## Project breakdown name

# Specification of the carbon bridges


*abstract*


| *Prepared by:* | *Checked by:* | *Approved by:* |
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## *History of Changes*

| ***Rev. No.*** | ***Date*** | ***Pages*** | ***Description of changes*** |
| --- | --- | --- | --- |
| A | dd/mm/yy | All | First version |

## *Table of Contents*

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1. High-light the section title to include
2. From the menu, click “Special” > “Marker”
3. In the pop-up window, select “Cross-Ref”, and click “Marker”
4. Repeat from the 1 for the next

5. From the menu, click “File” > “Generate”
6. In the pop-up window, mark “Table of Content” and click “generate”
7. If there exits the associated xxx.TOC file, it will be updated. If not, a xxx.TOC file will be created
8. If the paragraph format is not appropriate, edit the preference page of xxx.TOC from the menu, “View” > “Preference page”, and the last page in the preference page

# 1 Introduction

Signals of a silicon detector are amplified and digitized by means of a frontend ASIC which should be placed as close as to the silicon detector in order to minimize electrical noises while maximizing stability margin in its operation.

In the case of the SCT barrel module, the ASICs' are mounted on a copper polyimide laminated flexible circuit comprising a readout hybrid which is to be bridged over the silicon detector to realize the shortest bond path to the detector strips. For this end the flexible circuit has to be attached on a backing material.

The backing material is required to be not only mechanically rigid to support t the flexible circuit over the detector but also very much thermal conductive to bring out excessive heat from the ASICs' to the cooling point. It should also be a good electrical conductor to be able to improve overall groundings of the hybrid. The density of the material should of course be as low as possible for the sake of minimizing radiation length.

A carbon-carbon composite with unidirectional fibres is chosen to be the base material for the hybrid bridge for its superb properties of mechanical rigidity, large thermal conductivity, very long radiation length and sufficient electrical conductivity.

In the document, we specify carbon bridge material, dimensions, machining procedure and surface treatment. Acceptance criteria regarding QA are also specified.

# 2 Material of the carbon bridges

Carbon-carbon with uni-directional fibres. A product is available from Nippon Mitsubishi Oil Corporation, catalog no. NCC-AUD28

**Table 1: Properties of Carbon-carbon**

| Material | Uni-directional fibres |
|---|---|
| Thermal conductivity (fibre direction) [W/m/K] | 700 ± 20 |
| Thermal conductivity (transverse to fibres) [W/m/K] | 35±5 |
| Density [g/cm3] | 1.9 |
| Young's modulus (fibre direction) [GPa] | 294 |
| Tensile strength (fibre direction) [MPa] | 294 |
| Thermal expansion coefficient (CTE) (fibre direction) [ppm/K] | -0.8 |
| Thermal expansion coefficient (CTE) (transverse to fibres) [ppm/K] | 10 |
| Electrical resistivity (fibre direction) [Ωm] | $2.5 \times 10^{-6}$ |

# 3 Dimension of the carbon bridges

The dimension of the carbon bridge is shown in Fig. 1. While concerning our tight material budget, yet to ensure secure bondability of the hybrid after bridged over the module and sufficient capacity for heat conduction, the thickness of the bridge is optimized to be 300μm,

# 4 Fabrication of the carbon bridges

## 4.1 Machining

The bridge is shaped by means of milling, so that steps of the bridge are unified without additional adhesive layer to maximize thermal conduction. To ensure rigidity and thermal conductivity, orientation of the fibres should be chosen to be precisely parallel to the longitudinal direction of the bridge

## 4.2 Polymer coating

A polymer coating is applied on the whole surface of the bridge to improve reliability and easiness in handling. The polymer used for the coating is Parylene of 10μm thick.

## 4.3 Laser roughing and opening windows

As shown in Fig. 1, Adhesion places are treated with a laser for surface roughing. In order to efficiently dissipate heat from the ASICs', corresponding windows are open by means of a laser to have direct thermal contact. Those windows are also used to improve hybrid grounding by making electrical connection between carbon substrate and the ground plane of the flexible circuit via through-holes

# 5 Acceptance of the carbon bridges

## 5.1 Mechanical tolerance

Mechanical tolerance of the bridge is specified in Fig. 1. Namely, for instance, the thickness of the bridge should be within 300 ± 30μm and the length should be within 74.6 ± 0.2mm.

## 5.2 Mechanical performance

The bridge should be sample-tested to verify the rigidity requirements were fulfilled We require that the Young's modulus and tensile strength of the bridge should surpass 90% level of the values specified in Table 1, namely 265 GPa and 265 MPa respectively for Young's modulus and tensile strength.

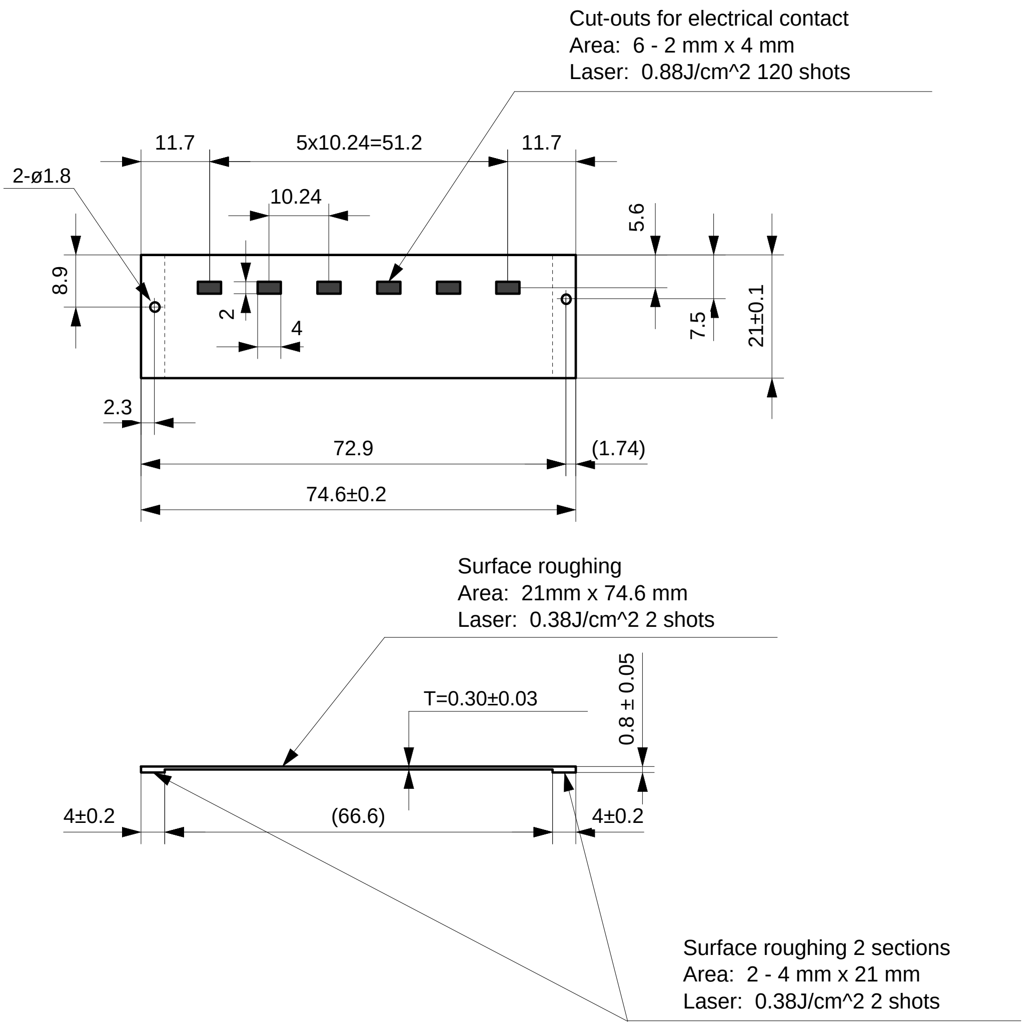
## 5.3 Thermal property

The bridge should be sample-tested to verify that its thermal conductivity is larger than 600 W/m/K.

## 5.4 Electrical conductivity

All bridges are examined that the polymer coating at windows are completely removed so that the carbon surfaces are electrically exposed. Using those windows the resistance of the bridge should be measured. The resistance when measured using the two farthest apart windows (about 5 cm apart each other) should be smaller than 25 mΩ.

**References**




Note: note for the location of the ϕ1.8 holes

Tolerance of laser-processing: ±0.3

Specification B
Quantity : 5000

| | | | |
|---|---|---|---|
| | TOLERANCES UNLESS STATED<br>GEN. ±0.1 | FINISH<br>REMOVE ALL BURRS | ORIGINAL SCALE<br>1/1 |
| | MATERIAL & SPEC.<br>CC-bridge+Parylene(10μm) | SURFACE TEXTURE μm<br>STOCK(UNLESS STATE) | QUANTITY<br>- pices |
| | TITLE CC-bridge+Parylene+Laser bridge2000 | DRAWING No.<br>A4-AT2k01-05 | 2k0201R0<br>T.Kohriki@KEK |

Fig. 1 Specification drawing of carbon bridge

[1] Author(s), "Title", reference id, date