

## ***Generating compliant NTSC/PAL video signals and detecting output short circuit conditions on the OMAP3 family of devices.***

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### **ABSTRACT**

Various devices in the OMAP 3xxx family of processors include video encoders capable of generating NTSC or PAL formatted video signals. Due to the process technology used for these devices the amplitude of the output video signal is limited to around 0.8V peak output when utilizing the internal direct drive video buffer. This signal is technically not compliant with either the NTSC video standard or the PAL video standard.

In most applications the reduced video signal amplitude is not a problem due to the fact that most video sink devices implement automatic gain circuits at their inputs, and in many case can even handle and correct for video signals down as low as 5% of a standard video signal.

In order to generate a more standards compliant signal it is necessary to externally amplify the video signal generated by the OMAP device. This application note discusses the requirements to generate a compliant signal and the implications of using an external buffer.

One consideration which should be taken into account in any system where the end user is able to access output connections is that of incorrect connectivity. In particular inadvertent shorting of outputs to ground can cause excessive current flow through the output drive circuits. This application note additionally discusses a method of detecting an fault output short circuit condition on the TVOUT connections from the OMAP family of devices.

The optimal configuration for the lowest power consumption in applications where the TV out functionality is not required is discussed.

Finally, general analog guidelines are discussed.

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Revision	Date	Modifier	Comments
0.1		A0212178	Original release
0.2	May 22nd 2009	A0212178	Updated un-buffered diagram to include stabilization LC

**Preliminary**

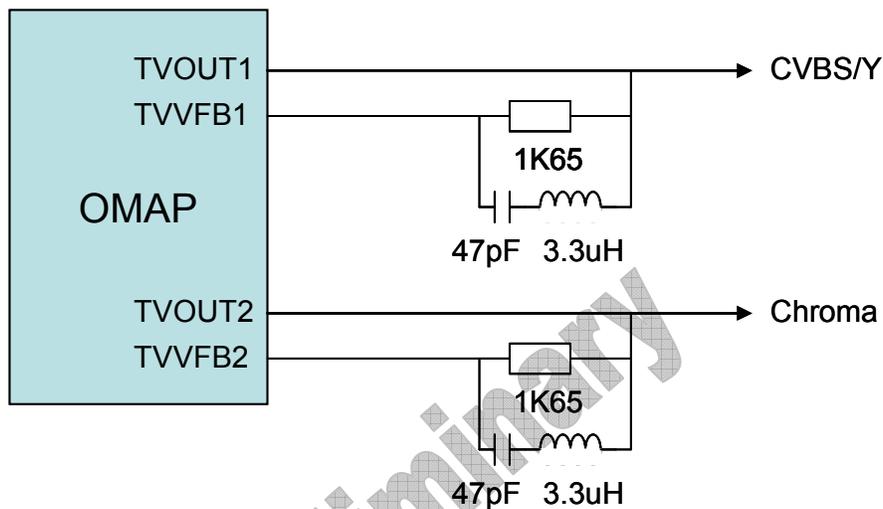
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Preliminary

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## Normal operation

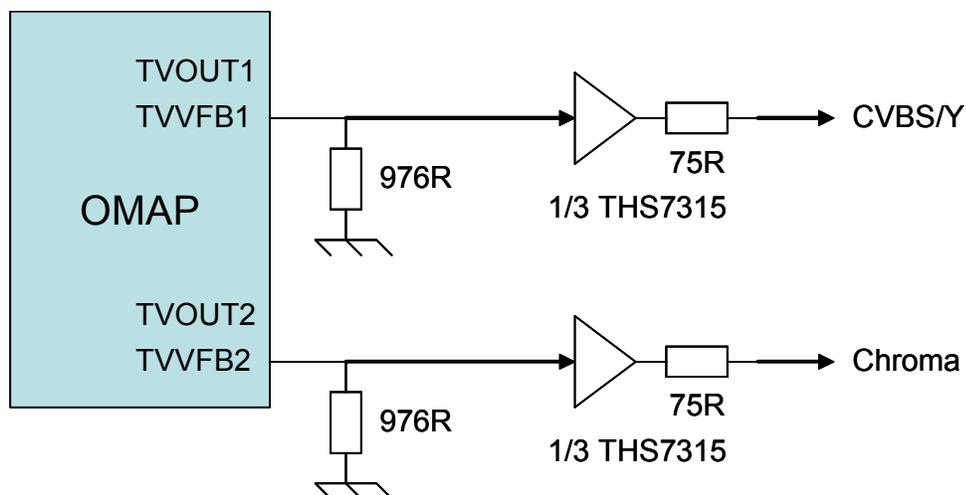
Under normal operation the analog output should be configured as shown below. This configuration will produce an analog output with a full scale range of approximately 0.8V. The TV detection function can be enabled in order to detect whether an external TV is connected. It should be noted that with this configuration that there is no 75R series resistor. If the output is shorted to ground there is the possibility of damaging the OMAP device. This short circuit fault condition cannot be distinguished from a connected TV condition without additional external circuitry. The inclusion of the inductor and capacitor in parallel with the feedback resistor significantly improves the immunity to high cable capacitances which can otherwise cause oscillations on the output video.



**Figure 1. Video output with internal buffers.**

## Buffered operation

In order to achieve a correct 1.21V video signal at the destination device input a 75R series line drive should be used, requiring an output swing of 2.42V at the buffer output. This voltage range is outside the limits of the OMAP internal video buffer therefore the internal buffer needs to be disabled and an external buffer provided as shown below.



**Figure 2. Video output with external buffers.**

In addition to the hardware modifications shown it is also necessary to configure the video DAC output to bypass the internal video buffer.

The following changes to the default video output configuration must be made.

- 1) 0x4800 22D8 (CONTROL\_DEVCONF1) bit 18 (TVOUTBYPASS) should be set to '1' to bypass the internal video buffer.
- 2) 0x4805 0CC4 (VENC\_OUTPUT\_CONTROL) bit 3 (VIDEO\_INVERT) should be set to '0'.

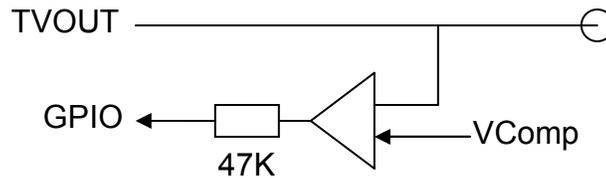
This configuration produces a correct 1.21V analog signal amplitude at the input of a 75R terminated video sink, and presents a correct 75R series resistance for improved signal integrity and short circuit tolerance. Due to the fact that the buffer is present between the OMAP device and the video sink the TV detect functionality will no longer be able to detect the presence of a video sink.

## Output short circuit detection

Care should be taken to ensure that the output video cannot be shorted when enabled. If any output is shorted to ground, even for short periods of time, then there is the possibility of damaging the OMAP device. If there is a possibility of shorting the output video to ground then it is advisable to add an external detection circuit similar to the circuit shown below. Under normal conditions the TVOUT signal will have a DC offset of approximately 400mV. When the output is short circuited the voltage level at the output will be significantly reduced, which can be detected with a comparator. Software running on OMAP should detect the output of the comparator and shut down the TV output buffer if a short circuit or low impedance output is detected. Additionally the application software should indicate to the user that the fault condition has been detected and request that the user attempt to fix the problem before the TV output is re-enabled. The series 47K resistor is included to ensure that a high level output from the comparator does not inject excessive current into the lower voltage level GPIO input pin. If this resistor is not present then the comparator may inject a large current through the GPIO input pin ESD structure and damage the OMAP device and/or the comparator.

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The same short circuit detection can be used for the buffered output as for the non buffered output if desired, but is not necessary to protect the OMAP or buffer devices due to the series 75R resistors. When used with a buffered output the comparator input should be taken from the output connector output.



VComp = approx 200mV

Figure 3. Output short circuit detection.

Preliminary

## TV output unused

When the TV output is not required then the following configuration should be implemented in order to reduce the power consumption to its minimum value.

The analog pins tv\_ref, vssadac, vdda\_dac, tv\_out1/2 and tv\_vfb1/2 should be grounded.

To avoid internal current leakage, the following bits must be set to 0:

DSS.DSS\_CONTROL[5] DAC\_POWERDN\_BGZ

DSS.VENC\_OUTPUT\_CONTROL[2:0]

PRCM.CM\_FCLKEN\_DSS[2] EN\_TV

CONTROL.CONTROL\_DEVCONF[18] TVOUTBYPASS

## General considerations

As with all sensitive analog signals it is important to ensure that the video signals are balanced and protected from external interference as much as possible. Additionally the power supplies sourcing the analog circuits must be clean and typically not directly connected to other sources of noise, particularly digital switching noise.

The following recommendations should be considered when laying out the PCB for the TV out signals.

- 1) Try to ensure a 75R trace impedance between the OMAP device and the output connector.
- 2) Ensure a good, solid ground return between the output connector and the OMAP device.
- 3) Try to guard the signal traces on either side with ground traces which have good, low resistance connectivity both at the OMAP device and the output connector.
- 4) Try to route high frequency signals as far away as possible from the analog signals.
- 5) Try to route digital signals and other possible noise coupling sources perpendicular to the analog traces whenever the two types of traces pass close.
- 6) Ensure good power supply de-coupling and isolation for analog supplies, keeping de-coupling capacitors as close as possible to the OMAP supply pin.
- 7) Ensure good VRef de-coupling, keeping de-coupling capacitors as close as possible to the OMAP de-coupling pin.