



Newflow

**P570 Dual
Chronometry
Validator**

User Manual





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MMXIX



Front Panel View



Rear Panel View

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1 Introduction

The Dual Chronometry Validator has been designed to work with a range of Flow Computers.

Its primary purpose is for simulating a small volume prover, and giving highly repeatable number of pulses and fractional pulses, for validation of the dual chronometry process.

In addition it can be used as a highly stable frequency source, and as a density meter simulator. In Densitometer mode, a highly stable period is generated with very fine resolution down to 25nS, depending upon the period selected.

Once configured, the unit will remember the last settings, and can be used stand-alone, but for configuration, an Android device with Bluetooth is required to act as the user interface.

1.1 Start up

When power is applied, the blue power LED will come on and stay on, and the two bi-color LEDs L1 & L2 will briefly flash red & green. The unit will then continue as previously configured.

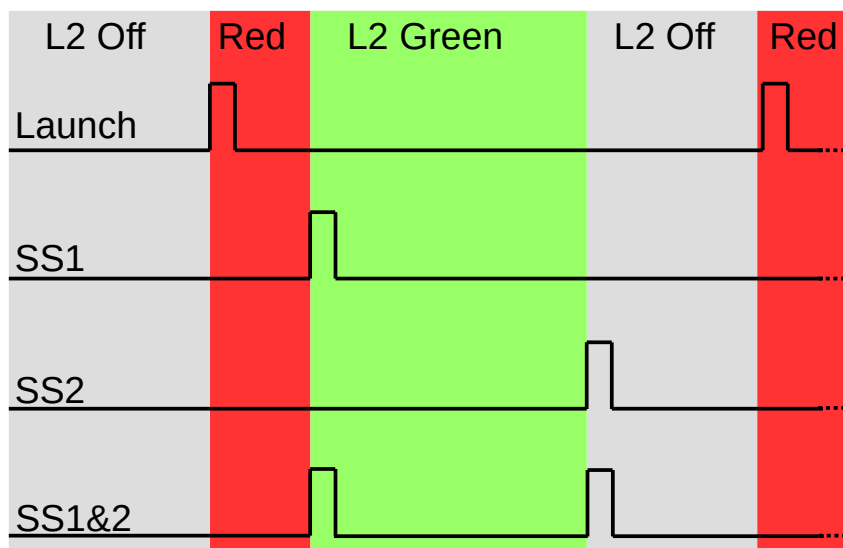
1.2 The Front Panel

There are three LEDs and a three position switch on the Front Panel.

POWER The left-hand LED is a blue LED which indicates when power is applied

L1 L1 is a dual color LED used to indicate if the Bluetooth link is established. If the LED is showing a short red blink, that indicates that no Android device is currently connected. If the LED shows a solid green light, then the Bluetooth is connected

L2 L2 is a dual color LED used to indicate the Prove Sequence. L2 red shows the pre-launch delay period, and green indicates the period between the sphere switches being active. When off, no prove is in progress.

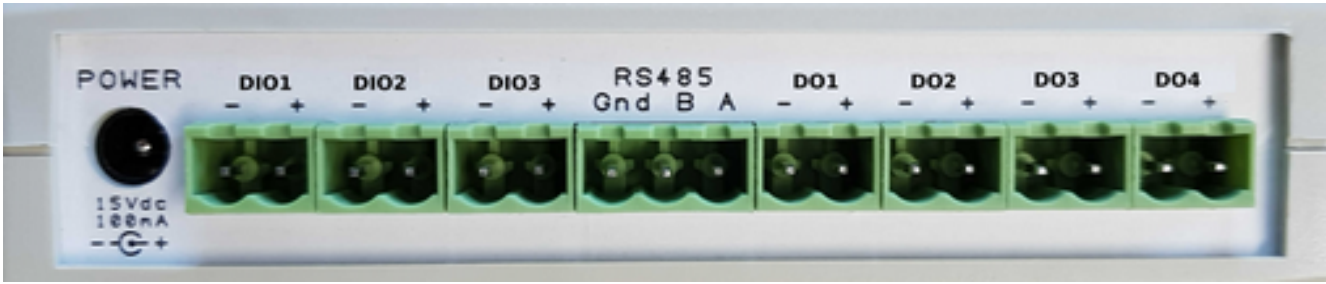


S1/S2 S1/S2 is a three position switch. The central position of the switch is off. The left hand position, S1, is a momentary ON position which will return to the center position when released, and will provide a Launch signal. The right-hand position, S2, is a toggle action

and sets the launch to automatic repeat mode.

1.3 The Rear Panel

The rear panel has the input power 2.1mm jack and eight sets of connectors for the simulation.



1.3.1 DC Power Requirements

The P570 Dual Chronometry Validator has a single 2.1mm jack plug with center positive. The validator will run with an input between 12 Volts and 28 Volts, although a 15 Volt minimum is preferred if you need the pull-up to be 12 Volts on the DIO[1..3] terminals. The simulator will require a maximum of 100mA.

1.3.2 Simulated Field Connections

There are four different types of field I/O circuits available, with the following characteristics:

<i>Terminal</i>	<i>I/O Description</i>
DIO[1..3]	Digital Input or Output with selectable pull-up, referenced to ground
RS485	Differential field I/O for serial communications or Raw Pulse Bus
DO[1..2]	High-speed open collector Digital Outputs, referenced to ground
DO[3..4]	Optically Isolated, Protected & current limited, switched Digital Outputs

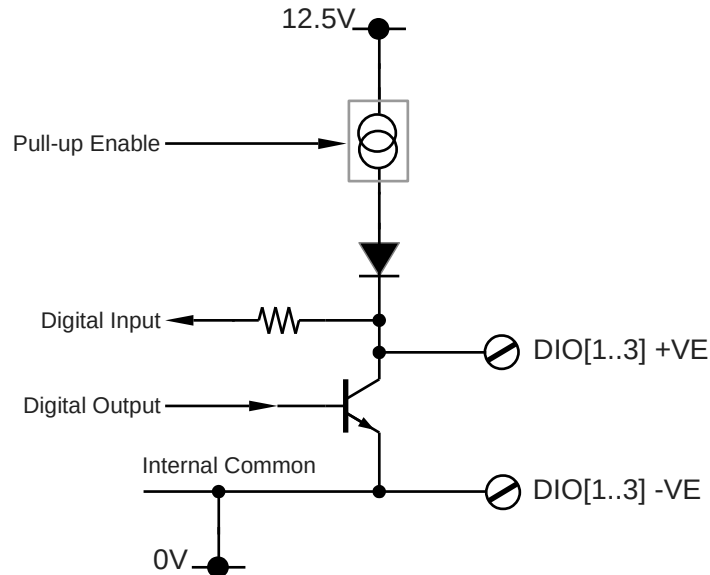
The I/O is utilized as shown below.

Note: the Normal or Dual Pulse mode setting is set or changed using the P570 Android App.

<i>Terminal</i>	<i>In or Out</i>	<i>Prover - Normal</i>	<i>Prover - Dual Pulse</i>
DIO1	Output	Meter Pulses	Meter Pulses Ch A
DIO2	Output	SS1 & SS2 combined	Meter Pulses Ch B
DIO3	Input	Launch Prover	Launch Prover (Input)
RS485	Output	Differential Meter Pulses	Differential Meter Pulses
DO1	Output	SS1	SS1 & SS2 combined
DO2	Output	SS2	SS2
DO3	Output	SS1	SS1
DO4	Output	SS2	SS2

1.3.3 Combined Digital Input & Output Circuit

The Combined Digital Input & Output connectors have the following equivalent circuit:

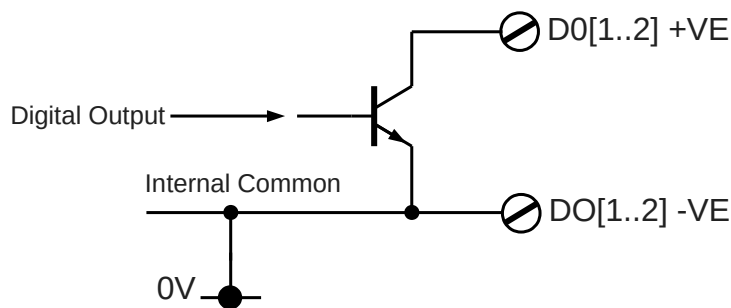


When DIO1 is set to be an output, the Digital Output will be fed with the Meter Pulses and the Digital Input signal from the hardware is ignored. Each of the internal Pull-up Enable signals can be controlled using the P570 DCV Android App. If the DIO1 Pull-up is enabled, DIO1 will produce a 12 volt square wave output, that should drive most flow computers. If a larger signal swing is needed, a 1K Ohm pull up to an external 24 Volt supply can be used, and the internal Pull-up Enable turned off.

When the Digital Output isn't driven, the circuit also functions as a Digital Input. DIO3 is configured as an input and, if DIO3 Pull-up is enabled, can be directly connected to a switch or an open collector. Alternatively, with the DIO3 Pull-up Enable turned off, a voltage input signal can be sensed.

1.3.4 High Speed Open Collector Outputs DO1 & DO2

The DO1 & DO2 Open Collectors have the following equivalent circuit:

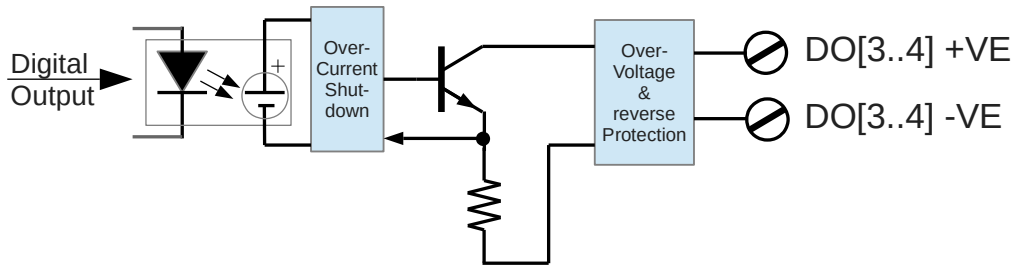


These are traditional open collector outputs that need an external pull-up to operate. These outputs share the same internal common 0V signal as the DIO[1..3] connections.

Note: DO1 provides a different function in Dual Pulse mode to Normal operation.

1.3.5 Optically Isolated Outputs DO3 & DO4

The Isolated DO3 & DO4 outputs have the following equivalent circuit:



The isolated Digital Output circuit is fully floating, so each can be used to either source current, by connecting the +VE connection to the 24 Volt supply, with the -VE connection providing a switched voltage source, or they can be used as a traditional open collector, with the -VE terminal connected to the supply ground.

This is an exceedingly rugged field output and, if overloaded, it will protect itself and shutdown. Once a shutdown has been triggered, the digital input will need to go off before it will reset. When next turned on, it will respond once more.

1.3.6 Differential Field I/O

These terminals can be used as differential inputs, outputs or for RS485 based serial communications, but when used with the P570 DCV App, it will provide the Meter Pulse outputs in differential form. This output is ground referenced.

2 Installing the Android Configuration Tool

In order to configure the P570 Dual Chronometry Validator, the P570 DCV Android application must be installed, and the Bluetooth link established.

2.1 Enabling the Bluetooth Link

To establish the Bluetooth link, go to settings on the Android device, select Bluetooth, ensure Bluetooth is turned on and then search for devices.

Assuming the P570 Dual Chronometry Validator is both turned on and in range (within 10 feet), your Android device should be able to detect the P570 as available.

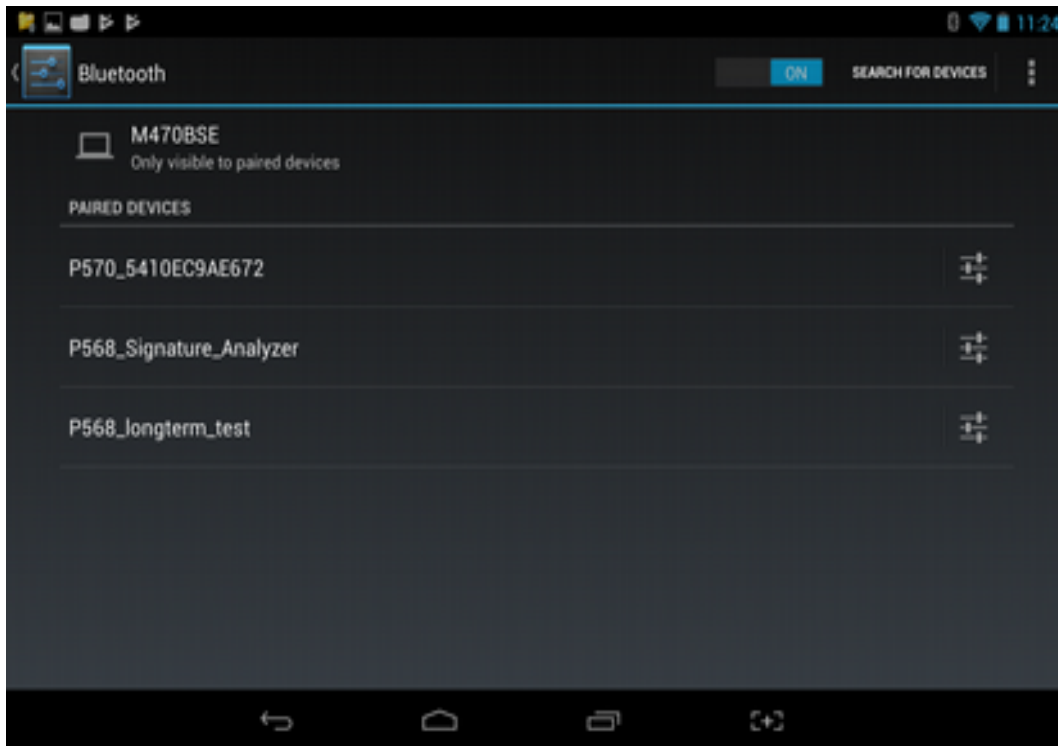
The screenshot below shows two devices already paired, and one new device (P570_5410EC9AE672) discovered by the device search.

The Bluetooth name is a combination of the Product Number P570 and a MAC address.

Note: if several P570 units are discovered, you can find out which is which by looking at the label on the underside the P570 Dual Chronometry Validator, and it will show the last 6 digits of the MAC address.



By clicking on the relevant device in the AVAILABLE DEVICES list, Android will then perform the pairing operation and will add the P570 unit into the PAIRED DEVICES list, as shown overleaf.



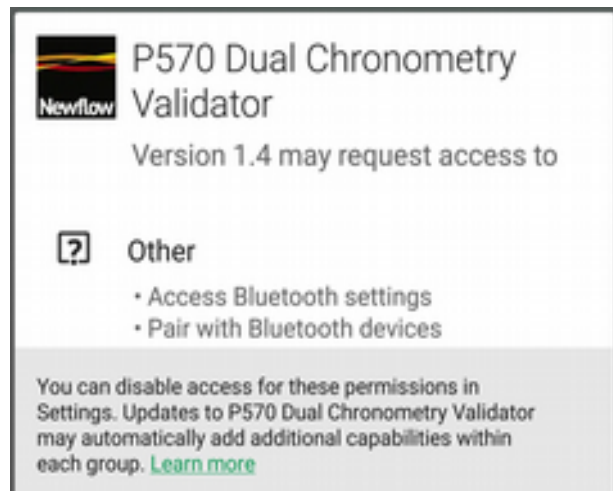
Now that your Android device is paired with the P570 Dual Chronometry Validator, you can install and launch the P570 DCV Android Application.

2.2 Installing the P570 DCV Android App

The P570 Dual Chronometry Validator is available on the Android Play Store. Search for P570 and the Newflow Ltd application will be quickly found.

When installing the Application, you will need to give permission for the Application to access the Bluetooth communications. The App does not look at anything else on your Android device, nor does it store any data on your Android device, it simply acts as the display.

Once you have installed the P570 App, launch it, and the user will be presented with the configuration screen, shown on the following page.



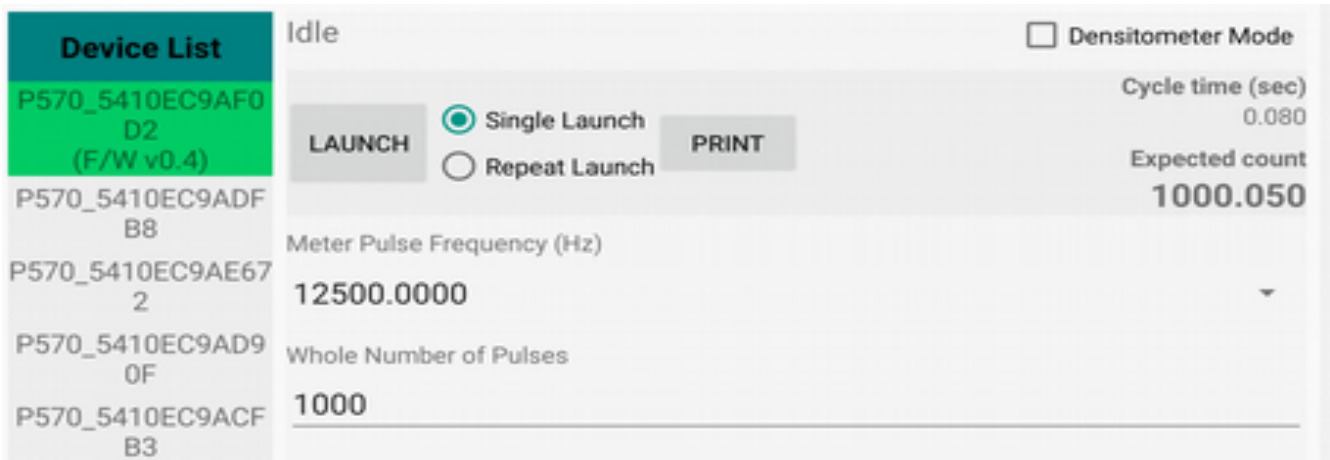
Note 1: Depending upon your device screen size, you may only see a portion of this whole screen at any one time, and will have to scroll up and down to get to all the features available.

Note 2: The P570 App is designed to run in Landscape mode, and regardless of your Android settings, the App will not rotate into Portrait mode.

3 Driving the P570 Android App

3.1 Starting the P570 DCV App

When the P570 DCV App is initially launched, the screen will look like the screenshot below:



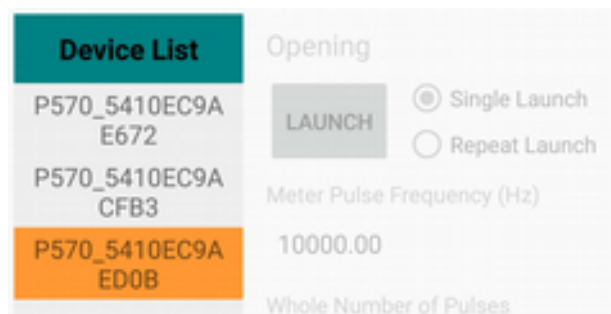
The left hand side of the screen, under the Device List heading, will show all the paired P570 DCV units, and the right hand side of the screen will be grayed out. The right hand side can be scrolled up and down, but none of the parameters can be altered unless a connection to the P570 DCV hardware has been established.

In the example shown on the screenshot above, there are five paired P570 units.

All paired P570 units will be shown on a gray background, and to the right of the Device List, it will state **Not Connected**.

Choose which P570 you wish to control and touch the appropriate P570_nnnnnnnn legend to select that unit. This will establish a Bluetooth connection with the unit.

The selected unit will initially show an orange background, whilst attempting to make a connection to the P570 DCV, as shown here on the right.



If the link cannot be established, for example the unit is too far away, then the background will be shown as red. If it is showing red, then click again to deselect, and click once more to retry, or try another paired device.

If a successful connection is made, then a green background will be displayed, the right hand side of the screen will be shown in higher contrast and the **Not Connected** status will be replaced by **Active**. When in prover mode, and a prove cycle has been completed, it will show **Idle** until Launched again

The screenshot on the next page shows the full screen when a successful connection has been made.

Note once a connection has been made, the firmware version of the P570 unit connected to will be displayed. In the example on the next page, the firmware (F/W) version is shown as v0.5.

Device List

P570_5410EC9AF0
D2
(F/W v0.5)

P570_5410EC9ADF
B8

P570_5410EC9AE67
2

P570_5410EC9AD9
0F

P570_5410EC9ACF
B3

Idle Densitometer Mode

LAUNCH

Single Launch

Repeat Launch


PRINT


Cycle time (sec)
0.080

Expected count
1000.050

Meter Pulse Frequency (Hz)
12500.0000

Whole Number of Pulses
1000

SS1 Early Percentage 0%


SS2 Late Percentage 5%


Operating Mode

Normal

Dual Pulse

SS1 & SS2 Output Polarity

Normal

Inverted

Prove Launch Input Polarity

Normal

Inverted

I/O Pin Pullups

DIO1

DIO2

DIO3

SS1 & SS2 On Time (ms)
50

Pre-launch Dwell Time (ms)
2500

Prove Repeat Interval (sec)
3

REFRESH

P570 Android App, full screen view

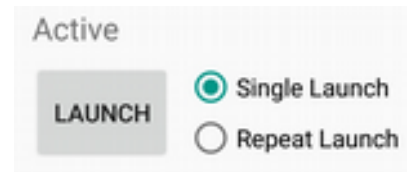
3.2 Driving the Android App

The description below is for Dual Chronometry Mode, and assumes that the Densitometer Mode tick box has not been activated. For a description of the Densitometer Mode, see [Section 5, Densitometer Mode](#). below.

The current app operates in a type of batch mode, in that you set all the options, but they are not applied until the **LAUNCH** button is pressed. In order to maintain the very high accuracy in dual chronometry mode, the commands from the Bluetooth interface are ignored whilst a prove is in progress, so if for example you request a large number of pulses at a slow frequency, the unit will appear to be unresponsive for a long time. Later versions may enable changes to be made on the fly.

3.2.1 Single or Repeat Prover Simulation mode

Starting at the top, there is the status line which shows the Bluetooth connection status. It may show **Not Connected**, **Opening**, **Idle** or **Active**. Underneath is a **LAUNCH** button and a pair of radio buttons. In normal operation select Single.



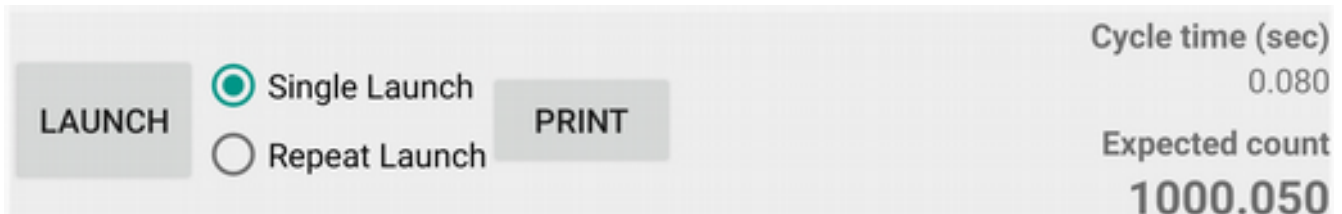
Each time the **LAUNCH** button is pressed, a simulated prover cycle is started.

A launch can also be initiated by moving the switch button left to SW1 position, or if the field terminal DIO3 is driven active.

If the Repeat radio button is selected, the Android app will continuously request prover cycles, until the "action" button, which will now be renamed **STOP**, is pressed. The unit defaults to Single.

3.2.2 Print Button

At the centre towards the top of the screen, there is a **PRINT** button.



Clicking the **PRINT** button will start the Android print services, if already installed. See [section 3.3](#) for further information.

3.2.3 Expected Count

At the top right-hand side of the screen is the Expected Count field. The Expected Count field shows 1000.050 in the screenshot above, and this figure should match the value calculated by the flow computer dual chronometry routine. Note the 3rd decimal place will always show a zero, as the P570 DCV moves the sphere switches edges in increments of exactly one hundredth of a meter pulse.

3.2.4 Meter Pulse Frequency (Hz)

This parameter sets the simulated Meter Pulse Frequency. This output runs continuously, and could be used as a highly stable, low jitter frequency source for other applications.

There are a wide range of frequencies available from 0.9 Hz up to 12500.00 Hz. The frequency is shown to two decimal places, but if the two decimal places are the same, such as .11 or .33, these are recurring decimal numbers and should be read as .11111111... and .33333333... for example.

Numbers shown as .00 or .25 are generally as accurate as the high specification TCVCXO will allow. Appendix A lists all the frequencies available, shown to full resolution.

Tapping the ▼ (down pointing arrow symbol) at the right hand side of the Meter Pulse Frequency line opens a scroll window, allowing a different frequency to be selected as shown in the screen shot.



In addition, tapping on the displayed frequency opens a numeric keyboard, allowing direct entry of the frequency. Note, not every frequency can be generated so the requested frequency will be validated, and the nearest available frequency will be picked, and displayed.

For example, if 1234.56 Hz is requested, 1234.5679 Hz will be displayed, and generated.

3.2.5 Whole Number of Pulses

The next selectable field is the whole "Number of Pulses" that is requested between the two prover switches SS1 and SS2. Tapping on the displayed number will open a numerical keypad allowing the operator to enter a different whole number of pulses. The number selected should be between 5 and 50,000 pulses.

3.2.6 SS1 & SS2 Percentage setting

Below the Number of Pulses dialog are two sliders, which control the fractional pulse count used by the dual chronometry.



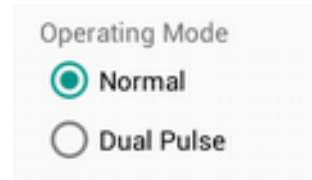
Slider SS1 Early Percentage determines where the first prover switch pulse is generated with respect to the meter pulses. In the example shown above, SS1 rising edge will occur fifteen one hundredths (15/100) of the meter pulse PERIOD before the rising edge of the next meter pulse.

Then the number of whole Number of meter pulses selected is counted, and when the last pulse is delivered, the SS2 Sphere Switch, SS2, is driven after the SS2 Late Percentage period has elapsed.

3.2.7 Operating Mode

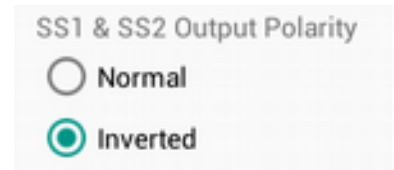
There are a pair of radio buttons to select whether the meter pulse is a single pulse train or two pulse trains in quadrature phase to simulate a meter with a Dual Pulse output.

Note: Changing to Dual Pulse changes the field I/O assignment.



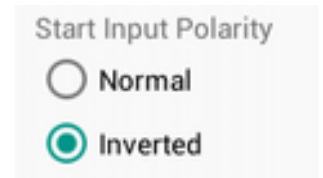
3.2.8 SS1 & SS2 Output Polarity

There are a pair of radio buttons to select the desired Sphere Switch polarity. In Normal mode, the SS1 & SS2 open-collector transistors are turned OFF most of the time, and are only turned ON for a short period (50 millisecond default) as the Sphere Switch is activated. So if an external pull-up is used (or the internal pull-up enable for DIO[x] channels), these will show a high signal voltage most of the time, and only go low when a Sphere Switch pulse is generated. If the Inverted option is selected, the SS1 & SS2 open-collector transistors are turned ON most of the time, and are only turned OFF for a short period (50 millisecond default) as the Sphere Switches are activated.



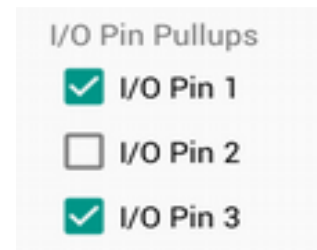
3.2.9 Start Input Polarity

The prove sequence can be started by a variety of actions. For example, in Single Launch mode, pressing the **LAUNCH** active button will start a prove as would moving the front panel switch to the S1 position. However for automated testing, the P570 Dual Chronometry Validator also has a digital input DIO3, which can be used to start a prove cycle. In normal mode, the input going low starts the prove cycle. If DIO3 internal pull-up is enable (see below) and DIO3 is connected to an open collector output on a flow computer, the sequence will start as the external open-collector is energized. Selecting "Inverted" swaps the polarity of the input signal, and now a rising input voltage level will start a prove cycle.



3.2.10 I/O Pin Pullups

The three Input and Output terminals DIO1, DIO2 and DIO3 have a software selectable pull-up option. Each I/O pin can be individually selected by clicking it. A green box with a tick, as show for I/O Pin 1 and I/O Pin 3 on the left hand side, indicates that the particular output has the pull-up enabled, and an empty box, as shown for I/O Pin 2, indicates that the pull-up is disabled.



3.2.11 SS1 & SS2 On Time (ms)

This is currently set to 50 milliseconds and cannot be altered.

3.2.12 Pre-Launch Dwell Time (ms)

This parameter sets the time between the start of a prove and the first Sphere Switch SS1 going active. During the pre-launch delay, the L2 LED will show a red light. Clicking the number will open a dialog box showing a list of Pre-Launch Delay intervals from 0 to 2500 milliseconds.

3.2.13 Prover Repeat Interval (sec)

This parameter is only used if Repeat mode has been selected, or the front panel switch is in the right hand position S2. This parameter sets the delay between the end of one prove cycle (SS2 has been triggered) and the launch command for the next cycle.

Clicking the number will open a dialog box showing a list of Prover Repeat Intervals from 1 second up to 30 seconds.

3.3 Printing the P570 Configuration

When validating a flow computer, it is useful to have a written record of the P570 configuration. At the top right hand side of the screen, there is a **PRINT** button. Clicking the **PRINT** button will launch the Android Print services, which have become both more powerful and easier to use with each new Android version.

If you have not already configured any Android Print services, your device will prompt you to install the appropriate printer services. Note that only HP and Samsung print services have been tested currently, but as the P570 output is a simple HTML document, problems are not anticipated with other Android supported printers.

4 Default Settings

<i>Parameter</i>	<i>Default Value</i>	<i>Optional Values</i>
Launch Mode	Single	Repeat Mode
Meter Pulse Frequency (Hz)	10,000	0.9 Hz to 12,500 Hz
Whole Number of Pulses	10,000	5 to 50,000
SS1 Early Percentage	15%	0% to 99%
SS2 Late Percentage	33%	0% to 99%
Pulse Operating Mode	Normal	Dual Pulse
SS1 & SS2 Output Polarity	Inverted	Normal
Prove LAUNCH Input Polarity	Normal	Inverted
DIO[1..3]	All On	Each can be On or Off
SS1 & SS2 On Time (ms)	50	Not changeable
Pre-Launch Delay (ms)	250	0 to 2,500 milliseconds
Pre-Launch Dwell Time (Sec)	3	1 to 30 seconds

5 Densitometer Mode

The screenshot shows the Densitometer Mode configuration screen. On the left, a 'Device List' contains several entries, with 'P570_5410EC9AF0 D2 (F/W v0.5)' highlighted in green. Below the list is a 'REFRESH' button. The main display area shows the following settings:

- Active** (Status)
- Densitometer Mode** (Checked)
- Input Period (µs)**: 1333.350
- Meter Pulse Frequency (Hz)**: 749.991
- I/O Pin Pullups**:
 - DIO1
 - DIO2
 - DIO3

In Densitometer mode, all I/O are driven as outputs, and all outputs drive the selected period. Independent control of the Digital Input Output (DIO) pull-up signal is provided, and the output signal can be set in either period mode (in microseconds) or frequency (in Hertz), and the display will show the equivalent frequency or period.

The range of periods that can be set is from 1µs to 416,665.6 µs, which equates to 1MHz down to 2.4Hz, and with very fine resolution, of 25 nanoseconds for most of the range.

The user can drive the interface in two ways:

Input the required period in microseconds. The app will redraw the screen showing the nearest possible period and the equivalent frequency in Hertz or

Input the required frequency. The app will display the nearest possible frequency in Hertz, and the equivalent period in microseconds

<i>Period Range</i>	<i>Frequency Range</i>	<i>Resolution</i>
1µs to 1636.65µs	1MHz to 611.04 Hz	25ns
1636.6µs to 12987µs	611.023 to 77Hz	200ns
12987.2µs to 100000µs	76.999Hz to 10Hz	1.6µs
100000µs to 416,665.6	10Hz to 2.4Hz	6.4µs

NOTE:

Only the differential output (labeled RS485) is guaranteed to operate above 12.5KHz. The other outputs may operate above 12.5KHz, but this will depend on the pull-up levels and the sensitivity of the circuit being driven, as the duty cycle will become asymmetric, and the levels will change due to the rise time of open collector output circuits.

6 FAQs

6.1 FAQ 1

- Q) I have accidentally selected a large number of pulses at a low frequency, and do not want to wait for it to end. Can I terminate the cycle early?
- A) Yes you can, but simply power cycling the unit will not work, since the configured values are stored in non-volatile memory. To reset to "sane" values, power the off, push and hold the switch to the S1 position, and power-on the unit. The default values will be re-loaded.

6.2 FAQ 2

- Q) I only have a 12 Volt supply. Can I still use the P570 Dual Chronometry Validator?
- A) Yes, the P570 DCV will work perfectly from a 12 Volt supply, but the internal pull-up voltage (if used) will be reduced to around 10 Volts. All the timing functions will operate as specified.

6.3 FAQ 3

- Q) Can I use the frequency output in Prover/DCV mode to simulate a Density Meter?
- A) Yes, but you have to work in frequency rather than period, and the frequency steps are much coarser than in Densitometer mode.

7 Appendix A

Index #	Frequency in Hz	Index #	Frequency in Hz
1	12500.0000000	31	00100.0000000
2	11111.1111111	32	00090.0090009
3	10000.0000000	33	00080.0000000
4	09090.9090909	34	00070.0035002
5	08000.0000000	35	00062.5000000
6	07017.5438596	36	00050.0000000
7	06250.0000000	37	00040.0000000
8	05000.0000000	38	00031.2500000
9	04000.0000000	39	00025.0000000
10	03125.0000000	40	00020.0000000
11	02500.0000000	41	00016.0000000
12	02000.0000000	42	00012.5000000
13	01600.0000000	43	00011.0001925
14	01333.3333333	44	00010.0000000
15	01250.0000000	45	00009.0000900
16	01111.1111111	46	00008.0000000
17	01000.0000000	47	00007.0001050
18	00900.9009009	48	00006.0002400
19	00800.0000000	49	00005.0000000
20	00700.5253940	50	00004.0000000
21	00625.0000000	51	00003.0001200
22	00500.0000000	52	00002.5000000
23	00400.0000000	53	00002.0000000
24	00312.5000000	54	00001.5000150
25	00250.0000000	55	00001.2500000
26	00200.0000000	56	00001.0000000
27	00160.0000000	58	00000.9000090
28	00133.3333333		
29	00125.0000000		
30	00111.1111111		

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