Evaluating the ADIN1100 Robust, Industrial, Low Power 10BASE-T1L PHY, and Media Converter to 10BASE-T with ADIN1200 Ethernet PHY

FEATURES

▸ User friendly access to all ADIN1100 features
▸ GUI software on PC or standalone hardware configured operation
▸ Flexible power supplies and prototyping options
▸ On-board Arm Cortex-M ADuCM4050 microcontroller
▸ 10BASE-T1L to 10BASE-T media converter

EVALUATION KIT CONTENTS

▸ EVAL-ADIN1100EBZ board
▸ 2× plugin screw terminal connectors for 10BASE-T1L cable and external power supply
▸ Category 5e Ethernet cable with RJ45 connectors (1 meter)
▸ USB-A to micro USB-B cable (1 meter)

EQUIPMENT NEEDED

▸ Link partner with 10BASE-T1L interface
▸ 10BASE-T1L-compatible, single-pair cable (1.5 mm^2 maximum, 16 American wire gauge (AWG) to fit screw terminal connector)
▸ Power supply source: 5 V dc to 32 V dc, 0.6 W, or USB as power for the board
▸ Optional: link partner with standard RJ45 Ethernet interface, autonegotiation resolving to 10BASE-T full duplex
▸ Optional: PC running Windows® 7 (or later version) with USB interface

SOFTWARE (OPTIONAL)

▸ ADIN1100 graphical user interface (GUI) software package
▸ Future Technology Devices International Limited (FTDI) USB virtual COM port driver for selected host
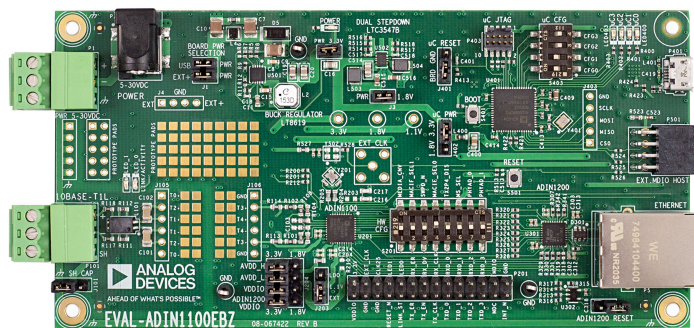▸ Serial port terminal software

DOCUMENTATION NEEDED

▸ ADIN1100 data sheet

GENERAL DESCRIPTION

The EVAL-ADIN1100EBZ is a flexible platform enabling quick evaluation of the ADIN1100 robust, low power 10BASE-T1L PHY. The EVAL-ADIN1100EBZ provides 10 Mbps single pair Ethernet (SPE) connections with devices across 1.7 km of cable.

The evaluation board offers two modes of operation for maximum flexibility. Connected to a PC via USB port, the full set of ADIN1100 register settings and features such as link quality monitoring and diagnostics can be accessed with the ADIN1100 GUI software.

Alternatively, the EVAL-ADIN1100EBZ board can operate in standalone mode where it is configured by setting hardware configuration links and switches. On-board LEDs provide status indication.

The ADIN1100 data (MII, RMII, and RGMII) and management (MDIO) interfaces are accessible on header connectors for easy connection to an external host controller.

A small prototyping area and test points are provided for experimentation with alternative cable connection topologies including isolation transformers and/or power coupling inductors.

The platform can perform as a 10BASE-T1L to 10BASE-T media converter. This feature enables connection to other devices (demonstration boards or custom prototypes) with a 10BASE-T1L Ethernet port and conversion of the data to standard Ethernet, which is accessible via the RJ45 connector.

Full details about the ADIN1100 are available in the ADIN1100 data sheet, which must be consulted when using the EVAL-ADIN1100EBZ.

EVAL-ADIN1100EBZ BOARD PHOTOGRAPH

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

9/2021—Revision 0: Initial Version

OVERVIEW

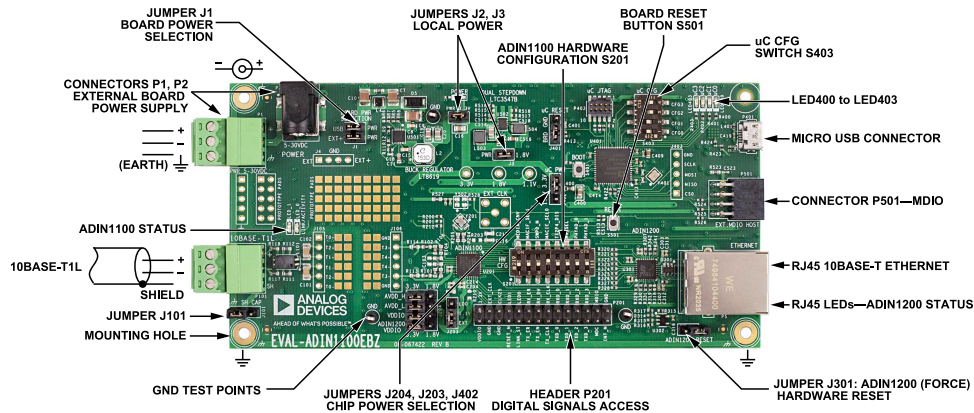See Table 1 for detailed descriptions of the components labeled in Figure 2.

Figure 2. Detailed View of the EVAL-ADIN1100EBZ

Table 1. Component Descriptions

| Reference Designator	Description
J1	Jumper for board power selection.
J2, J3	Jumpers for local power: 3.3 V and 1.8 V. Keep J2 and J3 inserted.
S201	ADIN1100 hardware configuration. See the ADIN1100 data sheet for descriptions of all options (on: high, pull-up resistor).
S501	EVAL-ADIN1100EBZ board reset button. Reset the board after any configuration change.
S403	Microcontroller configuration switch (labeled uC CFG) media converter. Mode 15: all off (see Table 6).
LED400 to LED403	Microcontroller LEDs (labeled uC0 to uC3).
	uC0 (green) for media converter (on: both links are up).
	uC1 (red) for error (on: system error).
	uC2 (orange) for microcontroller heartbeat (blinking: microcontroller is active).
	uC3 (blue) is reserved for future use or user functions.
P1, P2	Connectors for external board power supply, 5 V dc to 32 V dc. If the board is supplied from a USB, the external power is disabled.
LED_0, LED_1	ADIN1100 status. LED_0 gives link or activity status. LED_1 is on when the 2.4 V transmit level amplitude is used and off when the 1.0 V transmit level amplitude is used.
10BASE-T1L	Shield for 100 W twisted single pair Ethernet cable.
J101	Jumper for 10BASE-T1L able Shield. Connected to Earth directly or via a 4000 pF capacitor.
Mounting Hole	3.2 mm for M3 screw, Earth ground for electromagnetic compatibility (EMC).
Micro USB Connector	For use of the EVAL-ADIN1100EBZ board with PC GUI software or USB COM port to host terminal software: 115,200 baud rate, 8-bit, no parity, one stop bit. The board can receive power from a USB port or charger.
P501	Connector for MDIO. P501 can be used for managing external PHYs using the on-board microcontroller and related software. The on-board PHYs can be managed by an external host. In this case, keep the local microcontroller in reset by placing Jumper J401 in Position GND.
P5	RJ45 10BASE-T Ethernet connector for autonegotiation, advertising 10 Mb full duplex as the only option to link and operate. 10BASE-T1L is 10 Mb full duplex. The ADIN1100 acts as a media converter and does not buffer data.
RJ45	LEDs that give ADIN1200 status. Yellow: activity; green: link is up.
GND	Test points for oscilloscope probe or multimeter ground.
J204, J203, J402	Jumpers for chip power selection. Set ADIN1100 VDDIO = ADIN1200 VDDIO = the microcontroller power (J402).
P201	Header for digital signal access: MII, RMII, RGMII, MDIO, reset, clocks, LEDs, status, and interrupts.
J301	Jumper for ADIN1200 (force) hardware reset. If not using the media converter function, insert this jumper to keep the ADIN1200 in reset and release its digital signals. The ADIN1100 MII, RMII, or RGMII on Header P201 can then be used safely with the ADIN1200 held in reset.

OVERVIEW
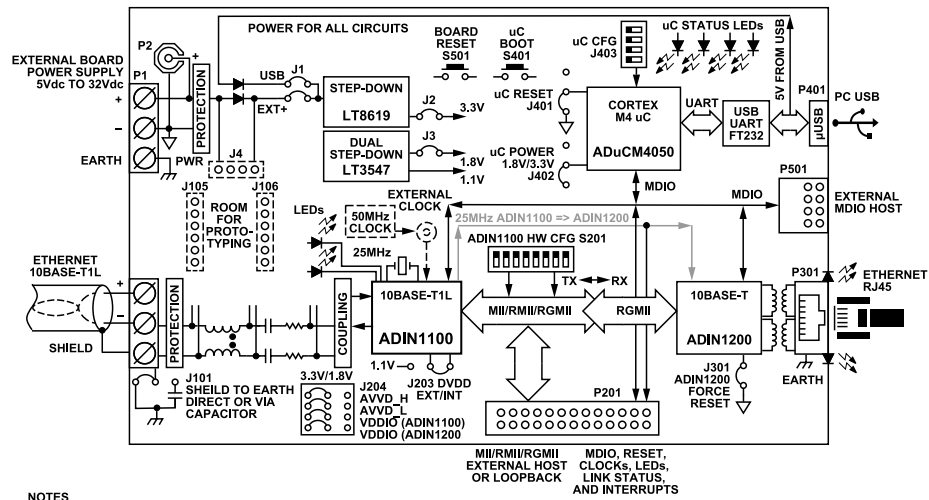
Figure 3. EVAL-ADIN1100EBZ Simplified Block Diagram

HARDWARE

POWER SUPPLIES

The EVAL-ADIN1100EBZ can be powered by a power supply with an output voltage between 5 V dc and 32 V dc connected via the plugin screw terminal connector, P1, or via the P2 barrel connector plug.

Alternatively, the EVAL-ADIN1100EBZ board can be powered from a host via its USB port, or by a USB charger connected to the micro USB connector, P401.

The power supply source can be selected by inserting a link on J1 (labeled BOARD PWR SELECTION). Inserting a link in Position USB enables the EVAL-ADIN1100EBZ board to receive power from the USB connector, P401. Inserting link in Position EXT+ enables the EVAL-ADIN1100EBZ board to receive power from the P1 and P2 connectors.

If both USB and EXT+ links are inserted on J1, a common cathode diode pair selects the highest voltage input to supply the EVAL-ADIN1100EBZ board.

The power from the source is converted by the LT8619 step down converter (U501) to 3.3 V, and with a link inserted in Position J2 (PWR 3.3V), the 3.3 V rail supplies all circuits on the EVAL-ADIN1100EBZ board. The presence of the 3.3 V power is indicated by the green LED1 (labeled POWER).

The power consumption of the EVAL-ADIN1100EBZ board depends on the mode of operation, with the maximum of approximately 0.5 W.

10BASE-T1L CABLE CONNECTION

The 10BASE-T1L cable can be connected via a pluggable screw terminal block to Connector P101. If more of the pluggable connectors are needed for easy connecting or changing of cables, additional connectors can be purchased from vendors or distributors, such as: Phoenix Contact, Part Number 1803581, which is a pluggable, 3-way, 3.81 mm, 28 AWG to 16 AWG, 1.5 mm^2 screw terminal block.

GROUND CONNECTIONS

The EVAL-ADIN1100EBZ board has an Earth node. Although this node may or may not be electrically connected to Earth ground, in a real device, this node is typically connected to the device metal housing or chassis. This Earth node can be connected as required in a wider demonstration system via the Earth terminal of the power supply connector, P1, or via an exposed metal plating of three mounting holes in the corners of the EVAL-ADIN1100EBZ board. (The fourth hole does not have metal plating, and has no Earth connection.)

The shield of the 10BASE-T1L cable can be disconnected from this Earth node, connected directly, or connected via a 4700 pF capacitor (C104). The required connection is selected by the relevant link position of J101.

The 10BASE-T Earth connection and metal body of the RJ45 connector (P5) are connected directly to the Earth node.

The local circuit ground, the external power supply (except the Earth terminal, P1), and the USB connector are connected to the Earth node via approximately 2000 pF of capacitance and approximately 4.7 MΩ of resistance.

The EVAL-ADIN1100EBZ has been designed only as an evaluation board. It has not been designed nor tested for electrical safety. Any equipment, device, wire, or cable connected to this EVAL-ADIN1100EBZ board must be already protected and safe to touch without danger of electric shock.

HARDWARE CONFIGURATION SETUP

The EVAL-ADIN1100EBZ hardware configuration is determined by links (jumpers) and configuration switches on the board. The descriptions and the default hardware configurations of these links and switches are outlined in Table 2, Table 3, Table 4, Table 5, and Table 6.

Table 2. EVAL-ADIN1100EBZ Board Link Configuration

Link Reference	Default Position	Link Function
J1	USB, EXT+	Board power supply source selection. Both USB and EXT+ can be inserted simultaneously.
J2	Inserted	Board 3.3 V power supply rail.
J3	Inserted	Board 1.8 V power supply rail.
J101	Earth	Shield. Connect the shield of the cable to the Earth node either directly or via a capacitor.
J203	LDO	ADIN1100 1.1 V power supply selection. LDO:sing the ADIN1100 on-chip internal 1.1 V linear regulator. EXT: supplied from the 1.1 V output of the LTC3547 step down regulator.
J204	3.3V	ADIN1100 3.3 V or 1.8 V power supply selection. If changing, keep the ADIN1100 VDDIO, ADIN1200 VDDIO, and microcontroller wer (J402) all at the same voltage level, 3.3 V or 1.8 V.
J301	Not inserted	ADIN1200 reset. Insert to keep the ADIN1200 in hardware reset and release its digital signals.
J401	BRD	Microcontroller reset. BRD: microcontroller is reset by the S501 push-button (labeled RESET). GND: microcontroller is held in reset.
J402	3.3V	Microcontroller power. Keep at the same level, 3.3 V or 1.8 V, as the ADIN1100 VDDIO and the ADIN1200 VDDIO.

HARDWARE

Table 3. Default Firmware Mode Configuration, S403 (Labeled uC CFG)[1]

Switch Position	Switch Name	Default Position
1	CFG_0	Off
2	CFG_1	Off
3	CFG_2	Off
4	CFG_3	Off

[1] Mode 15 media converter (default positions for S403 when shipped). All switches off. See Table 6.

Table 4. ADIN1100 Hardware Configuration, S201 (Labeled HW CFG)

Switch Position	Switch Name	Default Position	Description
1	MEDIA_CNV	Off	Media converter (only for RMII interface mode, not used on this board)
2	MACIF_SEL1	Off	MAC Interface Select 1
3	SWPD_N	Off	Software power-down
4	MACIF_SEL0	On	MAC Interface Select 0
5	TX2P4_DIS	Off	Transmit amplitude 2.4 V disable (always turn this switch on if AVDD_H = 1.8 V
6	MS_SEL	Off	Master/slave select (used as preference for autonegotiation)
7	PHYAD_0	Off	PHY Address 0 for management interface (MDIO)
8	PHYAD_1	Off	PHY Address 1 for management interface (MDIO)

Table 5. Board LED Indicators

Name	Colour	Reference Designator	Description
uC0	Green	LED400	In media converter mode, uC0 indicates media converter is working and both PHY links are up
uC1	Red	LED401	Error detected by firmware
uC2	Yellow	LED402	Short flash: heartbeat
			Long flash or on: receiving UART commands
uC3	Blue	LED403	Reserved
LED_0	Green	LED200	10BASE-T1L link up/activity
LED_1	Yellow	LED201	In firmware managed modes: 10BASE-T1L transmit amplitude 2.4 V
RJ45	Green	P5	10BASE-T link up
RJ45	Yellow	P5	10BASE-T activity
POWER	Green	LED1	Board 3.3 V power supply is present

HARDWARE

MICROCONTROLLER MODES OF OPERATION

The EVAL-ADIN1100EBZ can be used in various modes of operations implemented in the microcontroller firmware. Up to 16 modes of operations can be selected by setting the four positions of the S403 dual inline package (DIP) switch. The status of the switch is accepted (latched) after the board is powered up or reset.

Therefore, to change the mode of operation, the board must be reset by pressing the S501 reset button or by applying a power cycle after changing the position of the S403 DIP switch.

Table 6. Firmware Modes of Operation, Set by S403 (Labeled uC CFG)

CFG3[1]	CFG2	CFG1	CFG0	Mode	Description
On	On	On	On	0	Reserved
On	On	On	Off	1	Reserved
On	On	Off	On	2	Reserved
On	On	Off	Off	3	Reserved
On	Off	On	On	4	Reserved
On	Off	On	Off	5	Reserved
On	Off	Off	On	6	Reserved
On	Off	Off	Off	7	Reserved
Off	On	On	On	8	ADIN1100 PHY Test Mode 3 (idle)
Off	On	On	Off	9	ADIN1100 PHY Test Mode 2 (droop)
Off	On	Off	On	10	ADIN1100 PHY Test Mode 1 (jitter)
Off	On	Off	Off	11	ADIN1100 PHY transmit disable mode
Off	Off	On	On	12	ADIN1100 frame generator/checker
Off	Off	On	Off	13	ADIN1100 MAC remote loopback
Off	Off	Off	On	14	GUI/interactive mode
Off	Off	Off	Off	15	Media converter mode (default configuration)

[1]   Switch in on position means signal Logic 0 for microcontroller (shorted to ground). Switch in off position means signal Logic 1 (pulled up by a resistor).

SOFTWARE

The EVAL-ADIN1100EBZ can be used as standalone board, with the firmware already programmed in the microcontroller flash memory, the mode of operation set by the mode switch, and the status indicated by LEDs. There is no software needed for this standalone use case.

The EVAL-ADIN1100EBZ can also be connected to a PC via a USB port. The full set of ADIN1100 register settings and features such as link quality monitoring and diagnostics can be accessed with the ADIN1100 GUI software, available from Analog Devices, Inc.

Alternatively, the ADIN1100 and ADIN1200 registers, 10BASE-T1L link status monitoring, and some diagnostics can be accessed using a simple set of ASCII text commands and messages exchanged over the USB COM port and a serial port terminal software.

DRIVER FOR USB COM PORT

The EVAL-ADIN1100EBZ uses the FTDI FT232 for the USB COM port connectivity.

Make sure that the appropriate virtual COM port driver is included or installed on the host platform before connecting the EVAL-ADIN1100EBZ to that host via a USB cable.

FTDI virtual COM port drivers are available from the FTDI website.

SERIAL COM PORT AND TERMINAL SETTINGS

When the EVAL-ADIN1100EBZ is connected to the host, it becomes available in the host system as a USB COM port, and is assigned a COM port number. The number depends on the system settings, on the COM port devices previously connected and assigned in the system, and on the FTDI driver settings.

The EVAL-ADIN1100EBZ microcontroller firmware communicates over a standard UART interface, with the following settings:

▸ Speed = 115,200 baud rate
▸ One start bit
▸ Eight data bits
▸ No parity
▸ One stop bit

The protocol is based on ASCII text commands and messages. Each message sent from the firmware to the host is finished by both <CR> and <LF> characters. For the commands received from the host, the firmware expects <CR> or <LF>, or both <CR> and <LF> (see Table 7).

Table 7. Character Descriptions

Character	Description	ASCII Code
<CR>	Carriage return	0x0D (13 decimal)
<LF>	Line feed	0x0A (10 decimal)

TERMINAL SOFTWARE

The EVAL-ADIN1100EBZ firmware works with the common serial terminals. It has been tested on the Windows platform with PuTTY, RealTerm, Termite, and the HyperTerminal.

TERMINAL COMMANDS AND MESSAGES

The examples in the following sections were captured using CompuPhase Termite.

INITIAL WELCOME MESSAGE

When the EVAL-ADIN1100EBZ is connected to the terminal software using the serial COM port settings defined in the Serial COM Port and Terminal Settings section, the firmware sends the following initial welcome message after power-on or after pressing the EVAL-ADIN1100EBZ S501 button (labeled RESET):

```
=============================================
=
ANALOG DEVICES 10BASE-T1L PHY Demo
=============================================
=
(c) 2021 Analog Devices Inc. All rights re▶
served
=============================================
=
Firmware ver.: 12 . 1 . 4784b935
Hardware type: EVAL-ADIN1100EBZ
Hardware ver.: A
Hardware UID : AVAS142049
uCCFG3-2-1-0 : OFF-OFF-OFF-ON (Mode 14)
Firmware Mode: GUI / Interactive mode
=============================================
=
Type '<?><new line>' for a list of commands
=============================================
=
```

TERMINAL COMMANDS

The most important command is <?><new line>.

On the host keyboard, press the SHIFT + ? keys, followed by the ENTER key, and the firmware sends a list of all commands implemented in this version, as follows:

```
?
==========================================
List of Commands
* MDIO (Clause 22) write to Phy, all numbers
in hex.
'mdiowrite ,,'
* MDIO (Clause 22) read from Phy, all numbers
in hex.
'mdioread ,'
* MDIO (Clause 45) write to Phy, all numbers
```

SOFTWARE

```
in hex.
'mdiowr_cl45 ,,'
* MDIO (Clause 45) read from Phy, all numbers
in hex.
'mdiord_cl45 ,'
* Phy (hardware) reset
'phyreset'
* Phy status and link properties.
'phystatus'
* Start reporting status.
'start'
* Stop reporting status.
'stop'
* Clear / reset status counters.
'clear'
* uC Software Reset.
'reset'
* Mode change, overrides uC CFG until next Re▶
set.
'mode '
* List implemented modes.
'modes'
* Comment - string of up to 98 characters
'//'
* Show list of commands.
'?'
==============================================
```

STATUS AND DIAGNOSTICS

To see the status of the EVAL-ADIN1100EBZ, use the phystatus command, which reads and shows the latest status of the ADIN1200 10BASE-T PHY and ADIN1100 10BASE-T1L PHY, as follows:

```
phystatus
ADIN1200 Link is Up,
ADIN1100 Link is Up, Master, 2.4 V
MSE -37.2 dB Rx 0, Err 0
```

To see a continuous update, use the start command, as follows:

```
start
OK
MSE -38.4 dB Rx 255, Err 0
MSE -38.6 dB Rx 256, Err 0
MSE -38.7 dB Rx 257, Err 0
MSE -38.4 dB Rx 257, Err 0
MSE -38.7 dB Rx 257, Err 0
stop
OK
```

The firmware periodically sends an update, approximately every 1 sec. The update in the present firmware version returns the following results:

▶ MSE—10BASE-T1L mean square error, which indicates link quality.
▶ Rx—number of Ethernet frames received by the PHY from the 10BASE-T1L cable since the last board or firmware reset, or after use of the clear command.
▶ Err—number of frames with error received since the last board or firmware reset, or after use of the clear command.

To stop the continuous update, use the stop command or reset the EVAL-ADIN1100EBZ board.

MICROCONTROLLER FIRMWARE UPDATE

The Arm® Cortex®-M4 ADuCM4050 microcontroller (U401) is programmed before shipping the EVAL-ADIN1100EBZ board. Therefore, there is no need to program the ADuCM4050 unless a new version of firmware is available that must be updated on the EVAL-ADIN1100EBZ board.

The present firmware version can be checked via the USB COM port and terminal software. The version is displayed in the welcome message after a board reset or in response to the info command.

Firmware update is distributed as a compiled binary (.HEX) file. The easiest way to program it is using the USB COM port and **CrossCore Serial Flash Programmer**, available for free download at https://www.analog.com/crosscore-utilities#software-related-software.

The FTDI USB COM port driver must be installed on the PC before connecting the board and using the **CrossCore Serial Flash Programmer** GUI (see the Driver for USB COM Port section).

When the driver and programmer software are installed, and the firmware update (.HEX) file is ready, follow these steps:

1. Connect the board (using P401) via a micro USB cable to the PC.
2. Start the **CrossCore Serial Flash Programmer** software.
3. Set the programmer (see Figure 4) with the settings listed in Table 8.
4. For **File to download**, click **Browse** to download the firmware file on the PC (see Figure 4).
5. On the EVAL-ADIN1100EBZ board, simultaneously press and hold the S501 (RESET) and S401 (BOOT) buttons. Release the RESET button first, followed by releasing the BOOT button. The on-board microcontroller is then in the programming state, and the yellow microcontroller heartbeat LED402 stops blinking.
6. Click **Start** and the code starts to download with messages provided in the **Status** section and progress bar across the bottom of the window.

If using a terminal program for communicating with the EVAL-ADIN1100EBZ board, either disconnect it by releasing the COM port or stop the terminal program. Otherwise, a **Failed to open serial device** message appears. A **No autobaud response** message likely indicates that the microcontroller is not in the programming state. Go back to Step 5.

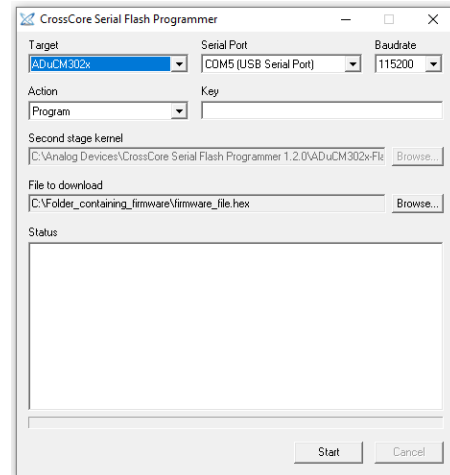7. After programing, press and release the S501 RESET button.

Figure 4. CrossCore Serial Flash Programmer

Table 8. CrossCore Serial Flash Programmer Settings

GUI Option	Setting
Target	**ADuCM302x**
Serial Port	**COMx (USB Serial Port)** (where x is the port number, which is set by the USB virtual COM port driver and can be checked in the Windows device manager)
Baudrate	**115200**
Action	**Program**
Key	Not applicable
Second stage kernel	Not applicable

NOTES

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.