Use of DGD2103 & DGD2104 in IR2103 & IR2104 Applications

Introduction

The DGD2103 and DGD2104 are high-side/low-side gate driver ICs capable of driving 600V MOSFET / IGBTs and have been designed to be a pin to pin, functionally compatible, drop in replacements to the IRS2103 and IRS2104 respectively. However, for applications using the older IR2103 or IR2104 there may need to be a small change of BOM to best match the gate drivers’ response.

Differences between the DGD2103/DGD2104 and the IR2103/IR2104

From the application perspective, the most significant differences in the specifications are rise/fall and output current capability as shown in Table 1 below.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
<th>DGD2103/DGD2104</th>
<th>IR2103/IR2104</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>IO+</td>
<td>Output high short circuit pulse current</td>
<td>130</td>
<td>290</td>
</tr>
<tr>
<td>IO-</td>
<td>Output low short circuit pulse current</td>
<td>270</td>
<td>600</td>
</tr>
<tr>
<td>tr</td>
<td>Turn-on rise time</td>
<td>70</td>
<td>170</td>
</tr>
<tr>
<td>tf</td>
<td>Turn-off fall time</td>
<td>35</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 1: Specification differences

A faster gate driver IC will turn-on and turn-off the MOSFET/IGBT quicker. In some applications, this will translate to a more efficient system because of less switching losses. But in some driver circuits, the faster dV/dt and dI/dt could cause more overshoot, and potentially greater –V_s undershoot, possibly causing a circuit to not function properly.

Hence, to use the DGD2103/DGD2104 in an IR2103/IR2104 application, and if the intention is to have the similar gate drive as the IR2103/IR2104, then the gate resistor would need to be increased to slow down the drive signal.

Matching the Rise/Fall time

A typical gate driver half-bridge circuit can be seen in Figure 1. Often for the HO and LO gate drives, external resistors (R_GH and R_GL) are used. To increase rise/fall time, R_GH and R_GL are increased.

Figure 1: Typical DGD2103 Half-Bridge Circuit
To best match the DGD2103/DGD2104 in an IR2103/IR2104 application, match the rise/fall time of the DGD2103/DGD2104 with that of the IR2103/IR2104 in that application. To show an example, using the circuit similar to Figure 1 except instead of the MOSFETs as load to the gate drive signal, a load capacitor ($C_L = 1000\text{pF}$) was used.

Figure 2: IR2103 with $R_{GL} = 3\Omega$, $t_r = 86\text{ns}$

Figure 3: DGD2103 with $R_{GL} = 3\Omega$, $t_r = 68\text{ns}$

Figure 4: DGD2103 with $R_{GL} = 100\Omega$, $t_r = 86\text{ns}$

Hence, by making the gate resistors, $R_{GH}$ and $R_{GL}$, larger you will have similar rise and fall times and will decrease the chances of any unwanted effects due to the higher $\text{dV/dt}$ and $\text{dI/dt}$. Note that in other driver circuits the value may be greater or less than $100\Omega$ depending on initial gate resistor value and MOSFET gate capacitance.
IMPORTANT NOTICE

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:
   1. are intended to implant into the body, or
   2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated

www.diodes.com