Build a Ultimate Utility Meter (UUM)
as seen in
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Last month we assembled and tested our UUM. This month I will show you how to operate the UUM.

UUM Operation

First let's go over the keys on the keypad. Some keys have a specific purpose depending on which command is active.

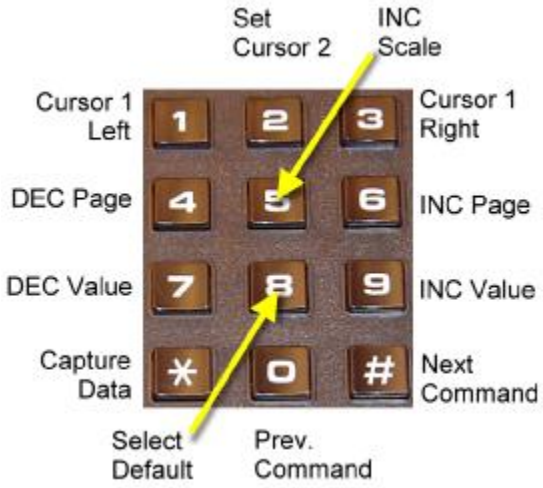

Figure 2

Cursor Keys
The logic analyzer has two cursors..

Figure 3

You move Cursor 1 using the keys 1 and 3. Think of Cursor 2 as a reference cursor. It is set by hitting the 2 key. The difference between the cursors is always displayed on the display shown in Figure 3..

Page Keys
The logic analyzer always captures 4 pages of data. To move between the pages use the INC Page and DEC Page keys shown in Figure 2. Notice that Cursor 2 always stays where you set it. Cursor 1 moves with the page. This way you can take measurements between pages.

A small black bar will move indicating the current page you are on, as shown in Figure 4.

Figure 4

Scale Key
The scale key allows you to change the resolution of the next capture. The scale shown in Figure 5 displays the number of microseconds for each pixel.

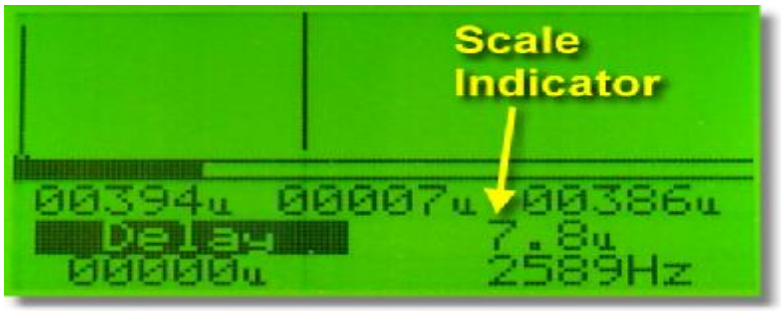

Figure 5

Note that this is the smallest point of resolution of the current capture.

The following scales are supported:
1.7us
3.0us
4.3us
5.7us
7.8us
13.4us
24.5us
48.2us
86.0us
200us

Capture Data key
This key will start a data capture. If triggers are used it will wait unitl the trigger condition has been set. You can kit the key if you wish to exit the capture mode.

Command Keys
The command keys allow you to change other parameters or issue certain commands. The active command/parameter name is displayed as shown in Figure 6.

Figure 6

Once a command is selected, the 7, 8 and 9 keys are used to change the values or execute the command.

Let's take a look at each command or parameter in detail.

Delay
This command (Figure 6) will allow you to insert a delay before the logic analyzer starts the actual capture. Use the 7 and 9 keys to change the value. The 8 key sets the value to 0.

Pullups
This command (Figure 7) allows you to turn weak pull up resistors on or off on all the analyzer ports. Use the 8 key to toggle on and off.

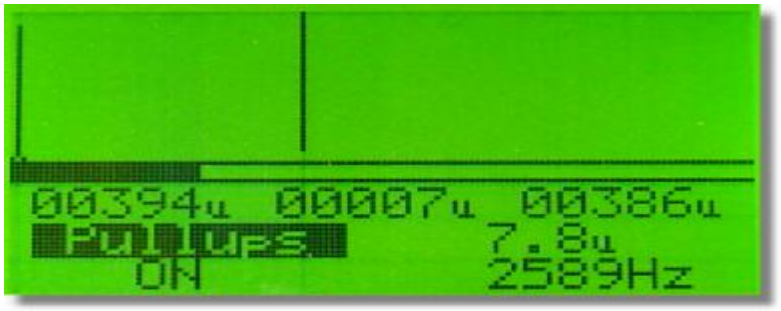

Figure 7

Backlight
The backlight command (Figure 8) allows you to set the intensity of the back light. Use the 7 and 9 keys to change the value. Use the 8 key to set it to 200.

Figure 8

Channels
There are 3 display modes for the logic analyzer. You can display all 8 channels as shown in Figure 10 or select channels 0-3 or 4-7 as shown in Figure 9. When you only need a couple of channels the 0-3 or 4-7 channel options are much easier to see.

Figure 9

Figure 10

You can change the channels at any time. The current capture data will be redrawn.

Reset
This command will reset both the graphic serial LCD and the controller. The 8 key will do the reset.

Figure 11

Save
This command allows you to save all the current parameters so that they will be loaded the next time you start the UUM.

Figure 12

Use the 8 key to save. Cursor location and scale settings are saved as well.

Edge Trigger
Here you can set one of the channels as a edge trigger. This normally is used to monitor a single repeating signal. It will wait one complete cycle, then trigger on the low to high or high to low depending on which is selected.

Figure 13

Using the edge trigger will turn off the word trigger if it has been activated.

Use the 7 and 9 keys to select the channel and the 8 key to toggle the low to high or high to low transition. If no trigger has been set up the word none will be displayed as shown in Figure 13.

Word Trigger
This command (Figure 14) will allow you to set a condition on any of the 8 channels. You can set each channel to Low, High or None. If set to None that channel will be ignored for the trigger condition.

When you start a capture with the * key the analyzer will wait untill all the channels are in the trigger condition. Once the conditions have been met the delay, if set, will be activated; then the capture will start.

Figure 14

Change the channels with the 7 and 9 keys then use the 8 key to toggle between the Low, High and None conditions. If you don't wish to use any trigger condition set all channels to None.

Signal
This command (Figure 15) will allow you to change the value of the build-in pulse generator. Use the 8 key to jump between the three parameters, and the 7 and 9 keys to change the values.

Valid Ranges
Range 0: .1us to 25.5us in .1us increments
Range 1: .4us to 102us in .4us increments
Range 2: 1.6us to 408us in 1.6us increments

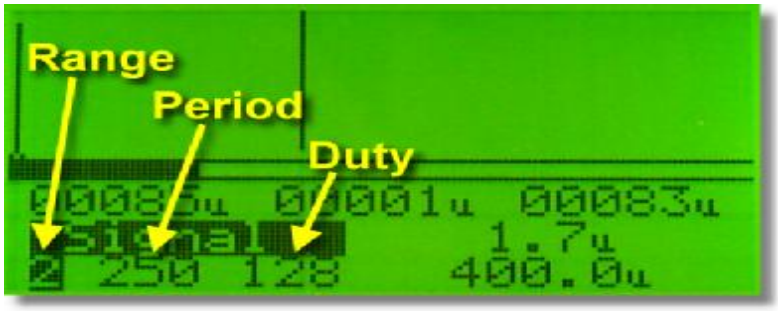

Figure 15

The output is placed on Port 13. It is marked Signal on the schematic.

Monitor
The monitor (Figure 16) is used as a logic probe to monitor 8 ports at one time. Use the 8 key to activate the monitor.

Figure 16

Once activated, the monitor screen will be displayed as shown in Figure 17.

Figure 17

A dark square indicates a logical 1, and an empty square indicates a logic 0. A small arrow will point to the ports that have changed recently.

To exit the monitor just hit the * key.

Analyzer Examples

1Wire (Figure 18)
Here I set port 1 on the analyzer to monitor the data channel on a 1wire device. This captured sequence shows the 1wire reset and a byte of 170 ($CC) being sent.

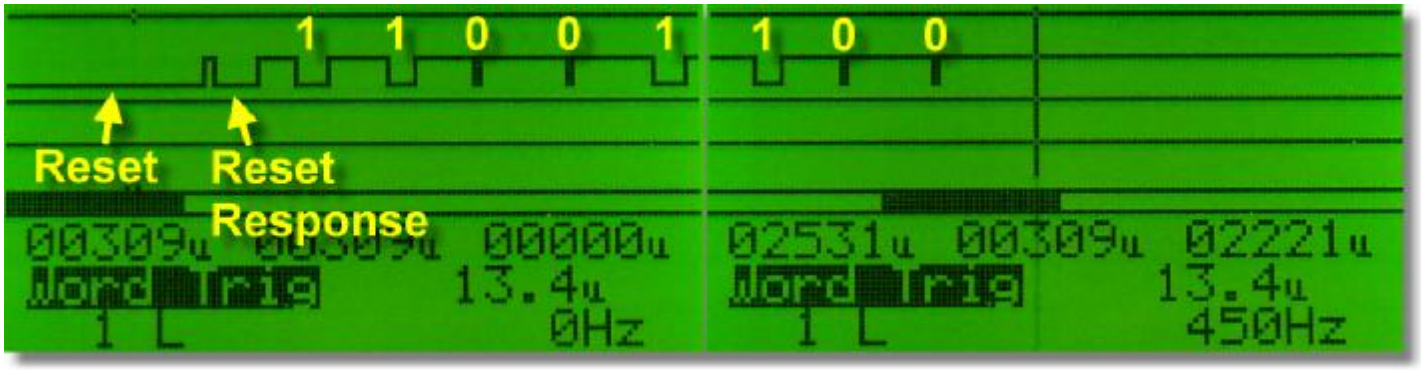

Figure 18

Figure 18 shows two of the captured pages. Notice that the Word Trigger for port 1 has been set to low. This means that once started the analyzer will wait until it sees the port go low.

Serial (Figure 19)
In this example I set port 1 to monitor the output of a microcontroller IO port as it sends the value of 170 at 9600 baud 8n1. Again the word trigger for port 1 is set to low.

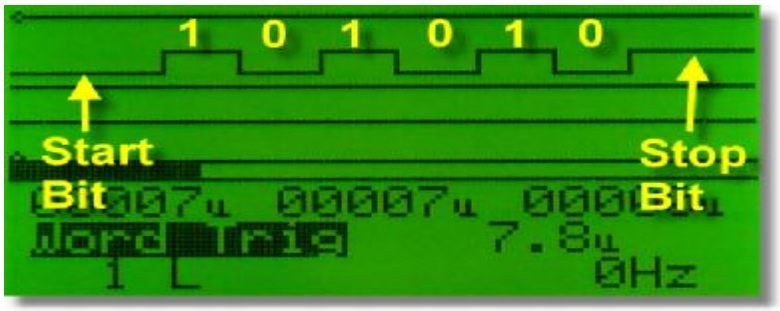

Figure 19

I2c (Figure 20)
This is an I2c control byte. The SDA line is on port 0, the SCL line is on port 1. You can see the start sequence followed by the control byte of 160.

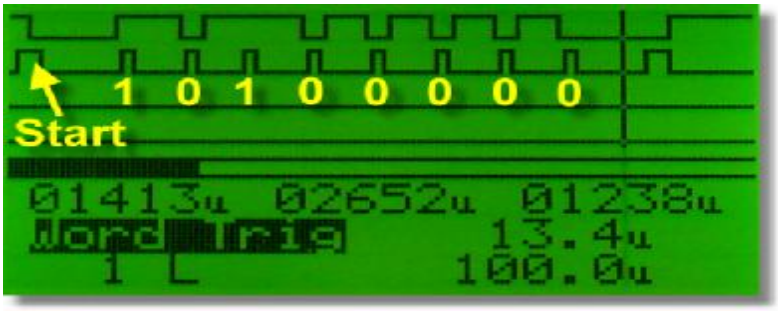

Figure 20

SPI (Figure 21)
This is the 3 control lines connected to a 74HC595 serial shift register. Port 0 is connected to the Serial In line. Port 1 is connected to the Clock line. Port 2 is connected to the Latch line.

Figure 21

One thing I noticed is that the SPI interface is the fastest interface shown. In most cases it is very difficult to capture the clock pulses as they can be quite fast.

Pulse (Figure 22)
For a repetitive pulse train use the edge trigger so that the pulse train will start at the same point at each capture.

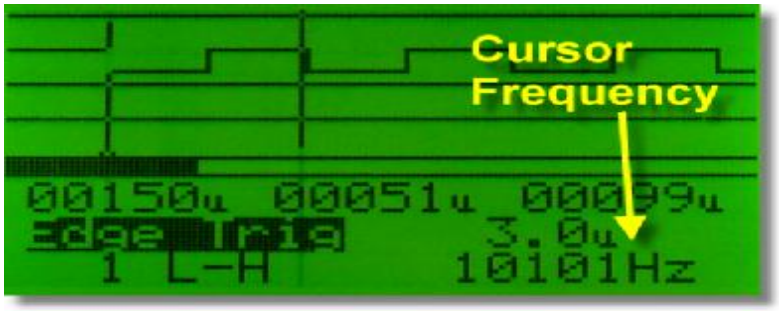

Figure 22

In this example I took the signal line (Port 13) and connected it to Port 1. I set the Edge Trigger on Port 1 to L-H. The signal generator is set up to send a 100us pulse at a 50% duty cycle.

Notices that as you move the cursors it will display the calculated frequency based on the period measured.

Extra

I have written a little program I call Frequency Counter as an example of the kinds of programs you can write.

The program is located in the projects/UUM directory and is called FreqCounter.txt Program this into the controller (prog/debug 2) Make sure you still have the Serial LCD on the first controller.

This is a frequency counter with three automatic gate ranges. It also gives you access to the signal generator. The input to the frequency counter is on Port 15. The output of the signal generator is on Port 13.

Figure 23

Final Thoughts

Pods

I create small pods that connect to the exposed headers. These are nothing more than small female headers with leads or components connected to the pins. These pods are removable so that I can add other pods for other experiments. For instance I have a small pod with a DS1820. This gives me a very accurate temperature gauge that I can use to calibrate other projects.

Software Upgrades

Since the UUM is programmable, you have total control of the UUM. This project promises to be a very popular and frequently updated one so visit the Kronos Robotics web site frequently for updates and additional information.

Hardware Upgrades

These are unlimited. I added a larger base so I could attach a breadboard. I also added a reset button. Another easy upgrade would be to use a DiosPro in place of the standard Dios Chips.

Links

The Kronos Robotics web site is located at: www.kronosrobotics.com
UUM forums http://www.kronosrobotics.com/forums/viewforum.php?f=16