

SER8CH User Manual

2014/10/22

COPYRIGHT: (c), Symmetric Research

Table of Contents:

Overview

Included Software

Connecting Hardware

Quick Start

Do's and Don'ts

Data Acquisition Applications

Terminal Programs

Examples Directory

Technical Details

Additional Help

*** OVERVIEW OF THE SER8CH-TINY:

The SER8CH-TINY is a data acquisition system with a 24 bit A/D converter and eight channel differential mux designed to communicate with the PC through RS232 or RS422 serial ports. Some of its leading features are:

- * A 24 bit A/D converter with eight channel mux front end (LTC2498)
- * Sampling rate of 0.5Hz (2 second sampling period) on all channels
- * Solder pads for analog and digital cable connections are light weight and flat
- * Very narrow board, 1 inch wide by 4 inches long, suitable for restricted space apps
- * Easy interfaces to RS232 and RS422, requires only RX/TX, no control signals
- * Compatible with long cable runs from the PC to SER8CH, 1000 feet
- * Suitable for use with standard Cat5e cable on long runs
- * Low power requirements, 8-24 volts DC at 10ma typical
- * Raspberry PI and BeagleBone compatibility without cape boards
- * Differential analog inputs, ideally suited to ratiometric bridge sensors
- * Buffered A/D reference for user applications
- * Integrated temp sensor and power condition sensors

To get running quickly follow the steps in the "Quick Start.txt" file and described below. There are also "ReadMe.txt" files in most of the directories. Comments about the overall system in general follow in this file. For more detail, circuit diagrams, and examples of usage, refer to the PDF User manual.

*** SOFTWARE INCLUDED WITH THE SYSTEM:

Several types of software and documentation are included in the directories of this distribution. Some of them are:

Docs	PDF SER8CH User Manual and LTC2498 spec sheet
Exe	Batch files to run all SER8CH executables
HyperTrm	Windows terminal program
Minicom	Linux terminal program
Utilities\Diag	SER8CH diagnostic program
DvmCmd	Data acquisition app with command line/console interface
DvmGui	Data acquisition app with DVM (digital volt meter) display
Examples	examples of typical applications
000 OS.txt	file with software distribution version
001 ReadMe.txt	this file ...
002 Quick Start.txt	steps for getting started
003 UserManual.lnk	shortcut for viewing the SER8CH PDF User Manual

New distributions may have additional software. Scan through directories such as Utilities and Examples to see what is available.

*** CONNECTING HARDWARE:

The SER8CH is compatible with most serial ports. Among them are:

- * PC motherboard RS232 ports
- * USB to RS232 dongles
- * USB to RS422 dongles
- * Raspberry PI (RX,TX) header pins
- * BeagleBone (RX,TX) header pins

Communications parameters are fixed at:

Baud rate: 9600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

Use the Diag program to automatically scan your system for all available serial ports. USB dongles may place their ports at surprisingly high COM numbers.

*** QUICK START:

To begin using the SER8CH-TINY the following general steps are required:

- 1) Set up a RS232 port, a dongle is described here
- 2) Connect the SER8CH
- 3) Install the SER8CH software
- 4) Run the Diag and Dvm programs
- 5) Connect analog inputs to various sources

More detail on each step follows ...

1) *** INSTALLING A USB to RS232 DONGLE:

Included with the SER8CH is an inexpensive USB to RS232 dongle from TrendNet. It is a single piece white plastic overmolded combo cable/dongle. This particular dongle is available on Amazon for \$9, and comes with its own CD disk and driver.

The TrendNet driver **MUST BE INSTALLED BEFORE** connecting the physical dongle to the PC. Failing to do so may hang the PC when the dongle is hot plugged and used. Other dongles like Keyspans are also perfectly acceptable. Follow the instructions that came with them for their driver installations.

Install the TrendNet USB to RS232 Serial dongle driver ...

- * Insert TrendNet CD and click Install Driver
- * Follow the steps they have, reboot the machine when done

- * Plug the USB end of the TrendNet into a USB port on your PC
- * Open the Windows Device Manager and expand the Ports group
- * Make a note of which serial COM ports are available
- * By now Windows Plug and Play should have found the TrendNet
- * Make a note of its COM port number

2) *** CONNECTING THE SER8CH:

The USB to RS232 dongle has a standard RS232 DB9 connector. An ADAPTER CABLE is included with the SER8CH to connect the dongle DB9 to the SER8CH DB9. This adapter cable also has a 2.1mm power connector for the wall adapter to supply power to the SER8CH.

The concept is most users will ultimately be using a length of Cat5e cable between the adapter cable and the SER8CH. Optimum wiring for the Cat5e cable is different than the usual RS232 pin out, and the adapter cable allows for that. For getting started there is no Cat5e cable, simply connect the adapter cable directly to the SER8CH ...

- * Connect the TrendNet DB9 onto the SER8CH adapter cable
- * Plug the 9v wall adapter 2.1mm connector onto the SER8CH adapter cable
- * Plug the other end of the adapter cable to the SER8CH
- * Power up the wall adapter, plugging it into a 110vac wall socket
- * The SER8CH green and yellow LEDs should light up
- * You are ready to proceed to software installation

Note: The SER8CH auto-detects the RS232 polarity at power up. Connect the USB RS232 dongle to the PC first, and after that power up the SER8CH. The SER8CH GREEN (power) and YELLOW (RS232 polarity) LEDs should light up.

When connecting to devices with the opposite RS232 polarity (like a Raspberry PI) the green and RED LEDs will turn on.

Once up and running the LEDs may indicate many system functions as determined by the applications. But at SER8CH power on they always indicate power and RS232 polarity.

3) *** INSTALLING THE SER8CH SOFTWARE:

Put the SER8CH CD in your drive. From that CD run install.bat. This step only unpacks the software onto your hard disk, creating a \SR\SER8CH directory with the supplied software. If a SER8CH directory already exists, (from a previous installation), delete or rename that directory first.

Once the SER8CH software is installed, use Windows File Explorer to visit the \SR\SER8CH directory and review the supplied items. You can double click on the DVM shortcut at the root directory to be up and running instantly.

4) *** DIAG, DVM, HYPERTRM:

Go to the Exe directory. There are several batch files there. You can run any of them by double clicking on them in Windows File Explorer. You can also start a command line and execute from there.

Diag is a useful program, scanning the serial ports on your machine and determining which of them has the SER8CH connected. Often USB to RS232 dongles install themselves at unexpected COM ports, sometimes with high numbers. Diag makes it easy to detect them.

Dvm comes in two versions. A GUI version that is much like a digital volt meter display. And a command line version with the same functionality, but more modest text only display which is preferable for many platforms. Dvm will automatically set the serial port parameters like baud rate etc when initializing.

You can also connect to the SER8CH with terminal programs like Windows HyperTrm, or Linux minicom. This is the most basic way to communicate and view data coming back from the SER8CH. Once the communication program is set up, the SER8CH understands basic single letter commands. Type 'H' to get a brief help screen. To use HyperTrm you must explicitly set the baud rate by hand. The values for the SER8CH are:

Baud rate: 9600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

5) *** CONNECT ANALOG INPUTS:

For details about the analog inputs and typical usage, please refer to the PDF User Manual. The Examples chapter has several "How to" discussions.

The SER8CH and LTC2498 analog inputs are designed to be easy to use with ratiometric bridge applications. Many other configurations are possible with suitable connections.

*** DOS AND DON'TS ***

- + DO connect the serial cable to the SER8CH-TINY before applying power.
- + DO connect AGND, the analog ground wire to set the ground level for the SER8CH-TINY.
- + DO make sure the voltages applied to the + and - wires on any channel (with respect to AGND) range from 0 to 5. This means NO negative voltages.
- + DO make sure the voltage difference between the + and - wires on any channel is between -2.5v and +2.5v. The DIFFERENCE can be negative, but the voltage on each individual wire must be positive.

*** DATA ACQUISITION APPLICATIONS:

After hooking up the SER8CH hardware, you will probably want to acquire some data. Double click on the Dvm shortcut to run most quickly. Study the DvmGui and DvmCmd directories for more detailed information.

*** TERMINAL PROGRAMS:

You can also interact with the SER8CH using terminal programs such as HyperTerm or minicom. Set the serial parameters for the port you are using to 9600 8-N-1 with no flow control.

Then type H to see a list of available commands. All SER8CH commands are a single letter, and are echoed (acknowledged back) with a leading \$ sign. So for example if you type an 'H' and see a \$H appear on the screen, the \$H is the SER8CH echoing back that it received the command and the action will follow.

*** EXAMPLES DIRECTORY ***

The Examples directory has many hands on "how to" demonstrations showing common setups for solving typical problems. These examples are discussed at length below.

001 AA Battery:

Measuring a voltage with the SER8CH-TINY is similar to using other voltmeters with the voltage source being connected between the red + and black - differential wires for a channel.

Figure ? shows a AA battery being measured.

However, the analog inputs are not floating as they are with a hand held voltmeter. So the green AGND wire must also be connected to the negative side of the voltage source. This provides the base level from which the + and - wires are measured.

Another difference with typical hand held voltmeters is the voltage between the + and - wires should be in the range of (0,5) volts. The system will tolerate moderate voltages outside of this range, but do not attempt to measure 110 vac from the wall socket with this device. Doing so will void the warranty.

If you need to measure voltages outside the (0,5) range, please use the techniques in the Scaling active sensor voltages chapter in this User Manual, or the (-10,+10) section further on in these examples.

Also be aware current flowing in the ground system can cause noise in

your measurements. Use a star layout for ground and ideally keep your sensor at one end of the star without system ground currents passing through its circuit.

*** TECHNICAL DETAILS ***

FULL SCALE:

The SER8CH-TINY is designed for differential signals. This means each channel has a + and a - wire and its amplitude is computed based on the difference between the two wires. The benefit is noise common to both wires is canceled out.

The A/D chip on the SER8CH-TINY is set up so the full scale positive count for a channel is realized when the difference between its + and - wires is HALF the reference voltage. And similarly, the full scale negative count is realized when the - wire value is greater than the + wire by HALF the reference voltage.

Since the reference voltage on the SER8CH-TINY is 5 volts, the 24 bit full scale counts of 8,388,608 and -8,388,607 occur at +2.5v and -2.5v respectively.

Each individual channel wire can range from 0 to 5v, but the difference between the + and - wires for each channel must be within +/- 2.5v.

This setup works particularly well for applications involving Wheatstone Bridge type sensors such as weigh scales and other comparison measurements.

POWER AND TEMPERATURE SCALING:

The SER8CH measures both on board power and temperature and saves these values in the output data file. The power value is an important indication of system health and the temperature can be helpful for applying corrections to the data which compensate for thermal effects on the system.

The on board power supply voltage (typically 5.35v) is first sent through a resistor divider. Then the voltage at the division point is input to a 10 bit ADC where it is compared to a Fixed Voltage Reference (FVR). The SER8CH uses a 20K,10K resistor divider between the power supply and ground giving divide by 3 and has an FVR of 2.048. A 10 bit ADC has a maximum of 1024 counts.

Starting with the ADC count and unwinding this path to get the true power supply voltage value is done with the following formula:

$$V = P * (2.048 / 1024) * ((10K+20K) / 10K) = 0.006 * P$$

where V is the power supply voltage
and P is the ADC count value

The temperature is measured by the precision A/D after measuring the eight analog channels for each sample. The A/D spec sheet describes the count to degrees conversion. Since the SER8CH uses a 5v reference value, the formula to convert the resulting A/D counts into degrees Celcius is:

$$T = D / 314 - 273$$

where T is the temperature in degrees C
and D is the 24 bit A/D count

The 273 is included to convert from degrees Kelvin and dividing by 314 is equivalent to multiplying by .00318471.

SERIAL POLARITY:

The history of RS232 signal polarity is long and a bit tortured because of the changes which have been introduced over the years. Particularly when the original +/- 12 volt signaling was expanded to support 0 to 5 volt TTL signalling. This legacy has resulted in some confusing terminology. For example a low or idle state is called MARK or 1-state. In addition, various inverting buffers may be included along the signal path resulting in more confusion about what is normal versus inverted polarity.

But, the good news is you don't need to worry about any of this with the SER8CH-TINY because it automatically determines the serial polarity on start up. It does this by checking the idle state of the incoming serial signal when it the SER8CH-TINY is powered up. So, be sure to connect your serial port before powering the SER8CH and the correct polarity will be automatically selected. This means the SER8CH-TINY will work when connected to a PC USB to serial port adapter as easily as when connected directly to a Raspberry PI single board computer.

When the LED mode is set to use the SR defaults, the selected polarity will be indicated by the state of the yellow and red LEDs. If RX idles high, the yellow LED is turned on indicating the polarity is normal. While if RX idles low the red LED is turned on indicating the polarity is reversed or inverted. A PC serial port would typically use normal polarity while a Raspberry PI would use reversed polarity.

RS323 VS RS422:

There are several serial protocols. The most common is RS232. This standard involves a receive (RX) signal and a transmit (TX) signal and is found on most PCs today. The RS422 standard is a more industrial protocol involving differential signaling to reduce common mode noise and allow for longer transmission lines. Its differential signals include TX+ and TX- transmit signals. The SER8CH-TINY can work with either the RS232 or RS422 signals. Just be sure to connect your wires up to the appropriately marked pads on the SER8CH-TINY board.

*** ADDITIONAL HELP:

If you have additional questions about the SER8CH, please contact us by email at: support@symres.com.

Thank you for purchasing the SER8CH-TINY. We hope it can be a useful measurement tool for your work!