



STC-1200

SEARCH TIMER CONTROLLER

AMPEX MM-1200 UPGRADE

Owner's Manual and User Guide

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1 INTRODUCTION

Thank you for purchasing your new STC-1200 search/timer/communications controller for Ampex MM-1200 studio recorders! All controller cards are tested individually prior to shipping. Before installing the card, please read this document thoroughly and retain it for future reference. Additional copies of this manual are available for a nominal printing fee or may be downloaded from our website at <http://www.rtaudio.com>.

All items are carefully packed to endure the rigors of shipping and handling. However, please inspect all contents and packaging immediately upon receipt. Please report any problems to us immediately. In the event of damage, retain all shipping and packaging materials for shipper damage claims inspection.

1.1 Description

The STC-1200 is an advanced search/timer and communications controller designed around the latest ARM 32-bit microprocessor technology. The STC-1200 controller uses a Tiva TM4C1294NCPDTI3 32-bit M4 ARM processor by Texas Instruments¹ that is designed for use in advanced motion control and communication systems applications. The STC-1200 provides auto-locator search/cue functions and provides several communications subsystems that provide TCP/IP, web server, RS-232, RS-422 and MIDI communications support.

The controller firmware runs under Texas Instruments TI-RTOS operating system. TI-RTOS brings true multi-threaded real-time programming power to ARM embedded systems. The auto-locator task runs at highest priority and manages all cue point search and store functions. In addition, the DRC-1200 wired remote provides a true hardware remote control with OLED display and user interface buttons for transport control and auto-locator functions.

1.2 Overview

The STC-1200 card will only work in machines that have been upgraded with the DTC-1200 transport controller board. Refer to the [DTC-1200 Installation Guide](#) for the required DTC wiring modifications necessary for DTC and STC operation. The DTC upgrade wiring modifications adds serial communication links between the two boards. This allows the DTC and STC to send commands and exchange data between the locator and transport controller subsystems in real time as needed.

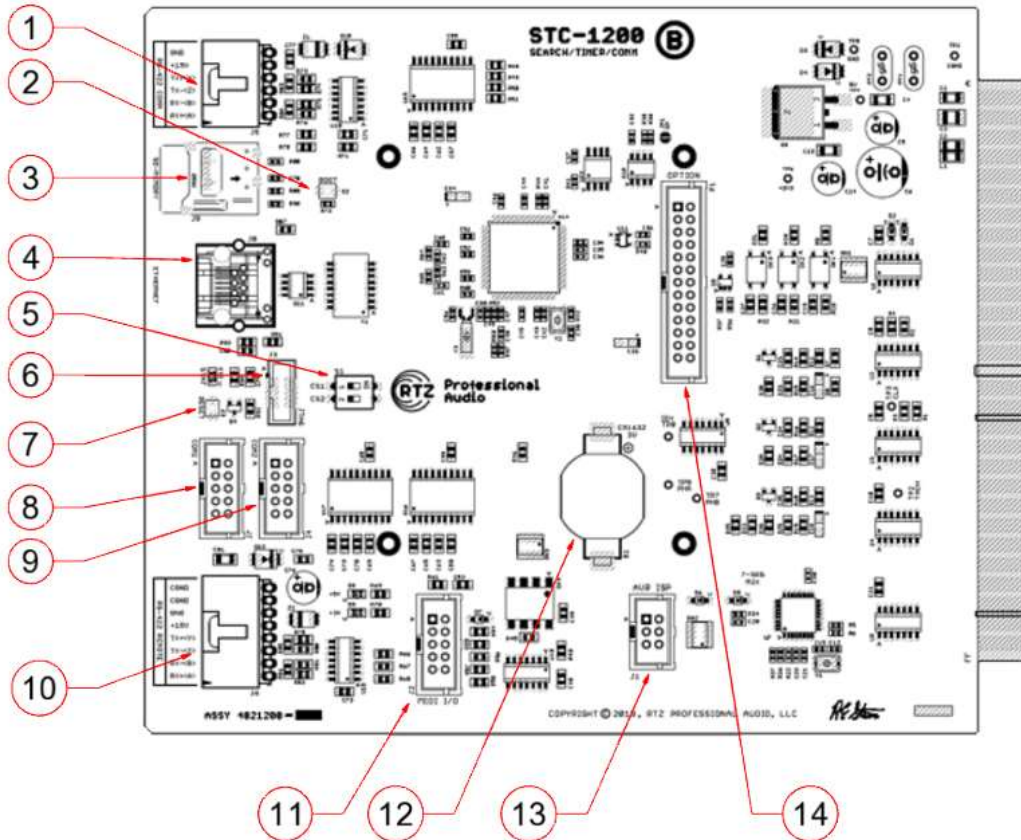
No external connections are required to use the STC in its most basic form. The single cue point store/locate buttons on the transport deck work just like the original Ampex locator functions. This single point memory is dedicated the deck locate button functions and is separate memory from the other ten locate points used by the locator remote. Thus, a tape operator could use this single locate point on the deck for his/her own purposes if needed and not affect any locate points stored by the remote.

1.3 Installing the STC-1200 Board

Confirm the 5V system power is set at the correct voltage. When adjusting the 5V power, it's best to measure the voltage at the control card cage edge connector. The wiring harness add some inline resistance due to resistance in the wire between the power supply and control card cage. Thus, a slight drop will be seen measuring 5V at the machine power supply test point verses at the control card cage edge connector. The incoming 5V to the STC should not exceed 5.1V or damage may occur to components on the STC and/or DTC boards. Note you can also measure the 5V voltage level on the STC card via test point TP4 on the STC card. Power down the machine, remove the original Ampex timer/cue card from the machine and install the STC-1200 card in the machine.

¹ Texas Instruments is a legal trademark of Texas Instruments Corporation.

Figure 1 - PCB Connector and Feature Items



1. Spare accessory RS-422 serial link port. Currently this port is unused and available for future communications, control and/or linking support.
2. BOOT switch used to activate bootloader during system resets. Hold the BOOT switch while simultaneously pressing the RESET switch to activate the bootloader.
3. Micro-SD memory card connector. Currently the web server style sheets and other files are stored on this drive. Do not remove this memory card from the board.
4. Ethernet 100 MB connector port. Connect a wire from your local Ethernet network hub to this port to use the web server remote/configuration interface.
5. DIP configuration settings switch. Refer to the DIP switch configuration section for a description of the switch functions.
6. JTAG programmer/debugger connection interface for the Tiva series processors. This port is used to flash firmware and debug code from the Tiva JTAG M4 ARM debugger.
7. System RESET switch. The main processor on the STC board is reset when this switch is pressed.
8. RS-232 serial port COM1. Normally this port is for TTY command line interface. It is also used for flashing firmware with the bootloader when the bootloader is activated.

9. RS-232 serial port COM2. This port is reserved for future system expansion use.
10. DRC-1200 wire remote power and RS-422 communications port. This port is dedicated for use by the DRC-1200 wired remote only.
11. MIDI I/O board connector interface. A ribbon cable runs from this connector to the MIDI I/O connector board mounted in the machine somewhere.
12. Real time clock backup battery. This requires a CR1632 type 3V lithium coin cell battery that powers the real time clock module when the machine is not powered up.
13. ISP programming connector for ATMEGA88 7-segment display driver processor. This is used to flash the firmware that drives the 7-segment display on the transport deck.
14. This connector provides an I/O OPTION port for future expansion daughter cards. A daughter card can be added to provide the master 9600 Hz time base and allow for variable speed control.

1.4 DIP Switch Configuration

The DIP switch allows setting the COM1 serial port baud rate and whether or not to enable the port for the DRC remote. If the DRC wired remote is not connected, the port should be disabled so the controller is not continuously spewing high speed display data out the unterminated transmit data lines on the port connector and emitting clocking noise potentially.

Table 1- DIP Switch Configuration

DIP SWITCH S1 SETTINGS	
SWITCH	FUNCTION
CS1	This switch sets RS-422 data rate to the DRC1200 remote port. The BAUD rate is set for 1.5Mbps if in ON positions. Otherwise the speed is set to 400Kbs in the OFF position. The DRC-1200 remote speed must be set to match this setting. The default speed is set to 1.5Mbps for fastest display refresh, but longer runs of cable or noisy environments may require slower speed if packet errors occur.
CS2	This switch enables the RS-422 serial port for the DRC-1200 remote in the ON position. If the DRC wired remote is not connected to the remote port, this switch should be set to the OFF position.

1.5 Initial Machine Power Up

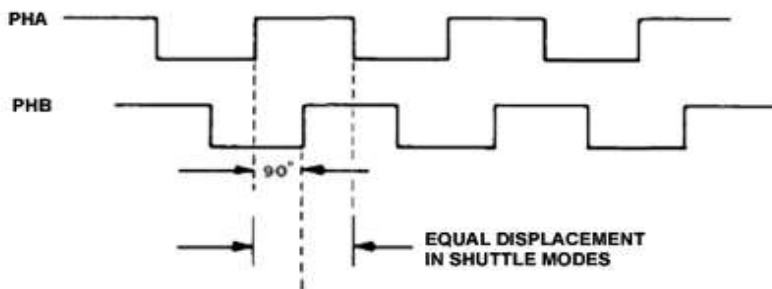
Install the STC board in the card cage rear slot connector J4. Power up the machine and confirm the 5V power is correct at test point TP4 on the STC board. Check the tape timer 7-segment display is working correctly by rolling the tape roller by hand. The time display should increment in seconds as the roller spins forward.

The quadrature signals must be adjusted properly in order for the tape position timer to work properly and accurately. Some machines have sensor gain adjustment trimmers in the timer roller /display housing. The quadrature signals from the roller encoder must be properly adjusted with the A/B encoder signals 90 degrees out of phase with each other.

1.6 Tape Roller Quadrature Encoder Signal Waveforms

The tape roller quadrature encoder signals are 5V logic and may be monitored with an oscilloscope at TP9 (PHA) and TP7 (PHB) on the STC controller board. The signals must be 90 degrees out of phase when the roller spins as shown below in Figure 2. The quadrature encoder works as described in the Ampex MM-1200 owner's manual. Refer the Ampex manual for the adjustment procedures for the roller quadrature encoder phototransistors and LED's if needed. Later model machines may have gain adjustment trimmers in the timer roller assembly itself.

Figure 2 - Quadrature Encoder A/B Waveforms



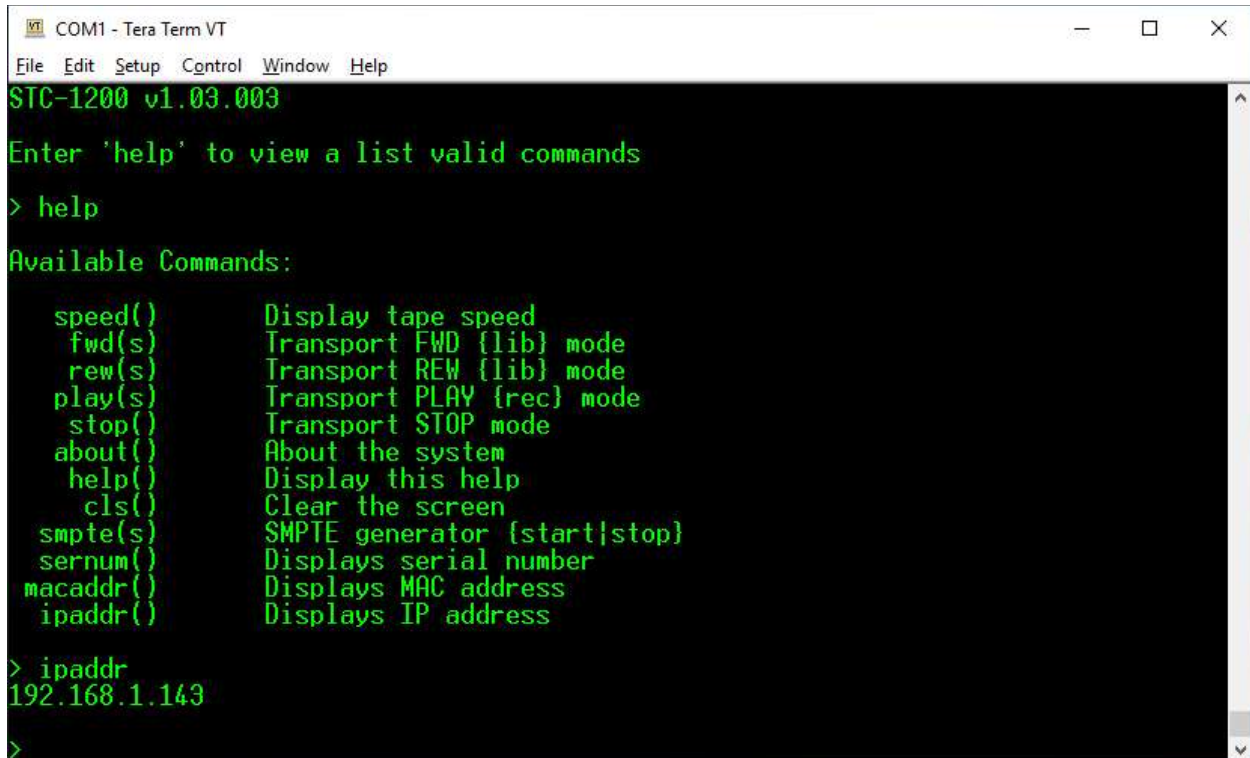
If the tape timer appears to be inaccurate, confirm that the PHA and PHB signals of the quadrature encoder match as shown above in shuttle mode and adjust if necessary.

2 Command Line Interface

The STC provides a serial command line interface on serial port COM1 at baud rate 115,200. Connect a serial port terminal emulator (eg, TeraTerm) to this port to access the command line interface. Enter the command **help** to see a list of valid commands.

Note the command **ipaddr** may be used to display the TCP/IP address assigned to the machined from a DHCP server. The Ethernet port must be connected to a network with a DHCP server available. Usually, the DHCP server resides in a cable modem or router/gateway.

Figure 3 – TTY Command Line Interface



```
COM1 - Tera Term VT
File Edit Setup Control Window Help
STC-1200 v1.03.003
Enter 'help' to view a list valid commands
> help
Available Commands:
    speed()      Display tape speed
    fwd(s)       Transport FWD {lib} mode
    rew(s)       Transport REW {lib} mode
    play(s)      Transport PLAY {rec} mode
    stop()       Transport STOP mode
    about()      About the system
    help()       Display this help
    cls()        Clear the screen
    smpte(s)     SMPTE generator {start|stop}
    sernum()     Displays serial number
    macaddr()    Displays MAC address
    ipaddr()     Displays IP address
> ipaddr
192.168.1.143
>
```

3 Web Server Interface

The web server maybe accessed from most any modern browser on smart phones, tablets and desktop computers. This simple interface allows configuration and basic remote control, but no real-time tape time display is available on the remote web page. However, basic transport and locate functions can still be used to control the machine.

3.1 Network Connection

The STC requires a DHCP server available on the network. Usually, most cable modems or routers in home and small business networks provide the DHCP server services. Consult the documentation for your cable modem or router for more information on enabling and configuring the DHCP server. Most systems will have this enabled by default so computers in your home network can automatically acquire an IP address to assign to all of the machines and network devices connected to your local network.

When the STC boots, it attempts to connect to a DHCP server and request an IP address to assign to the STC board. Once this address is assigned, clients on the local network can then connect with most any modern browser to this IP address.

Use the command line interface and execute the *ipaddr* command to obtain the IP address assigned to the machine. Then, type this address into a browser on your local network to access the STC web server pages.

Figure 4 - Web Server Home Page

This is the home page of the STC web server. Basic information about the machine and STC status is shown here during normal operation.

The screenshot shows a web browser window with the address bar displaying `192.168.1.143/index.html`. The page content is as follows:

STC-1200

Tape Machine Services

- Home
- Configure
- Remote

Firmware Version: 1.03.003

PCB Serial#: 0A700800-64100021-2870A000-A0000000

MAC Address: FC:C2:3D:10:3D:47

IP Address: 192.168.1.143

Tape Speed: 30 IPS

Roller Encoder Errors: 0

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Figure 5 - Web Server Configuration Page

This is the basic STC parameter configuration page. Settings may be stored or reset from this page to change configuration settings.

STC-1200
Tape Machine Services

Home
Configure
Remote

General Settings

- Remote displays long tape time format?
- Blink machines 7-seg display during locates?

Locator Settings

Jog near velocity:
240

Jog mid velocity:
500

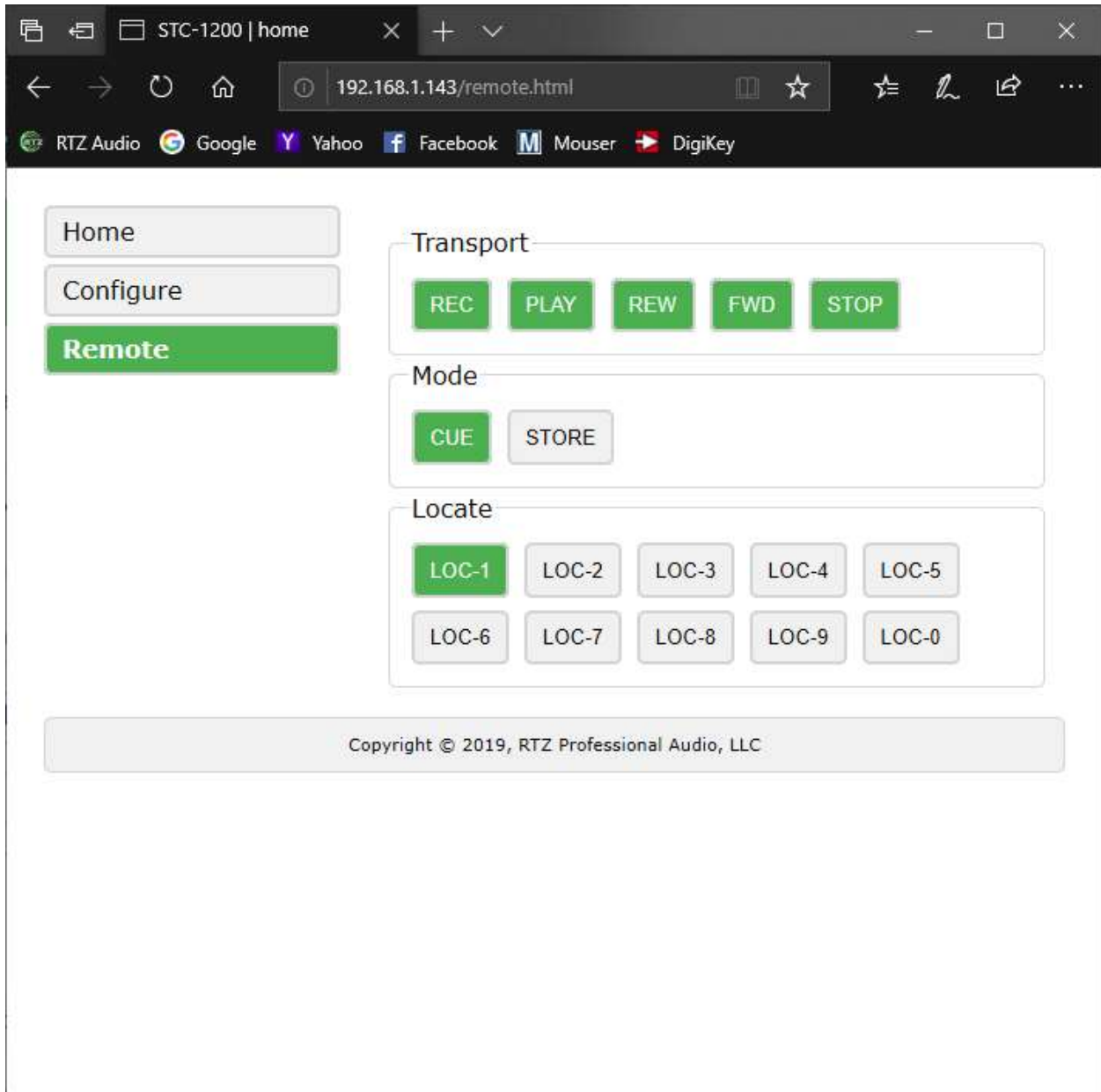
Jog far velocity:
0

Save Reset

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Figure 6 - Web Server Remote Page

This is the basic transport remote control web page. Here you can control the transport and locator for basic machine use. The interface allows storing and locating to any of the ten cue point memory locations shared by the DRC-1200 wired remote. Either interface may be used to control the machine.



4 FIRMWARE UPGRADE via BOOTLOADER

All STC-1200 controller boards ship with bootloader firmware installed in the first 16K of flash memory space starting at address 0x0000. The first 16KB of code space is reserved exclusively for the bootloader firmware in the STC-1200 design. The main transport controller firmware resides just after the 16KB bootloader area at hex address 0x4000 (16384).

The processor always begins execution with the bootloader at power up or anytime a system reset is issued. The bootloader checks for presence of the transport controller firmware by doing a blank check of the application firmware code space. If no code is found, it automatically enters in the bootloader download state waiting for firmware download data packets via the COM1 serial port on the STC-1200. Otherwise the bootloader checks the status of the BOOT switch at boot time and enters the bootloader download state if the switch is pressed during a system reset. In normal boot mode the bootloader transfers execution to address 0x4000 and begins normal execution of the application firmware. Note that COM1 is also used for the STC's TTY command line interface during normal application execution.

The computer used to download the firmware must have a standard RS-232 port available. Most computer motherboards have a single RS-232 connector header on the board. Refer to your computer motherboard documentation for RS-232 port information. You may also use a RS-232-to-USB serial converter if your PC or laptop does not have a RS-232 port available.

4.1 Enabling the STC-1200 bootloader

Connect the RS-232 serial cable from the PC to the COM1 serial port on the STC as shown in Figure 7. Then, press and hold the BOOT switch S2 (located behind the SD drive socket) and simultaneously press the RESET button S3 to activate the boot loader. The STC board will reboot and turn the STAT LED off to indicate it's ready to begin receiving firmware download data via the COM1 serial port.

Figure 7 - COM1 Serial Port Connection



The bootloader indicates ready state by turning off the STAT LED. The STC-1200 board is now ready to accept downloading via the COM1 serial port at 19,200 BAUD.

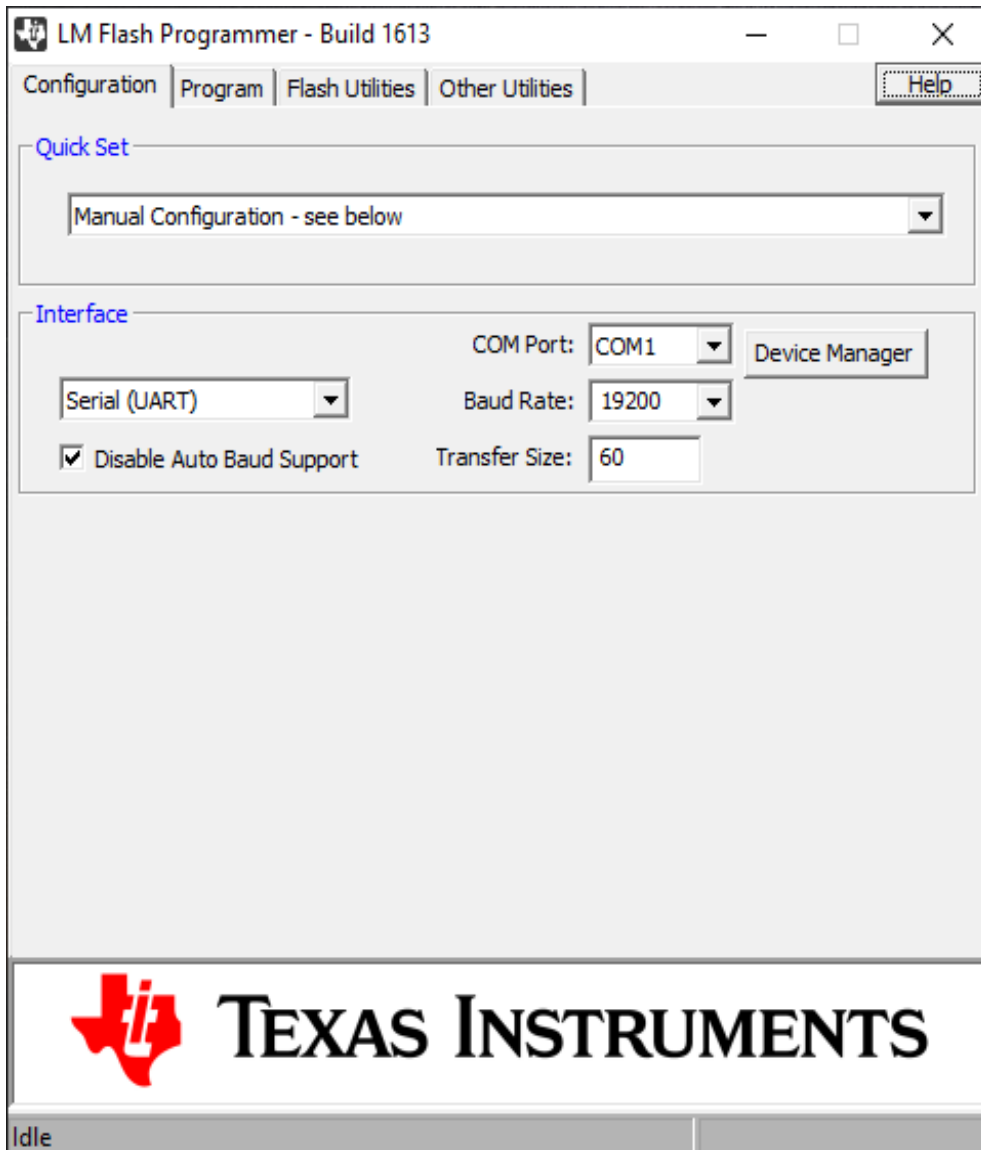
4.2 LMFLASH Installation and Serial Port Configuration

LMFLASH is a free application from Texas Instruments that allows downloading firmware updates to the STC-1200 via the COM1 RS-232 serial port on the STC-1200. You may need to create an account at ti.com to download this utility. The LMFLASH link is also on the [RTZ Audio](#) website.

Make sure no other applications are using the serial port (usually COM1) prior starting LMFLASH. You must close any instances of TeraTerm prior to using LMFLASH or the COM1 serial port will be locked.

Start the LMFLASH application and set the serial port settings as shown below on the configuration tab. The serial port must be configured for 19,200 BAUD (e.g. 19200,N,8,1). Be sure to disable the **Auto Baud Support** option as shown below in Figure 8.

Figure 8 - LMFLASH Serial Port Settings

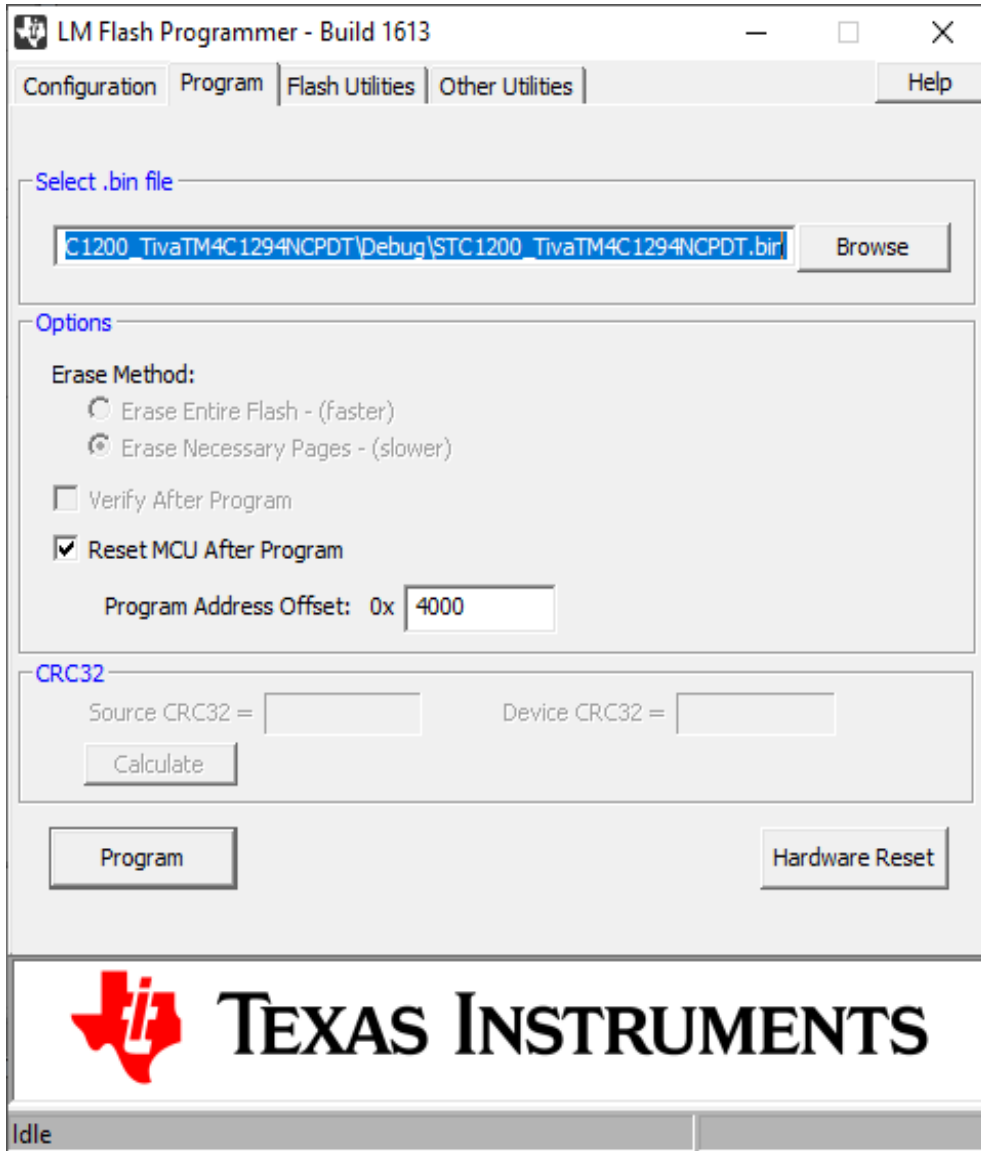


4.3 Select Binary Image and Program Address

Next select the new STC-1200 binary firmware image to be flashed on the board. The latest binary firmware images are available at our rtzaudio.com website. The STC-1200 binary image will generally be named **STC1200_TivaTM4C1294NCPDT.bin** and should be placed on your local computer with LMFLASH installed. You may want to make a backup copy of this file in the event it's needed in the future for some reason.

Warning, you must set "Program Address Offset" to 4000 as shown below. Failure to set the program address to 4000 may overwrite the bootloader. In this case, a JTAG programmer must be used to re-flash the bootloader into the processor flash memory.

Figure 9 - Binary File Image Selection



4.4 Downloading the Binary Image

Once the binary image and program address is set to 4000, the LMFLASH is ready to begin downloading. First, check that the STC-1200 is ready with the bootloader activated and ready to receive the new firmware image. The STC and should be waiting with the STAT1 LED off indicating the bootloader is ready to receive a new download. Then, click the *Program* button in LMFLASH to begin downloading the new firmware image to flash.

Once programming begins, the STAT LED will blink as each package of data is received and written to flash. The status bar of the LMFLASH application shows the progress of the download/flash operation. Once the process completes, restart the processor via the RESET button or power cycle the machine to begin executing the new firmware.

If the download fails to start, check that the serial port is connected and set correctly. The LMFLASH application serial port baud rate must be set to 19,200 baud in order to communicate with the bootloader.

Figure 10 - Downloading Binary Image

