AND8484

DrMOS Interface to ON Semiconductor Controllers

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APPLICATION NOTE

Applicability

This app note applies to **NCP5369** DrMOS driver/FET devices driven by the following controllers:

NCP6151, 6151A, 6151D
NCP6131S, 6131N, 6131L
NCP6121
NCP6133
NCP6153

Introduction

The NCP5369 DrMOS driver from ON Semiconductor includes a voltage divider on the PWM input that forces the input into a known state if there is a high impedance on the input signal to that pin. When mated with some ON Semiconductor controllers such as the NCP6151 this can cause a boot problem with the controllers.

These controllers are designed to have a relatively high impedance (typically 10 kΩ to 200 kΩ) termination on their PWM pins. These termination resistors are used during the boot process of the controllers to determine the ADDR, I_{max} and VBOOT settings.

To get the initial settings, during power up, the controller puts both of the driver FETs in a non-conducting state and then applies a 10 μA current source to the output. The controller then measures the voltage on that pin and sets the appropriate values in the proper register.

This is a very effective method of presetting values with a minimum of pins. However, this presents a problem if the controller is driving a device with a relatively low input impedance, such as the NCP5369 DrMOS driver/FET combo.

The voltage divider acts as a load to the controller output and changes the voltage on that pin during the boot process and therefore affects the contents of those registers.

In order to boot correctly, the loading resistor must be changed to set the correct voltage with the internal impedance of the driver present. The following analysis and table give the corrected values of loading resistors.

This analysis is based on the impedance of the DrMOS being correct. This will only be the case if the DrMOS device is powered AND is in its enabled state. If the enable is pulled low during boot, the internal impedance will not be correct as the reference voltage associated with it is turned off and will float up to some intermediate value.

The equivalent circuit for the input of the NCP5369 is as follows:

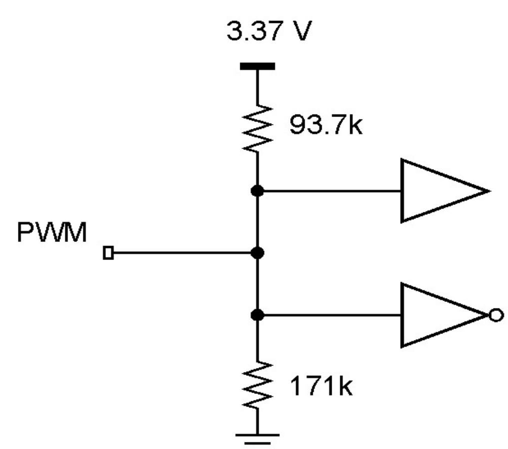

Figure 1. NCP5369 Equivalent Input Circuit

The equivalent interface circuit is shown in Figure 2. The Thevenin equivalent for the NCP5369 reduces that input to a single resistor and voltage source, while the 10 μA current source is shown in the controller. Based on these circuits, the equivalent programming resistor can be calculated.

A typical table of programming resistors from a controller data sheet is shown in Figure 3.

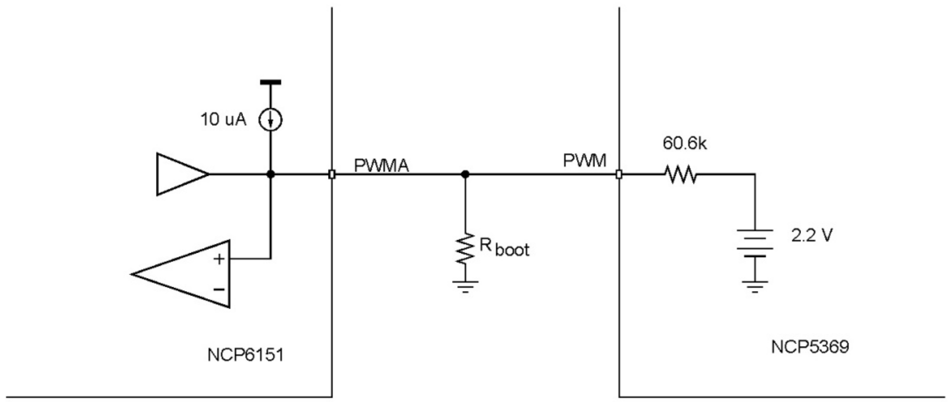

Figure 2. Equivalent Interface Circuit

BOOT VOLTAGE TABLE

Boot Voltage (V)	Resistor Value (Ω)
0	10k
0.9	25k
1.0	45k
1.1	70k
1.2	95k
1.35	125k
1.5	165k
VCC	Shutdown (V_{bootA} only)

Figure 3. Boot Voltage Table

The nominal boot voltage can be calculated from the value of the boot resistor and the 10 μA current source. For example, a 95 kΩ resistor should generate a voltage of 10 μA x 95 kΩ or 0.95 V.

To calculate the equivalent resistor when loaded with the input impedance of the NCP5369, the current through the new resistor value will be the 10 μA from the controller plus the current from the NCP5369. That current is the difference in the 2.2 V internal source and the boot voltage divided by the 60.6 kΩ resistor.

$$V_{BOOT} = 10\ \mu A \cdot R_{BOOT}$$

Where R_{BOOT} is the value from the controller data sheet.

$$i_{BOOT} = 10\ \mu A + \frac{2.2\ V - V_{BOOT}}{60.6\ k\Omega}$$

And

$$R_{BOOT\_NEW} = V_{BOOT}/i_{BOOT}$$

The following table shows many of the common values of required boot resistors.

Data Sheet Value	Adjusted Value
10 kΩ	2.26 kΩ
25 kΩ	5.97 kΩ
45 kΩ	11.7 kΩ
70 kΩ	20.3 kΩ
95 kΩ	31.4 kΩ
125 kΩ	49.3 kΩ
165 kΩ	88.0 kΩ

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