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LUMA GAIN BACKGROUND

The ADV7180/ADV7181C luma gain is purely digital and is implemented using a digital multiplier which has the advantage of making the luma gain independent of process and temperature. The luma gain is adjusted either automatically by an Automatic Gain Control (AGC) or manually.

LUMA AGC

The Luma AGC monitors changes in the horizontal sync depth and it adjusts the gain accordingly. The input horizontal sync depth range for which the Luma AGC will compensate for is shown in the following table. Also shown in the table is the value of the **Luma Gain Control Register LMG[11:0]** at these voltages. The AGC does not apply any more gain/attenuation outside of these voltages. The Luma AGC, by default, has a peak white detector enabled which will stop increasing the Luma level when it reaches a certain level. For the purposes of this document, it should be turned off when using the AGC write 0b'100 to **AGC Mode Control Register LAGC[2:0]** (Address 0x2C).

Part	Standard	Minimum Sync Depth		Maximum Sync Depth*	
		Input Sync Depth	LMG[11:0] Readback (decimal)	Input Sync Depth	LMG[11:0] Readback (decimal)
ADV7180: 64 and 40 lead models	NTSC M	95 mV	3545	404 mV	1123
	PAL B/G	95 mV	3801	424 mV	1154
ADV7180: 32 and 48 lead models	NTSC M	90 mV	3545	404 mV	1082
	PAL B/G	90 mV	3801	424 mV	1104
ADV7181C	NTSC M	70 mV	3545	404 mV	842
	PAL B/G	70 mV	3801	424 mV	861

*Limited by max sync depth of source used. ADV7180/ADV7181C can support larger sync depths.

PROGRAMMING THE MANUAL LUMA GAIN

Two I²C writes are required to program a manual gain.

1. Disable the AGC: Write 0b'100 to the **AGC Mode Control Register LAGC[2:0]** (Address 0x2C).
2. Write the desired gain: Write the desired value in hex to the **Luma Gain Control Register LMG[11:0]** (Address 0x2F/0x30) where bits [3:0] of 0x2F are the MSBs [11:8] and bits [7:0] of register 0x30 are the LSBs [7:0].

Since the relationship between the **Luma Gain Control Register LMG[11:0]** and the resulting luma gain is uncertain, the ADV7180/ADV7181C must be calibrated in order to find out this relationship, as described in the following section.

CALIBRATING IN ORDER TO APPLY A MEANINGFUL MANUAL LUMA GAIN

Brief Description

Calibrate by applying a standard CVBS signal at the input to the Video System and note the luma level. Then measure the luma level of the CVBS signal at the output and manually adjust the **Luma Gain Control Register LMG[11:0]** until they are equal. This value in the **Luma Gain Control Register LMG[11:0]** gives a gain of 1 and it is called the Luma Calibration Factor. Note that only decimal values between 1024 to 4095 are allowed to be written to the **Luma Gain Control Register LMG[11:0]** (that is, 0x400 to 0xFFF). The following formula is used to calculate the luma gain.

$$Luma\ Gain = \frac{LMG[11:0]_{decimal}}{Luma\ Calibration\ Factor}$$

Note: LMG[11:0] is a decimal value between 1024 and 4095.

For the ADV7180 evaluation boards, the Luma Calibration Factor tends to be in the range of 1500 to1600 (decimal). For the ADV7181C evaluation boards, the Luma Calibration Factor tends to be in the range of 1160 to 1210 (decimal). The Luma Calibration Factor has to be calculated separately for PAL and NTSC.

Detailed Description

These steps describe how to calculate the Luma Calibration Factor for an ADV7180/ADV7181C evaluation board.

1. Using a video source, set the content to a grey field and apply as a standard CVBS signal to the CVBS input of the board.
2. Using an oscilloscope, measure the signal at the CVBS input to ensure its sync depth, color burst and luma are at the standard levels.
3. Connect up the output parallel pixel bus of the ADV7180/ADV7181C to a serializer and connect the serial data into the Serial Data Input (SDI) of a Tektronix VM700 video measurement set.
4. On the VM700, select *Configure->Digital*.
5. Press the waveform button on the VM700 and measure the luma level correctly from the black level. Turn off the Luma AGC and manually change the value of the **Luma Gain Control Register LMG[11:0]** until the luma level on the VM700 matches the input measured in step 2. This value, in decimal, is the Luma Calibration Factor.

This method is the most accurate. However, if you are unable to access a VM700, you can measure the luma level at the output of the encoder on the ADV7180/ADV7181C evaluation board. The encoder may apply some gain of its own but, in experiments, this was found to be within 1 to 2% of the values achieved using the SDI of the VM700. Therefore, the gain of the encoder can be considered to be negligible.

Note:

The ADV7180 evaluation boards have a 36Ω/39Ω resistor divider on all the analog inputs in order to keep the video signal in the ADC range. To calculate the Luma Calibration Factor without the resistor divider, repeat the previous steps but in step 2 measure the CVBS signal at the Analog video input pin of the part.

REVISION HISTORY

02/14 – Rev. A: Format updated
12/10 – Rev. 0: Initial Version

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