Engineering Note

End-cap Module and Services Position Numbering Scheme

This document describes a logical numbering scheme to be used when describing the location of modules and their associated services on a disc and out to PPF1.

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Distribution List

History of Changes

Rev. No.	*Date*	*Pages*	*Description of changes*
A	14.3.03		First draft prepared for comments
B	26.3.03	All	Incorporated comments by N. Hessey Incorporated FSI jewel diagram from S. Gibson
C	12.6.03	6,9,10	Modified to take into account the fact that disc 9 is 'turned round'. Included references.
D	16.7.03		Small changes to the description of the optoharness patchpanels & update of diagrams.
e	23.7.03	4,9,10	Added mapping to service gaps

Table of Contents

1 Introduction

This document shows a proposed scheme for referencing the positions of modules and their associated services on the forward wheels. It is driven by the need to have a common reference during design, production and assembly for module positions, power tapes, optical harnesses and patch panels. It is based on the scheme proposed by Tony Smith in a document 'Suggested module and power tape referencing scheme' dated October '99.

Whilst each component in the tracker will have a unique identification number in the SCT production database this will not (and, indeed, should not) convey the physical position in the tracker. In addition, each component will be manufactured to an issued drawing stored in CDD. However, there will be several items made to the same drawing which will be assembled into the tracker in different locations. What is needed is a reference to physical positions on the wheel which do not correspond to different physical parts but simply to a logical place. These will be used in two different situations (and maybe others):

- When referring to a component which needs to have a different type dependent upon its position on the disc.
- When recording in the production database the exact position in the detector in which a particular item has been assembled.

One convention which seems to be generally accepted within the SCT is that the 'front' side of the discs is that which will face the interaction region and will have outer and inner modules mounted on it. Unfortunately this is the opposite view of the wheels which would be seen when considering services which enter the tracker from the outside, here the services are usually drawn as if the viewer were outside the tracker looking towards the interaction region. This document proposes that for the purpose of identifying which cables service which module we use the view from the interaction region as this corresponds with the convention already in use for the views of the discs.

The proposed scheme is shown diagrammatically on a separate page at the end of this document. This is deliberate so that the diagram can be printed out and kept handy for easy reference.

2 Interface between SCT End-caps and Services

An important aspect to note is that both SCT End-caps are identical. They are not the mirror image of each other. This is particularly important to remember when the services pass out of the detector.

In this document all references are made relative to a view from the interaction point. This reflects the reality of the design of the SCT End-caps. If a particular service only exists in one quadrant of a disc (for example a DCS humidity sensor) and its cable exits from the detector, say, on the +X side for End-cap A then it will exit on the –X side for End-cap C.

Section 12 shows the relationship between the SCT End-cap numbering scheme defined in this document and the gap numbering used for the services layouts.

3 Wheel Quadrants and Modules

The forward wheels are laid out with a four fold rotational symmetry with each quadrant of the wheel having 13 outer modules, 10 middle modules and 10 inner modules. The inner and outer modules being mounted on the 'front' of the wheel, nearest the interaction region, and the middle ring of modules being mounted on the 'back' of the wheel. It is proposed that we identify the four quadrants of the wheel as: top left (TL), top right (TR), bottom left (BL) and bottom right (BR) from a viewpoint looking outwards from the interaction region. Within the quadrants, the rings of modules would be identified by the letters O for outer M for middle and I for inner. Within each arc of modules, in each quadrant, the module locations would be numbered clockwise from 1 to 13, 1 to 10 and 1 to 10 for the Outer, Middle and Inner rings respectively.

Wheel 9 is manufactured in the same way as all other wheels but when it is assembled into the support structure it is turned round so that the outer modules end up on the side of the wheel away from the interaction point. The numbering for wheel 9 is described in section 11.

4 Patch Panel PPF0

Referring to the diagram in section 13, on each quadrant there are 4 electrical patch panels. Each of these patch panels has 3 slots. There is one wiggly tape per slot. These patch panels slots can be numbered from 1 to 12 going clockwise in each quadrant in the same way as the modules. Note that the patch panels are normally shown in drawings on the 'back' of the disc and in this view the numbering goes anticlockwise. The patch panel locations can be referenced by the range of slots in that patch panel e.g. P0e1:3 or P0e4:6. Each patch panel slot contains 3 possible connector positions. These should be numbered from the disc outwards; C1, C2, C3.

On each quadrant there are 2 optical patch panels. Traditionally these have already been referred to as A and B so we will continue to follow that convention. There are 8 positions in each optical patch panel arranged in a 2x4 array. These are numbered A1 to A8 and B1 to B8. The positions are defined in the diagram in section 8 of this document. For discs which are not fully populated the patch panels may be cut down in size thereby reducing the number of positions which are available.

On each quadrant there is one cooling patch panel and they are identical on each quadrant. To reference a particular cooling patch panel position it is only necessary to refer to the quadrant code.

There is only one DCS patch panel per quadrant which is in the same location as the cooling patch panel. However, these may vary slightly from one quadrant to another.

5 Patch Panels PPF1

For each quadrant, there are 4 electrical patch panels at PPF1. Each PPF1 patch panel has 3 slots each of which corresponds to a patch panel slot at PPF0. Therefore the same numbering scheme can be used but changing the ‘0’ to a ‘1’ i.e. P1e1 to P1e12.

The LM tape connectors at PPF1 are numbered so that connector C1 mates with connector C1 at PPF0.

There are 2 cooling patch panels per quadrant at PPF1. One of these is for the inlets and the other is for the exhausts. These can be referred to by P1ci and P1ce.

There are two optical patch panels per quadrant at PPF1. These map the ones at PPF0 and are called P1oA and P1oB. There is one DCS patch panel per quadrant at PPF1 which can be called P1d.

In all these cases the quadrants can be referred to in the same way as on the disc. Note that TR is on the +X side of the detector for End-cap A but on the –X side for End-cap C.

6 On-disc Wiggly Tapes

There are 12 wiggly tapes per quadrant, each of which serves either 2 or 3 (or occasionally 1) modules. Tapes are numbered 1 to 12 clockwise in each quadrant which means that tape W1 is attached to slot P0e1 and so on. The module end of the wiggly tape can be referenced by the module code that it serves, e.g. M8, O12 etc.

The complete mapping of wiggly tapes to modules and PPF0e connectors is given in reference [1].

7 Low Mass Tapes

Each low mass tape bundle consists of 2 or 3 tapes from PPF0e running along the cylinder, through the TRT wheels and along the cryostat wall to PPF1. At the PPF0 end it has two or three PPF0 interface boards each one with one connector. At the PPF1 end the 2 or 3 tapes are soldered to one PPF1e board.

The tape bundles can be labelled with the same number as the PPF0e slot. Each individual low mass tape additionally needs a position in the bundle. It is proposed that this is labelled from the outside layer inwards L1 to L3 so that as the tapes run along the outside of the support cylinder the lowest numbers are on top. This matches the PPF0e connector positions so that L1 (on the outside) is connected to connector C1 closest to the disc. Where there are only 2 tapes in a bundle (e.g. Disc 1 with its missing inner modules) then connector C3 is omitted and the cylinder tapes will be L1 and L2.

More details are given in reference [1].

8 Optical Harnesses

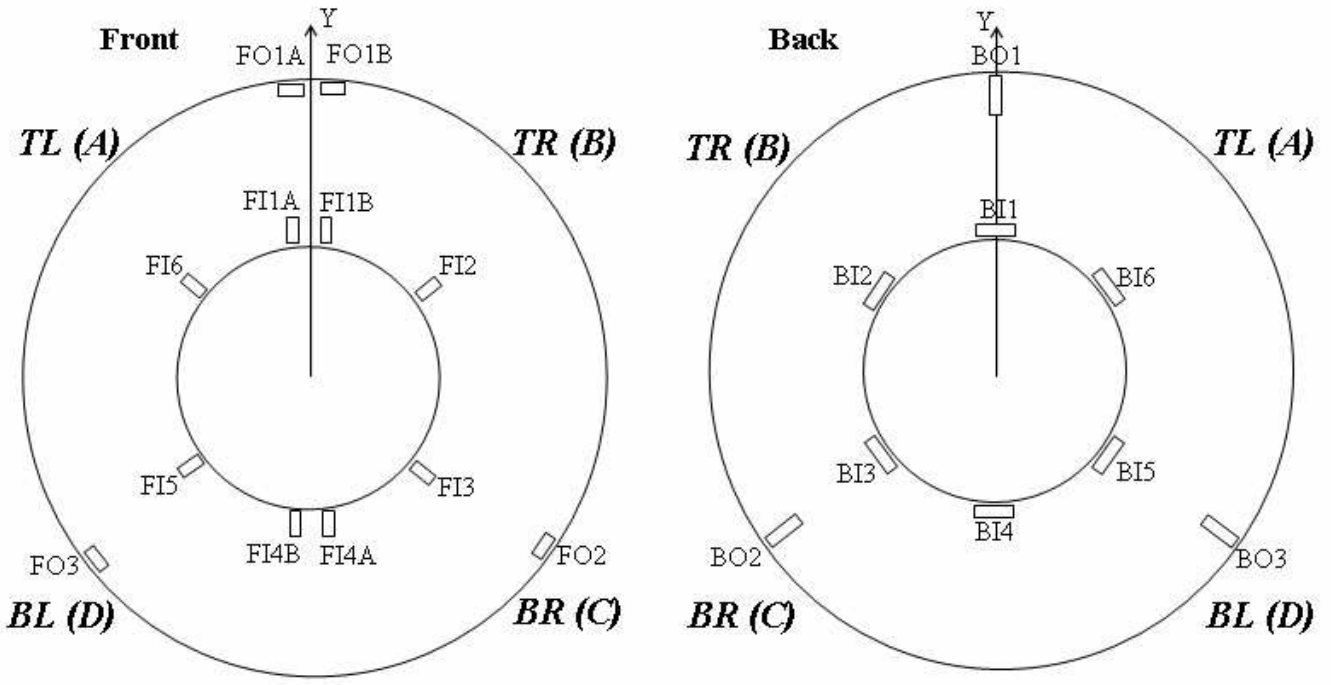
There are 6 on-disc harnesses per quadrant. Each one has two connectors at the PPF0 end. Two harnesses serve the outer modules (HO1 and HO2), two the middle (HM1 and HM2) and two the inner (HI1 and HI2) apart from one outer module which is served from one of the other harnesses. On the cylinder there are a series of 12-way ribbons. Some of these connect at PPF0 to a 12-way ribbon on the disc, others split just before PPF0 and connect to two 6-way ribbons on the disc. The only sensible way to reference the ribbons is to refer to the PPF0 connector slots that they connect to.

On disc 9, when the middle modules are missing, the middle module harnesses are also missing. Therefore, there is one special harness called HO3 which picks up the 4 outer modules (one from each quadrant) which would have been served by the missing middle harnesses.

More details of the mapping are given in reference [2].

9 FSI Jewels

The labelling scheme for the FSI jewels is defined by Oxford and is included in the figure below. Not all jewels exist on all discs. This is described in detail in reference [3].



10 Summary of Codes

To reference uniquely the position of any of these parts they should first be prefixed by the disc number, the End-cap (A or C), then the disc quadrant and finally the component as per the following table. i.e. NE-XX-yy-zz

where N = disc number 1 to 9, E = End-cap letter A or C, XX is the quadrant code, TR, TL, BR, BL.

Where it is only necessary to reference the type of a component rather than the exact position then it may be useful to introduce O and E for odd and even discs. Similarly XX can be used instead of the quadrant code when talking about a component rather than its position.

Item	**yy**	**zz**
Modules		
Outer modules	O1 to O13	
Middle modules	M1 to M10	
Inner modules	I1 to 10	
Patch panels PPF0		
Electrical	P0e1:3, P0e4:6, P0e7:9, P0e10:12	
PPFOe slots	P0e1 to P0e12	
PPFOe connectors	P0e1 to P0e12	C1 to C3
Optical	P0oA and P0oB	1 to 8 (for A),1 to 4 (for B)
Cooling	P0c	
DCS	P0d	
Patch Panels PPF1		
Electrical	P1e1:3, P1e4:6, P1e7:9, P1e10:12	
PPF1e slots	P1e1 to P1e12	
PPF1e connectors	P1e1 to P1e12	C1 to C3
Optical	P1oA and P1oB	1 to 8
Cooling	P1c	
DCS	P1d	
LM tapes		
Wiggly tapes	W1-12	
Cylinder tape bundles	T1-12	
Individual tapes	T1-12	L1-3
Optical Harnesses		
On-disc harness	HO1, HO2, HM1, HM2, HI1, HI2	
Cylinder ribbons	RA1, RA3A4 etc.	

11 Wheel 9

Wheel 9 is fundamentally different to the other wheels. The reason for this is that there is very little space available between the rear support and the wheel. If the wheel were assembled into the support cylinder in the same way as the other wheels then there would not be space for either the patch panel (PPF0) or a

services aperture in the support cylinder. The way with which this has been dealt is to turn disc 9 around so that the outer modules are on the side of the wheel facing away from the interaction point. The wheel is manufactured and assembled in the same way as the other discs so that when it is turned round the patch panel is then on the other side of the wheel to the support. This means that there is plenty of space for the patch panel and the services aperture in the support cylinder is not too close to the crucial joint between the cylinder and the rear support.

Wheel 9 has to be assembled with the same u/v orientation as wheel 8. This means that when it is turned around it has the opposite orientation as wheel 8 maintaining the alternating orientation from one wheel to the next.

Wheel 9 does not have any inner or middle modules, only outers. There are a maximum of 2 connectors in each electrical patch panel slot. For the optical fibres, the harness which serve the middle and inner modules are omitted. The two remaining harnesses per quadrant serve 6 each of the outer modules leaving 1 outer module per quadrant which is normally served by a middle harness. Therefore there is a special harness for disc 9 which just picks up the remaining 4 modules.

11.1 Wheel 9 numbering

It is proposed that the services on wheel 9 have the same numbering as all other wheels during manufacture and assembly as if it were not turned round. I.e. the ‘front’ of the wheel is still the side on which the outer modules are located. This means that when assembled into the cylinder the TR quadrant of wheel 9 will be located in the position of TL of all other wheels. This makes sense because the wheel is assembled in every way the same as the other wheels and only turned around at the point of assembly into the cylinder. This proposal has the advantage of not requiring special manufacture and assembly drawings/instructions for wheel 9 and therefore less chance of a mistake being made.

The disadvantage is that the mapping between services on the disc and on the cylinder will be different to other wheels and needs careful documenting. This is described further in the following section.

11.2 Wheel 9 Differences

Wheel 9 has special PPF0 interface PCBs. The wiggly on-disc LM tapes and associated connectors at PPF0e are the same as for the other disc. When the wheel is turned round this means that the side which would have been on the left of the detector for other discs will be on the right. It is still required for the LM tapes which lie on the cylinder and are routed out to PPF1e to have the same orientation as the other tapes so the small interface PCBs which terminate the LM tapes at PPF0e have to be specials which reverse all the tracks.

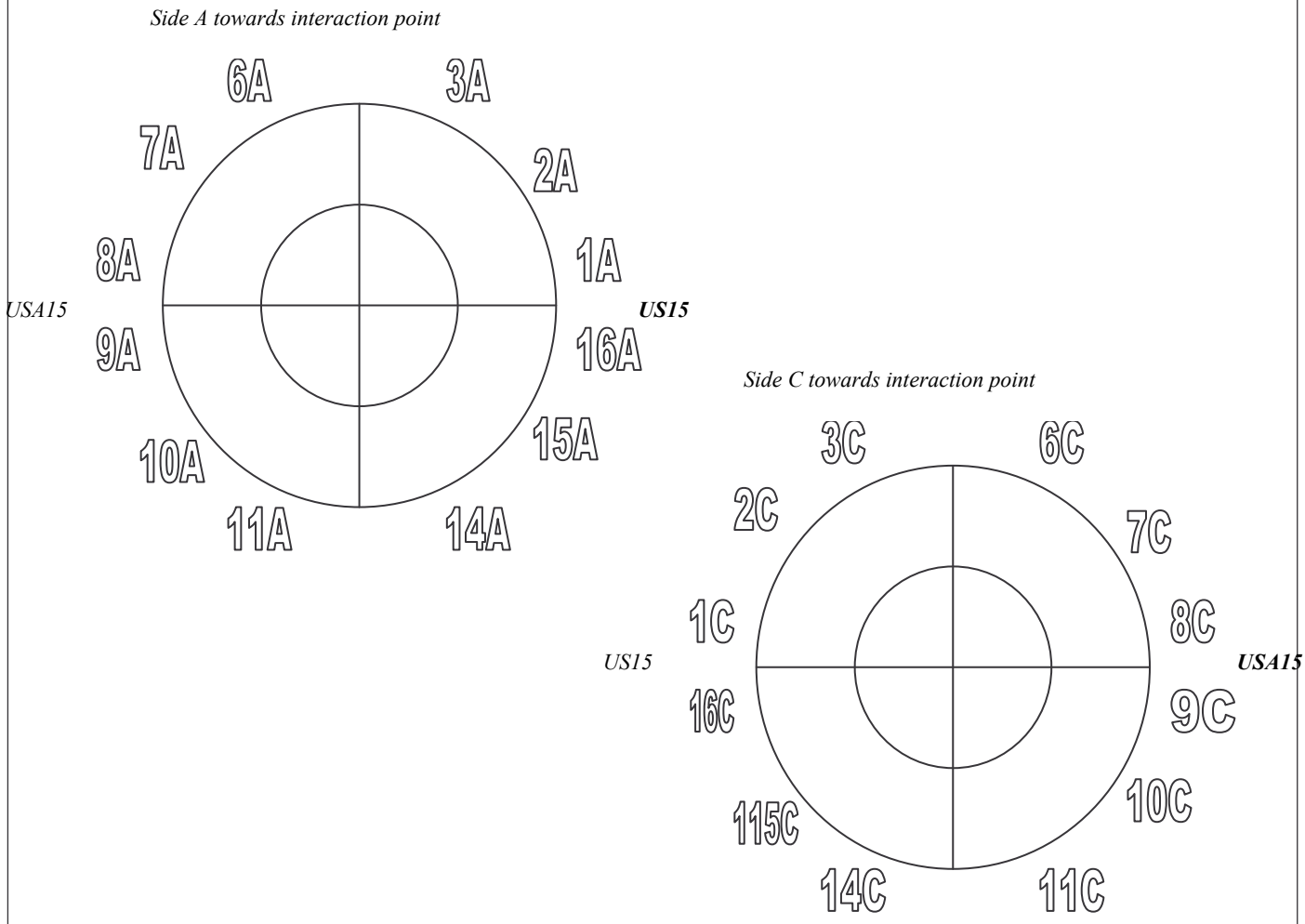
It is also the case that connector C2 is closer to the interaction point than C1 (again the opposite to other wheels). This is not a problem but it needs remembering that that for wheel 9 wiggly tape W1 still has connector C1 at PPF0e but that this connects to the LM tape L2 and connector C2 connects to LM tape L1.

The routing of the services from PPF0 to PPF1 is also affected for both the LM tapes and the optical fibres. The patch panel slots positions are all reversed for wheel 9. PPF0e slot 1 is in the position of slot 9.

For the optical patch panel A1 is in the position of B2.

12 Mapping to Services Gaps

The numbering of the service gaps is defined in the drawing ATLECS__0029, Services Baseline up to Patch Panels 2 and is shown simplified in the following diagram:



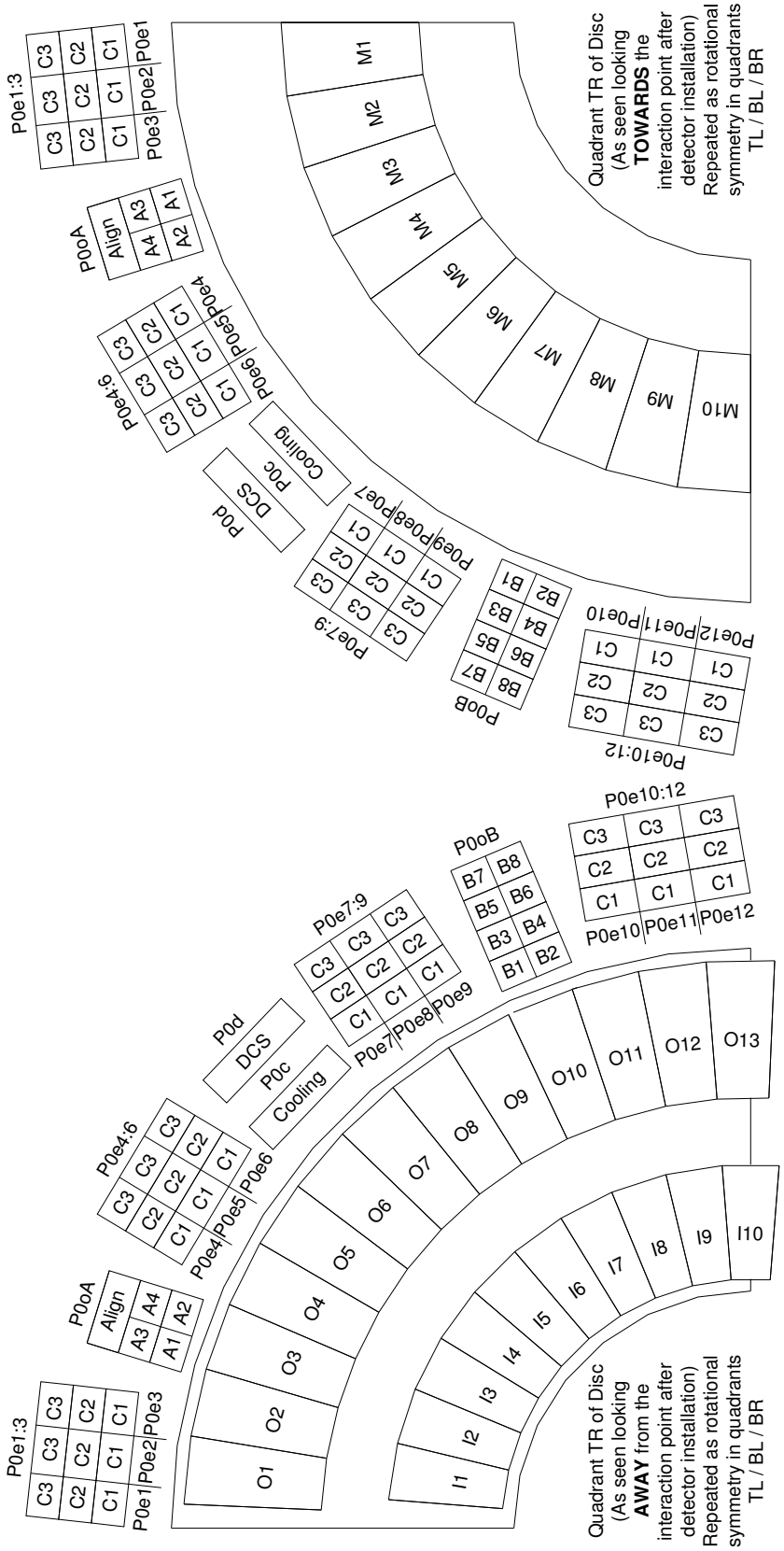
The mapping between gaps and patch panels is given in the following table:

Gap	Patch panels at PPF1
1A	NA-TL-P1e1:3, P1oA, P1e4:6
2A	NA-TL-P1c, P1d
3A	NA-TL-P1e7:9, P1oB, P1e10:12
6A	NA-TR-P1e1:3, P1oA, P1e4:6
7A	NA-TR-P1c, P1d
8A	NA-TR-P1e7:9, P1oB, P1e10:12
9A	NA-BR-P1e1:3, P1oA, P1e4:6
10A	NA-BR-P1c, P1d

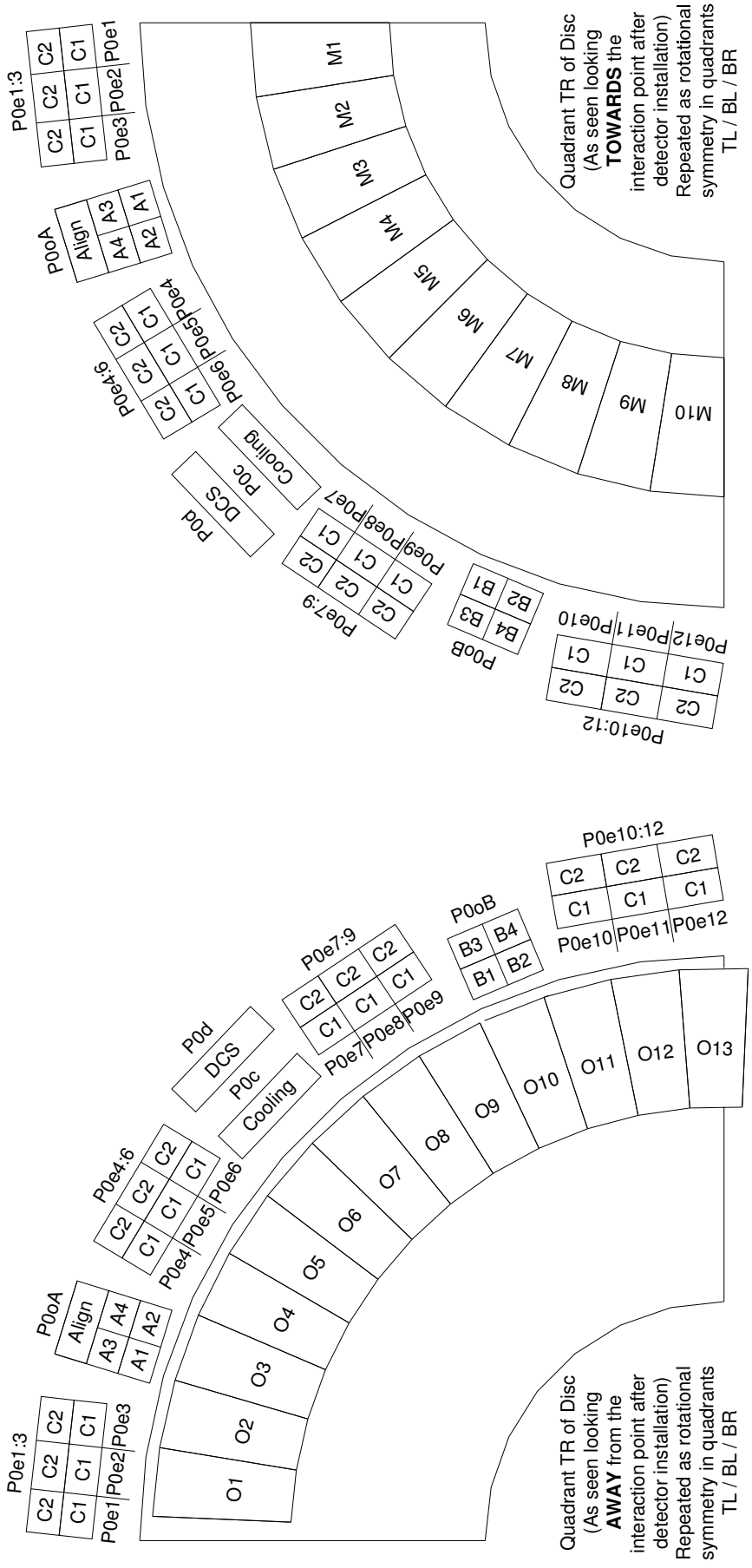
11A	NA-BR-P1e7:9, P1oB, P1e10:12
14A	NA-BL-P1e1:3, P1oA, P1e4:6
15A	NA-BL-P1c, P1d
16A	NA-BL-P1e7:9, P1oB, P1e10:12
1C	NC-TR-P1e7:9, P1oB, P1e10:12
2C	NC-TR-P1c, P1d
3C	NC-TR-P1e1:3, P1oA, P1e4:6
6C	NC-TL-P1e7:9, P1oB, P1e10:12
7C	NC-TL-P1c, P1d
8C	NC-TL-P1e1:3, P1oA, P1e4:6
9C	NC-BL-P1e7:9, P1oB, P1e10:12
10C	NC-BL-P1c, P1d
11C	NC-BL-P1e1:3, P1oA, P1e4:6
14C	NC-BR-P1e7:9, P1oB, P1e10:12
15C	NC-BL-P1c, P1d
16C	NC-BR-P1e1:3, P1oA, P1e4:6

13 Diagrams of numbering scheme

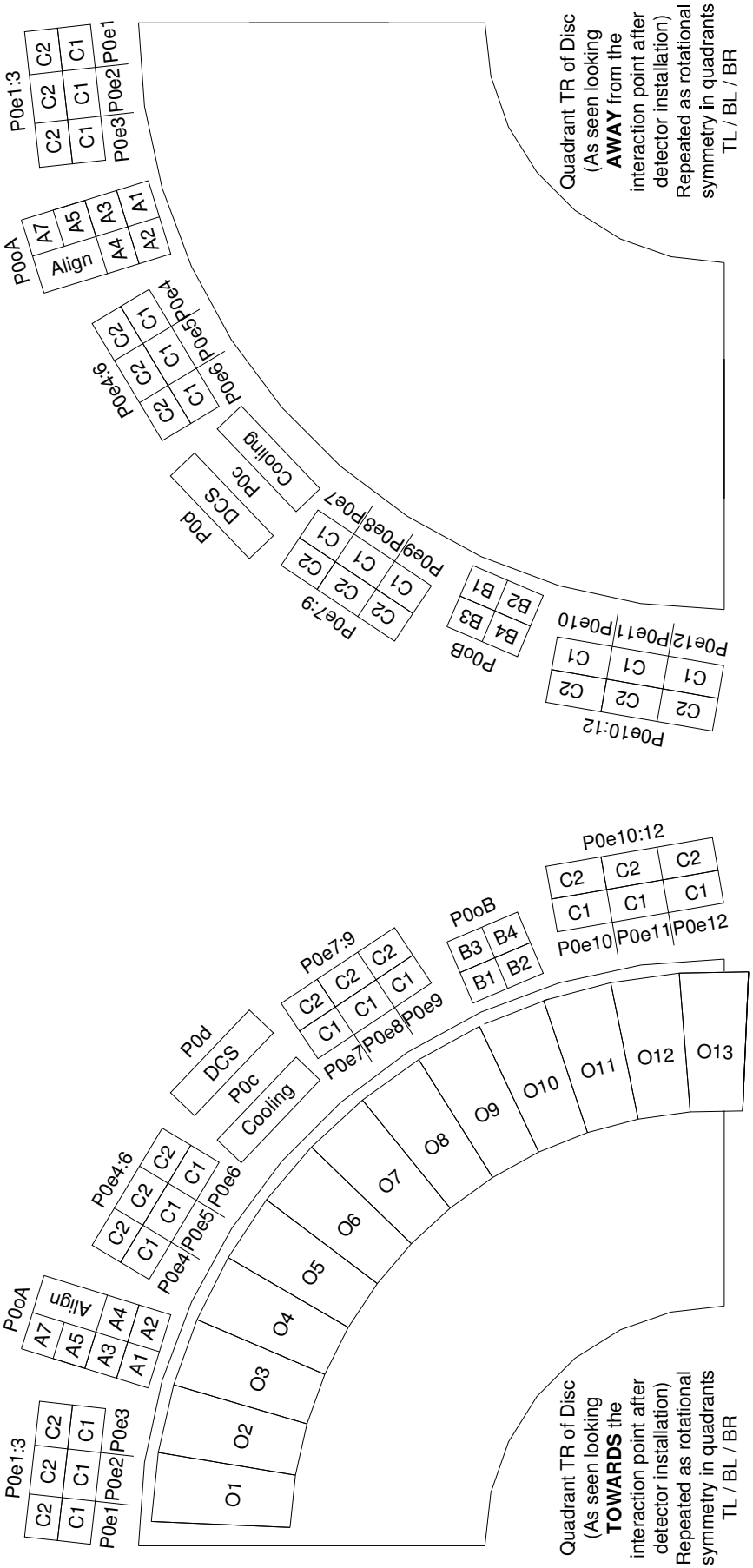
Discs 2,3,4,5 & 6



Discs 1,7 & 8


Quadrant TR of Disc
(As seen looking
TOWARDS the
interaction point after
detector installation)
Repeated as rotational
symmetry in quadrants
TL / BL / BR
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
P0e1:3
P0e1
P0e2
P0e3
P00A
Align
A3
A1
A4
A2
P0e4:6
P0e4
P0e5
P0e6
P0e6
P0e5
P0e4
P0d
DCS
P0c
Cooling
P0e7:9
P0e7
P0e8
P0e9
P00B
B2
B1
B4
B3
P0e10:12
P0e10
P0e11
P0e12
C2
C1
O1
O2
O3
O4
O5
O6
O7
O8
O9
O10
O11
O12
O13
Quadrant TR of Disc
(As seen looking
AWAY from the
interaction point after
detector installation)
Repeated as rotational
symmetry in quadrants
TL / BL / BR

Disc 9


P0e1:3
P0e1
P0e2
P0e3
P00A
Align
A7
A5
A3
A1
A4
A2
P0e4:6
P0e4
P0e5
P0e6
P0d
DCS
P0c
Cooling
P0e7:9
P0e7
P0e8
P0e9
P00B
B3
B4
B1
B2
P0e10:12
P0e10
P0e11
P0e12
C2
C1
O1
O2
O3
O4
O5
O6
O7
O8
O9
O10
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Quadrant TR of Disc
(As seen looking
TOWARDS the
interaction point after
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Repeated as rotational
symmetry in quadrants
TL / BL / BR
Quadrant TR of Disc
(As seen looking
AWAY from the
interaction point after
detector installation)
Repeated as rotational
symmetry in quadrants
TL / BL / BR

14 References

1 ATL-IS-EN-0024: SCT End-cap LM tape mapping table – module to PPF1

2 ATL-IS-EN-0025: SCT End-cap Opto Harness Mapping from modules to PPF1

3 ATL-IS-ES-0081: ATLAS SCT End-cap Alignment System Layout