ATLAS SCT Silicon Detectors

Barcode and database entry of the series production of silicon microstrip detectors

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Distribution List

SCT detector procurement group
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History of Changes

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A	29/11/99	All	First version
B	24/2/00	Most	Revised after the Nov SCT week and into the ATLAS template

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1 Introduction

The SCT requires about 19,000 silicon microstrip detectors. Its series production will take place in the years of 2000 through 2003. The quality of the detectors will be ensured through evaluation and feedback to the processes involved:

1. Testing of the detectors
2. Accumulation of data
3. Evaluation of data
4. Feedback to the processes involved

Each step requires a thought-out definition of the procedures. Detector testing procedures are already well developed [1]. The database for storing the data is also developed and ready to be utilized [2]. Evaluation of data and feedback procedures are to come once a quantity of detectors are in hand.

Most of these activities involve the database, especially accumulating and evaluating the data. Critical to these activities are minimizing the work load involved and reducing the chance of introducing errors. In order to accomplish these aims, the data entry must be simple, eliminating human-intensive interfaces as far as possible. For these reasons, the use of Barcodes has been proposed in the database entry and updating. In this note, the following elements in maintaining the quality control data the database are described:

1. Barcodes
2. Database
3. Procedures

2 Barcodes

2.1 ATLAS part identification

The format of the part identification in the ATLAS is proposed in the documents [3] [4] [5] [6]. The identifier is made of 14 alphanumeric characters. An example is

$$\text{20IS0120123456} \qquad (1)$$

where the “20” signifies ATLAS, “IS” the subsystem code for the SCT, “012” is the numeric code for an institute, and “0123456” is an identification number of a part from the institute. For the barcode type, ATLAS has recommended “Code128” which can handle alphanumeric characters and is compact [7].

2.2 SCT part identification number

In some case, SCT requires very small barcode labels because of limited space, such as in modules, cables, etc. An investigation on barcodes has shown

1. Purely numeric string is the most space-efficient because of no need of control characters. In Code128, the code subset “C” defines numeric only
2. Code128, with purely numeric strings, is the most compact among barcode types

3. The mnemonic subsystem code can be replaced by the corresponding PBS numeric code, “22” for “SCT”.

The SCT part identification number corresponding to a valid ATLAS part identification (1) could be

$$20220120123456 \quad (2)$$

2.3 The minimum and a typical bar code size

The code length is determined by the width of the narrow bar. The AIM or ANSI standard specifies the minimum width of 0.191 mm or 0.165 mm, respectively. However, these limits are improved with an advent of laser-type scanners. With a laser-type scanner, the limit could be 0.125 mm. In a working distance of a few to 10 cm, a safe limit could be 0.15 mm. With a narrow bar width of 0.15 mm, the width of 14 digit numeric barcode (SCT barcode) is 16.8 mm, without including the white margins surrounding the barcode. The minimum height of a barcode could be 3 mm. The barcode can be associated with “human-readable” characters and extra texts. The font size of the associated and human-readable texts could be 3 point. Including the white margin and human readability, the minimum size would be 20 mm x 7 mm.

For a larger barcode, a typical narrow bar width would be 0.4 mm. A LED type reader has less resolution if it is worked in a distance more than a few cm. A trial showed a narrow bar width of 0.4 mm was easily handled, e.g., from a distance of about 2 cm. With the narrow bar width, the length of the SCT barcode is 49 mm. A typical height could be 10 mm. The font of the texts could be 9 point. Including the human readability, the typical size would be 55 mm x 22 mm. An example of barcodes of the minimum and the typical size is shown in Figure 1.

In summary, the size of the SCT barcode would be

1. 20 mm x 7 mm, with a narrow bar width of 0.15 mm, for the minimum, with a laser scanner
2. 55 mm x 22 mm, with a narrow bar width of 0.4 mm, with a LED reader, if space is not limited

ATLAS SCT HPK B2

2 0 2 2 0 1 2 0 1 2 3 4 5 6

ATLAS SCT HPK B2

2 0 2 2 0 1 2 0 1 2 3 4 5 6

Figure 1: An example of the minimum size (top) and a typical size (bottom) of the SCT barcode

2.4 Associated texts

A plain text version of the barcode can be added under the bar code, which is typically handled by barcode generating programs as an "human-readability" option. In order to help identify detectors without looking into the database, four text blocks are proposed on the label above the barcode:

1. ATLAS
2. SCT
3. Manufacturer mnemonic code, where the relevant manufacturer codes of the silicon microstrip detectors are listed in Table 1
4. Detector type mnemonic code (see section 2.5).

Table 1: Manufacturer's codes

Manufacturer	Alphabetic code	Numeric code
Hamamatsu	HPK[a]	090
CSEM	CSE	091
Sintef	SIN	092
Micron	MIC	093
CiS	CIS	094

a. HAM is already reserved for Hampton University

2.5 Detector type sequence number

The ATLAS part identification has only two classifications within the subsystem: institute (or manufacturer) and identification number. Although the part identification numbers have no meaning encoded in them, it would be more natural to number the detectors in a systematic way. There are 7 types of silicon microstrip detectors, B1, B2, W12, W21, W22, W31, W32, as summarized in Table 2. In addition to the main detectors, there are baby detectors and test structures associated to the main detectors. The most significant 2 digits of the 7 digit of identification number can be classified to these detector types. The rest of the 5 digits can be the sequence number of the detectors within the types. The multiple of baby detectors out of one wafer can be associated to the mnemonic of Bxxx, e.g., BW12, and 1300001, 2300001, 3300001, etc. and the test structures to TW12 and 5300001, 6300001, etc.

In the database, these detector types are recorded in a separate field. The classification of the detector types in the above is internal of the SCT detector identification and independent of the database management program (DBMS). The detector type must be entered correctly into the detector type field for each detector.

Table 2: detector type codes

detector type	Mnemonic code	2 numeric digits
Barrel 260 µm	B1	01
Barrel 285 µm	B2	02
Forward inner ring	W12	03
Forward inner of middle ring	W21	04
Forward outer of middle ring	W22	05
Forward inner of outer ring	W31	06
Forward outer of outer ring	W32	07
Baby detectors	Bxxx[a]	1x ~ 4x[b]
Test structures	Txxx	5x ~ 8x
Others	Xxxx	9x

a. “xxx” symbolizes the mnemonic code of the main detectors
b. “x” symbolizes the least digit of the numeric code of the main detectors

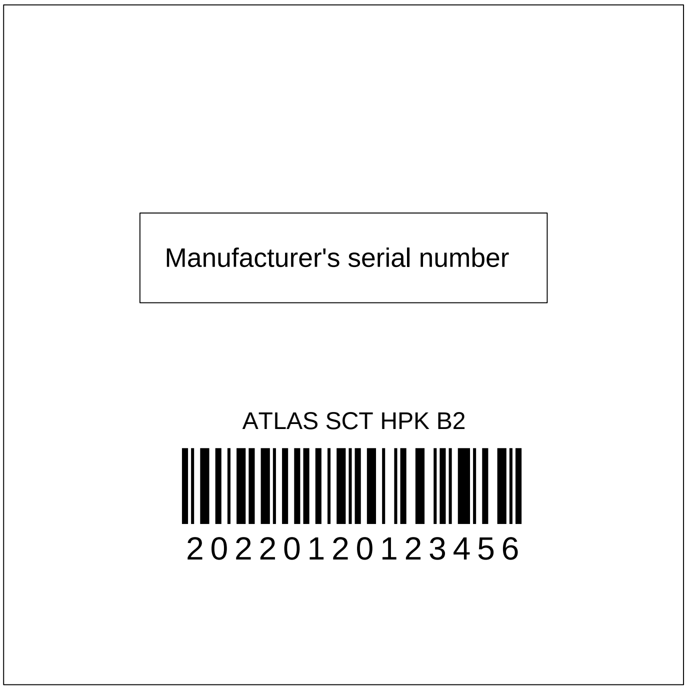

Figure 2: An example of envelope, together with a manufacturer’s serial number and the SCT barcode

2.6 Barcode generation

The uniqueness of the part identification number is critical. This can be achieved in two ways:

1. The database generates an unique number when the object information is entered. A way of printing a sheet of barcode labels with that number could be provided.
2. A set of barcodes could be generated beforehand. The manufacturer could be supplied with the uniquely numbered barcode labels by the SCT institute, or the manufacturer could prepare a set of barcode printed envelopes under SCT supervision. An implication of pre-printed barcodes is that it is allowed to have missing numbers in the sequence because a label or envelope would be thrown away in case of rejection.

An example of a detector envelope or package is shown in Figure 2 where the SCT barcode is printed under the manufacturer's serial number. The manufacturer's serial number would help identifying the process lot and wafer, in addition to the SCT part identification number.

3 Database

3.1 Manufacturer's actions

Manufacturers are responsible for

1. Initial registration of the main detectors, baby detectors, and test structures, being shipped into the database
2. Upload of manufacturer data sheet into the database
3. Notification of shipment in the database

3.2 Confidentiality

To ensure confidentially, the database will restrict manufacturers to read/write access to their own testings only. The restriction will be at the server level, and will not depend on a particular interface.

3.3 Interfaces

Initial registration of detectors can be done with either OMNIS or Web interfaces. Uploading of data sheets can be done with the special Java application or with routines which will be provided for the OMNIS interface. Both applications will read the data from text files with the same format. In the Java case, the data goes straight to the master database server in Geneva. With OMNIS it goes first to a local database on a PC and is later merged with the master server.

4 Procedures

4.1 Preparation of the barcode printed envelopes

The detector envelopes can be prepared any step of the testing by the manufacturer. The earlier the preparation the more chance to utilize the barcode in the testing stages, which may ease the identification of the product and reduce the chance of introducing human errors.

4.2 Marking and testing the detectors

The barcode of the envelope can be scanned and used for, e.g.,

1. scratching the detector identification pads, which should carry the last 6 digits of the SCT part identification number in the binary-encoded decimal format

2. identifying the detectors in the various testing stages
3. tracing the detectors in the processes until the delivery

Since the detectors are an sensitive item, if a detector is inside, the barcode on the envelope should be read with non-contacting type barcode reader, such as a laser or a LED type.

4.3 Registration to the database

All the test data are uploaded from a single text file using OMNIS or Java application. The format of the data file can be obtained from the web [8]. If useful, an interface program can be provided for the creation of this text file to the correct format in a Labview environment, which also reads the bar code and prompts the operator for all the required info (but with default entries defined by a file). Alternatively this text file could be generated automatically using the manufacturers own test programs.

5 Additional Information

An example of a laser type barcode reader is shown in Figure 3. The barcode reader has been connected between the keyboard and the keyboard input to the PC, and acts just like typing the keyboard. This form of input method would be the easiest to use. Other form of input method, e.g., connecting to a serial port (RS232C), should be available together with an appropriate reader programme.

Figure 3: An example of the laser type barcode reader which scans the barcode and inputs to a spreadsheet

References

[1] ATLAS SCT Detector QA Procedures, ATLAS SCT/Detector FDR/99-7
[2] D. Ferrere, J. Foster, et al., SCT database
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[4] “System and Subsystem Codes”, ATC-OQ-QA-2031
[5] “Product Breakdown Structure”, ATC-OQ-QA-3031
[6] “ATLAS Institute Code”, ATL-GE-QA-2032
[7] “Coding schemes and Bar codes for Part Identifiers”, EDMS 100243
[8] Data file format: http://dpnc.unige.ch/atlas/atlaspage/db/doc/mfr_upload/specifications.html