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AND9046/D

Integrated Load Detection for Video Drivers

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APPLICATION NOTE

Introduction

In this two parts application note illustrating the power saving features on the new generation of video drivers, we will continue with the output load detection explanation.

The idea of the first feature was to detect any incoming analog video signals into the driver (application note AND8473/D). The second step is now to check the status of the load to save even more power to the application.

It's costly and difficult for the chipset to detect the presence of a TV on the RCA connectors dedicated to the analog video channels, especially when the output of the video drivers need to be AC coupled. This load detection feature presented, answers the need by integrating the load detection into the video driver. Therefore the chipset does not need to manage the presence of the TV connection, resulting in simplified chipset code and lower power dissipation.

As a quick reminder, the video driver is build of a clamp or bias circuitry. The second stage is generally a 6^{th} order Butterworth low pass filter (LPF) and last stage will be the 6 dB amplifier (see figure below).

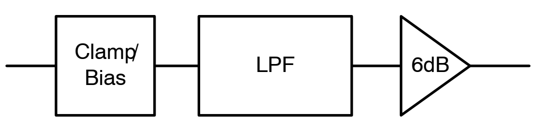

Figure 1. Typical Video Driver Architecture

One may think the load detection is a trivial function but it's only true with an amplifier driving a DC coupled line. In general, a discrete current sense technique is used to fulfill this requirement. Meanwhile video drivers are also required to drive AC coupled output lines through a large capacitor, generally more the 220 μF. In order to answer the widest range of applications, the newest video drivers like the NCS2584 are also able to detect the load when the outputs are AC coupled. The main idea is put the driver in a very low power consumption mode when the television is unplugged.

To have a good sense of the function, the focus needs to be brought on the amplifier stage. Two cases need to be demonstrated when the driver is OFF:

- AC coupled output
- DC coupled output

AC Coupled Output

When the output of the driver is OFF and AC coupled, two phases occur.

Phase 1:

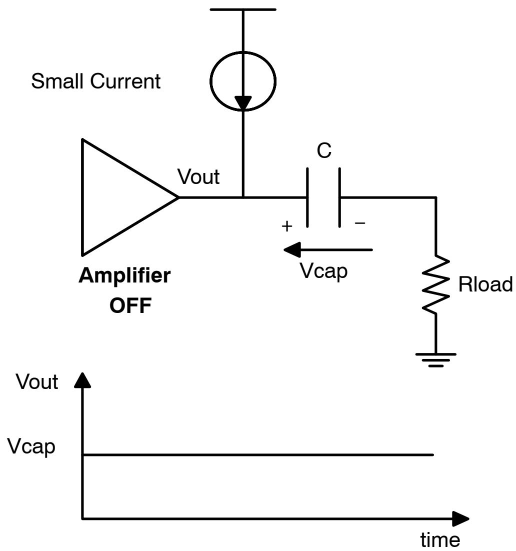

Figure 2. Phase 1, AC Coupled and Loaded Output

Phase 2:

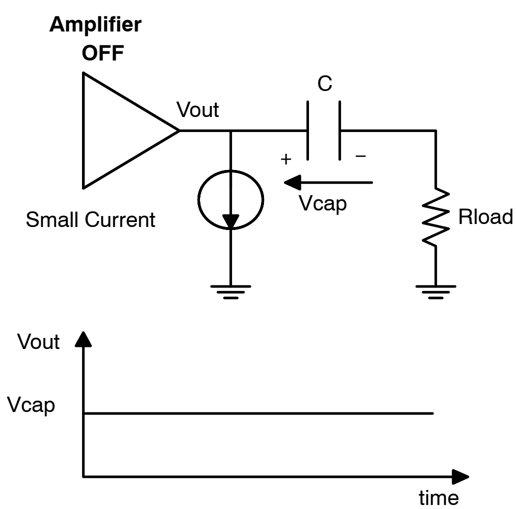

Figure 3. Phase 2, AC Coupled and Loaded Output

In the phase 1, a small current is pushed in the node of the output buffer stage. The output voltage V_{out} becomes equal to the voltage across the capacitor V_{cap}. V_{cap} is equal to the initial capacitor voltage and we assume the drop across the load due to the small current is negligible. The value of C (the output capacitor) is important (220 μF). Consequently, its charging time by the the small current can be considered as negligible. During the second phase the current on the output node is sunk and V_{out} is still equal to V_{cap} which remains unchanged.

Now, when the load is removed, the output voltage is going the vary from 0 to the device supply voltage level V_{CC}.

Phase 1:

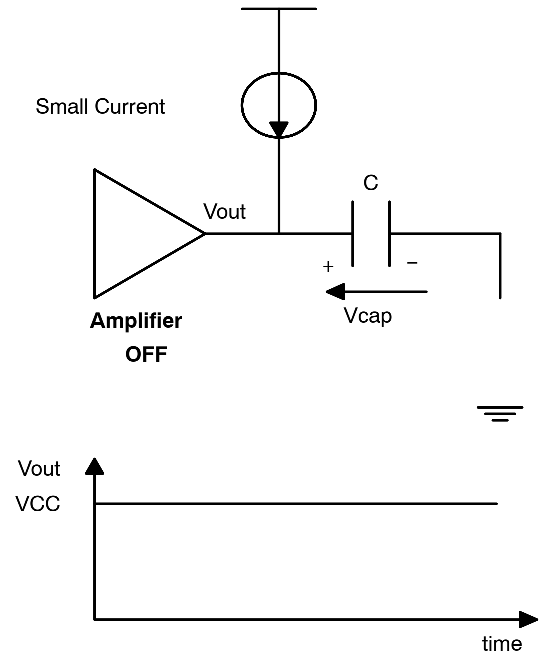

Figure 4. Phase 1, AC Coupled and Unloaded Output

Phase 2 :

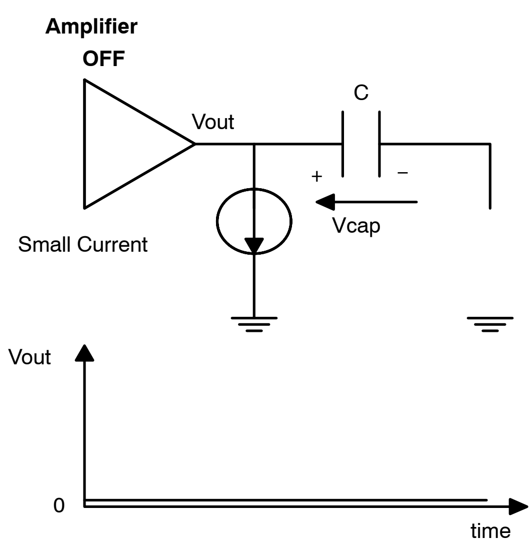

Figure 5. Phase 2, AC Coupled and Unloaded Output

In the phase 1, there is no more load to absorb the current fed into the output node. That’s why the voltage at this point goes to V_{CC}. For the same reason , in phase 2, the output voltage is brought to the ground.

In AC coupling configuration without load, the output voltage before the capacitor varies from 0 to V_{CC} periodically.

DC Coupled Output

Now, when the output of the driver is OFF and DC coupled, two phases also occur.

Phase 1:

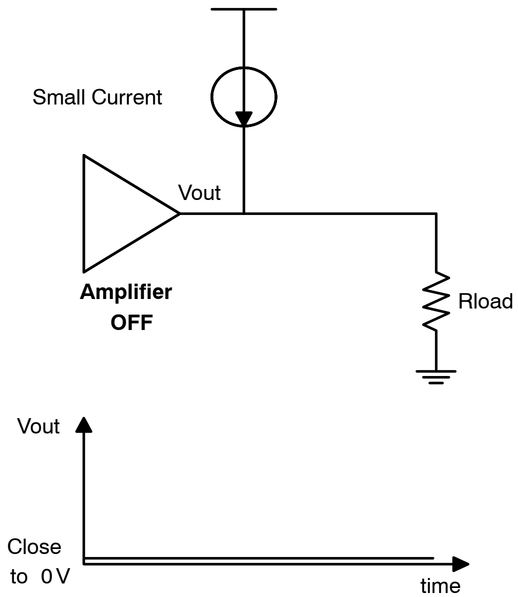

Figure 6. Phase 1, DC Coupled and Loaded Output

Phase 2 :

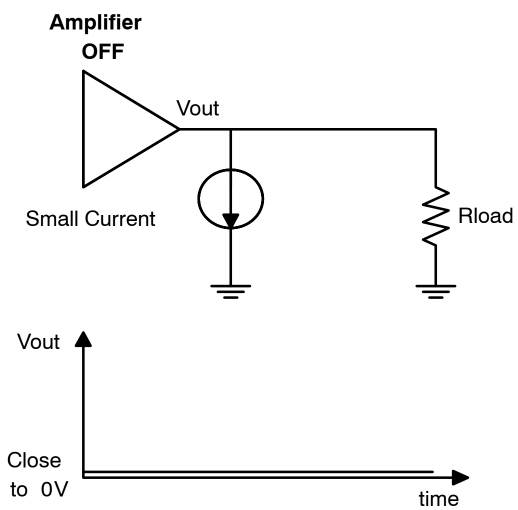

Figure 7. Phase 2, DC coupled and loaded output

During phase 1 and phase 2, the output capacitor is not present anymore to hold a voltage when the load is connected. The output voltage is consequently pulled close to 0 V.

When the load is disconnected and the output is DC coupled, the output voltage will swing between the rails. The same two phases occur as described when the output is AC coupled.

Phase 1:

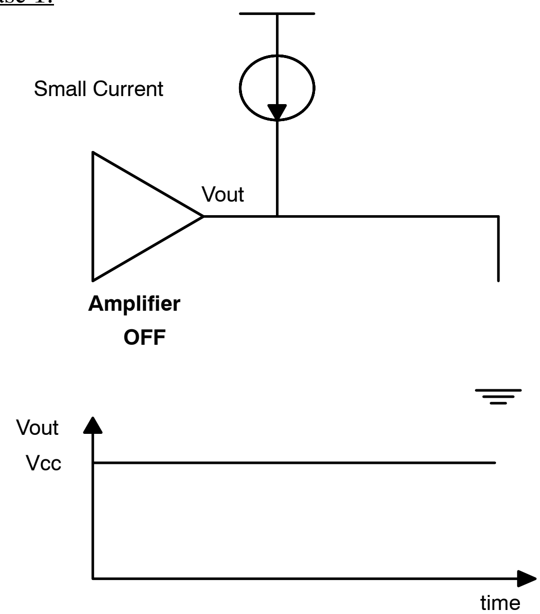

Figure 8. Phase 1, DC Coupled and Unloaded Output

Phase 2 :

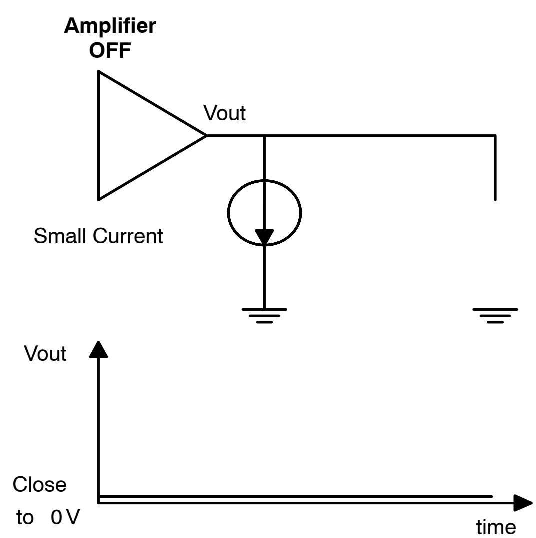

Figure 9. Phase 2, DC Coupled and Unloaded Output

Now understanding those phenomenons, a simple voltage comparator is needed to operate the detection of the load.

Conclusion

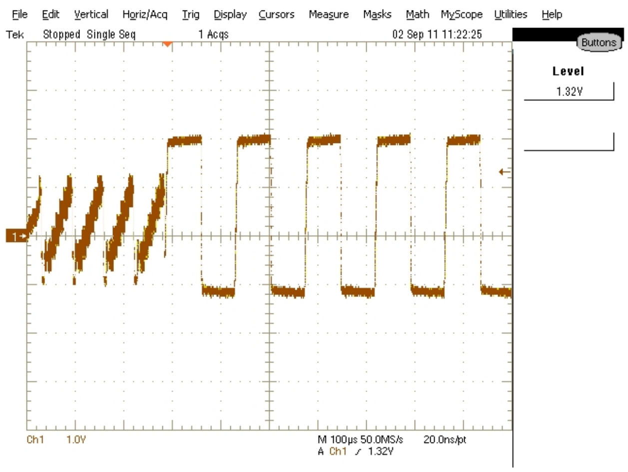

Figure 10. Transition from Loaded to Unloaded AC Coupled Output

The figure above illustrates a Cvbs type signal sent through the driver until the TV is unplugged. At this point of time, the output swings between the rails. The square signal is centered on 0 because it is measured after the capacitor.

The Figure 11 illustrates what is happening on the driver output when the user plugs the TV RCA cable back in the player. The device leaves its switching mode and directly drives the video signal.

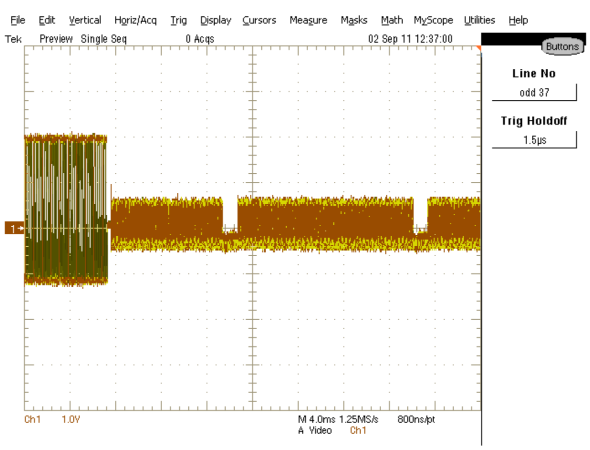

Figure 11. Transition from Unloaded to Loaded AC Coupled Output

It's best to understand the general behavior of those two types of detection through a state machine. The input video signal detection being treated in the application note AND8473/D "Integrated Input Auto-Detection Mode for Video Drivers".

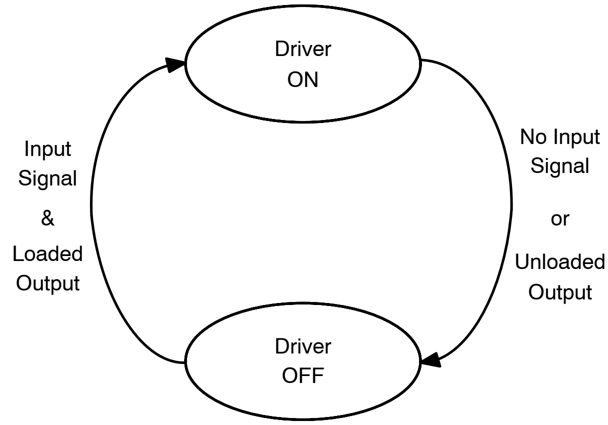

Figure 12. State Machine

The driver is only turned ON when both conditions are met: receiving the proper video signal from the micro controller and having the TV plugged into the player to create a load for the driver. In any other case, the driver will be turned OFF.

This latest generation of analog video drivers has been designed to support the power saving challenges of the consumer industry. Due to this embedded detection feature, system designers will not have to worry about how to improve their design for the analog video outputs. The NCS2584 will help to simplify the control of the video driver and will also be the best fit in an Energy Star® design compliance environment.

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