

YAG Quadrant and Heated YAG Quadrant Series Silicon PIN Quadrant Detector



The YAG series high-performance Si PIN photodiodes are well suited for applications such as munition guidance, laser spot tracking and others.

Excelitas Technologies' YAG series of Silicon PIN quadrant detectors are high-performance N-type or P-type Si PIN photodiodes in hermetically sealed TO packages. These photodiodes perform well over the 400 nm to 1100 nm wavelength range, with enhanced IR responsivity, making them ideal for 1064 nm detection applications. For P-type photodiode, a guard ring collects current generated outside the active area, ensuring the current will not contribute to noise. N-type photodiode, given its different structure, is provided with a channel stop that prevents the electrical field extension to the outer edge of the chip ensuring signal integrity and low-noise performance.

The YAG devices are quadrant photodiodes with circular active area with four pie-shaped quadrant sections created from the doping process, each with an isolated signal lead.

These can also be ordered with additional YAG-optimized anti-reflection coating (-AR suffix) on the window to help further increase the transmission of light through the front window. Also, a resistive heater and thermistor temperature sensor option (-H suffix) can be included within the hermetic enclosure to help further increase the responsivity at the YAG wavelength.

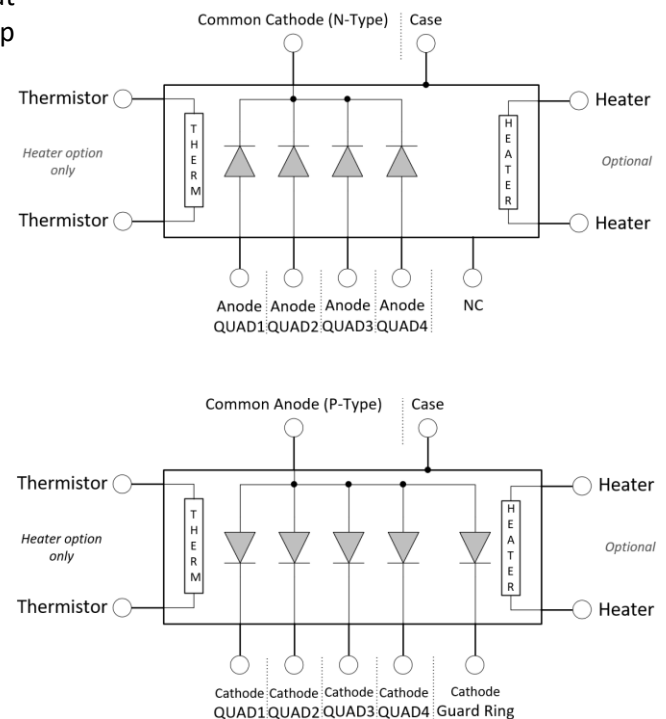
Recognizing that different applications have different performance requirements, Excelitas offers a wide range of customization of these photodiodes to meet your unique design challenges. Various active area, custom device testing and qualification and packaging options (alternative temperature sensor, high-shock resistance packaging, ceramic carrier, custom pin-out configuration, varying pin length, etc.) are among many of the application specific solutions available.

Key Features and Benefits

- High quantum efficiency at 1064 nm
- Wide spectral range
- Crosstalk <1% between elements
- No "dead zones" between quadrants
- Linearity over wide dynamic range
- Planar diffused structure
- Package style: Hermetic TO-can
- RoHS-compliant
- Available in N- and P-type configuration

Applications

- Laser spot tracking
- Munition guidance
- Laser seeker head
- Semi-Active Laser (SAL) sensor



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Table 1 – Operating data and specifications at 23°C (typical performance at 180V reverse voltage bias)

Parameter (See notes 3 and 4)	YAG-200*-4AH-*** (note 1)			YAG-444*-4AH-*** (note 2)			YAG-555*-4AH-*** (note 2)			Units
	Min	Typical	Max	Min	Typical	Max	Min	Typical	Max	
Number of elements	4			4			4			
Active area (per element)		5.1			25			39		mm ²
Active area, overall diameter		5.1			11.3			14.1		mm
Spectral range	400-1100									nm
Responsivity (See Figures 3 and 4)										A/W
at 900 nm		0.60			0.60			0.60		
at 1064 nm		0.44			0.44			0.44		
at 1064 nm (-AR or -ARH suffix)		0.47			0.47			0.47		
Bandwidth, 50 Ω load		30			30			30		MHz
Rise time, 50 Ω load		12			12			12		ns
Operating voltage (V _{op})	0		180	0		180	0		180	V
Breakdown voltage (V _{br})	200			200			200			V
Capacitance		2	10		9	15		12	20	pF
Dark current (I _d)		10	50		30	100		50	150	nA
Channel resistance (note 6)		>1			>1			>1		MΩ
Noise current		0.10			0.20			0.20		pA/√Hz
Noise equivalent power (NEP)										pW/√Hz
900 nm, 1 MHz		0.10			0.25			0.25		
1064 nm, 1MHz		0.15			0.30			0.30		
Response linearity (over 7 decades)		<1%			<1%			<1 %		
Crosstalk		<1%			<1%			<1 %		
Field of View (See Figure 2)										degrees
Nominal view α		115			115			75		
Nominal view α'		155			160			160		
Nominal view α (-H suffix)		110			105			35		
Nominal view α' (-H suffix)		150			160			165		
Heater resistance at 23°C (note 5)	36	40	44	36	40	44	36	40	44	Ohms
Heater peak power (note 5, 7)			4			16.1			16.1	Watt
Heating Time (note 5, 8)	3	5	7	3	5	7	3	5	7	s
Thermistor resistance at 25 °C (note 5)		10±2%			10±2%			10±2%		kOhms

Notes:

1. For YAG-200*-4AH-*** family, values are preliminary.
2. For N type option YAG-444N-4AH-*** and YAG-555N-4AH-***, values are preliminary.
3. Active area and all characteristics are listed per element.
4. Breakdown voltage (V_{br}) measurement at 100 μA dark current (I_d), in appropriate polarity depending on wafer type.
5. This parameter applies to the Heated YAG families only (-H or -ARH suffix).
6. Channel resistance is the resistance measured between active elements.
7. Peak Power at startup considering: -40°C ambient, 36Ω resistance and maximum heater DC voltage as per Table 2.
8. From 23°C to 70°C with maximum supply on the heater as per Table 2.

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Table 2 – Absolute – Maximum Ratings, Limiting Values

Parameter	YAG-200*-4AH-*** (note 1)		YAG-444*-4AH-*** (note 2)		YAG-555*-4AH-*** (note 2)		Units
	Min	Max	Min	Max	Min	Max	
Environment Temperature							
storage, T _{stg}	-55	+125	-55	+125	-55	+125	°C
operating, T _A	-55	+125	-55	+125	-55	+125	
operating, T _A (-H suffix)	-40	+85	-40	+85	-40	+85	
Heater DC Voltage (note 3)		12		24		24	V

Notes:

1. For YAG-200*-4AH-*** family, values are preliminary.
2. For N type option YAG-444N-4AH-*** and YAG-555N-4AH-***, values are preliminary.
3. No testing has been performed above this voltage (tested under constant DC voltage condition).

Equation – Temperature function of thermistor resistance

Temperature of the detector can be obtained using the Steinhart-Hart equation as described below. Coefficient A, B and C are provided given the type and model of thermistor and the temperature range of interest.

$$T (^{\circ}C) = \left[\frac{1}{A + B \ln(R) + C \ln(R)^3} \right] - 273.15$$

where,

$$A = 1.12903E^{-3}$$

$$B = 2.34124E^{-4}$$

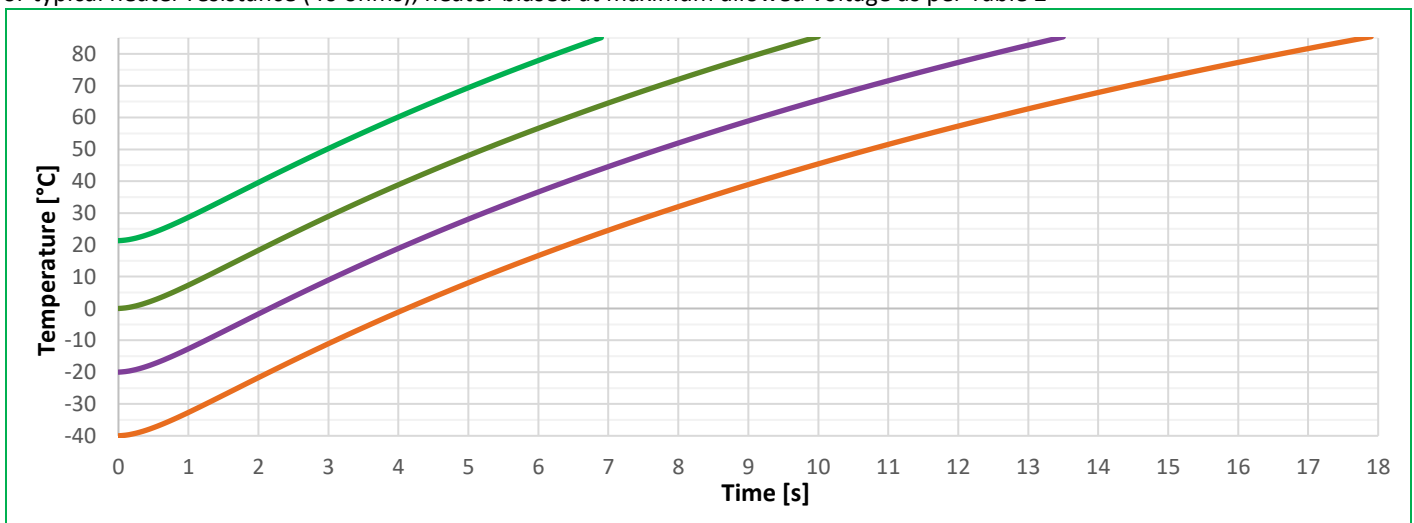
$$C = 0.878344E^{-7}$$

$$R = \text{Thermistor Resistance } (\Omega)$$

YAG Temperature - Thermistor Values					
-40 °C	335.8 KΩ	0 °C	32.6 KΩ	40 °C	5.3 KΩ
-35 °C	242.2 KΩ	10 °C	19.9 KΩ	50 °C	3.6 KΩ
-30 °C	176.7 KΩ	20 °C	12.5 KΩ	60 °C	2.5 KΩ
-20 °C	97.0 KΩ	25 °C	10.0 KΩ	65 °C	2.1 KΩ
-10 °C	55.3 KΩ	35 °C	6.5 KΩ	70 °C	1.8 KΩ

Figure 1 – Typical Heater Performance for YAG Heated (-H) series

For typical heater resistance (40 ohms), heater biased at maximum allowed voltage as per Table 2



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Figure 2 – Approximate field of view

For incident radiation at angles $\leq \alpha/2$, the photosensitive surface is totally illuminated.

For incident radiation at angles $> \alpha/2$, but $\leq \alpha'/2$, the photosensitive surface is partially illuminated

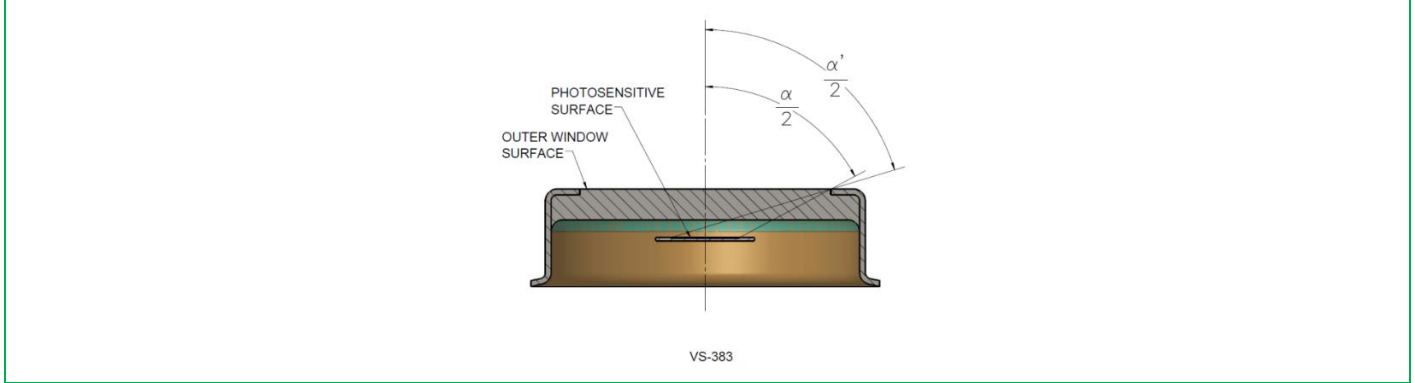


Figure 3 – Typical Spectral Response at 23°C (with no optional anti-reflection coating on window)

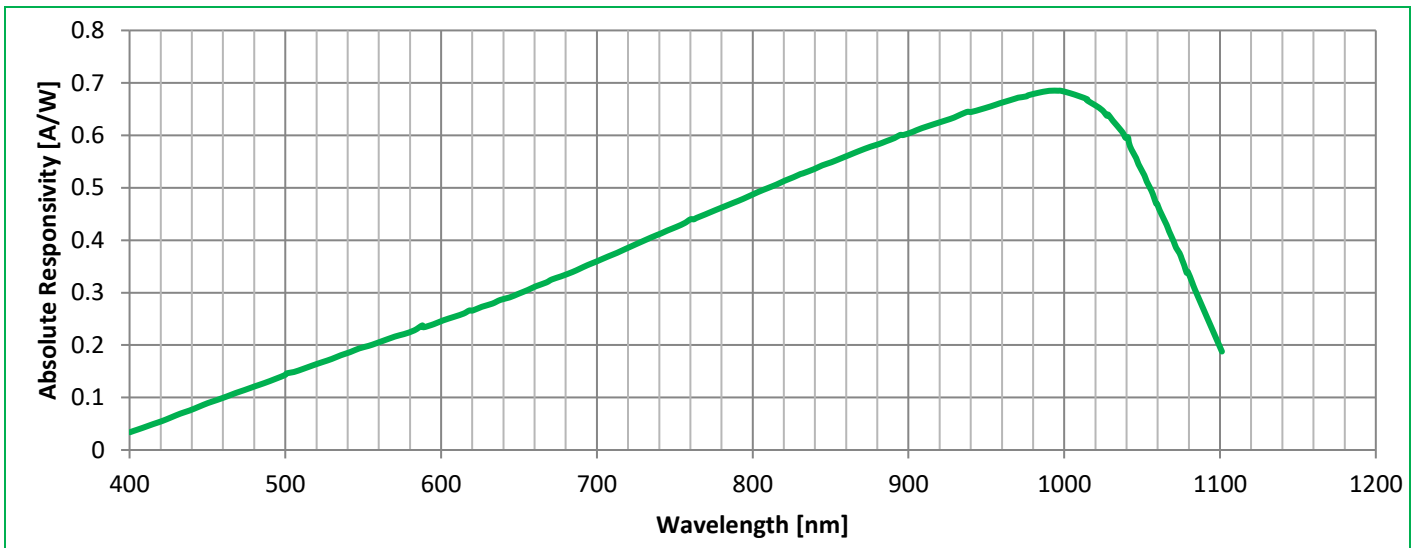
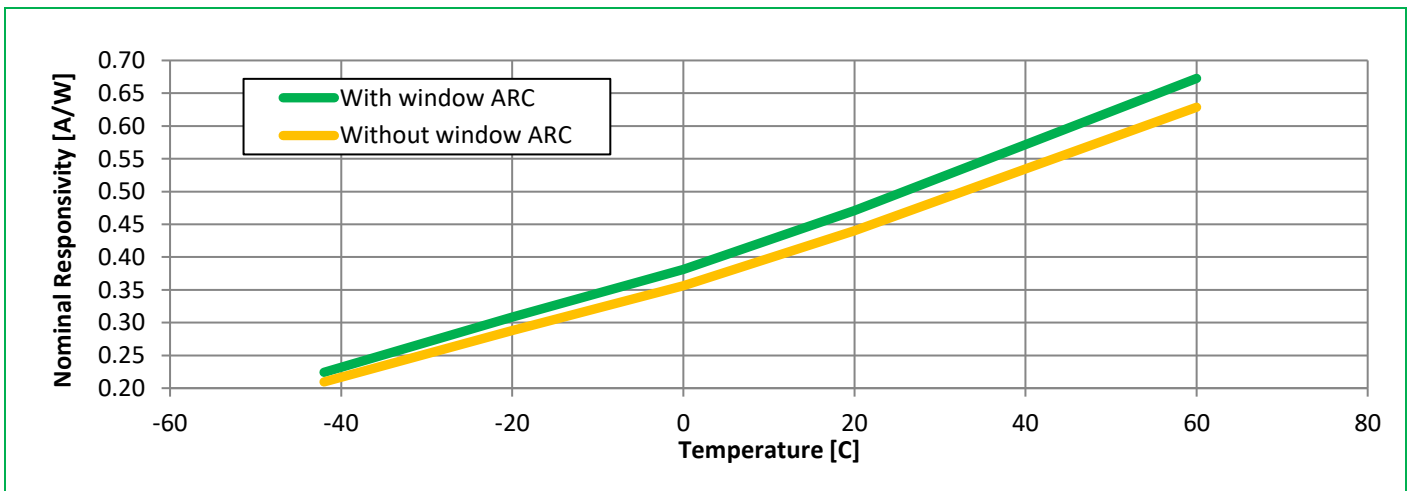


Figure 4 – Typical increase in responsivity as a function of photodiode temperature (at 1064nm)

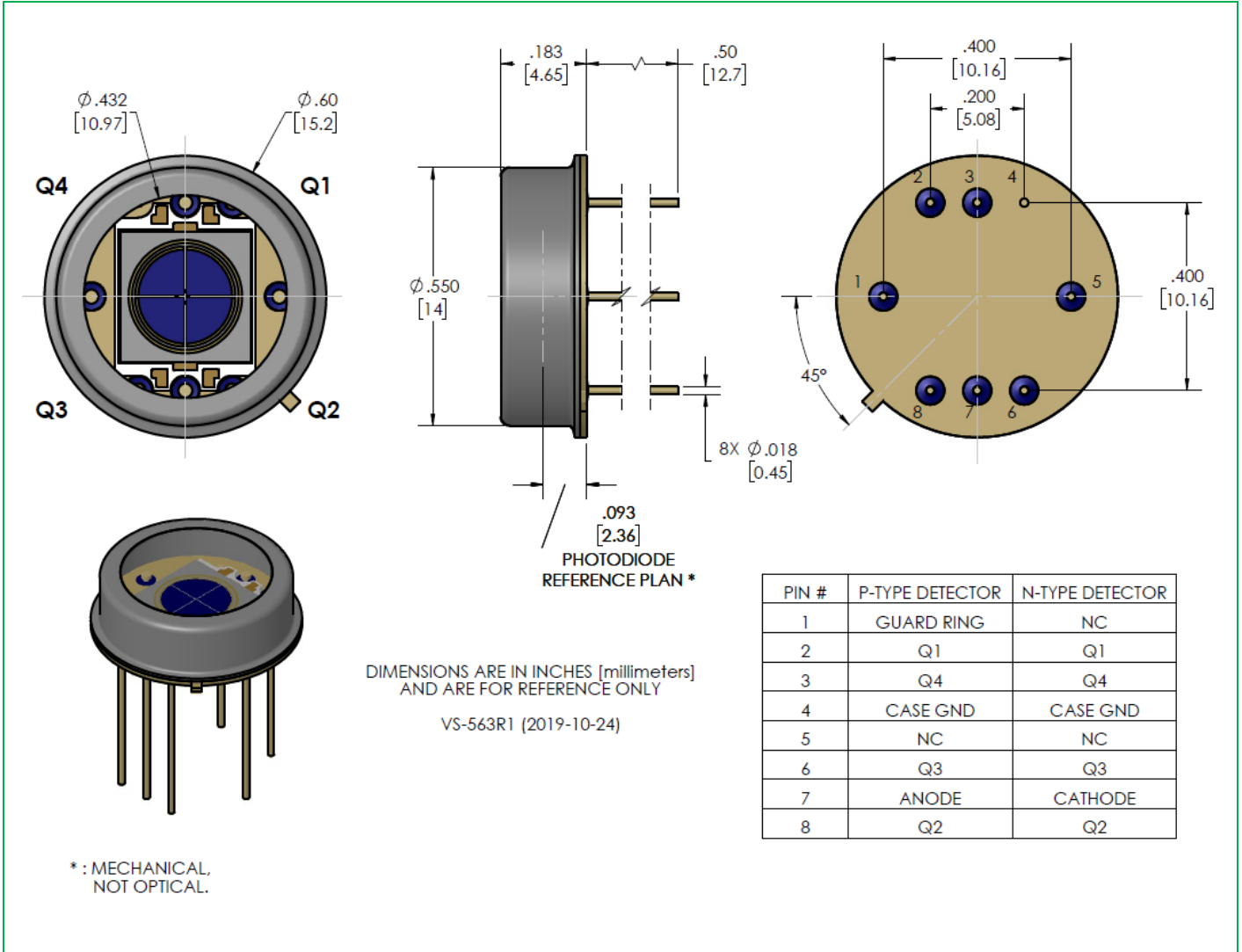


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Figure 5 – Package Dimensions and Pin Assignment of YAG-200 series

Reference only and subject to change without notice

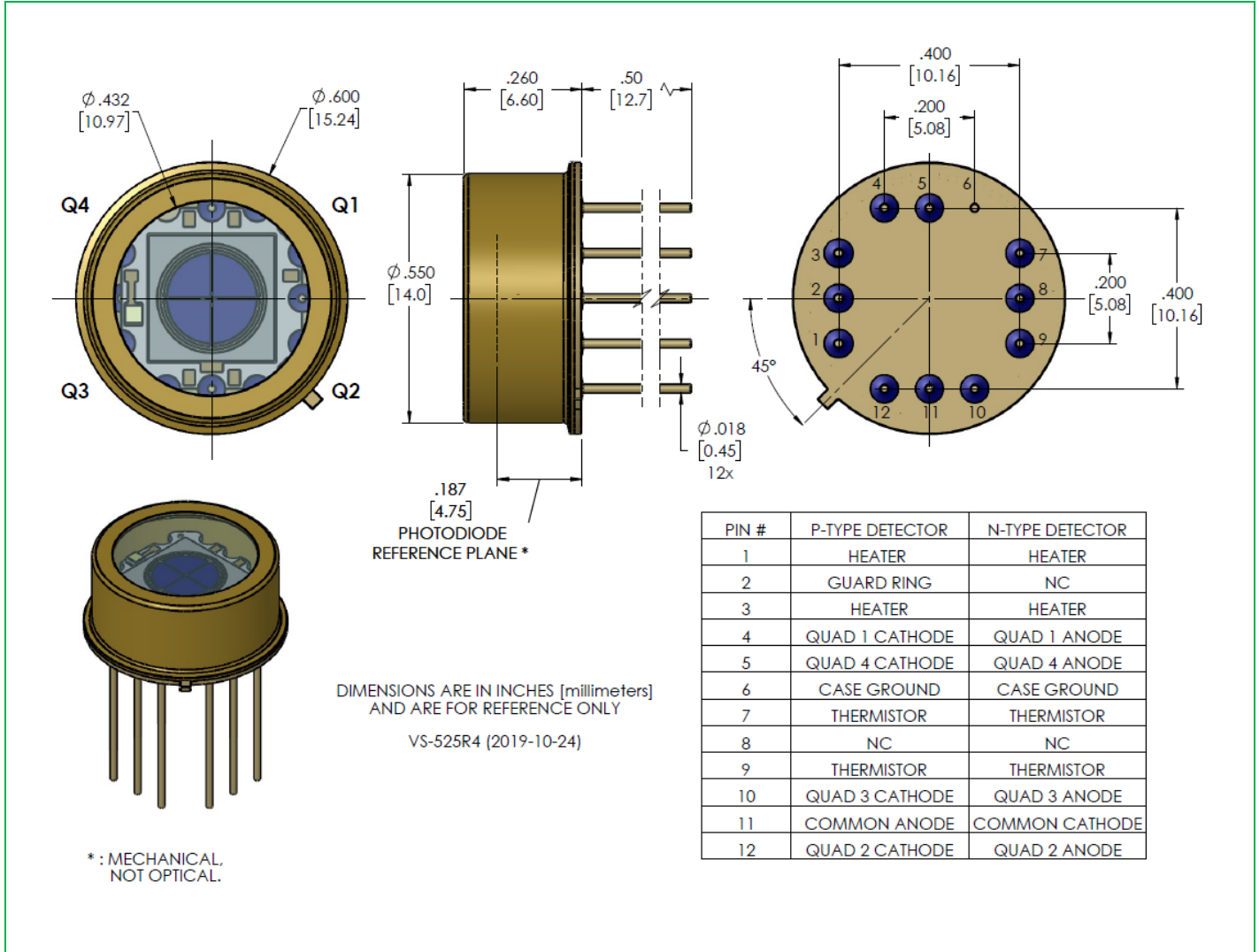


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Figure 6 – Package Dimensions and Pin Assignment of YAG-200 Heated (-H) series

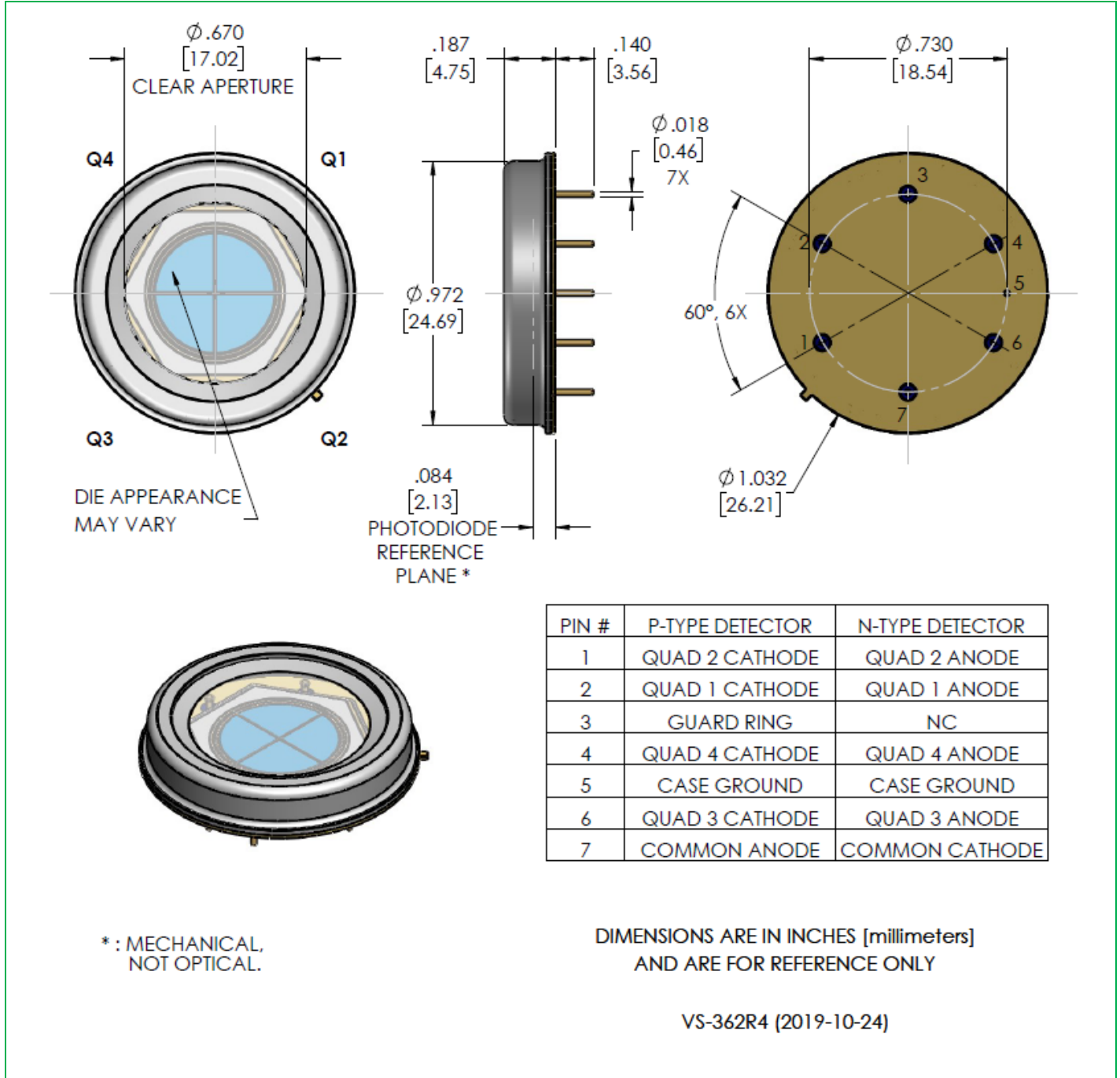
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Figure 7 – Package Dimensions and Pin Assignment of YAG-444/555 series
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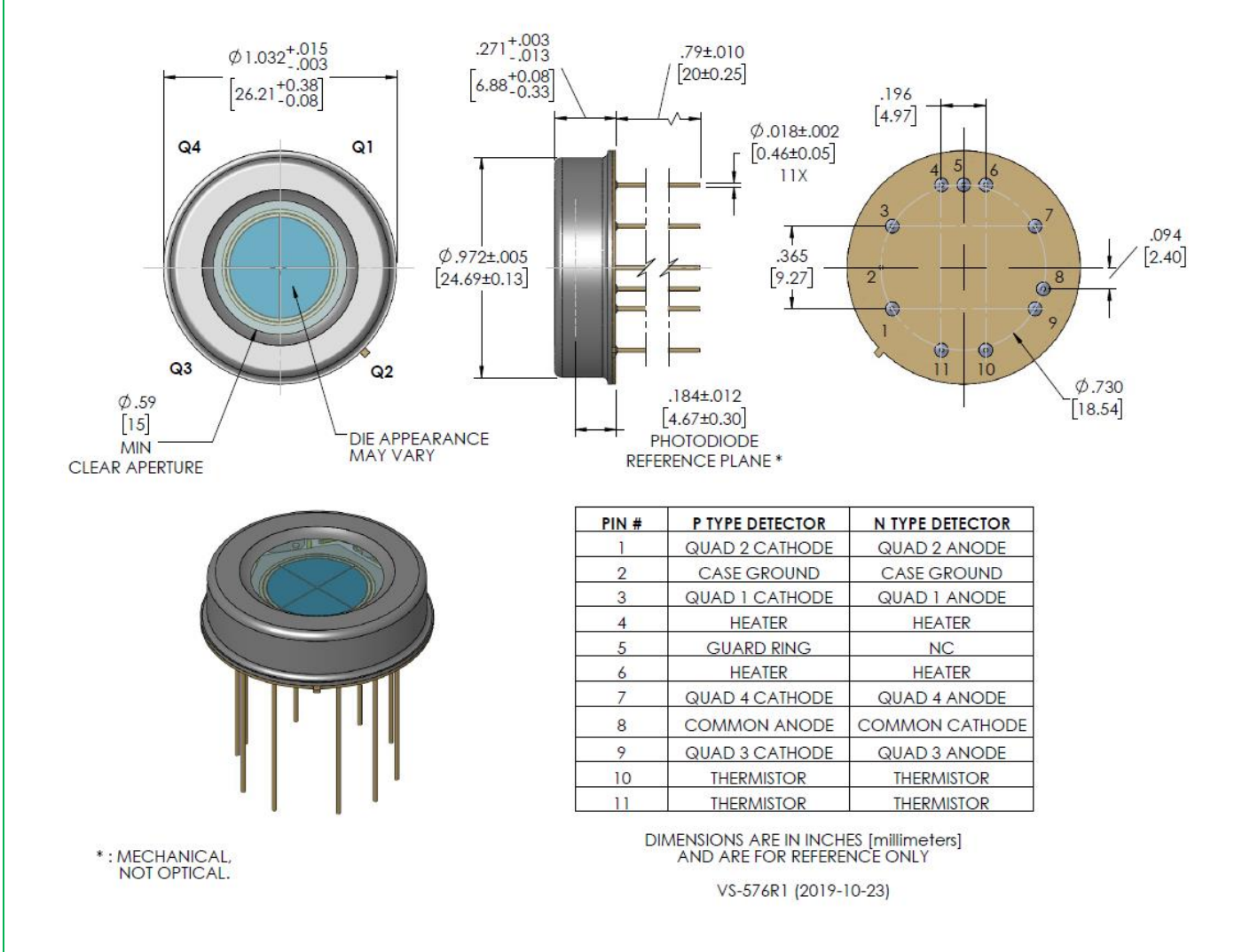


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Figure 8 – Package Dimensions and Pin Assignment of YAG-444/555 Heated (-H) series

Reference only and subject to change without notice



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Ordering guide

	YAG-	DDD	X	-4AH	-*** (Optional)
1064 nm enhanced PIN photodiode	YAG-				
5.1 mm (200 mils) active diameter		200			
11.3 mm (444 mils) active diameter		444			
14.1 mm (555 mils) active diameter		555			
P-type (Common anode)					
N-type (Common cathode)			N		
Quadrant detector				-4AH	
(Optional) Anti-reflection coating (ARC) on window					-AR
(Optional) Built-in heater					-H
(Optional) Anti-reflection coating (ARC) on window & built-in heater					-ARH

Ordering Notes:

- Please contact Excelitas to confirm that your desired option is available.

Ordering Examples:

- **YAG-444-4AH:** Quadrant photodiode of 11.3mm active diameter, with common anode
- **YAG-555N-4AH-H:** Quadrant photodiode of 14.1mm active diameter, with common cathode, built-in heater
- **YAG-200-4AH-ARH:** Quadrant photodiode of 5.1mm active diameter, with common anode, built-in heater & window ARC

Export controls

Due to specific parameters, some of these photodiodes fall under the Canada's Export Controls List (ECL) and require an End User Statement from all purchasing parties as an export permit may be required for some destinations.

Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the photodiode window has been opened.

RoHS Compliance

The YAG-series of quadrant detectors is designed and built to be fully compliant with the European Union Directive 2011/65/EU – Restriction of the use of certain Hazardous Substances (RoHS) in Electrical and Electronic equipment.



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About Excelitas Technologies

Excelitas Technologies is a global technology leader focused on delivering innovative, customized solutions to meet the lighting, detection and other high-performance technology needs of OEM customers.

Excelitas has a long and rich history of serving our OEM customer base with optoelectronic sensors and modules for more than 45 years beginning with PerkinElmer, EG&G, and RCA. The constant throughout has been our innovation and commitment to delivering the highest quality solutions to our customers worldwide.

From aerospace and defense to analytical instrumentation, clinical diagnostics, medical, industrial, and safety and security applications, Excelitas Technologies is committed to enabling our customers' success in their specialty end-markets. Excelitas Technologies has approximately 5,000 employees in North America, Europe and Asia, serving customers across the world.

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