

Product Guide:

Silicon Photodiodes, Silicon PIN Photodiodes, and Avalanche Photodiodes

The following listings provide a guide to silicon photodiodes, silicon PIN photodiodes, and avalanche photodiodes (APDs). These are semiconductor devices that respond to the presence of photons, deriving a corresponding electrical current from that response in an external circuit. Photodiodes have become the workhorse of the detection industry, with applications in such diverse fields as defense, spectroscopy, medical imaging, laser rangefinding, laboratory instrumentation, surface characterization, photography, and others.

It would have been appropriate to include in this product guide the “older brother” of these light-detecting devices—the photomultiplier tube (PMT)—but space would not permit this. The PMT offers low-light-level detection at a reasonable speed, but its spectral range is limited and its efficiency falls well below that of its chief rival, the APD.

Other limitations on these listings are that hybrids had to be omitted, so that what follows are single-element devices, and it

was impossible to extend the listings to fiber optic wavelengths. Furthermore, this is not intended to be a comprehensive guide, but rather a representative one, showing a select group of capabilities to suggest the scope of the leading manufacturers’ offerings. For a comprehensive listing of models, consult the manufacturers’ web sites and literature.

All figures in the table are typical. Comparisons between manufacturers’ offerings are complicated by the fact that there is no agreed-upon matrix for specifications, so some arbitrary choices had to be made. Where the manufacturer did not supply a key figure, the reader should go to the source for additional information.

In addition to making progress in the reliability and ruggedness of these versatile devices in recent years, another important development is the expansion of their response into shorter wavelengths. Practically every leading manufacturer has a blue-enhanced and a UV-enhanced product line now.

Company & Model No.	Active Area (mm)	Spectral Response (λ)	Responsivity (A/W)	Dark Current (nA) (typ)	Rise Time (μ s)	Noise Equivalent Power (W/Hz ^{1/2})	Package	
HAMAMATSU (www.hamamatsu.com)								
Silicon Photodiodes								
S1336-18BQ	1.1 × 1.1	190 to 1100	0.12	20 pA	0.1	5.7×10^{-15}	Metal TO-18	
S1336-18BK	1.1 × 1.1	320 to 1100	—	20 pA	0.1	5.7×10^{-15}	Metal TO-18	
S1336-5BQ	2.4 × 2.4	190 to 1100	0.12	30 pA	0.2	8.1×10^{-15}	Metal TO-5	
S1336-5BK	2.4 × 2.4	320 to 1100	—	30 pA	0.2	8.1×10^{-15}	Metal TO-5	
S1336-44BQ	3.6 × 3.6	190 to 1100	0.12	50 pA	0.5	1.0×10^{-14}	Metal TO-5	
S1336-44BK	3.6 × 3.6	320 to 1100	—	50 pA	0.5	1.0×10^{-14}	Metal TO-5	
S1336-8BQ	5.8 × 5.8	190 to 1100	0.12	100 pA	1	1.3×10^{-14}	Metal TO-5	
S-1336-8BK	5.8 × 5.8	320 to 1100	—	100 pA	1	1.3×10^{-14}	Metal TO-5	
S1337-16BQ	1.1 × 5.9	190 to 1100	0.12	30 pA	0.2	8.1×10^{-15}	Ceramic 2.7 × 115	
S1337-16BR	1.1 × 5.9	190 to 1100	0.12	30 pA	0.2	6.5×10^{-15}	Ceramic 2.7 × 15	
S1227-16BQ	1.1 × 5.9	190 to 1000	0.12	5 pA	0.5	2.5×10^{-15}	Ceramic 2.7 × 15	
S1227-16BR	1.1 × 5.9	320 to 1000	—	5 pA	0.5	2.1×10^{-15}	Ceramic 2.7 × 15	
S2386-18K	1.1 × 1.1	320 to 1100	0.38	2 pA	0.4	6.8×10^{-16}	Metal TO-18	
S2387-16R	1.1 × 5.9	320 to 1100	0.38	5 pA	1.8	9.9×10^{-16}	Ceramic 2.7 × 15	
Silicon PIN Photodiodes								
S5821	1.2	320 to 1100	0.55	0.05	—	6.7×10^{-15}	TO-18	
S5971	1.2	320 to 1060	0.55	0.07	—	7.4×10^{-15}	TO-18	
S4707-01	2.4 × 2.8	320 to 1100	0.5	0.08	—	9.0×10^{-15}	Plastic	
S5052	3.0	320 to 1000	0.45	0.02	—	55×10^{-15}	Plastic with lens	
S1223	2.4 × 2.8	320 to 1100	0.54	0.1	—	9.4×10^{-15}	TO-5	
S5106	5 × 5	320 to 1100	0.62	0.4	—	1.6×10^{-14}	Ceramic chip-carrier	
Silicon Avalanche Photodetectors (APDs)								
S2381	0.2	400 to 1000	0.5	0.05	—	100	TO-18	Gain = 100
S2385	5.0	400 to 1000	0.5	0.05	—	40	TO-18	Gain = 100
S6045-01	0.2	400 to 1000	0.5	0.05	—	100	TO-18	Gain = 100
S6045-06	5.0	400 to 1000	0.5	3	—	40	TO-8	Gain = 40
S5343	1.0	200 to 1000	0.42	1	—	50	TO-18	Gain = 50
S5345	5.0	200 to 1000	0.42	300	—	50	TO-8	Gain = 50

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UDT (www.udt.com)							
Silicon Photodiodes							
PIN-020A	0.51	350 to 1100	0.65 (970 nm)	0.01	26 ns	2.8 e-15	TO-18
PIN-040A	1.02	350 to 1100	0.65 (970 nm)	0.05	24 ns	6.2 e-15	TO-18
PIN-25D	27.9	350 to 1100	0.65 (970 nm)	15	250 ns	1.1 e-13	BNC
FIL-3C	1.27 × 2.54	350 to 1100	0.65 (970 nm)	0.15	13 ns	1.1 e-14	Plastic
PIN-2DPI	0.81 × 1.37	350 to 1100	0.60 (970 nm)	—	30 ns	2.1 e-15	TO-18
PIN-125DPL	1.27 × 1.27	350 to 1100	0.60 (980 nm)	—	30 ns	2.1 e-15	TO-18
FIL-3V	1.27 × 2.54	350 to 1100	0.60 (980 nm)	—	20 ns	3.0 e-15	Plastic
PIN-5DP/SB	2.54	350 to 1100	0.20	—	0.2 ns	5.2 e-14	TO-5
UV-001	1.0	254 to 1100	0.14 (254 nm)	—	0.2 ns	6.4 e-14	TO-5
FIL-UV005	2.54	254 to 1100	0.14 (254 nm)	—	0.9	9.2 e-14	Plastic
PIN-HS005	0.127	350 to 1100	0.40 (830 nm)	0.01	0.30 ns	3.6 e-15	TO-18
PIN-HR005	0.127	350 to 1100	0.50 (830 nm)	0.01	0.60 ns	5.0 e-15	TO-18
PIN-UH5016	0.406	350 to 1100	0.35 (830 nm)	0.20	0.25 ns	7.2 e-15	TO-18
Avalanche Photodiodes							
PIN-APD032 (850 nm)	0.8	—	75	3	2.0 ns	—	TO-5 Gain = 120
PIN-APD032 (1064 nm)	0.8	—	20	3	2.0 ns	—	TO-5 Gain = 120
ADVANCED PHOTONIX (www.advancedphotonix.com)							
Silicon PIN Photodiodes							
SD 057-14-21-011	0.051 × 0.051	300 to 1100	0.36	0.1	10 ns	1 × 10 ⁻¹⁴	—
SD 076-14-21-011	0.105 × 0.043	300 to 1100	0.36	0.2	11 ns	1.4 × 10 ⁻¹⁴	—
SD 290-14-21-041	0.300 × 0.230	300 to 1100	0.36	2.5	70 ns	5.6 × 10 ⁻¹⁴	—
SD 445-14-21-305	0.394 × 0.394	300 to 1100	0.36	6.0	200 ns	8.6 × 10 ⁻¹⁴	—
SD-057-11-21-015	0.51 × 0.51	300 to 1100	0.36	0.5	7 ns	2.8 × 10 ⁻¹⁴	—
SD 057-11-21-011	0.51 × 0.51	300 to 1100	0.36	0.5	7 ns	2.8 × 10 ⁻¹⁴	—
SD 445-11-21-041	0.394 × 0.394	300 to 1100	0.36	30.0	140 ns	2.0 × 10 ⁻¹³	—
SD 020-11-33-211	0.020 × 0.20	300 to 1100	0.55	0.5	1 ns	2.4 × 10 ⁻¹⁴	—
SD 290-11-31-241	0.300 × 0.220	300 to 1100	0.50	110	3 ns	3.8 × 10 ⁻¹³	—
SD 172-13-23-222	0.185 × 0.125	200 to 1100	0.10	4.4	30 ns	7.2 × 10 ⁻¹⁴	—
SD 041-12-22-011	0.040 × 0.033	250 to 1100	0.28	0.3	5 ns	1.7 × 10 ⁻¹⁴	—
Avalanche Photodiodes ("Large-Area APDs")							
118-70-75-520	3 (dia.)	—	30 @ 160 nm	20	8 ns	—	Gain = 250
118-70-773-520	3 (dia.)	—	38 @ 350 nm	20	8 ns	—	Gain = 250
118-70-74-520	3 (dia.)	—	70 @ 500 nm	20	8 ns	—	Gain = 250
118-70-72-520	3 (dia.)	—	100 @ 750 nm	20	8 ns	—	Gain = 250
(All four of the above are also available with 5-mm, 10-mm, and 16-mm active areas, with similar specifications.)							
118-70-73-581	3 (dia.)	—	35 @ 350 nm	20	8 ns	—	Gain = 250
118-70-74-581	3 (dia.)	—	65 @ 500 nm	20	8 ns	—	Gain = 250
118-70-72-581	3 (dia.)	—	93 @ 750 nm	20	8 ns	—	Gain = 350
(All three of the above are also available with 5-mm, 10-mm, and 16-mm active areas, with similar specifications.)							
118-70-73-591	3 (dia.)	—	55 @ 350 nm	4	8 ns	—	Gain = 350
118-70-74-591	3 (dia.)	—	95 @ 500 nm	4	8 ns	—	Gain = 350
118-70-72-591	3 (dia.)	—	135 @ 750 nm	4	8 ns	—	Gain = 350
197-70-73-521	5 (dia.)	—	35 @ 350 nm	50	8 ns	—	Gain = 250
197-70-74-521	5 (dia.)	—	65 @ 500 nm	50	8 ns	—	Gain = 250
197-70-72-521	5 (dia.)	—	93 @ 750 nm	50	8 ns	—	Gain = 250
PERKINELMER (www.perkinelmer.com)							
Silicon PIN Photodiodes							
C30971E	0.5	400 to 1100	0.5	10	0.5 ns	113	TO-18
C30971EQCXX	0.5	400 to 1100	0.45	10	0.5 ns	126	—
C30971BFC	0.5	400 to 1100	0.45	10	0.5 ns	126	—
FFD-040B	1	400 to 1100	0.58	1	2 ns	31	TO
DF-254	4.4 × 4.7	400 to 1100	0.12	—	—	245	—

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PERKINELMER, cont'd							
Silicon PIN Photodiodes							
DF-300	4.4 × 4.7	400 to 1100	0.12	—	—	350	
C30735-1	0.20	400 to 1100	0.55	0.05	0.3 ns	11	—
YAG-040A	1	400 to 1100	0.4	3	12 ns	97	—
YAG-100A	2.5	400 to 1100	0.4	10	15 ns	155	—
YAG-444A	11.3	400 to 1100	0.4	75	25 ns	406	—
C30831E	0.5	400 to 1100	0.6	0.5	3 ns	21	TO
C308310E	11.4	400 to 1100	0.6	30	12 ns	163	TO
UV-040BG/UV-040BQ	1	220 to 1100	0.12 (@ 250 nm)	—	—	5	TO
Avalanche Photodiodes							
C30902E	0.5	400 to 1100	77	15	0.5 ns	3.0	—
C30703E/F	10 × 10	400 to 1100	16	10	5 ns	40	—
C30724E	0.5	400 to 1100	9	25	5 ns	11	TO-18
C30902S	0.5	400 to 1100	128	2	0.5 ns	0.3	—
C30954E	0.8	400 to 1100	36	50	2 ns	14	—
RADIATION MONITORING DEVICES (www.rmdinc.com)							
Silicon Avalanche Photodiodes							
S0223	4	—	—	—	5 ns	19	— Gain = 200-2000
S0814	64	—	—	—	8 ns	42	— Gain = 200-2000
S1315	169	—	—	—	10 ns	85	— Gain = 200-2000
PACIFIC SILICON SENSOR (www.pacific-sensor.com)							
PSS 1-7	1.13	350 to 1100	0.65	1	30 ns	1 × 10 ⁻¹⁴	—
PSS 2-7	1.60	350 to 1100	0.65	1	35 ns	1 × 10 ⁻¹⁴	—
PSS 15-7	4.3 × 4.3	350 to 1100	0.65	1	30 ns	3 × 10 ⁻¹⁴	—
PSS 80-7	8 × 10	350 to 1100	0.65	5	45ns	5 × 10 ⁻¹⁴	—
PSS 100-7	11.28	350 to 1100	0.65	55	10 ns	6 × 10 ⁻¹⁴	—
PSS Q200-7	10 × 20	350 to 1100	0.65	60	60 ns	6 × 10 ⁻¹⁴	—
PSS 1-2	1.13	200 to 1100	0.1 (@ 200 nm)	0.2	0.5 ns	—	—
PSS Q33-2	5.5 × 6.1	200 to 1100	0.1 (@ 200 nm)	2	2 ns	—	—
PSS 100-2	11.28	200 to 1100	0.1(@ 200 nm)	10	10 μs	—	—
PSS 1-6	1.13	350 to 1100	0.62	0.05	2 μs	6.5 × 10 ⁻¹⁵	—
PSS 10-6	3.57	350 to 1100	0.62	1	20 ns	2.9 × 10 ⁻¹⁴	—
PSS 100-6	11.28	350 to 1100	0.62	10	40 ns	1 × 10 ⁻¹³	—
Silicon Avalanche Photodiodes							
AD-230-8	0.23	400 to 1100	0.45	0.6	0.18 ns	—	— Gain=200
AD-800-8	0.80	400 to 1100	0.45	6.0	0.70 ns	—	— Gain=200
AD-2500-8	2.52	400 to 1100	0.45	30.0	2.00 ns	—	— Gain=200
INTERNATIONAL RADIATION DETECTORS (www.ird-inc.com)							
Silicon Photodiodes							
AXUV-100	10 × 10	XUV to 1100	—	Selectable	10 μs	—	Ceramic
AXUV-96	6 × 16	XUV to 1100	—	Selectable	10	—	Metal
AXUV-SP2	6 × 16	XUV to 1100	—	Selectable	10	—	Ceramic
AXUV-50HE1	8 (dia.)	XUV to 1100	—	Selectable	6	—	Ceramic
AXUV-20	5 (dia.)	XUV to 1100	—	Selectable	2	—	Metal
AXUV-20BNC	5 (dia.)	XUV to 1100	—	Selectable	2	—	BNC
AXUV-20HE1	5 (dia.)	XUV to 1100	—	Selectable	1	—	Ceramic
AXUV-10	10 (dia.)	XUV to 1100	—	Selectable	2	—	Ceramic
UVG-100	10 × 10	130 to 600	—	Selectable	10	—	Ceramic
UVG-300	22 × 15	130 to 600	—	Selectable	15	—	Plastic
UVG-20B	5 (dia.)	130 to 600	—	Selectable	2	—	TO-8
SXUV-100	10 × 10	130 to 600	—	Selectable	10	—	Ceramic
SXUV-5	2.5 (dia.)	130 to 600	—	20	2 ns	—	TO-5
SXUV-HS5	1 × 1	130 to 600	—	1	700 ps	—	SMA