

SD394SPIEVK

LMH0394 Evaluation Board with SPI Interactive GUI User Guide

National Semiconductor
EVK User Manual

October 14, 2010



Overview

The SD394SPI Evaluation Kit (EVK) enables evaluation of the LMH0394 3G/HD/SD SDI Adaptive Cable Equalizer. A graphical user interface allows managing the SPI registers of the LMH0394 device.

Evaluation Kit Contents

The EVK contains the following parts:

- SD394EVK board assembly with the LMH0394 cable equalizer
- SPA dongle (SPI→USB card)
- USB cable
- 6-pin parallel cable
- SD394SPIEVK User Guide

Evaluation Board Description

Figure 1 shows the SD394 evaluation board and highlights some of its features.

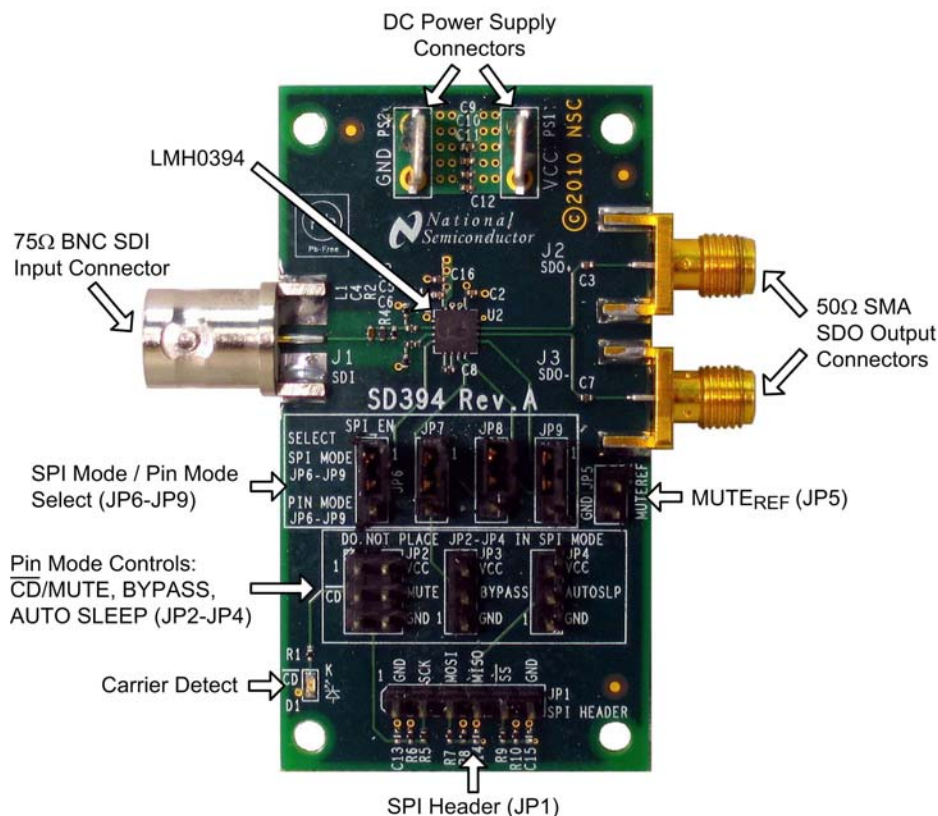


FIGURE 1. SD394 Evaluation Board

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. The SDO output connectors have onboard 4.7μF AC coupling capacitors (C3 and C7). 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, SDO should be terminated with a 50Ω SMA termination.

DC Power Connectors

The VCC and GND power connectors, PS1 and PS2 respectively, should be powered with a DC input voltage of 2.5V ± 5%.

SPI Mode / Pin Mode Select (JP6 – JP9)

JP6, JP7, JP8, and JP9 are used to select between SPI Mode or Pin Mode. To select Pin Mode, set these jumpers in the down position as shown in Figure 2. To select SPI Mode, set these jumpers in the up position as shown in Figure 3. For proper operation, either Pin Mode or SPI Mode must be selected. **Do not leave JP6-JP9 open.**

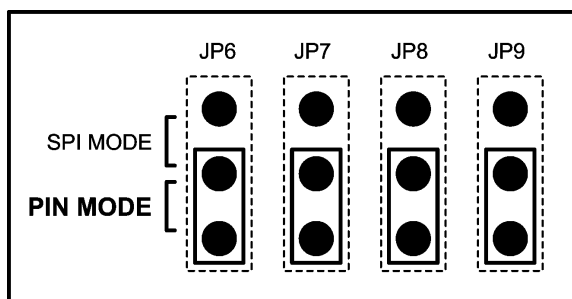


FIGURE 2. Pin Mode Select

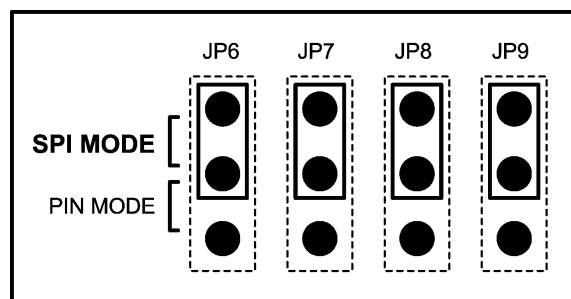


FIGURE 3. SPI Mode Select

MUTERE_{REF} (JP5)

JP5 allows control of the MUTERE_{REF} function and may be used in either Pin Mode or SPI Mode. MUTERE_{REF} is an input voltage used to set the threshold for \overline{CD} . The MUTERE_{REF} DC input voltage should be between 0V and 2.5V. Refer to the LMH0394 datasheet for details. Leave JP5 unconnected for normal operation.

Pin Mode Controls (JP2 – JP4)

JP2, JP3, and JP4 are used to control the \overline{CD} and Mute, Bypass, and Auto Sleep functions while the device is configured in Pin Mode. **Do not place jumpers on JP2, JP3, or JP4 while the device is configured for SPI Mode.**

\overline{CD} and MUTE (JP2)

JP2 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 if the SDI signal is not

present. 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 MUTE pin has an internal pulldown (to disable mute), so JP2 may be left unconnected and the device will never mute.

BYPASS (JP3)

JP3 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 BYPASS pin has an internal pulldown (to disable bypass), so JP2 may be left unconnected for normal operation.

AUTO SLEEP (JP4)

JP4 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 LMH0394 from automatically powering down, set the jumper to pull AUTO SLEEP to GND. The AUTO SLEEP pin has an internal pullup (to enable auto sleep), so JP4 may be left unconnected to enable auto sleep mode.

SPI Header (JP1)

JP1 is the SPI (Serial Peripheral Interface) header. It allows access to the SPI pins (\overline{SS} , MISO, MOSI, and SCK) while the LMH0394 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. The SPA dongle requires special software and must be connected to the PC via the USB – see the Software Setup section.

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.

Typical Performance

Equalizer Output

Figures 4, 5, and 6 show output waveforms for the SD394 with various Belden 1694A cable lengths. The input signal is a 2.97 Gbps PRBS10, and the output signal is measured on the Agilent DCA-J 86100C oscilloscope.

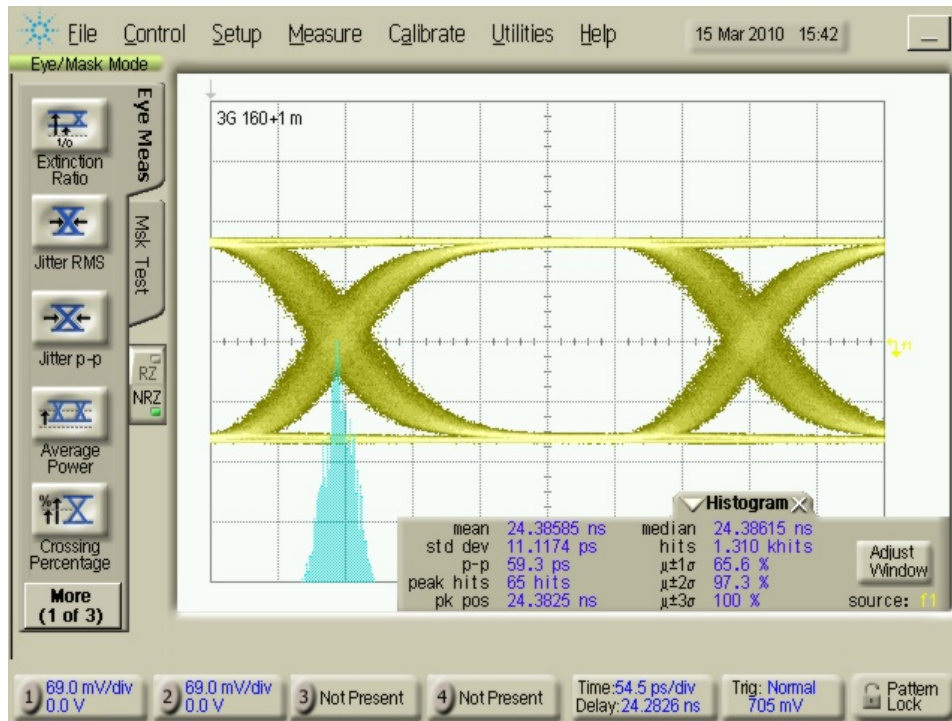


FIGURE 4. SD394 Output Waveform at 2.97 Gbps with 160m Belden 1694A Cable

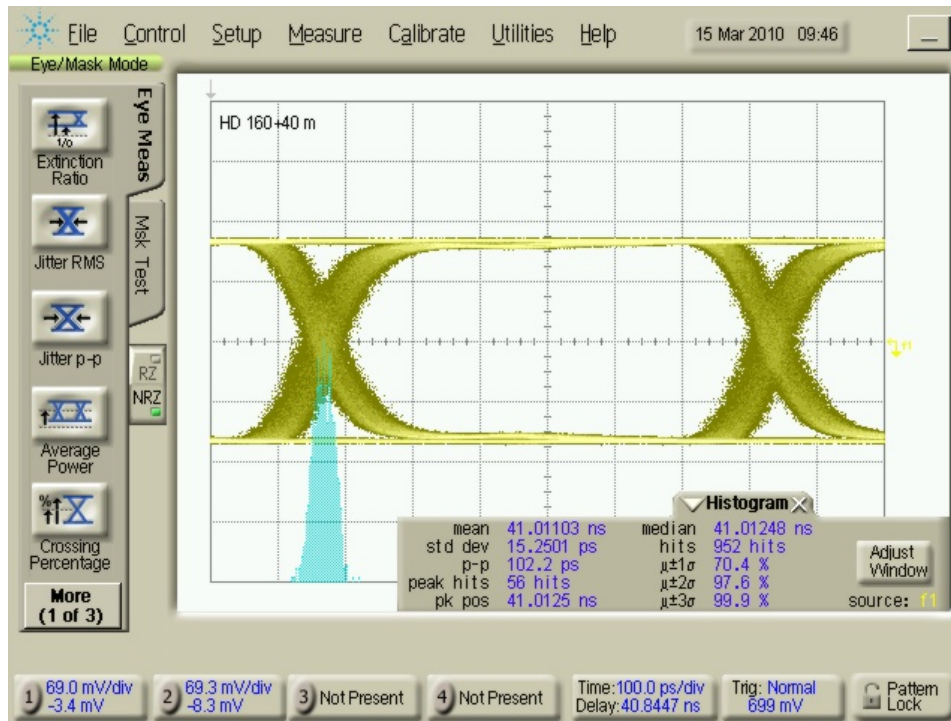


FIGURE 5. SD394 Output Waveform at 1.485 Gbps with 200m Belden 1694A Cable

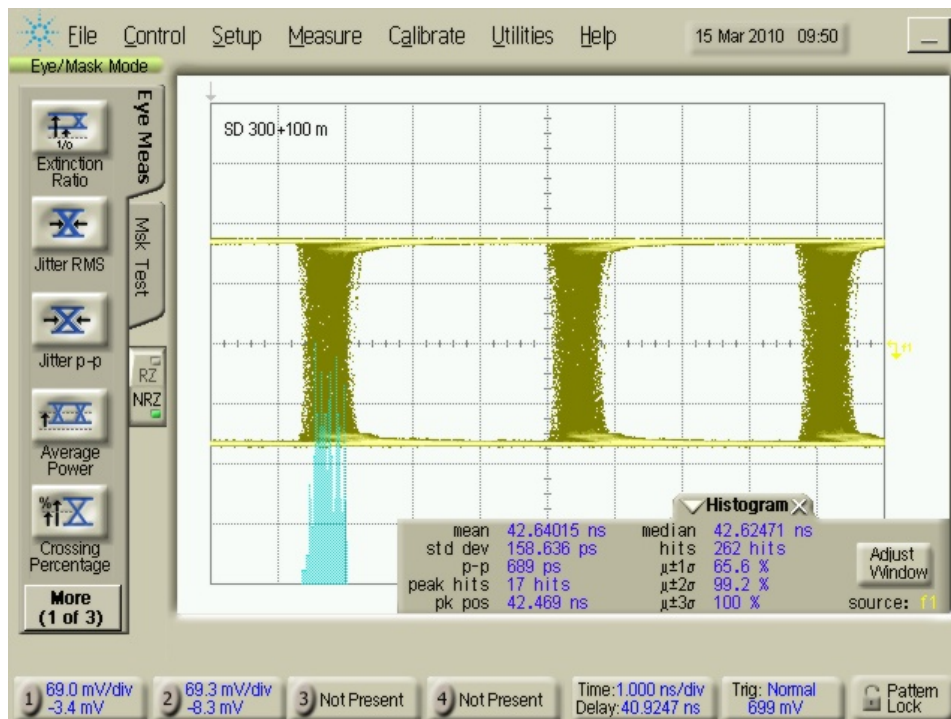


FIGURE 6. SD394 Output Waveform at 270 Mbps with 400m Belden 1694A Cable

Input Return Loss

Figure 7 shows input return loss of the LMH0394 as measured at the BNC on the SD394. The return loss is measured using the Agilent 8722ES VNA with a 75Ω BNC to 75Ω Type N connector on the input. Note that return loss is layout dependent.

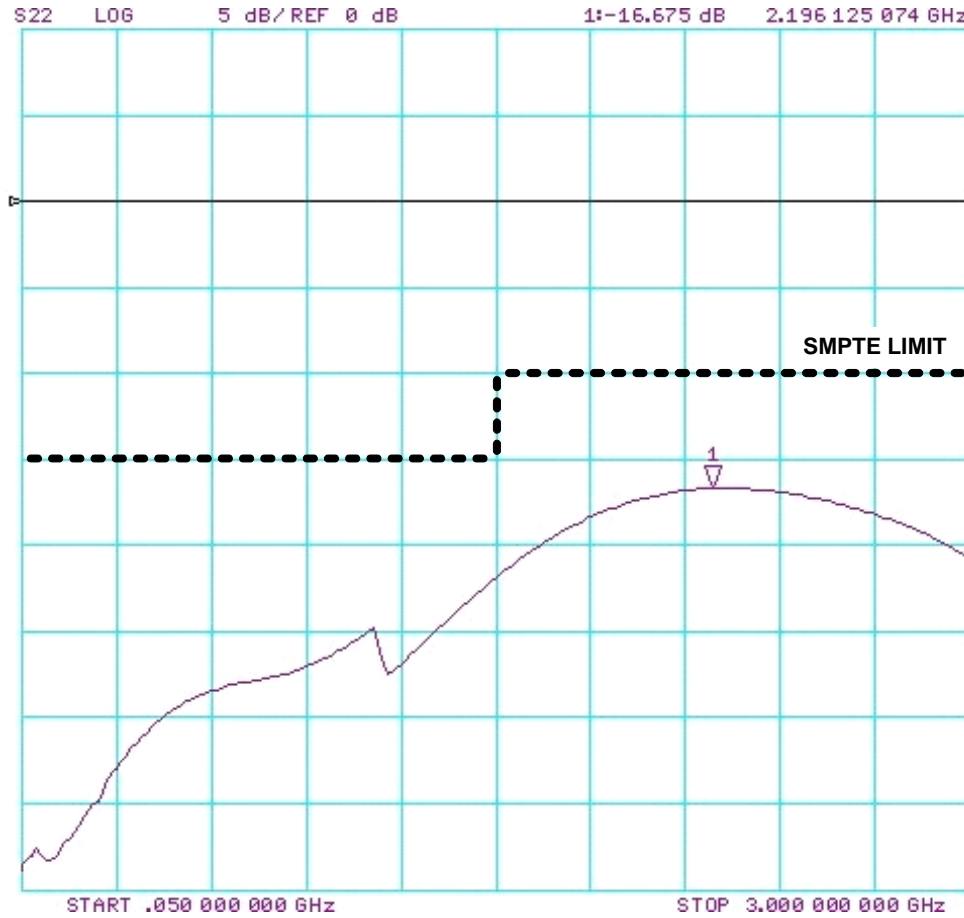


FIGURE 7. SD394 Input Return Loss

SPA Dongle Description

The SPA dongle is required to use the SPI interactive GUI. The SPA dongle connects between the USB connector (J3) and the USB input of a PC. The SPA dongle is shown in Figure 8. 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.

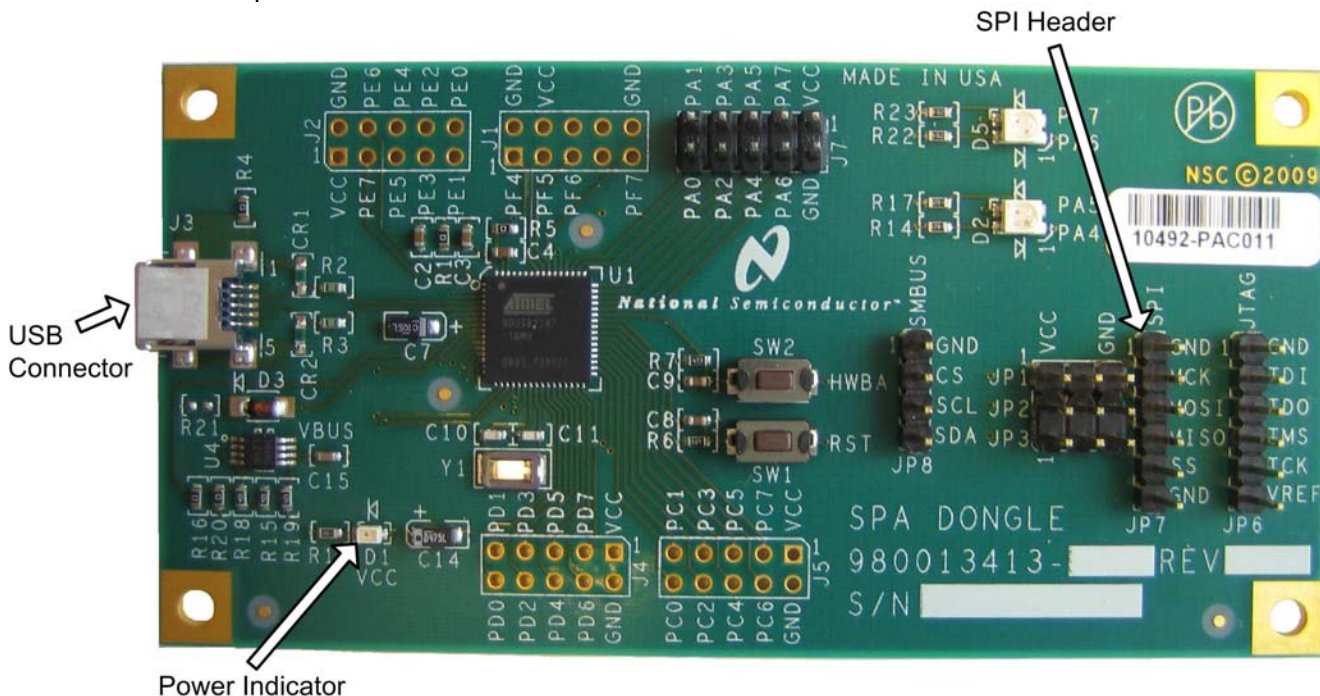


FIGURE 8. SPA Dongle

Figure 9 shows the connection between the SD394 and the SPA dongle. For proper operation, the SPI pins must be connected between the SD394 JP1 and the SPA dongle JP7.

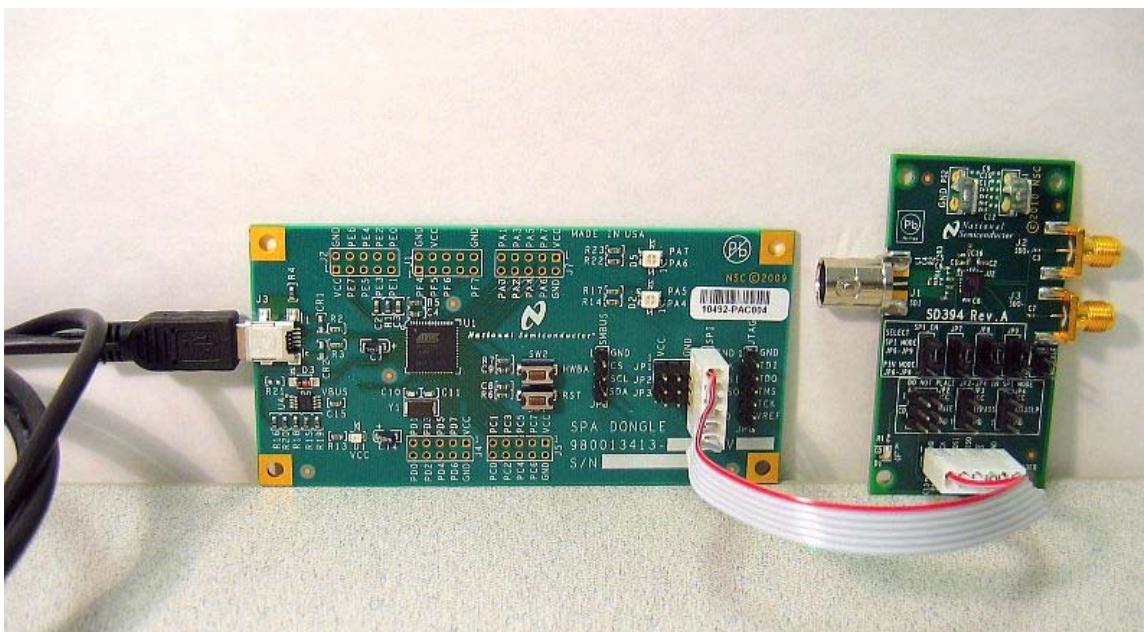


FIGURE 9. SD394 Connection to SPA Dongle

Software Setup

System Requirements

Operating System: Windows XP or Vista
USB: 2.0

Installation

Download the latest software from the LMH0394 Evaluation Board page, which can be found on the “Boards” tab in the LMH0394 product folder. Extract the ALPF_monthdayyear_major version_minor version.exe” (ex. ALPF_06142010_128_0104.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” 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 JP1 of the SD394 evaluation board to JP7 of the SPA dongle via the 6-pin parallel cable. Power on the SD394 evaluation board with a 2.5 VDC power supply. Connect the SPA dongle to the PC with the mini 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 10 below. If it does not, see “Trouble Shooting” at the end of this document. Click on “LMH0394 – Nano” to select the device and open up the device profile and its associated tabs.

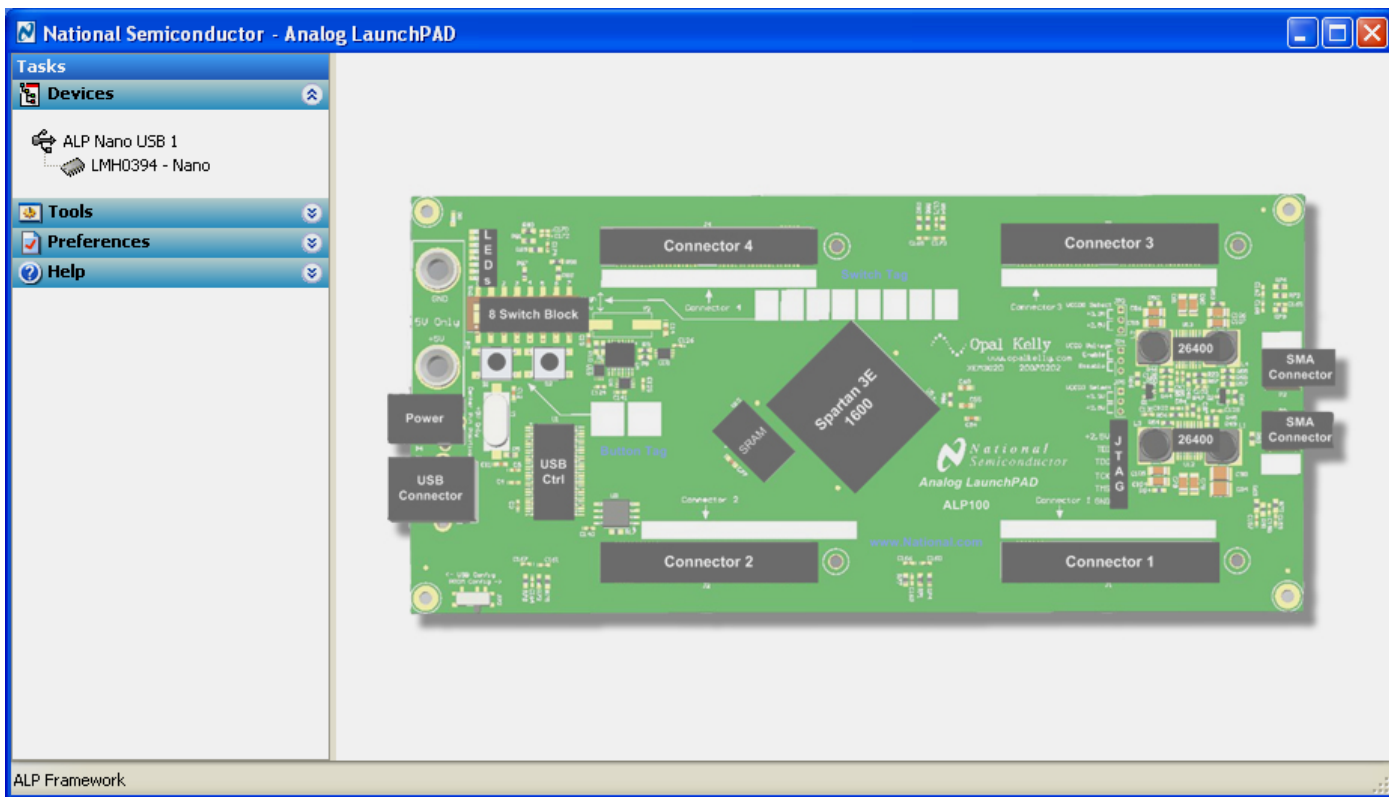


FIGURE 10. ALP Startup Screen for the LMH0394

Information Tab

The Information tab is shown in Figure 11. Please note the device revision could be different.

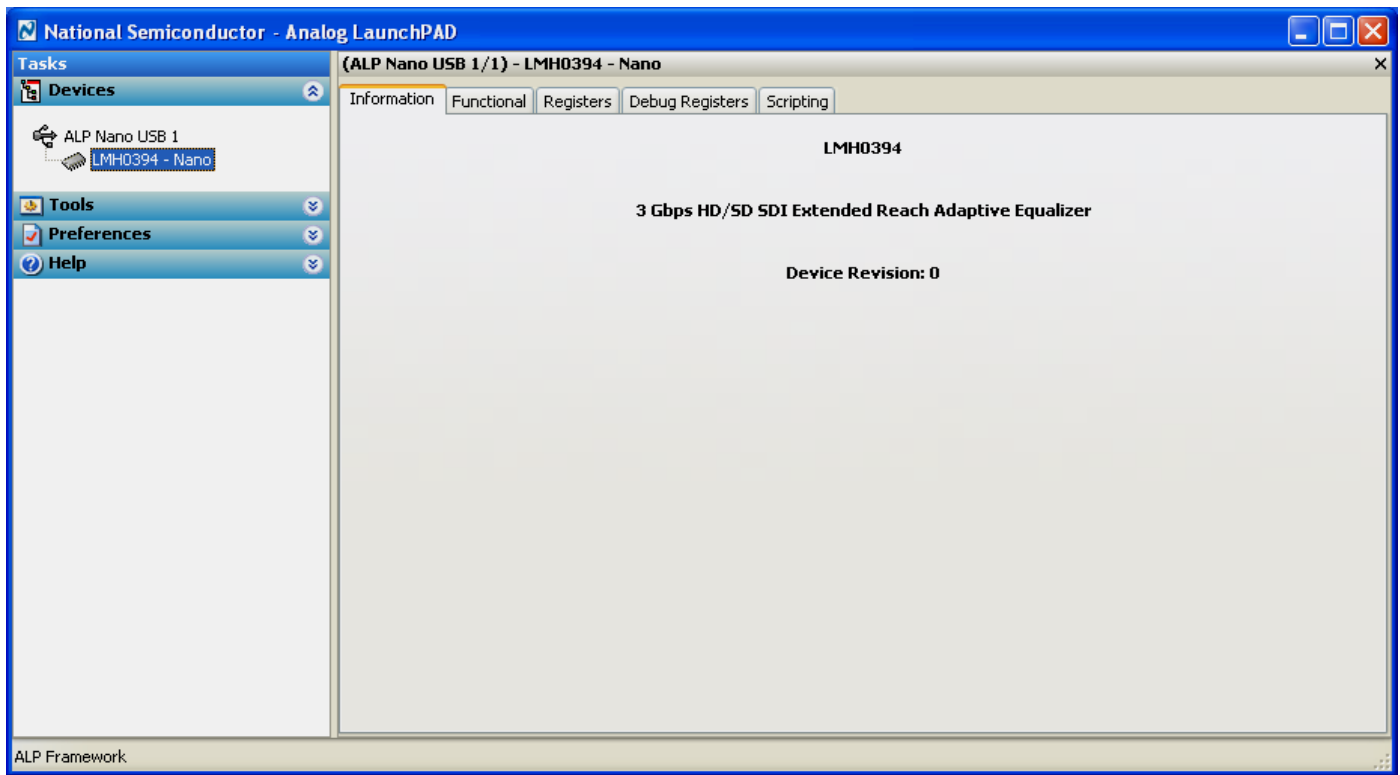


FIGURE 11. LMH0394 Information Tab

Functional Tab

The Functional tab is the main tab of the GUI and presents a high level view of the LMH0394 equalizer, as shown in Figure 12.

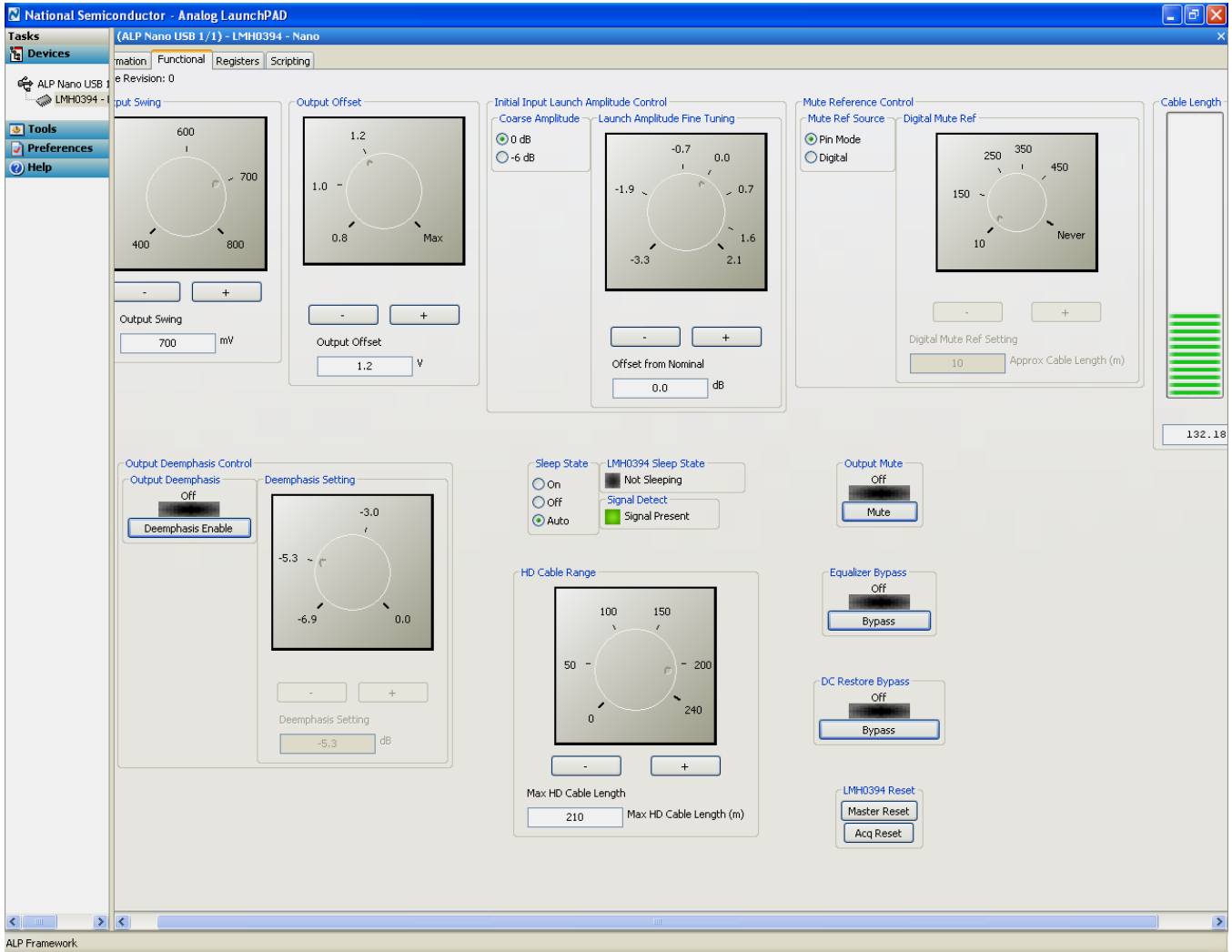


FIGURE 12. LMH0394 Functional Tab

Registers Tab

The Registers tab displays all registers for the LMH0394 equalizer. Figure 13 shows the Registers tab. The Value field indicates the value of the currently selected register.

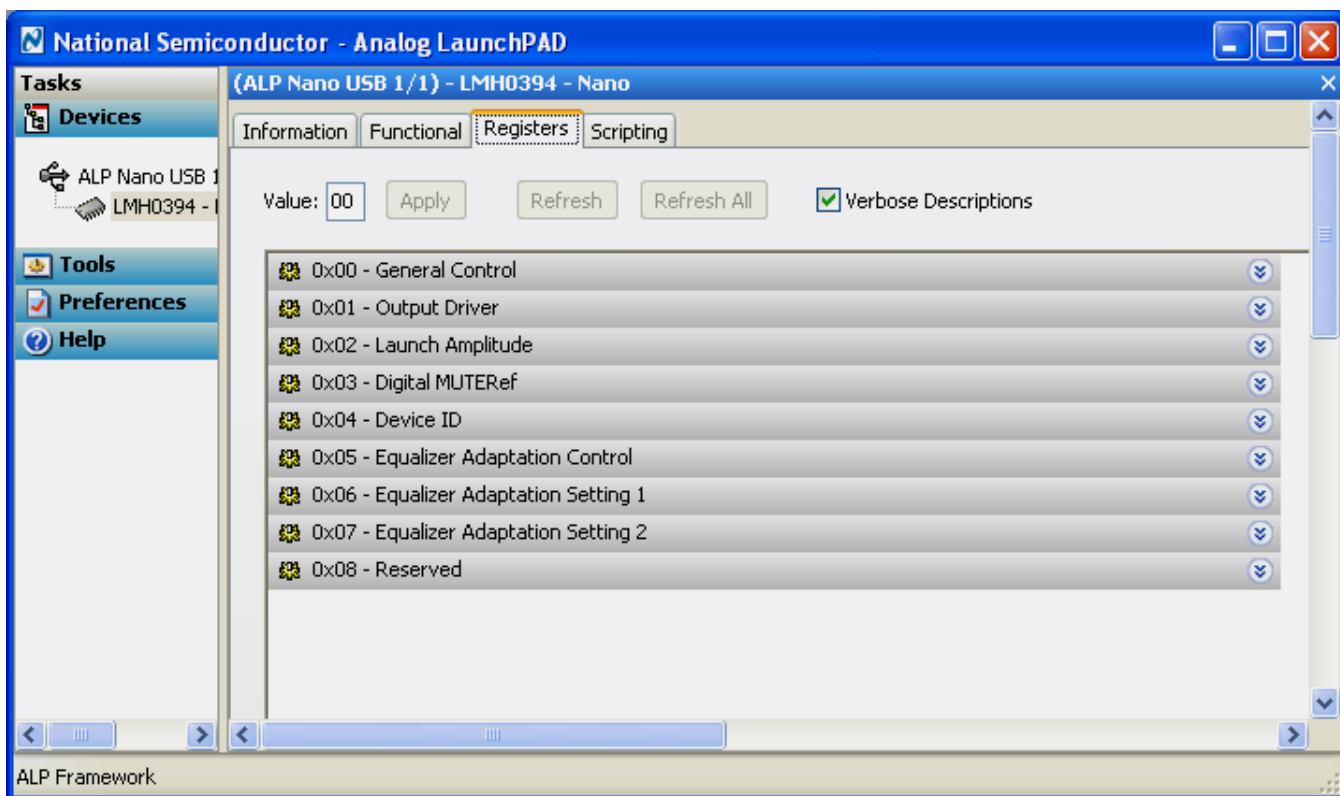


FIGURE 13. LMH0394Registers Tab

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 14 with Verbose Descriptions checked and Figure 15 with Verbose Descriptions un-checked.

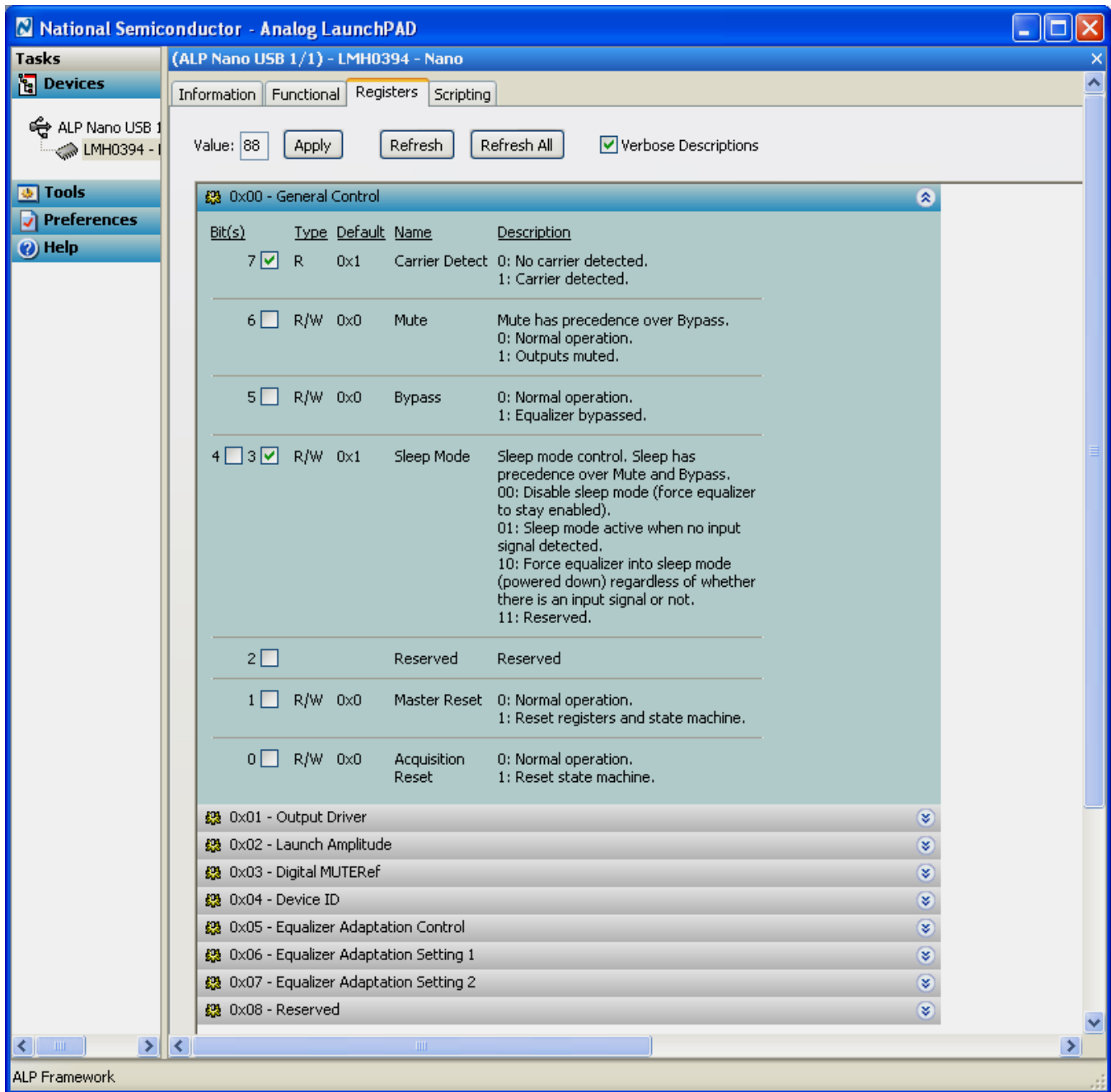


FIGURE 14. LMH0394 Registers Tab with Verbose Descriptions

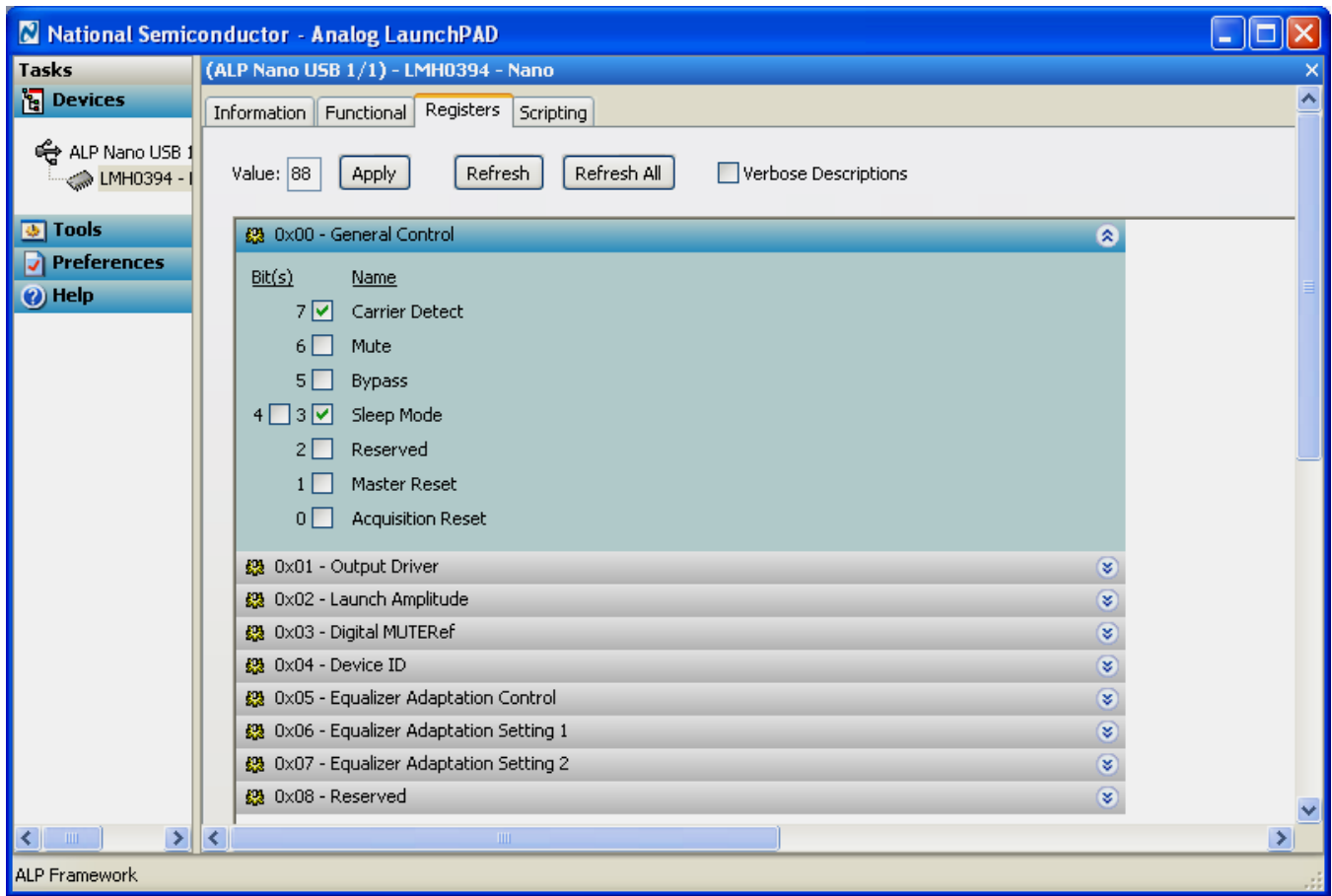


FIGURE 15. LMH0394 Registers Tab without Verbose Descriptions

The Display button provides another view of the register set and is depicted in Figure 16. The Display dialog supports the Windows copy command (Ctrl+c).

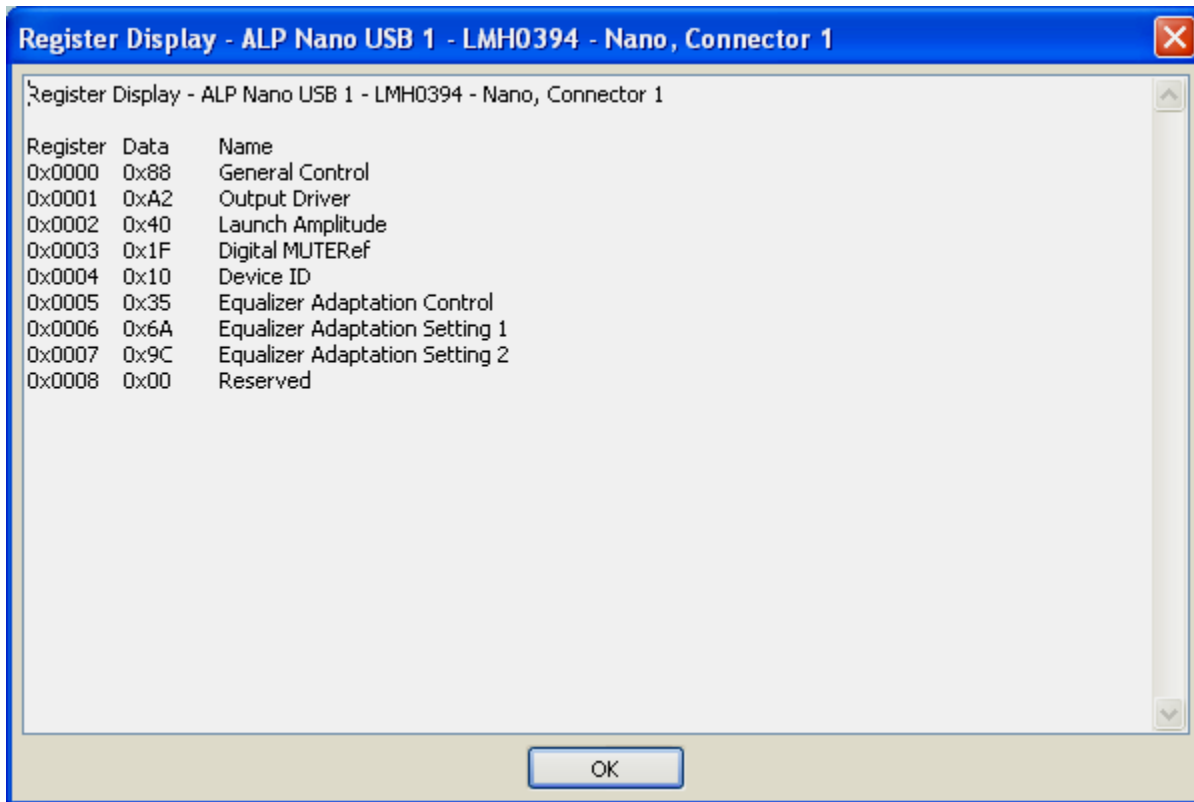


FIGURE 16. LMH0394 Register Display

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

Trouble Shooting

If the following window (Figure 17) opens after starting the ALP software, double check the hardware setup.

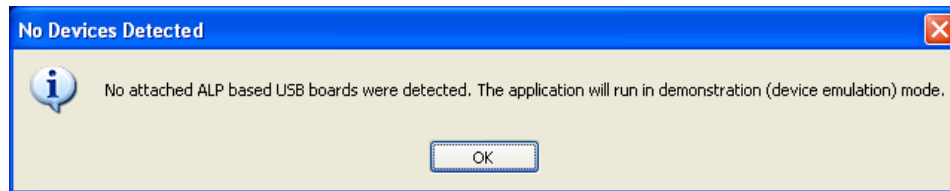


FIGURE 17. Analog LaunchPAD No Devices Error

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 18.

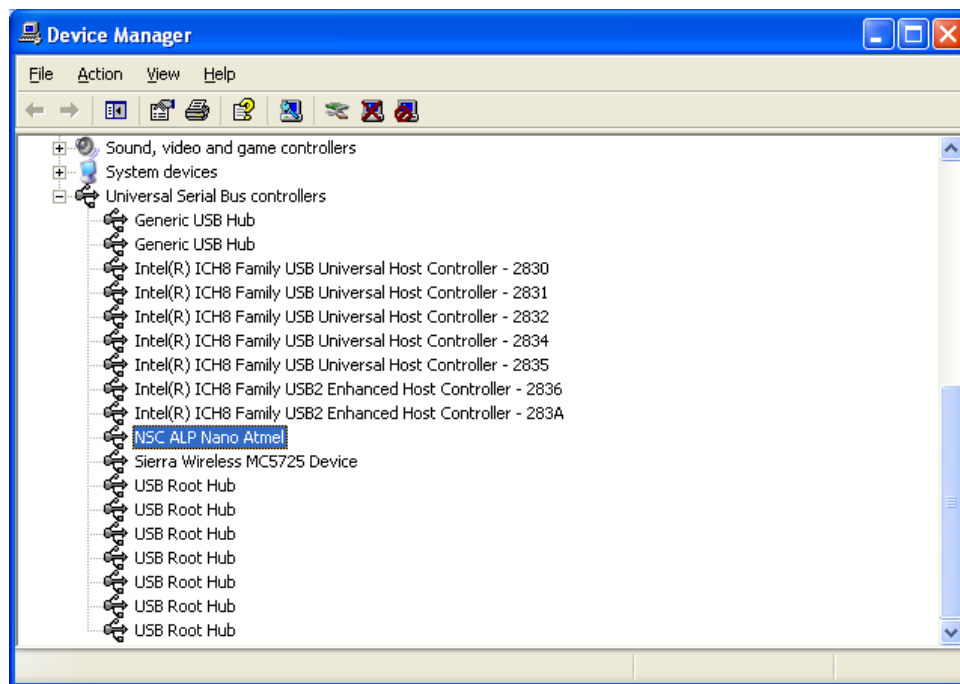


FIGURE 18. Windows XP, Analog LaunchPAD USB Driver

The software should start with only "LMH0394 - 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 19.

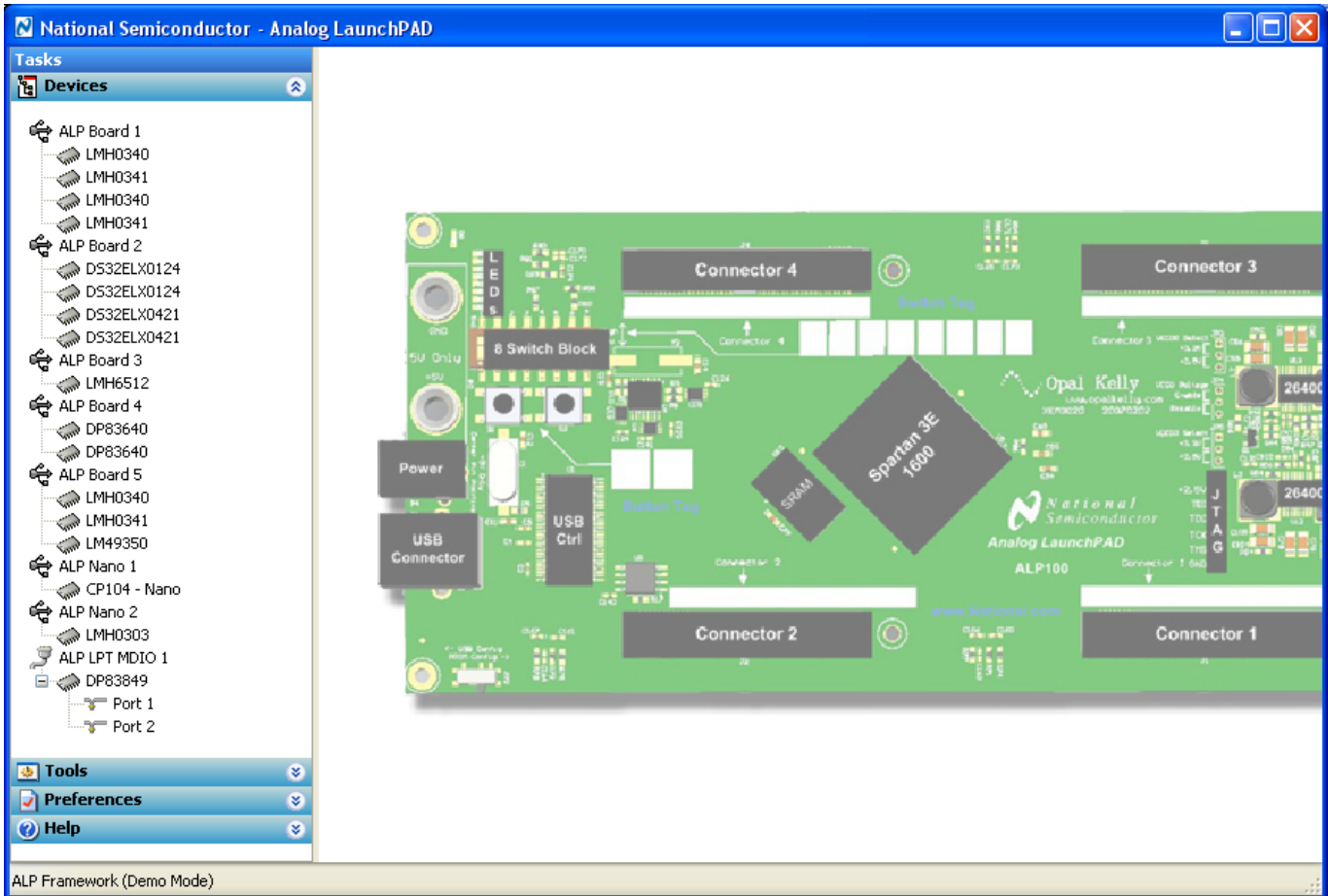


FIGURE 19. Analog LaunchPAD in Demo Mode

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

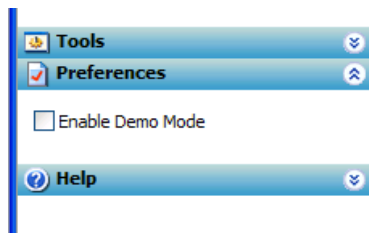


FIGURE 20. Analog LaunchPAD Preferences Menu

After demo mode is disabled, the ALP software will poll the ALP hardware. The ALP software will update and have only “LMH0394- Nano” under the “Devices” pull down menu.

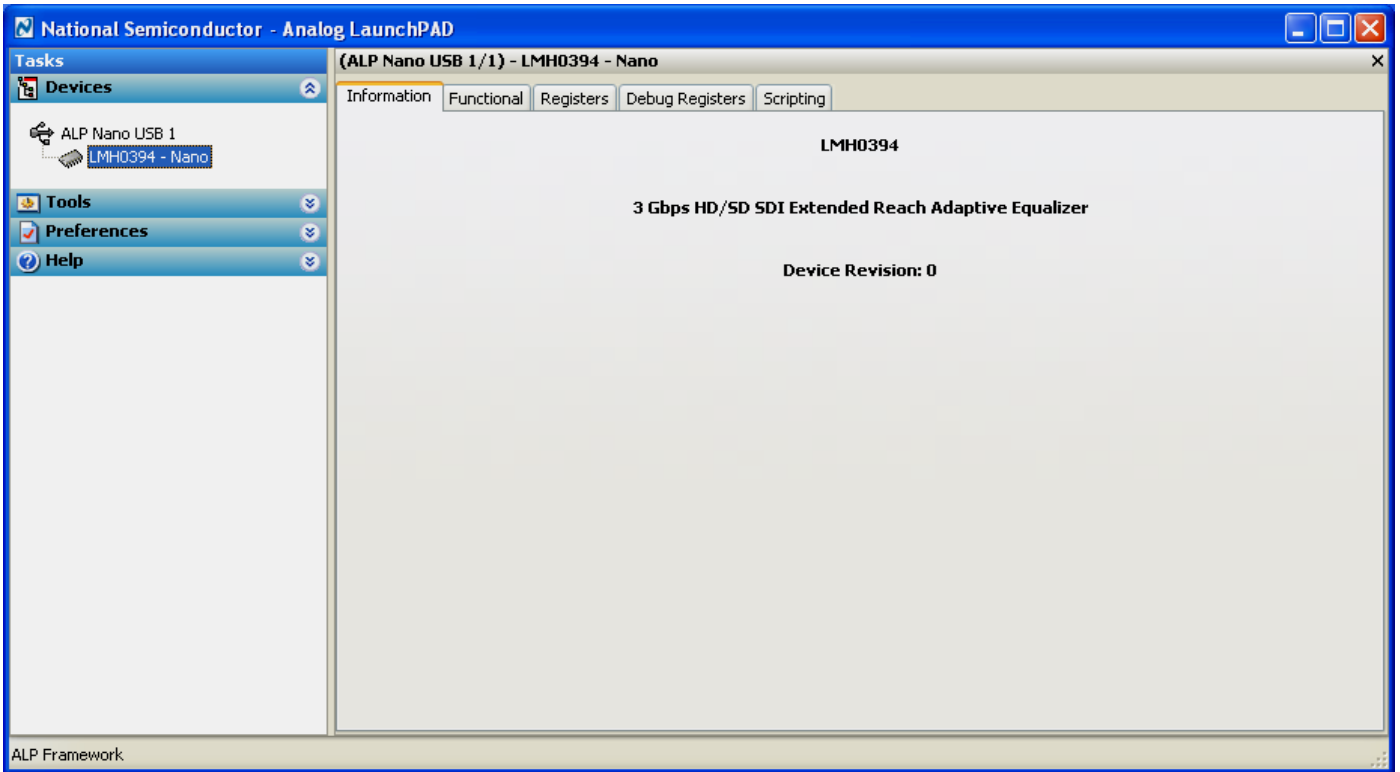


FIGURE 21. Analog LaunchPAD Screen with Demo Mode Off

SD394 Bill of Materials

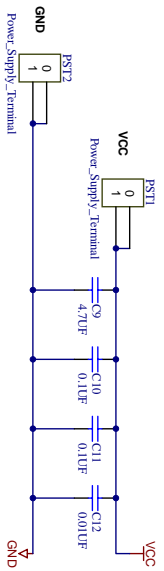
Reference Designator	Qty	Description	Manufacturer	Manufacturer Part No.
C1, C2, C12	3	Capacitor, 0.01uF, 16V, X7R, 0402	Panasonic - ECG	ECJ-0EB1C103K
C3, C7, C9, C16	4	Capacitor, 4.7uF, 6.3V, X5R, 0402	Panasonic - ECG	ECJ-0EB0J475M
C5, C6	2	Capacitor, 1uF, 6.3V, X5R, 0402	Panasonic - ECG	ECJ-0EB0J105M
C10, C11	2	Capacitor, 0.1uF, 16V, X7R, 0402	Kemet	C0402C104K9RACTU
D1	1	LED, Green, 0603	Lite-On	LTST-C190GKT
J1	1	BNC, 75-ohm, Amphenol, edge launch	Amphenol	031-6009
J2, J3	2	SMA, 50-ohm, edge launch	Johnson Components	142-0701-851
JP1	1	Header, 6x1, 0.1"	3M/ESD	929647-01-06-I
JP2	1	Header, 3x2, 0.1"	3M/ESD	929665-01-03-I
JP3, JP4, JP6, JP7, JP8, JP9	6	Header, 3x1, 0.1"	3M/ESD	929647-01-36-I
JP5	1	Header, 2x1, 0.1"	3M/ESD	929647-01-02-I
L1	1	Inductor, 5.6nH, 0402	Murata	LQP15MN5N6B02D
PST1, PST2	2	Power Supply Terminal	Keystone	1287-ST
R1	1	Resistor, 300-ohm, 1/10W, 5%, 0603	Panasonic - ECG	ERJ-3GGEYJ301V
R2, R3	2	Resistor, 75-ohm, 1/16W, 1%, 0402	Yageo America	RC0402FR-0775RL
R4	1	Resistor, 37.4-ohm, 1/16W, 1%, 0402	Vishay/Dale	CRCW040237R4FKED
R5, R7, R9	3	Resistor, 3.16k-ohm, 1/10W, 1%, 0402	Panasonic - ECG	ERJ-2RKF3161X
R6, R8, R10	3	Resistor, 9.76k-ohm, 1/10W, 1%, 0402	Panasonic - ECG	ERJ-2RKF9761X
R11	1	Resistor, 0-ohm, 1/10W, 5%, 0402	Panasonic - ECG	ERJ-2GE0R00X
U2	1	LMH0394 Cable Equalizer, LLP-16	National Semiconductor	LMH0394SQ

SPA Dongle Bill of Materials

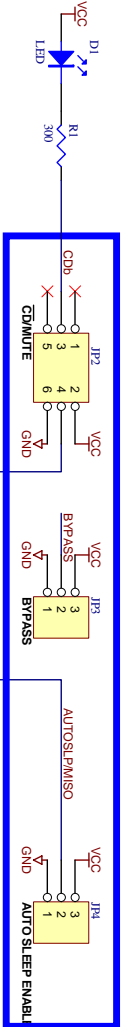
Reference Designator	Qty	Description	Manufacturer	Manufacturer Part No.
CR2,CR1	2	SUPPRESSOR ESD 24VDC 0603 SMD	Littelfuse Inc	PGB1010603MR
C1,C2,C3,C4,C5,C6,C100	7	CAP CER .1UF 50V 10% X7R 0603	Murata	GRM188R71H104KA93D
C7	1	CAPACITOR TANT 1.0UF 16V 10% SMD	Kemet	T491A105K016AT
C8,C9	2	CAP CER .22UF 50V Y5V 0603	TDK Corporation	C1608Y5V1H224Z
C10,C11	2	CAP CERAMIC 12PF 50V NP0 0603	Kemet	C0603C120J5GACTU
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
J7	1	HEADER, 5x2, 0.1"	3M/ESD	929836-02-05-RK
R1,R4,R5,R16,R20,R100	6	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GGEY0R00V
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 8.00MHZ 8PF FUND SMD	NDK	NX5032GA 8MHZ AT-W

Schematics (following pages)

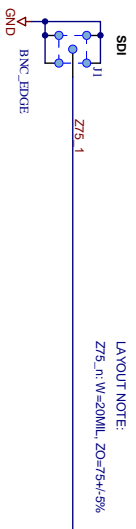
	LMH0394	LMH0384
VCC(PST1)	2.5V	3.3V
R5	3.16K	0
R7	3.16K	0
R9	3.16K	0
R6	9.76K	Do Not Load
R8	9.76K	Do Not Load
R10	9.76K	Do Not Load



Do not place JP2-JP4 in SPI Mode

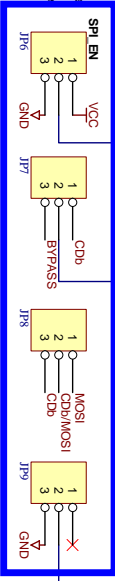
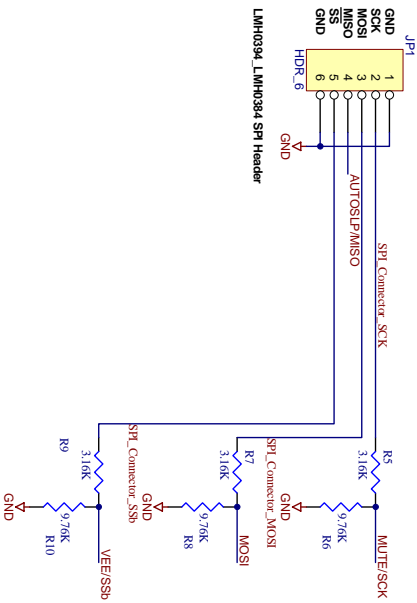
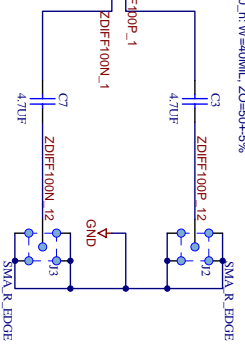


Place C1, C16, & C2 as close to U2 pin as possible/VCC

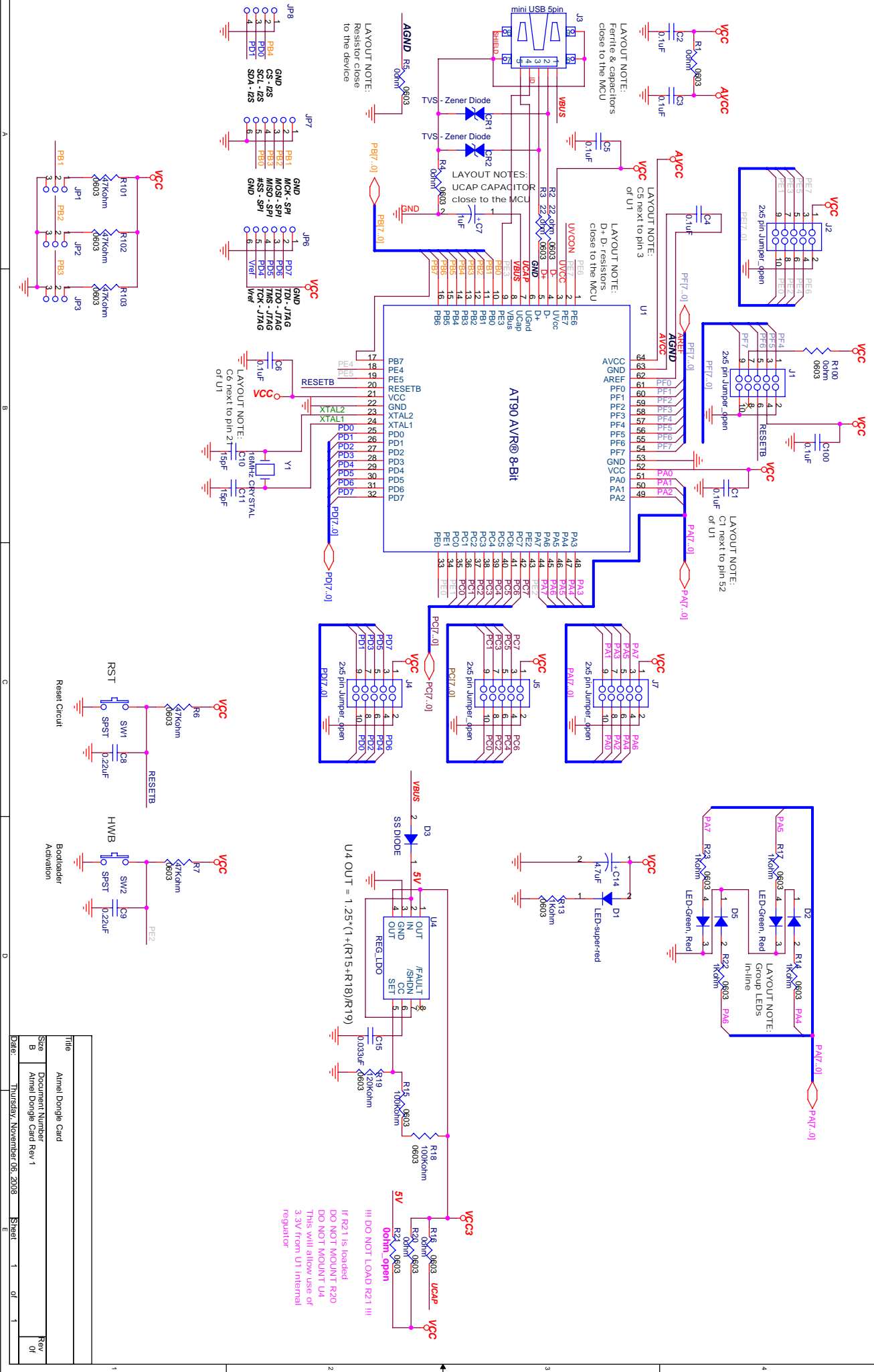


LAYOUT NOTE:
Z75_n:W=20MIL, ZO=75+-5%

LAYOUT NOTE:
Z50_n:W=40MIL, ZO=50+-5%



LMH0394-LMH0394 SPI Mode / Pin Mode Select (JP6-JP9)



Title	Atmel Dongle Card
Document Number	Atmel Dongle Card Rev 1
Size	B
Rev	01
Date:	Thursday, November 06, 2008
Sheet	1 of 1

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated