



S c i e n t i f i c

Using ProScan III TTL outputs to increase image acquisition speed

“Two Wire Trigger” method for Photometrics camera and Prior Scientific ProScan III stage to create a “High Speed Scanning” mode.

Introduction

High resolution digital slide scanning and instruments designed to scan glass slides have become increasingly popular for several reasons. Digitally scanned slides:

- Allow the user to easily store large numbers of slide images for shared research.
- Are the basis of telemedicine applications such as remote pathology.
- Are less susceptible to damage and degradation than the original glass slides.

In the application described below an older upright microscope was outfitted with a Prior Scientific motorized stage and controller, a Photometrics camera and a computer with Nikon Elements. A 5V TTL from the Prior ProScan III controller was set up to signal the camera when the ProScan H101 stage is in position to take the next image. A 5V TTL from the camera then signals the ProScan III controller when it is done exposing an image and it is safe to move to the next location. Utilizing TTL signals eliminates the delays associated with serial/USB communication and significantly reduces scanning time.

Equipment: Photometrics HQ camera
Nikon Elements Software
Nikon E600 Microscope
Prior H101 Stage with H31XYZE controller

Overview

Customer had a requirement to scan slides faster using his imaging program than the current communications via RS232 would allow. Integrating TTL signaling between the stage controller and camera cut in half the time it took to scan each slide.

Hardware Setup:

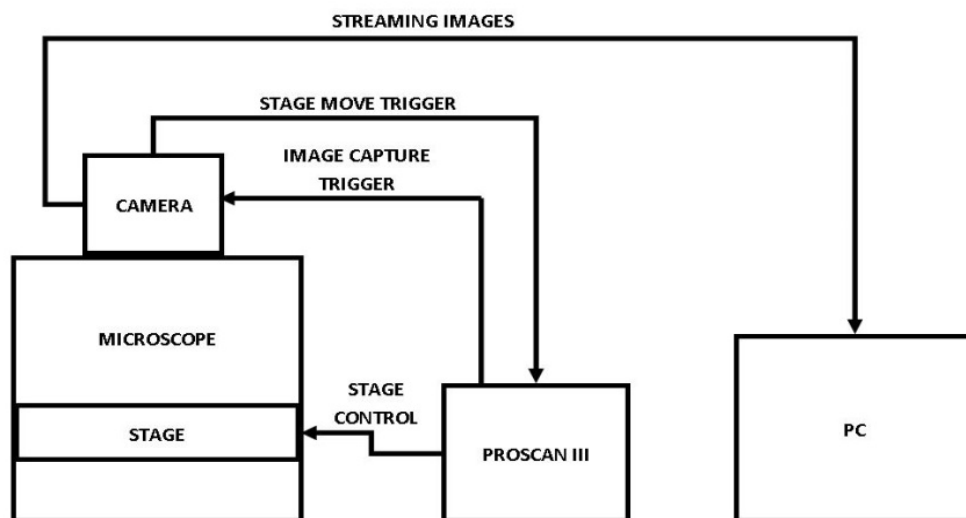
Connect ProScan III TTL Output #1 to the Camera “Trigger In” connection

Connect ProScan III TTL Input #1 to the Camera “Exposure Out” connection,

Note:

1. The camera used was a Photometrics HQ. The camera itself was in the “Strobe” mode of camera acquisition. In this mode, the Camera “Trigger In” circuit looks for a transition from Low to High and when triggered, an image is taken for the preset exposure time. The camera “Exposure Out” circuit goes High during exposure and transitions to low in between exposures.
2. Connections in and out of the ProScan III are via Prior Part number HP1369 TTL to BNC adapter cable and BNC to BNC cables. (BNC to BNC cables can be purchased at most electronics suppliers)
See image below.

HP1369 with BNC to BNC adapter cable



Control System Diagram

ProScan III setup:

Note all of the commands listed can be found in the ProScan 3 manual sections 5.8 Patterns and 5.15-5.17 TTL I/O

Delete all trigger points and actions associated with TTL Input #1 (Good programming practice in case a TTL action had been assigned to TTL Input #1 previously.)

TTLDEL,1

Set the PS3 to accept a TTL signal transitioning from high to low on TTL Input #1. (this will occur during the time that the camera switches from exposure time to Readout time and Clearing)

TTLTP,1,0

Set the PS3 to output a TTL signal transitioning from high to low when the stage is moving and from low to high when the stage is not moving on TTL Output #2. This will trigger the camera to take an image when the stage stops. The camera is looking for a transition from low to high to start the exposure.

TTLMOT,2,0

Define the action to occur when TTL Input #1 goes from high to low. In this instance each time TTL Input #1 transitions from high to low the stage will increment to the next position in a raster pattern. TTL action 91 corresponds to a raster pattern. The TTL Action command generally follows the format: TTLACT, TTL input #, Action #,0,0,0 (last 3 zeros are ignored but required for compatibility with other actions)

TTLACT,1,91,0,0,0

Define Pattern completion position. "E,0" will return the stage to the origin after completing the pattern, "E,1" will keep the stage at the final pattern position.

E,1

Define the number of X and Y steps in the pattern. The command below defines a 6 x 4 pattern grid

N,5,3

Define the X and Y pattern step sizes in microns. These will typically correlate to the field of view for the objective and camera combination in use.

X,900,670 (each X movement will be 900 microns, each Y will be 670)

Set TTL Output #1 low so that the camera will see the transition from low to high

TTL,1,0 Note: The TTLMOT command and the TTL command are controlling the same physical connection in this example. the numbering convention for the "TTL" command numbers TTL outputs from 0-3. The numbering convention for the "TTLMOT" command numbers TTL outputs from 1-4.

Set the TTL Output #1 to high, with a 2 second delay (delay required to work with software used)

TTL,1,1,2000 See note above

Arm the TTL trigger, i.e... Set the controller to begin the TTL actions (pattern) when it sees the proper transition on TTL Input #1.

TTLTRG,1

Sequence of Events:

Once the PS3 is programmed with the correct sequence, the RAM capture function used to capture "Streaming" images is called within Elements. Each image waits for the camera Trigger In circuit to sense the stage has stopped moving before exposing the next image. The RAM capture function allows you to select the proper amount of frames to capture so that the process will stop after the stage has finished the pattern. In this example the number of frames is 6 x 4 or 24 frames.

This method allows for any exposure time and any "digitizing" time to work correctly and smoothly. In initial tests, Images were being acquired at twice the rate of the normal scanning method utilizing serial communications.

The method described should be considered a building block for imaging software developers to incorporate this technique to speed up scanning.

Commands used:

TTLDEL,1	// Deletes all previous TTL actions for TTL 1
TTLTP,1,0	// Trigger Point- When TTL input #1 Goes Low perform trigger Action #1
TTLMOT,2,0	// Sets Output #2 Low when stage moving
TTLACT,1,91,0,0,0"	// Define Trigger Action #1 – X and Y raster pattern, as defined by "E", "N" and "X" on Pulse from Trigger Point #1
"E,1"	// Resets Origin to current position
N,5,3"	// Sets Raster to 6x4 grid
X,900,670"	// Set X and Y Step sizes, X = 900 and Y= 670 microns on TTL
"TTL,1,0"	// Set Output #1 Low – Camera sees transition from Low to High so set to Low at Start.
"TTL,1,1,2000	// Set Output #1 High with Delay 2 Sec -
"TTLTRG,1"	// Arm Trigger