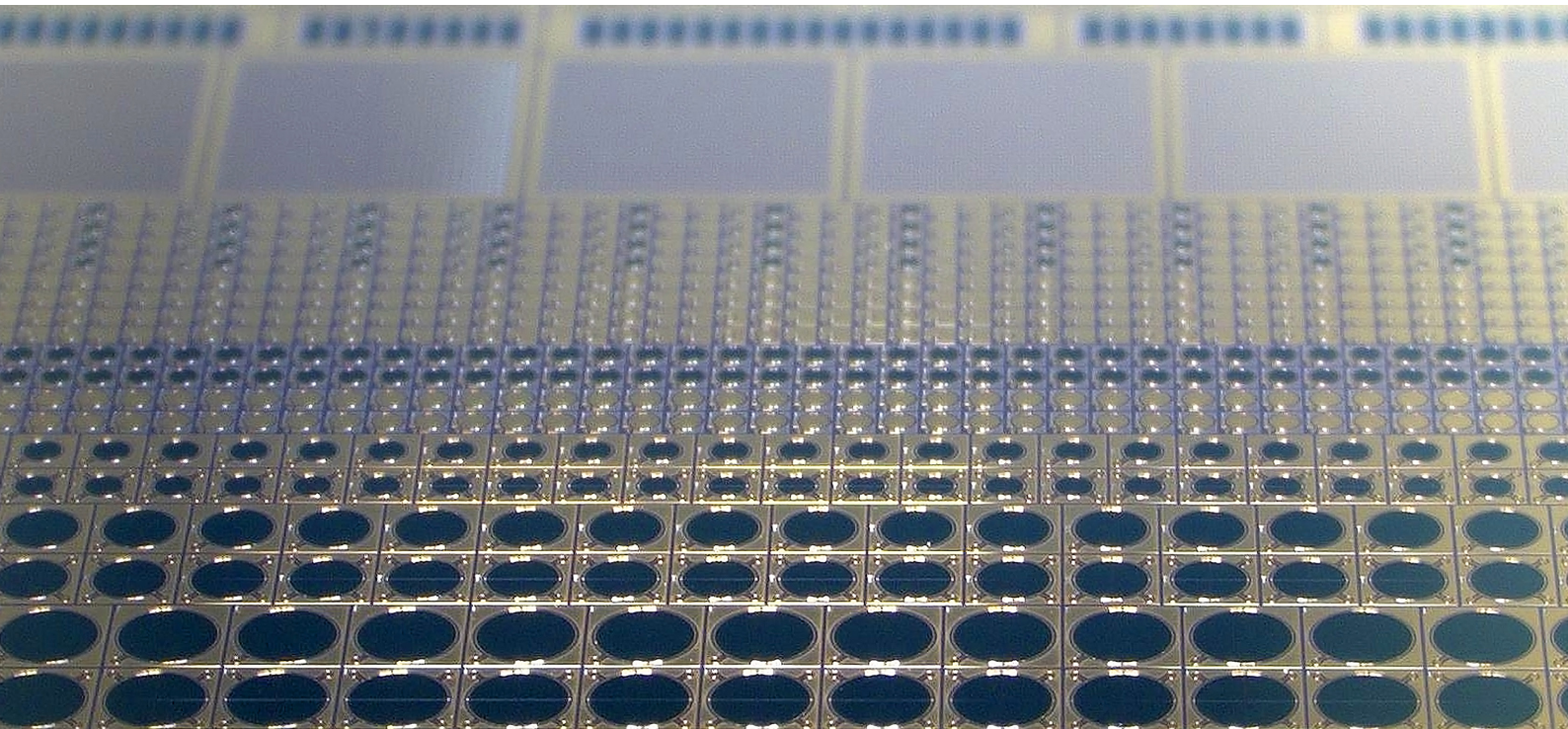


# InGaAs AND EXTENDED InGaAs PHOTODIODES



## AT A GLANCE

high quantum efficiency  
surface illuminated InGaAs  
photodiodes for  
sensing applications

### Features

- low noise, high responsivity photodiodes
- single diode, segmented diodes or array configuration
- backside or front side illumination
- lens integration for back side illuminated photodiode (optional)
- flip-chip or wire bonding
- zero bias operation possible

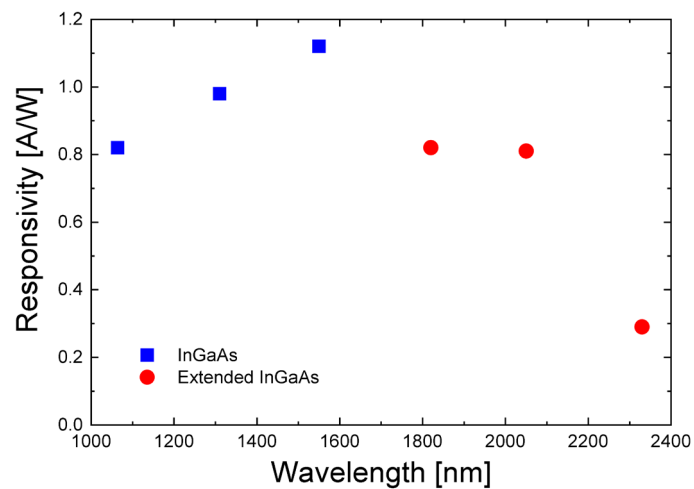
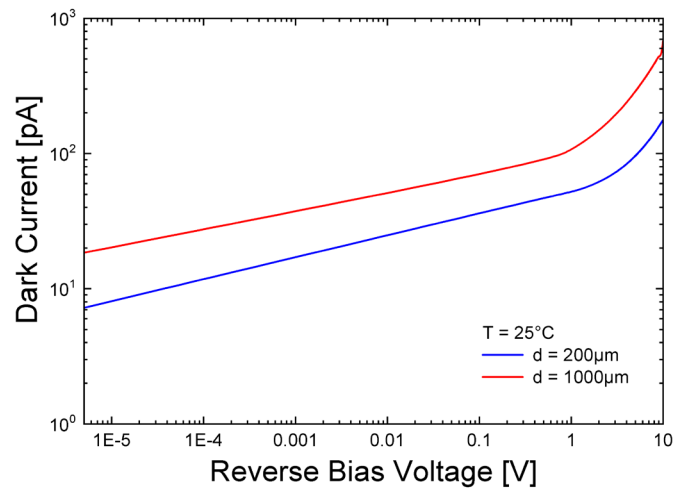
### Applications

- SWIR sensing and imaging

### Technical Background

Surface-illuminated photodiodes with low noise and high quantum efficiency are key components for short wavelength infrared (SWIR) sensing applications. The standard InGaAs photodiodes operate at a wavelength of 820 nm up to 1650 nm. For the extended InGaAs devices, the upper absorption wavelength can be shifted up to 2500 nm.

The photodiode chips are based on mature InP technology and are fabricated at the wafer process line of HHI, having Telcordia and space-qualified processes. Due to the ability of customising the photodiode chips, costumers obtain the optimal performance for their application.



Dr.-Ing. Patrick Runge  
**Photonic Components**

Phone +49 30 31002-498  
 patrick.runge@hhi.fraunhofer.de

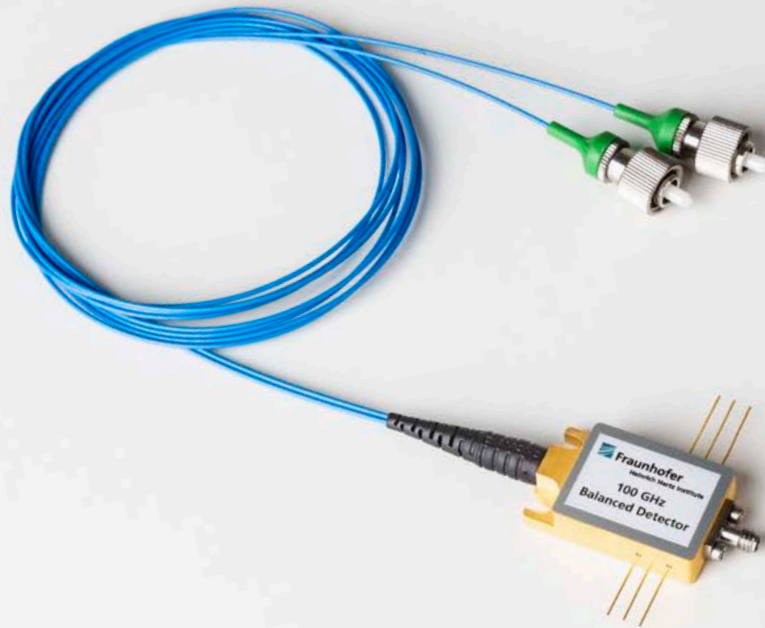
Fraunhofer Heinrich Hertz Institute  
 Einsteinufer 37, 10587 Berlin  
 Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)

### Customization

- optical aperture up to a few mm-diameter
- quantum efficiency up to 99%
- planar or mesa type photodiodes
- single photodiode, segmented photodiode or array configuration
- segmented photodiodes and arrays with common or isolated cathode
- backside or front side illumination
- lens integration for backside illuminated photodiode
- flip-chip or wire bonding
- customized pitches and pad configurations
- APD and SPAD photodiode types also available

# 100 GHz BALANCED PHOTODETECTOR MODULE



## AT A GLANCE

high-speed balanced photodetector module for > 1 T/bs coherent telecom applications

### Features

- up to 100 GHz 3 dB-bandwidth
- detection of 128 GBaud x-QAM signals with optical 90° hybrid
- integrated bias network
- low bias operation
- 1 mm RF connector

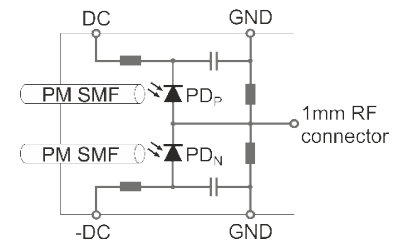
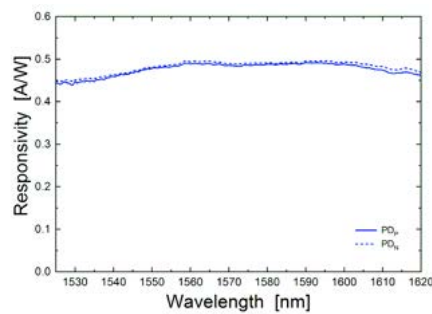
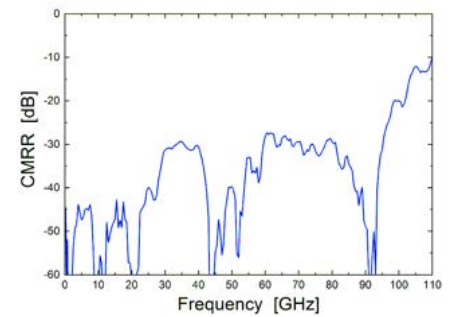
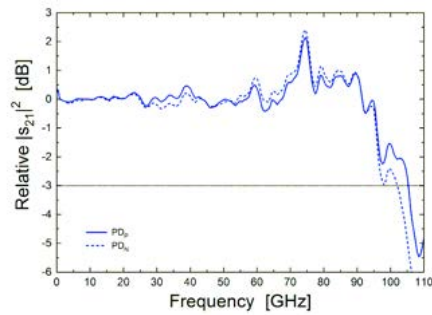
### Applications

- telecommunication
- coherent test- & measurement systems
- microwave photonics

### Technical Background

High-speed balanced photodetector modules are of interest for the development of next-generation telecom coherent optical communication links. Since these R&D links are always a step ahead in terms of symbol rates, photodetector modules with a RF bandwidth beyond state-of-the-art are needed at the receiver side. In combination with a 90° optical hybrid, the balanced photodetectors provide the functionality of a coherent receiver for detecting dual-polarization higher order QAM signals.

The photodetector chips inside the modules are based on mature InP technology and are fabricated at the wafer process line of HHI, offering Telcordia and space-qualified processes. The chips are packaged at HHI facilities.



### Technical Specifications

- 3 dB-bandwidth: up to 100 GHz
- wavelength: 1480 nm - 1620 nm
- low dark current: < 100 nA @ 3 V
- bias voltage: +2 V and -2 V
- 1 mm female RF connector
- RF output matched to 50  $\Omega$
- optical input: FC/APC PM SMF fibre  
or  
SC/APC PM SMF fibre

Dr.-Ing. Patrick Runge  
Photonic Components

Phone +49 30 31002-498  
patrick.runge@hhi.fraunhofer.de

Fraunhofer Heinrich Hertz Institute  
Einsteinufer 37, 10587 Berlin  
Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)

# 100 GHz PHOTODETECTOR MODULE



## AT A GLANCE

high-speed photodetector module for > 1 T/bs PAM datacom, telecom and microwave photonics applications

### Features

- up to 100 GHz 3 dB-bandwidth
- detection of 128 GBaud amplitude modulated signals
- operation in O-band and C+L-band
- integrated bias network
- low bias operation
- 1 mm RF connector

### Applications

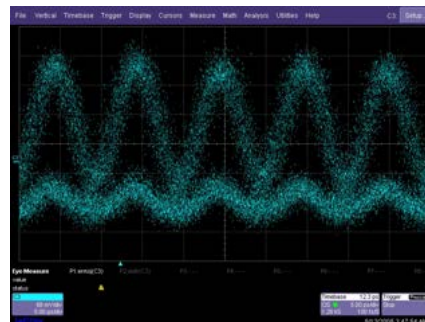
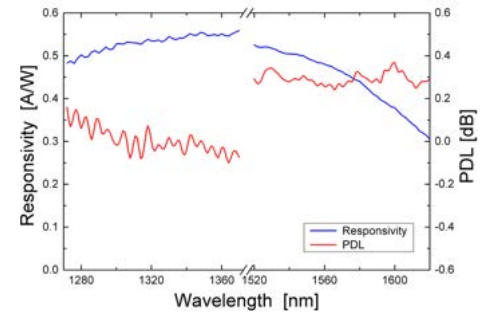
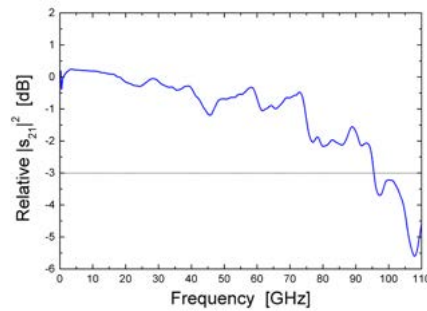
- datacommunication
- telecommunication
- test- & measurement systems
- microwave photonics

### Technical Background

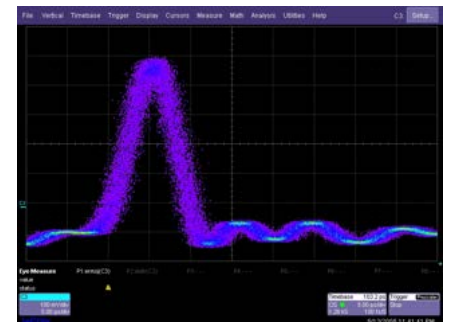
High-speed photodetector modules are of interest for the development of next-generation optical communication links in datacom and telecom. Since these R&D links are always a step ahead in terms of symbol rates, photodetector modules with a RF bandwidth beyond state-of-the-art are needed at the receiver side. Furthermore, the high-speed performance of the photodetector modules makes them applicable to microwave photonics.

The photodetector chips inside the modules are based on mature InP technology and are fabricated at the wafer process line of HHI, offering Telcordia and space-qualified processes. The chips are packaged at HHI facilities.





107 GB/s PRBS sequence



2.4 ps FWHM input pulse

### Technical Specifications

- 3 dB-bandwidth: up to 100 GHz
- C+L-band option  
wavelength: 1480 nm - 1620 nm  
responsivity: 0.5 A/W @ 1550 nm
- O-band & C+L-band option  
wavelength: 1270 nm - 1620 nm  
responsivity: 0.45 A/W @ 1550 nm  
0.5 A/W @ 1310 nm
- PDL: < 0.5 dB
- optical input power: up to +15 dBm
- dark current: < 100 nA @ 3 V
- bias voltage: +2 V
- 1 mm female RF connector
- RF output matched to 50 Ω
- optical input: FC/APC SMF fibre

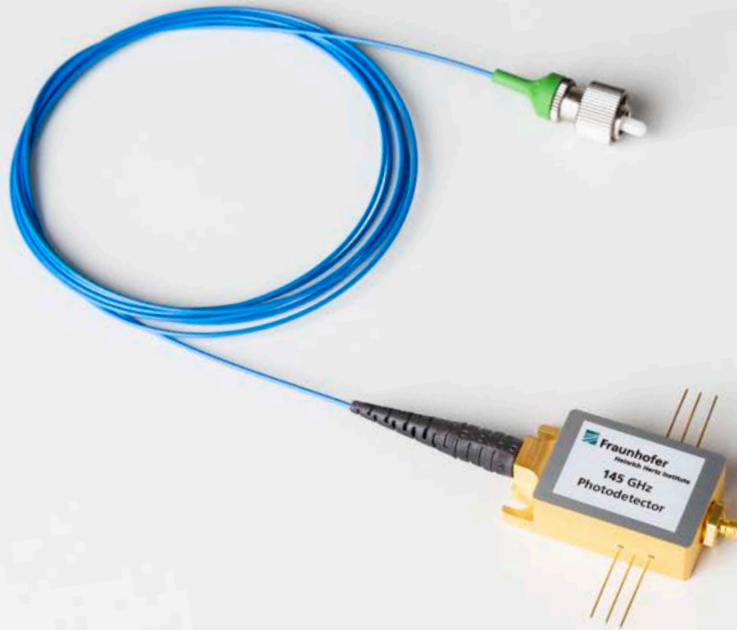
Dr.-Ing. Patrick Runge  
Photonic Components

Phone +49 30 31002-498  
patrick.runge@hhi.fraunhofer.de

Fraunhofer Heinrich Hertz Institute  
Einsteinufer 37, 10587 Berlin  
Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)

# 145 GHz PHOTODETECTOR MODULE



## AT A GLANCE

high-speed photodetector module for > 1 T/bs PAM datacom, telecom and microwave photonics applications

### Features

- up to 145 GHz 3 dB-bandwidth
- detection of 200 GBaud amplitude modulated signals
- operation in C- and L-band
- integrated bias network
- low bias operation
- 0.8mm RF connector

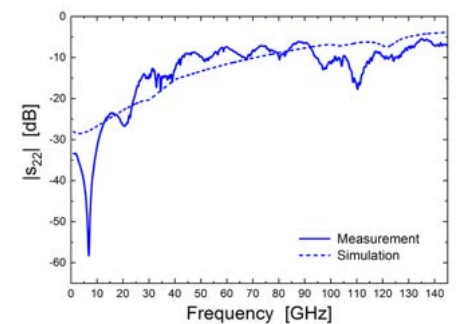
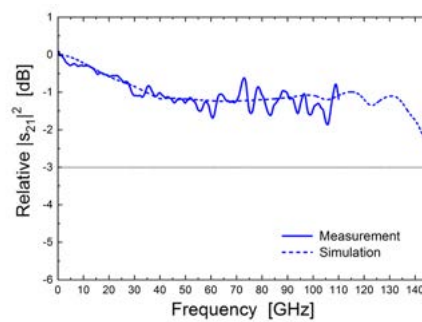
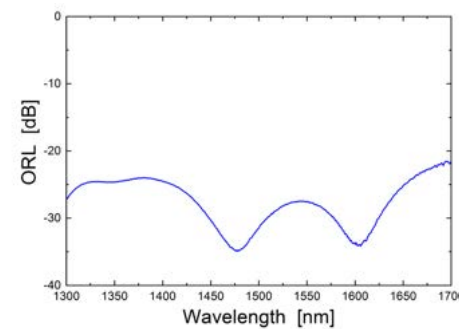
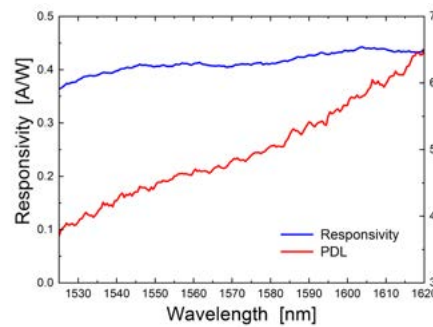
### Applications

- datacommunication
- telecommunication
- test- & measurement systems
- microwave photonics

### Technical Background

High-speed photodetector modules are of interest for the development of next-generation optical communication links in datacom and telecom. Since these R&D links are always a step ahead in terms of symbol rates, photodetector modules with a RF bandwidth beyond state-of-the-art are needed at the receiver side. Furthermore, the high-speed performance of the photodetector modules makes them applicable in microwave photonics.

The photodetector chips inside the modules are based on mature InP technology and are fabricated at the wafer process line of HHI, having Telcordia and space-qualified processes. The modules are also packaged at Fraunhofer HHI facilities.



### Technical Specifications

- wavelength: 1480 nm - 1620 nm
- 3 dB-bandwidth: up to 145 GHz
- low dark current: < 100 nA @ 3V
- bias voltage: +2V
- 0.8mm female RF connector
- RF output matched to 50  $\Omega$
- optical input: FC/APC PM SMF fibre

Dr.-Ing. Patrick Runge  
Photonic Components

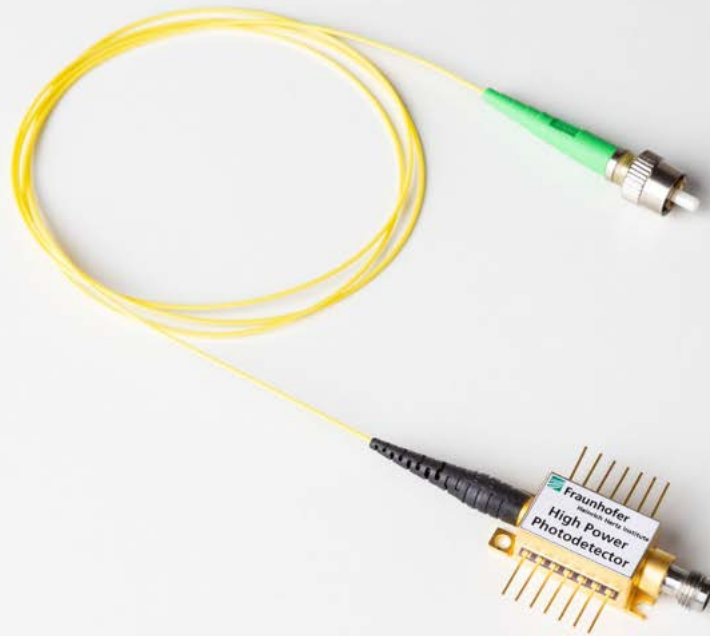
Phone +49 30 31002-498  
patrick.runge@hhi.fraunhofer.de

Fraunhofer Heinrich Hertz Institute  
Einsteinufer 37, 10587 Berlin  
Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)



# HIGH-POWER PHOTODETECTOR MODULE



## AT A GLANCE

High-speed photodetector module for microwave photonics applications

### Features

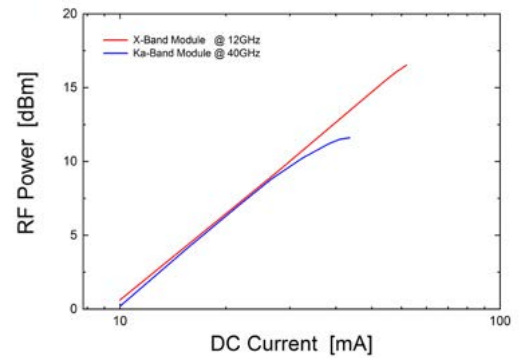
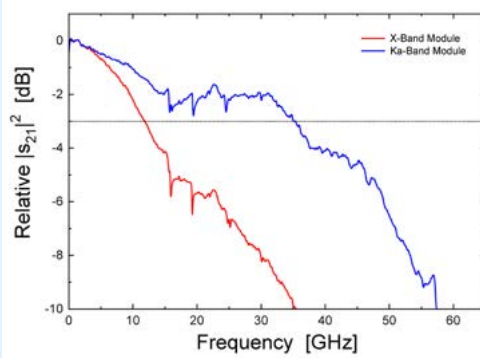
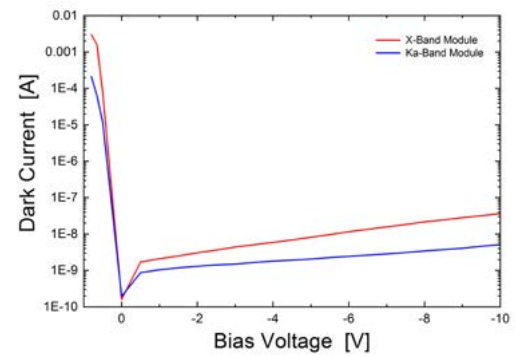
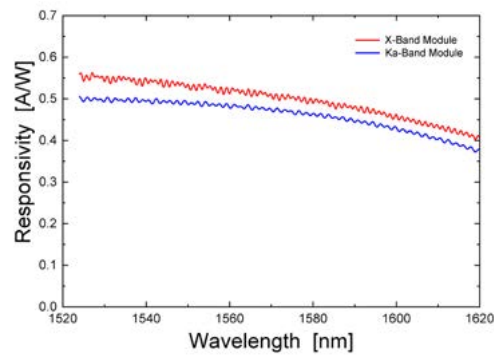
- up to 65 GHz 3 dB-bandwidth
- single or balanced configuration
- operation in C- and L-band
- integrated bias network
- 1.85 mm RF connector

### Applications

- radio-over-fibre
- phased array antennas
- precision frequency generation
- photonic channelizer

### Technical Background

High-power photodetector modules are of interest for down-converting optically generated signals in the field of microwave photonics. The photodetector chips inside the modules are based on mature InP technology and are fabricated at the wafer process line of HHI, having Telcordia and space-qualified processes. The modules are also packaged at HHI facilities.



### Technical Specifications

- wavelength: 1480 nm - 1620 nm
- 3 dB-bandwidth: up to 65 GHz
- low dark current: < 100 nA @ 3 V
- 1.85 mm female RF connector
- optical input: FC/APC SMF fibre

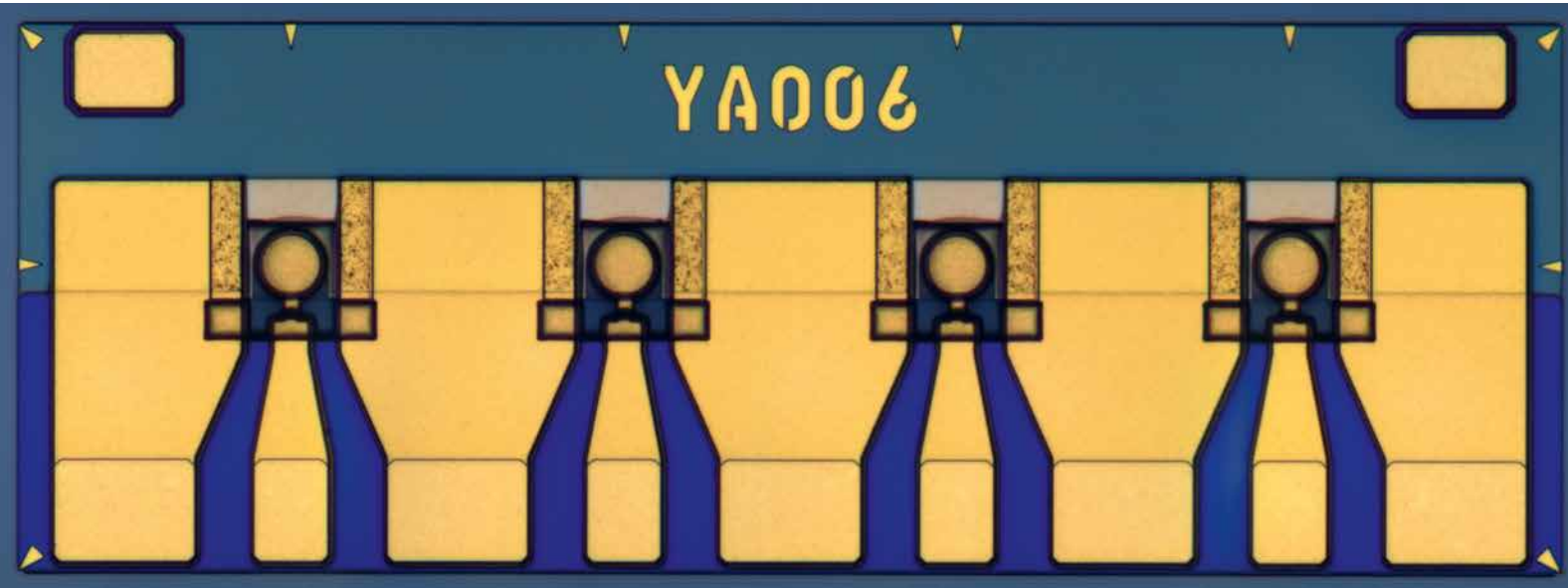
Dr.-Ing. Patrick Runge  
Photonic Components

Phone +49 30 31002-498  
patrick.runge@hhi.fraunhofer.de

Fraunhofer Heinrich Hertz Institute  
Einsteinufer 37, 10587 Berlin  
Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)

# 56 GBaud, 32 GBaud AND 28 GBaud SURFACE ILLUMINATED PHOTODIODES



## AT A GLANCE

high-speed surface illuminated InGaAs photodiodes for datacom, telecom and sensing applications

### Features

- up to 60 GHz 3 dB-bandwidth
- back side or top side illumination
- single diode or array configuration
- lens integration for back side illuminated photodiode (optional)
- integrated bias-T (optional)
- flip chip or wire bonding
- IEEE P802.3 bs compliant

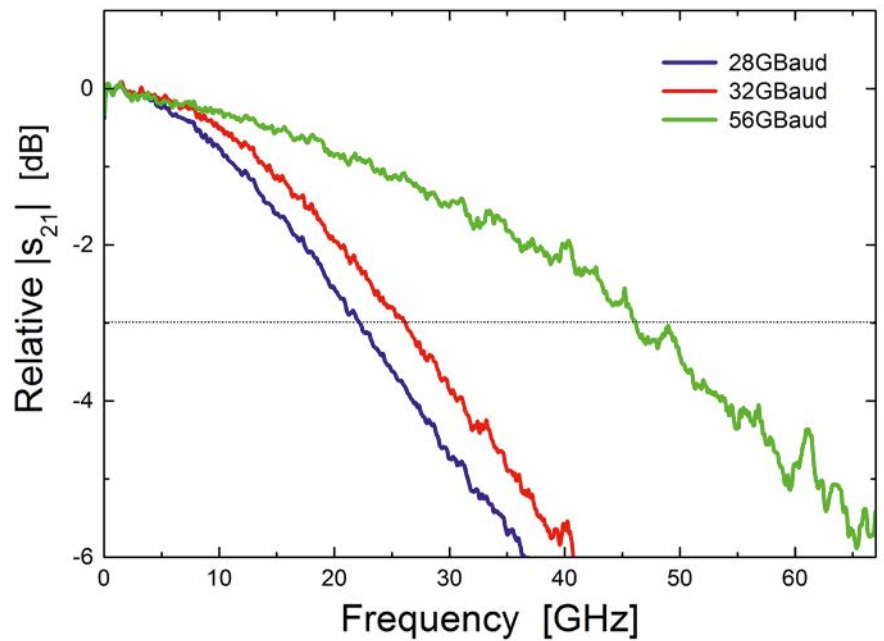
### Applications

- datacommunication
- telecommunication
- sensing

### Technical Background

High-speed surface-illuminated photodiodes are key components for hybrid-integrated photodetectors in datacom and telecom transceivers. The photodiodes operate at a wavelength of 1310 nm for intra-datacenter links or 1550 nm for inter-datacenter and long-haul optical communication links.

The photodiode chips are based on mature InP technology and are fabricated at the wafer process line of HHI, offering-Telcordia and space-qualified processes. Due to the ability of customising the photodiode chips, customers get the optimal performance for their application.



#### Technical Specifications

- wavelength: 1060 nm - 1700 nm
- responsivity:
  - 28GBaud: 0.95 A/W @ 1310 nm
  - 32GBaud: 0.75 A/W @ 1550 nm
  - 56GBaud: 0.7 A/W @ 1310 nm  
0.55 A/W @ 1550 nm
- low dark current: < 10 nA @ 5V
- IEEE P802.3bs compliant

#### Customisation

- 3 dB-bandwidth up to 60 GHz
- customised responsivity-bandwidth trade-off
- back side or top side illumination
- single diode or array configuration
- integrated bias-T
- lens integration for back side illuminated photodiode
- flip chip or wire bonding
- customised pitches and pad configurations

Dr.-Ing. Patrick Runge  
Photonic Components

Phone +49 30 31002-498  
patrick.runge@hhi.fraunhofer.de

Fraunhofer Heinrich Hertz Institute  
Einsteinufer 37, 10587 Berlin  
Germany

[www.hhi.fraunhofer.de/pc](http://www.hhi.fraunhofer.de/pc)