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| Title | **Installation and Operation manual** |
| Description | Installation and Operation manual (including installation, operation, troubleshooting, maintenance, storage, recycling and safety instructions) of Tune and Longitudinal diagnostics, Schottky Pickup for CR |
| Organization | NRC «Kurchatov Institute» – ITEP |
| Valid for: | FAIR Contract № *CC2.5.6.3.1*  Work Packages: PSP 2.5.6.3.2 |

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**Preamble**

This document contains the information on installation, operation, troubleshooting, maintenance, storage and recycling of the Beam Diagnostic (BD) component Tune and Longitudinal diagnostics, Schottky Pickup for the FAIR Collector Ring (CR) System.

Reliability and longevity of the Schottky system depends not only on quality of manufacturing of the equipment, but also on proper compliance with installation requirements, operating modes and ambient operating conditions. Therefore, fulfillment of all requirements set in the Installation and Operation Manual is mandatory.

1. **Introduction**

**Intended use**

Schottky Pickup is designed for non-perturbative beam diagnostics, which allow you to measure the most fundamental beam parameters like e.g. revolution frequency, momentum spread, incoherent betatrone tunes. Moreover, Schottky signals can be used for the more advanced diagnostic of the machine chromaticity, rms transversal beam emittance or even for the monitoring of the beam intensity for very low-current beams. Schottky measurements can be applied to bunched as well as un-bunched (coasting) beam.

Comprises items related to the Work Packages: PSP 2.5.6.3.2.

The detailed information about Schottky Pickup for the Collector Ring (CR) is described in detailed specification – *F-DS-BD-34e\_Special\_SchottkyPickup\_CR\_v2.5\_docx\_cpdf* – located at https://edms.cern.ch/document/1560768/2.5.1.

Schottky system are produced in accordance with the technical specifications. Schottky system must be used in accordance with the technical specifications and delivered documentation.

**Product identification**

Schottky pickup is labeled with a metal tag containing their identification information. The basic identification is given by the ITEP serial number.

**Personnel**

Only qualified and authorized personnel may perform installation, operation and maintenance of the Schottky pickup, and only with a valid Work Permits.

1. **Technical parameters**

The functional parameters of the CR Schottky System are listed below.

Table 1 Basic component parameters for CR



|  |  |  |
| --- | --- | --- |
| Parameter | Value | Unit |
| **Schottky pickup CR** |  |  |
| **Number of elements** |  |  |
| Total length flange-to-flange | 1000 | mm |
| Horizontal aperture | 400 | mm |
| Vertical aperture | 200 | mm |
| Tolerances, Vac. Chamber and plates | better than 1 | mm |
| Pickup load impedance | 50+-2 | Ohm |
| Plat-to-plate capacitance | <10 | pF |
| Feedthrough capacitance | <5 | pF |
| Frequency range | 10-100 | MHz |
| **Signal analysis** |  |  |
| Resolution ”tune” | 10-4 |  |
| relative frequency resolution  (up to 100 points per bandwidth) | 10-6 |  |
| frequency accuracy | 100 | Hz |
| Longitudinal detection threshold of  injected / cooled beam | 105 /104 | ions of U92+ |
| Transverse detection threshold of  injected / cooled beam | 106/107 | ions of U92+ |
| reference maximum intensity for the  system design | 1010 | ions of U92+ |
| **Amplifier** |  |  |
| Input impedance | 50 | Ohm |
| Max. gain | 40 | dB |
| Power-off state | bypass |  |
| Bypass attenuation | <0.5 | dB |
| Noise figure, 10-100 MHz | <1 | dB |
| Gain Flatness, 10-100 MHz | <2 | dB |
| Amplifier input matching VSWR | 1.5 |  |
| Amplifier output matching VSWR | 1.5 |  |
| Max input voltage | ±1 | V |

1. **Safety**

**Standards of Performance**

Managers shall analyze work for hazards, authorize work to proceed and ensure that work is performed within established controls.

All staff and users shall identify, evaluate and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.

**Risk assessment**

ITEP conduct hazard analysis and risk assessment to identify the hazards and appropriate controls. The hazard-check list of the product is presented in the relevant document Risk analysis FCRDSCH\_Risk\_assessment.

Mechanical hazards are considered in more detail below.

**Mechanical hazards**

Schottky pickup is heavy component that could be dangerous for surrounding people

* Follow handling and installation instructions (see Part 4.Handling, Part 5.Installation).
* Schottky pickup must be properly fastened to a suitable stand to prevent any fall.

1. **Handling**

Procedures of product handling and installation shall provide preservation of product quality obtained during its production.

Transport support should be used for transportation of Schottky System to the required place, crane should be used for installation onto corresponding stand.

**Handling safety**

Before handling the Schottky Pickup, check that:

* Lifting eye bolts are correctly tightened;
* Used chains, straps and hooks have the weight rating adapted to the BPM weight, corresponding number of attachment points and corresponding lifting angles.

1. **Installation**

The Schottky Pickup is marked in CR drawing as CR01SCH01. The Schottky Pickup will be placed in position shown in Figure 1.



Figure 1. Location of the Schottky Pickup in the CR.

**Installation of the Schottky Pickup**

|  |  |
| --- | --- |
|  |  |

Figure 2. Scheme of assembling of the Schottky Pickup.

1. Set the Schottky Pickup onto stand inside the dipole corrector;
2. Align the Schottky Pickup vessel on their stand using geodesic laser;
3. Check and fine tune of the electrodes position with screw mechanism;
4. Weld or screw the Schottky Pickup flanges with counterparts of CR vacuum system;
5. Connect the RF signal cables to the Schottky Pickup signal output feedthroughs;
6. Connect the control and power supply cables to the Schottky Pickup analog preamplifiers.

Mechanical dimensions useful for the installation are given in the drawings delivered with the scraper. The wiring diagrams useful for the electrical connections are given in the drawings or technical specifications delivered with the scraper.

1. **Operation**

**Operating conditions**

* The Schottky Pickup are intended for use in a closed electrical installation at a temperature from 15°С to 35°С and humidity from 30% to 70%;
* Schottky Pickup have a remote control for the analog preamplifiers;
* Never take off Schottky Pickup protections during operation.

1. **Troubleshooting**

|  |  |
| --- | --- |
| **Problem** | **Action** |
| Signal lost | * Check RF cables connection (Schottky Pickup, analog preamplifier); * Check analog preamplifiers power supplies; * Check digital electronics (according their troubleshooting list). |
| Vacuum non-tightness | * Leak check by helium leak detector; * Eliminate the leak if possible; * Change on the new chamber. |

1. **Maintenance**

Schottky Pickup should be inspected regularly at least twice a year.

**Regular inspections**

* Visual inspection of welding lines;
* Visual inspection of vacuum feedthroughs;
* Inspection of cable insulation, electrical connections;
* Measure and compare the voltages of power supplies to the design value;
* If applicable, visual inspection of vacuum measurement by gauges, RGA and current of turbo-pump rotation rate;
* If applicable, leak check (< 1·10-10 mbar l/s for helium)

1. **Storage**

Storage conditions of the Schottky Pickup shall provide preservation of product quality obtained during its production.

Be sure you keep the product in a dry place that cannot span high humidity. Storage temperature is from 5°C to 40°C, storage humidity is from 30% to 70%. Storage area should be free of dust, acid and alkaline vapors, corrosive gases and other contaminants causing corrosion and destruction of the coatings.

1. **Recycling**

At the end of the service life, recycling of the Schottky Pickup is carried out by the owner at its own discretion.

The Schottky Pickup has to be checked for radiation before recycling. Further special requirements for safety and disposal are not imposed. It is generally accepted the use of basic means of recycling which are used for the other electrical equipment.

Schottky Pickup and its components do not contain precious metals and alloys. Materials used for packaging can be completely recycled.