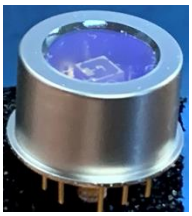
DAPD 1x8 Array 1550 Series

PRELIMINARY

DAPD-1x8-1550-200
Discrete Amplification Photon Detector
1x8 Stand-Alone Array



Amplification Technologies' DAPD 1x8 Array 1550 Series photodetector array is a near-infrared spectral-range high-speed photodetector designed for the detection of extremely low-level light signals, with a broad response range of 950nm to 1650nm. The array is comprised of 8 elements, arranged in a 1 by 5 array (linear) configuration, with a center-to-center pitch of 200 microns, and a total detection area of 1.0mm by 0.2mm. Each detector-element is separately connected to a dedicated external lead, using a hermetically sealed TO8-type package.

The DAPD 1x8 Array 1550 series takes advantage of the Discrete Amplification method of amplifying low-level electrical signal using multi-channel amplification and a monolithically integrated negative feedback avalanche mechanism, developed and patented by Amplification Technologies. The Discrete Amplification technology with internal amplification offers very high gain (approximately 100,000 electrons per one photon), a gain that is combined with a very-low excess noise factor (lower than 1.05) and a fast response (faster than 0.6ns rise time). These characteristics allows the DAPD to detect single photons, as well as multi-photon packets, and is optimized for the detection of extremely low light levels.

The DAPD series photodetector is packaged in a hermetically sealed TO8 package made of KOVAR, which includes a low power three-stage thermos-electric cooler (TEC) and a thermistor. This package allows for the operation of the detector array in a wide ambient temperature range, while keeping the detector array at a steady temperature of -50°C, provided proper heat dissipation is applied at the bottom of the package.

Key Features

- $In_{0.47}Ga_{0.53}As$ absorber design for a wide wavelength range operation of 950nm to 1650nm
- Sapphire optical window, with a broad-band anti reflection coating

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- Designed to operate at a wide range of ambient temperatures of +55°C to -55°C, where the array temperature is cooled using a low power consumption three-stage Thermo-Electric Cooler
- Custom design for 0.1ns to 20ns LIDAR pulse detection with high repetition rate of up to 100MHz
- Excellent voltage biasing stability
- Very high gain of approximately 100,000 electrons per photon, which is high enough to allow for the utilization of a 50Ω RF pre-amplifier; no trans-impedance matching is necessary (see recommended Basic Electronic Connection Diagram)
- Low noise-factor (excess noise factor lower than 1.05)

Applications

The DAPD 1x8 array series is designed to operate with time-of-flight lidar systems, three-dimensions LIDAR imaging, and environmental monitoring applications. The 8-element ("pixel") photodetector is optimized for operation with laser pulse length between 0.5ns to 20ns. Each element ("pixel") out of the 8 detectors is connected separately to a dedicated lead in the package. A common-cathode connection is shared among all 8 elements. The ability to connect to any of the 8 pixels is providing multiple levels of flexibility. For example, the detector array can be connected in a four detectors configuration (e.g. 1x4).

Electronic amplification as a 50Ω system provides addition flexibility in design functionality, using off-the-shelve 50Ω electronic amplification. The array is designed to operate with a constant operating bias, in a continuous-mode operation, even when operating at pulse-detection mode. This further reduces electrical system design complexity, and offers numerous options to integrate the detector array systems with analog to digital sampling electronic systems.

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Specifications

Note: Specifications are at a temperature of -45°C; all values are typical

Parameter	DAPD 1x8 Array 1550 series 200 µm Pitch	Unit
Active area dimensions	**1000 by 200**	μm^2
Active area single pixel	**180 by 200**	μm^2
Number of pixels	**8**	-
Photon Detection Efficiency at 1550 nm (PDE)[1]	**15**	%
Spectral response range (λ)	**950 – 1650**	nm
Single photo-electron Gain (M)	**$1x10^5$**	-
Excess Noise Factor	**1.05**	-
Dark count rate (single pixel)	**50**	MHz
Operating bias	**50 – 70**	V
Rise time (10% - 90%)	**600**	ps
Single amplification channel Recovery time (at -45°C)	**250**	ns

(1) Photon detection efficiency includes afterpulsing.
(2) Actual operation bias value is provided in a test report

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Absolute Maximum Rating

Parameter	DAPD 1x8 Array 200 µm pitch	Unit
Damage Threshold	**5.0**	nJ
Operating current (reverse bias)	**50**	µA
Operating voltage	**$-(V_{op}+3)$**[1]	V

(1) The operating bias V_{op} for best sensitivity is provided by Amplification Technologies after testing

PIN-OUT Chart and Package Dimensions

PIN-OUT Chart

The pin-out chart defines the corresponding lead to the anode of each pixel. Each anode of the 8 elements is connected to a separate lead, in a staggered configuration, opposing each other. Two cathode (G) connections are available one on each side of the TO8 package for proper electrical connectivity and grounding rules.

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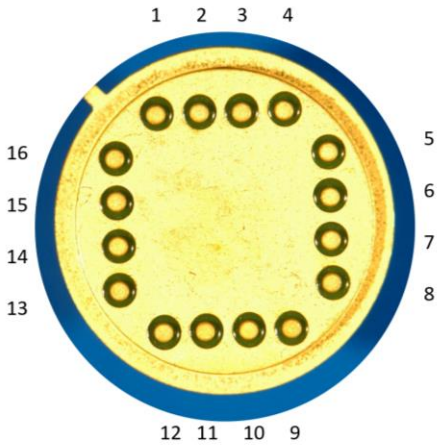
Lead #	Function
1	Thermistor
2	Cathode (shared)
3	Case Ground
4	Thermistor
5	Pixel #1 Anode
6	Pixel #3 Anode
7	Pixel #5 Anode
8	Pixel #7 Anode
9	TEC (-)
10	Case Ground
11	Cathode (Shared)
12	TEC (+)
13	Pixel #2 Anode
14	Pixel #4 Anode
15	Pixel #6 Anode
16	Pixel #8 Anode



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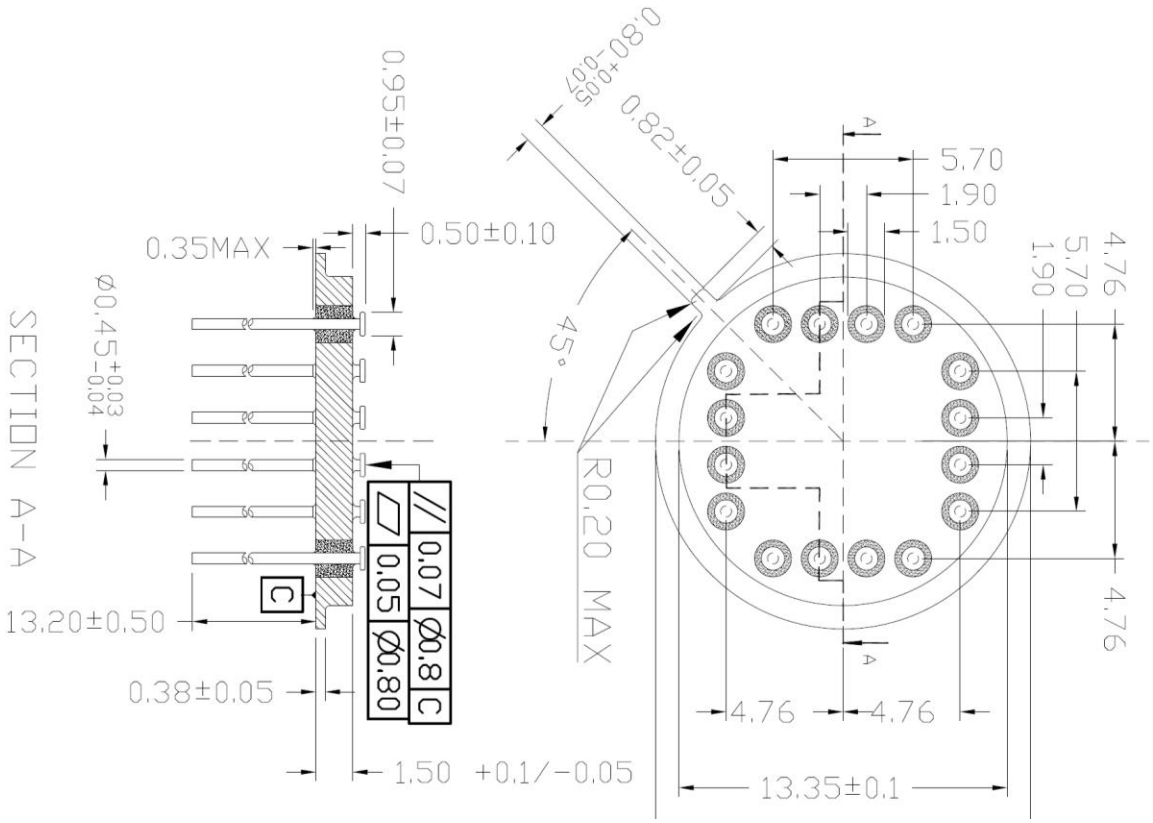
Package Dimensions

Pin Count	Base Diameter	Cap Diameter	Cap Height	Lead Length	Lead Pitch
16	15.2 mm	14 mm	8.5 mm	3.0 mm	1.91 mm

Note: The leads are delivered cut to 3.0mm (±0.25mm) length



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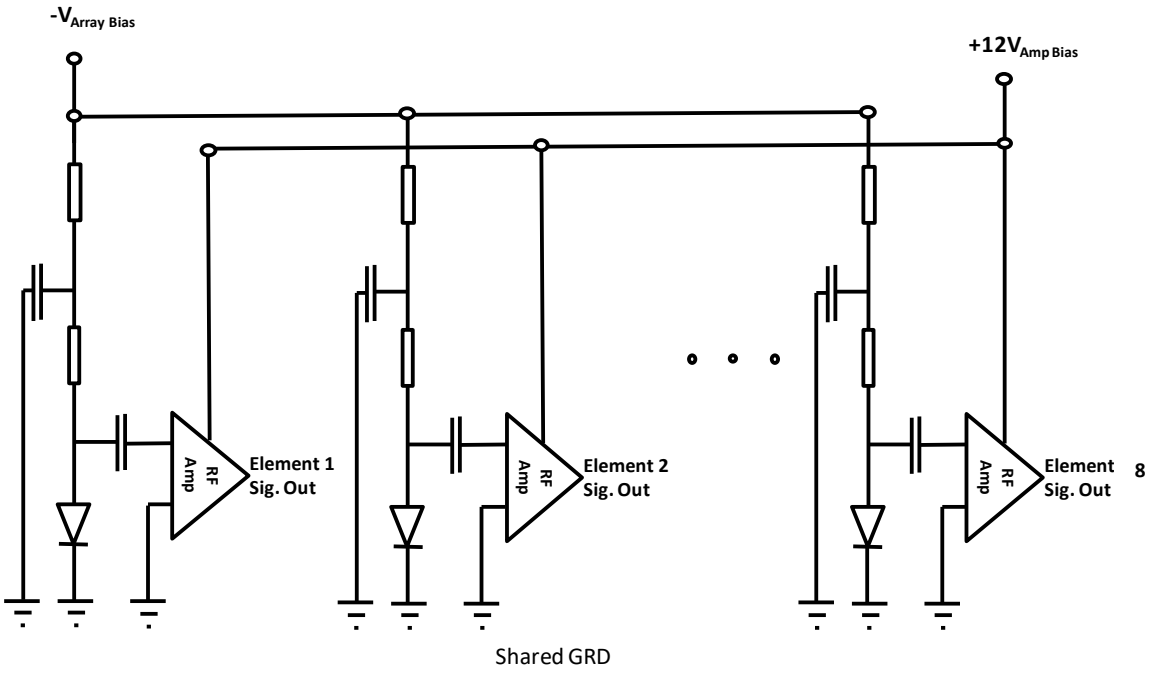
Basic Electronic Connection Diagram for DAPDNIR 5x5 Array 1550 Series

The reference electrical connectivity diagram assumes electronic amplification using a 50Ω matched pre-amplifier. For lidar systems with a pulse longer than approximately 1ns an additional integration amplification stage is necessary, such as of an operation amplifier with a feedback resistor designed for the LIDAR pulse duration.



Thermo-Electric Cooler (TEC) Parameters

The Thermoelectric cooler is a three-stage cooler that is designed to cool the detector array to -50°C, at ambient temperature, with proper heat sinking applied to the bottom of the array package.

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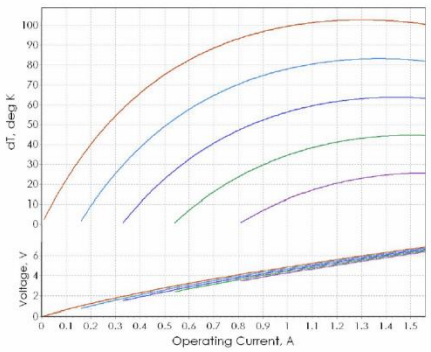
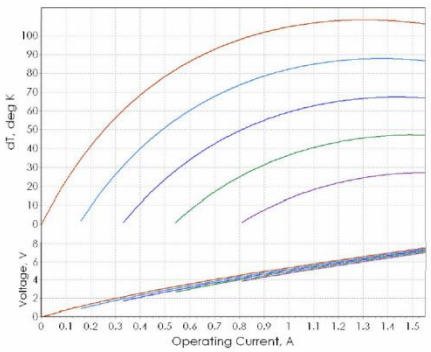
@ 27°C, Vacuum	ΔTmax K	Qmax W	Imax A	Umax V
2MC04-059-05AN	103	1.70	1.2	5.9



@50°C, N2	ΔTmax K	Qmax W	Imax A	Umax V
2MC04-059-05AN	108	1.87	1.2	6.6



Maximum recommended current: 1.2A
Maximum recommended voltage: 6.0V

Note: proper heat sink is required to achieve cooling of the detector array to -50°C.

Thermistor:

The thermistor is a glass beaded negative temperature coefficient (NTC), with 5% accuracy. The 20°C resistance is 2.2kΩ. The Steinhart-Hart coefficients, as well as the definition of the coefficients based on the equation, are provided below. The Steinhart-Hart equation is given as follows:

$1/T = (A * 10\text{-}3) + (B * 10\text{-}4)(\ln R) + (C * 10\text{-}7)(\ln R)3$

Where: the temperature, T, is expressed in °K; the thermistor resistance, R, in Ω

The Steinhart-Hart parameters for this thermistor are:

A = 0.775
B = 3.425
C = 0.002

Precautions for Use

The device is ESD sensitive. The use of grounding straps, anti-static mats and other standard electrostatic discharge protective equipment and methods are mandatory when handling or testing these devices.
Operating the TEC without proper heat sink will cause overflow of current and an irreversible damage to the detector array and the TEC.

Quality Vision

Amplification Technologies is committed to providing products with the highest levels of quality and reliability using best available manufacturing processes. Our top priority is total customer satisfaction. Amplification Technologies maintains a strict quality control program to ensure that all products meet or surpass published specifications.

Ordering Information

When ordering, please specify the following part number information:
DAPD-1x8-1550-200.

Where:
-1550: wavelength optimization
-200: array pitch (center-to-center distance in microns)

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