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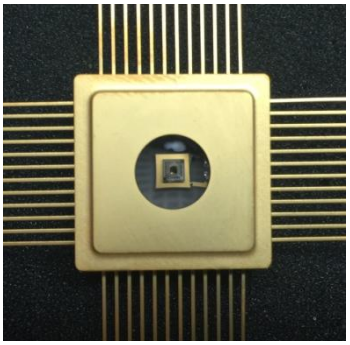
AMPLIFICATION TECHNOLOGIES

PRELIMINARY

DAPDNIR-5x5-1550-100-300
Discrete Amplification Photon Detector
5x5 Stand-Alone Array



Amplification Technologies DAPDNIR 5x5 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 25 detectors, arranged in a 5 by 5 array configuration, with a center-to-center pitch of 100 microns, and a total detection area of 0.5mm by 0.5mm. Each detector is separately connected to a dedicated external lead, using a hermetically sealed custom package.

The DAPDNIR 5x5 Array 1550 series takes advantage of the breakthrough 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), which 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 for the DAPD to detect single photons, and optimization for the detection of extremely low light levels.

The NIRDAP series photodetector is packaged in a hermetically sealed package made of KOVAR, which includes a low power two-stage thermo 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
- Designed to operate at a wide range of ambient temperatures, where the array temperature is cooled using a low power two-stage Thermo Electric Cooler

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- Custom design for 0.1ns to 20ns LIDAR pulse detection with high repetition rate of up to 50MHz
- Excellent biasing-voltage stability
- Very high gain of approximately75,000 electrons per photon which is high enough to allow for a 50Ω RF pre-amplifier; no trans-impedance matching is necessary (see recommended Basic Electronic Connection Diagram)
- Low noise-factor

Applications

The NIR DAPD Ranging series is designed to operate with LIDAR systems, three-dimensions LIDAR imaging, and environmental monitoring applications. The detector is optimized for operation with laser pulse length between 0.5ns to 20ns. Each detector out of the 25 detectors is connected separately to a dedicated pin in the package, were a common cathode connection is available on all four sides of the package. The ability to connect to any of the 25 pixels is providing multiple levels of flexibility. For example the detector array can be connected in a quadrant configuration or as a single broad area detector.

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 continues-mode operation, even when operated 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 systems, frame grabbers, etc.

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Specifications

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

Parameter	DAPDNIR 5x5 Array 1550 series 100 µm Pitch	Unit
Active area dimensions	**500 by 500**	μm^2
Active area single pixel	**90 by 90**	μm^2
Number of pixels	**25**	-
Photon Detection Efficiency @1064 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)	**4**	MHz
Operating bias	**50 – 70**	V
Rise time (10% - 90%)	**600**	ps
Single amplification channel Recovery time (at -35°C)	**50**	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	DAPDNIR 5x5 Array 1064 series **100** µm pitch	Unit
Damage Threshold	**0.5**	nJ
Operating current (reverse bias)	**50**	µA
Operating voltage	**$-(V_{op}+4)$**[1]	V

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

PINOUT Chart and Package Dimensions

PINOUT Chart

The pin-out chart defines the corresponding lead to the anode of each pixel. Pixel 15 is the center one, where the four corners are pixels (clockwise): 6, 13, 20, and 25. Note that the size of the active area of the array is out of scale in this chart. “G” designates a connection to the common cathode of the detector array. Two cathode (G) connections are available on each of the four sides of the package for proper electrical connectivity and grounding rules.

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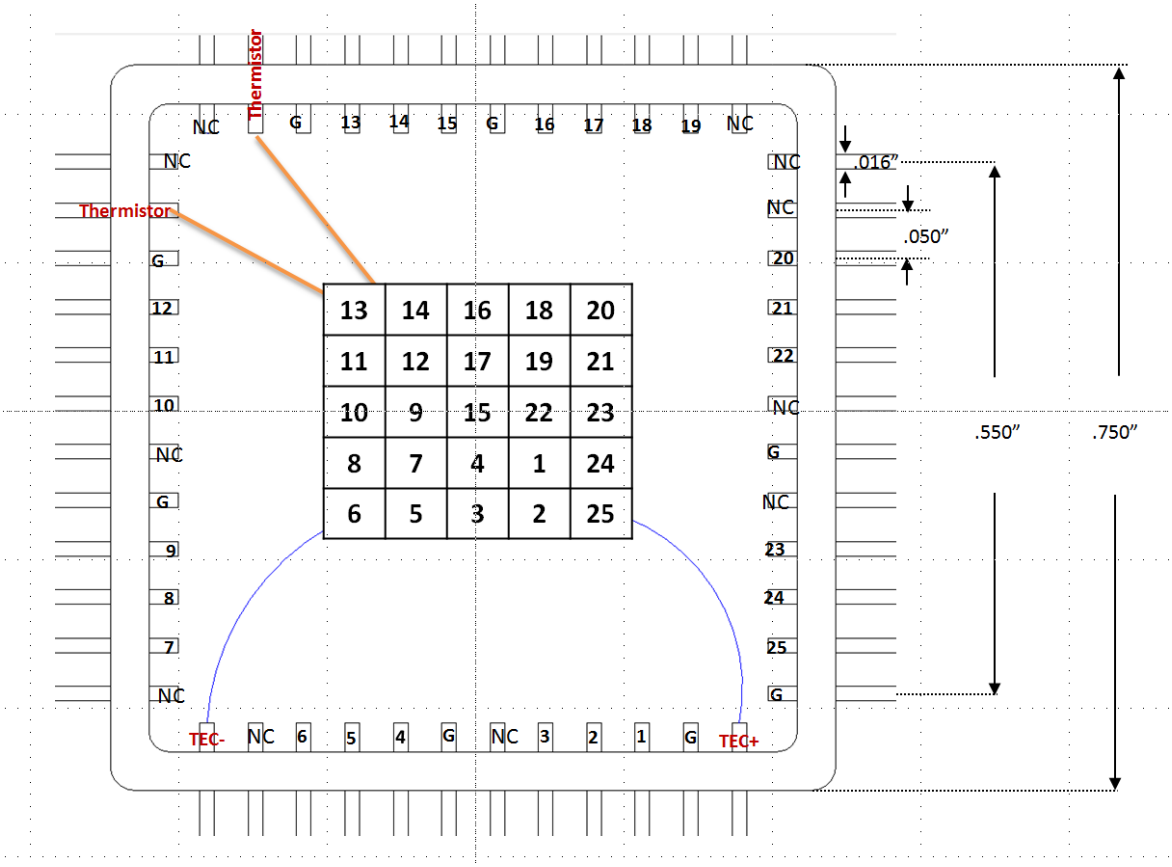
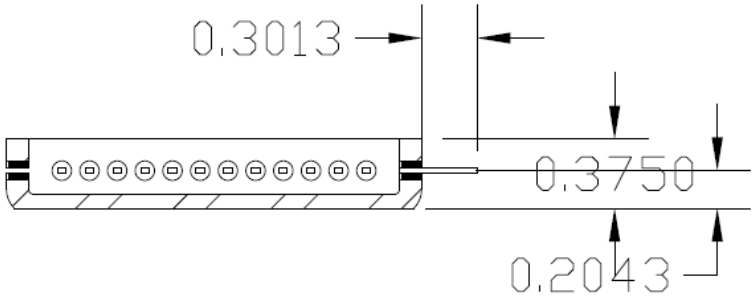


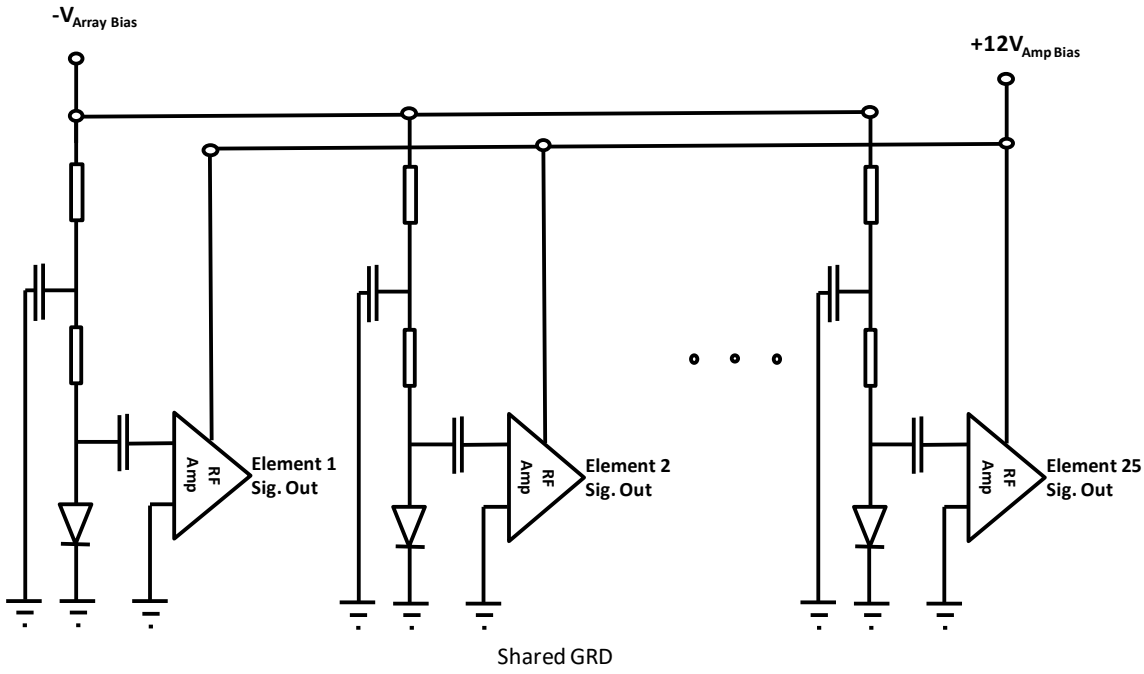
Package Dimensions



Note: The leads are delivered cut to 7.5mm (±1.5mm) length

Basic Electronic Connection Diagram for DAPDNIR 5x5 Array 1550 Series

The reference electrical connectivity diagram assumes electronic amplification using a 50Ohm 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 two-stage cooler that is designed to cool the detector array to -35°C at ambient temperature, with proper heat sinking applied to the bottom of the array package.

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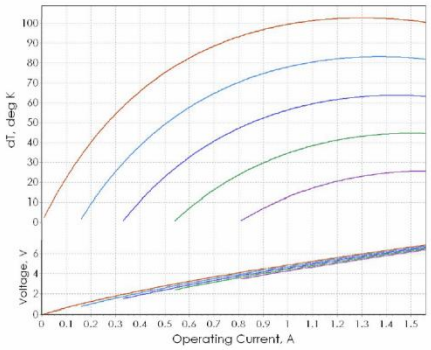
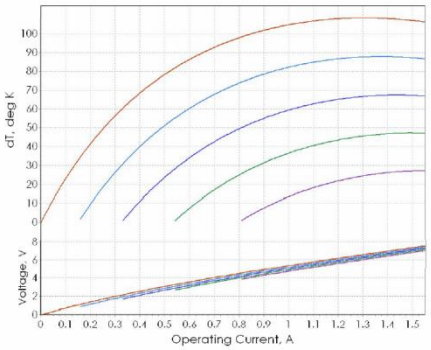
@ 27°C, Vacuum	ΔTmax K	Qmax W	Imax A	Umax V
2MC04-059-05AN	103	1.70	1.2	5.9



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



Maximum recommended current: 1.0A
Maximum recommended voltage: 4.0V

Note: proper heat sink is required to achieve cooling of the detector array to -35°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 * 10-3) + (B * 10-4)(ln R) + (C * 10-7)(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-5x5 Array-1550-100-300.**

Where:

-1550: wavelength optimization
-100: array pitch (center-to-center distance in microns)
-**300**: lead length is 0.300” (75mm)