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High-Speed Detectors





Newport offers a complete line of **Fiber-Optic High-Speed Detectors** with thirteen new models to meet most measurement needs. These high-speed detectors find a wide variety of uses in the test and measurement of fast optical signals.

Both amplified and unamplified models are available in compact, rugged, instrument-style cases. Each unit houses a sealed, fiber-coupled detector module together with internally regulated power, current monitor, power indicating LED's and a convenient, top-mounted power switch. Unamplified models offer internal battery power for the utmost ease of use, and all models come with the choice of either ST or FC fiber optic input connectors (to be specified at time of order).

These detectors are specifically designed to fulfill the variety of photonics testing and measurement applications including digital telephone and data communications, analog microwave communications, as well as general high-speed research from 300 ps temporal resolution (1.5 GHz) to 7 picoseconds (60 GHz). **VIS-ir** (400-1700 nm) products for broad measurement interests are available as well as a full range of **IR** (950-1650 nm) and **XR** (700-1650 nm) products optimized for communications applications.

These products can also be used for free-space applications, by simply using the open end of a fiber-optic patch cord as the point of light collection. 50 µm and 62.5 µm core fibers offer collection numerical apertures of 0.2 and 0.3 in a very flexible, compact form that can easily be positioned inside any experimental setup.

For more details about the detectors, please visit www.newport.com and search for 'High Speed Detectors'.

- **PX-D7:** fastest visible detector available — 7 ps, 60 GHz
- **D-8ir:** fastest 1310/1550 nm detector available — 8 ps, 50 GHz
- **DG-15xr:** fastest 750-1650 nm detector available, 20 GHz
- **AD-10ir:** fastest 1310/1550 nm amplified detector available, 40 GHz
- **AD-50APDir:** highest sensitivity amplified detector available, -29 dBm

The complete line of D and AD Series high-speed detectors were developed for Newport by Picometrix®, Inc., Ann Arbor, Michigan. Picometrix is dedicated to the development and manufacture of state-of-the art picosecond optoelectronic devices and instrumentation. Clean-pulse™ technology is a trademark of Picometrix.

Unamplified

- Models from 100 ps (4 GHz) to 8 ps (50 GHz)
- 950–1650 nm and 700–1650 nm versions
- DG-15ir and DG-15xr for frequency domain applications to 20 GHz
- Optimized for maximum responsivity
- Self-contained, battery operated units

Amplified

- Models from 200 ps (2.5 GHz) to 50 ps (10 GHz)
- 950–650 nm and 700–1650 nm versions
- AD-40xr, fastest 700-1650 nm detector with 62.5 µm fiber input
- Integrated transimpedance amplifiers provide high conversion gains of up to 800 V/W
- Built-in current monitor

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Applications Product Selector

Application	Bit Rate Gb/s	Recommended Product(s)
InfiniBand	2.5	AD-200xr, AD-180xr
Fiber Channel	1.06	AD-200xr, AD-180xr
2x Fiber Channel	2.12	AD-200xr, AD-180xr
10Gb Fiber Channel	10.52	AD-50xr[1], AD-40xr
Gb Ethernet	1.25	AD-200xr, AD-180xr
2Gb Ethernet	2.5	AD-200xr, AD-180xr
10Gb Ethernet - W or R	9.95 or 10.3	AD-50xr[1], AD-40xr
10Gb Ethernet	12.5	AD-40xr
10Gb Ethernet (4-Channel)	3.125	AD-180xr
OC-48	2.49	AD-200ir[1], AD-200xr[1]
OC-192	9.95	AD-50ir[1], AD-50xr[1], AD-50APDir
OC-192 FEC	10.7	AD-50ir, AD-50xr, AD-50APDir
OC-192 SFEC	12.5	AD-40ir, AD-40xr, AD-40APDir
OC-768	39.8	AD-10ir
OC-768 FEC	43.0	AD-10ir

1) Reference Receiver option available

The Applications Table above can help you identify products best suited to their application. Applications listed are many of the most common "standard" telecom and datacom system definitions, along with the bit-rate they operate at.

The product column calls out those products specifically suited to operate as a system level receiver for the specified bit-rates. In this situation, the bandwidth of the receiver needs to fall in a fairly tight range. Too little bandwidth creates eye-closure problems, and too much bandwidth allows waveform artifacts to induce errors.

These products have been designed to have an electrical bandwidth (in GHz) that is approximately 75-80% of the bit-rate (in Gb/s). This provides the best fidelity in a classic receive application.

For precise system and transmitter characterization to industry standards, we offer "Reference Receiver" options for several products at 2.5 Gb/s and 10 Gb/s bit-rates. These special receivers have their frequency and phase characteristics controlled to precise standards in order to produce a known or "reference" response against which other system components can be measured. These receivers also offer frequency response down to DC in order to enable accurate extinction ratio measurements within the system.

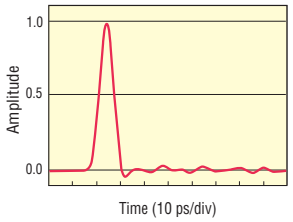
For diagnostic applications, where the user desires to see any artifacts that are present on the signal waveform, we recommend choosing a receiver with at least two to three times the normal receive bandwidth.

IR and XR Series detectors

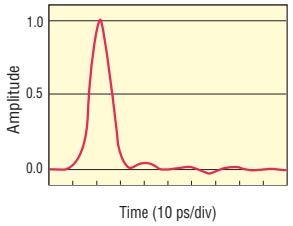
IR and XR D-Series Unamplified Detectors are designed to meet the rigorous standards of the telephone and data communications industry. The product line is targeted to the needs of communication systems developers both at bit-rate speeds as well as diagnostic speeds. As such, they have optimized performance in narrower wavelength bands. Two different wavelength ranges are available, denoted by the suffixes **-ir** and **-xr**. The **-ir** versions are optimized for wavelengths in the 950-1650 nm range, while the **-xr** series offers an extended range of 700-1650 nm, for both telecom and datacom wavelengths in a single unit. The DG-15ir and DG-15xr are frequency domain products for analog, microwave applications that require a flat power bandwidth from DC-20 GHz.

All these communications products are based on proprietary, high-performance PIN photodiode structures that yield maximum speed and sensitivity for each model. In addition, these products have other features such as fiber diameter, optical return loss and risetimes that meet or exceed the specifications set by commercial communications standards for telecom and datacom. Most of the unamplified products are available with

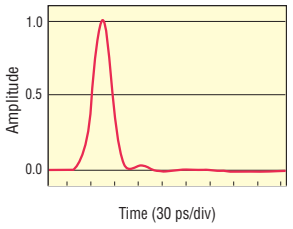
Impulse Responses



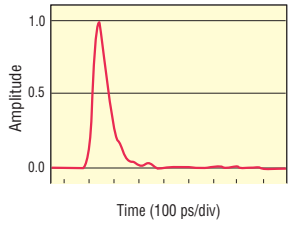
PX-D7 *Impulse Response*



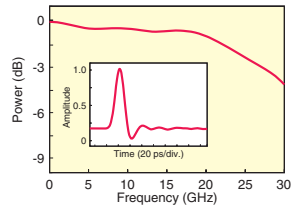
D-15 *and* D-15*ir Impulse Response*



D-30 *Impulse Response*



D-100 *impulse Response*



Frequency plot for the DG-15*ir and* DG-15*xr*

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either a 1k Ω internal termination for maximum conversion gain (standard), or an optional 50 Ω termination for low reflection (VSWR) applications.

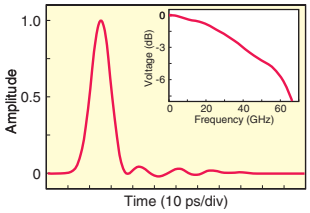
The **IR and XR AD-Series Amplified Detectors** present the user with the same versatile photodiodes coupled with a transimpedance amplifier for a high conversion gain and superior sensitivity. These products include receivers for the data rates from 2.5 Gb/s to 40 Gb/s enabling them to be used for testing OC-768, OC-192 and OC-48 speed systems at the receiving end of the link. **Reference receivers** at 2.5 Gb/s and 10 Gb/s are now also available. For uses requiring high-sensitivity two new APDir amplified detectors are available for 10 Gb/s and 12.5 Gb/s applications.

The IR and XR 10 Gb/s and 12.5 Gb/s PIN designs offer proven telecom level reliability with higher than average responsivity. The XR versions provide unprecedented responsivity across the entire 700nm to 1650nm spectrum.

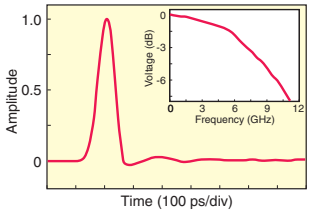
The APDir products utilize an APD design that is novel and has demonstrated world record receiver sensitivities that are now available. These Avalanche Photodiodes provide the detector with internal gain levels that have not been achievable before in conventional designs.

The 40 Gb/s photodiodes also have a patented design that greatly increases responsivity without sacrificing spectral response. They also have extremely low polarization dependent responsivity and proven, telecom level reliability.

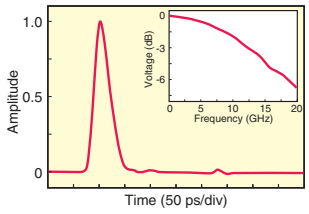
Detector Impulse Responses



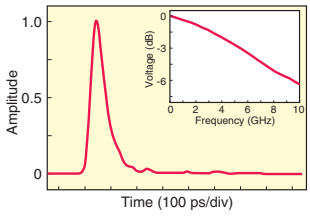
Time plot for the D-8*ir*



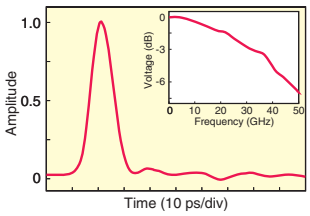
Time plot for the D-25*xr*



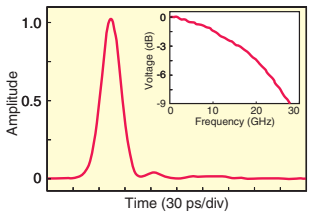
Time plot for the D-50*ir*



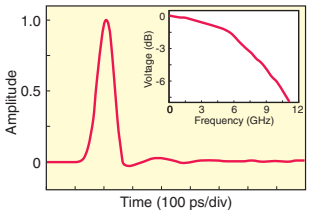
Time plot for the D-100 *and* D-100*ir*



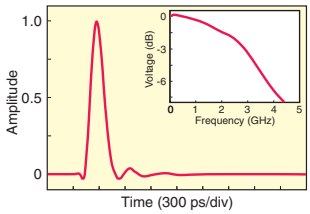
Time plot for the D-15 *and* D-15*ir*



Time plot for the D-30 *and* D-30*ir*



Time plot for the D-70*xr*



Time plot for the AD-200, AD-200*ir and* AD-200*xr*

Frequency Domain Detectors

The DG-15ir and DG-15xr photodetectors are specifically designed to be analog, frequency-domain detectors for communications applications where a flat frequency response (±1 dB) from DC-20 GHz is required. The DG-15ir is specifically optimized for the 950-1650nm spectral range with single-mode fiber input, while the DG-15xr provides the same DC-20 GHz performance with 700-1650nm spectral coverage and multimode fiber input. These units are also battery powered, and fully self-contained.

Microwave applications typically benefit from this type of frequency response, where the responsivity of the detector must remain constant over the entire usable 20 GHz band. These models have the same basic performance as the D-15ir (29 GHz opt bandwidth) except that the frequency response shape has been flattened to 20 GHz. As a result of this frequency response shape, the pulse or time-domain performance is compromised resulting in a pulse that rings slightly (see plots and application note).

As with all the D-Series communications detectors, the detector element is optimized for maximum responsivity and the optical return loss is better than 30 dB with a single-mode fiber input on the DG-15ir and 14 dB with multimode fiber on the DG-15xr. Output termination is fixed at 50 ohms for low reflection (VSWR) performance.

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Specifications

IR Receivers

Model	AD-10ir	AD-40ir	AD-40APDir	AD-50ir	AD-50ir/RR	AD-50APDir	AD-200ir	AD-200ir/RR
Spectral Response (nm)	950–1650	950–1650	950–1650	950–1650	950–1650	950–1650	950–1650	950–1650
Bit Rate (Gb/s) (Test Rate)	43	12.5	40	50	50	50	200	200
Impulse Response, Maximum (ps)[1]	10	40	40	50	50	50	200	200
Voltage Bandwidth, -3 dB Typical (GHz)[2]	43	12	12	10	10	10	2.5	2.5
Power Bandwidth, -3 dB Typical (GHz)[3]	35	9	9	8	8	7.5	1.8	1.8
Conversion Gain, Minimum (into 50Ω) @ 1310 nm @ 1310 nm (V/W)	110	400	3500	425	425	3500	800	800
Sensitivity Typical @ 1550 nm (dBm)	-8	-20	-27	-20	-20	-29	-24	-24
Return Loss, Electrical (dB)	-8	-10	-10	-10	-10	-10	-10	-10
Dark Current, Maximum (at 25°C) (nA)	20	20	100	20	20	100	20	20
NEP, Maximum @ 1310 nm (pW/√Hz)[4]	40	9	3	15	15	3	15	15
Maximum Average Power, Peak @ 1310 nm (mW)	4	5	5	2.5	2.5	2.5	0.7	0.7
Input Fiber Diameter (µm)	9	9	9	9	9	9	9	9
Optical Return Loss, Maximum (dB)	-30	-30	-30	-30	-30	-30	-30	-30
Ouput Impedance, Nominal (Ω)	50	50	50	50	50	50	50	50
Output Connector	Anritsu-V	SMA	SMA	SMA	SMA	SMA	SMA	SMA

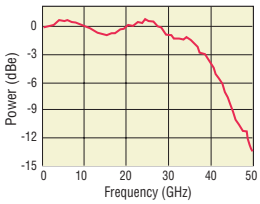
XR Receivers

Model	AD-40xr	AD-50xr	AD-50xr/RR	AD-70xr	AD-180xr	AD-200xr	AD-200xr/RR
Spectral Response (nm)	700–1650	700–1650	700–1650	700–1650	700–1650	700–1650	700–1650
Bit Rate (Gb/s) (Test Rate)	12.5	10.7	10.3	N/A	2.5	2.5	2.5
Impulse Response, Maximum (ps)[1]	40	50	50	70	180	200	200
Voltage Bandwidth, -3 dB Typical (GHz)[2]	12	10	10	6	3	2.5	2.5
Power Bandwidth, -3 dB Typical (GHz)[3]	8.5	8	7.5	4.5	2.3	1.8	1.8
Conversion Gain, Minimum (into 50Ω) @ 1310 nm (V/W)	400	450	450	450	800	800	800
Sensitivity Typical @ 1550 nm (dBm)	-19	-19	-19	N/A	-23	-23	-23
Return Loss, Electrical (dB)	-10	-10	-10	-10	-10	-10	-10
Dark Current, Maximum (at 25°C) (nA)	50	50	50	50	50	50	50
NEP, Maximum @ 1310 nm (pW/√Hz)[4]	10	20	20	20	20	15	20
Maximum Average Power (mW)	5	2.5	5.5	5.5	5	5	5
Input Fiber Diameter (µm)	62.5	62.5	62.5	62.5	62.5	62.5	62.5
Optical Return Loss, Maximum (dB)	-14	-14	-14	-14	-14	-14	-14
Ouput Impedance, Nominal (Ω)	50	50	50	50	50	50	50
Output Connector	SMA	SMA	SMA	SMA	SMA	SMA	SMA

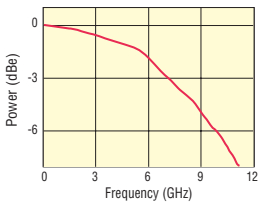
1) Full duration at half-max
2) Often termed “optical” bandwidth
3) Often termed electrical bandwidth
4) Limited by thermal noise of external 50 Ω load resistor
5) 50 Ω termination available as special order

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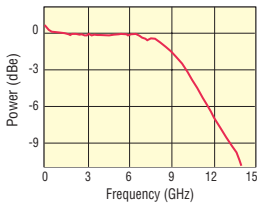
Frequency Responses



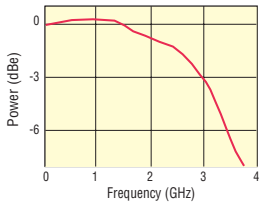
AD-10*ir*



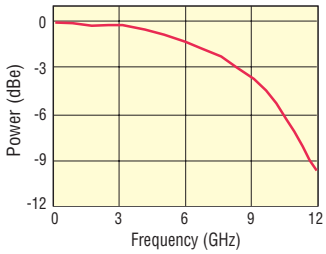
AD-70*xr*



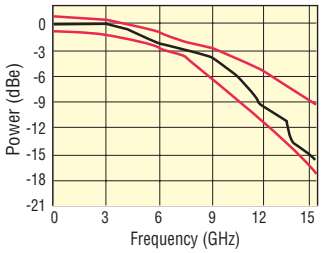
AD-40APD*ir*



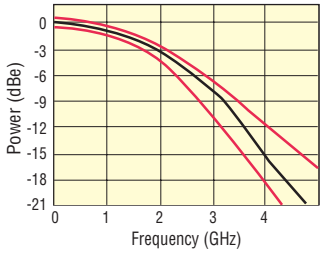
AD-180*xr*



AD-50*ir*, AD-50*xr*, AD-50APD*ir*



AD-50*ir*/RR, AD-50*xr*/RR



AD-200*ir*/RR, AD-200*xr*/RR

Unamplified Detectors - IR and XR Series

Model	D-8ir	D-15ir	DG-15ir	D-30ir	D-50ir	D-100ir	DG-15xr	D-25xr	D-70xr
Spectral Response (nm)	950–1650	950–1650	950–1650	950–1650	950–1650	950–1650	700–1650	700–1650	700–1650
Impulse Response, Maximum (ps)[1]	8	15	Freq. Domain	30	50	100	Freq. Domain	25	70
Voltage Bandwidth, -3 dB Typical (GHz)[2]	50	29	N/A	15	10	4	N/A	20	6
Power Bandwidth, -3 dB Typical (GHz)[3]	40	21	20 (-1 dB)	11	7.5	3.5	20 (-1 dB)	17	4.5
Responsivity, Minimum @ 850 nm (A/W)	N/A	N/A	N/A	N/A	N/A	N/A	0.5	0.5	0.5
Conversion Gain (into 50Ω) @ 850 nm ()	N/A	N/A	N/A	N/A	N/A	N/A	13	25	25
Responsivity, Minimum @ 1310 nm (A/W)	0.7	0.6	0.6	0.8	0.9	0.9	0.8	0.8	0.8
Conversion Gain, (into 50Ω) @ 1310 nm @ 1310 nm ()	17.5	30	15	40	45	45	20	40	40
Dark Current, Maximum (at 25°C) (nA)	20	20	20	20	20	20	50	20	20
NEP, Maximum (pW/√Hz)[4]	50	30	60	23	20	20	45	21	23
Maximum Average Power (mW)	5	5	5	5	5	5	5	5	5
Input Fiber Diameter (dB)	9	9	9	9	9	62.5	62.5	62.5	62.5
Optical Return Loss, Maximum (dB)	-30	-30	-30	-30	-30	-30	-14	-14	-14
Ouput Termination, Nominal (Ω)	50	1k	50	1k	1k	1k	50	1k	1k
Output Connector	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K	Anritsu-K

1) Full duration at half-max
2) Often termed "optical" bandwidth
3) Often termed electrical bandwidth
4) Limited by thermal noise of external 50 Ω load resistor
5) 50 Ω termination available as special order

AC vs. DC Output Coupling

All of our high-speed detector and receiver products are available with DC output coupling which allows the user to make DC and high-speed optical measurements with the same detector or receiver model. If the user desires to make AC-only measurements, we recommend adding an external DC-blocking capacitor to the output of the device. By selecting the capacitor value, the user can choose a low-frequency cut-off point that is best suited to his needs. Your Newport sales-engineer can help with these recommendations.

When DC-coupling to a receiver, the user must be aware of the output DC offset voltage that may be present. Most products have a zero-voltage output offset and pose no problem for output connection. Some receivers, however, do have a DC -level present at the output. This is dictated by the amplifier used in the product and is often tolerated so that DC measurements can be made. For some models, that have a significant DC offset (up to 3 volts), we offer the user an AC-coupled version that integrates the DC-block within the receiver so no extra part needs to be used. With this option, the low-frequency cut-off is limited to about 1 MHz. If you need lower frequency performance, purchase the DC-coupled version and supply your own external DC-block.

VIS-ir Series Detectors

VIS-ir D-Series Unamplified Detectors are based on interdigitated MSM type photodiode detector structures that enable use in the widest variety of applications. They have exceptionally broad wavelength sensitivity from 400 to 1700 nm (except the PX-D7) and large (at least 50 µm), multimode fiber-optic inputs.

The MSM detector design is unique in that it can achieve very high speed (up to 60 GHz or 7 ps) with a large 50 µm active area. As a result, the 50 µm optical input fiber makes these products much easier to use than comparable single-mode products. A 50 µm fiber can provide up to 100 times more light gathering capacity than single-mode fibers in certain measurement situations. The multimode fiber also effectively reduces back reflections into single-mode systems because of the large difference in core areas. Detectors with either ST or FC input connector styles are offered. These features, coupled with the full spectral sensitivity of 400-1700 nm make these products a great value for general high-speed research.

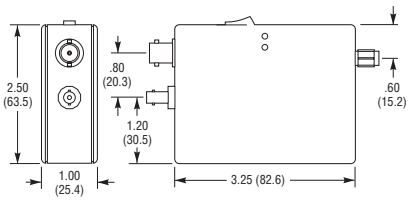
VIS-ir AD-Series Amplified Detectors offer the same broad spectral range and large input fibers as their unamplified counterparts, and also include a transimpedance amplification stage that boosts their conversion gain to at least 200 V/W. To effectively minimize parasitics and to shield the amplifier components from outside noise sources, both the detection element and the amplifier are integrated on a common substrate contained in the microwave module.

Amplified Detectors - VIS-IR Detectors

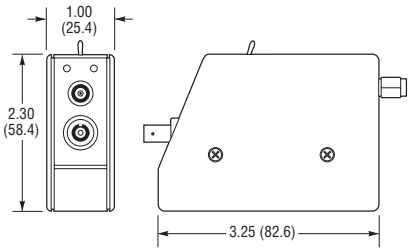
Model	AD-200	AD-300
Spectral Response (nm)	400–1700	400–1700
Impulse Response, Maximum (ps)[1]	200	300
Voltage Bandwidth, -3 dB Typical (GHz)[2]	2.5	1.5
Power Bandwidth, -3 dB Typical (GHz)[3]	1.8	1.1
Conversion Gain (into 50Ω) @ 850 nm (V/W)	200	200
Conversion Gain, (into 50Ω) @ 1310 nm @ 1310 nm (V/W)	200	200
Dark Current, Maximum (at 25°C) (nA)	50	50
NEP, Maximum (pW/√Hz)[4]	60	60
Maximum Average Power (mW)	5	5
Input Fiber Diameter (µm)	50	50
Ouput Termination, Nominal (Ω)	50	50
Output Connector	SMA	SMA

Dimensions

D/AD-Series



PX-D7



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Unamplified Detectors - VIS-IR Detectors

Model	PX-D7	D-15	D-30	D-100
Spectral Response (nm)	400–900	400–1700	400–1700	400–1700
Impulse Response, Maximum (ps)[1]	7	15	30	100
Voltage Bandwidth, -3 dB Typical (GHz)[2]	60	29	15	4
Power Bandwidth, -3 dB Typical (GHz)[3]	45	21	11	2.8
Conversion Gain (into 50Ω) @ 850 nm (V/W)	1	10	10	10
Dark Current, Maximum (at 25°C) (nA)	100	50	50	50
NEP, Maximum (pW/√Hz)[4]	900	90	90	90
Maximum Average Power (mW)	5	5	5	5
Input Fiber Diameter (µm)	50	50	50	50
Ouput Termination, Nominal (Ω)	100	1k	1k	1k
Output Connector	Anritsu-V	Anritsu-K	Anritsu-K	Anritsu-K

1) Full duration at half-max
2) Often termed "optical" bandwidth
3) Often termed electrical bandwidth
4) Limited by thermal noise of external 50 Ω load resistor
5) 50 Ω termination available as special order

Ordering Information

Model	Description
Unamplified	
PX-D7	VIS-IR Receiver, 45 GHz, 400-900 nm
D-15	VIS-IR Receiver, 21 GHz, 400-1700 nm
D-30	VIS-IR Receiver, 11 GHz, 400-1700 nm
D-100	VIS-IR Receiver, 2.8 GHz, 400-1700 nm
D-8ir	IR Detector, 8 ps, 950-1650 nm
D-15ir	IR Detector, 15 ps, 950-1650 nm
DG-15ir	20 GHz Flat Frequency Response Detector
D-30ir	IR Detector, 30 ps, 950-1650 nm
D-50ir	IR Detector, 50 ps, 950-1650 nm
D-100ir	IR Detector, 100 ps, 950-1650 nm
DG-15xr	20 GHz Flat Frequency Response Detector
D-25xr	Extended IR Detector, 25 ps, 700-1650 nm
D-70xr	Extended IR Detector, 70 ps, 700-1650 nm
Amplified	
AD-200	VIS-IR Receiver, 2.5 GHz, 400-1700 nm
AD-300	VIS-IR Receiver, 1.5 GHz, 400-1700 nm
AD-10ir	IR Receiver, 43 GHz, 950-1650 nm
AD-40ir	IR Receiver, 12 GHz, 950-1650 nm
AD-40APDir	IR Receiver, 12 GHz, 950-1650 nm
AD-50ir[1]	IR Receiver, 10 GHz, 950-1650 nm
AD-50ir/RR[1]	IR Receiver, 10 GHz, 950-1650 nm
AD-50APDir	IR Receiver, 10 GHz, 950-1650 nm
AD-200ir	IR Receiver, 2.5 GHz, 950-1650 nm
AD-200ir/RR	IR Receiver, 2.5 GHz, 950-1650 nm
AD-40xr	Extended-IR Receiver, 12 GHz, 700-1650 nm
AD-50xr[1]	Extended-IR Receiver, 10 GHz, 700-1650 nm
AD-50xr/RR	Reference Receiver, 10 GHz, 950-1650 nm
AD-70xr	Extended-IR Receiver, 6 GHz, 700-1650 nm
AD-180xr	Extended-IR Receiver, 6 GHz, 700-1650 nm
AD-200xr	Extended-IR Receiver, 2.5 GHz, 700-1650 nm
AD-300	VIS-IR Receiver, 1.5 GHz, 400-1700 nm
AD-200	VIS-IR Receiver, 2.5 GHz, 400-1700 nm
AD-200xr/RR	Reference Receiver, 2.5 GHz, 700-1650 nm

General:

Select detector of choice from above ordering information table and add the -ST or -FC suffix to complete the Model number for ST or FC connector input option, respectively.

Examples:

D-15-ST—15ps detector with ST connector input.

D-30-FC—30ps detector with FC connector input.

1) These IR-receivers and Extended IR-receivers are offered with AC or DC coupling, add the /AC or /DC designation to complete the Model number for AC or DC coupling.

Example:

AD-50IR/**AC**-FC

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