Solid State Ion Chambers (PIN Diodes)

Solid-state ionization chambers are usually reverse-biased silicon PIN diodes with frontal areas ranging from a few to 100 mm^2, and with depletion depths ranging from perhaps 100 to 300 μm. They can be used in either the current output mode or the pulsed output mode. We review the basic characteristics of two PIN diodes, the Siemens BPW 34 and the Hamamatsu S2662, used in some beam loss monitors.

Property	BPW 34	Hamamatsu S2662
Area	2.75 x 2.75 mm^2	7.5 x 20 mm^2
Depletion depth	~100 μm	~100 μm
Volume	0.75 mm^3	15 mm^3
Leakage current	~100 pA	~500 pA
Integrating mode		
Coulombs per rad	5 nC	100 nC
Rad equiv. of leakage current	70 rads/hr	20 rads/hr
Rad hardness (leakage current)	~1 Mrad	~1 Mrad
Pulse mode		
MIPs per rad	2.3E6	4.6E7
Max rads/sec (@ 10^7 counts/sec)	4 rads/sec	0.2 rads/sec
Rad hardness (spurious counts)	~100 Mrads	~100 Mrads

PIN Diode Pulse-Mode Coincidence Circuit BLM

In order to minimize the sensitivity to synchrotron radiation, two PIN diodes can be placed back-to-back, and the two pulse-output signals put into a coincidence circuit. Such a unit has been developed at DESY for use in the HERA tunnel which also has a 30-GeV electron ring[10]. The detector geometry is shown in Figure 7. Low energy photons will interact in only one PIN diode, while MIPs interact in both, producing a coincidence. The unit also has directional sensitivity. The whole unit measures about 69 mm by 34 mm by 18 mm. It is now commercially available[11].

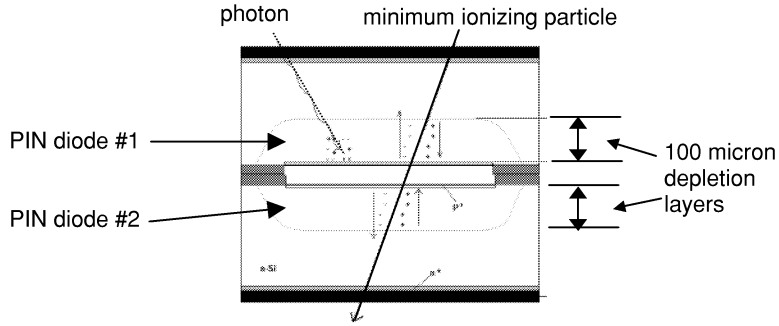

Figure 7. PIN diode coincidence circuit.