



# Radioactive Material Safety Data Sheet

March 10, 2015

*SCT-NP1-8-E4*

## 1 Description of Source

Source *SCT-NP1-8-E4* is a proton irradiated Si chip with a rectangular surface area of  $2 \times 2 \text{ cm}^2$  and a thickness of  $700 \mu\text{m}$  attached to a  $100 \mu\text{m}$  thick Si sensor. It has been exposed to a fluence of  $\sim 5.0 \times 10^{15} \text{ p/cm}^2$  of 24 MeV protons in 2013. Some of the elements used inside the chip have been activated by the protons and therefore it is now a source of  $\beta$  and  $\gamma$  radiation.

## 2 Isotopes

The main radio-isotopes inside the chip are  $\sim 50 \text{ Bq}$  of  $^{57}\text{Co}$  (on 9 March 2015).

- $^{57}\text{Co}$  decays by electron capture with a half life of  $\tau = 272 \text{ days}$  emitting photons and electrons. The mono-energetic electrons are all below  $0.14 \text{ MeV}$ . The maximum energy of emitted  $\gamma$  radiation is  $0.69 \text{ MeV}$ .

The main activity stems from the  $\gamma$ -radiation which goes up to  $0.69 \text{ MeV}$  in energy and averages at  $0.077 \text{ MeV}$ .

## 3 Radiation Dose Rates

The  $\gamma$  radiation is not shielded by the chip itself nor by the attached sensor. Directly on top of the chip the  $\gamma$  dose rate is  $0.3 \mu\text{Sv/h}$ . The  $\beta^+$  and electron emissions are largely shielded by the chip itself (for the radiation below) and the attached sensor (for the radiation above). Hot areas remain the chip edges on all sides and the sensor-free region on top where the bond pads are located. In these regions the radiation levels can reach  $2 \mu\text{Sv/h}$ . In  $1 \text{ cm}$  distance from the chip the  $\gamma$  radiation dose rates reduce to  $0.1 \mu\text{Sv/h}$  and drop quadratically with distance beyond. Figure 1 shows a simulation of the expected radiation levels in the vicinity of the chip.

## 4 Protective Measures

Since the radiation levels are rather low no particular shielding is required when working with the chip.

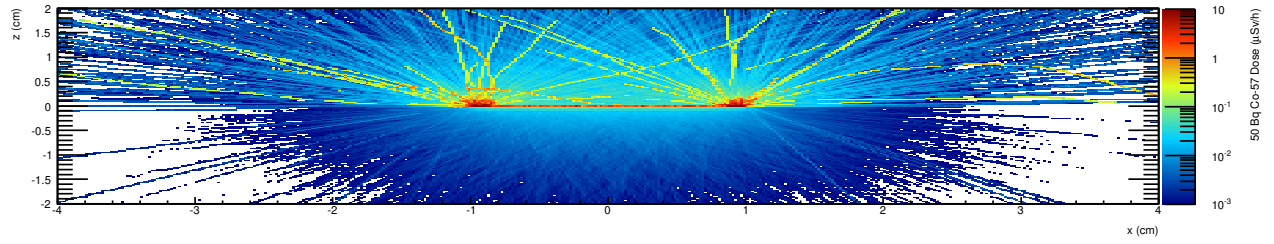


Figure 1: Simulated dose rate in air for the chip with 50 Bq of  $^{57}\text{Co}$ . The radioactivity is assumed to come uniformly from the chip surface which is covered by Au bump bonds and a  $100\,\mu\text{m}$  thick Si sensor except for the last 1.3 mm on the  $\pm x$  sides of the chip where the Bond Pads are. The plot shows a side view from the chip with radiation levels in the center of the chip in the not shown  $y$  dimension.

## 5 Handling Instructions

The chip should be carried in a plexi-glass box whenever it is transferred from one place to another and rubber gloves need to be worn when handling the chip.

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