



ITER-India
(Institute For Plasma Research)



Title	Global Tender No. I-I/ET-TPT/GTE/23009/23-24 dated 12-03-2024 for Silicon Photodiode with readout electronics
Sub Title	PART-A (II): Scope of Supply & Work and Technical Specifications

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Title: Silicon Photodiode with readout electronics

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I. Scope of supply and scope of work

S. No	Description	Quantity
1.	Supply of Silicon Photodiode with read out electronics as per specification in section II.	01 sets
2.	The system should be appropriately packaged and supplied on a free door delivery basis at the purchaser site (ITER-India, lab)	
3.	Site inspection and acceptance test as per APPENDIX I	

II. Introduction

A Si PiN photodiode is used for the detection of X-rays to estimate photon flux from the X-ray source. The photodiode must have a large surface area in order to have large collection of the X-ray photons. These X-ray photons will generate a photocurrent on the photodiode and will be measured and displayed using the readout unit. The readout unit compatible with the large area photodiode will operate the photodiode in both photovoltaic as well as in photoconductive modes.

The Si PiN diode will also be installed inside the vacuum chamber of the X-ray source and will also be simultaneously impinged by visible light photons. To filter out visible light, the filter will be used which will have high transmissivity in the X-ray energy range of 100 eV – 14 KeV.

A UHV compatible housing which will accommodate photodiode and X-ray filter is to be supplied by the supplier. This housing will be connected through an electrical feedthrough made on a 40 CF double-sided SMA flange for high vacuum operations of the photodiode detector system.

Scope of supply:

1. Large area photodiode mounted on suitable vacuum compatible diode housing with provision of mounting the filter
2. Readout unit
3. DAQ software for Windows PC
4. Visible light filters (Parylene, Mylar) mounted on individual rings of Stainless steel
5. Electrical feedthrough on flange
6. Both air and vacuum side cables (data communication and power) and connectors for connecting diode with readout unit,
7. AC-DC power adapter, if any

III. Technical specifications of Silicon Photodiode with readout electronics (Qty 01)

#	Parameter	Unit	ITER-India specifications
X-ray Photodiode detector system			
1.	Range of photon energy measurement	eV	≥ 100 to ≥ 13000
2.	Measurable photon flux (min/max)	Ph/s	$1e5$ to $1e13$ with a resolution of $< 3e5$ @100 eV
3.	Bias voltage	V	Compatible with PiN diode for operation in Photovoltaic and photoconductive modes
4.	O/P current range (Minimum)	nA	≥ 100 (Photovoltaic mode) $\geq (+/-) 200$ (Photoconductive mode)
5.	O/P current range (Maximum)	μA	≥ 10 (Photovoltaic mode) $\geq (+/-) 20$ (Photoconductive mode)
6.	Current resolution	pA	≤ 1 (Photovoltaic mode), 100 (Photoconductive mode)
7.	Linearity	%	< 0.01
8.	Readout rate	Hz	≥ 0.1
Detector			
9.	Detector type	-	Silicon PiN Diode
10.	Detector Active Area	mm^2	≥ 550
11.	Photosensitivity	A/W	> 0.20 @ ~ 100 eV
12.	Rise time	μsec	≤ 50

13.	Dark current	nA	≤10
14.	Window		Windowless diode with a protective cover that can be removed for measurements
15.	Sensor thickness	mm	To be provided by the supplier
16.	Quantum efficiency	%	To be provided by the supplier
17.	Detector mount	-	<ul style="list-style-type: none"> • Diode mounted on a mount integrating a protective cover and visible light-blocking filter • Stainless steel such as SS 304, 316 etc. • Suitable for High Vacuum, 10^{-7} mbar or better
Readout unit and power supply (built-in or separate)			
18.	Display		<p>Clear, backlit and digital display.</p> <p>Accurate display of current as specified from A.3 – A.6 above.</p>
19.	Software	-	<p>- All applications for detector control, data acquisition, display and conversion to photon flux.</p> <p>- The software should be compatible with MS Windows 10 operating system.</p> <p>- All supplied software should be made available with a perpetual license.</p>
20.	Data Communication port	-	<p>USB or Ethernet</p> <p>– details of all interfaces to be provided by the supplier</p>
21.	Cables and connectors	-	All cables and connectors to be supplied,

			details to be provided by the supplier
22.	Standard accessories	-	All standard accessories including mounting hardware, electrical feedthrough, cables, connectors external – details to be provided by the supplier
23.	Input electrical power	-	220±10 V AC, 50 Hz, Single phase
Visible light blocking filter (Qty. 3 filters of each type)			
24.	Filter Type-1 Material (thickness)	μ	Perylene–N (0.2 μ) coated with Magnesium (0.2 μ)
25.	Filter Type-2 Material (thickness)	μ	Mylar (0.9 μ) coated with Aluminium (0.2 μ)
26.	Filter mount		Both Type-1 and Type-2 filters to be mounted on individual rings allowing ~30mm clear aperture Ring OD~40mm, ID ~ 30mm, thickness ~2mm, material Stainless steel 304, 316 etc. All filters should be mountable on diode mount; with the possibility of interchanging filter type
Vacuum Feedthrough for in-vacuum mounting of the diode (Qty. 1)			
27.	Feedthrough on flange		Made on 40 CF double-sided SMA flange, for High Vacuum vacuum operations ~10 ⁻⁷ mbar and a leak rate of ≤ 10 ⁻⁹ Pa.m ³ /s
28.	Material		Stainless steel such as 304, 316 etc.
29.	Cables and connectors		Both air and vacuum side cables and connectors are to be supplied with the unit.

Others

30.	Overall dimensions (LxWxH) of each unit	mm	To be provided by Supplier
31.	Warranty	year	1 year

Note

1. Quotations are invited for a complete X-ray beam monitoring system consisting of a Silicon Photodiode, power supply, readout unit, and standard accessories required for the operation and measurement of the photon flux.
2. The supplier must fill out the last column of Appendix-2 Compliance Matrix with the specification or remarks against each parameter.
3. The quote should include detailed technical specifications along with real pictures, diagrams, and drawings of each unit.
4. The complete manuals including the Operation manual, and Maintenance manual need to be supplied at the time of delivery of the photodiode system.

IV. Acceptance test criterion

The acceptance test criterion is as follows:

Part A: Pre-dispatch tests/Factory acceptance tests

For shipment clearance of the detector, the supplier needs to send a complete test report (details of the tests are attached in Appendix-1).

Part B: Acceptance tests at ITER-India laboratory/Site acceptance tests

The final acceptance of the detector will be given after conforming to the technical specification and performance of the detector at ITER-India.

Appendix-1**Proposed Acceptance tests**

Tests are to be carried out for confirming the performance of the Silicon Photodiode along with the readout unit, and test report(s) need to be supplied for shipment clearance by ITER-India, IPR. The test results and all the test conditions, and settings should be provided in the test report.

1. Photo of every part in shipment box to be provided before dispatch.
2. Diode to be checked for the dark current measured at room temperature ($\sim 25^{\circ}\text{C}$) and max reverse bias voltage and checked against the maximum value of dark current. Measurement of Shunt resistance R_{sh} test (at typical settings 10mV and 25°C) also to be performed.
3. Diode to be checked for photocurrent measured using X-ray sources such as radioactive Fe55+ or X-ray tube e.g. Cu etc.
4. Vacuum test of the complete assembly to be performed in High Vac. 10^{-7}mbar , and leak rate $1 \times 10^{-9} \text{ Pa m}^3/\text{s}$. Complete assembly means filter mounted on photodiode installed inside vacuum chamber and connections are made through feedthrough.



Appendix-2
Technical Compliance Matrix

#	Parameter	Unit	ITER-India specifications	Supplier's specifications
A. X-ray Photodiode detector system				
1.	Range of photon energy measurement	eV	≥100 to ≥13000	To be filled by supplier
2.	Measurable photon flux (min/max)	Ph/s	1e5 to 1e13 with a resolution of < 3e5 @100 eV	To be filled by supplier
3.	Bias voltage	V	Compatible with PiN diode for operation in Photovoltaic and photoconductive modes	To be filled by supplier
4.	O/P current range (Minimum)	nA	≥100 (Photovoltaic mode) ≥ (+/-) 200 (Photoconductive mode)	To be filled by supplier
5.	O/P current range (Maximum)	μA	≥10 (Photovoltaic mode) ≥(+/-)20 (Photoconductive mode)	To be filled by supplier
6.	Current resolution	pA	≤1 (Photovoltaic mode), 100 (Photoconductive mode)	To be filled by supplier
7.	Linearity	%	< 0.01	To be filled by supplier
8.	Readout rate	Hz	≥ 0.1	To be filled by supplier
B. Detector				

9.	Detector type	-	Silicon PiN Diode	To be filled by supplier
10.	Detector Active Area	mm ²	≥ 550	To be filled by supplier
11.	Photosensitivity	A/W	>0.20 @ ~ 100 eV	To be filled by supplier
12.	Rise time	μsec	≤50	To be filled by supplier
13.	Dark current	nA	≤10	To be filled by supplier
14.	Window		Windowless diode with a protective cover that can be removed for measurements	To be filled by supplier
15.	Sensor thickness	mm	To be provided by the supplier	To be filled by supplier
16.	Quantum efficiency	%	To be provided by the supplier	To be filled by supplier
17.	Detector mount	-	<ul style="list-style-type: none"> • Diode mounted on a mount integrating a protective cover and visible light-blocking filter • Stainless steel such as SS 304, 316 etc. • Suitable for High Vacuum, 10⁻⁷ mbar or better 	To be filled by supplier
C. Readout unit and power supply (built-in or separate)				
18.	Display		Clear, backlit and digital display.	

			Accurate display of current as specified from A.3 – A.6 above.	
19.	Software	-	<ul style="list-style-type: none"> - All applications for detector control, data acquisition, display and conversion to photon flux. - The software should be compatible with MS Windows 10 operating system. - All supplied software should be made available with a perpetual license. 	To be filled by supplier
20.	Data Communication port	-	USB or Ethernet – details of all interfaces to be provided by the supplier	To be filled by supplier
21.	Cables and connectors	-	All cables and connectors to be supplied, details to be provided by the supplier	To be filled by supplier
22.	Standard accessories	-	All standard accessories including mounting hardware, electrical feedthrough, cables, connectors external – details to be provided by the supplier	To be filled by supplier
23.	Input electrical power	-	220±10 V AC, 50 Hz, Single phase	To be filled by supplier

D. Visible light blocking filter (Qty. 3 filters of each type)

24.	Filter Type-1 Material (thickness)	μ	Perylene-N (0.2μ) coated with Magnesium (0.2μ)	To be filled by supplier
25.	Filter Type-2 Material (thickness)	μ	Mylar (0.9μ) coated with Aluminium (0.2μ)	To be filled by supplier
26.	Filter mount		<ul style="list-style-type: none"> Both Type-1 and Type-2 filters to be mounted on individual rings allowing $\sim 30\text{mm}$ clear aperture Ring OD$\sim 40\text{mm}$, ID $\sim 30\text{mm}$, thickness $\sim 2\text{mm}$, material Stainless steel 304, 316 etc. All filters should be mountable on diode mount; with the possibility of interchanging filter type 	To be filled by supplier

E. Vacuum Feedthrough for in-vacuum mounting of the diode (Qty. 1)

27.	Feedthrough on flange		Made on 40 CF double-sided SMA flange, for High Vacuum vacuum operations $\sim 10^{-7}\text{mbar}$ and a leak rate of $\leq 10^{-9} \text{ Pa.m}^3/\text{s}$	To be filled by supplier
28.	Material		Stainless steel such as 304, 316 etc.	To be filled by supplier



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29.	Cables and connectors		Both air and vacuum side cables and connectors are to be supplied with the unit.	To be filled by supplier
F. Others				
30.	Overall dimensions (LxWxH) of each unit	mm	To be provided by Supplier	To be filled by supplier
31.	Warranty	year	1 year	To be filled by supplier

Bidder's Representative Sign :

Bidder's Representative Name :

Bidder Representative Designation:

Company's seal :