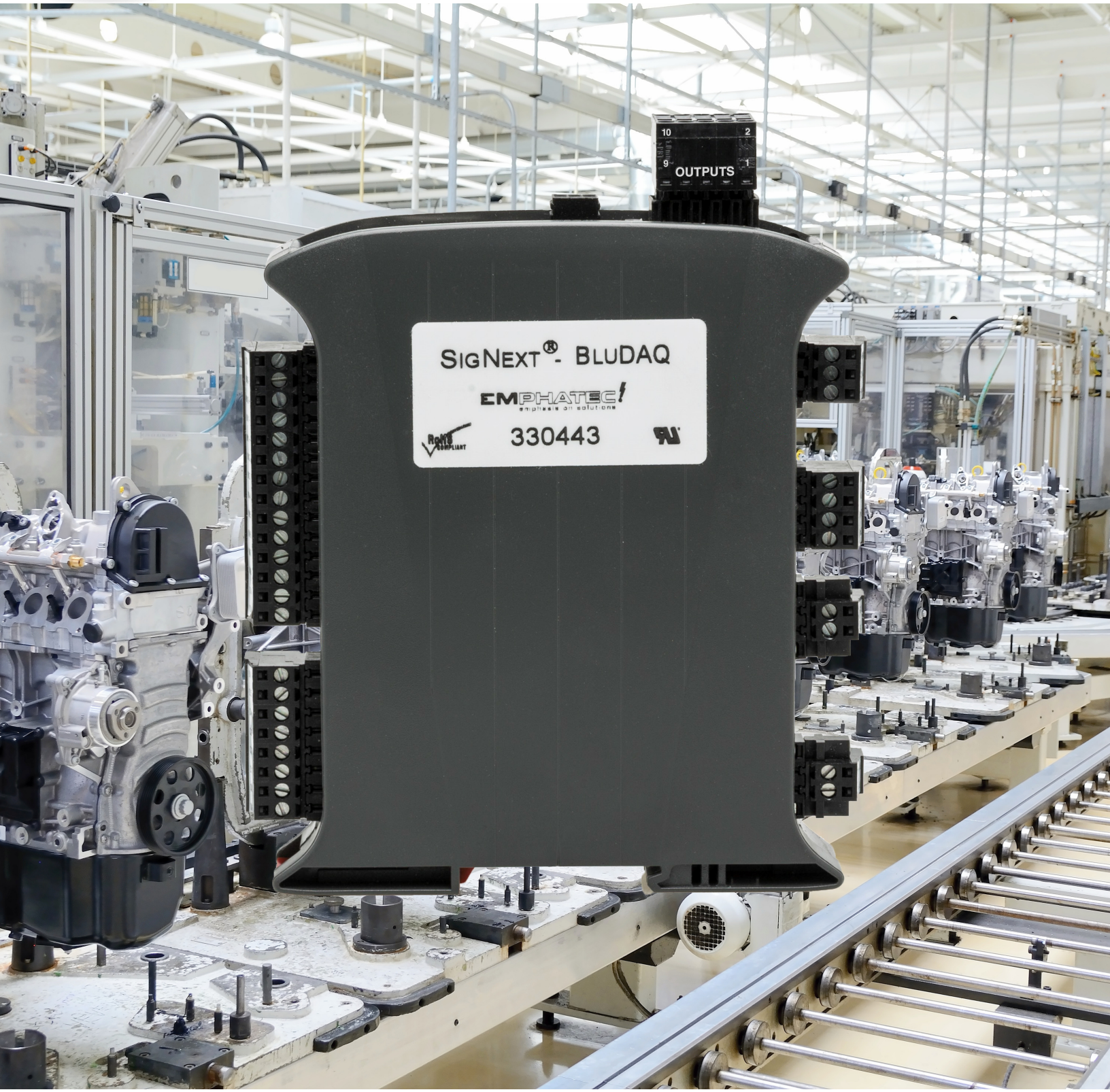
BLUDAQ®

USER MANUAL



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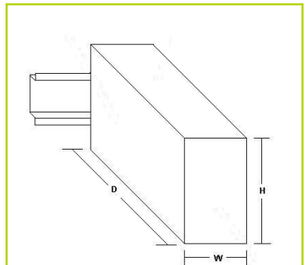
INTRODUCTION

The BLUDAQ® System is a revolutionary approach to monitoring industrial automation that allows you to acquire data from inside a closed panel. The system consists of three parts- the Data Acquisition Unit (DAU), the Bluetooth communications device and an Android tablet.

All specifications in this document are typical. Please refer to the BLUDAQ® data sheet for more precise technical specifications.

DATA ACQUISITION UNIT (DAU)

Catalog #330443



The data acquisition unit is a rail mounted device in a housing 110mm high, 122mm deep and 22.5mm wide. The depth increases to 185mm when the Bluetooth transceiver is installed.

Power input
The DAU is powered from 24VDC at 40mA approximately excluding Bluetooth module (With the Bluetooth module add 300mA).

Analog inputs
There is an on-board multiplexer that provides the following analog input signals:

- 2 isolated analog current (AC/DC) inputs 0-10A, with 2KVchannel to channel and channel to system isolation
- 1 isolated DC voltage input, 300V span in max, 1KV isolation.
- 7 analog inputs 0-30V AC/DC coupled
- 2 differential analog inputs 0-0.5V. Common mode voltage 30V.
- 1 thermocouple input -100 to 450°C
- 1 built in ambient temperature sensor -40 to 80°C

Digital inputs
6 digital inputs 12-30V. In addition, channel D0 doubles as an event counter (to 32767- the number count is not preserved through a power cycle event) and D1 doubles as a frequency counter (to 500KHz).

Analog Input Frequency
The frequency response for the analog inputs is up to 90KHz, depending on the waveform. For each sample period the DAU will capture two analog channels and six digital inputs. The analog data is gathered as 8 bit values and will gather 200 readings on each channel at a settable sample rate. Any of the 11 analog inputs can be multiplexed for viewing on either of the two analog input channels.

Analog output
There is a single analog output adjustable from 0 to 10VDC, 10mA.

PWM output
There is a single PWM output configured as open collector capable of switching 30V 100mA. Its output frequency can be varied from 1KHz to 50KHz and its duty cycle from 0% to 100%.

Digital Outputs
There are 3 open collector digital outputs capable of switching 30V 100mA.

RS232
Communications between the DAU and the Bluetoooth module is via a DB9 connector on the front panel configured for RS232 serial operation.

BLUETOOTH COMMUNICATIONS DEVICE

Transceiver
The Bluetooth transceiver's antenna should be mounted outside the steel panel for wireless communication when the panel door is closed. It can be mounted inside a panel with a window in the door. As there are so many variables it is best to test BLUDAQ® to see if the communication link can be established - we have seen applications where it worked in a steel enclosure with the door closed but with a reduced transmission distance. Remote mounting the transmitter requires an RS232 cable (catalog number 330479) while mounting the transceiver on the BLUDAQ® and remote mounting the antenna requires a coaxial antenna cable (consult Emphatec for catalog number)

Emphatec offers a Bluetooth transceiver, the Parani SD1000, which is provided with the BLUDAQ® module using catalog number 330482. This transceiver is provided with an antenna that can be mounted on the transceiver or remotely. The transceiver has been configured by Emphatec and is FCC approved. A high gain antenna is available for increased transmission distances. BLUDAQ® has been tested with other transceivers such as the Firefly RN-240M. Switches on the RN-240M were set as follows: SW1, 3 and 4=off, SW2=on.

If you wish to try the BLUDAQ® with a different transceiver, the communication settings should be 8 bits, 115200 baud, 1 stop, no parity. Do not use any other baud rate.

Cable
The suggested configuration uses a 9 way D-Sub cable (straight through) male to female. Catalog number 33079.

Bluetooth receiver
The receiver is integrated into the Android tablet.

ANDROID TABLET

All development has been done on a Samsung GT-P7510 tablet and a Google Nexus 7. See Appendix C for the latest evaluations.

Wi-Fi
At start up the BLUDAQ® will turn off the Wi-Fi of the tablet. The Wi-Fi and incoming phone calls can disturb and disconnect the Bluetooth link. Do not re-establish the Wi-Fi during BLUDAQ operation.

AutoOff
In normal operation, an Android tablet will enter sleep mode when there is no user interaction. The BLUDAQ® app will disable this feature while it is running.

SETUP

1. Mount the DAU on a rail
2. Connect 24VDC to the connector (TB5/1 or TB5/2- 24VDC; TB5/3 or TB5/4- 0V).
3. Wire analog inputs as necessary to the appropriate input, making a note of which is connected to which pin.
4. Wire digital inputs as necessary to the appropriate input, making a note of which is connected to which pin.
5. Wire digital outputs as necessary
6. Wire analog output as necessary
7. Connect K type thermocouple to the connector on the front panel of the DAU if desired.
8. Connect the Bluetooth module to the 9-way D-Sub on the DAU.
9. Turn on power.
10. Check that the LED on DAU flashes red. (Red indicates that there is no return communication.)
11. Check the DIP switches are set correctly on the Bluetooth module.
12. Insert Bluetooth module in 9-way D-sub on the outside of the panel or in its intended location inside a panel will a glass insert in the door.
13. Check that the green LED on the Bluetooth module flashes at about 1Hz.
14. Turn on the Android tablet and start the BLUDAQ® app by tapping on the icon seen in Figure 1 in the Apps category. Access to the Apps category may be different for each Android tablet

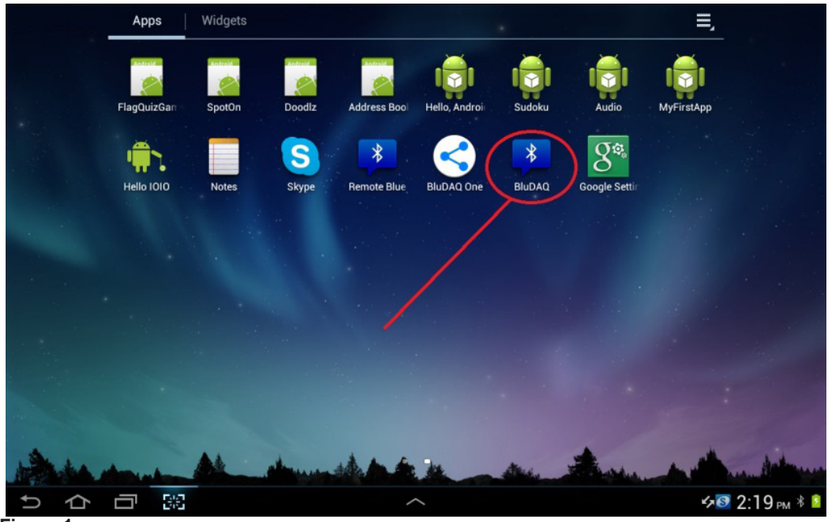


Figure 1

15. The app should start up with a blank oscilloscope screen.

16. You should notice the message “no reception from BLUDAQ® module” and “not connected” in the top right of the screen. See Figure 2.

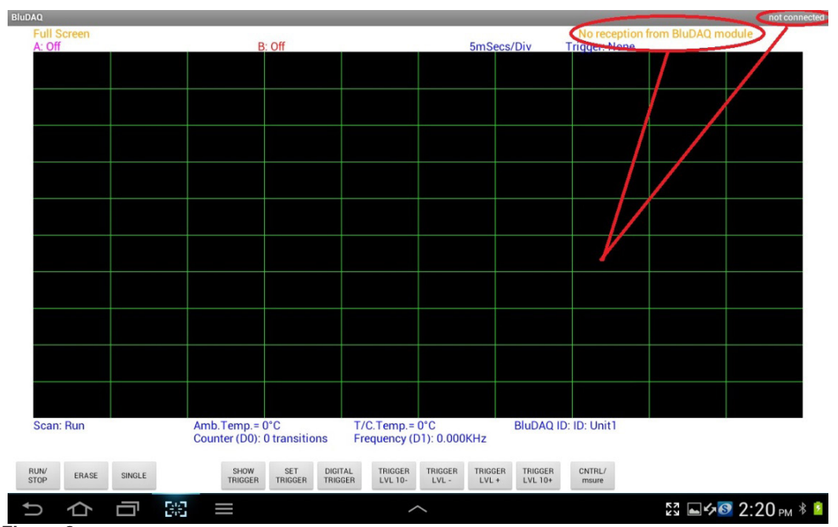


Figure 2

17. Establish Bluetooth communications by touching the key on the bottom of the screen made up of 3 horizontal lines. This symbol and its location vary between different Android devices as seen in Figure 3 and Figure 4. Some newer devices don’t have this symbol at all. See the note at the end of the device table in Appendix C for how this is handled.

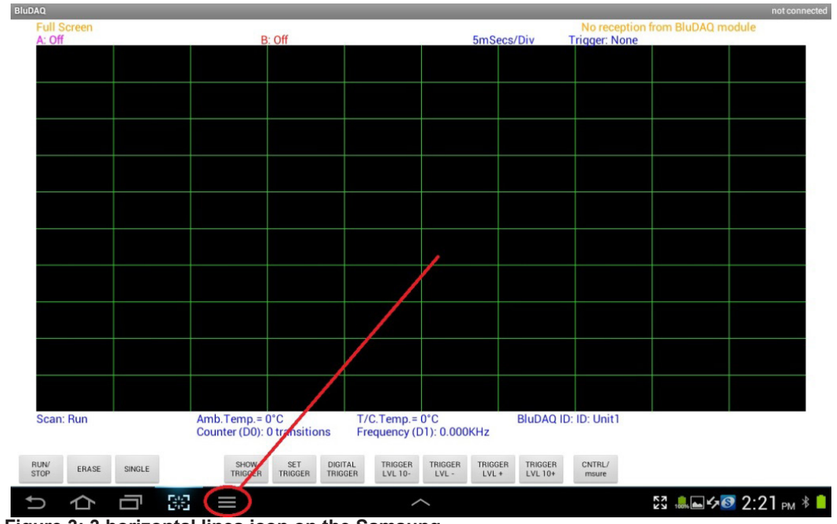


Figure 3: 3 horizontal lines icon on the Samsung

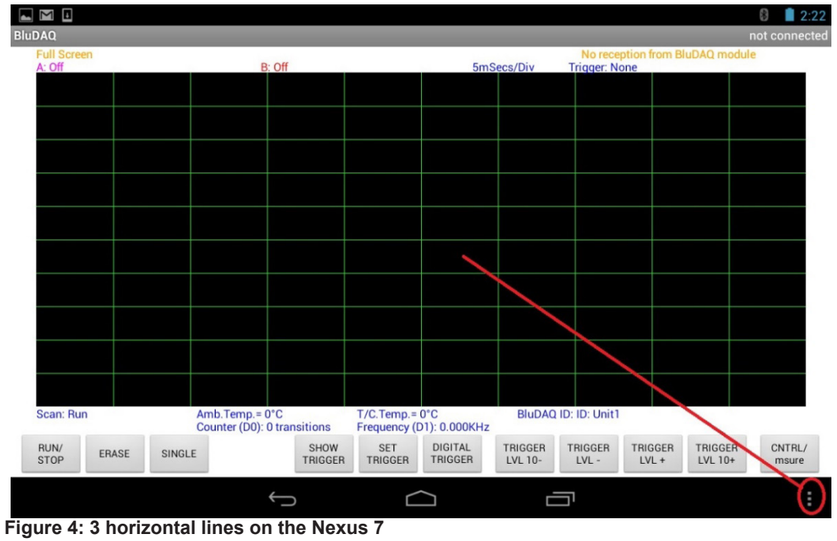


Figure 4: 3 horizontal lines on the Nexus 7

18. Then select “Connect a device” in the dialog that pops up along the bottom of the display as in Figure 5

Figure 5

19. Look at the dialog that appears (Figure 6) if you don’t see the device you want, tap on “Scan for devices” and then select the device you want from the list provided.

Figure 6

20. Once you have paired with the Bluetooth transmitter, select the device from the Paired List as in Figure 6 above.

21. You may be prompted for a password, depending on a number of factors. Unless you have changed it, the default is “1234” or “0000”. Enter this and press OK to initiate the connection (see Figure 7). Note to click the *OK* and not the *Done*. The latter will simply hide the keyboard and you will have to tap OK anyway.

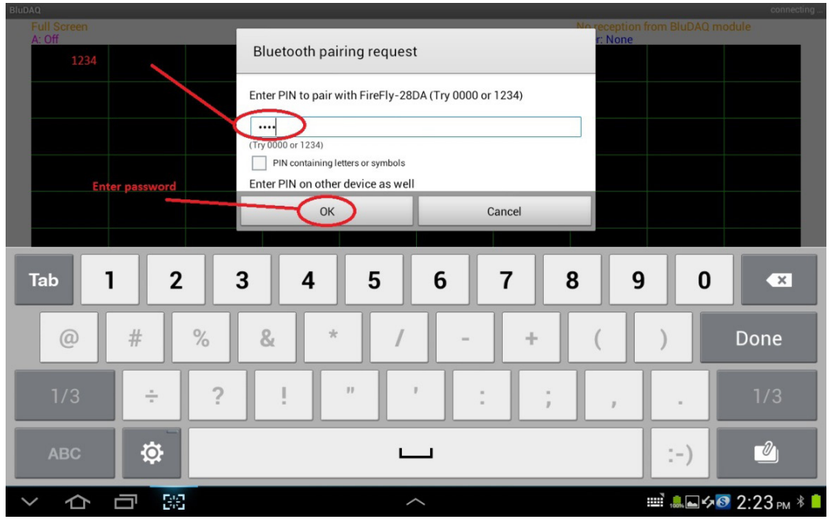


Figure 7

22. Once connection is made, the “no reception from BLUDAQ® module” message is cleared and the message at the top right of the screen changes to indicate that the connection is made and what it is connected to. Also the green LED on the RS-240M becomes a solid green. The yellow LED indicates serial traffic. The LED on the DAU changes to flickering green to indicate a complete data path.
23. Double tap on the Android screen. A menu will pop up similar to Figure 8. If it is not the Setup Screen, touch the SETUP button which will bring up the Setup Screen.

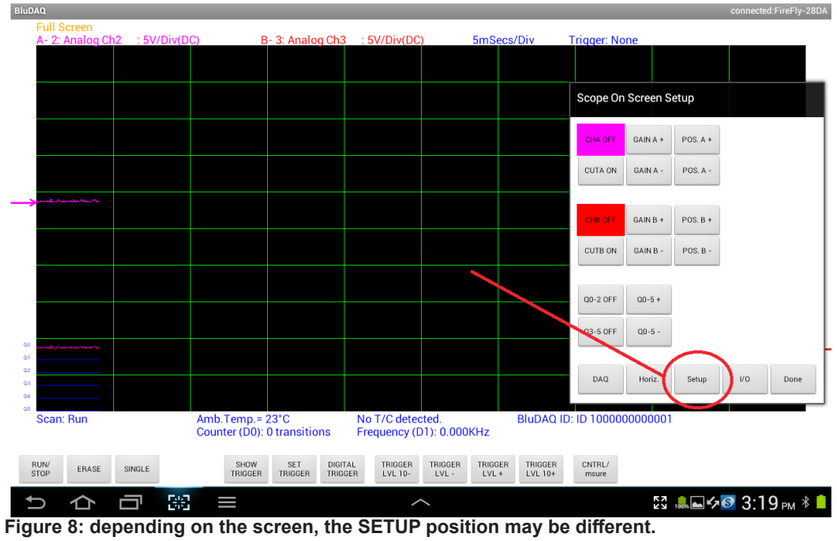


Figure 8: depending on the screen, the SETUP position may be different.

24. Enter the unit ID number and the names of each of the inputs that you recorded earlier. The ID number will help you identify the module if you have more than one especially if you are documenting all your readings. The input names will appear on the screen when the channel is accessed so that you don’t have to look up a cross reference to see what the input is displaying. You are limited to 16 characters per channel. You can enter more, but the name will be truncated to the first 16 characters. The channel input number is automatically prefixed, so you don’t need to add that, nor can you remove it and is not included in the 16 character limit (Figure 9)

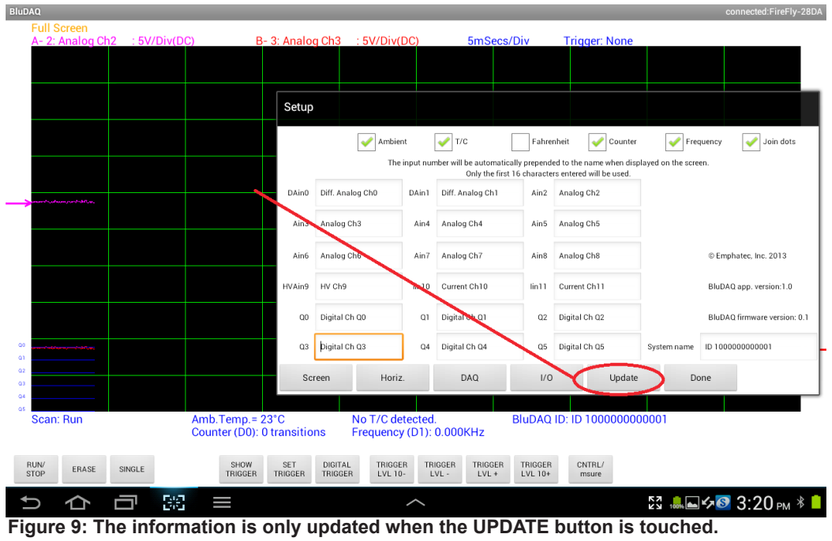


Figure 9: The information is only updated when the UPDATE button is touched.

25. To enter data in a box- touch that box and the keyboard will pop up. Press DONE on the keyboard to get rid of the keyboard, but this will not affect anything on the menu.
26. On the SETUP screen you also have the option of enabling the temperature display on the main screen (along the bottom) of the thermocouple and/or the module temperature and displaying in degrees Celsius or Fahrenheit.
27. On the SETUP screen you have the option of enabling the display of the Frequency measured on D1.
28. On the SETUP screen you have the option of enabling the display of the Event Counter measured on D0.
29. Click on UPDATE when done. This information is stored on the DAU.

SCREEN CONTROLS

An important concept to understand is that, unlike an oscilloscope, there are two distinct parts to the BLUDAQ®. The controls that adjust the display on the tablet will not affect the data acquisition of the DAU and vice versa.

As you look at the screen in normal operation there are a series of control buttons arrayed across the bottom. There are the most frequently used and so we have tried to minimize nesting menus that we use on less accessed controls. We used the nested menus to try to maximize the screen space available for the traces. Also unseen are gestures that will also provide primary control of the traces, although the functions may also be achieved from the menus.

In order to get going, let's turn off the trigger so that there is a display on the screen. Touch the *SET TRIGGER* button at the bottom of the screen (Figure 10).

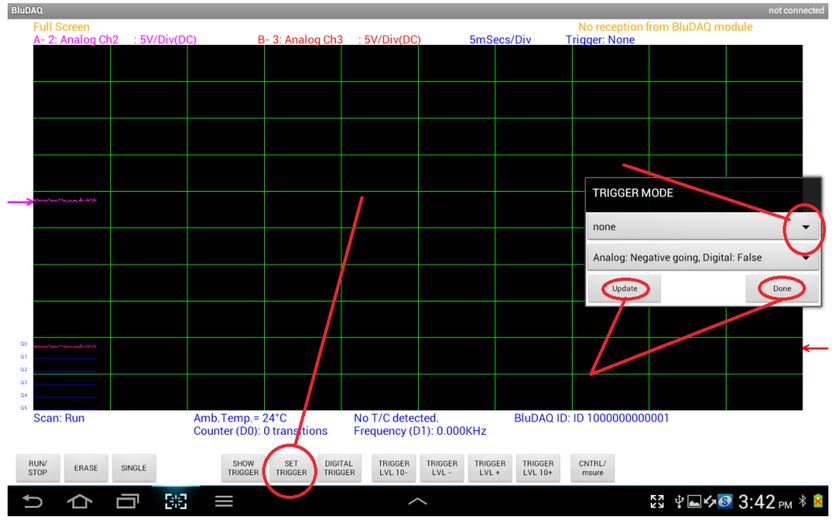


Figure 10: First tap SET TRIGGER and then the down arrow on the upper spinner. Figure 11 will pop up.

It will pop up the *TRIGGER MODE* menu. Touch the upper spinner (with the downward pointing arrow) and then choose the *NONE* option (Figure 11) and then select *UPDATE* and the *DONE* to get rid of the menu.

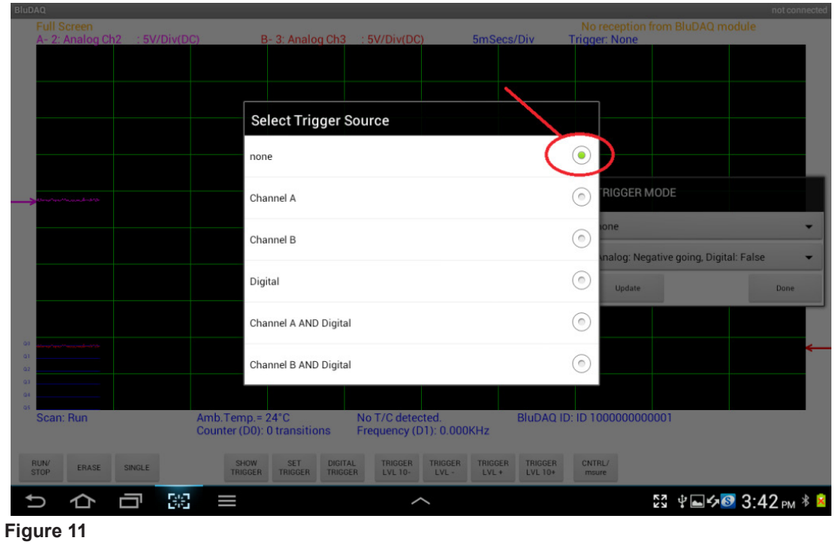


Figure 11

To bring up a menu, double tap on the display. The last used menu will pop up similar to Figure 12 (or the *Scope On Screen Setup* if this is the first time).

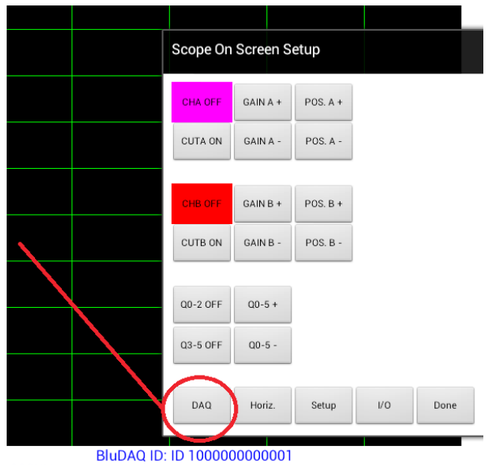


Figure 12

Select the **DAQ** button to access the *DAQ Setup* control menu as seen in Figure 13.

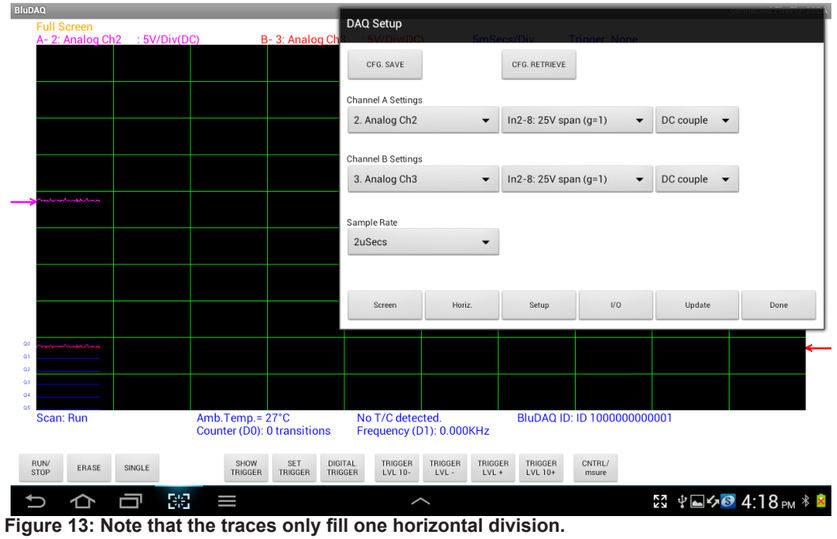


Figure 13: Note that the traces only fill one horizontal division.

Channel A Settings controls the input multiplexer to channel A. The text that appears here is set up on the SETUP menu as shown in Figure 9. On the spinner in the *Channel A Settings*, select an input that has some signal on it and set the gain to the desired value although G=1 is the best place to start. (It would have been nice to modify the options on the gain spinner according to the channel selected on the first spinner. A shortcoming in the Android development environment prevents this being done simply.) Choose if you want the signal to be *AC* or *DC coupled*. AC coupling works best at G=1 as a result of trade-offs that have been made to reduce the hardware footprint. If you have another input (or even the same input) you can route it to channel B in the same way using the *Channel B Settings* spinner.

Depending on the frequency of your signal select the sample rate from the *Sample Rate* spinner. I would suggest you use a sample rate of at least 5 times your maximum frequency. Then touch the *UPDATE* button and the *CANCEL*. *DONE* would do both simultaneously. With a little luck you should be seeing two analog signals on the screen- Channel A in purple and Channel B in red. You should also see the 6 digital inputs in dark blue in the lowest part of the screen. Depending on the settings, these may only take up the first horizontal division of the screen. We will address this shortly. (**Note that although there is an option for 1uS sample rate, because of a couple of reasons this cannot be implemented on the current hardware. Setting to 1uS will result in the same results as 2uS**.) This information pertains to the DAU and is saved and configured there.

In order to get more of a feel you need to find a signal source. You can in fact use the PWM output of the DAU. Connect PWM output (TB1/9) to the analog inputs 2 and 3 (TB7/6 and TB7/7), the digital input Q2 (TB8/5) with a 1K pull-up resistor to 24V (TB8/8). The actual waveform will be switching about 20V as a result of input configuration resistors. See Figure 14 for a schematic.

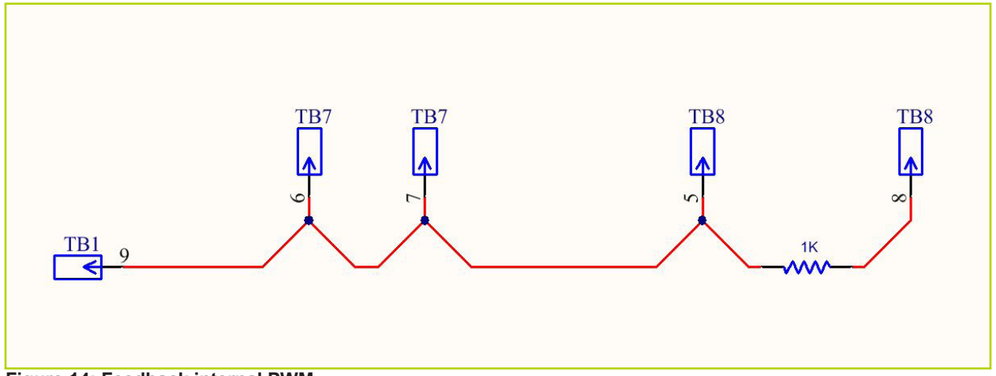


Figure 14: Feedback internal PWM

On the assumption that the BLUDAQ® is still connected over the Bluetooth connection, double tap the screen. (On the Samsung this is sometimes a finicky operation. I find if you tap in the margins around

the screen that it sometimes works better.) We want the *Scope On Screen Setup* menu. If it is not up, tap on the *Screen* button of whatever menu pops up (See Figure 15). Changing properties on this screen does not change anything on the DAU, it only affects how you see the data.

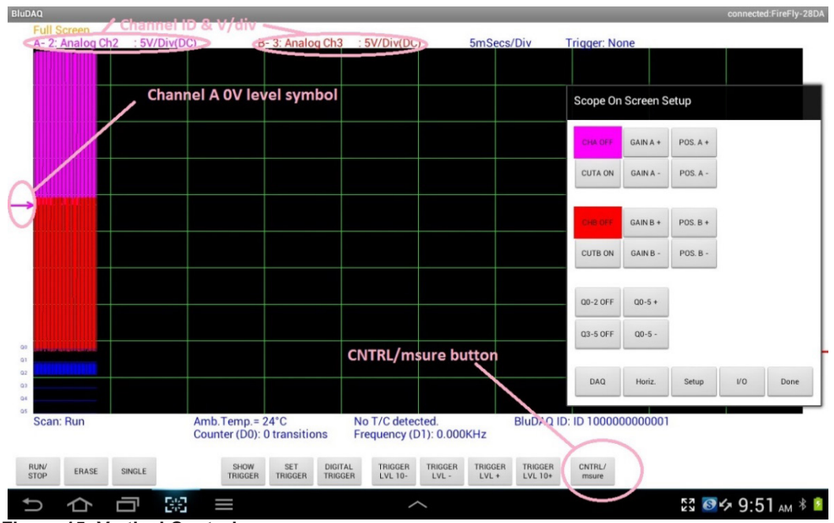


Figure 15: Vertical Control

Vertical Control
(Touch *Screen* in any menu but *Scope On Screen Setup* menu)

The controls are grouped into four blocks and attempts to emulate how you interact with the vertical settings of a standard oscilloscope. The top block affects the vertical properties of Channel A and the second the vertical properties of Channel B. The third block deals with the digital channels and the fourth, as we have seen before is the menu control block.

The top left hand button of an analog channel block *CHA ON* (and *CHB ON*) is colour coded to the same colour as used for the trace on the screen. In a toggle fashion, it will turn the associated channel on or off updating the button text from *ON* to *OFF*. Remember this does not affect the DAU- if the trigger is on Channel A and you turn off Channel A, the trigger will not be affected.

GAIN A (or *GAIN B*) changes the volts per division on the display. Again, it does NOT affect the setting on the DAU. *GAIN A +* (or *GAIN B +*) increases the volts per division- in other words the displayed signal will get smaller. *GAIN A-* (or *GAIN B-*)of course does the opposite. Possible settings (per division) are: 10mV, 20mV, 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, 10V, 20V, 50V, 10mA, 20mA, 50mA, 100mA, 200mA, 500mA, 1A, 2A, 5A, 10A, 20A, 50A. Settings at the ends of the range may not yield sensible results.

Channel 0 and 1 are intended for low voltage inputs, but will withstand high common mode voltages. The can be set to AC coupled, but the reading will be offset. In this state the */Div* setting (described later in Figure 15: Vertical Control) will appear as ---*V.*

The HV input can be configured as AC coupled, but the gain of the signal will likely be wrong although it is not bad for a gain of (set as raw) 1. The */Div* setting (described later in Figure 15: Vertical Control) will appear as ---*V* in this event.

The current inputs I10 and I11 are hall-effect and therefore can detect AC or DC current passing in each sensor. The DAU can be set to AC or DC coupled- there is no difference. Each input can measure a positive or negative DC current or AC. It is only calibrated for input gain g=1. If you select a different gain the */Div* setting (described later in Figure 15: Vertical Control) will appear as --- *A* in this event.

The *POS A+* and *POS A-* (or *POS B+* and *POS B-*) move the vertical position of channel A (or B) up or down. The 0V position is indicated on the screen by an arrow. For Channel A, it is a purple arrow in the left margin, visible in Figure 15. For Channel B it is a red arrow in the right margin, which is hidden behind the menu in Figure 15.

Unique to the BLUDAQ® is the CUT function. This will subtract the common mode voltage from the DC coupled signal so that only the AC riding on the DC is shown. It is a software manipulation that looks for the minimum DC value for the particular channel in the scan and subtracts it from every reading. This mode is indicated on the screen by changing the arrow signal for the 0V level on the screen from an arrow -> to just the arrowhead >.

If you look at the top margin of the display (Figure 15) you will see the channel identifier (in purple for Channel A and red for Channel B) and the description created in Figure 9 along with the volts per division setting.

Some of these functions are also implemented using more intuitive stretch and pinch gestures as we will see shortly. For the moment let's continue with this menu. In the third block you can turn the screen view of the digital inputs on or off in groups of 3 using *Q0-2 ON* (and *OFF*) and *Q3-5 ON* (and *OFF*). It is possible to spread the vertical distance between the channels by touching *Q0-5-* and reduce the spread with *Q0-5+*. There are only the two settings.

The fourth block switches between menus or *DONE* which will clear the menu window.

Vertical Gesture Control
When there is no menu showing and the button on the extreme right in the bottom margin reads *CNTRL/msure* it is possible to use gestures to control some of the vertical (and horizontal as we will see later) settings. A single touch in the left-hand margin will move the Channel A level to meet your

finger. Similarly, a single touch in the right-hand margin will move the Channel B level to meet your finger.

To change the vertical gain for channel A, place two fingers on the screen so they are almost one above the other and pinch or stretch. The trace should respond and the purple text on the top left should indicate the updated setting. Channel B works very similarly, except that you use three fingers (a little more difficult to master).

Horizontal Control
(Touch *Horiz* in any menu but *Horizontal Controls Setup* menu)

Bring up the *Horizontal Controls Setup* menu as in Figure 16. The *T/DIV-* and *T/DIV+* buttons serve to increase or decrease the horizontal scale of the time base. (Once again remember this affects what appears on the screen- the DAU continues sampling at the same rate.) *T/DIV-* increases the amount of time represented by each division (the horizontal spread becomes more compressed) and of course *T/DIV+* does the opposite. The actual setting appears in the upper margin in blue (see Figure 16).

As the horizontal display spreads the number of sample points is too great to appear to appear on the screen simultaneously. In this condition it is possible to scroll through all the sample points moving the display *LEFT* or *RIGHT* using the buttons in the second group. You can accelerate the process by using *LEFTx10* and *RIGHTx10*.

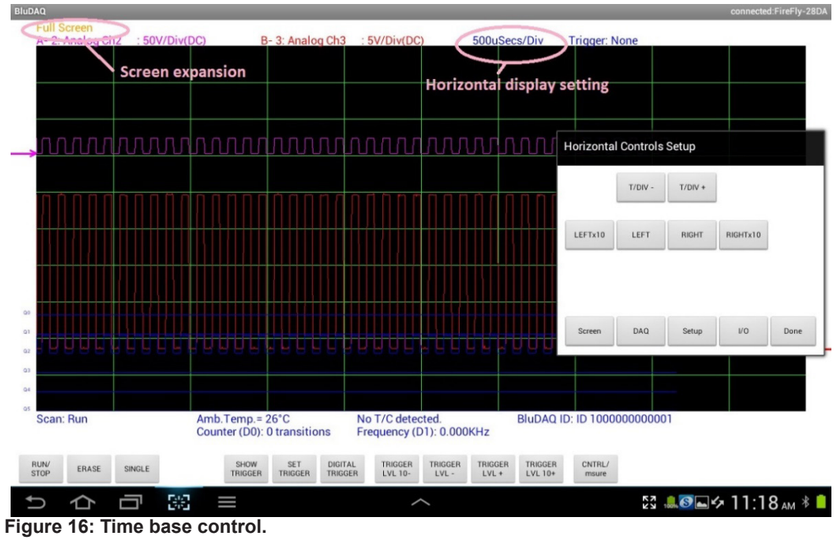


Figure 16: Time base control.

When all the sample points appear on the screen the screen expansion message at the extreme top left of the top margin (Figure 16) reads *Full Screen* in yellow. When the number of points overflow the display, this message changes to *Expanded Screen. Start at Sample n*. n is the sample number that is the first to appear on the screen.

These functions are also implemented using more intuitive drag, stretch and pinch gestures.

Horizontal Gesture Control
To change to horizontal scan (and remember this is on the tablet only) place two fingers on the screen so that they are almost horizontal and pinch or stretch and watch how the display expands on contracts. You can also see the setting change in the blue text on the center right. It can take a little getting used to.

Where the number of samples expands beyond the edges of the screen, you can scroll through by dragging a single finger left or right.

DISPLAY

We now know that to bring up most of the menus to control the display you need to double tap on the screen. Let's look at what is on the normal screen and how to interpret and interact with it.

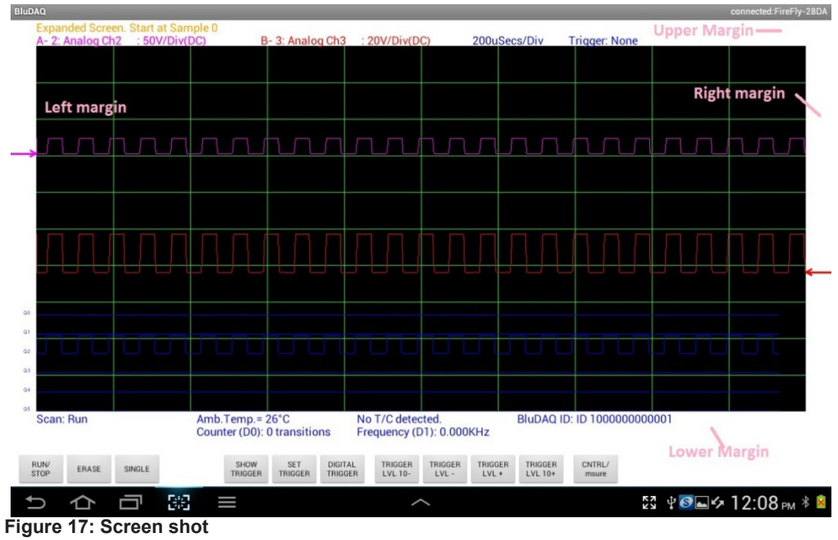


Figure 17: Screen shot

As a summary Figure 17 is a screenshot of a functioning screen displaying the PWM output that is built into the DAU and fed back as described in Figure 14. We did deal with adjusting the vertical and

horizontal gains and we can see 3 waveforms on the screen. Channel A is showing the signal on AIN2 (the 3rd analog input). Everything associated with this channel alone is in the colour purple. And the channel ID and descriptor is in the second line of the upper margin prefixed with the letter “A”. The 0V level for channel A is indicated by a purple arrow in the left margin of the display.
Channel B is showing the signal on AIN3 (the 4th analog input). Everything associated with this channel alone is in the colour red. And the channel ID and descriptor is in the second line of the upper margin prefixed with the letter “B”. The 0V level for channel B is indicated by a red arrow in the left margin of the display.

The time base is indicated in the blue in the second line of the upper margin and this is followed by the *Trigger* setting (also in blue). We did set that up as *None* (see Figure 11). We also can see the expansion status of the time base from the message in yellow in the first line of the upper margin.

The digital inputs are in the dark blue along the bottom of the display.

Let’s move to the lower margin where you will find room for three lines of text and several control buttons.

On the extreme right of the first line of the lower margin is the BLUDAQ® ID. This is a string stored in the DAU to help identify the unit to the operator. In the case of where there are several DAUs in a factory it is helpful in knowing what the associated function is especially when documenting the results. This is entered in the System name block of the Setup menu as seen in Figure 9.

In the middle of the first line of the lower margin there are two spots allocated to temperature measurement. The first is the ambient temperature of the DAU module (and also used for cold junction compensation of the thermocouple) and the second is the temperature of an external thermocouple which can go from xx to xx°C. In the *SETUP* menu which we still have to discuss, it is possible to remove these readings individually and to change the units to °F. As you can see from the figure- if the thermocouple is faulty there is a message to that effect.

The DAU will count the number of transitions on digital input Q0. It will count to a maximum of 32767 transitions. It will also measure the frequency on digital input Q1 to a maximum frequency of 800 KHz. These two numbers are reported below the temperatures on the second line of the lower margin. You can also disable the view (it does not change the action of the DAU) and reset the event counter from the *SETUP* menu as well.

The first block of three buttons should be familiar to anyone who has used a ‘scope. *RUN/STOP* enables the tablet to display the acquired data. Irrespective of this setting the DAU continues to acquire data, it only controls what is displayed. Of course the data must be triggered to display. The status is described on the first line of the lower margin with the status *Scan* and it can be *Run*, *Stop*, and *Single* (when waiting for a trigger). *Erase* will clear the current data pending the next set of data.

The *SHOW TRIGGER* button will turn on the trigger level (in yellow) on the screen and will keep it there for several seconds. The trigger level can be adjusted using the *TRIGGER LVL 10-,* TRIGGER LVL-, *TRIGGER LVL 10+, TRIGGER LVL+* buttons. All this is doing essentially is adding or subtracting bits (as units or tens) to a digital to analog converter internal to the DAU. Changing the trigger level will also turn on the trigger level (in yellow) on the screen and will keep it there for several seconds. Whilst the trigger is set to “*none*” the trigger shows up on both traces so that you can adjust it for the channel that you want when you change the setting.

Now let’s return to the *SET TRIGGER* button. It allows you to choose you trigger source between none, Channel A, Channel B, a digital pattern on the digital inputs (set on the DIGITAL TRIGGER button, which we will discuss shortly) and it also has the facility for a composite trigger. In the composite trigger, when a digital pattern is true it enables the trigger on the analog channel. This would be convenient if you only wanted to look for analog signals when a relay is active, as an example. The direction can be set to positive going (or true for a digital trigger) or negative going (or false for a digital trigger) by using the lower spinner in the *TRIGGER MODE* menu. The actual trigger setting is shown on the top shoulder of the screen towards the right hand side in blue.

The pattern used in for the digital trigger is set up by touching the *DIGITAL TRIGGER* button. The trigger pattern can then be set up on the resulting menu. You can set a logic 1, 0 or X, the latter being for don’t care state. *SET* will save the change while *CANCEL* will simply shut down the dialog. No matter how the pattern is set, it will only have an effect in the trigger settings where the digital trigger is active. When the Trigger Mode is set to *Digital* and *Analog: Positive Going, Digital True* when the digital pattern is seen, the device is triggered. Conversely when the setting is *Negative Going, Digital False* the device is triggered when the pattern changes.

It is possible to measure the signals using gestures as well. The mode between the regular display and measurement is toggled by the *CTRL/msure* button on the bottom right of the screen. Toggling between the regular mode and the measurement mode is done by pressing the right hand button. It changes from *CTRL/msure* to *MSURE/cntrl* (as in Figure 18) and back together with the colour of the text . When it is in the measurement mode (*MSURE/cntrl*) all the other touch functions of the screen are disabled. You cannot double-tap for menus, stretch or pinch the waveform or move the 0V level.

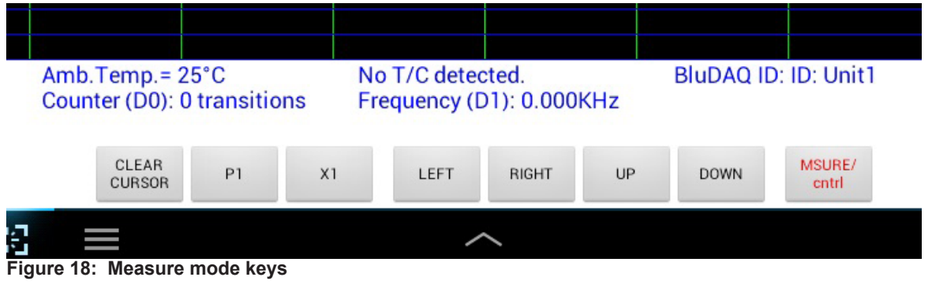


Figure 18: Measure mode keys

To make a measurement you need to define two points on the screen. Which point is determined by the state of the button marked *P1* or *P2*, not coincidentally for point 1 and point 2. Touch the button so that it reads P1 for the first point and touch the screen. The point you are touching is indicated by the intersection of two orange lines. You can move your finger all round until you find the spot that you want. You can fine tune by using the *LEFT*, *RIGHT*, *UP*, and *DOWN* cursor motion buttons. The *X1*/*X10* button is a magnifier of the movement. When it is set to *X10* the adjustment is much coarser when using the cursor motion buttons.

Touch P1 to toggle it to P2 and repeat the exercise in touching the screen and the point will be indicated by the intersection of two light blue lines. The second point can be adjusted with the cursor motion buttons as well.

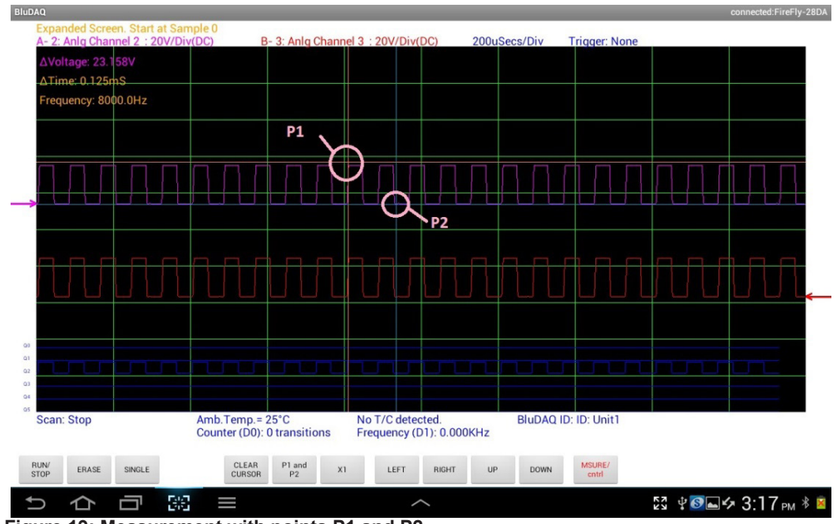


Figure 19: Measurement with points P1 and P2

In the measure mode (which we are in now), select which voltage range to use on the vertical scale by touching in the vertical margins, left for channel A and right for channel B. In the measurement mode the zero level adjustment is inactive. If the channel is enabled, that channel is then set as basis for vertical scale measurements.

The difference in the vertical dimension is reported as ΔVoltage in the upper left of the screen and the colour indicates which channel scaling is being used- purple for channel A and red for channel B as always. The difference in the timebase is indicated by the ΔTime and a frequency is calculated that is the inverse of the time measurement. Figure 19 gives some idea of how an on-screen measurement is made.

The markings will remain on the screen until the *CLEAR CURSOR* button is pressed.

I/O Setup
(Touch *I/O* in any menu but *I/O Setup* menu)

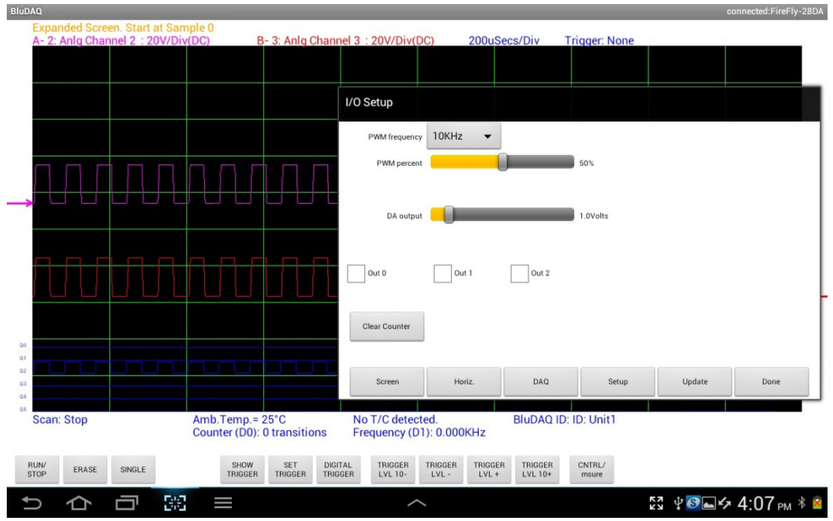


Figure 20: I/O Setup menu

As mentioned earlier, the *Clear Counter* button on the I/O Setup, as seen in Figure 20, resets the Q0 transition counter as displayed in the lower margin.

In order to help with debugging a panel, the DAU has a number of outputs.

It has a PWM output that can be set to a basic frequency of 1KHz, 2KHz, 5KHz, 10KHz, and 50KHz using the spinner at the top of the menu. The output is an open collector transistor output that is capable of withstanding 50VDC and can switch 100mA. The PWM ratio can be set using the *PWM percent* slider from 0% to 100%. The percentage indicates the ratio of the active time (when the output is low/sinking current) to the period of the waveform.

There is also a D/A converter that will output 0-10VDC based on the output of the slider *DA output*. The output is capable of driving sourcing 10mA.

There are also 3 independent digital (Darlington) outputs each capable of sinking 100mA and withstanding 50VDC. To activate an output (goes low, sinking current) tap the associated check box. The check mark indicates that it will be active.

For any of the changes on the I/O Setup menu to take effect, you have to tap the *Update* button.

CFG SAVE/ CFG RETRIEVE (DAQ screen)

You may have notice in Figure 13 that there are two buttons on the *DAQ Setup* menu marked *CFG SAVE* and *CFG RETRIEVE*. It is possible that you have several DAUs in a plant that are configured almost identically. Once the first one is set up (including channel names etc.as well as the gain/ sample rate etc. settings), tap on *CFG SAVE* which will save the configuration settings internal to the tablet. Then move on to the next DAU unit. Once communications is established with the new unit, tap on *CFG RETRIEVE* The menu will shut down. Double tap to bring it back and select the Setup menu. Change the details you want and then touch *UPDATE*. The settings will then be downloaded to the new unit. The UPDATE button on the DAQ setup menu will force the update in exactly the same way.

Screen Capture

Where present the screen capture feature of an Android tablet appears to be particular to each tablet. On the Samsung there is an icon on the lower left of the screen that you can see identified in Figure 21.

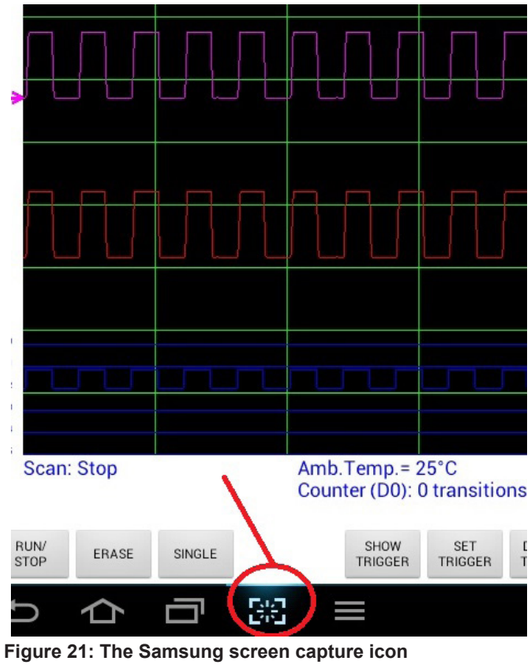


Figure 21: The Samsung screen capture icon

Tap and **HOLD** this icon until the process displayed on the screen is complete. If you just tap it, the

Samsung will invoke an app that will allow you to edit the screenshot. Unfortunately this will sever the Bluetooth connection. So remember to hold until it is complete, about a second.

Although undocumented the Google Nexus 7 also has the ability to take a screenshot. Simultaneously press the ON/OFF button and the Volume Down button, which can take some practice. It does not have the screenshot edit app, so you don't have to worry about it.

The screenshots can be viewed on the tablet using the Gallery app. They can also be downloaded to a PC via the USB port connection to the tablet (see Appendix A). It is possible that the destination of the screenshot can be controlled from some setting on the tablet. The screenshots were in \Pictures\ screenshots in .png format.

Appendix A
PC connection

Both the Samsung and the Nexus should be automatically installed on the first time you connect one to a PC. No USB drivers are required.

Appendix B
Installing BLUDAQ®

In order to install an app on an Android device, you need to adjust the security to allow the app to install. In *Settings* | *Security*, enable *Unknown Sources.*
a) Via Wi-Fi/Internet
On the *Settings* app on the tablet, first make sure that the Wi-Fi is enabled and that the tablet is connected. Then select the *Security* menu and enable *Unknown sources*.
Using the Internet browser go to the website www.emphatec.com and then go the downloads section. Click on the file *blueDAQ.apk* and the app should be installed.

b) Via a PC (Samsung only).
Locate a copy of the file *blueDAQ.apk*. It can be found on the download section of the Emphatec website www.emphatec.com, from an e-mail or on a USB stick. Save the file on your hard disk in the first two cases. Connect your tablet to the PC using a USB cable. Copy the *blueDAQ.apk* file to the *Download* folder on the tablet. Find the *MyFiles* app and click on it. Navigate to the *Download* folder and tap on the *blueDAQ.apk* file. This should initiate the installation.

c) Via e-mail
Access the email message with the *blueDAQ.apk* attachment. This access can be via an internet portal of your email. Tap on the attachment and it should initiate the download. Then go to the *Downloads* app. And tap the *blueDAQ.apk* and proceed with the installation.

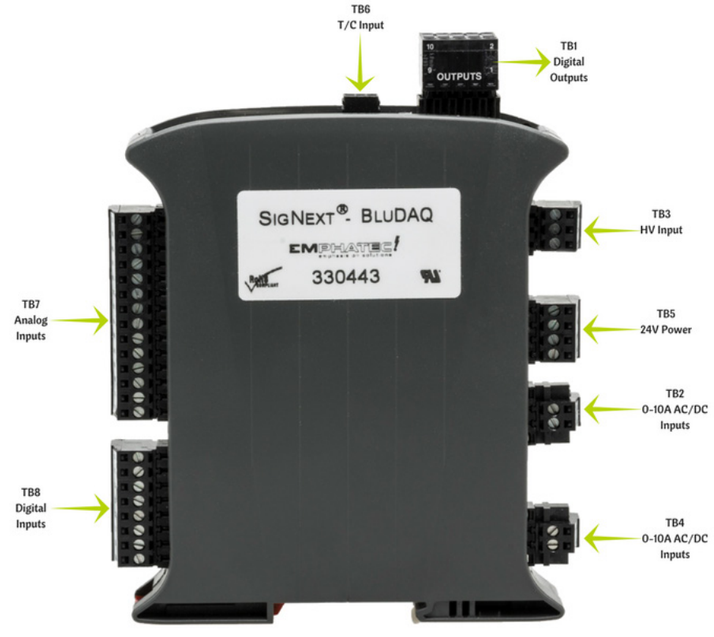
Appendix C
Compatibility

There are dozens of Android tablets and we have only been able to test a few of them. Below is a list of the tablets we have tested. As a note it does seem that the screen capture differs between manufacturers

Manufacturer	Model	Android Version	Display	Rating	Comment
Samsung	GT-P7510	4.0.4	10” 1280x800	+++++	Must touch and hold screen capture for >1sec or Bluetooth connection will be lost
Google	Nexus 7	4.2.1	7” 1280x800	+++	Made by Asus, so Asus should also be OK Sometime difficult with connection to Bluetooth
Ampe	A77	4.0.4	7” 800x480	+	No screen capture identified. Jagged display Difficult touch sensitivity Despite disabled auto-off, still turned off.
Dell	Venue 7	4.2.2	7” 1280x800	++++	Good price. Touch seems more sensitive than Nexus. Snapshot works the same, but less finicky
Asus	Transformer Pad TF700T	4.1.1	10.1” 1920 x 1200	+++++	Must touch and hold screen capture for >1sec or Bluetooth connection will be lost (screen capture using Recent Apps button must be enabled in settings)
Samsung	SM-T110	4.2.2	7” 1024 x 600	++	Lower screen resolution, the waveform looks a little jagged. Problems in viewing with the horizontal scan rate set to 200uS/Div and a 2uS sample rate. The utility “pop-in” on the left side complicates setting the Channel A DC level when you touch in the left margin.
Samsung	SM-T330NU	4.4.2	7” 1280 x 800	++++	See note below for tablets with the return and task manager screened on the face of the tablet. Screen capture achieved by wiping hand across screen (see device’s user manual)
Tablets where the return (back arrow) and task manager (two rectangles) are screened on the face of the tablet, with a tactile home button do not have a menu button that allows you to bring up the connection to Bluetooth sequence. On the units marked with * above, initiation of the Bluetooth connection sequence is achieved by touching and holding the task manager button (two rectangles) until the initial dialog as shown in Figure 5 appears.					

Also Android has a spell check feature that will run on any app. So if you see wavy red lines underneath some text appearing on the BLUDAQ® app, you can cure it by going to the **Settings** | **Language & Input** and unchecking the **Spell checker**.

Appendix D
Pinout on BLUDAQ® DAU.



N.B. Pin 1 (on all connectors marked TB except TB1) is always on the left when looking at the connector.

TB1: BLUDAQ Control
(Connector Weidmuller B2L3.5/10 BL (1727660000))

Pin 1 is at the top left and the top row is odd-numbered, i.e. 1,3,5…
To insert or release a wire you will need to open the cable clamp. To release to spring clamp, insert a small screwdriver in the rectangular slot associated with the particular hole.

Pin Number	Description
1	24V supply input/output, but intended for output as supply for open collector outputs OUT0, OUT1, OUT2 and PWM
2	DFT1- input used for test and calibration- not available for general use.
3	DFT2- input used for test and calibration- not available for general use.
4	OUT1- general purpose open collector output. Activated and de-activated from the I/O screen on the BLUDAQ® app on the tablet.
5	OUT0- general purpose open collector output. Activated and deactivated from the I/O screen on the BLUDAQ® app on the tablet.
6	OUT2- general purpose open collector output. Activated and deactivated from the I/O screen on the BLUDAQ® app on the tablet.
7	RTS- output used for test and calibration- not available for general use
8	PWM- open collector output driven by a PWM. Frequency and mark/space ratio set from the I/O screen on the BLUDAQ® app on the tablet.
9	DA- 0-10V analog output set from the I/O screen on the BLUDAQ® app on the tablet.
10	0V 24V return, supply input/output but intended for ground reference for output like DAC

TB2: Channel I0 (isolated current input)
(Connector Weidmuller BL3.5F/2 BL (1615780000))

Pin Number	Description	
1	Current in	} Use this direction for positive deflection of the wave on the screen. Use the opposite for negative deflection. Of course it is not pertinent for AC input. Isolated from 24V system power.
2	Current out	

TB3: Isolated HV input
(Connector Weidmuller BL3.5/3 BL (1615680000))

Pin Number	Description
1	0V HV return (**not** the same as 0V 24V return)
2	Not installed/used
3	HV (isolated from 24V system power)

TB4: Channel I1 (isolated current input)
(Connector Weidmuller BL3.5F/2 BL (1615780000))

Pin Number	Description	
1	Current in	} Use this direction for positive deflection of the wave on the screen. Use the opposite for negative deflection. Of course it is not pertinent for AC input. Isolated from 24V system power.
2	Current out	

TB5: 24V System Power
(Connector Weidmuller BL3.5/4 BL (1615690000))

Pin Number	Description
1	24VDC supply
2	24VDC supply
3	0V-24VDC return
4	0V-24VDC return

TB6: K type Thermocouple Input
(Connector Phoenix Contact PTSM 0,5/ 3-P-2,5 (1778845))

If you are using solid core wire you can insert a wire by first stripping it and then pressing it into the appropriate circular hole in the plug. To release to spring clamp insert a small screwdriver in the rectangular slot associated with the particular hole. To insert stranded wire you will need to open the cable clamp in this way as well.

Pin Number	Description
1	TC+
2	TC- (can be tied to 0V-24Vreturn externally, but may need recalibration in this mode to reduce the error. Introduces and error about 8°C without calibration).

TB7: Analog Input
(Connector Weidmuller BL3.5/14 BL (1615750000))

Pin Number	Description
1	0V-: 24VDC return
2	In0-: Differential low voltage input return. This terminal can be up to 30VDC relative to 0VDC-24DCreturn, but it cannot be floating.
3	In0: Differential low voltage input
4	In1-: Differential low voltage input return. This terminal can be up to 30VDC relative to 0VDC-24DCreturn, but it cannot be floating.
5	In1+: Differential low voltage input
6	In2: Analog input voltage
7	In3: Analog input voltage
8	In4: Analog input voltage

9	In5: Analog input voltage
10	In6: Analog input voltage
11	In7 Analog input voltage
12	In8: Analog input voltage
13	0V-24VDC return
14	0V-24VDC return

TB8: Digital Input
(Connector Weidmuller BL3.5/8 BL (1615700000))

Pin Number	Description
1	24V supply input/output, but intended for output as supply for potential free switches or PLC outputs
2	Q0: Digital input
3	Q1: Digital input
4	Q2: Digital input
5	Q3: Digital input
6	Q4: Digital input
7	Q5: Digital input
8	0V-24VDC return

P1: RS232 Connector (9 way D-subminiature socket)
Pin numbers are marked on the connector

Pin Number	Description
1	Not connected
2	TxD (data from DAU)
3	RxD (data to DAU)
4	Not connected
5	0V
6	Not connected
7	CTS (into DAU) not implemented
8	RTS (out of DAU) not implemented
9	5V