it is recommended to use the lowest possible load supply voltage or to set any series dropping voltage ($V_{DROP}$) as

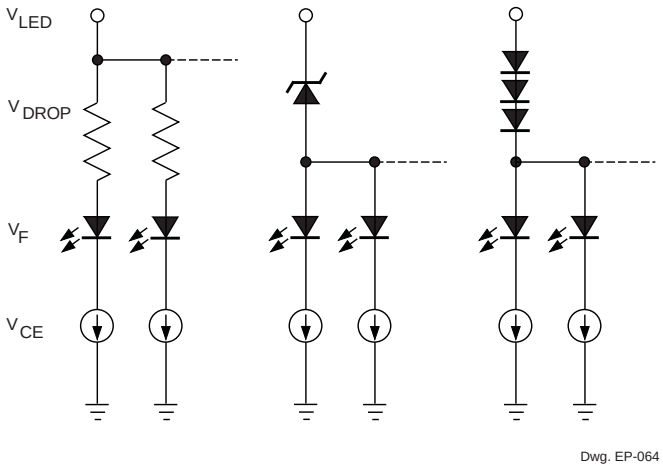
$$V_{DROP} = V_{LED} - V_F - V_{CE}$$

with $V_{DROP} = I_o \bullet R_{DROP}$ for a single driver, or a Zener diode ($V_Z$), or a series string of diodes (approximately 0.7 V per diode) for a group of drivers. If the available voltage source will cause unacceptable dissipation and series resistors or diode(s) are undesirable, a regulator such as the Sanken Series SAI or Series SI can be used to provide supply voltages as low as 3.3 V.

For reference, typical LED forward voltages are:

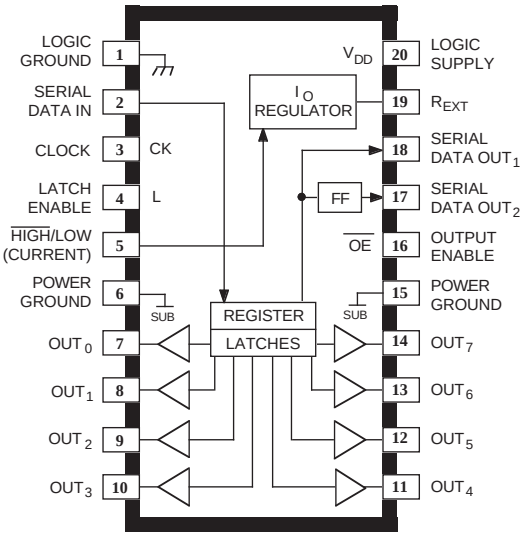
| | |
|---|---|
| White | 3.5 – 4.0 V |
| Blue | 3.0 – 4.0 V |
| Green | 1.8 – 2.2 V |
| Yellow | 2.0 – 2.1 V |
| Amber | 1.9 – 2.65 V |
| Red | 1.6 – 2.25 V |
| Infrared | 1.2 – 1.5 V |

**Pattern Layout.** This device has separate logic-ground and power-ground terminals. If ground pattern layout contains large common-mode resistance, and the voltage between the system ground and the LATCH ENABLE or CLOCK terminals exceeds 2.5 V (because of switching noise), these devices may not operate correctly.



## Pin-out Diagram

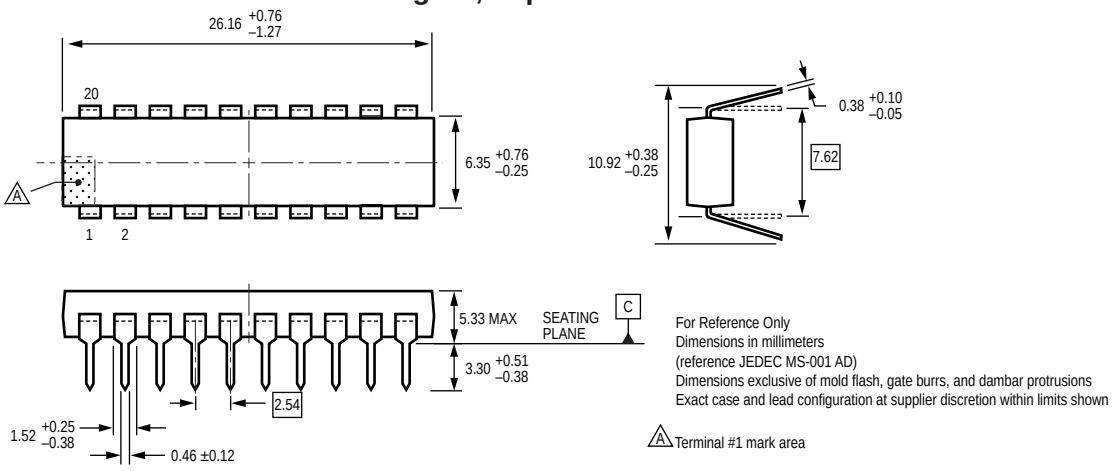
(A and LW packages)




## TERMINAL DESCRIPTION

| Terminal No. | Terminal Name | Function |
|---|---|---|
| 1 | LOGIC GROUND | Reference terminal for control logic. |
| 2 | SERIAL DATA IN | Serial-data input to the shift-register. |
| 3 | CLOCK | Clock input terminal for data shift on rising edge. |
| 4 | LATCH ENABLE | Data strobe input terminal; serial data is latched with high-level input. |
| 5 | HIGH/LOW (CURRENT) | Logic low for 100% of programmed current level; logic high for 50% of programmed current level. |
| 6 | POWER GROUND | Ground. |
| 7-14 | $OUT_{0-7}$ | The eight current-sinking output terminals. |
| 15 | POWER GROUND | Ground. |
| 16 | OUTPUT ENABLE | When (active) low, the output drivers are enabled; when high, all output drivers are turned OFF (blanked). |
| 17 | SERIAL $OUT_2$ | CMOS serial-data output (on clock falling edge). |
| 18 | SERIAL $OUT_1$ | CMOS serial-data output (on clock rising edge) to the following shift-registers. |
| 19 | $R_{EXT}$ | An external resistor at this terminal establishes the output current for all sink drivers. |
| 20 | LOGIC SUPPLY | ($V_{DD}$) The logic supply voltage. Typically 5 V. |

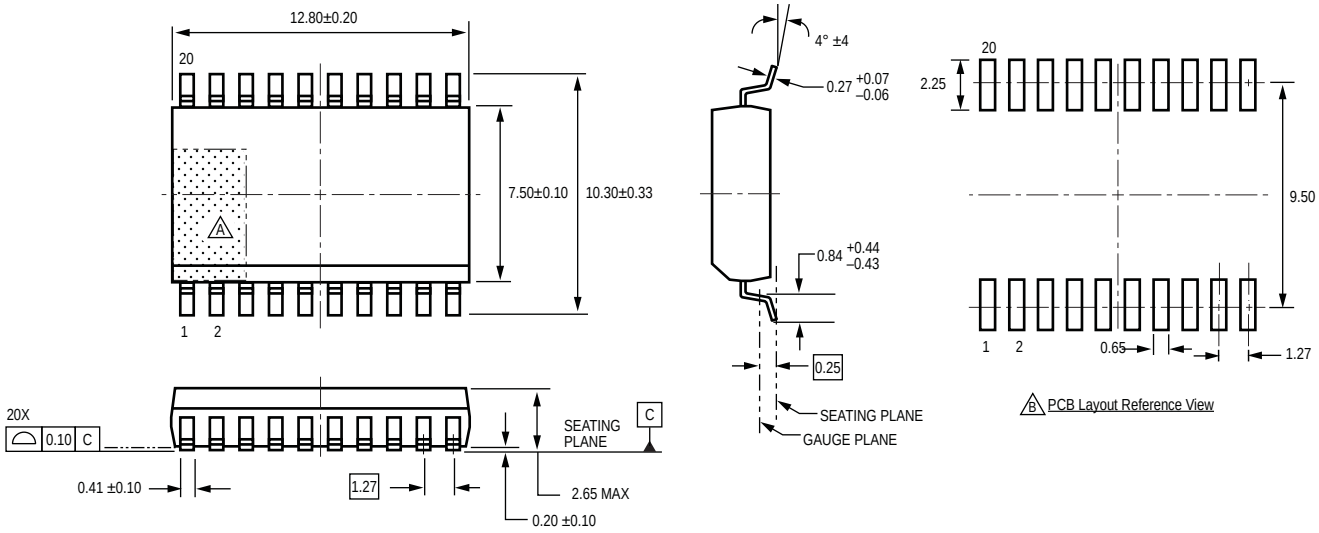
## Package A,20-pin DIP




For Reference Only
Dimensions in millimeters
(reference JEDEC MS-001 AD)
Dimensions exclusive of mold flash, gate burrs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown

A Terminal #1 mark area

## Package LW, 20-pin SOICW




For Reference Only
Dimensions in millimeters
(Reference JEDEC MS-013 AC)
Dimensions exclusive of mold flash, gate burrs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown

A Terminal #1 mark area

B Reference pad layout (reference IPC SOIC127P1030X265-20M)
All pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances



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