

The MBI5167 Application Note- Substituting for MBI5168

Foreword

The MBI5167 is designed for LED displays which need to operate at low current and match the luminous intensity of each channel. The digital part of the MBI5167 is the same as that of the MBI5168, and the output stage of the MBI5167 exploits PrecisionDrive™ technology with further enhancement in accuracy at low current range. In addition, the MBI5167 applies the same pin configuration of the MBI5168. This article is, therefore, to guide the developers to substitute the MBI5167 for the MBI5168 under the specific conditions.

Application circuit

The MBI5167 application circuit is the same as the MBI5168. Please refer to Figure 1.

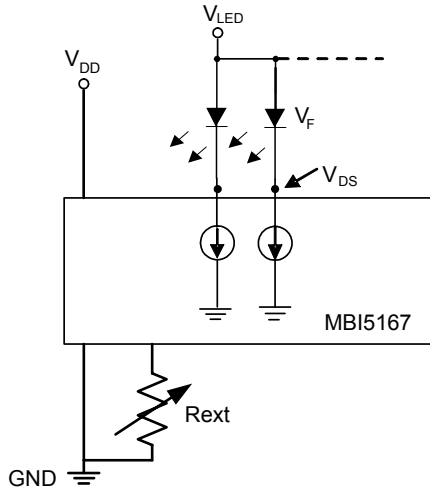


Figure 1.

Characteristic comparison between the MBI5167 and MBI5168

The following table is the characteristic differences between the MBI5167 and MBI5168.

Characteristics	MBI5167	MBI5168
Excellent output current accuracy between channels	$\pm 1.5\%$ (typ.); $\pm 3\%$ (max.)	$\pm 3\%$ (max.)
Constant output current (I_{OUT}) range that guarantees the current accuracy	3-30mA@ $V_{DD}=3.3V$	5-120mA@ $V_{DD}=3.3V$
	3-45mA@ $V_{DD}=5.0V$	5-120mA@ $V_{DD}=5.0V$
V_{DS} vs. I_{OUT} saturation point volt ($V_{DS,sat}$) at $I_{OUT}=25mA$	0.7V@ $V_{DD}=3.3V$	0.5V@ $V_{DD}=3.3V$
	0.6V@ $V_{DD}=5.0V$	0.45V@ $V_{DD}=5.0V$
Supply current (I_{DD}) at Rext open, \overline{OUTn} off ($V_{DD}=3.3V$)	1.4mA	0.8mA
Supply current (I_{DD}) at Rext open, \overline{OUTn} off ($V_{DD}=5.0V$)	1.7mA	3.0mA
Voltage of R-EXT (V_{R-EXT})	1.24V	1.253V
Output rise time of output ports	150ns (typ.)@ $V_{DD}=3.3V$	120ns (typ.)@ $V_{DD}=5.0V$
	140ns (typ.)@ $V_{DD}=5.0V$	
Output fall time of output ports	70ns (typ.)@ $V_{DD}=3.3V$	200ns (typ.)@ $V_{DD}=5.0V$
	65ns (typ.)@ $V_{DD}=5.0V$	
Built-in staggered output delay time	40ns	none
Package type	GD, GP	GN, GD, GDW, GP

Table 1.

The notes of using the MBI5167

In specific conditions, the MBI5167 is equivalent to the MBI5168. Please pay attention to the following items for further instructions.

1. The maximum output current that guarantees the accuracy of the MBI5167 (45mA) is much lower than that of the MBI5168 (120mA). If developers use the MBI5168 at $I_{OUT} > 45\text{mA}$, developers cannot use the MBI5167. The MBI5167's current accuracy is $\pm 3\%$ between channels and $\pm 6\%$ between ICs, when :
 - a. the output current application range is from 3mA~30mA and the V_{DD} is 3.3V.
 - b. the output current application range is from 3mA~45mA and the V_{DD} is 5.0V.
2. If the developer applies the same R_{ext} , I_{OUT} of the MBI5167 will be slightly lower than that of the MBI5168, since I_{OUT} and R_{ext} satisfy the equation: $I_{OUT} = (V_{R-EXT}/R_{ext}) \times 15$, and the V_{R-EXT} of the MBI5167 is 1.24V, which is different from that of the MBI5168. (MBI5168's $V_{R-EXT}=1.253\text{V}$).
3. The developer has to double check the voltage level of V_{LED} , the supply voltage to LEDs. At the same constant output current, the saturation point voltage ($V_{DS,sat}$) of the MBI5167 (i.e. 0.65V at $I_{OUT}=25\text{mA}$) is a little higher than that of the MBI5168 (i.e. 0.45V at $I_{OUT}=25\text{mA}$). The developer should refer to the datasheet V_{DS} vs. I_{OUT} relationship to keep the operating point at the flat zone.
4. The MBI5167 has a built-in staggered circuit to perform delay mechanism. The delay time of output channels is 40ns between even number channel $\overline{OUT2n}$ (e.g. $\overline{OUT0}$, $\overline{OUT2}$, $\overline{OUT4}$, etc.) and odd number channel $\overline{OUT2n+1}$ (e.g. $\overline{OUT1}$, $\overline{OUT3}$, $\overline{OUT5}$, etc.). This delay prevents large inrush current, which causes spikes and noise when output ports are turned on.
5. The output rising time of the MBI5167 is longer than that of the MBI5168, and the output falling time of the MBI5167 is shorter than that of the MBI5168. Therefore, the minimum \overline{OE} pulse width is longer. Developers could decide the \overline{OE} pulse width accordingly.
6. The MBI5167 provides only two package types including SOP (GD) and SSOP (GP) for developers' selection.

Summary

The MBI5167 can be easily used as an alternative to the MBI5168. With the constant current characteristics down to 3mA, and the built-in staggered circuit, the MBI5167 is more flexible on low power consumption and well suited for operating at low constant current conditions. Developers should follow this application note and pay attention to those items which are different from the MBI5168. And please refer to MBI's "General Application Note for LED Driver IC" for detailed DC operating, digital signal and circuit layout information.