

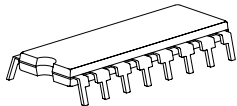


**8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Features**

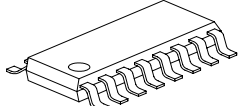
- Compatible with MBI5168 in package and electrical characteristics
- Exploit **Share-I-O™** technique to provide two operation modes: Normal Mode with the same functionality as MB5168, Open-/Short-Circuit Detection mode to detect individual LED errors
- 8 constant-current output channels
- Constant output current invariant to load voltage change
- Excellent output current accuracy, between channels: < ±3% (max.), and between ICs: < ±6% (max.)
- Output current adjusted through an external resistor
- Constant output current range: 5 -120 mA
- Fast response of output current,  $\overline{OE}$  (min.): 200 ns @ $I_{out} < 60mA$   
 $\overline{OE}$  (min.): 400 ns @ $I_{out} = 60\sim 100mA$
- 25MHz clock frequency
- Schmitt trigger input
- 3.3V~ 5V supply voltage
- Optional for "Pb-free & Green" Package

**Dual In-Line Package**



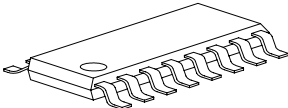
P-DIP16-300-2.54 Weight : 1.02g

**Small Outline Package**



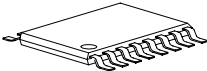
SOP16-150-1.27 Weight : 0.13g

**Wide-body SOP**



SOP16-300-1.27 Weight : 0.37g

**Shrink SOP**



SSOP16-150-0.64 Weight : 0.07g

| Current Accuracy |             | Conditions   |
|------------------|-------------|--|
| Between Channels | Between ICs |  |
| < ±3%            | < ±6%       | $I_{OUT} = 10 \sim 100 \text{ mA}$ ,<br>$V_{DS} = 0.8V, V_{DD} = 5.0V$ |

## MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

### Product Description

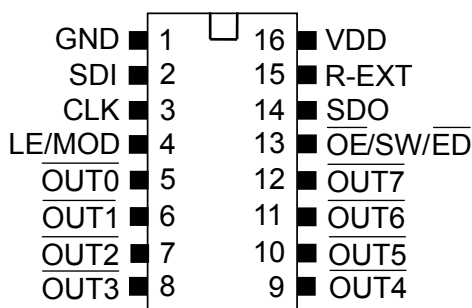
MBI5169 succeeds MBI5168 and also exploits **PrecisionDrive™** technology to enhance its output characteristics. Furthermore, MBI5169 uses the idea of **Share-I-O™** technology to make MBI5169 backward compatible with MBI5168 in both package and electrical characteristics and extend its functionality for LED load Open-/Short-circuit Detection in LED display systems, especially LED traffic sign applications.

MBI5169 contains an 8-bit Shift Register and an 8-bit Output Latch, which convert serial input data into parallel output format. At MBI5169 output stages, eight regulated current ports are designed to provide uniform and constant current sinks with small skew between ports for driving LED's within a wide range of forward voltage (Vf) variations. Users may adjust the output current from 5 mA to 120 mA with an external resistor  $R_{ext}$ , which gives users flexibility in controlling the light intensity of LED's. MBI5169 guarantees to endure maximum 17V at the output ports. Besides, the high clock frequency up to 25 MHz also satisfies the system requirements of high volume data transmission.

By means of the **Share-I-O™** technique, MBI5169 adds new functionality on pins SDO, LE, and  $\overline{OE}$  of MBI5168 to provide an additionally effective function, Open-/Short-circuit Detection, without any extra pins. Thus, MBI5169 could be a drop-in replacement of MBI5168. The printed circuit board originally designed for MBI5168 may be also applied to MBI5169. In MBI5169 there are two operation modes and three phases: Normal Mode phase, Mode Switching transition phase, and Open-/Short-circuit Detection mode phase. The signal on the multiple function pin  $\overline{OE}/\overline{SW}/\overline{ED}$  would be monitored. Once an one-clock-wide short pulse appears on the pin  $\overline{OE}/\overline{SW}/\overline{ED}$ , MBI5169 would enter the Mode Switching phase. At this moment, the voltage level on the pin LE/MOD is used for determining the next mode to which MBI5169 is going to switch.

In the Open-/Short-circuit Detection mode phase, the low-voltage-level signal  $\overline{OE}/\overline{SW}/\overline{ED}$  can enable output channels and detect the status of the output current to tell if the driving current level is enough or not. The detected error status would be loaded into the 8-bit Shift Register and be shifted out via the pin SDO along with the signal CLK. Then system controller could read the error status and know whether the LED's are properly lit or not. In the Normal Mode phase, MBI5169 performs as MBI5168. Users can get detailed ideas about how MBI5169 works in the section **Operation Principle**.

### Pin Assignment



## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Terminal Description**

| Pin No. | Pin Name                                    | Function   |
|---------|---|--|
| 1       | GND   | Ground terminal for control logic and current sinks  |
| 2       | SDI   | Serial-data input to the Shift Register  |
| 3       | CLK   | Clock input terminal for data shift at the rising edge   |
| 4       | LE/MOD                                      | <p><b>Data strobe input terminal:</b> except in the Mode Switching phase, serial data is transferred to the respective Output Latch when LE/MOD is high; the data is latched inside the Output Latch when LE/MOD goes low. If the data in the Output Latch is "1" (High), the respective output channel will be enabled after <math>\overline{OE}/\overline{SW}/\overline{ED}</math> is pulled down to low.</p> <p><b>Mode selection input terminal:</b> in the Mode Switching phase, LE/MOD couldn't strobe serial data but its level is used for determining the next mode to which MBI5169 is going to switch. When LE/MOD is high, the next mode is the Open-/Short-circuit Detection mode; when low, the next mode is the Normal Mode. (See <b>Operation Principle</b>)</p>   |
| 5-12    | $\overline{OUT0} \sim \overline{OUT7}$      | Constant current output terminals  |
| 13      | $\overline{OE}/\overline{SW}/\overline{ED}$ | <p><b>Output enable terminal:</b> no matter in what phase MBI5169 operates, the signal <math>\overline{OE}/\overline{SW}/\overline{ED}</math> can always enable output drivers to sink current. When its level is (active) low, the output drivers are enabled; when high, all output drivers are turned OFF (blanked).</p> <p><b>Mode switching trigger terminal:</b> a one-clock-wide short signal pulse of <math>\overline{OE}/\overline{SW}/\overline{ED}</math> could put MBI5169 into the Mode Switching phase.</p> <p><b>Error detection enable terminal:</b> in the Open-/Short-circuit Detection mode, the active low signal <math>\overline{OE}/\overline{SW}/\overline{ED}</math> can make MBI5169 not just enable output drivers but detect LED load error status. The detected error status would be stored into the Shift Register. (See <b>Operation Principle</b>)</p> |
| 14      | SDO   | Serial-data output to the following SDI of next driver IC  |
| 15      | R-EXT                                       | Input terminal used for connecting an external resistor in order to set up the current level of all output ports   |
| 16      | VDD   | Supply voltage terminal  |

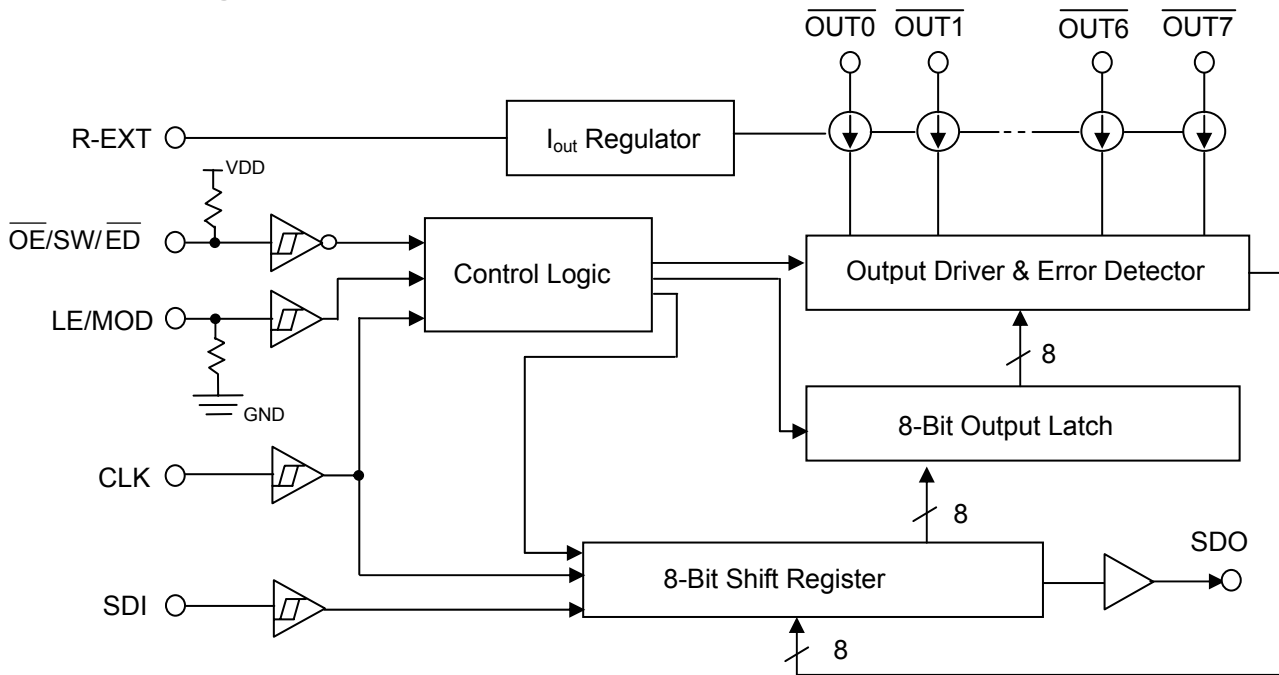
In MBI5169, the relationship between the functions of pin 4 and 13 and the operation phases is listed below:

| Pin No. | Pin Name                                    | Function   | Normal Mode | Mode Switching | Open-/Short-circuit Detection Mode |
|---------|---|--|-------------|----------------|------------------------------------|
| 4       | LE/MOD                                      | LE: latching serial data into the Output Latch   | Yes         | No             | Yes                                |
|         |   | MOD: mode selection  | No          | Yes            | No                                 |
| 13      | $\overline{OE}/\overline{SW}/\overline{ED}$ | $\overline{OE}$ : enabling the current output drivers                                  | Yes         | Yes            | Yes                                |
|         |   | $\overline{SW}$ : entering the Mode Switching phase                                    | Yes         | Yes            | Yes                                |
|         |   | $\overline{ED}$ : enabling error detection and storing results into the Shift Register | No          | No             | Yes                                |

MBI5169

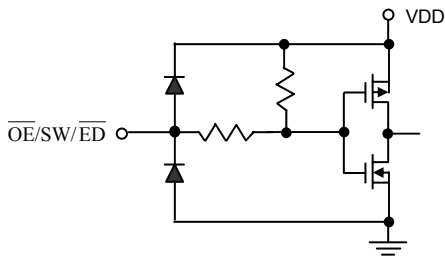
8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

Block Diagram

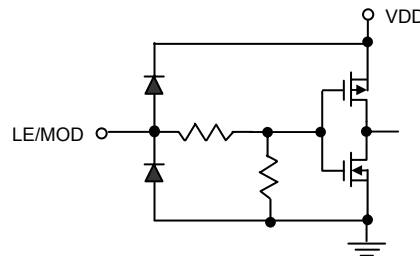


Equivalent Circuits of Inputs and Outputs

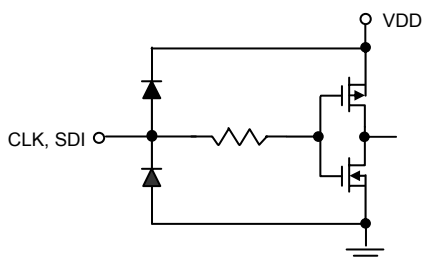
OE/SW/ED Terminal



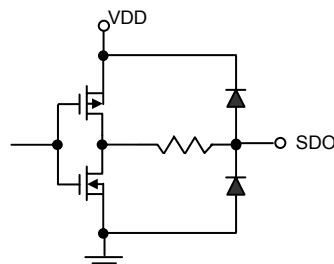
LE/MOD Terminal



CLK, SDI Terminal



SDO Terminal

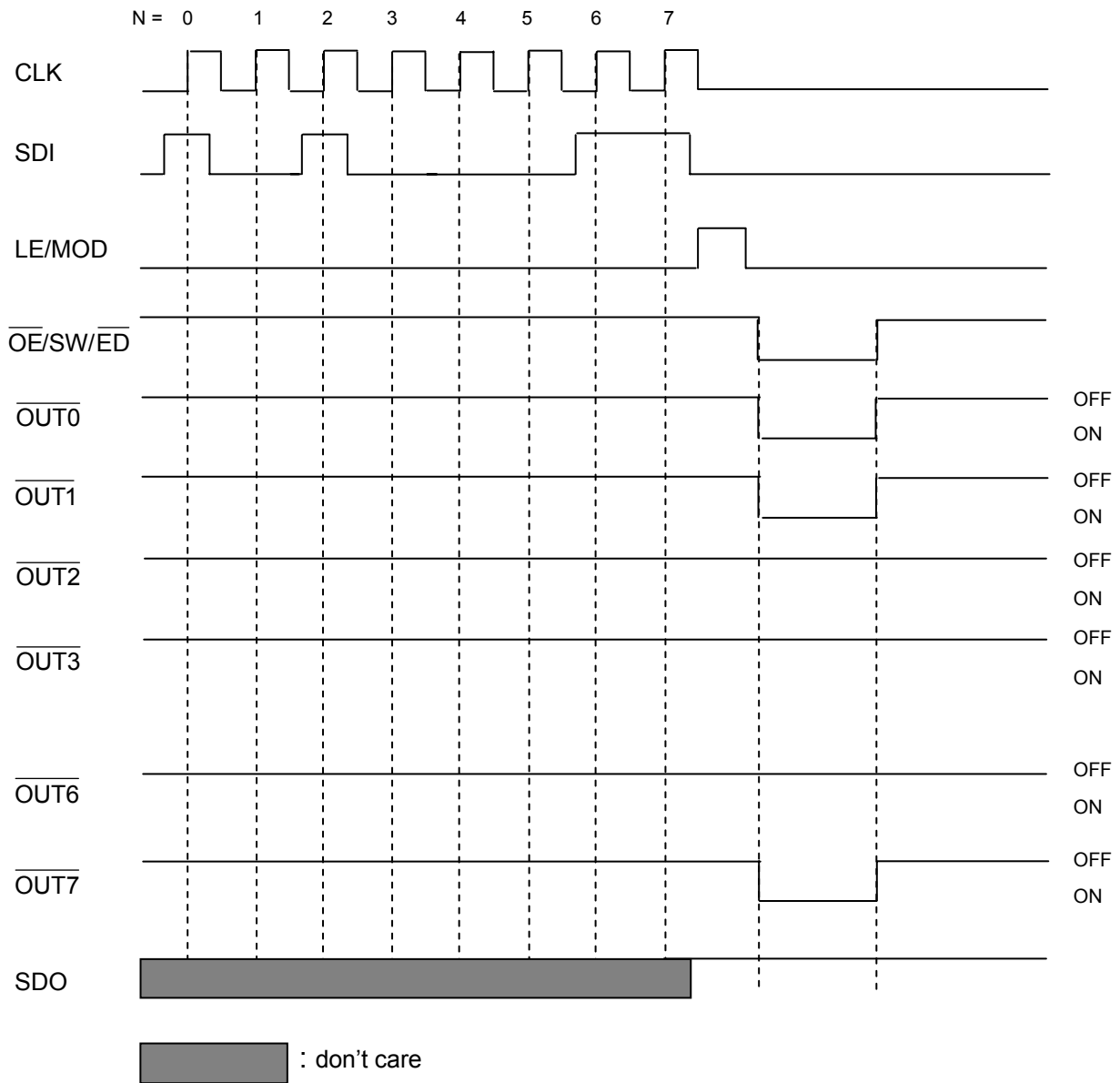


MBI5169

8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Timing Diagram**

Normal Mode

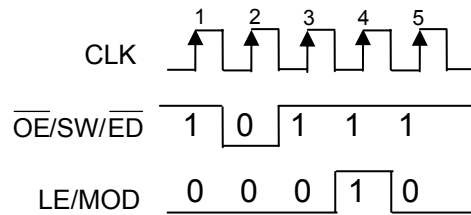


**Truth Table (In Normal Mode)**

| CLK | LE/MOD | OE/SW/ED | SDI       | OUT0 ... OUT5 ... OUT7   | SDO       |
|-----|--------|----------|-----------|--|-----------|
|     | H      | L        | $D_n$     | $\overline{D_n} \dots \overline{D_{n-5}} \dots \overline{D_{n-7}}$     | $D_{n-7}$ |
|     | L      | L        | $D_{n+1}$ | No Change  | $D_{n-6}$ |
|     | H      | L        | $D_{n+2}$ | $\overline{D_{n+2}} \dots \overline{D_{n-3}} \dots \overline{D_{n-5}}$ | $D_{n-5}$ |
|     | X      | L        | $D_{n+3}$ | $\overline{D_{n+2}} \dots \overline{D_{n-3}} \dots \overline{D_{n-5}}$ | $D_{n-5}$ |
|     | X      | H        | $D_{n+3}$ | Off  | $D_{n-5}$ |

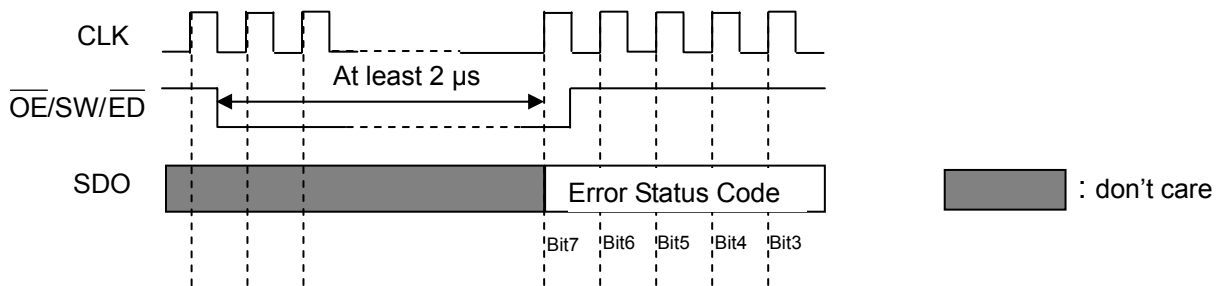
**MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Switching to Open-/Short-Circuit Detection Mode**



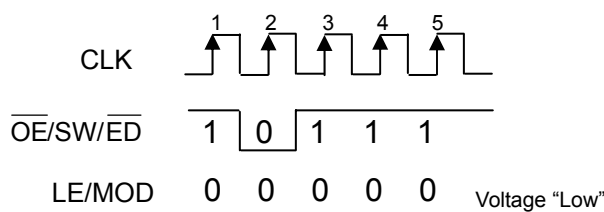
The above shows an example of the signal sequence that can set the next operation mode of MBI5169 to be the Open-/Short-circuit Detection mode. The LE/MOD active pulse here would not latch any serial data.

**Reading Error Status Code (In Open-/Short-Circuit Detection Mode)**



When MBI5169 is working in the Open-/Short-circuit Detection mode, the above signal sequence example can let a system controller read the Error Status codes via the pin SDO.

**Switching to Normal Mode**



The above signal sequence example can make MBI5169 resume to the Normal Mode.

**Note:**

If users want to know the detailed process, that is how to enter the Open-/Short-circuit Detection mode, detect the LED load error status, and go back to the Normal Mode, please refer to the contents in **Operation Principle**.

## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Maximum Ratings**

| Characteristics   |     |     | Symbol        | Rating                | Unit             |                    |
|---|-----|-----|---------------|-----------------------|------------------|--------------------|
| Supply Voltage  |     |     | $V_{DD}$      | 0 ~ 7.0               | V                |                    |
| Input Voltage   |     |     | $V_{IN}$      | -0.4 ~ $V_{DD} + 0.4$ | V                |                    |
| Output Current  |     |     | $I_{OUT}$     | +120                  | mA               |                    |
| Output Voltage  |     |     | $V_{DS}$      | -0.5 ~ +20.0          | V                |                    |
| Clock Frequency   |     |     | $F_{CLK}$     | 25                    | MHz              |                    |
| GND Terminal Current                                    |     |     | $I_{GND}$     | 1000                  | mA               |                    |
| Power Dissipation<br>(On PCB, $T_a=25^\circ\text{C}$ )  | CN  | GN  | $P_D$         | 1.55                  | 1.66             | W                  |
|   | CD  | GD  |               | 1.17                  | 1.43             |                    |
|   | CDW | GDW |               | 1.62                  | 1.46             |                    |
|   | CP  | GP  |               | 1.05                  | 1.25             |                    |
| Thermal Resistance<br>(On PCB, $T_a=25^\circ\text{C}$ ) | CN  | GN  | $R_{th(j-a)}$ | 64.35                 | 60.20            | $^\circ\text{C/W}$ |
|   | CD  | GD  |               | 85.82                 | 70.14            |                    |
|   | CDW | GDW |               | 61.63                 | 68.67            |                    |
|   | CP  | GP  |               | 94.91                 | 80.00            |                    |
| Operating Temperature                                   |     |     | $T_{opr}$     | -40 ~ +85             | $^\circ\text{C}$ |                    |
| Storage Temperature                                     |     |     | $T_{stg}$     | -55 ~ +150            | $^\circ\text{C}$ |                    |

## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Recommended Operating Conditions**

| Characteristics  | Symbol        | Condition   | Min.        | Typ. | Max.         | Unit |
|--|---------------|---|-------------|------|--------------|------|
| Supply Voltage   | $V_{DD}$      | -   | 4.5         | 5.0  | 5.5          | V    |
| Output Voltage   | $V_{DS}$      | $\overline{OUT0} \sim \overline{OUT7}$                                | -           | -    | 17.0         | V    |
| Output Current   | $I_{OUT}$     | $\overline{OUT0} \sim \overline{OUT7}$                                | 5           | -    | 120          | mA   |
|  | $I_{OH}$      | SDO   | -           | -    | -1.0         | mA   |
|  | $I_{OL}$      | SDO   | -           | -    | 1.0          | mA   |
| Input Voltage  | $V_{IH}$      | CLK, $\overline{OE}/\overline{SW}/\overline{ED}$<br>LE/MOD, and SDI   | $0.7V_{DD}$ | -    | $V_{DD}+0.3$ | V    |
|  | $V_{IL}$      | CLK, $\overline{OE}/\overline{SW}/\overline{ED}$ ,<br>LE/MOD, and SDI | -0.3        | -    | $0.3V_{DD}$  | V    |
| CLK Pulse Width  | $t_{w(CLK)}$  | -   | 20          | -    | -            | ns   |
| Setup Time for SDI   | $t_{su(D)}$   |   | 5           | -    | -            | ns   |
| Hold Time for SDI  | $t_{h(D)}$    |   | 10          | -    | -            | ns   |
| LE/MOD Pulse Width   | $t_{w(L)}$    |   | 20          | -    | -            | ns   |
| Setup Time for LE/MOD                                      | $t_{su(L)}$   | For data strobe   | 5           | -    | -            | ns   |
| Hold Time for LE/MOD                                       | $t_{h(L)}$    |   | 10          | -    | -            | ns   |
| Setup Time for LE/MOD                                      | $t_{su(MOD)}$ | In Mode Switching   | 5           | -    | -            | ns   |
| Hold Time for LE/MOD                                       | $t_{h(MOD)}$  |   | 10          | -    | -            | ns   |
| $\overline{OE}/\overline{SW}/\overline{ED}$ Pulse Width    | $t_{w(SW)}$   | To trigger Mode Switching   | 20          | -    | -            | ns   |
|  | $t_{w(OE)}$   | $I_{out} < 60\text{mA}$   | 200         | -    | -            | ns   |
|  | $t_{w(OE)}$   | $I_{out} = 60\sim 100\text{mA}$                                       | 400         | -    | -            | ns   |
|  | $t_{w(ED)}$   | When detecting LED error status                                       | 2010        | -    | -            | ns   |
| Setup Time for Correctly-Generated Error Status Code *     | $t_{su(ER)}$  | When detecting LED error status                                       | 2000        | -    | -            | ns   |
| Setup Time for $\overline{OE}/\overline{SW}/\overline{ED}$ | $t_{su(SW)}$  | To trigger Mode Switching or when detecting LED error status          | 5           | -    | -            | ns   |
| Hold Time for $\overline{OE}/\overline{SW}/\overline{ED}$  | $t_{h(SW)}$   |   | 10          | -    | -            | ns   |
| Clock Frequency  | $F_{CLK}$     | Cascade Operation ( $V_{DD} = 5.0\text{V}$ )                          | -           | -    | 25           | MHz  |

\* In the Open-/Short-circuit Detection mode, when  $\overline{OE}/\overline{SW}/\overline{ED}$  is pulled down to LOW for enabling output drivers and error detection, the output drivers must be enabled for at least 2us so that the error status code could be correctly generated. See **Operation Principle** and **Timing Waveform**.



## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Electrical Characteristics ( $V_{DD} = 5.0V$ )**

| Characteristics                              |           | Symbol  | Condition   |                        | Min.        | Typ.      | Max.        | Unit       |
|--|-----------|---|---|------------------------|-------------|-----------|-------------|------------|
| Supply Voltage                               |           | $V_{DD}$  | -   |                        | 4.5         | 5.0       | 5.5         | V          |
| Output Voltage                               |           | $V_{DS}$  | $\overline{OUT0} \sim \overline{OUT7}$  |                        | -           | -         | 17.0        | V          |
| Output Current                               |           | $I_{OUT}$   | Test Circuit for Electrical Characteristics                                   |                        | 5           | -         | 120         | mA         |
|  |           | $I_{OH}$  | SDO   |                        | -           | -         | -1.0        | mA         |
|  |           | $I_{OL}$  | SDO   |                        | -           | -         | 1.0         | mA         |
| Input Voltage                                | "H" level | $V_{IH}$  | $T_a = -40 \sim 85^\circ C$   |                        | $0.7V_{DD}$ | -         | $V_{DD}$    | V          |
|  | "L" level | $V_{IL}$  | $T_a = -40 \sim 85^\circ C$   |                        | GND         | -         | $0.3V_{DD}$ | V          |
| Output Leakage Current                       |           |   | $V_{DS} = 17.0V$ and channel off  |                        | -           | -         | 0.5         | $\mu A$    |
| Output Voltage                               | SDO       | $V_{OL}$  | $I_{OL} = +1.0mA$   |                        | -           | -         | 0.4         | V          |
|  |           | $V_{OH}$  | $I_{OH} = -1.0mA$   |                        | 4.6         | -         | -           | V          |
| Output Current 1                             |           | $I_{OUT1}$  | $V_{DS} = 0.5V$   | $R_{ext} = 744 \Omega$ | -           | 25.26     | -           | mA         |
| Current Skew (between channels)              |           | $dI_{OUT1}$   | $I_{OUT} = 25.26mA$<br>$V_{DS} \geq 0.5V$                                     | $R_{ext} = 744 \Omega$ | -           | $\pm 1$   | $\pm 3$     | %          |
| Output Current 2                             |           | $I_{OUT2}$  | $V_{DS} = 0.6V$   | $R_{ext} = 372 \Omega$ | -           | 50.52     | -           | mA         |
| Current Skew (between channels)              |           | $dI_{OUT2}$   | $I_{OUT} = 50.52mA$<br>$V_{DS} \geq 0.6V$                                     | $R_{ext} = 372 \Omega$ | -           | $\pm 1$   | $\pm 3$     | %          |
| Output Current 3                             |           | $I_{OUT3}$  | $V_{DS} = 0.8V$   | $R_{ext} = 186 \Omega$ | -           | 101.0     | -           | mA         |
| Current Skew (between channels)              |           | $dI_{OUT3}$   | $I_{OUT} = 101.0mA$<br>$V_{DS} \geq 0.8V$                                     | $R_{ext} = 186 \Omega$ | -           | $\pm 1$   | $\pm 3$     | %          |
| Output Current vs. Output Voltage Regulation |           | $\%/dV_{DS}$  | $V_{DS}$ within 1.0V and 3.0V   |                        | -           | $\pm 0.1$ | -           | % / V      |
| Output Current vs. Supply Voltage Regulation |           | $\%/dV_{DD}$  | $V_{DD}$ within 4.5V and 5.5V   |                        | -           | $\pm 1$   | -           | % / V      |
| Pull-up Resistance                           |           | $R_{IN(up)}$  | $\overline{OE}/\overline{SW}/\overline{ED}$                                   |                        | 250         | 500       | 800         | K $\Omega$ |
| Pull-down Resistance                         |           | $R_{IN(down)}$  | LE/MOD  |                        | 250         | 500       | 800         | K $\Omega$ |
| Threshold Current for Error Detection**      |           | $I_{out, Th1}$  | $R_{ext} = 744 \Omega$ , $I_{out, target} = 25.26mA$                          |                        | -           | -         | 25.2        | mA         |
|  |           | $I_{out, Th2}$  | $R_{ext} = 372 \Omega$ , $I_{out, target} = 50.52mA$                          |                        | -           | -         | 40.3        | mA         |
|  |           | $I_{out, Th3}$  | $R_{ext} = 186 \Omega$ , $I_{out, target} = 101.0mA$                          |                        | -           | -         | 70.6        | mA         |
| Supply Current                               | "OFF"     | $I_{DD(off) 0}$   | $R_{ext} = \text{Open}$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$ |                        | -           | 2.85      | 3.65        | mA         |
|  |           | $I_{DD(off) 1}$   | $R_{ext} = 744 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$  |                        | -           | 5.9       | 7.9         |            |
|  |           | $I_{DD(off) 2}$   | $R_{ext} = 372 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$  |                        | -           | 8.7       | 10.7        |            |
|  |           | $I_{DD(off) 3}$   | $R_{ext} = 186 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$  |                        | -           | 14.4      | 16.4        |            |
|  | "ON"      | $I_{DD(on) 1}$  | $R_{ext} = 744 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{On}$   |                        | -           | 5.8       | 7.8         |            |
|  |           | $I_{DD(on) 2}$  | $R_{ext} = 372 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{On}$   |                        | -           | 8.7       | 10.7        |            |
| $I_{DD(on) 3}$                               |           | $R_{ext} = 186 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{On}$ |   | -                      | 13.5        | 15.5      |             |            |

\*\* To effectively detect the load open-circuit error at the output ports, MBI5169 has a built-in current detection circuit. The current detection circuit will detect the effective current  $I_{out, effect}$  and compare it with the threshold current  $I_{out, Th}$ . If  $I_{out, effect}$  is less than the threshold current  $I_{out, Th}$ , an error flag (LOW) will be asserted and stored into the built-in Shift Register. Each external resistor  $R_{ext}$  would determine a target output current  $I_{out, target}$ , which has a corresponding threshold current  $I_{out, Th}$ . To bias LED operation point properly and detect LED errors, there is a minimum effective output current requirement for each  $R_{ext}$ , such as  $I_{out, Th1}$ ,  $I_{out, Th2}$ , and  $I_{out, Th3}$ .

## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Electrical Characteristics ( $V_{DD} = 3.3V$ )**

| Characteristics                                 |           | Symbol          | Condition   |                        | Min.        | Typ.      | Max.        | Unit       |
|---|-----------|-----------------|---|------------------------|-------------|-----------|-------------|------------|
| Supply Voltage                                  |           | $V_{DD}$        | -   |                        | 3.0         | 3.3       | 3.6         | V          |
| Output Voltage                                  |           | $V_{DS}$        | $\overline{OUT0} \sim \overline{OUT7}$  |                        | -           | -         | 17.0        | V          |
| Output Current                                  |           | $I_{OUT}$       | Test Circuit for Electrical Characteristics                                   |                        | 5           | -         | 120         | mA         |
|   |           | $I_{OH}$        | SDO   |                        | -           | -         | -1.0        | mA         |
|   |           | $I_{OL}$        | SDO   |                        | -           | -         | 1.0         | mA         |
| Input Voltage                                   | "H" level | $V_{IH}$        | $T_a = -40 \sim 85^\circ C$   |                        | $0.7V_{DD}$ | -         | $V_{DD}$    | V          |
|   | "L" level | $V_{IL}$        | $T_a = -40 \sim 85^\circ C$   |                        | GND         | -         | $0.3V_{DD}$ | V          |
| Output Leakage Current                          |           |                 | $V_{DS} = 17.0V$ and channel off  |                        | -           | -         | 0.5         | $\mu A$    |
| Output Voltage                                  | SDO       | $V_{OL}$        | $I_{OL} = +1.0mA$   |                        | -           | -         | 0.4         | V          |
|   |           | $V_{OH}$        | $I_{OH} = -1.0mA$   |                        | 2.9         | -         | -           | V          |
| Output Current 1                                |           | $I_{OUT1}$      | $V_{DS} = 0.5V$   | $R_{ext} = 744 \Omega$ | -           | 25.26     | -           | mA         |
| Current Skew<br>(between channels)              |           | $dI_{OUT1}$     | $I_{OUT} = 25.26mA$<br>$V_{DS} \geq 0.5V$                                     | $R_{ext} = 744 \Omega$ | -           | $\pm 1$   | $\pm 3$     | %          |
| Output Current 2                                |           | $I_{OUT2}$      | $V_{DS} = 0.6V$   | $R_{ext} = 372 \Omega$ | -           | 50.52     | -           | mA         |
| Current Skew<br>(between channels)              |           | $dI_{OUT2}$     | $I_{OUT} = 50.52mA$<br>$V_{DS} \geq 0.6V$                                     | $R_{ext} = 372 \Omega$ | -           | $\pm 1$   | $\pm 3$     | %          |
| Output Current vs.<br>Output Voltage Regulation |           | $\%/dV_{DS}$    | $V_{DS}$ within 1.0V and 3.0V   |                        | -           | $\pm 0.1$ | -           | % / V      |
| Output Current vs.<br>Supply Voltage Regulation |           | $\%/dV_{DD}$    | $V_{DD}$ within 3.2V and 3.6V   |                        | -           | $\pm 1$   | -           | % / V      |
| Pull-up Resistance                              |           | $R_{IN(up)}$    | $\overline{OE}/\overline{SW}/\overline{ED}$                                   |                        | 250         | 500       | 800         | K $\Omega$ |
| Pull-down Resistance                            |           | $R_{IN(down)}$  | LE/MOD  |                        | 250         | 500       | 800         | K $\Omega$ |
| Threshold Current for<br>Error Detection        |           | $I_{out, Th1}$  | $R_{ext} = 744 \Omega$ , $I_{out, target} = 25.26mA$                          |                        | -           | -         | 25.2        | mA         |
|   |           | $I_{out, Th2}$  | $R_{ext} = 372 \Omega$ , $I_{out, target} = 50.52mA$                          |                        | -           | -         | 40.3        | mA         |
| Supply<br>Current                               | "OFF"     | $I_{DD(off) 0}$ | $R_{ext} = \text{Open}$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$ |                        | -           | 0.78      | 1.58        | mA         |
|   |           | $I_{DD(off) 1}$ | $R_{ext} = 744 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$  |                        | -           | 3.6       | 4.4         |            |
|   |           | $I_{DD(off) 2}$ | $R_{ext} = 372 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{Off}$  |                        | -           | 6.5       | 7.3         |            |
|   | "ON"      | $I_{DD(on) 1}$  | $R_{ext} = 744 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{On}$   |                        | -           | 3.6       | 4.2         |            |
|   |           | $I_{DD(on) 2}$  | $R_{ext} = 372 \Omega$ , $\overline{OUT0} \sim \overline{OUT7} = \text{On}$   |                        | -           | 6.4       | 7.2         |            |

## MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

**Switching Characteristics ( $V_{DD} = 5.0V$ )**

| Characteristics                     |   | Symbol       | Condition  | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|--------------|--|------|------|------|------|
| Propagation Delay Time ("L" to "H") | CLK - $\overline{OUTn}$                     | $t_{pLH1}$   | Test Circuit for Switching Characteristics<br><br>$V_{DD}=5.0 V$<br>$V_{DS}=0.8 V$<br>$V_{IH}=V_{DD}$<br>$V_{IL}=GND$<br>$R_{ext}=372 \Omega$<br>$V_L=4.0 V$<br>$R_L=64 \Omega$<br>$C_L=10 pF$ | -    | 100  | 150  | ns   |
|                                     | LE/MOD - $\overline{OUTn}$                  | $t_{pLH2}$   |  | -    | 100  | 150  | ns   |
|                                     | $\overline{OE/SW/ED}$ - $\overline{OUTn}$   | $t_{pLH3}$   |  | -    | 100  | 150  | ns   |
|                                     | CLK - SDO                                   | $t_{pLH}$    |  | 20   | 25   | 30   | ns   |
| Propagation Delay Time ("H" to "L") | CLK - $\overline{OUTn}$                     | $t_{pHL1}$   |  | -    | 100  | 150  | ns   |
|                                     | LE/MOD - $\overline{OUTn}$                  | $t_{pHL2}$   |  | -    | 100  | 150  | ns   |
|                                     | $\overline{OE/SW/ED}$ - $\overline{OUTn}$   | $t_{pHL3}$   |  | -    | 100  | 150  | ns   |
|                                     | CLK - SDO                                   | $t_{pHL}$    |  | 20   | 25   | 30   | ns   |
| Pulse Width                         | CLK   | $t_{w(CLK)}$ |  | 20   | -    | -    | ns   |
|                                     | LE/MOD                                      | $t_{w(L)}$   |  | 20   | -    | -    | ns   |
|                                     | $\overline{OE/SW/ED}$ (@ $I_{out} < 60mA$ ) | $t_{w(OE)}$  |  | 200  | -    | -    | ns   |
| Hold Time for LE/MOD                |   | $t_{h(L)}$   |  | 10   | -    | -    | ns   |
| Setup Time for LE/MOD               |   | $t_{su(L)}$  |  | 5    | -    | -    | ns   |
| Maximum CLK Rise Time               |   | $t_r^{***}$  |  | -    | -    | 500  | ns   |
| Maximum CLK Fall Time               |   | $t_f^{***}$  | -  | -    | 500  | ns   |      |
| Output Rise Time of Vout (turn off) |   | $t_{or}$     | -  | 120  | 150  | ns   |      |
| Output Fall Time of Vout (turn on)  |   | $t_{of}$     | -  | 200  | 250  | ns   |      |
| Clock Frequency                     |   | $F_{CLK}$    | Cascade Operation  | -    | -    | 25.0 | MHz  |

\*\*\* If MBI5169 are connected in cascade and  $t_r$  or  $t_f$  is large, it may be critical to achieve the timing required for data transfer between two cascaded LED drivers MBI5169.

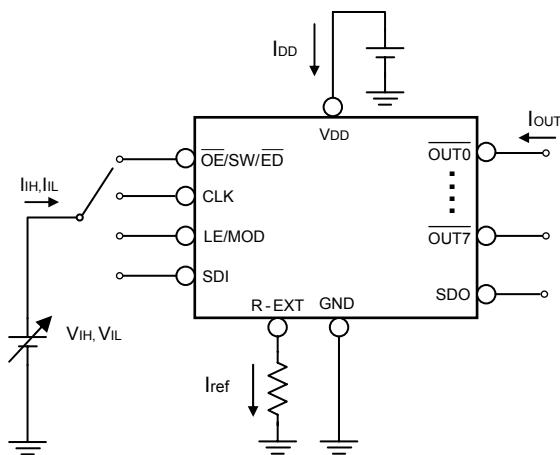
MBI5169

8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

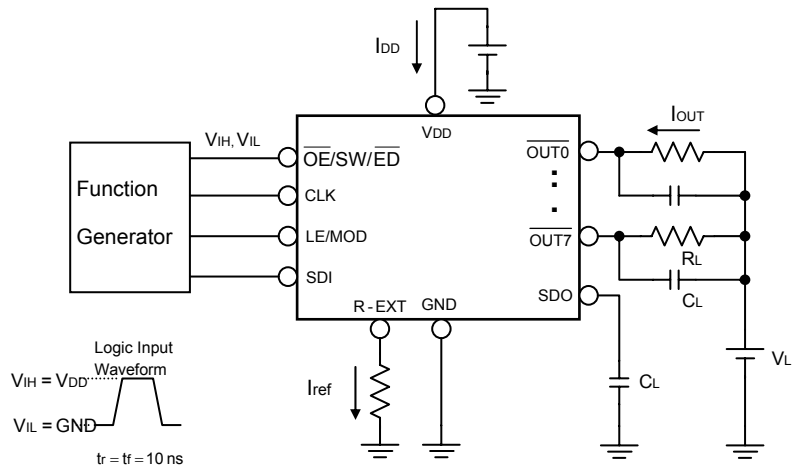
**Switching Characteristics (V<sub>DD</sub> = 3.3V)**

| Characteristics                     |   | Symbol              | Condition   | Min. | Typ. | Max. | Unit |
|-------------------------------------|---|---------------------|---|------|------|------|------|
| Propagation Delay Time ("L" to "H") | CLK - $\overline{\text{OUTn}}$                            | $t_{pLH1}$          | Test Circuit for Switching Characteristics<br><br>$V_{DD}=3.3\text{ V}$<br>$V_{DS}=0.8\text{ V}$<br>$V_{IH}=V_{DD}$<br>$V_{IL}=\text{GND}$<br>$R_{ext}=372\ \Omega$<br>$V_L=4.0\text{ V}$<br>$R_L=64\ \Omega$<br>$C_L=10\text{ pF}$ | -    | 100  | 150  | ns   |
|                                     | LE/MOD - $\overline{\text{OUTn}}$                         | $t_{pLH2}$          |   | -    | 100  | 150  | ns   |
|                                     | $\overline{\text{OE/SW/ED}}$ - $\overline{\text{OUTn}}$   | $t_{pLH3}$          |   | -    | 100  | 150  | ns   |
|                                     | CLK - SDO   | $t_{pLH}$           |   | 45   | 55   | 65   | ns   |
| Propagation Delay Time ("H" to "L") | CLK - $\overline{\text{OUTn}}$                            | $t_{pHL1}$          |   | -    | 130  | 200  | ns   |
|                                     | LE/MOD - $\overline{\text{OUTn}}$                         | $t_{pHL2}$          |   | -    | 130  | 200  | ns   |
|                                     | $\overline{\text{OE/SW/ED}}$ - $\overline{\text{OUTn}}$   | $t_{pHL3}$          |   | -    | 130  | 200  | ns   |
|                                     | CLK - SDO   | $t_{pHL}$           |   | 45   | 55   | 65   | ns   |
| Pulse Width                         | CLK   | $t_{w(\text{CLK})}$ |   | 20   | -    | -    | ns   |
|                                     | LE/MOD  | $t_{w(L)}$          |   | 20   | -    | -    | ns   |
|                                     | $\overline{\text{OE/SW/ED}}$ (@ $I_{out} < 60\text{mA}$ ) | $t_{w(\text{OE})}$  |   | 200  | -    | -    | ns   |
| Hold Time for LE/MOD                |   | $t_{h(L)}$          |   | 10   | -    | -    | ns   |
| Setup Time for LE/MOD               |   | $t_{su(L)}$         |   | 5    | -    | -    | ns   |
| Maximum CLK Rise Time               |   | $t_r$               |   | -    | -    | 500  | ns   |
| Maximum CLK Fall Time               |   | $t_f$               |   | -    | -    | 500  | ns   |
| Output Rise Time of Vout (turn off) |   | $t_{or}$            |   | -    | 120  | 150  | ns   |
| Output Fall Time of Vout (turn on)  |   | $t_{of}$            | -   | 200  | 400  | ns   |      |
| Clock Frequency                     |   | $F_{\text{CLK}}$    | Cascade Operation   | -    | -    | 12.0 | MHz  |

**Test Circuit for Electrical Characteristics**



**Test Circuit for Switching Characteristics**

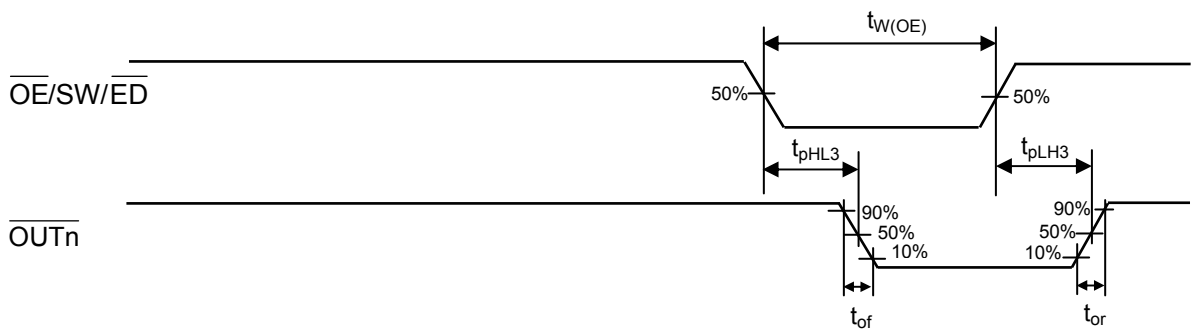
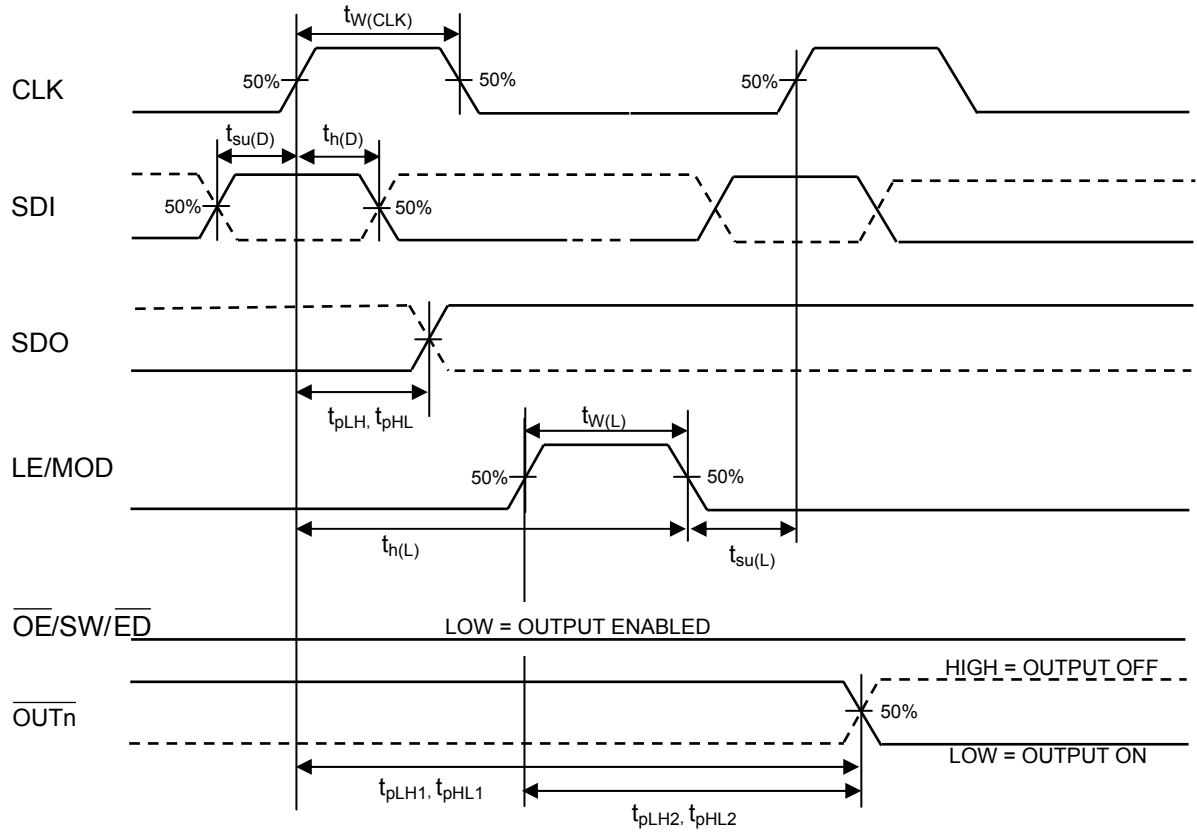


MBI5169

8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

Timing Waveform

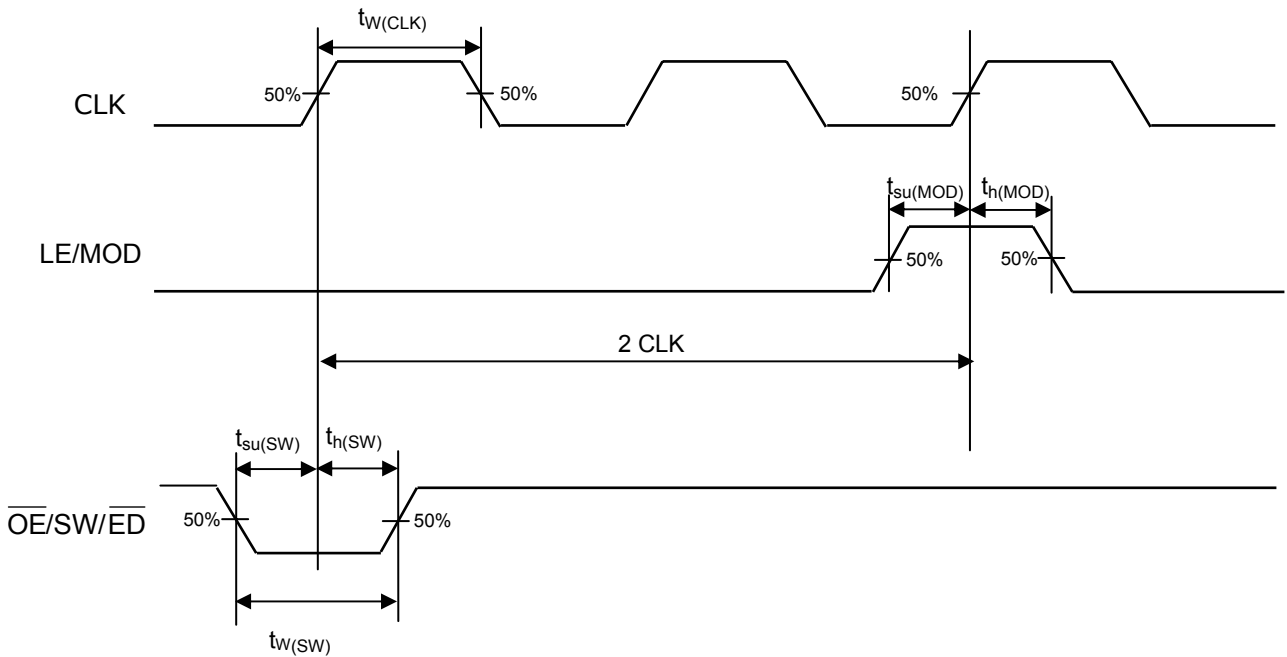
Normal Mode



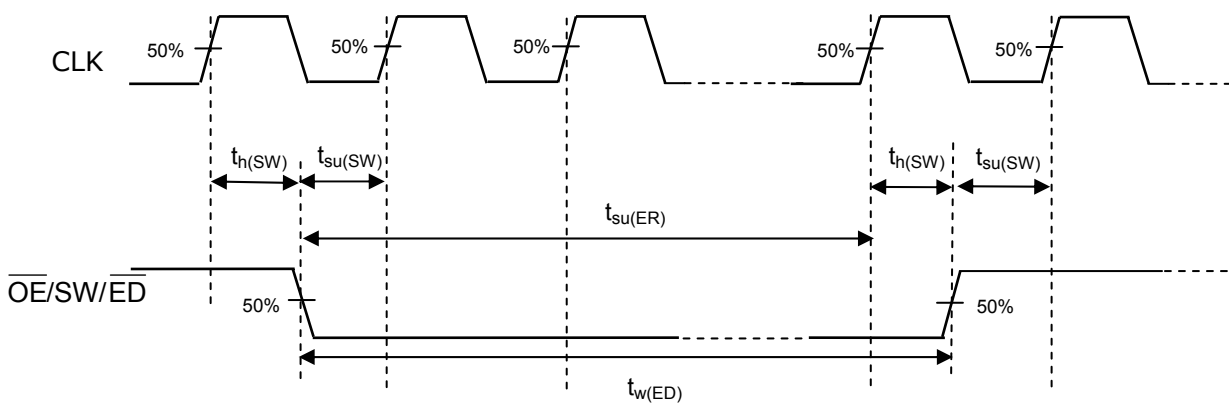
# MBI5169

# 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

## Switching to Open-/Short-Circuit Detection Mode



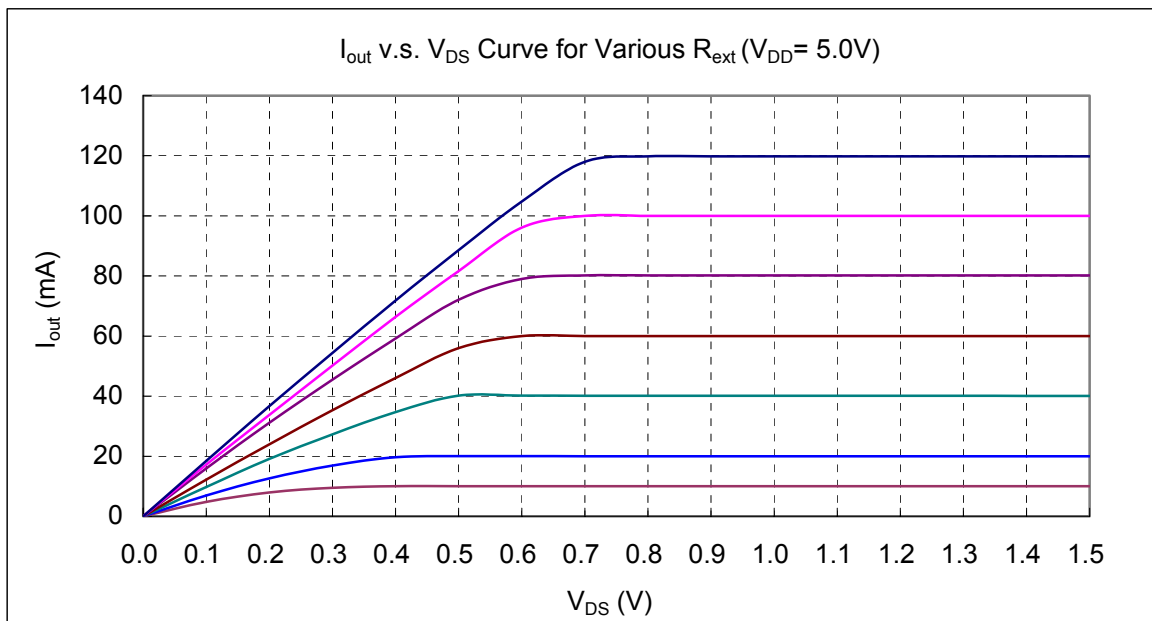
## Reading Error Status Code



**MBI5169****8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection****Operation Principle****Constant Current**

In LED display applications, MBI5169 provides nearly no current variations from channel to channel and from IC to IC. This can be achieved by:

- 1) While  $I_{OUT} \leq 100\text{mA}$ , the maximum current skew between channels is less than  $\pm 3\%$  and that between ICs is less than  $\pm 6\%$ .
- 2) In addition, the characteristics curve of output stage in the saturation region is flat and users can refer to the figure as shown below. Thus, the output current can be kept constant regardless of the variations of LED forward voltages ( $V_f$ ).



# MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

## Adjusting Output Current

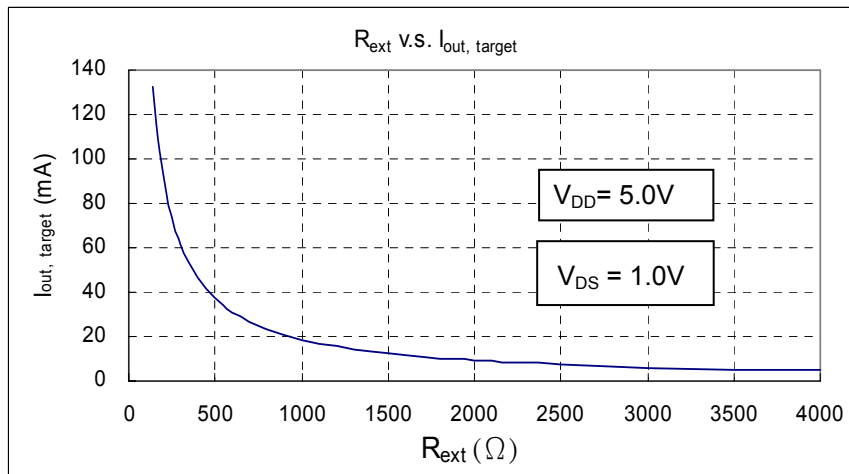
MBI5169 scales up the reference current  $I_{ref}$  set by the external resistor  $R_{ext}$  to sink a current  $I_{out}$  at each output port. As shown in the output characteristics figure, the output current in the saturation region is so flat that we define it as target current  $I_{out, target}$ . Following the below formulas, users can calculate the target output current  $I_{out, target}$ :

$$V_{R-EXT} = 1.253V$$

$$I_{ref} = V_{R-EXT} / R_{ext} \quad \text{if another end of the external resistor } R_{ext} \text{ is connected to ground.}$$

$$I_{out, target} = I_{ref} \times 15 = (1.253\text{Volt} / R_{ext}) \times 15$$

Where  $R_{ext}$  is the resistance of the external resistor connected to the R-EXT terminal and  $V_{R-EXT}$  is the voltage of the R-EXT terminal. The magnitude of current (as a function of  $R_{ext}$ ) is around 50.52mA at 372Ω and 25.26mA at 744Ω. The following plot shows the relationship curve between the target output current of each channel ( $I_{out, target}$ ) and the corresponding external resistor  $R_{ext}$ .



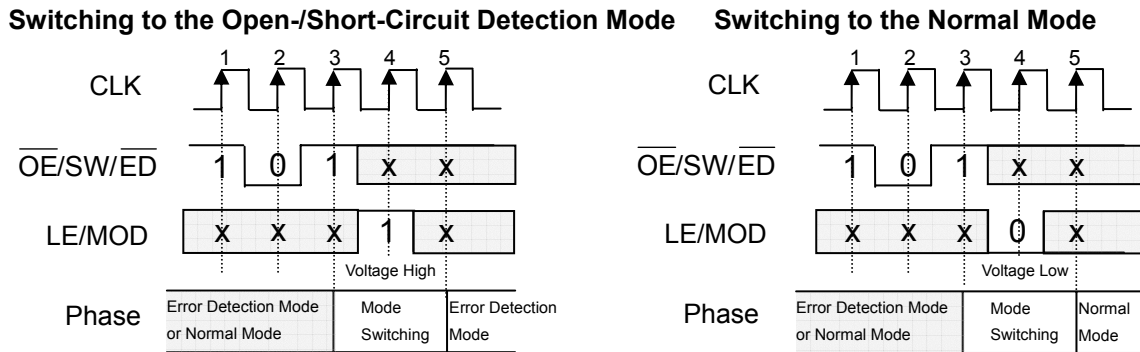
## Operation Phases

MBI5169 exploits the **Share-I-O™** technique to extend the functionality of pins in MBI5168 in order to provide LED load error detection in Open-/Short-circuit Detection mode phase as well as the original function of MBI5168 in the Normal Mode phase. In order to switch between the two modes, MBI5169 monitors the signal  $\overline{OE}/\overline{SW}/\overline{ED}$ . Once a one-clock-wide pulse of  $\overline{OE}/\overline{SW}/\overline{ED}$  appears, MBI5169 would enter the two-clock-period transition phase---the Mode Switching phase. After power-on, the default operation mode is the Normal Mode.



**MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Operation Mode Switching**



As shown in the above figures, once a one-clock-wide short pulse “101” of  $\overline{OE}/\overline{SW}/\overline{ED}$  appears, MBI5169 would enter the mode switching phase. At the 4<sup>th</sup> rising edge of CLK, if LE/MOD is sampled as “Voltage High”, MBI5169 would switch to the Open-/Short-circuit Detection mode; otherwise, it would switch to the Normal Mode. Worthwhile noticing, the signal LE/MOD between the 3<sup>rd</sup> and the 5<sup>th</sup> rising edges of CLK can not latch any data. Its level is just used for determining which mode to switch. However, the short pulse of  $\overline{OE}/\overline{SW}/\overline{ED}$  can still enable the output ports. During the mode switching, the serial data can still be transferred through the pin SDI and shifted out from the pin SDO.

**Note:**

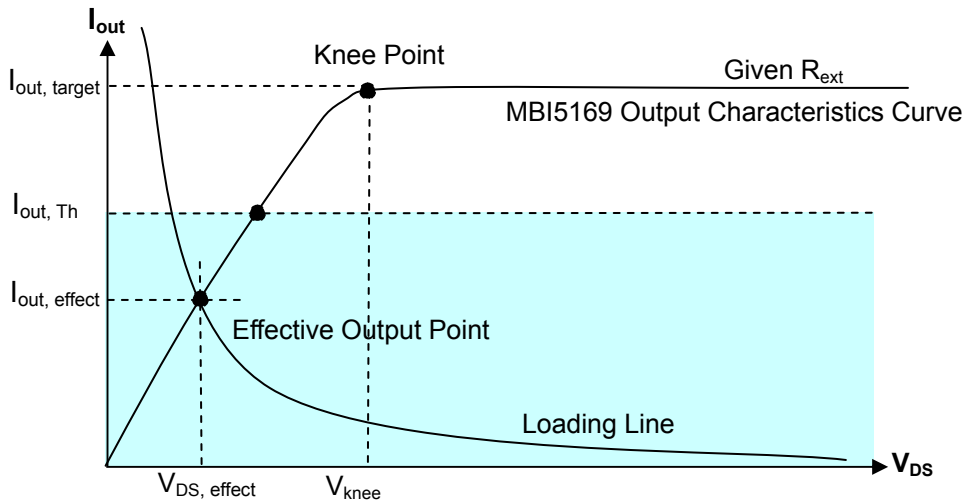
1. The signal sequence for the mode switching could be frequently used for making sure under which mode MBI5169 is working.
2. The aforementioned “1” and “0” are sampled at the rising edge of CLK. The “X” means its level would not affect the result of mode switching mechanism.

**Normal Mode Phase**

MBI5169 in the Normal Mode phase has similar functionality to MBI5168. The serial data could be transferred into MBI5169 via the pin SDI, shifted in the Shift Register, and go out via the pin SDO. The LE/MOD can latch the serial data in the Shift Register to the Output Latch.  $\overline{OE}/\overline{SW}/\overline{ED}$  would enable the output drivers to sink current. The only difference is mentioned in the last paragraph about monitoring short pulse  $\overline{OE}/\overline{SW}/\overline{ED}$ . The short pulse would trigger MBI5169 to switch the operation mode. However, as long as the signal LE/MOD is not Voltage High in the Mode Switching phase, MBI5169 would still remain in the Normal Mode as if no mode switching occurs.

**MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Open-Circuit Detection Principle**



The principle of MBI5169 LED Open-Circuit Detection is based on the comparison between the effective current level  $I_{out, effect}$  of each output port and the threshold current  $I_{out, Th}$  corresponding to  $I_{out, target}$ . The cross point between the **Loading Line** and **MBI5169 Output Characteristics Curve** is called as effective output point ( $V_{DS, effect}$ ,  $I_{out, effect}$ ). If LED fails, for instance, due to open circuit, the **Loading Line** and the effective output point would change. Then, MBI5169 would catch the error status. But if the port is disabled, the output current would be absolutely 0mA and MBI5169 could not distinguish the change of the **Loading Line**. Thus, to detect the status of LED correctly, the output ports must be enabled. The relationship between the detected Error Status code and the position of the effective output point is shown in the following table.

| State of Output Port | Condition of Effective Output Point     | Detected Open-Circuit Error Status Code | Meaning      |
|----------------------|---|---|--------------|
| OFF                  | $I_{out, effect} = 0mA \ll I_{out, Th}$ | "0"                                     | -            |
| ON                   | $I_{out, effect} < I_{out, Th}$         | "0"                                     | Open Circuit |
|                      | $I_{out, effect} \geq I_{out, Th}$      | "1"                                     | Normal       |

Note : As  $I_{out, target} \geq 25mA$ , the threshold current  $I_{out, Th} = I_{out, target} \times 0.6 + 10mA$

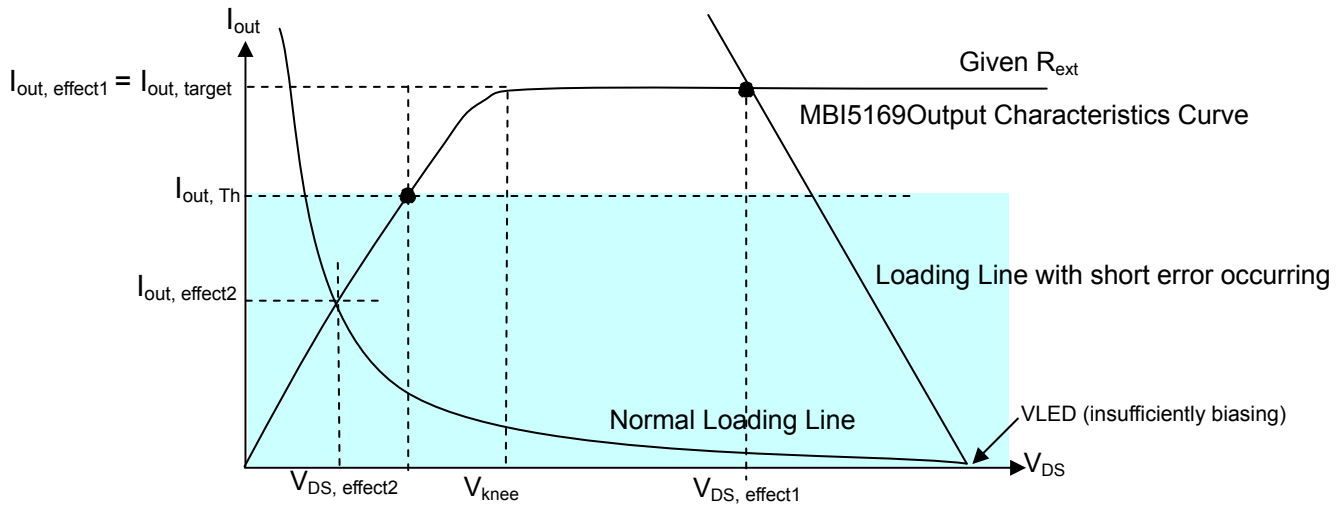
As  $I_{out, target} < 25mA$ , the threshold current  $I_{out, Th} = I_{out, target}$

Because the target current  $I_{out, target}$  in the saturation region set by the external resistor  $R_{ext}$  is a little bigger than the corresponding threshold current  $I_{out, Th}$  for error detection, system design engineers had better place the effective output point of normal LED load in the saturation region near the knee point, for instance, if they want to detect the LED open error. Then while LED is open, the effective output point would move to the origin, where  $I_{out} = 0mA$ . So, MBI5169 can distinguish and detect it and report an error status codes "0".

In fact, if LED's are normal, the enabled ports would report error status codes "1" and the disabled would report "0". The error status codes are the same as the content in the Output Latch.

**MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Short-Circuit Detection Principle**

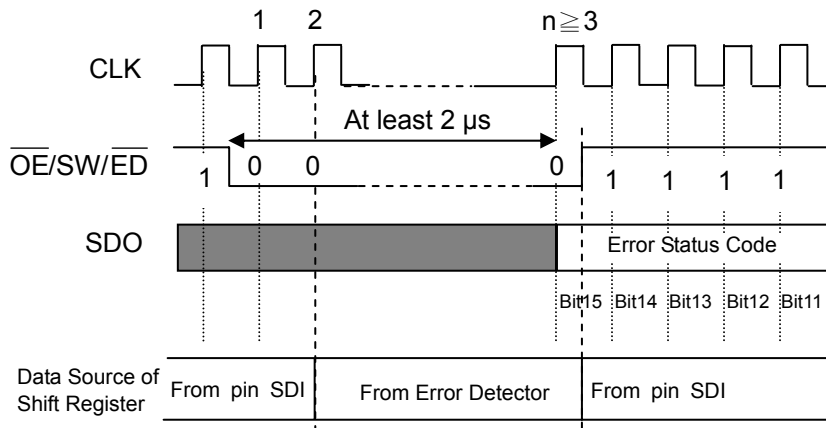


When LED is damaged, a short-circuit error may occur. To effectively detect the short-circuit error, LEDs need insufficiently biasing. The principle of MBI5169 LED Short Circuit Detection is based on the fact that the LED loading status is judged by comparing the effective current value ( $I_{out, effect}$ ) of each output port with the threshold current ( $I_{out, Th}$ ). When normal LED is insufficiently biased, its effective output point would be located at the segment  $I_{out, effect} < I_{out, Th}$  of **MBI5169 Output Characteristics Curve**, compared with LED with a short error falling within the segment  $I_{out, effect} > I_{out, Th}$ . The relationship between the Error Status code and the effective output point is shown below:

| State of Output Port | Condition of Effective Output Point | Detected Short-Circuit Error Status Code | Meaning       |
|----------------------|-------------------------------------|--|---------------|
| OFF                  | $I_{out, effect} = 0$               | "0"                                      | -             |
| ON                   | $I_{out, effect} < I_{out, Th}$     | "0"                                      | Normal        |
|                      | $I_{out, effect} \geq I_{out, Th}$  | "1"                                      | Short Circuit |

**MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection**

**Open-/Short-Circuit Detection Mode Phase and Reading Error Status Code**



In the Open-/Short-circuit Detection mode, as long as  $\overline{OE/SW/ED}$  is not at the Voltage Low, the serial data can still be shifted to the Shift Register via the pin SDI and shifted out via the SDO pin, and the positive pulse of LE/MOD can also make the data in the Shift Register latched to 8-bit Output Latch, as in the Normal Mode.

The difference between the Open-/Short-circuit Detection mode from the Normal Mode is that when the state of  $\overline{OE/SW/ED}$  is pulled down to Voltage Low, MBI5169 in the Open-/Short-circuit Detection mode would execute error detection and load error status codes into the Shift Register, as well as enabling output ports to sink current. The above figure shows the timing sequence for error detection. The shown “0” and “1” are sampled at the rising edge of each CLK. At least three “0” must be sampled at the Voltage Low signal  $\overline{OE/SW/ED}$ . Just after the 2<sup>nd</sup> “0” is sampled, the data input source of the Shift Register would come from 8-bit parallel error status codes out of the circuit Error Detector, instead of serial data out of the pin SDI. Normally, the error status codes will be correctly generated at least 2μs after the falling edge of  $\overline{OE/SW/ED}$ . The occurrence of the 3<sup>rd</sup> or later “0” results in the event that MBI5169 saves the detected error status codes into the Shift Register. Thus, when  $\overline{OE/SW/ED}$  is at the Voltage Low state, the serial data cannot be shifted into MBI5169 via the pin SDI. But when the state of  $\overline{OE/SW/ED}$  is pulled up to Voltage High from Voltage Low, the data input source of the Shift Register would again come from the pin SDI. At the same time, the output ports are disabled and the error detection is completed. Then, the error status codes saved in the Shift Register could be shifted out via the pin SDO bit by bit along with CLK, as well as the new serial data can be shifted into MBI5169 via the pin SDI.

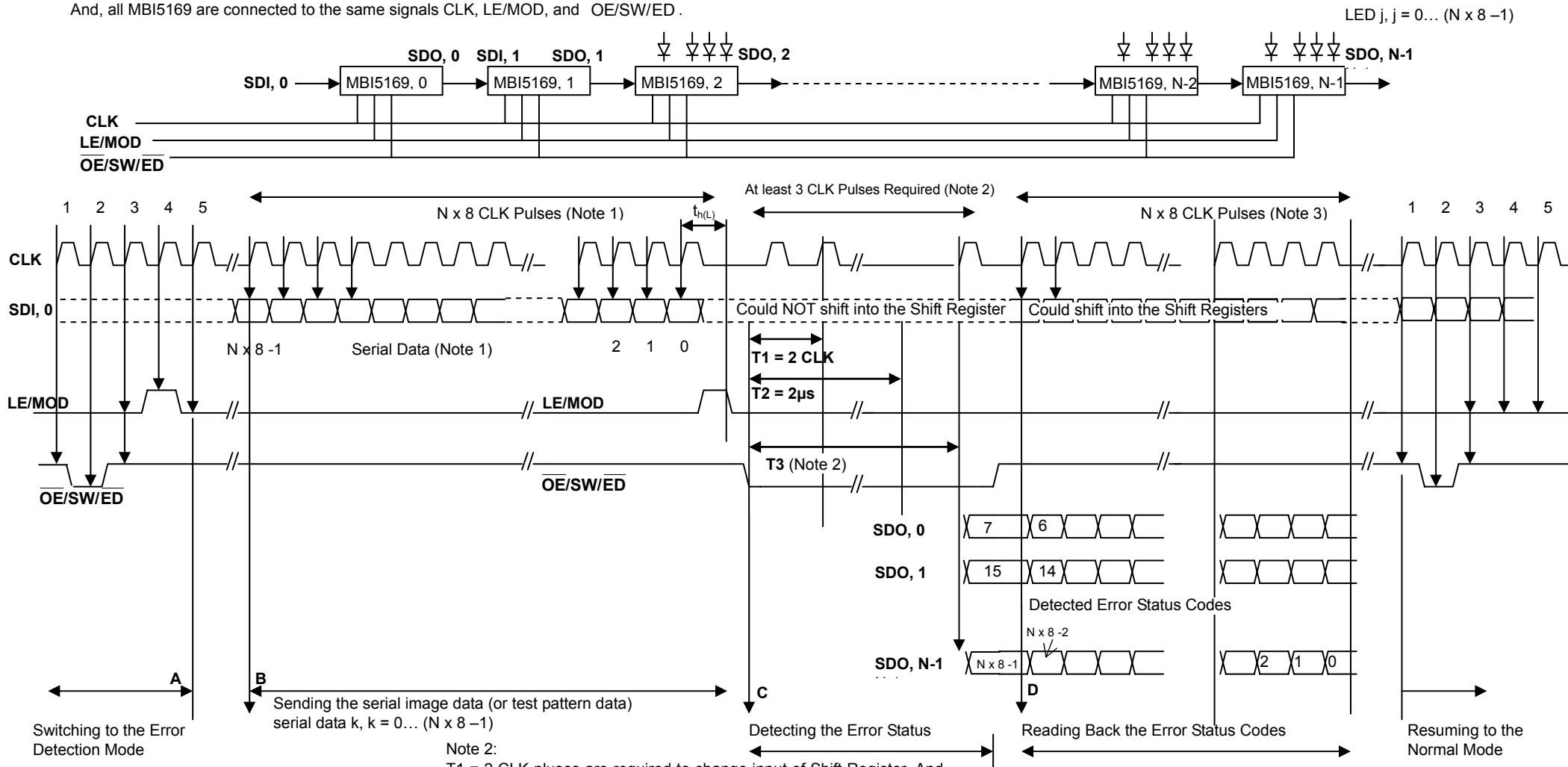
To sum up, MBI5169 in the Open-/Short-circuit Detection mode could transfer and latch new serial image data and show them to the output ports, as well as detecting LED load error status. The limitation is that in the Open-/Short-circuit Detection mode, it couldn't be allowed to **simultaneously** transfer serial data and detect LED load error status.

# MBI5169

## 8-Bit Constant Current LED Sink Driver with Open/Short Error Detection

### Timing Chart for Open-/Short- Circuit Detection Mode (An Example)

N of MBI5169 are connected in cascade, ie, SDO, k --> SDI, k+1.  
 And, all MBI5169 are connected to the same signals CLK, LE/MOD, and  $\overline{OE}/\overline{SW}/\overline{ED}$ .



Switching to the Error Detection Mode

Note 1:  
 $N \times 8$  CLK pulses are required to shift the serial image data  $N \times 8$  bits needed by N of MBI5169.

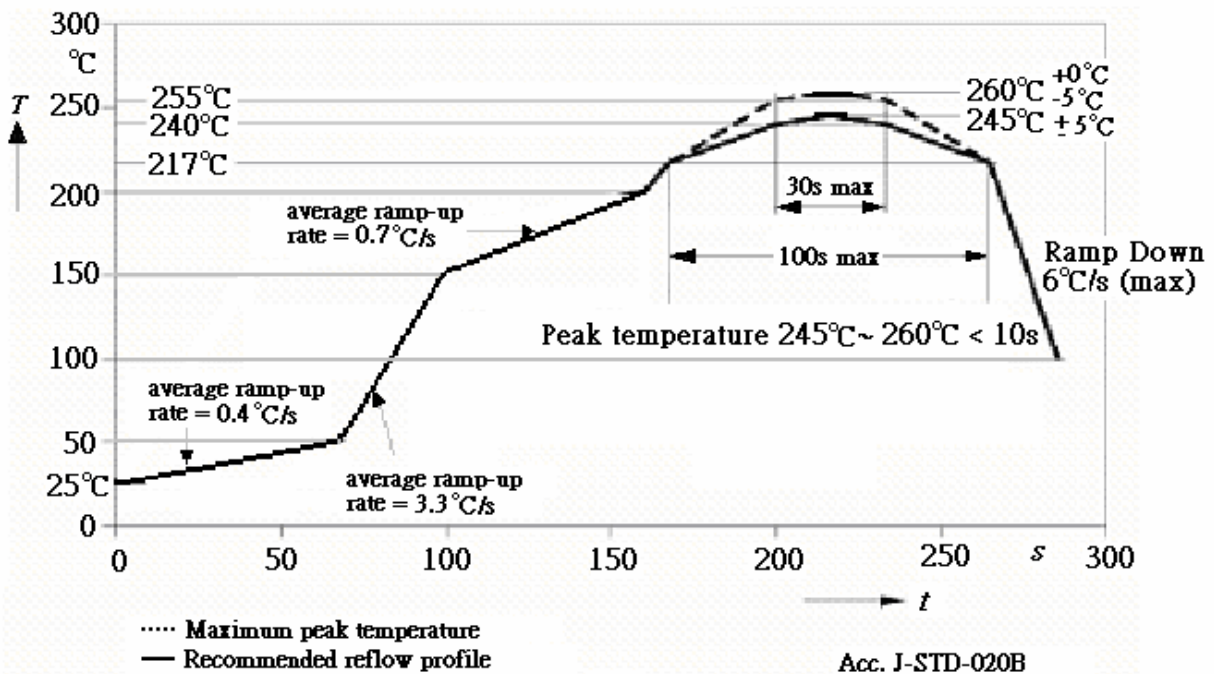
Note 2:  
 $T1 = 2 \text{ CLK}$  pluses are required to change input of Shift Register. And, when Short-Circuit Detection is executed, LEDs should be insufficiently biased during this period.  
 $T2 = 2 \mu\text{s}$  is required to obtain the stable error status result.  
 $T3 =$  the third CLK pulses is required before  $\overline{OE}/\overline{SW}/\overline{ED}$  goes Voltage High. The rising edge of CLK writes the error status codes back to the

Note 3:  
 The rising edge of CLK after the rising edge of  $\overline{OE}/\overline{SW}/\overline{ED}$  would shift the new serial image data and error codes. An LED error will be represented by a "0", to overwrite the original image data "1". Image Data k, k = 0... (N x 8 - 1), = all "1" is suggested.  $N \times 8$  CLK pulses shift all  $N \times 8$  error results (Error Status Code) via Node SDO, N-1.

### Application Information

#### Soldering Process of "Pb-free & Green" Package Plating\*

Macroblock has defines "Pb-Free & Green" to mean semiconductor products that are compatible with the current RoHS requirements and selected **100% pure tin (Sn)** to provide forward and backward compatibility with both the current industry-standard SnPb-based soldering processes and higher-temperature Pb-free processes. Pure tin is widely accepted by customers and suppliers of electronic devices in Europe, Asia and the US as the lead-free surface finish of choice to replace tin-lead. Also, it is backward compatible to standard 215°C to 240°C reflow processes which adopt tin/lead (SnPb) solder paste. However, in the whole Pb-free soldering processes and materials, 100% pure tin (Sn), will all require up to 260°C for proper soldering on boards, referring to J-STD-020B as shown below.



\*Note1: For details, please refer to Macroblock's "Policy on Pb-free & Green Package".

# MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

## Package Power Dissipation (P<sub>D</sub>)

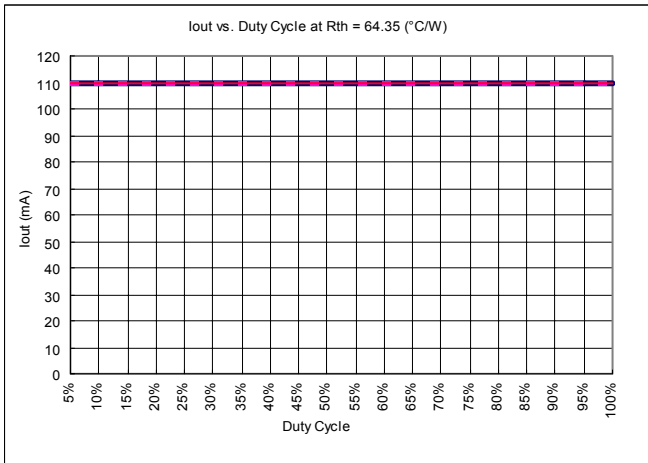
The maximum allowable package power dissipation is determined as  $P_D(max) = (T_j - T_a) / R_{th(j-a)}$ . When 8 output channels are turned on simultaneously, the actual package power dissipation is

$$P_D(act) = (I_{DD} \times V_{DD}) + (I_{OUT} \times Duty \times V_{DS} \times 8)$$

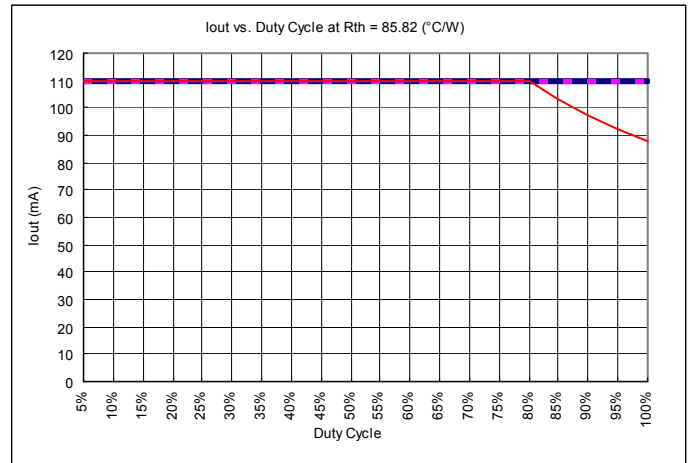
Therefore, to keep  $P_D(act) \leq P_D(max)$ , the allowable maximum output current as a function of duty cycle is

$$I_{OUT} = \{ [(T_j - T_a) / R_{th(j-a)}] - (I_{DD} \times V_{DD}) \} / V_{DS} / Duty / 8$$

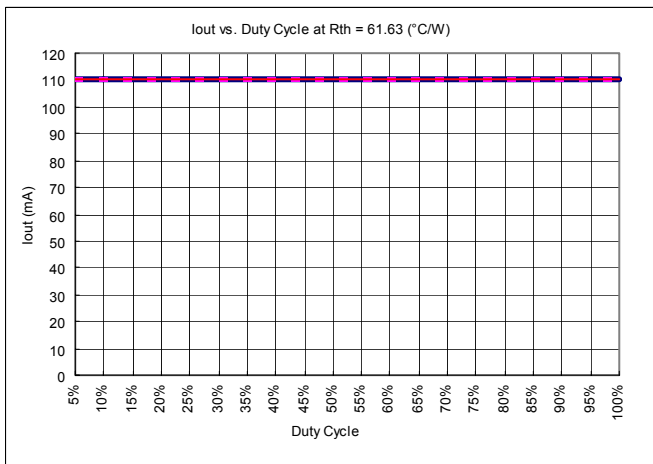
where  $T_j = 150^\circ C$ .



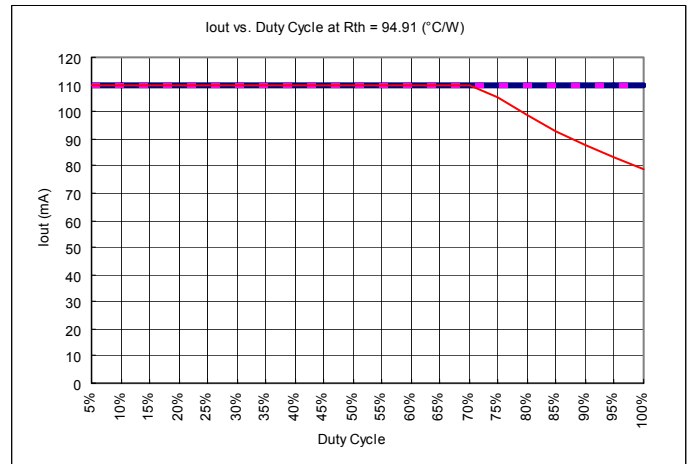
CN\GN Device Type



CD\GD Device Type



CDW\GDW Device



CP\GP Device Type

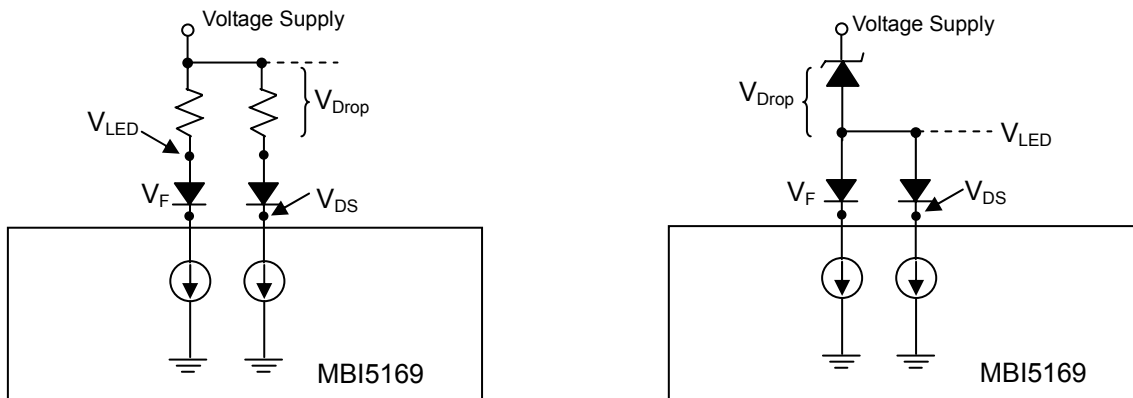
**Condition :**  $V_{DS} = 1.0V$ ,  $V_{DD} = 5.0V$ , 8 output channels active,  $T_a$  is listed in the legend below.

| Device Type |     | $R_{th(j-a)} (^{\circ}C/W)$ |       | Note |
|-------------|-----|-----------------------------|-------|------|
| CN          | GN  | 64.35                       | 60.20 |      |
| CD          | GD  | 85.82                       | 70.14 |      |
| CDW         | GDW | 61.63                       | 68.67 |      |
| CP          | GP  | 94.91                       | 80.00 |      |

## MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

### Load Supply Voltage ( $V_{LED}$ )

Considering the package power dissipating limits, users had better operate MBI5169 within  $V_{DS} = 0.4V \sim 1.0V$ . If  $V_{LED}$  is higher, for instance, than 5V,  $V_{DS}$  may be so high that  $P_{D(act)} > P_{D(max)}$ , where  $V_{DS} = V_{LED} - V_F$ . In this case, it is recommended to use as low supply voltage as possible or to arrange a voltage reducer,  $V_{DROP}$ . The voltage reducer lets  $V_{DS} = (V_{LED} - V_F) - V_{DROP}$ . Resistors or Zener diodes can be used as the reducers in the applications as shown in the following figures.



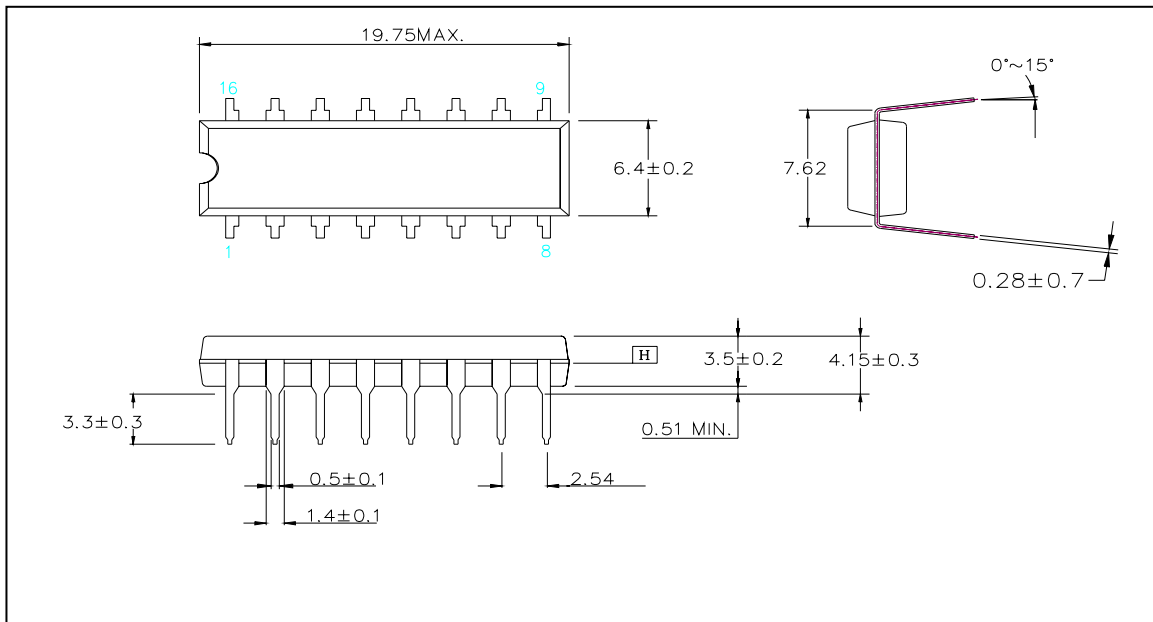
### Switching Noise Reduction

LED Driver ICs are frequently used in switch-mode applications which always behave with switching noise due to parasitic inductance on PCB. To eliminate switching noise, refer to "Application Note for 8-bit and 16-bit LED Drivers- Overshoot".

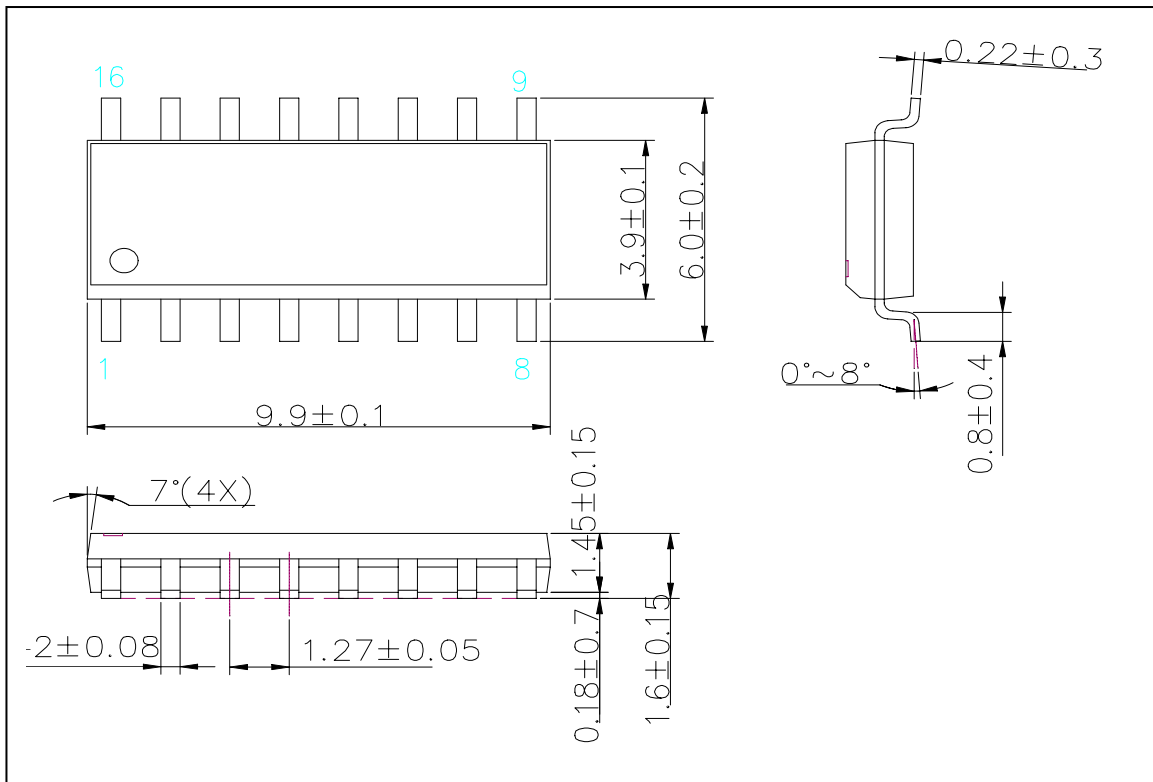


# MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

## Outline Drawings



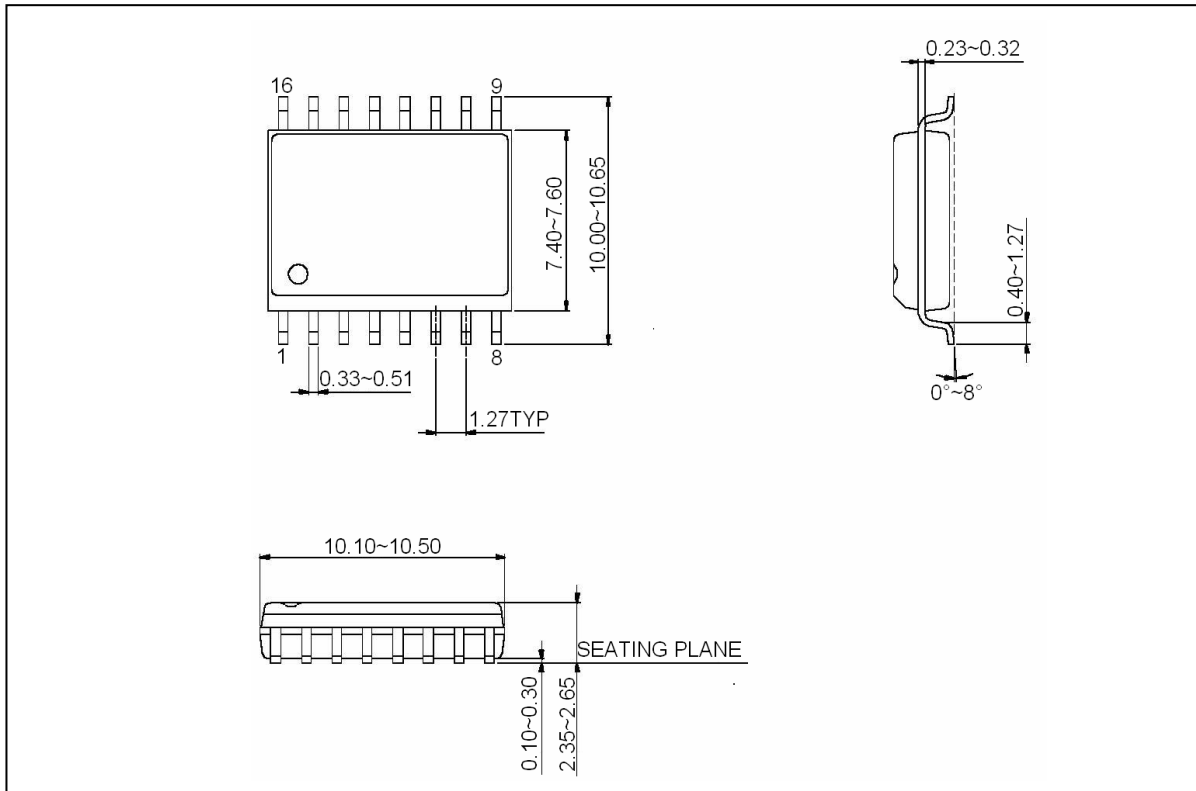
MBI5169CN\IGN Outline Drawing



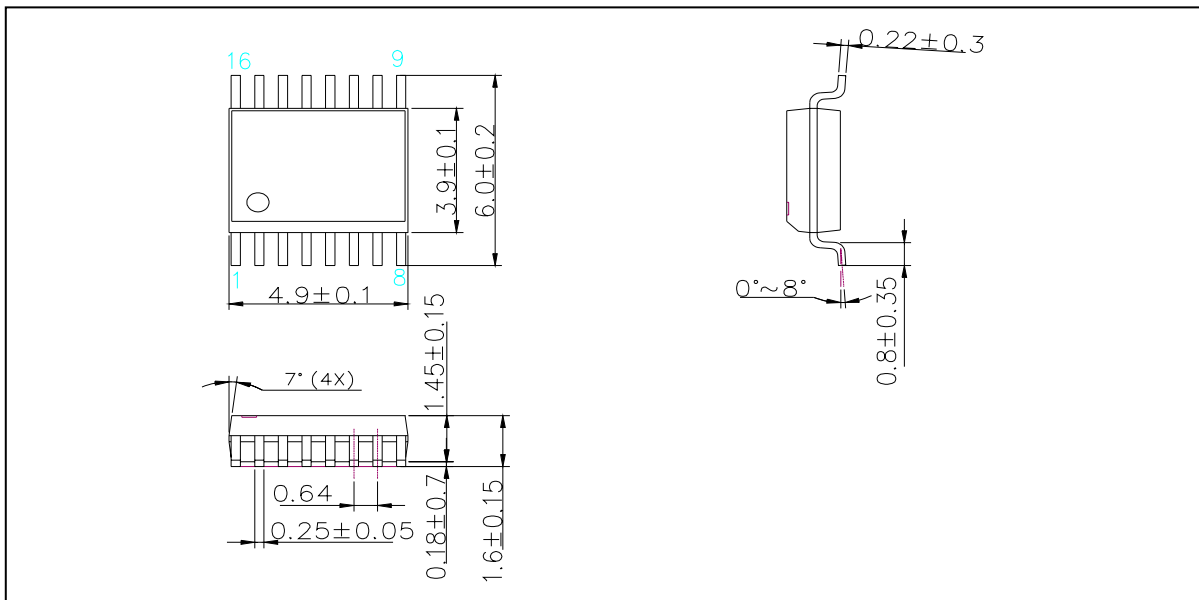
MBI5169CD\GD Outline Drawing

MBI5169

8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection



MBI5169CDW/GDW Outline Drawing

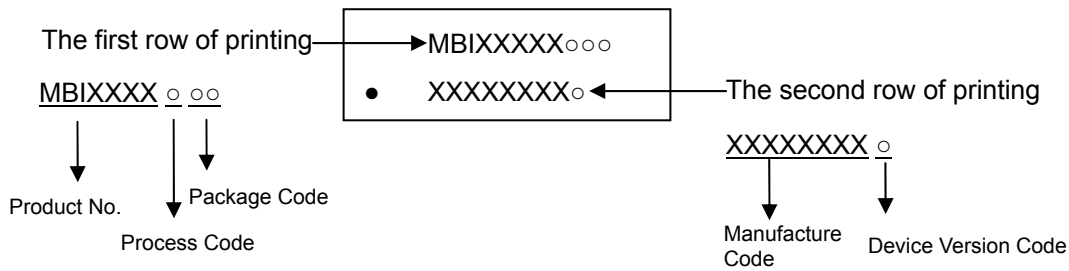


MBI5169CP/GP Outline Drawing

Note: The unit for the outline drawing is mm.

# MBI5169 8-Bit Constant Current LED Sink Driver with Open/Short Circuit Detection

## Product Top-mark Information



## Product Revision History

| Datasheet version | Device version code |
|-------------------|---------------------|
| VA.00             | Not defined         |
| VA.02             | A                   |

## Product Ordering Information

| Part Number | Package Type     | Weight (g) |
|-------------|------------------|------------|
| MBI5169CN   | P-DIP16-300-2.54 | 1.02       |
| MBI5169CD   | SOP16-150-1.27   | 0.13       |
| MBI5169CDW  | SOP16-300-1.27   | 0.37       |
| MBI5169CP   | SSOP16-150-0.64  | 0.07       |

| Part Number | “Pb-free & Green” Package Type | Weight (g) |
|-------------|--------------------------------|------------|
| MBI5169GN   | P-DIP16-300-2.54               | 1.02       |
| MBI5169GD   | SOP16-150-1.27                 | 0.13       |
| MBI5169GDW  | SOP16-300-1.27                 | 0.37       |
| MBI5169GP   | SSOP16-150-0.64                | 0.07       |

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