

Performing Scans with the Riegl LMS-Z210



The Riegl LMS-Z210 is a high performance 3D laser measurement system. The LMS-Z210 is supported by Riegl's RiSCAN PRO software for performing scans over a 360° range in the horizontal plane and 80° range in the vertical range. Utilizing a class 1 laser, the sensor is able to resolve objects with 80% reflectivity up to 650m away! 3D laser scanners such as the LMS-Z210 are quickly replacing their 2D predecessors.

INTRODUCTION

The purpose of this tutorial is to teach you how to operate the LMS-Z210 using Riegl's RiSCAN PRO software. This tutorial will tell you how the Riegl works, how to set up the Riegl hardware and how to operate the RiSCAN PRO software.

The rest of the tutorial is presented as follows:

- **Background**
- **Materials**
- **Hardware**
- **Software**
- **Final Words**

BACKGROUND

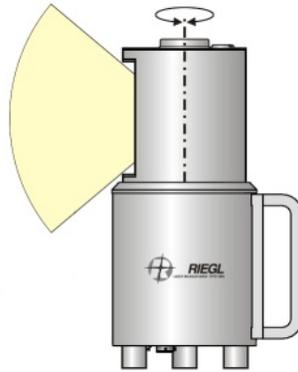
Riegl is an Austrian company that specializes in high quality, high performance laser sensors. Riegl offers a few specialized laser scanners designed for use in topography and civil engineering applications.

The LPM series of sensors are designed for surveying tasks, allowing the user to measure the distance to several points along a surface. These sensors can measure in ranges up to 2500m for 80% reflective objects. They are mounted on highly accurate pan tilt units that allow back calculation of the position of the object being measured.

The LMS-Q series of laser scanners are 2D laser scanners pitched as airborne laser sensors. These sensors are ruggedized so that they can be attached to planes and helicopters. They afford similar resolution and accuracy as the LMS-Z series of 3D scanners.

The LMS-Z series of laser scanners are 3D scanners designed for a variety of tasks related to topography and civil engineering. However, as the popularity of laser scanners grows amongst roboticists, the demand for 3D laser scanners is ever increasing. The Riegl LMS-Z series have been adopted by seven DARPA Urban Challenge teams for use in robotic ground vehicle navigation. The sensors are valued for their ease of interface, onboard signal processing and above all ruggedness.

As mentioned, this tutorial will focus on operating the LMS-Z210. All of the sensors operate based on time of flight measurements of laser pulses. The LMS-Z210 shines a laser off of a rotating mirror. As the mirror spins, the laser scans 80° in the vertical plane, effectively creating a fan of laser light as shown in the picture below.



Any object that breaks this fan reflects laser light back to the sensor. The distance is calculated based on how long the laser takes to bounce back to the sensor. The sensor head is then rotated 360° to measure the full environment, providing 3D laser data. The specs for the LMS-Z210 are given below:

Model Name	LMS-Z210i
Measurement Range for reflectivity >80%	400m
for reflectivity >10%	120m
Minimum range:	4m
Measurement resolution:	5mm
Measurement accuracy:	+/-25mm (single shot)
Vertical field of view:	80°
Vertical angular resolution:	0.005°
Vertical scan rate:	1 scan/sec to 20 scans/sec
Horizontal field of view:	360°
Horizontal angular resolution:	0.005°
Horizontal scan rate:	0.01°/sec to 15°/sec
Interface: for config & data output:	Ethernet TCP/IP, 10/100 MBit/sec
for config	RS-232, 19.2 kBd
for data output	ECP parallel port
Dimensions:	437mm x 210mm (Length x Dia.)
Weight:	approx. 13kg
Power supply voltage:	11 - 18 V DC
Current consumption @ 12V	typ. 6.5 A max 8 A

MATERIALS

To complete this tutorial, you will need the following:

- A Riegl LMS-Z210 laser scanner with cables
 - An appropriate power source (see specs above)
 - The full version of RiSCAN PRO software (with license)
 - A computer running Windows XP with a serial port and ECP parallel port
- NOTE: Most parallel ports on desktop computers support ECP, however USB adapters do not necessarily support ECP.

The RiSCAN PRO software can be downloaded from Riegl's ftp site. Contact Riegl technical support for assistance in gaining access to the ftp site. The version used in this tutorial is available at the following link (password protected): [riscan_pro-1.4.2b5_full.zip](#)

HARDWARE

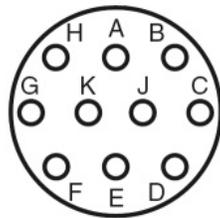


The moving part of the LMS-Z210 **must not** be turned manually, otherwise the internal gears will be damaged!

In order to operate the LMS-Z210 you must first have the proper cables. One of the cables should have a round MIL connector. This is the power cable, as pictured below:



This cable should be wired as follows:



Pin	Assignment	Color	Note
A	Laser safety lock	gray	
B	4-20mA out		not used
C	RxD		RS232 data input
D	Standard/High Speed		not used
E	Trigger	pink	Input for ext. SYNC
F	Sync. Marker	violet	TTL output (opitonally)
G	TxD		RS232 data output
H	GNDout	blue	
J	GNDin	white	
K	+UB 11-18 VDC	brown	

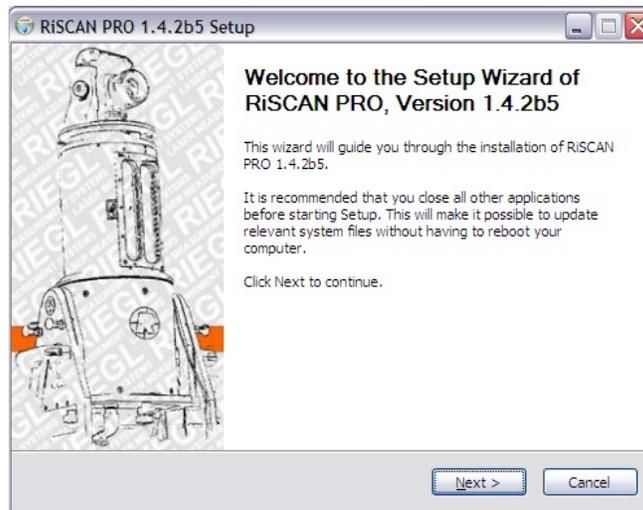
Laser Safety Lock <====> GNDout
 +UB 11-18 VDC <====> Power Source +
 GNDin <====> Power Source -

The other necessary cables are a serial cable and parallel cable (pictured below). While it is not necessary, all cables should have a ferrite core to reduce noise.

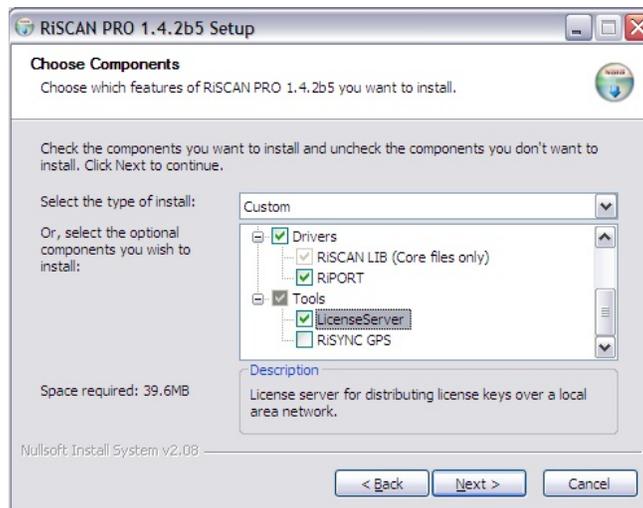


Connect the sensor to the computer using the serial and parallel cable. Plug the power cable into the bottom of the sensor. Connect the other end of the cable to the power supply. When the power supply is turned on, you should see the sensor head begin to rotate. The mirrors should then begin turning, and the sensor should continually scan. You're now ready to start working with the Riegl.

SOFTWARE

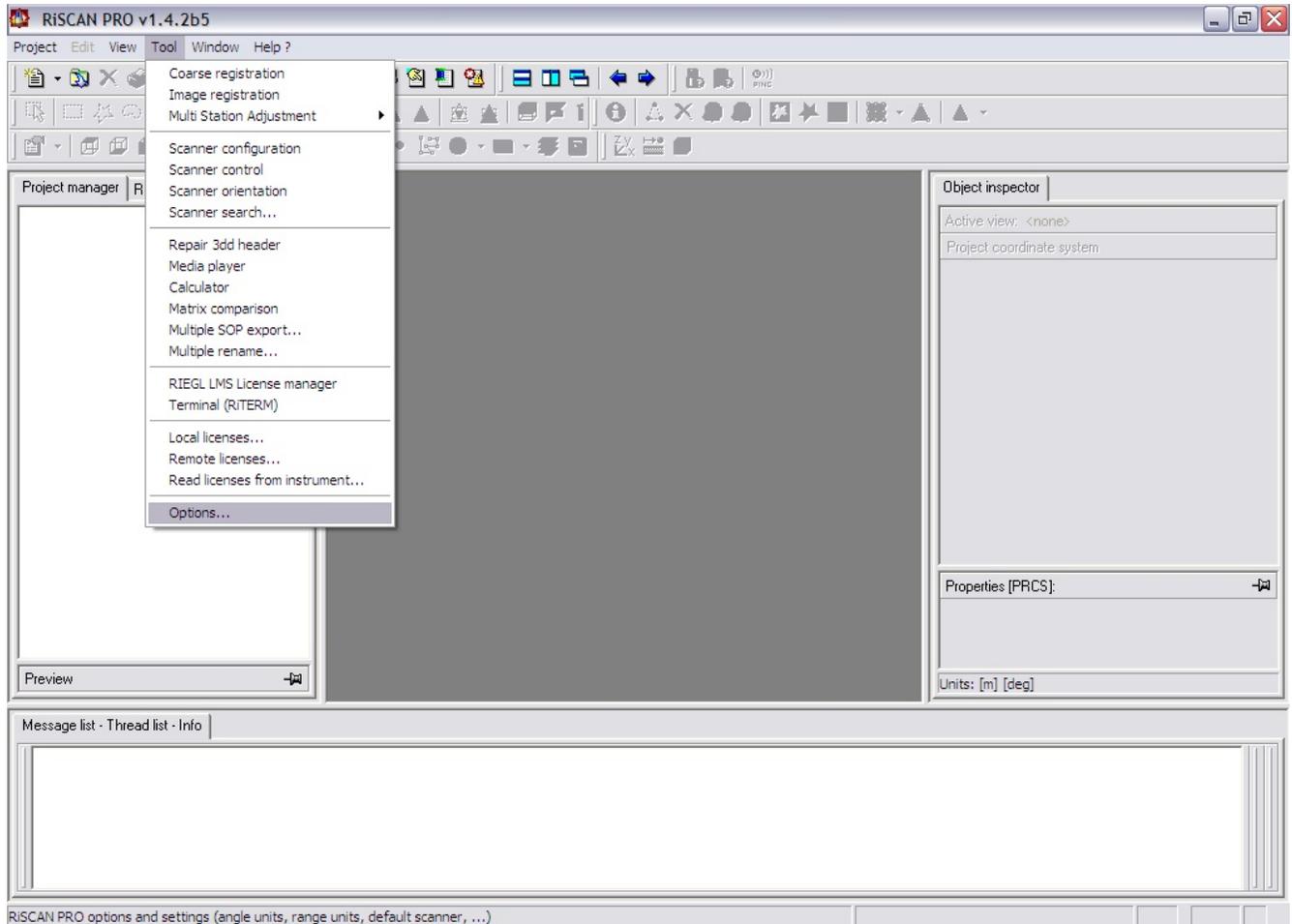


After downloading RiSCAN PRO Full install RiSCAN PRO. It is important that you select "RiPORT" under "Drivers" and "LicenseServer" under "Tools" as shown below. This will ensure that the communications drivers necessary will be installed.



Accept default settings for the remainder of the install process. You will be prompted for a license key at several points. This should have been provided with your sensor. If not, contact Riegl technical support to obtain a license key.

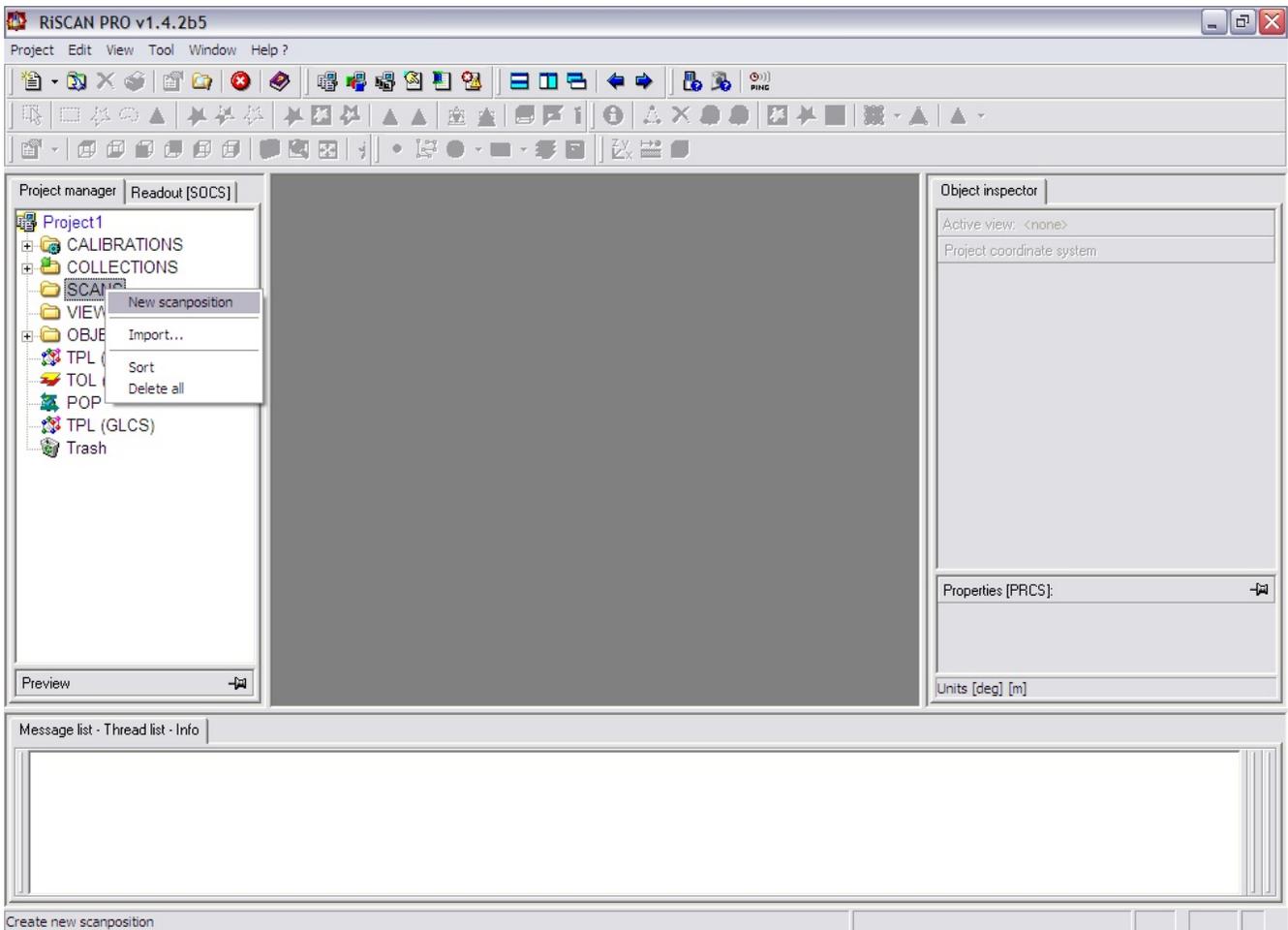
Once the install has completed, start RiSCAN PRO. After starting RiSCAN PRO you should see the following screen. In the menu bar, select "Tool -> Options".



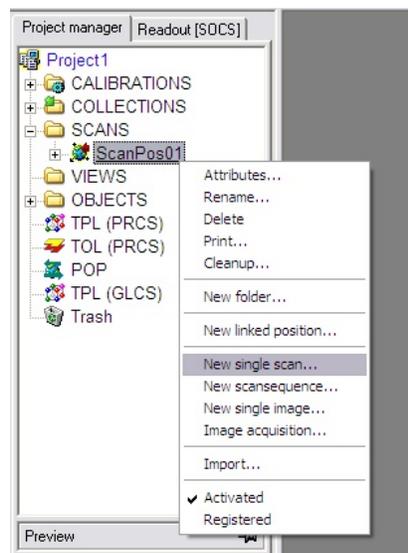
This is where all of the default options are set for the software. You will need to set the following options:

- General -> Default scanner settings -> Compatibility mode for legacy LMS-Z210 instruments
- Additional -> Project manager -> Select everything except "AutoExpand and collapse sub trees when clicking on element"
- New Project -> Serial & Parallel -> (Appropriate COM Port), 19200, RiPT0

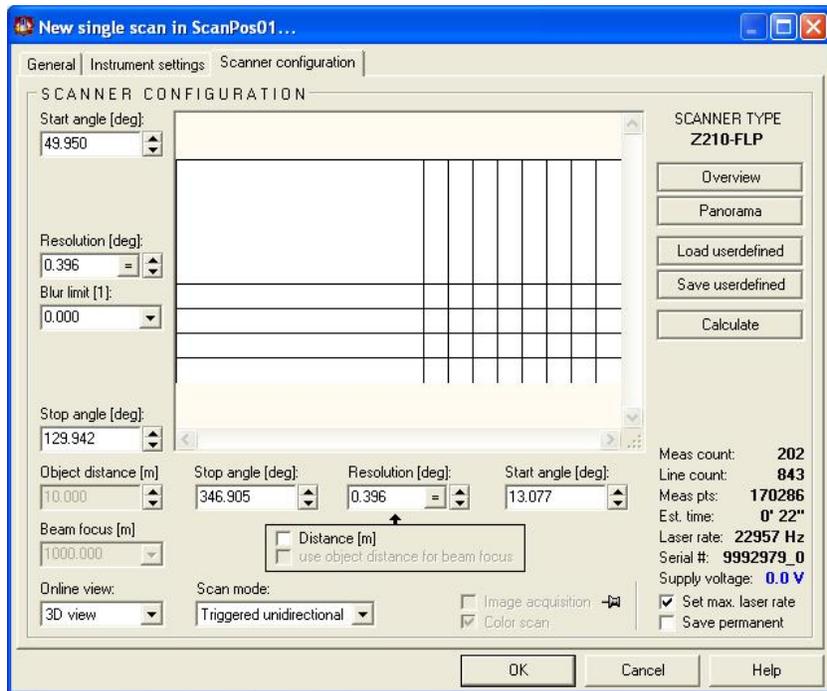
After setting these options, click "OK". Now you can start a new project. From the menu bar, select "Project -> New -> Project". Give the project a name and select "Save". You should the new project appear in the project manager. There should be a list with several folders as shown below. Right click the "SCANS" folder and select "New Scanposition".



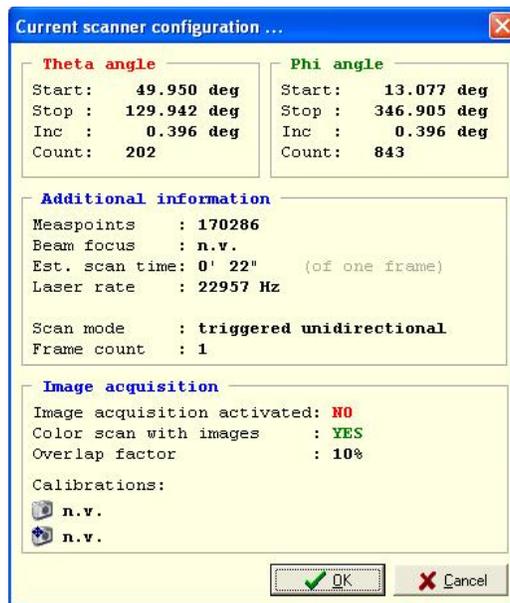
This will bring up a window where you can define the orientation of the sensor and the sensor type. This is primarily used for stitching scans together. Select the defaults by clicking "Ok". You should now see several items appear under the "SCANS" folder. Right click "ScanPos01" and select "New single scan..." as shown below. At this point the power supply should be turned on and the scanner should be rotating.



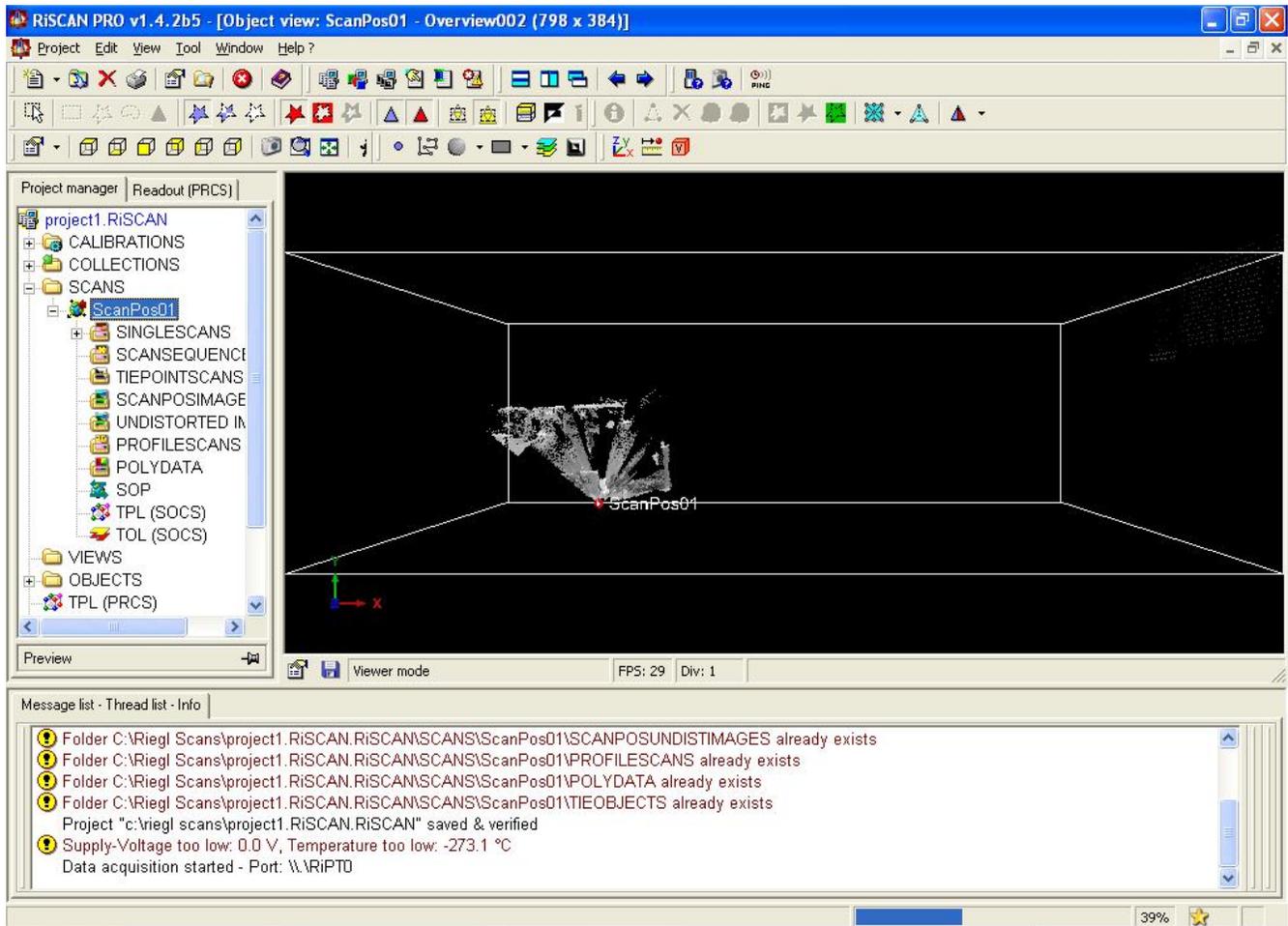
The software will now communicate with the scanner. If the software is successfully communicating, you should see the window below with the serial number of the scanner displayed. This window allows you to setup the scan. Here you can specify the resolution of the scan, the scan range and other settings. To perform a typical quick scan, click "Overview" and then select "OK".



The software will now prompt you with the following window asking you to confirm the scan settings. Select "OK" to begin the scan.



You should now notice the scanner rotating to begin a scan. As the scan is performed you will see the data plotted in RiSCAN PRO, as shown below.



Congratulations! You have just performed your first scan with the Riegl LMS-Z210!

FINAL WORDS

After reviewing this tutorial you should be able to set up a Riegl LMS-Z210 and perform a scan with the RiSCAN PRO software. If you have questions about this tutorial you can email me at Keithicus@drexel.edu.