Mechanical Survey Procedures and Data Analysis for ATLAS SCT Barrel Modules at the US Site

Version 2.0
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Revision History
V1.0 21-June-2002 Original Version
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Purpose
The goal of this manual is to document the existing mechanical surveying procedures of the modules, so that a new person could be easily brought up to speed.

Location and Equipment
All equipment is located in LBNL Room 50B-4004 (aka "4th floor clean room"). The surveying is done with "Avant 400 ZIP" SmartScope manufactured by the OGP. The data analysis is done at "50B-cleanroom" PC located about 70 ft North from the SmartScope. During a survey, a module is held by a custom-built fixture (Fig. 1).
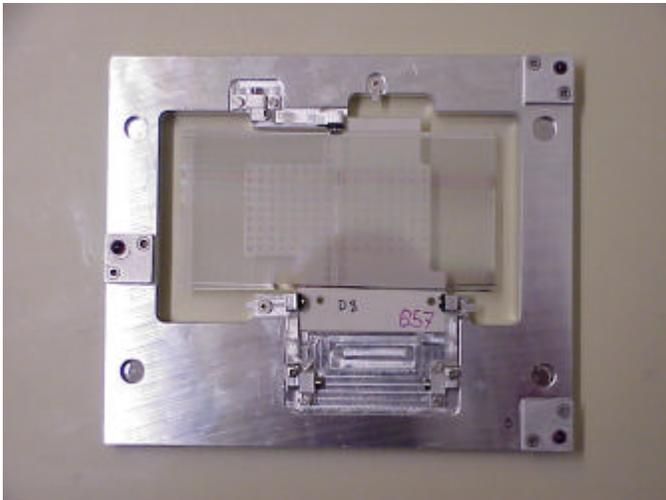

Figure 1. Mechanical survey fixture (with a dummy module).

Surveying Sequence
The following steps are taken to fully survey a module:
1) Secure the module in the fixture and place the fixture on the SmartScope table
2) Run two XY survey programs (one for each of "top" and "bottom" sides)
3) Run two Z survey programs (one for each of "top" and "bottom" sides)
4) Move the data to the analysis PC and process the Excel spreadsheets

We describe the individual steps in more details below.

(1) Module Attachment
A module is attached to the fixture with three clamps. Two of them are parallel, they go over the "hole" and "slot" washers on the cooling facing, and the third one pins down the opposite facing. The arrangement was designed to mimic the module attachment in the real experiment. To fixate the module in place, one has to:

- Unscrew leverage screws and open the clamps
- Position the module on the plate
- Fix the XY location of the module with precision shoulder pins going thru the destination holes in the plate, with tips going thru the hole and slot washers of the module baseboard
- While holding the barrels, close the clamps and screw down the leverage screws. **Attention: make sure that the clamps are still holding the rubber O-rings, and that they are not blocking parts of hole and slot apertures from the top-down view.**
- Remove the shoulder pins

On the SmartScope table there should be a large Al plate for securing the metrology fixture in the absolute coordinates. If absent, it should be located and installed (screwed down with two large screws) in the top left corner. The fixture is positioned on the plate with the use of three ruby balls glued on to its surface. The one in the low right corner goes over a machined hole in the plate, the ball in the top right corner goes over a machined slot in the plate, and the third (left) ball is placed over a pedestal area for the 3D fixation. No mechanical action is required to secure the fixture over the plate, due to the three-ball design. The metrology fixture is flipped over for the other side surveys.

(2) XY Surveys
All the programs are located in *C:\Partrtn* folder of the SmartScope PC. The following programs do the XY ("in-plane") surveys: *Survey-XY-top-W2.rtn* and *Survey-XY-bot-W2.rtn.* They are for the top and bottom surfaces of the module correspondingly.

The SmartScope control program is called *MeasureMind*. All other user-written programs are scripts executed by *MeasureMind* one step at a time. To start the user program (script), one a) pulls down *File->Open* menu to load it in the

memory, b) pulls down *File->Run* menu option to start the execution, c) click "OK" button over the yellow field on the right of the screen.

All our survey programs start by the manual targeting steps over two fixture pinholes. This procedure is designed to alleviate the otherwise strict mechanical requirements of the Al plate absolute position. After tuning the position with a joystick, the user hits the left button of the device to go ahead to the next step.

Soon after the beginning there are another two manual steps, for positioning over the crosses in the black boxes of the leftmost module sensor on the surface being surveyed. This procedure takes off possible variation in the module mechanics.

There are no other manual steps, and the program normally runs smoothly until the end. In the cases of poorly machined hole and slot washers it is possible for the program to stop, due to either inability to focus on the surface, or absence of a measurable edge in the view. In such cases, the user is prompted for an action (such as manual focusing). After acknowledging the failure (hit "OK" button), tuning, and hitting the left joystick button the user is given an option to continue the program execution.

At the end of the survey we save the data with the "Print" option. One pulls the *File->Print* menu item, chooses *C:\Printrtn\Data* directory, and saves a file with the following name convention:
XY-{Module Number**}-{**top/bot**}-**Date**-**Time**.txt**

Attention: It is important that the data are saved immediately after the program execution, without any other measuring steps in-between.

It takes about 7 minutes for each program to execute.

(3) Z Surveys
The Z surveys are done with programs *Survey-Z-top-W2_clear.rtn* and
Survey-Z-bot-W2_clear.rtn for the bare modules. The modules with hybrids attached are surveyed with programs with *Survey-Z-top-W2_hybrid.rtn* and *Survey-Z-bot-W2_hybrid.rtn.*

Most of the XY surveys ideology is applied to the Z surveys as well. The convention for the data file names is similar:
Z-{Module Number**}-{**top/bot**}-**Date**-**Time**.txt**

It takes about 15 minutes for each program to execute.

(4) Data Processing

Once the surveys are done, the data files are copied to the *DataExchange* folder on the *Desktop*. This is a shared folder on the "50B-cleanroom" PC. There, it is known as *C:\DataExchange* folder.

The data processing is done in Excel spreadsheets, located in *C:\Electrical Modules\{Module Number}* folder. The user creates the folder, if the module has not been surveyed before. Other modules spreadsheets can be used as a starting point. (For X-Y this will be replaced by the equivalent Perl scripts).

The XY spreadsheets have the naming convention of
CU-FF-Survey-{module number**}-{**Date**}-{**Assembly Step**}.xls**
The data input goes in the two tables on "Sheet 1". One can "click-and-paste" the data by opening a data file from Excel clicking thru the options to interpret the ASCII file in a tabular format. Only bottom 14 rows of the data file are used. Those are the measurement summary. Once both top and bottom survey results are pasted on "Sheet 1", "Sheet 7" will display the analysis summary with table of the physics quantities measurement, nominal values, and deviations. The rightmost column shows either "OK" or "NOT-OK" value, based on weather the quantity is in specs or not.

The Z spreadsheets have the naming convention of
survey_Z_{**module number**}_{**Date**}_{**Assembly Step**}.xls
The data input goes in two rightmost tables on "RawDataInput" sheet. Similar "click-and-paste" procedure would work, as the one for the XY surveys. Care has to be taken to extract the proper number of rows from the bottom of the data file. Once the tables are filled in, the "Tolerances" sheet displays the measurement summary. Sheets "OptimalFrameView" and "CommonDeviationsView" show the individual module Z shape and its deviation from the ideal.