SD384SPIEVK
LMH0384 Evaluation Board with SPI Interactive GUI User Guide

National Semiconductor
EVK User Manual
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Overview

The SD384SPI Evaluation Kit (EVK) enables evaluation of the LMH0384 3G/HD/SD SDI Adaptive Cable Equalizer. A graphical user interface allows managing the SPI registers of the LMH0384 device.

Evaluation Kit (SD384SPIEVK) Contents

The EVK contains the following parts:

- SD384EVK board assembly with the LMH0384 cable equalizer
- SPA dongle (SPI→USB card)
- USB cable
- 6-pin parallel cable
- SD384SPIEVK User Guide

Evaluation Board Description

Figure 1 shows the SD384 evaluation board and highlights some of its features.

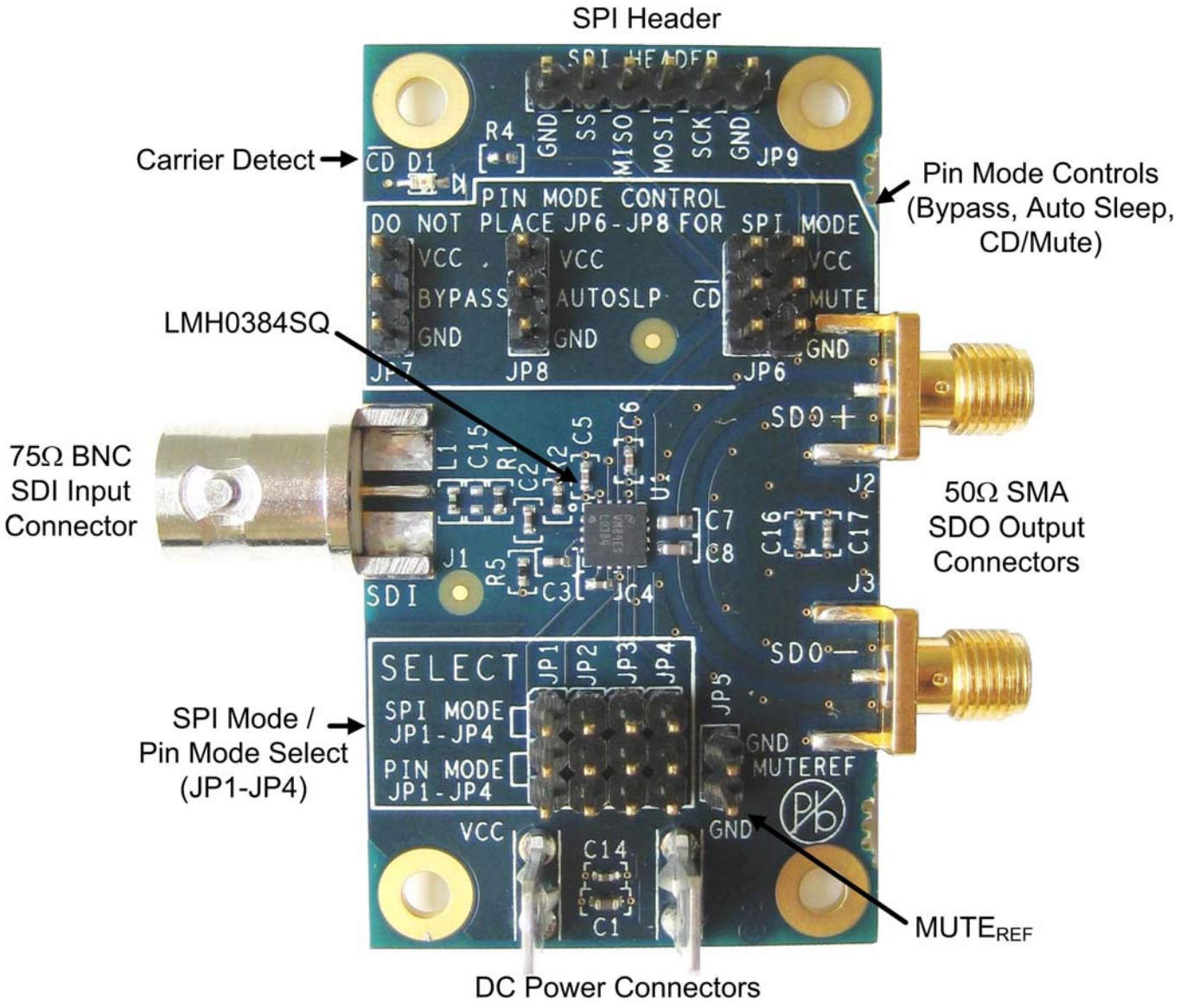


Figure 1. SD384 Evaluation Board

SDI Input and SDO Output

The SDI input connector (J1) is a 75Ω BNC connector. The SDI input should conform to the SMPTE 424M, SMPTE 292M, or SMPTE 259M standards.

The SDO output connectors (J2 and J3) are 50Ω SMA connectors. When using only one side of the output pair, the other side should be terminated with a 50Ω SMA termination. For example, when only using the SDO output, $\overline{\text{SDO}}$ should be terminated with a 50Ω SMA termination.

DC Power Connectors

The VCC and GND power connectors should be powered with a DC input voltage of 3.3V ± 5% (3.6V maximum).

SPI Mode / Pin Mode Select (JP1 – JP4)

JP1, JP2, JP3, and JP4 are used to select between SPI Mode or Pin mode. To select Pin Mode, set four jumpers as shown in Figure 2, and to select SPI Mode, set four jumpers as shown in Figure 3. Either Pin Mode or SPI mode must be selected for proper operation; do not leave JP1-JP4 open.

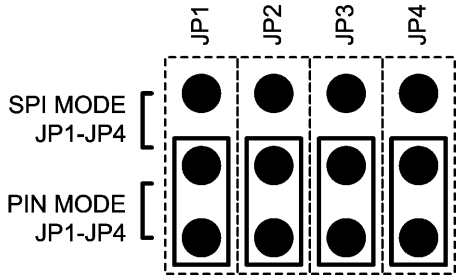


Figure 2. Pin Mode Select

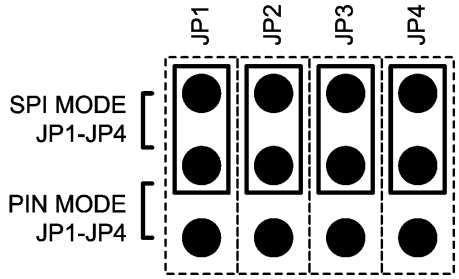


Figure 3. SPI Mode Select

$MUTE_{REF}$ (JP5)

JP5 allows control of the $MUTE_{REF}$ function and may be used in either Pin Mode or SPI Mode. $MUTE_{REF}$ is an input voltage used to set the threshold for $\overline{CD}$. The $MUTE_{REF}$ DC input voltage should be between 0V and 3.3V. Refer to the LMH0384 datasheet for details. Leave JP5 unconnected for normal operation.

Pin Mode Controls (JP6 – JP8)

JP6, JP7, and JP8 are used to control LMH0384 features while the device is configured for Pin Mode. **Jumpers should not be placed on JP6, JP7, or JP8 while the device is configured for SPI Mode.**

$\overline{CD}$ and MUTE (JP6)

JP6 allows Carrier Detect ($\overline{CD}$) monitoring and MUTE control. $\overline{CD}$ is high when no input signal is present. MUTE may be used to force the outputs on or off, or tied to $\overline{CD}$ to allow automatic mute operation based on the input signal. To activate mute and force the outputs into a muted condition, set the jumper to pull MUTE to VCC. To turn off mute so that the outputs will never mute, set the jumper to tie MUTE to GND. For normal operation, set the jumper to tie $\overline{CD}$ to MUTE for automatic mute control. The LMH0384 MUTE pin has an internal pulldown (to disable mute), so JP6 may be left unconnected and the LMH0384 will never mute.

BYPASS (JP7)

JP7 allows control of the equalization BYPASS function. To put the device into bypass mode, set the jumper to pull BYPASS to VCC. To turn off bypass (for normal operation) set the jumper to pull BYPASS to GND. The LMH0384 BYPASS pin has an internal pulldown (to disable bypass), so JP7 may be left unconnected for normal operation.

AUTO SLEEP (JP8)

JP8 allows control of the AUTO SLEEP function. To put the device into auto sleep mode in which it will power down when no input is detected, set the jumper to pull AUTO SLEEP to VCC. To turn off auto sleep and prevent the LMH0384 from automatically powering down, set the jumper to pull AUTO SLEEP to GND. The LMH0384 AUTO SLEEP pin has an internal pullup (to enable auto sleep), so JP8 may be left unconnected to enable auto sleep mode.

SPI Header (JP9)

JP9 is the SPI (Serial Peripheral Interface) header. It allows access to the SPI pins ($\overline{SS}$, MISO, MOSI, and SCK) while the LMH0384 is in SPI mode. To use the SPI interactive GUI, plug the 6-pin parallel cable between this header and JP7 on the SPA dongle to connect the pins one-for-one as shown in Table 1. The SPA dongle requires special software and must be connected to the PC via the USB – see the Software Setup section.

Table 1. SPI Connections between SD384 and SPA Dongle

SD384 JP9			SPA dongle JP7	
Pin #	**Name**		**Pin #**	**Name**
1	GND	→	1	GND
2	SCK	→	2	MCK
3	MOSI	→	3	MOSI
4	MISO	→	4	MOSI
5	SS	→	5	SS
6	GND	→	6	GND

Carrier Detect LED (D1)

D1 shows the status of Carrier Detect. This LED is GREEN when an input signal has been detected, and OFF when no input is detected. D1 shows the status of Carrier Detect while in Pin Mode or SPI Mode.

SPA Dongle Description

The SPA dongle is required to use the SPI interactive GUI. The SPA dongle connects between the LMH0384 SPI pins and the USB input of a PC. The SPA dongle is shown in Figure 4. JP7 is the SPI Header. The SPA dongle is powered through the USB, and the D1 LED is RED when the SPA dongle is connected to a PC via the USB to indicate the board is powered.

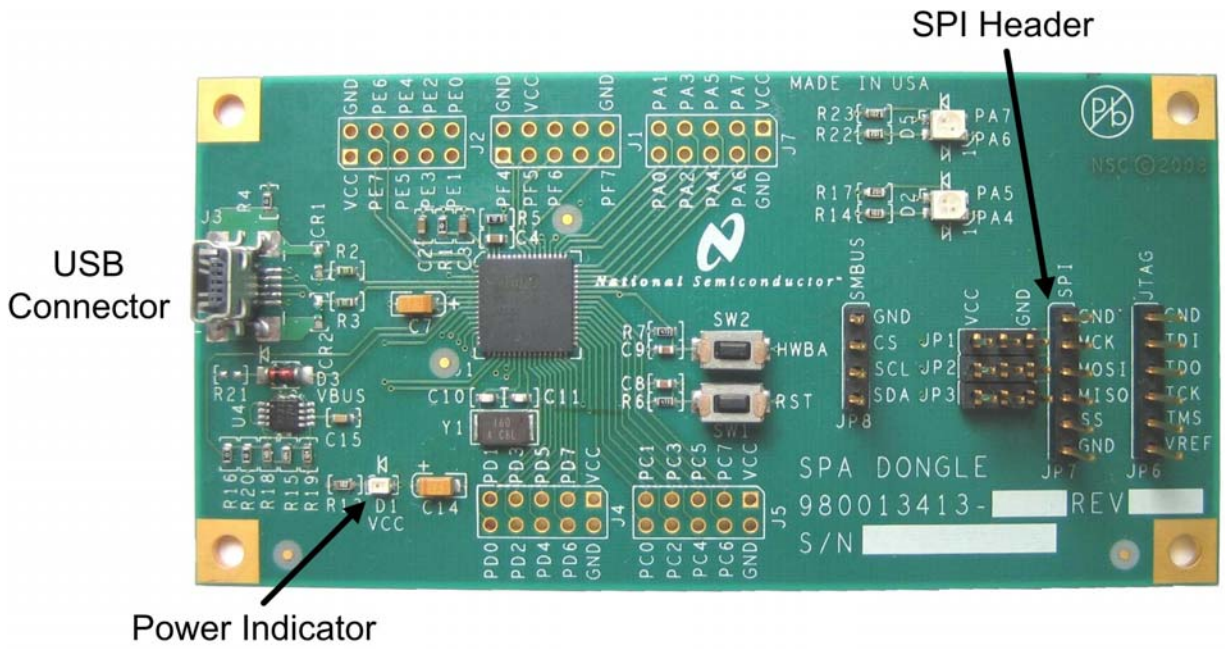


Figure 4. SPA Dongle

Software Setup

System Requirements

Operating System: Windows XP or Vista
USB: 2.0

Installation

Download the latest software from the LMH0384 Evaluation Board page, which can be found here: http://www.national.com/analog/interface/sdi_sdv_evaluation_boards. Extract the ALPF_monthdayyear_major version_minor version.exe" (ex. ALPF_07082009_127_0005.exe) file to a temporary location that can be deleted later.

Make sure the SPA dongle is not connected to the PC. The following installation instructions are for the Windows XP Operating System.

Install the ALP software
Execute the ALP Setup Wizard program called "ALPF_monthdayyear_major version_minor version.exe" (ex. ALPF_07082009_127_0005.exe) that was extracted to a temporary location.

There are 7 steps to the installation once the setup wizard is started:

1. Select the "Next" button.
2. Select "I accept the agreement" and then select the "Next" button.
3. Select the location to install the ALP software and then select the "Next" button.
4. Select the location for the start menu shortcut and then select the "Next" button.
5. There will then be a screen that allows the creation of a desktop and Quick Launch icon. After selecting the desired choices select the "Next" button.
6. Select the "Install" button, and the software will then be installed to the selected location.
7. Uncheck "Launch Analog LaunchPAD" and select the "Finish" button. The ALP software will start if "Launch Analog LaunchPAD" is checked, but it will not be useful until the USB driver is installed.

Connect JP9 of the SD384 evaluation board to JP7 of the SPA dongle via the 6-pin parallel cable as shown in Table 1. Power on the SD384 evaluation board with a 3.3 VDC power supply. Connect the SPA dongle to the PC with the USB cable. The "Found New Hardware Wizard" will open on the PC. Proceed to the next section to install the USB driver.

Install the USB driver
There are 6 steps to install the USB driver:

1. Select "No, not at this time" then select the "Next" button.
2. Select "Install from a list or specific location" then select the "Next" button.
3. Select "Search for the best driver in these locations". Uncheck "Search removable media" and check "Include this location in the search".
4. Browse to the Install Directory which is typically located at "C:\Program Files\National Semiconductor Corp\Analog LaunchPAD\vx.x.x\Drivers" and select the "Next" button. Windows should find the driver.
5. Select "Continue Anyway".
6. Select the "Finish" button.

The software installation is complete. The ALP software may now be launched, as described in the next section.

Software Description

Startup

Make sure all the software has been installed and the hardware is powered on and connected to the PC. Execute "Analog LaunchPAD" from the start menu. The default start menu location is "Programs\National Semiconductor Corp\Analog LaunchPAD vx.x.x\Analog LaunchPAD".

The application should come up in the state shown in Figure 5 below. If it does not, see "Trouble Shooting" at the end of this document. Click on "LMH0384 – Nano" to select the device and open up the device profile and its associated tabs.

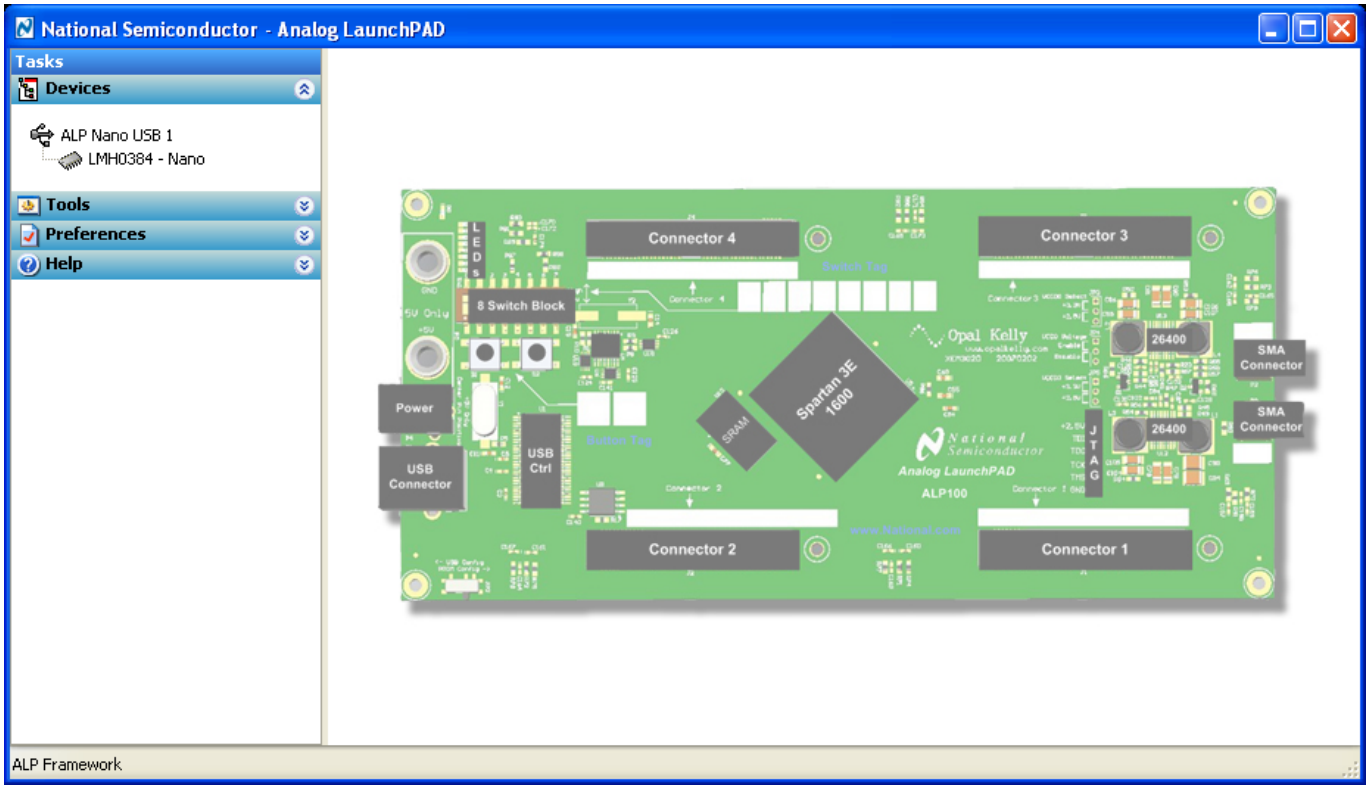


Figure 5. ALP Startup Screen for the LMH0384

Information Tab

The Information tab is shown in Figure 6.

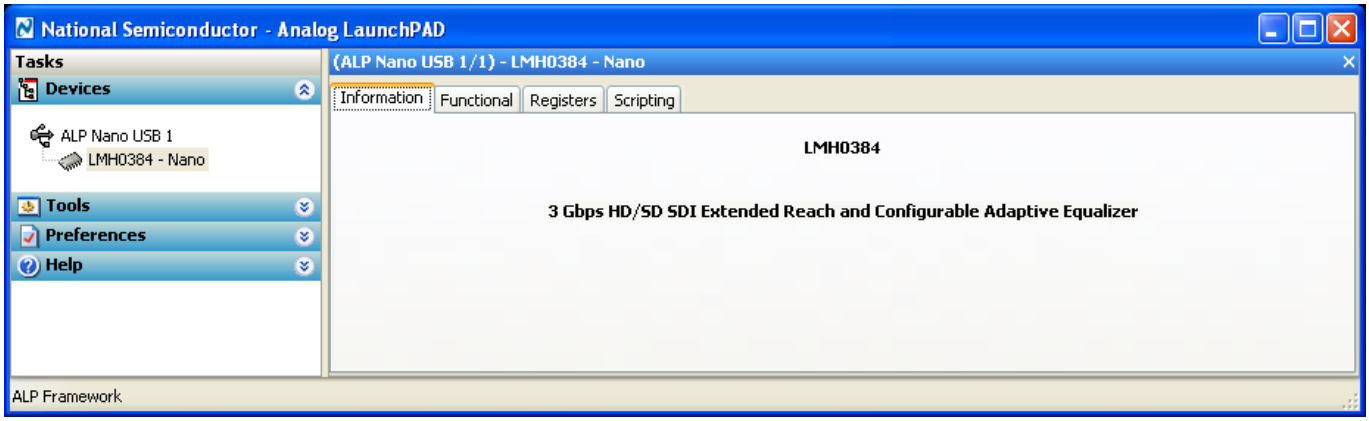


Figure 6. LMH0384 Information Tab

Functional Tab

The Functional tab is the main tab of the GUI and presents a high level view of the LMH0384, as shown in Figure 7.

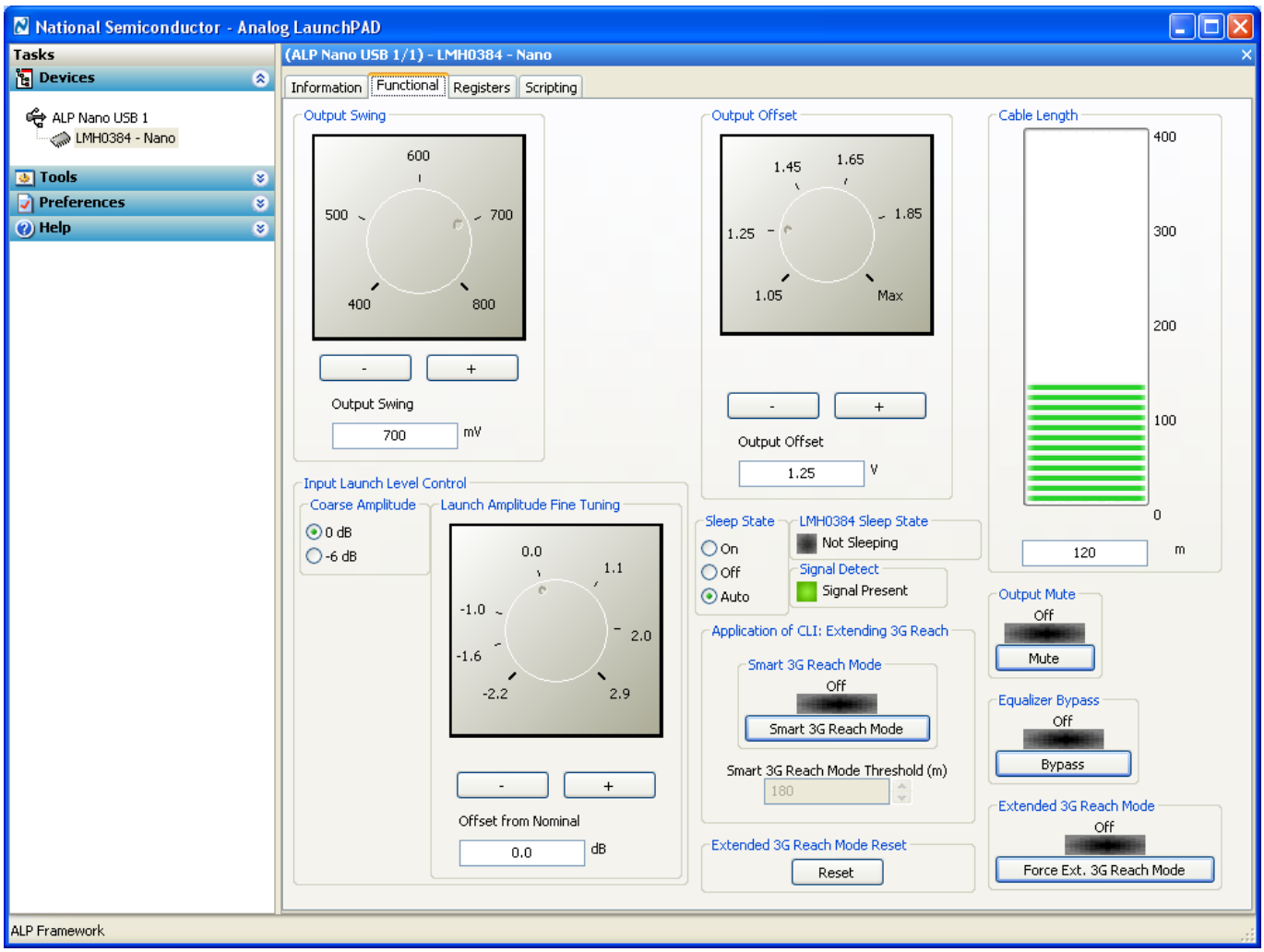
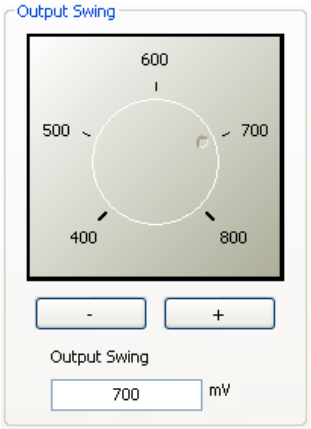


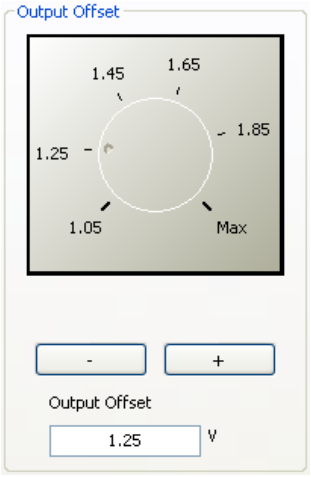
Figure 7. LMH0384 Functional Tab

Output Swing



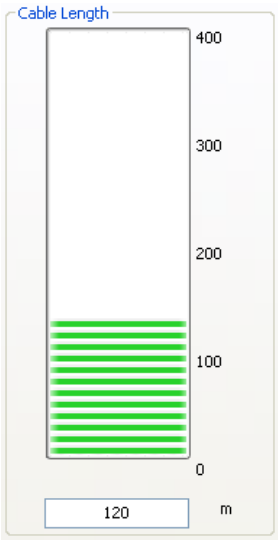
The Output Swing control shows the current value of the LMH0384 output amplitude and allows adjustment in 100 mV increments from 400 mV_{P-P} to 800 mV_{P-P}. The default setting is 700 mV_{P-P}. The Output Swing may be set either by clicking on the "+" or "-" buttons, or by grabbing and spinning the "handle" on the knob for a quick adjustment.

Output Offset



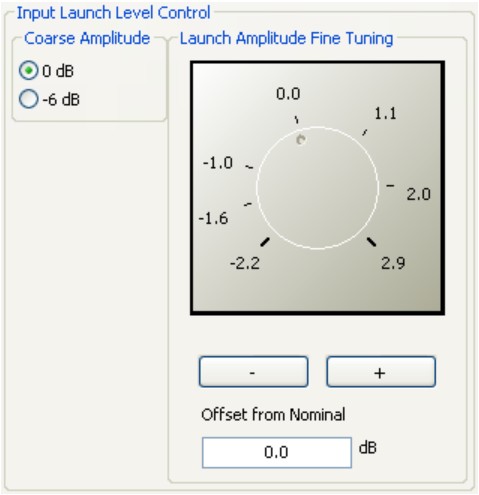
The Output Offset control shows the current value of the LMH0384 output common mode voltage and allows adjustment in 200 mV increments from 1.05V to 1.85V. At the "Max" setting, the outputs are referenced to the positive supply and the output common mode is 2.1V. The default setting is 1.25V. The Output Offset may be set either by clicking on the "+" or "-" buttons, or by grabbing and spinning the "handle" on the knob for a quick adjustment.

Cable Length



The Cable Length shows the interpreted Belden 1694A cable length of the CLI register, both with a visual bar graph and a decimal readout. The Cable Length is only valid when an input signal is detected, and is greyed out when there is no input to the LMH0384.

Input Launch Level Control

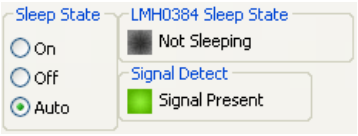


The Input Launch Level Control is useful to compensate for attenuation of the input signal prior to the equalizer due to a passive splitter or non-ideal input termination network.

The Coarse Amplitude control shows the current setting of the Coarse Control register and may be used to set the input for either 0 dB (default) or 6 dB of input attenuation. At the default setting of 0 dB, the LMH0384 operates normally and expects a launch amplitude of 800 mV_{P-P}. With the Coarse Amplitude set to -6 dB, the LMH0384 is optimized for input signals with 6 dB of input attenuation (400 mV_{P-P}).

The Launch Amplitude Fine Tuning may be used to further fine tune the LMH0384 input compensation, from -2.2 dB to 2.9 dB. The Launch Amplitude Fine Tuning may be set either by clicking on the "+" or "-" buttons, or by grabbing and spinning the "handle" on the knob for a quick adjustment.

Sleep State and Signal Detect

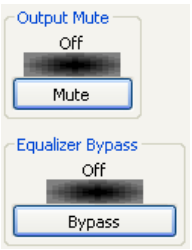


The Sleep State control shows the status of the Sleep Mode register bits and allows control over the sleep mode. The Sleep State settings are as follows:
On: Force the LMH0384 into sleep mode (powered down) regardless of whether there is an input signal or not.
Off: Disable sleep mode (force LMH0384 to stay enabled).
Auto: Sleep mode active when no input signal detected (default mode).

The LMH0384 Sleep State indicator shows the current status of the LMH0384 sleep state. It is GREEN to indicate sleeping or OFF to indicate not sleeping.

The Signal Detect shows the status of the input carrier detect. It is GREEN to indicate the input signal is present or OFF to indicate the input signal is absent.

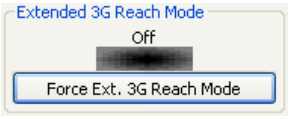
Output Mute and Equalizer Bypass



The Output Mute indicator shows the mute status, and the button may be used to toggle the mute function. The indicator is GREEN to indicate mute (LMH0384 outputs are muted) and OFF to indicate normal mode (outputs are not muted).

The Equalizer Bypass indicator shows the bypass status, and the button may be used to toggle the bypass function. The indicator is GREEN to indicate bypass is active (equalization is bypassed) and OFF to indicate normal mode.

Extended 3G Reach Mode



The Extended 3G Reach Mode indicator shows the status of the Extended 3G Reach Mode register bit, and the button may be used to toggle this register bit. The indicator is GREEN when the bit is set for extended 3G reach mode, and OFF when the LMH0384 is set for normal mode. Note that the indicator shows the status of the register bit – not whether the device is actually in extended 3G reach mode or not. If extended 3G reach mode is set, the LMH0384 will remain in this mode until the input cable is physically changed or power is cycled. For example, extended 3G reach mode is forced, and then it is turned off. The indicator will show it is off, but the

LMH0384 will still be in extended 3G reach mode until the input cable is changed or the device power is cycled. The GUI provides a simple way to reset the extended 3G reach mode: the Extended 3G Reach Mode Reset button. This button will reset the equalizer, and is similar to removing and re-applying the input cable.

Application of CLI: Extending 3G Reach

This control may be used to enable a "Smart 3G Reach Mode" to extend the LMH0384 3G reach by up to 15m while still maintaining the performance at HD and SD data rates. When this mode is active, it automatically controls the extended 3G reach mode and only enables extended 3G reach mode when the input cable length to the equalizer is less than the threshold. The indicator is GREEN when this mode is active, and OFF when this mode is not used (default). When this mode is active, the "Smart 3G Reach Mode Threshold" may also be changed. The default threshold is 180m (Belden 1694A), which means that extended 3G reach mode will only be active when the input cable length is <180m. When the input cable length is ≥180m, extended 3G reach mode will automatically turn off, allowing equalization of much longer cable lengths for HD and SD data rates. When Smart 3G Reach Mode is active, the Extended 3G Reach Mode control cannot be used (since it is controlled automatically). Refer to the LMH0384 datasheet for details.

Registers Tab

The Registers tab displays all registers for the LMH0384. Figure 8 shows the Registers tab. The Value field indicates the value of the currently selected register.

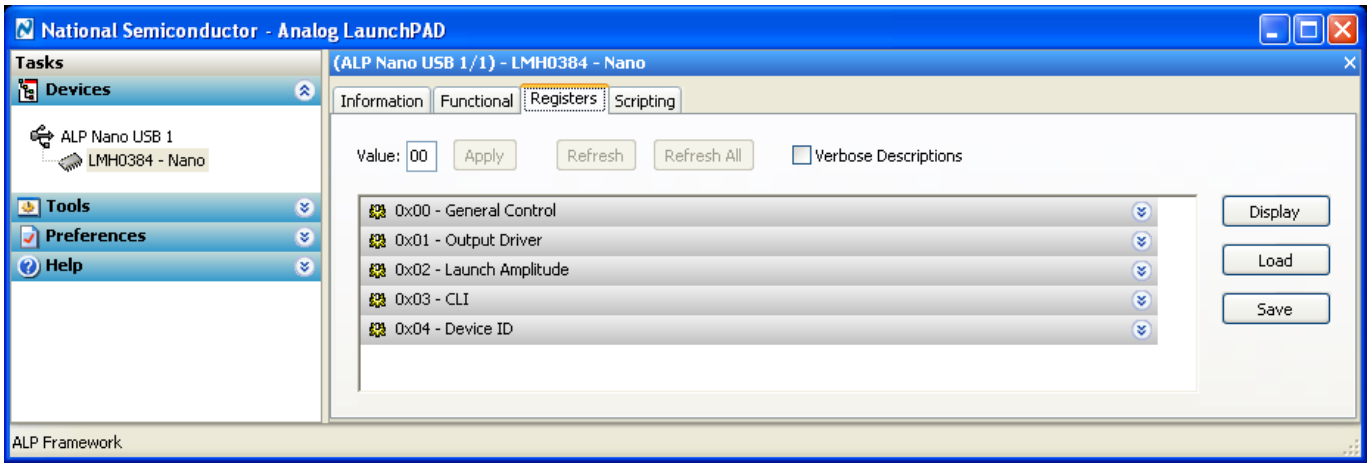


Figure 8. LMH0384 Registers Tab

Each register can be examined in detail by either double clicking on the desired registers fold bar (with the address and the register name, e.g. 0x00 – General Control) or by single clicking the icon at the right of the fold bar (two inverted carats).

The Refresh button will re-read the currently selected register and the Refresh All will read all registers in the device. Changes may be made to the registers by checking or un-checking the individual register bits or typing in a new register value in the Value field. After setting the appropriate register value, the Apply button must be pressed to apply the changes. The detailed view of the General Control register is shown in Figure 9 with Verbose Descriptions checked and Figure 10 with Verbose Descriptions un-checked.

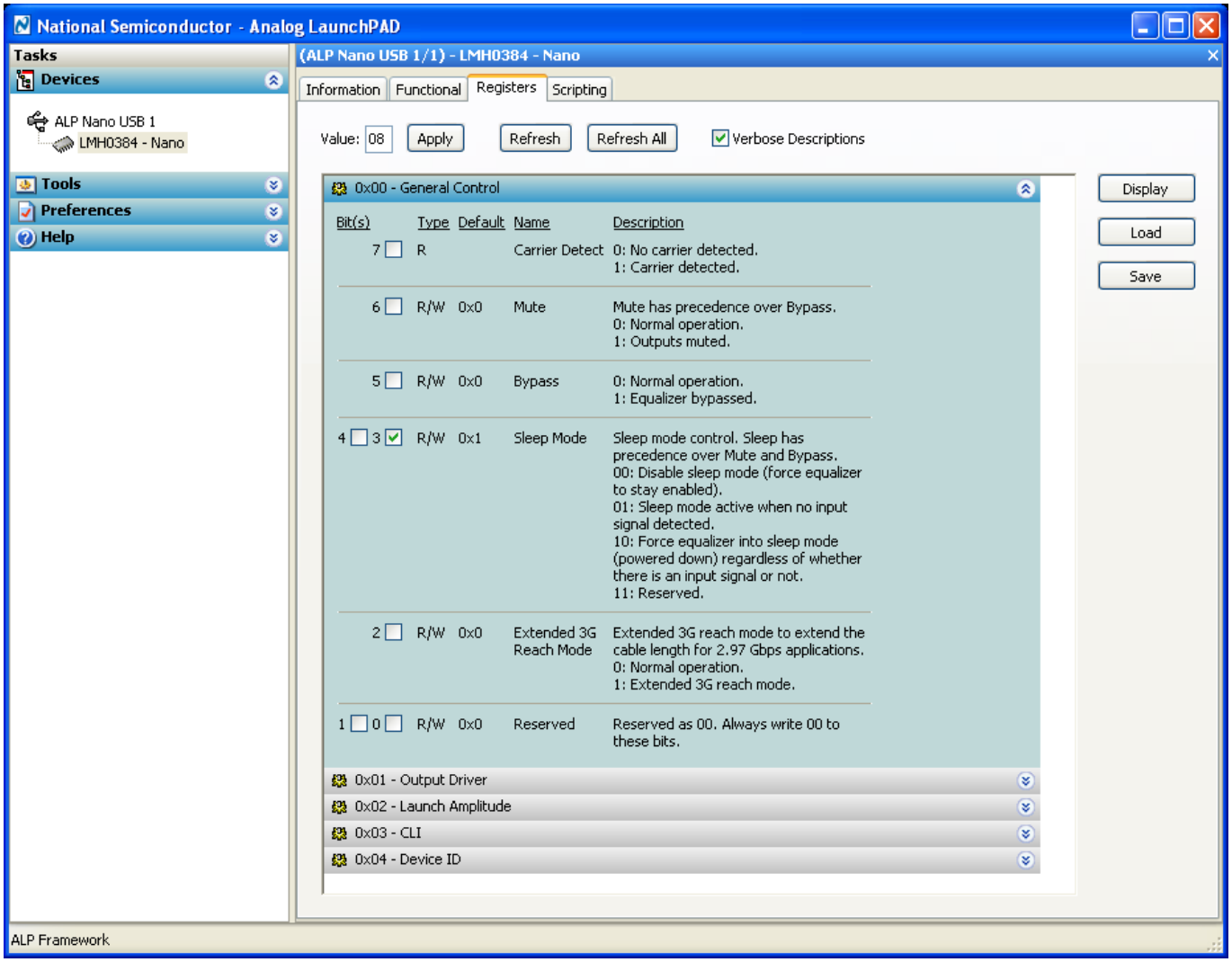


Figure 9. LMH0384 Registers Tab with Verbose Descriptions

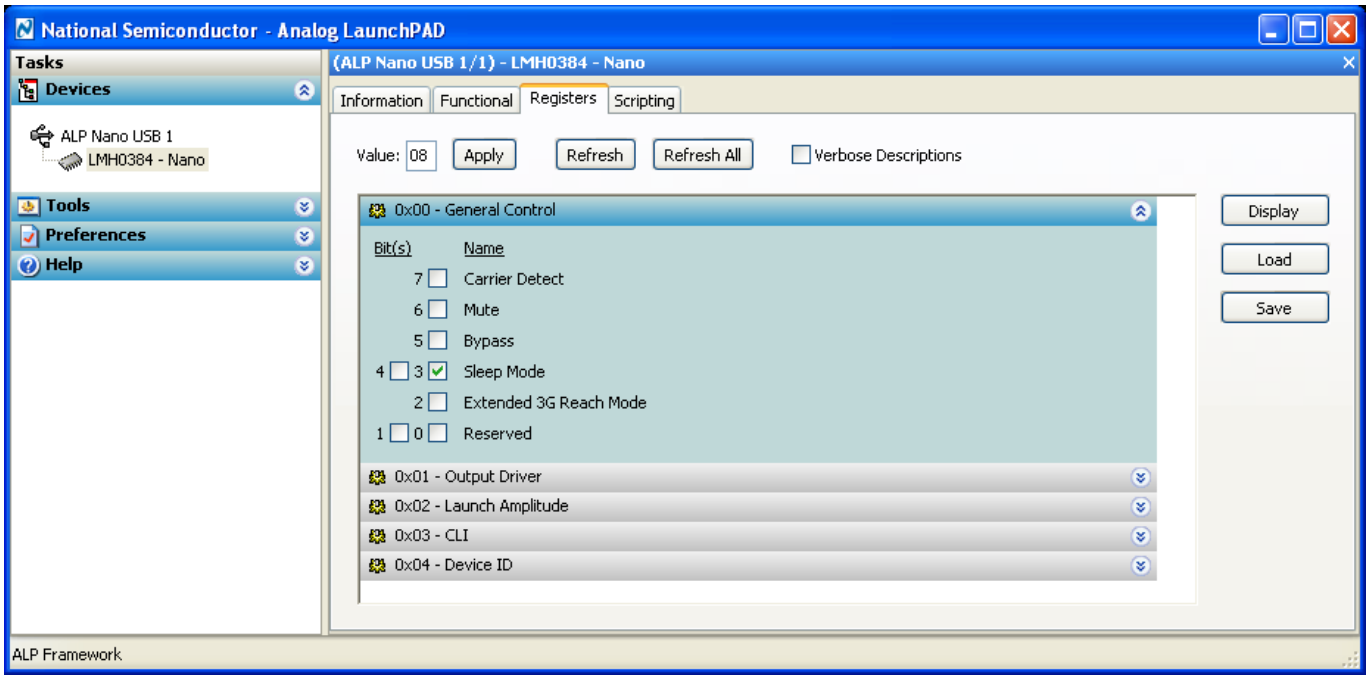


Figure 10. LMH0384 Registers Tab without Verbose Descriptions

The Display button provides another view of the register set and is depicted in Figure 11. The Display dialog supports the Windows copy command (Ctrl+c).

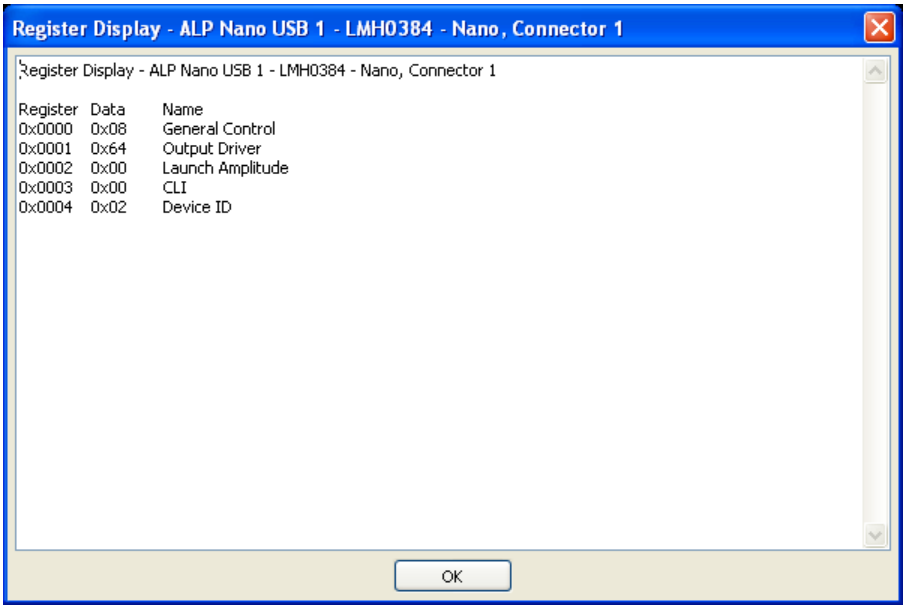


Figure 11. LMH0384 Register Display

The Load and Save buttons provide a handy mechanism for restoring or saving the register set external to the evaluation board.

Typical Performance

Figures 12 and 13 show typical output waveforms of the SD384, with the 1m of Belden 1694A cable on the input and 110m of Belden 1694A cable on the input, respectively. The input signal is a 2.97 Gbps PRBS10, and the output signal is measured on the Agilent DCA-J 86100C Oscilloscope.

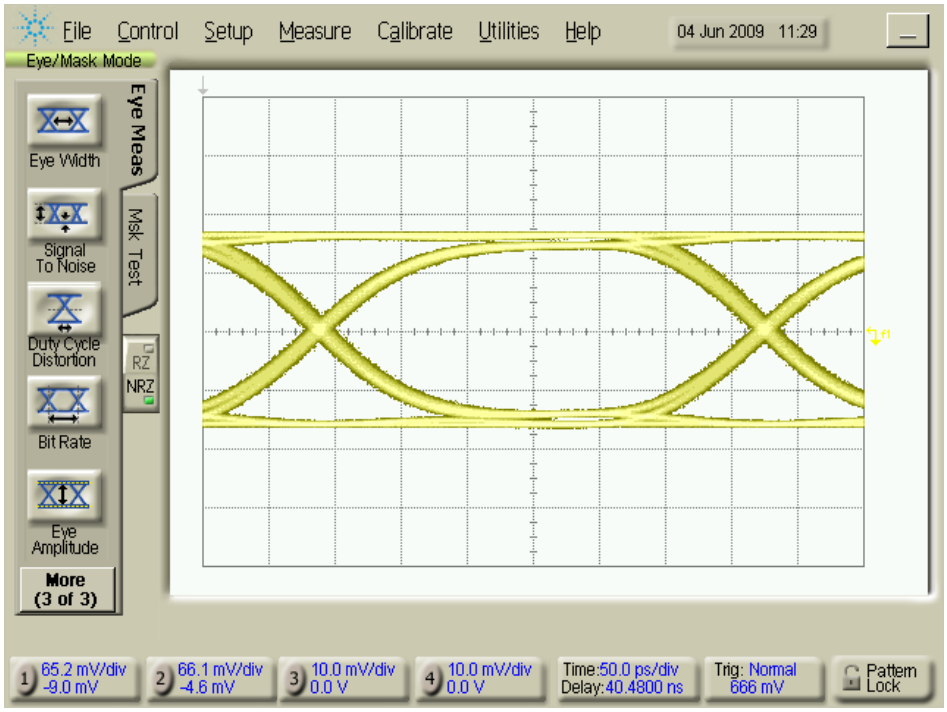


Figure 12. SD384 Output Waveform at 2.97 Gbps with 1m Belden 1694A Cable

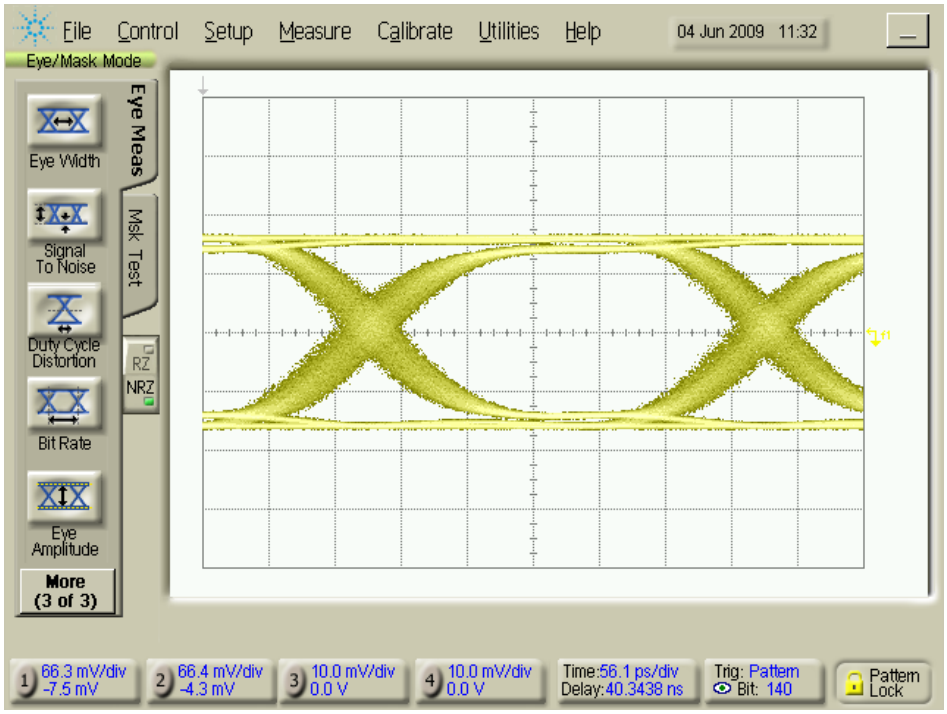


Figure 13. SD384 Output Waveform at 2.97 Gbps with 110m Belden 1694A Cable

Trouble Shooting

If the following window (Figure 14) opens after starting the ALP software, double check the hardware setup.

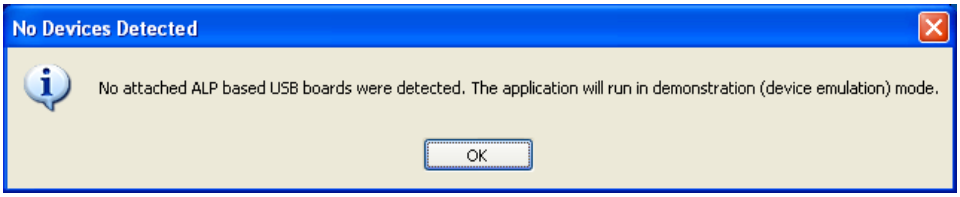


Figure 14. Analog LaunchPAD No Devices Error

It may also be that the USB driver is not installed. Check the device manager. There should be an ”NSC ALP Nano Atmel” device under the “Universal Serial Bus Controllers” as shown in Figure 15.

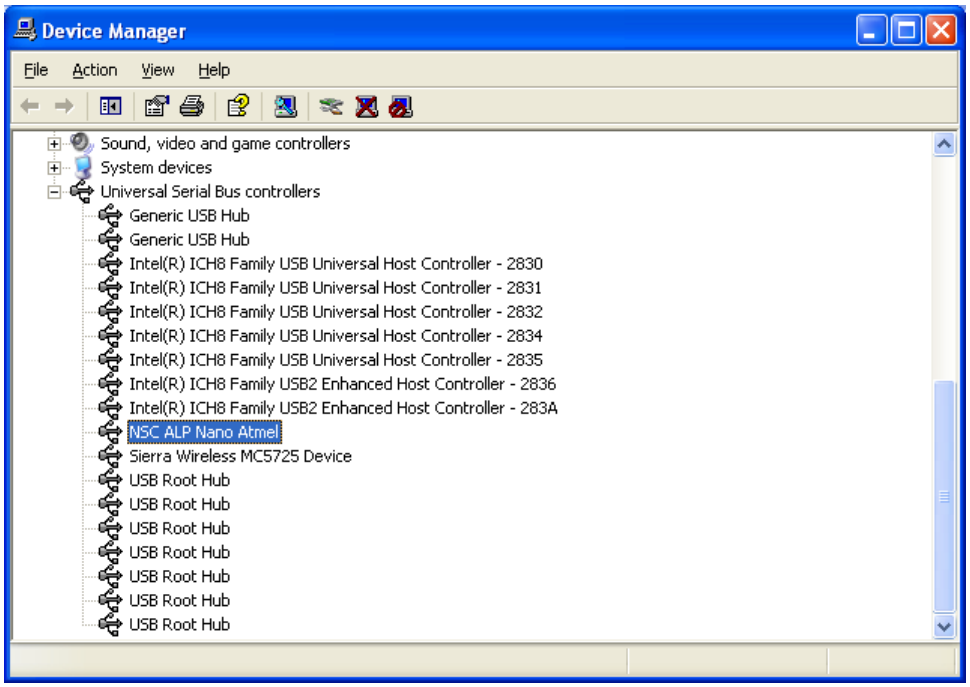


Figure 15. Windows XP, Analog LaunchPAD USB Driver

The software should start with only “LMH0384 - Nano” in the “Devices” pull down menu. If there are more devices then the software is most likely in demo mode. When the ALP is operating in demo mode there is a “(Demo Mode)” indication in the lower left of the application status bar as shown in Figure 16.

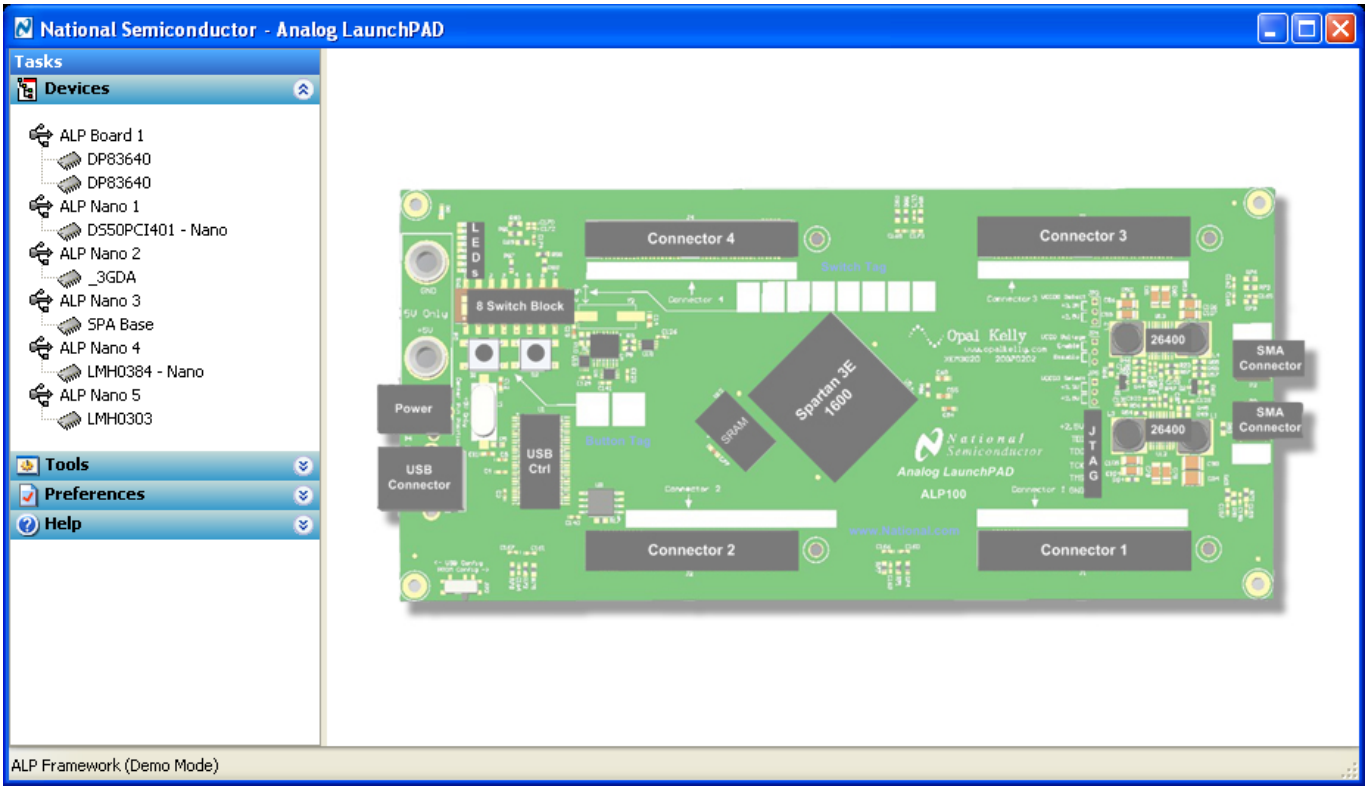


Figure 16. Analog LaunchPAD in Demo Mode

Disable the demo mode by selecting the “Preferences” pull down menu and un-checking “Enable Demo Mode”.

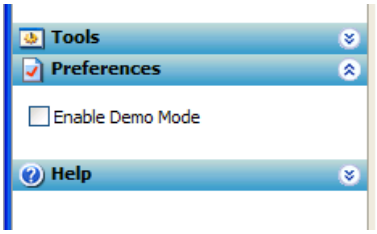


Figure 17. Analog LaunchPAD Preferences Menu

After demo mode is disabled, the ALP software will poll the ALP hardware. The ALP software will update and have only “LMH0384 - Nano” under the “Devices” pull down menu.

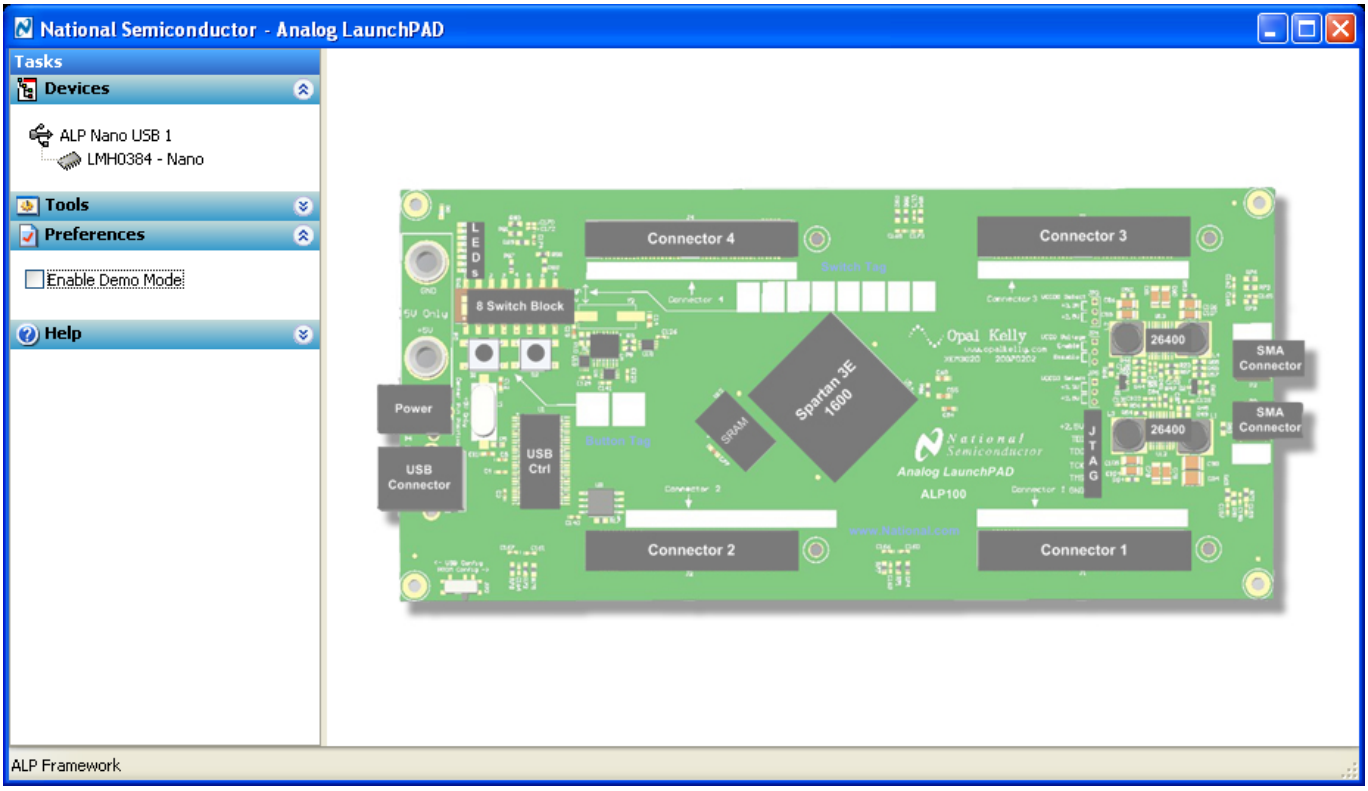
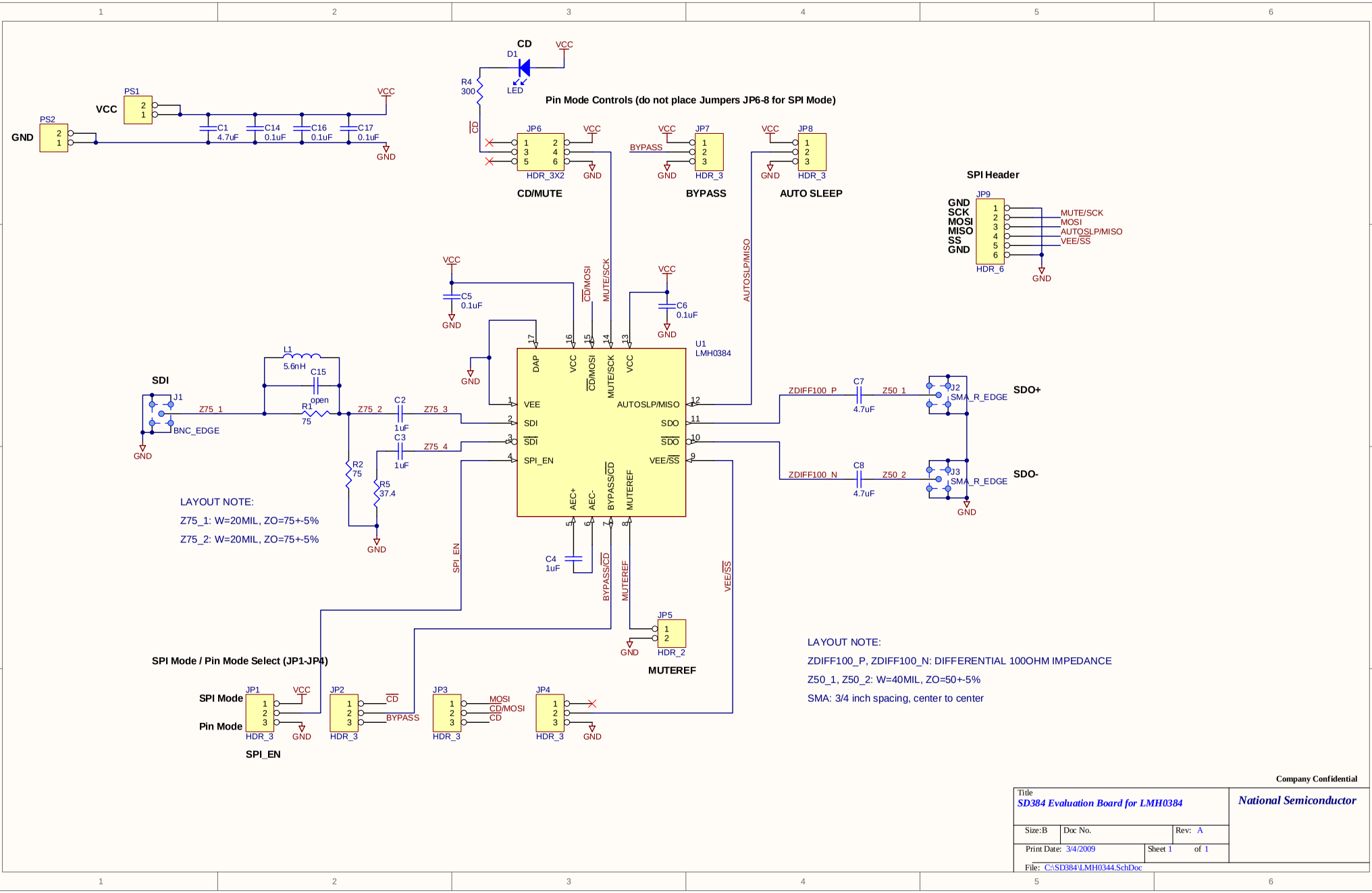


Figure 18. Analog LaunchPAD Screen with Demo Mode Off

SD384 Bill of Materials

Reference Designator	Qty	Description	Manufacturer	Manufacturer Part No.
C1, C7, C8	3	Capacitor, 4.7uF, 6.3V, X5R, 0603	Panasonic - ECG	ECJ-1VB0J475M
C2, C3, C4	3	Capacitor, 1uF, 6.3V, X5R, 0402	Panasonic - ECG	ECJ-0EB0J105M
C5, C6, C14, C16, C17	5	Capacitor, 0.1uF, 16V, X5R, 0402	Panasonic - ECG	ECJ-0EB1C104K
D1	1	LED, Green, 0603	Lite-On	LTST-C190GKT
J1	1	BNC, Amphenol, 75-ohm, edge launch	Amphenol	31-6009
J2, J3	2	SMA, 50-ohm, edge launch	Johnson Components	142-0701-851
JP1, JP2, JP3, JP4, JP7, JP8	6	Header, 3x1, 0.1"	3M/ESD	929834-02-36
JP5	1	Header, 2x1, 0.1"	3M/ESD	929834-02-36
JP6	1	Header, 3x2, 0.1"	3M/ESD	929836-02-36
JP9	1	Header, 6x1, 0.1"	3M/ESD	929834-02-36
L1	1	Inductor, 5.6nH, 0402	Murata	LQP15MN5N6B02D
PS1, PS2	2	PCB Quick-Fit Male Terminal, .052" diameter, .250" tab size	Keystone Electronics	1287-ST
R1, R2	2	Resistor, 75-ohm, 1/16W, 1%, 0402	Yageo	RC0402FR-0775RL
R5	1	Resistor, 37.4-ohm, 1/16W, 1%, 0402	Vishay/Dale	CRCW040237R4FKED
R4	1	Resistor, 300-ohm, 1/10W, 5%, 0402	Panasonic - ECG	ERJ-2GEJ301X
U1	1	LMH0384 Cable Equalizer, LLP-16	National Semiconductor	LMH0384SQ

SD384 Schematic



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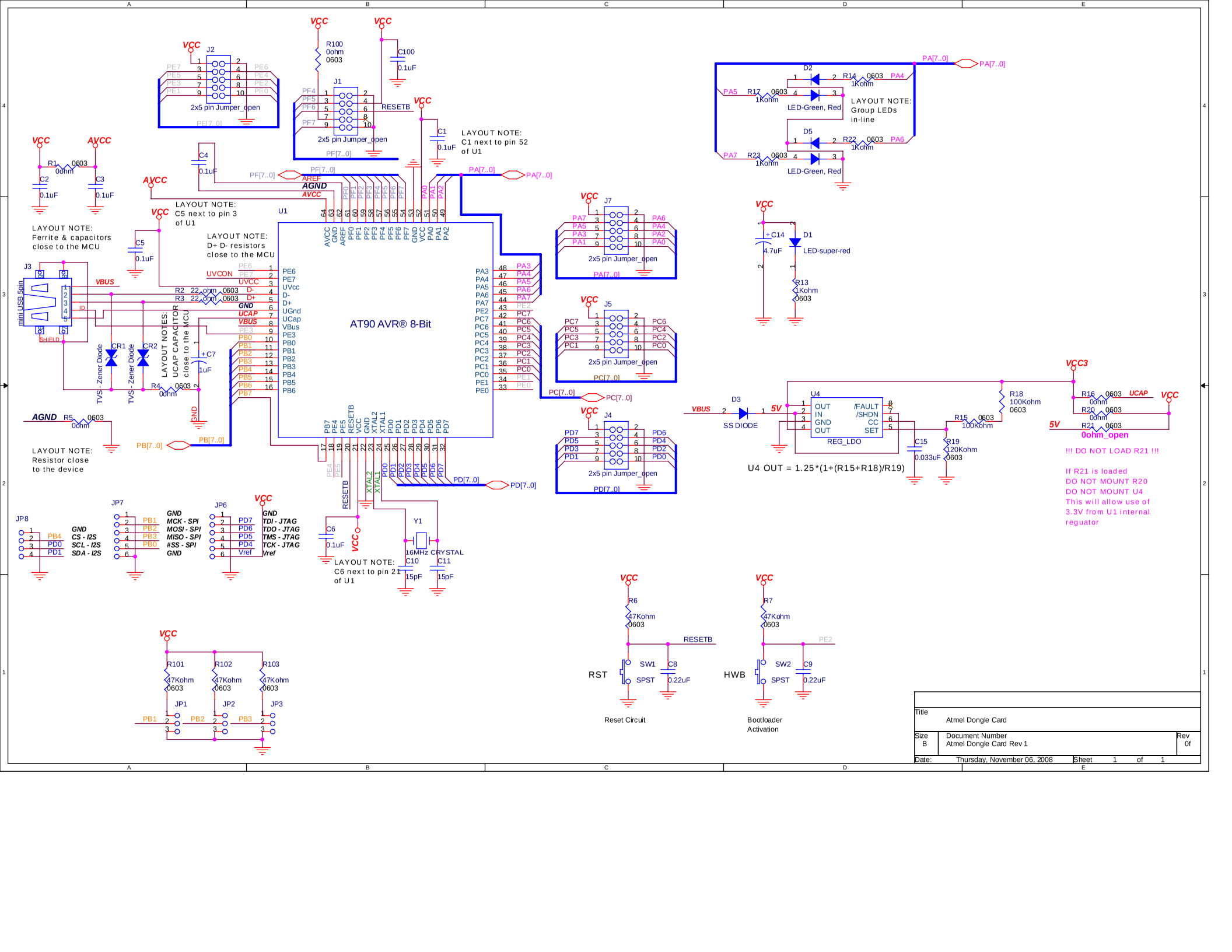
Title: *SD384 Evaluation Board for LMH0384*		*National Semiconductor*
Size:B	Doc No.	Rev: A
Print Date: 3/4/2009	Sheet 1 of 1	
File: C:\SD384\LMH0344.SchDoc		

SPA Dongle Bill of Materials

Reference Designator	Qty	Description	Manufacturer	Manufacturer Part No.
CR2,CR1	2	SUPPRESSOR ESD 24VDC 0603 SMD	Littelfuse Inc	PGB1010603MR
C1,C2,C3,C4,C5,C6,C100	7	CAP CER .1UF 50V 10% X7R 0603	Murata	GRM188R71H104KA93D
C7	1	CAPACITOR TANT 1.0UF 16V 10% SMD	Kemet	T491A105K016AT
C8,C9	2	CAP CER .22UF 50V Y5V 0603	TDK Corporation	C1608Y5V1H224Z
C10,C11	2	CAP CERAMIC 15PF 50V NP0 0603	Kemet	C0603C150J5GACTU
C14	1	CAPACITOR TANT 4.7UF 16V 10% SMD	Kemet	T491A475K016AT
C15	1	CAP CERM 33000PF 5% 50V X7R 0603	AVX Corporation	06035C333JAT2A
D1	1	LED TOPLED 628NM SUP RED CLR SMD	Osram Opto Semiconductors	LS M670-H2L1-1-0-10-R18-Z
D5,D2	2	LED TOPLED 628/570 RED/GRN 4PLCC	Osram Opto Semiconductors	LSG T670-JL-1-0+JL-1-0-10-R18-Z
D3	1	DIODE HI CONDUCTANCE 100V LL-34	Fairchild Semiconductor	FDLL4148
JP1,JP2,JP3	3	CONN HEADER VERT .100 3POS 15AU	AMP/Tyco	87224-3
JP6,JP7	2	CONN HEADER VERT .100 6POS 15AU	AMP/Tyco	87224-6
JP8	1	CONN HEADER VERT .100 4POS 15AU	AMP/Tyco	87224-4
J3	1	CONN RECEPT MINI USB2.0 5POS.	Hirose	UX60-MB-5ST
R1,R4,R5,R16,R20,R100	6	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEY0R00V
R2,R3	2	RES 22 OHM 1/16W 3300PPM 5% 0603	Panasonic	ERA-V33J220V
R6,R7,R101,R102,R103	5	RES 47K OHM 1/16W .1% 0603 SMD	Panasonic	ERA-3AEB473V
R13,R14,R17,R22,R23	5	RES 1.0K OHM 1/16W .1% 0603 SMD	Panasonic	ERA-3AEB102V
R18,R15	2	RES 100K OHM 1/16W .1% 0603 SMD	Panasonic	ERA-3AEB104V
R19	1	RES 120K OHM 1/16W .1% 0603 SMD	Panasonic	ERA-3AEB124V
SW1,SW2	2	SWITCH TACT	APEM Components	ADTSM31NV
U1	1	IC AVR MCU 128K 64QFN	Atmel	AT90USB1287-16MU
U4	1	IC REG LDO 300MA ADJ 8MSOP	National Semiconductor	LP3982IMM-ADJ/NOPB
Y1	1	CRYSTAL 16.000MHZ 18PF FUND SMD	Abracon Corporation	ABM3-16.000MHZ-B2-T

SPA Dongle Schematic


AT90 AVR® 8-Bit
U1
J1
J2
J3
J4
J5
J7
2x5 pin Jumper_open
mini USB 5pin
LAYOUT NOTE:
Ferrite & capacitors close to the MCU
LAYOUT NOTE:
C5 next to pin 3 of U1
LAYOUT NOTE:
D+ D- resistors close to the MCU
LAYOUT NOTES:
UCAP CAPACITOR close to the MCU
LAYOUT NOTE:
Resistor close to the device
LAYOUT NOTE:
C1 next to pin 52 of U1
LAYOUT NOTE:
C6 next to pin 21 of U1
LAYOUT NOTE:
Group LEDs in-line
LED-Green, Red
LED-super-red
SS DIODE
REG_LDO
U4 OUT = 1.25*(1+(R15+R18)/R19)
0ohm_open
!!! DO NOT LOAD R21 !!!
If R21 is loaded
DO NOT MOUNT R20
DO NOT MOUNT U4
This will allow use of 3.3V from U1 internal reguator
16MHz CRYSTAL
Reset Circuit
Bootloader Activation
Title
Atmel Dongle Card
Document Number
Atmel Dongle Card Rev 1
Rev 0f
Date: Thursday, November 06, 2008
Sheet 1 of 1

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