



# ENCODERLAB

For Testing and Simulating Incremental Encoder signals

Part No. ENC-LAB01

Users Manual

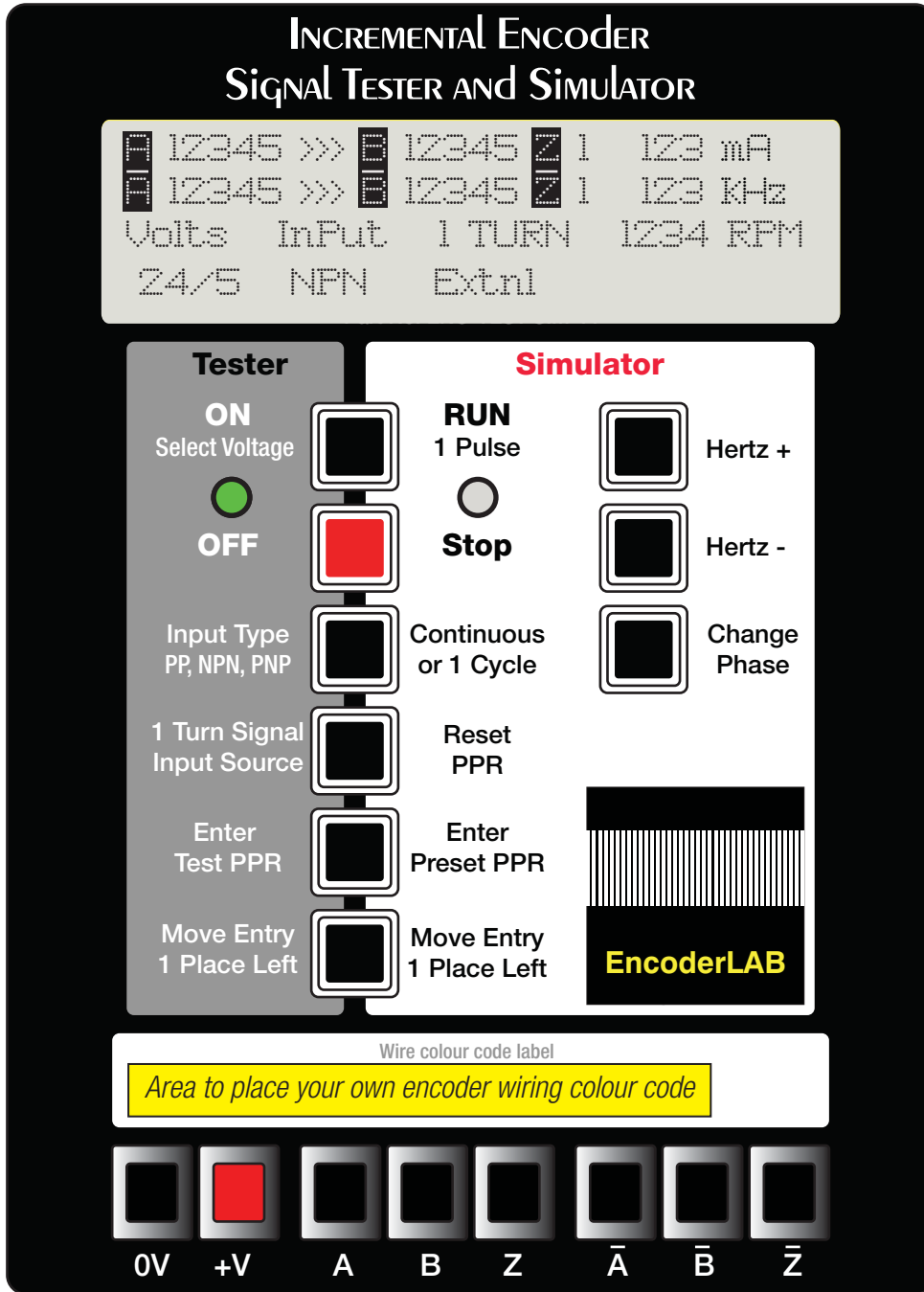


## Introduction

The EncoderLAB is designed to test and simulate all aspects of an incremental shaft encoder, or any other instrument which produces square wave output signals, such as linear encoders and flow meters. This instrument combines into the one housing and updates two separate encoder instruments PCA has produced for many years.

The large four line LCD display allows the user to see in one view all the test results on just one screen. In addition there is Windows software available which will repeat and analyse the information shown on the LCD display, and produce an oscilloscope view of the input wave form, a test report for each encoder and adds all the information into a production log file for future analysis.

## Encoder Testing Mode - Operator button functions



### Specification

#### Mechanical

Foot print: 140mm x 210mm  
 Height Max: 85mm  
 Weight: 630g

#### Input Power Supply

12 Volts 1 Amp

#### Power adapter Australasia Only

Input: 100 - 240 Volts AC  
 Output: 12 Volts DC 1.5 A

#### Testing Limits

A & B Counters Max 99,999  
 Z Counters 9  
 Encoder supply 5, 12 or 24 DC  
 Encoder Load 150 mA  
 Frequency 25Hz to 500kHz  
 Short circuit and over current protected.  
 Automatic turn off with no load

#### Encoder Termination

9 Pin D type plug parallel with  
 8 Spring loaded wiring posts  
 Connect only 1 at a time

#### Simulator Limits

Frequency 20Hz to 500kHz

#### Input Power Supply

5 Volts to 30 Volts DC  
 Self powered from the adapter  
 lead connected to plug 4

*Full size*

On the connection panel at the rear of the instrument is a slide switch to select between Tester and Simulator mode of operation. To use the testing mode the switch must be set in the Tester position, when in this position the Tester LED will illuminate green to confirm the selection.

**ON** Turns on the power supply to the encoder under test. The first press applies 5 Volts, the second press 12 Volts, the third press 24 Volts and the fourth is for encoders which have an input voltage of 24 Volt but an output signal of 5 Volts. Any further operations of the ON button will start the cycle again commencing with 5 Volts. The LCD display shows the output voltage applied to the encoder.

When an encoder is connected for testing the first press of the ON button, turns the LED red, once an encoder signal is received on the A input, the LED flashes red.

Immediately the load is less than 5mA the voltage resets to the off condition. This function is to reduce the risk of over voltage being applied to the encoder under test; the user must make a conscious decision about the voltage with each new encoder to be tested.

NOTE: It is possible to override this automatic reset function by holding down the ON button for 10 seconds then reselecting the desired voltage again. The encoder supply voltage will then remain on that setting until, the Stop button is pressed, there is a current overload or the power supply to the instrument is turned off. This is a useful function for the operator is testing many encoders of the same input voltage.

**OFF** Turns off the supply voltage to the encoder under test and returns the voltage selected back to start position

of the cycle as described above. The LED will then turn to a steady green and the LCD display will show OFF.

Remember: The power normally turns OFF automatically immediately after the encoder is disconnected.

**Input Type** This switch has four functions indexed one step with each press of the button; the LCD Display reads NPN, PNP, PP or ALT. The selection process switches the load resistor on the input of the instrument between positive (NPN) negative PNP, no load (PP), or ALT switches the input load resistor between negative and positive supplies every three seconds.

**1 Turn Signal Input Source** The one turn reference signal is required so the internal counters in the instrument know when one full rotation of the encoder shaft is completed. Each operation of the button indexes through the three modes, with the LCD display showing the current selection under the Input heading.

**External:** The signal is from the remote external zero reference device which must be mounted on the drive motor, and connected to the instrument on plug P3 pin 5.

**Internal:** The Z signal inside the encoder under test.

**Simulated:** If neither of the other two signals are available or the encoder under test has more than 99,000 PPR this setting is required. The signal setup is outlined in the description of operation for the next two buttons.

**Enter Test PPR** This button starts the simulated pre-set PPR value counter. The value increments by 1 with each press of the button, rolling through numbers 0 to 9. The current value is shown on the LCD display on the right hand number last row in the LCD display field.

**Move Entry 1 Place Left** Each press of the button moves the current value displayed in the right hand character, one place left. To clear the value back to the zero, operate this button until the display reads all zeros.

### Rear Plug Wiring Panel



The centre pin of P5 is positive

**Power Switch** Isolator for the DC power supply.

**Mode Switch** Slide switch to select between the two modes of operation, Simulator or Tester.

**Plug 1** 9 Pin D type for an Oscilloscope (Female) NOTE: Plugs 1 and 2 are in parallel with the 8 wiring posts

**Plug 2** 9 Pin D type plug for connection of an adaptor lead for the encoders with plug connections. (Female)

**Plug 3** 9 Pin D type plug for connection of the 1 pulse reference signal. (Female)

**Plug 4** 9 Pin D type plug for output signals from the encoder simulator. (Male)\_

NOTE: When in the Simulator mode the power for the box is derived from this plug, not the power pack input. The power pack can still be used to allow the instrument to be configured without connection to a control system.

**Plug 5** Power input socket the traditional round 5.5mm socket with 2mm center pin which is the positive terminal. It is expected that overseas users will purchase a power adapter to suit their country. A 12 Volt DC 1.5 amp adapter will be provide to Australasian customers.

**Plug 6** USB communication socket.

**Plug 7** RJ45 Network communication socket.

**OPERATOR PANEL** 8 Spring loaded wire terminating posts for connection of encoders with cables.

## Encoder Testing Procedure

### Step 1 *Turn on the power*

Plug in the 12 Volt power pack and turn the instrument on with the slide switch on the back panel. Select the Test mode on the back panel then the left LED in the operator panel should be showing green.

### Step 2 *Connect an encoder for test*

An encoder can be connected to the instrument in two ways, but NOT both at the same time. For wired encoders there are eight spring loaded wiring posts along the front of the instrument. For encoders with plugs there is a 9 Pin D type plug P1 on the rear of the instrument for connection of customised adapter leads.

1 = 0 Volts	5 = Z signal
2 = + Volts	6 = /A signal
3 = A signal	7 = /B signal
4 = B signal	8 = /Z signal

### Step 3 *Select the one turn input mode*

There are three modes of operation:

Mode 1. An external reference signal connected to plug P3 pin 5 on the rear panel. This mode is the best to use if there is no Z signal from the encoder because it will tell you the PPR of the encoder.

Mode 2. Uses the Z signal in the encoder, this mode will also tell you the PPR of the encoder, and is best to use with high PPR encoders.

Mode 3. If there is no signal available for either of the other two modes, you can load any value to simulate an encoder function. When using this mode the PPR of the encoder under test cannot be determined, but the integrity of test remains the same.

### Step 4 *Select the ON button*

This provides the power to the encoder; the first press applies 5 Volts, the second 12 Volts, the third 24 Volts and the fourth applies 24 Volts to the encoder but reads the output signals as 5 Volt signals. The input signals from the other input voltage settings are expected to be the same as the applied voltage.

There is a user configurable time delay between the time the voltage is selected and when it is actually applied to the encoder, the default is three seconds.

The power for the encoder can be removed at any time by either pressing the red OFF button, or disconnecting the encoder. If you are testing a group of encoders with the same voltage the automatic turn off can be overridden. To override this automatic function, hold down the ON button for ten seconds, then select the voltage you require and the voltage will remain present until the power to the instrument is removed or there is an over current fault.

The LED will turn from green to red as soon as the power is applied to the encoder.

### Step 5 *Select the input type*

There are four input signal modes of operation:

PNP: This selection expects the signal from the encoder to switch the internal 4.7k load resistor to the + supply.

NPN: This selection expects the signal from the encoder to switch the internal 4.7k load resistor to the 0 supply

PP: This input has no load resistors and expects the input signal to switch between the + and 0 supplies. Only this input mode gives the most accurate milliamp reading of the encoder because the other two settings include the current for the internal 4.7 k load resistors in the total reading.

ALT: In this mode the load resistors alternate every three seconds between the 0 and + supply voltage.

### Step 6 *Spin the encoder*

At this time the signal counters on the LCD display should all be showing a valid reading for all the channels that have been connected. The Z channel if fitted should always show 1, and the other channels should always show equal values which must be the same as the PPR of the encoder.

NOTE. Some encoders may show one signal less than the other in one direction and not the other, this is of no concern it is because not all encoders have the Z signal synchronised with either the A or the B channel.

The LED will now blink red when ever the A input is receiving signals from the encoder under test.

### Step 7 *Check for correct operation*

1. A and B counters should display the same value, this is the PPR, pulses per revolution of the encoder.

2. The Z counter should only show 1

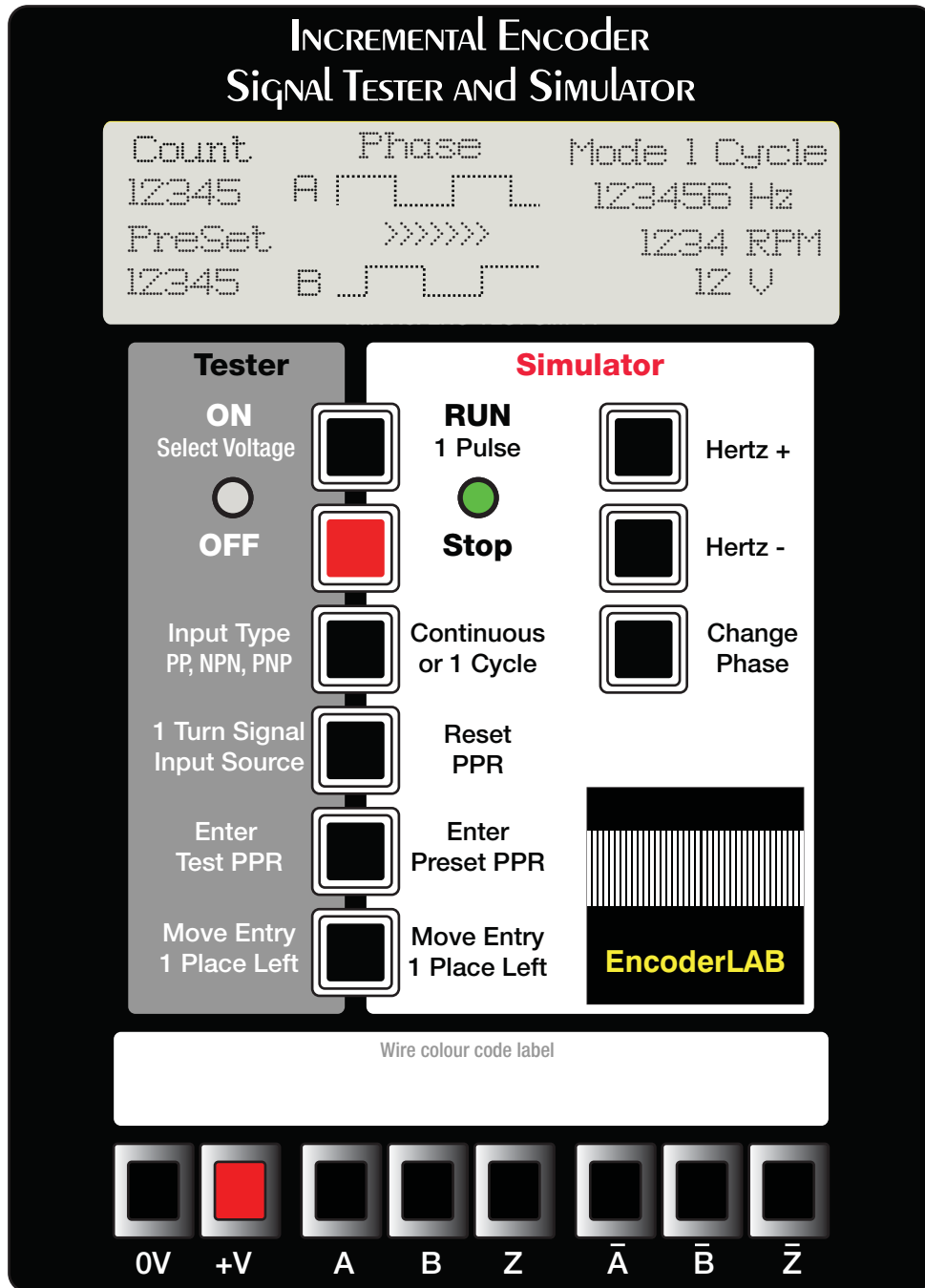
3. The direction arrow heads should be showing the same direction when the complimentary channels /A and /B are fitted to the encoder.

4. The current reading would normally be between 30 to 60 milliamps, 150mA is the upper limit of the instrument.

Mechanically turn the encoder over a range of speeds. There are two factors to consider, the maximum mechanical RPM and the maximum signal frequency. NOTE The maximum RPM for high PPR encoders cannot be achieved because the limit is determine by the maximum electrical frequency rating for the encoder.

The upper limit for the tester is 499 kilohertz, above this a To Fast warning will display. If you need to operate above that frequency it is best to use an oscilloscope connected to Plug 2 on the back of the instrument to view the signal wave form. The unit can still provide the power to drive the encoder, only the instrument counters will not show a valid reading.

**Encoder Simulator Mode - Operator button functions**



*Full size*

In this mode of operation the instrument generates the same six outputs channels as any standard square wave output encoder. This provides the ability to test other instruments and systems that require encoder signals without having a mechanical means of generating the encoder signals.

There are two output modes of operation; continuous and one cycle. Often when testing machinery in the field machine functions are initiated by a specific count value, which in live operation happens too quickly to allow visualisation of the process. This function allows the user to press the RUN button to send the last value minus one, in a time suitable to allow time to observe the results of the process, then with a second operation of the RUN button

just one signal is produced to complete the total preset value.

On the connection panel at the rear of the instrument is a slide switch to select between the testing and simulator mode of operation, to use the simulator mode the switch must be set to the Simulate position. The Simulator LED will illuminate green to confirm the selection.

NOTE: The spring loaded wiring posts on the front panel have no function in the simulator mode.

## **Encoder Simulator Mode - Operator button functions**

**RUN/1 Cycle** Enables the output signals from the simulator to run in either of two modes of operation, the mode is determined by the selection made with the Cycle button below. In Continuous mode the output runs continuously until the Stop button is pressed. When in 1 cycle mode the function of a press alternates between bursts of the preset PPR value minus 1, and just 1 pulse to complete the full PPR cycle.

The LED will switch from green to red blinking once there are signals present on the output channels; the LCD display shows the mode selected, the preset PPR and the progress of the counter as well as a graphical representation of the output wave form and direction of rotation.

**STOP** Disables all output signals until the Run button is pressed again, the LED turns from red blinking back to green.

**Continuous or 1 Cycle** Toggles the output signals between continuous operation and 1 turn bursts of the preset PPR value as outlined in the RUN button explanation above.

**RESET PPR** Resets the preset PPR value to zero ready to load a new simulated value as outlined below.

**Enter Preset PPR** This button starts the process to enter the simulated PPR value, The display will roll through numbers 1 to 0 stepping one each time the button is pressed.

LCD Display will show the current value in the right hand number of the count PreSet field.

**Move Entry 1 Place Left** Each press of the button moves the current preset value on the right hand character one place left and enters a 0 in the left field  
LCD Display: Shows the current value in the PreSet field moving one decimal place.

**HERTZ +** Increases the output frequency while ever the button is pressed.

**HERTZ -** Decreases the output frequency while ever the button is pressed.

**CHANGE PHASE:** toggles between the A/B and B/A Phase rotation.

LCD Display: Shows a graphical display of the A and B square wave format. With the arrows in this direction > > A leads B which is equivalent to turning the shaft of an actual encoder clockwise, when the value is counter clockwise the arrow heads display this way < < <.

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## **Encoder Simulation Procedure**

### **Step 1** *Turn on the power*

Plug in the 12 Volt power pack and turn the instrument on with the slide switch on the back panel. Select the simulator mode on the back connection panel then the right Simulator LED should be showing green.

### **Step 2** *Connect an adapter lead to P4*

A connection lead with 9 Pin plug at one end and flying leads at the other is connected to plug4 on the rear panel, the flying leads are connected to the machine or instrument under test terminals.

### **Step 3** *Select the output mode of operation*

There are two modes of operation:

#### **Mode 1. Continuous**

In this mode the output square wave runs continuously once the RUN button has been pressed.

#### **Mode 2. 1 Cycle**

In this mode the number of output signals set in the instrument minus 1 are applied to the output, then the signals stop. To complete the total number of pulses one more pulse is produced when the RUN button is operated. This completes the cycle, operate the RUN button again to repeat the cycle.

### **Step 4** *Select the PPR simulation value*

First operate the Reset PPR button to return the PreSet

register to one, next enter the most significant character, then operate the Move Entry 1 Place Left button for as many times as necessary to complete the full pre-set number.

Following is listed the steps to enter a value of 2500.

1. Reset PPR
2. Operate Enter Preset PPR button twice, 2 will now be displayed
3. Operate Move Left button once the display will now read 20
4. Operate the Enter button five times and 25 will now be displayed.
5. Operate the Move Left button twice more and the display will show 2500.

### **Step 5** *Run the output signals*

Operate the RUN button and output signals will now be transmitted to the 9 pin plug. The LED will now blink red as the signals are transmitted.

### **Step 6** *Change output frequency*

Operate the Hertz + or Hertz – buttons to change the output frequency. Operating the Change Phase button will reverse the A/B phase relationship.

The LCD display shows the square wave relationship and >>> show the direction of rotation for a live encoder if the shaft were turning clockwise when looking at the front face of the encoder, and A is leading B.

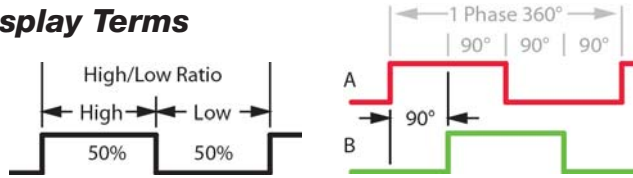
## EncoderLAB Software Outline

The instrument is a complete stand alone item and it is not necessary to use a computer with it to fully test an encoder. However it is designed to be connected to a PC via either a USB port or an Ethernet network with the RJ45 socket, located on the rear panel. When connected to the PC the user screen in the tester mode displays all the operating values in one display, including an oscilloscope display

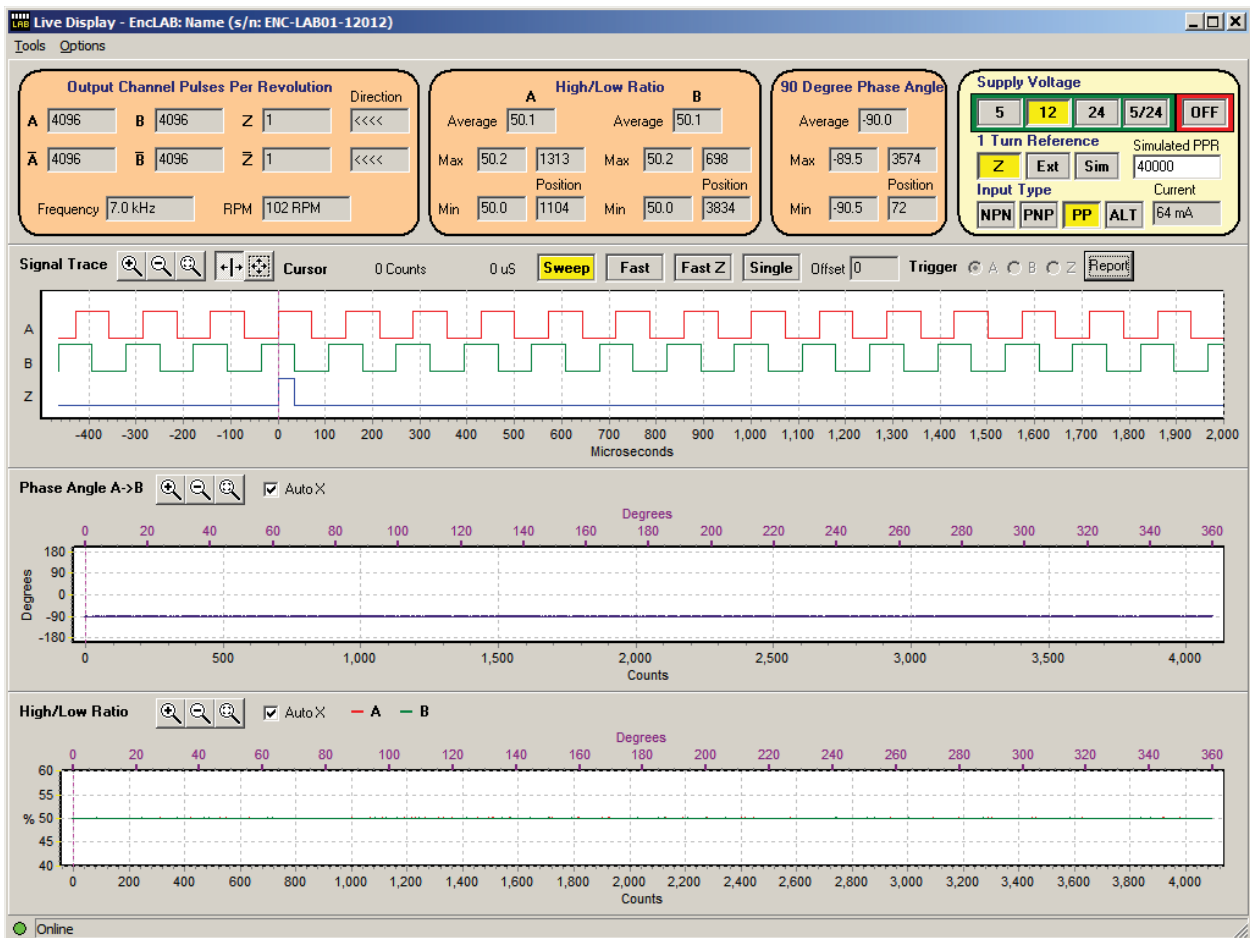
play of the encoder output wave form as well as variations in the 90 degree phase shift and the high to low ratio of the output channels. In addition the setup configuration parameters of the supply voltage and associated thresholds values for the input signals and the one turn reset source can be changed on the screen.

### Explanation of Computer Display Terms

The total square waves for one shaft revolution = PPR

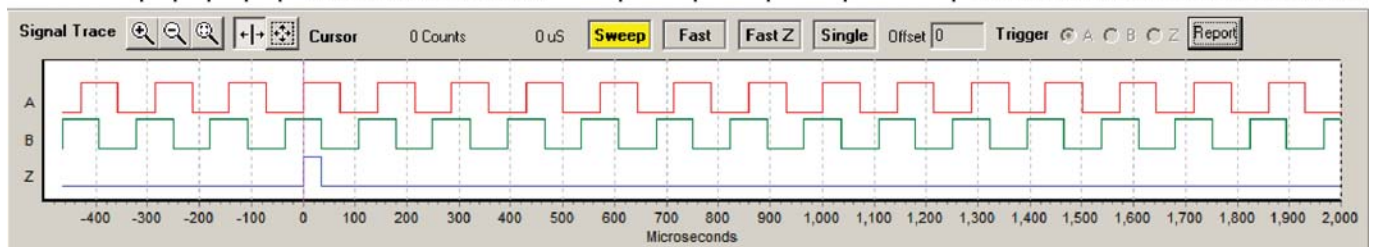


These parameters are all selectable on the screen.



In the Fast Mode the Oscilloscope wave form is auto scaling, as a result the 4 wave forms remain the same over the full frequency range.

Encoder assemblers can use this and the numerical readings to set up the mask to disk relationship eliminating the need for a traditional Oscilloscope.



## Reporting Provisions

There are three reporting formats.

First there is a .csv file available for every encoder, it stores the information from the PC screen and lists the timing for every individual square wave. This is initiated from the Tools drop down menu and is only produced on demand.

Second and Third reports are initiated from the Report

command on the user screen, the information on the screen, plus the details requested once the report screen is opened, are used to produce a one page .pdf file for printing to deliver with the encoder, and the same information is also used to add another line into a common .csv file. This file allows the user to analyse information for all the encoders they produce as well as keeping a history in one file of all the test information. NOTE: Detailed analysis of each square wave is not stored in these files.

The screenshot shows the EncoderLAB software interface. On the left, the 'Live Display' window shows signal traces for channels A, B, and Z, along with phase angle and high/low ratio graphs. The 'Encoder Test Report' window is open, displaying the following information:

Report: 2013-0123\_2013-09-02 Date: 2 Sep 2013  
 Company: The Lime Drink Company  
 Attention: John Brown Phone No: 1234 1234  
 Email: johnbrown@lime.com Fax No:

Serial No: 2013-0123 Part No: INSL-12HR-37AM/04096  
 Tested By: John Tester Test Date: 2 Sep 2013 Repair No: New

**Clockwise A/B**

Output A	Output B	Output Z	Test Parameters
PPR: 4096	PPR: 4096	PPR: 1	Freq: 51 kHz
High To Low Ratio	High To Low Ratio	Phase Angle A/B	RPM: 742 RPM
Min: 50.7 @ 1688	Min: 50.7 @ 3523	Min: 89.4 @ 2166	Current: 66 mA
Max: 50.9 @ 3669	Max: 50.9 @ 3979	Max: 90.3 @ 3524	Voltage: 12V
Avg: 50.8	Avg: 50.8	Avg: 89.8 >>>>	Ref: Z
Compliment /A	Compliment /B	Clockwise A/B	Input: NPN
PPR: 4096	PPR: 4096		

**Anticlockwise B/A**

Output A	Output B	Output Z	Test Parameters
PPR: 4096	PPR: 4096	PPR: 1	Freq: 51 kHz
High To Low Ratio	High To Low Ratio	Phase Angle A/B	RPM: 742 RPM
Min: 50.7 @ 3567	Min: 33.9 @ 2034	Min: -90.5 @ 1469	Current: 66 mA
Max: 50.9 @ 3357	Max: 101.5 @ 4070	Max: 180.0 @ 2034	Voltage: 12V
Avg: 50.8	Avg: 50.8	Avg: -0.7 <<<<	Ref: Z
Compliment /A	Compliment /B	Anticlockwise B/A	Input: NPN
PPR: 4096	PPR: 4096		

**Comments**  
Encoder performs according to specification PASS

EncoderLAB  
Another incremental encoder performance report

## Simulation Mode

The user can change all the parameters on the screen.

The 'Encoder Simulator' window shows the following parameters:

- Run: Run
- Mode: Continuous
- PPR: 2500
- Freq: 82000 Hz
- Phase: A/B

Buttons: Set, Reload, Close

## Networking

Any number of the EncoderLAB instruments can be connected to an Ethernet network, a user screens can be opened on one PC to monitor the operation of each EncoderLAB on the network. The location of the report files is also freely configurable by the user to suit their individual operational requirements. Each user can update the same log file or you may have individual files for each instrument or each group of encoder products.

## PLEASE NOTE

This software information is a summary, the manual, installation instructions and the software are available from our web site [www.encoderlab.com.au](http://www.encoderlab.com.au).