OPTICAL CHOPPER SYNCHRONISER

OPERATOR'S NOTES

Applicable to Prototype Instruments Only

Provisional Version

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1 DOCUMENT SCOPE

This document applies to the prototype version of the Optical Chopper Synchroniser Units for use with Scitec Instruments Optical Choppers.

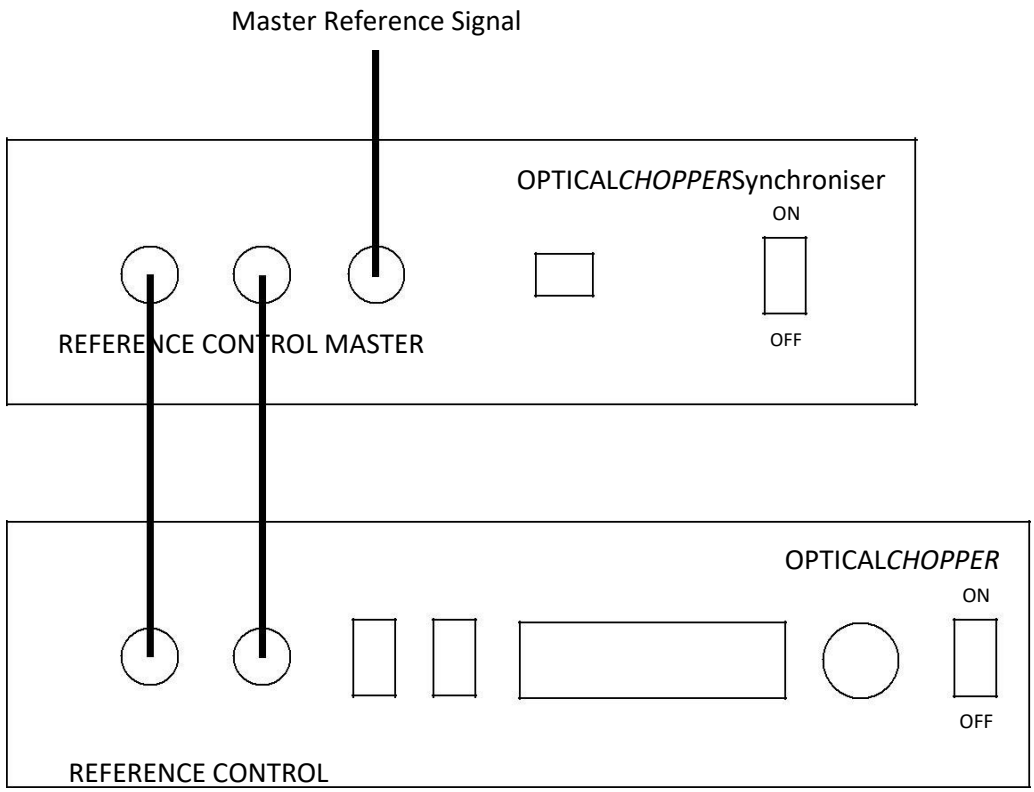
2 INTRODUCTION

The Scitec Instruments Optical Chopper Synchroniser allows an optical chopper to be synchronised to an external reference signal.

The chopper is both phase and frequency locked to the positive going edge of the master reference signal and additionally the time difference (lead/lag) can be controlled by the USB interface.

3 PHYSICAL INSTALLATION/CONNECTIONS

Connect the synchroniser to the chopper and the master reference as shown below:



4 MASTER REFERENCE SIGNAL

The inputs to the Optical Chopper Synchroniser are filtered and taken through a 74HCT series gate with Schmitt trigger inputs. The unit will work with TTL levels or 74HC series 0-5V logic levels.

Square waves with clean edges will give better synchronisation than slowly rising or noisy signals.

Avoid long periods with the chopper or the synchroniser powered with the other unit off. Also avoid unit off with reference applied.

5 OPERATION

The recommended start up sequence for operation is;

Set the Optical Chopper to EXT. If the Optical Chopper is a 300CD unit then the manual speed control should be set fully clockwise. This is not necessary for 310CD unit.

With the Master Reference disconnected or switched to 0V power up both the synchroniser and the optical chopper. Wait for approximately 10 seconds for the synchroniser control loop to stabilise.

Connect or enable the Master Reference.

The control loop output from the synchroniser will be at the lowest speed setting and within 20-30 seconds will synchronise to the master reference.

It is recommended to disconnect or disable the master reference before switching off.

6 DETAILED OPERATION

In order to achieve reliable control of phase in most cases the default slew limitation of the motor controller within the Optical Chopper has to be disabled.

All units connected up with Master Reference input active. Switching on the Optical Chopper before the Synchroniser will result in a large control transient to maximum frequency as the synchroniser powers up.

All units connected up with Master Reference input active. Switching on the Synchroniser before the Optical Chopper will result in a large control output from the Synchroniser as it attempts to speed up the Chopper. On switching on the Optical Chopper it will immediately be drive to maximum frequency.

All units connected up with Master Reference input active but the Optical Chopper set to INT control at a frequency lower than the reference will result in a large control output from the Synchroniser as it attempts to speed up the Chopper. On switching the Optical Chopper to EXT it will immediately be drive to maximum frequency.

All units connected up with Master Reference input active but the Optical Chopper set to INT control at a frequency higher than the reference will result in a large control output from the Synchroniser as it attempts to speed up the Chopper. On switching the Optical Chopper to EXT it will

immediately be driven to minimum frequency, the rapid load on the internal power supply may cause it to shut down.

Switching both units on together with the master reference is likely to give unpredictable results depending on the relative time constants of the units.

The configuration of the Optical Chopper Synchroniser is specific to the type of Optical Chopper and the number of slots in the disc fitted. The unit supplied may work with other similar units but reliable operation is not guaranteed. The configuration marking on the rear face of the unit indicates the type of synchroniser and number of slots for which it has been built.

The Synchroniser includes a control loop with an integrating element. If the unit has been out of lock for some time (typically more than 30 seconds) the frequency error is likely to have driven the integrator into saturation. This will not damage the unit but it will take some time (typically 20-30 seconds) for the integrator output to come back within the control range.

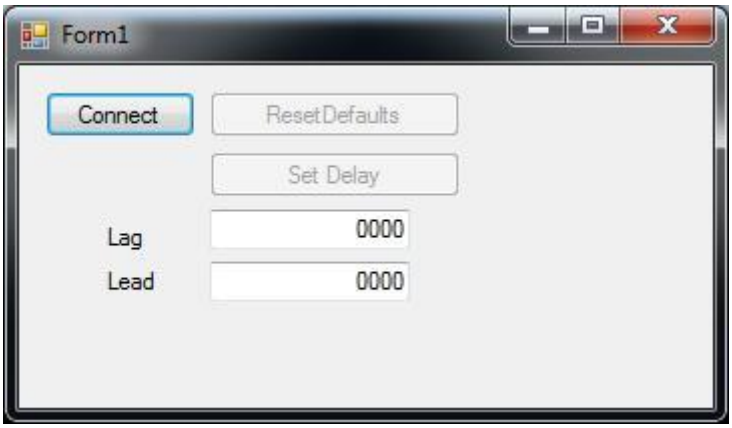
6 LEAD/LAG ADJUSTMENT

The control loop of the synchroniser includes programmable delays for adjustment of the relative timing of the Master Reference and the Optical Chopper Reference signal. The phase detector used in the Synchroniser is an edge detector and will synchronise the positive going Optical Chopper edge to the Master Reference positive going edge.

Lead – The Optical Chopper Reference occurs earlier than the Master Reference.

Lag – The Optical Chopper Reference occurs later than the Master Reference.

If Lead/Lag adjustments are required then these may be carried out with the USB GUI, see APPENDIX A for software installation.



When the Synchroniser is connected to the PC and powered up it will appear in the devices list as a ‘Scitec HID Synchroniser’. A USB 2.0 Type A Plug to Type B Plug lead is required, Farnell part number 2088256 or similar.

While using the USB interface the Optical Chopper should also be powered or the Synchroniser should be disconnected from the Optical Chopper.

To use the interface click on ‘Connect’, this is will establish the USB link between the GUI and the HID device. Reset Defaults will reset the Synchroniser to the original Lead and Lag values, normally 0 and 0. To set a delay enter values into the Lead & Lag boxes and click Set Delay. Delays are set as multiples of 200ns up to a maximum of 65535.

Note that it is possible to set a delay outside of the period of the Master Reference waveform. In this case the synchronisation signal to the phase detector is lost and the frequency of the Optical Chopper will be driven to maximum or minimum frequency. If an incorrect value is set inadvertently it is recommended to Reset Defaults before the frequency deviates too far from the Master Reference, allow the control loop to stabilise and then enter correct values.

Close to one full cycle of delay the jitter in the mechanical system or noise on one of the digital signals may take the Synchroniser cycle outside of the delay making the system loose lock occasionally.

It is possible to set Lead and Lag to the same value, this has the phase detector running at a different time to the Master Reference. In practice this is unlikely to be useful as Lead and Lag cancel out. If Lead and Lag exceed the cycle time then the input to the phase detector and synchronisation is still lost even if they are the same.

The prototype Optical Chopper Synchronisers use the USB VID=0x04D8 and PID=0x003F. These are default values for the prototype chipset and not uniquely assigned to Scitec products or the Synchroniser. There is a small risk that the Synchroniser GUI might attempt to connect to other HID devices with the same VID and PID or that other software might attempt to write to the Synchroniser HID. In this case not having both units connected to the same system is likely to resolve the issue.

Disclaimer: The Optical Chopper Synchroniser is a prototype unit. The unit uses a PSU section compliant with the EN regulations detailed in APPENDIX B. It is not guaranteed to be compliant to specific EMC requirements. It is the responsibility of the end user to determine suitability for their application.

APPENDIX A: GUI Installation

The GUI is supplied as a Win32 executable that uses the *.NET framework 2.0 and above. The *.NET framework is installed as part of some windows operating systems. If not already installed the *.NET framework is available as a download from www.microsoft.com/net/download/framework.

The GUI and the associated vcruntime140.dll file may be copied to any convenient place on the PC such as the desktop and run by clicking directly on the icon. If they are both copied to the same directory it is not necessary to carry out the installation with administrator privileges.

APPENDIX B: Specification

Phase Lock Function

Phase difference between the positive going edges of both the phase reference and chopper reference input signals is minimised.

Phase lock typically achieved within 10 seconds over the full operating range of the chopper.

Phase lock maintained to within 2 degrees >90% of the time.

Relative Signal/Reference time delay in increments of 200ns from +/-0 to +/-13.1068 ms.

Phase control function set for specific chopper model/disk combination as indicated on rear panel.

Phase Reference source Input/Control Output

Locks to a TTL or 0-5V square wave reference signal.

Output drive compatible with 300CD, 310CD, and 360C OEM choppers fitted with any compatible Scitec disk.

Input and Output Connections

Inputs/outputs are referenced to mains earth through the front panel bonding.

Signal connections (Master Reference:input, Chopper Reference:input , Control:output) through BNC jack connectors.

Inputs filtered with single pole roll-off at 160kHz.

Control Interface

HID USB 2.0 interface with a control application with lead/lag delay set in increments of 200nS from 0-13.1ms. Set delay values are retained on next power up.

GUI is Win32 application to run under Windows XP, 7, 8.x and 10. (Framework 4.0)

Power supply

Universal mains (90-264 Vac, 127-375 Vdc, input frequency 47-440Hz) power input with IEC connector.

Mains input current (<0.75 A at 90V, <0.35A at

230V). Mains isolation voltage

input/output (signal) 3000 Vac.

input/chassis (ground) 1500Vac

Power Supply Section compliant with

Radiated emissions EN55022/11, FCC part 15 Level A.

Conducted emissions EN55022/11, FCC part 15 Level

B. Electrostatic discharge EN61000-4-2 Level 2.

Electrical fast transients/bursts EN61000-4-4 Level 3

Surge Susceptibility EN61000-4-5 Level 3 RF field susceptibility EN61000-4-5 level

3 RF conducted disturbance EN61000-4-6 Level 3

The Synchroniser internal mains wiring is protected by a 2A, 5 × 20mm panel mounted fuse.

Prototype Unit Case

Physical dimensions: Depth 280mm Width 200mm Height 76mm.

Material Flame Retardant ABS with Aluminium front and rear panels.

RoHS

RoHS: The Synchroniser is constructed using RoHS compliant materials.