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Electronic Polarization Controller - EPC
&
EPC Interface

Operational manual



Overview

The Phoenix EPC and Interface are part of the Firebird ™ instrumentation range and provide for polarization state adjustment.

This manual provides the information for the operation of the Phoenix Electronic Polarization Controller (EPC) and the microprocessor interface unit to facilitate PC control.

The first section describes the operation of the EPC which can be used independently of the microprocessor based interface. The second section explains operation with the interface in place both in manual and PC controlled modes.

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Section 1 Electronic Polarization Controller – EPC

1.1 Introduction

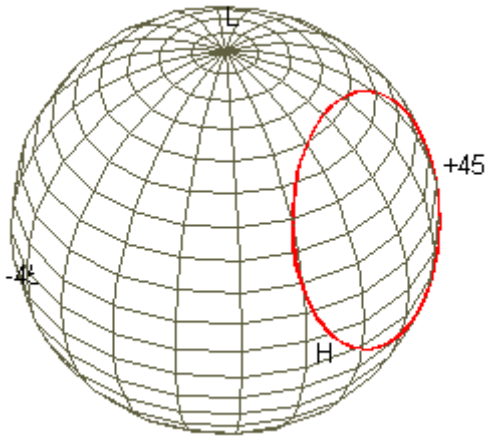
The single channel polarization controller is one of the family which includes OEM component scanners for integration into manufacturers' equipment and multi-channel controllers for testing of component arrays.

This controller provides the flexibility to select either manual control to set polarization state or analogue voltage control to set or scan the polarization state. Full coverage of the Poincaré sphere is achievable enabling conversion of any arbitrary State of Polarization (SOP) to any other SOP.

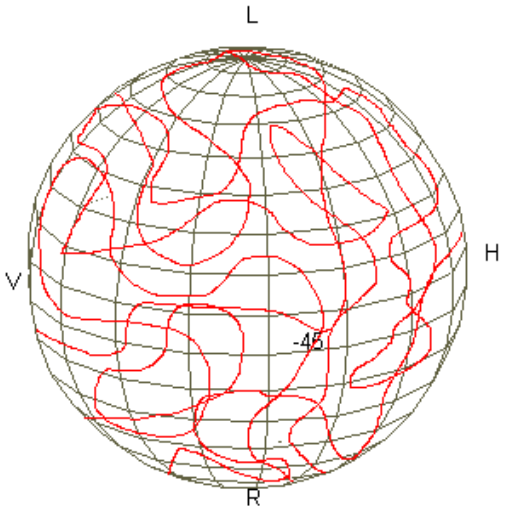
1.2 Principle of Operation

The principle of operation of the range of Phoenix polarization control devices is to vary the birefringence of a length of polarization maintaining optical fiber through thermal control. The two axes of the fiber resolve the incident SOP into two orthogonal components, varying the birefringence alters the phase difference between the two components as they propagate along the fiber which when recombined produces another SOP. In terms of Poincaré sphere representation the devices move the SOP from one point on the surface of the sphere to another point along a route defined by the particular device type. This technique forms the basis of a range of devices which enable the definition of any output SOP from any input SOP.

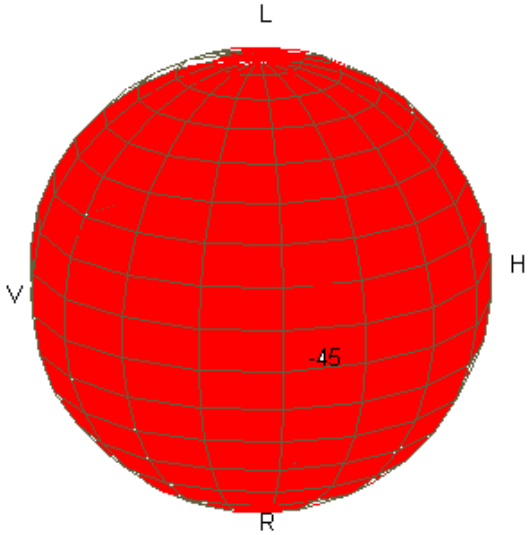
The polarization controller or scanner consists of three independently controllable fiber waveplates. Varying the voltage applied to each section causes the SOP to describe a circle around the Poincaré sphere. Each section describes a circle at a different relative angle to the others. By adjusting the three sections any position can be reached on the sphere from any starting point.



Single section describes a circle on the sphere



Any position on the sphere can be achieved with 3-sections



Polarization scanning

Applying a time varying current to the three sections provides continuous SOP scanning over the full surface of the Poincaré sphere.

In scanning mode the device can be used for component polarization parameter measurement, such as PDL or PDR.

1.3 Specification

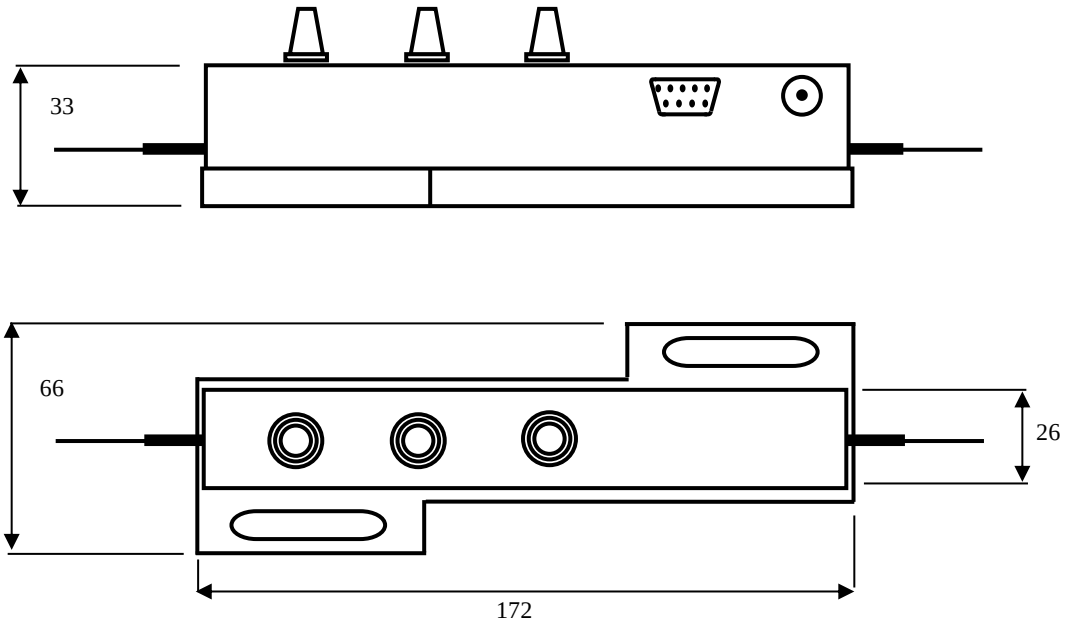
SPECIFICATION:	Units	
Wavelength range	nm	980 – 1080 or 1300-1640
Insertion Loss[1]	dB	<0.8
PMD	ps	<0.15
Insertion loss variation[2]	dB	<0.05
Return Loss	dB	>60
Maximum Voltage[3]	V	10
Scan rate[4]	deg./s	150
Operating Temperature Range	^{0}C	-5 to 70
Storage Temperature	^{0}C	-40 to +85
Fiber type		SMF28, 900¤m buffer
Input & Output Fiber Lengths	mm	1000
Power		External mains 110V to 240V adapter to 12V/1A DC.

Notes:

1. Losses do not include connectors.
2. The variation of output power for full coverage of the Poincaré Sphere.
3. Analogue drive voltage, 0-10V gives 0-2π differential phase shift for the waveplate.
4. Scan rate is the rate of polarization change for a cycle of the Poincaré sphere for each section

1.4 Packaging outline

All dimensions are approximate and may vary slightly, dimensions in mm.



1.5 Operating instructions

The controller has two external connectors, one to supply electrical power and the other D-type connector to provide control signals when external control is enabled.

The controller requires electrical power to operate supplied through a mains adapter.

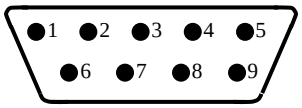
The controller is very simple to operate.

- Connect the power supply adapter to the jack socket input of the controller.
- Connect to mains and switch on.
- The SOP through the fiber can then be controlled via. the three control knobs on top of the device.
- The default condition without external control connection is 0V pin 1 which enables manual control through the knobs.
- The controller will have a factory setting to give between 1 and 1.25 circle revolutions of the Poincaré sphere for each waveplate at the longest specified wavelength.

For remote electrical operation a voltage of 0 to 10V is required to each of the three waveplates through pins 2, 3 & 4 of the connector. The inputs to each of the controllers are buffered, therefore there are no current requirements. A 5V control voltage is also

required to switch between manual and external voltage control. Applying 5V to pin 1 of the connector enables the external voltage control, 0V or N/C enables manual control.

1.6 D-type connector pin allocation



Pin	Connection
1	L (0V) manual operation: H (5V) manual disabled, external enabled.
2	Waveplate 1: 0 to10V
3	Waveplate 2: 0 to10V
4	Waveplate 3: 0 to10V
5	Ground connection for all waveplate controls and control line.
6	N/C
7	N/C
8	N/C
9	N/C

Section 2 Microprocessor based EPC/PC interface

2.1 Introduction

The microprocessor based interface unit provides a connection to a PC to program and control the EPC providing the user with more flexibility to program the required polarization variation.

The interface has been designed to enhance the operation of the EPC.

2.2 Specification

Electronics	
Power in	90 - 250 Volts AC at 45 - 450 Hz using supplied PSU
Power consumption	3 watts maximum
Power connector	12V DC using supplied PSU
USB	USB Type B connector
Scan waveform	Sine, Square, Ramp or Random
Period settings	0.1s - 99,999 seconds in 0.1 second steps
PC Software	
Computer	PC running Windows XP or later with USB port
Graphics resolution	Color display with at least 1280 x 1024 pixels
RAM	1 GByte minimum
Mechanical	
Size	76.4x76.4x20mm
Weight	200g
Environmental	10 - 50 degrees Celsius

Fastest 2π scan rate is defined by the waveplate drive voltage and thermal time constant.

2.3. Driver and software installation

2.3.1 PC Software

Before installing the software check the following:

- The PC is running Windows 10. Earlier versions of Windows may not operate. No other operating systems are currently supported.
- Screen-savers and power saving modes should be disabled.
- The software requires the Microsoft .NET framework, version 4.6 or later. It is unlikely that this will not have been installed already but if the PC software is to be installed on an older computer check this framework is present before continuing.

NOTE: Do NOT connect the Polarization controller to the computer USB port until instructed to do so in the installation steps below.

This program runs on 64 bit Windows 10 only. Older versions of Windows, and other operating systems may not operate.

You will need to sign in as an administrator to install this software.

The supplied installation program will install both the Polarization controller software and the associated USB drivers.

Create a separate directory and copy the supplied installation program into it.

Double-click or otherwise run the installation program and follow the on-screen instructions.

The software is now ready to use. Always start it via the desktop short-cut just created. If you want to remove this software an uninstall entry will have been created in the "Programs and Features" section of the Windows Control Panel.

2.4 Operation

2.4.1 Overview

The Phoenix EPC Interface allows the EPC to be controlled remotely from a PC using a USB port. Each wave plate heater can be set to a constant level or scanned with a user-selectable waveform. Each wave plate can be programmed independently of the others.

- The waveform can be set to sine, ramp, square wave or random operation can be used.
- The waveform period can be set from 0.1 second to 99,999 seconds. The waveplate time response determines the minimum period.

In random mode the outputs change at the period interval. In Scan mode a full range scan can be achieved at periods of 1 second or above. The Random period can be set below one second. The minimum random period is 50 ms.

There is a short delay of a few seconds after power-up before the interface is fully operational.

2.4.2 Connections

The interface unit has 4 connections: 1 USB port, 1 9 pin D-type connection, 2 power jack sockets. The socket next to the USB port is the power input and the socket next to the D-type can be used to power the EPC. Alternatively, the EPC can be powered from a separate power supply. **NOTE:** If power is input to the incorrect socket the interface will not operate.

- Connect the mains adaptor to the EPC Interface using the power socket next to the USB connector.
- Power for the EPC is supplied from the interface.
- Connect EPC to the interface using the supplied 9W D cable and the power cable.

2.4.3 Manual operation

When the interface is powered up it defaults to manual operation. The interface can operate in Manual mode with or without a PC connected. Before it can be controlled by the PC it needs to be switched to Manual mode using the Auto/Manual button.

In manual mode the wave plate settings are controlled using the potentiometers on top of the EPC. Manual mode is disabled when the unit is set for PC control.

2.4.4 PC Operation

To select PC control, click the blue 'Auto' button under the 'Scan' button of Waveplate 1. This will change color to yellow showing Auto(PC) mode has been selected.

The software controls the operation of the microprocessor in the EPC Interface unit. Under software control the operator can specify the scan parameters;
- Maximum and minimum voltage
- Scan waveform type – Sine, Ramp, Square, Random
- Waveform period
- Flyback time
- Dead time

Always close the PC software before either powering down the interface or disconnecting the communications cables. This allows the software to shut down the unit properly.

If the software is shut down accidently, or the computer crashes, re-initialize the interface by powering it down for 30 seconds.

Fixed polarization state setting

Figure 1 shows the PC screen on program launch in 'Manual' mode.

To select PC control click 'Auto' button which will change to yellow and display 'Manual'.

Each EPC can be selected individually to program the parameters using the tabs with the serial number for the EPC.

The window shows settings for the three waveplates in each EPC. Each waveplate can be individually programmed.

The voltage slider enables setting of the voltage applied to the waveplate. The voltage can also be set by typing the required value into the box above the slider.

Once programmed into the microprocessor the instrument will maintain the settings until changed through the program.

Continuous polarization scanning

Selecting the ‘Scan’ button changes the screen to that shown in figure 2.

Each waveplate can be set individually. In this case the waveform, amplitude and period can be selected.

Scan/Stop	Selects between scan option and static option
Selectable waveforms	Select from Square, Sine, Ramp and Random
Period	Select waveform period in seconds
Dead Time	Select the time between scans in seconds. i.e. for each period the voltage will be scanned then delayed by this time.
Flyback	This is the time for the second half of the period to provide asymmetric scan. For example to change from triangle to ramp.
Upper voltage	Set the upper limit of the scan
Lower voltage	Set the lower limit of the scan

PC control and setting

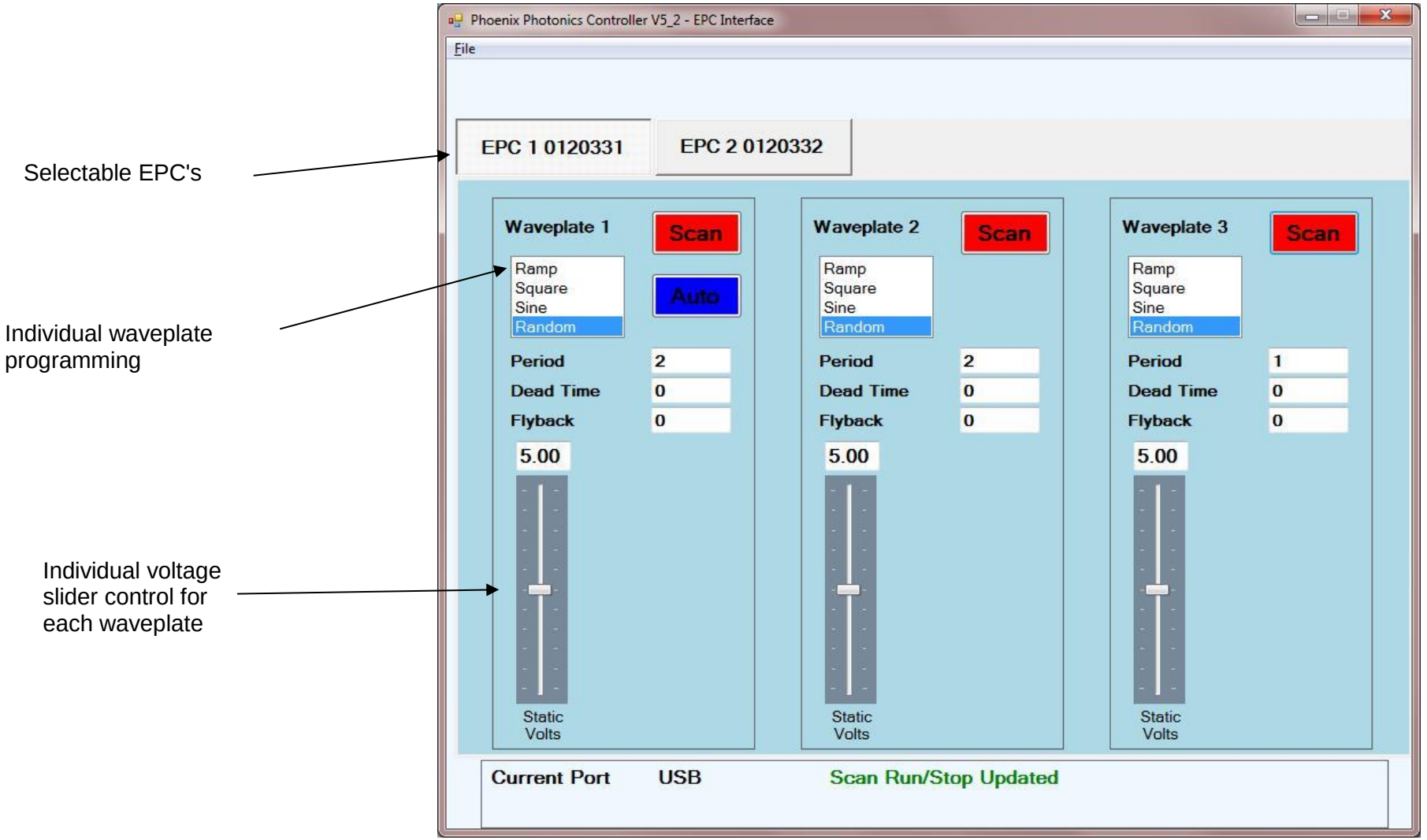


Figure 1 Screen for individual waveplate voltage control

Scanning mode

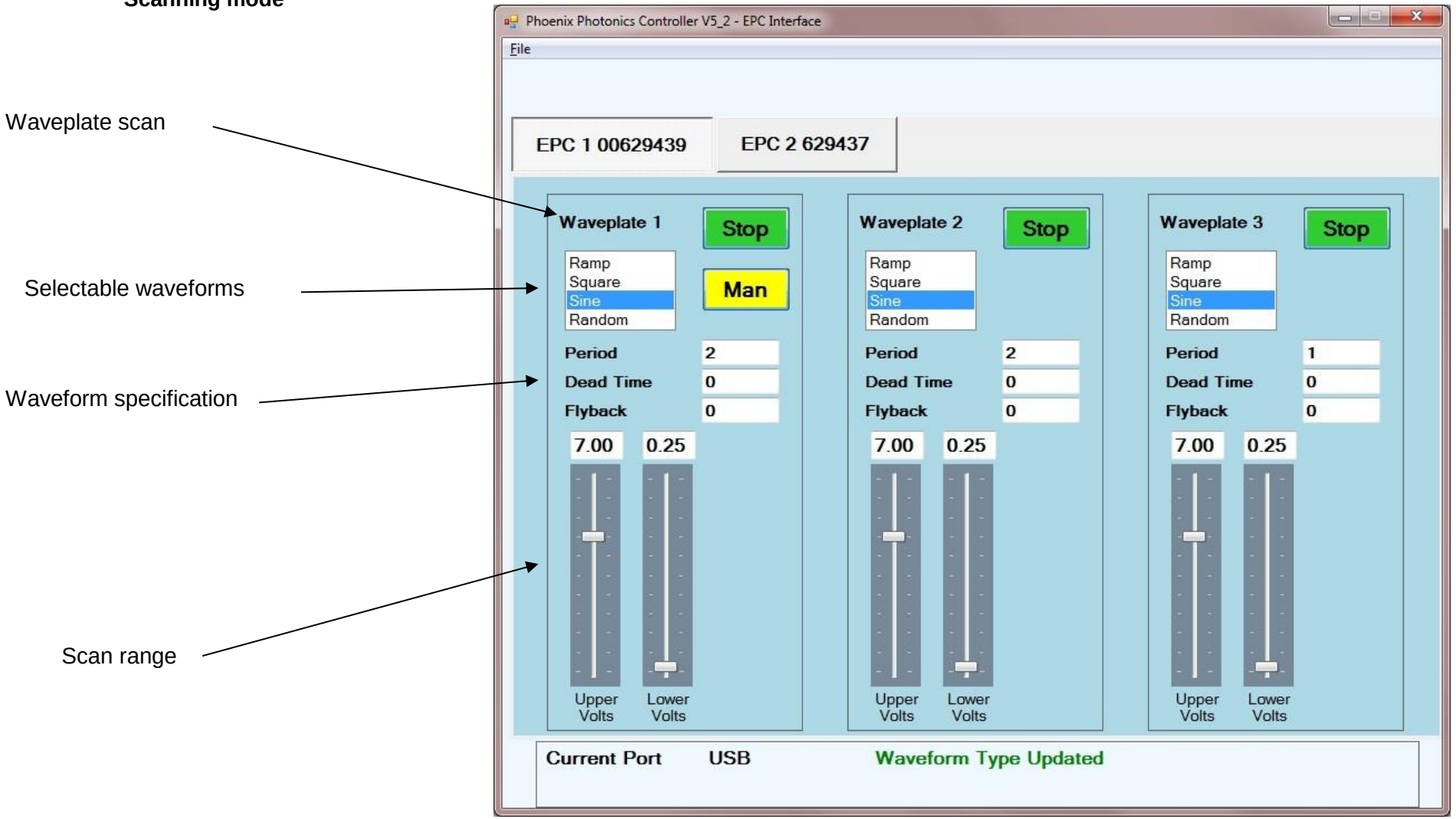


Figure 2 Screen to set-up scanning waveform parameters

2.5 Fault Diagnosis and Maintenance

2.5.1 Electronics Hardware

Confirm that the EPC is operating correctly in manual mode.

Check all interface cables between the interface EPC and PC.

Check power supplies have been connected to the correct ports.

There are no user-serviceable parts inside, so in the event of a problem the unit will need to be returned for repair.

2.5.2 Software

Before checking the software installed on the PC check that the unit works correctly in Manual mode.

Check the software starts up correctly and initializes the interface. Any problems at this stage will be indicated by either error messages at the bottom of the screen or pop-up windows. The pop-up windows are normally a sign of communications failure. The interface can't be used with a PC until these are fixed.

If the PC is not communicating with the interface check that the correct cables have been used and that they are plugged in properly. Check the PC ports work correctly.

2.5.3 Communication

Most operational problems are communication problems between the PC and the interface.

Any problems detected by the PC software are indicated by error messages. These error messages are displayed either in pop-up windows or in the status area at the bottom of the screen.

If a communications error occurs, reset the interface and close and restart the PC software. The interface is reset by switching it off, waiting at least 30 seconds, then switching it on again.

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