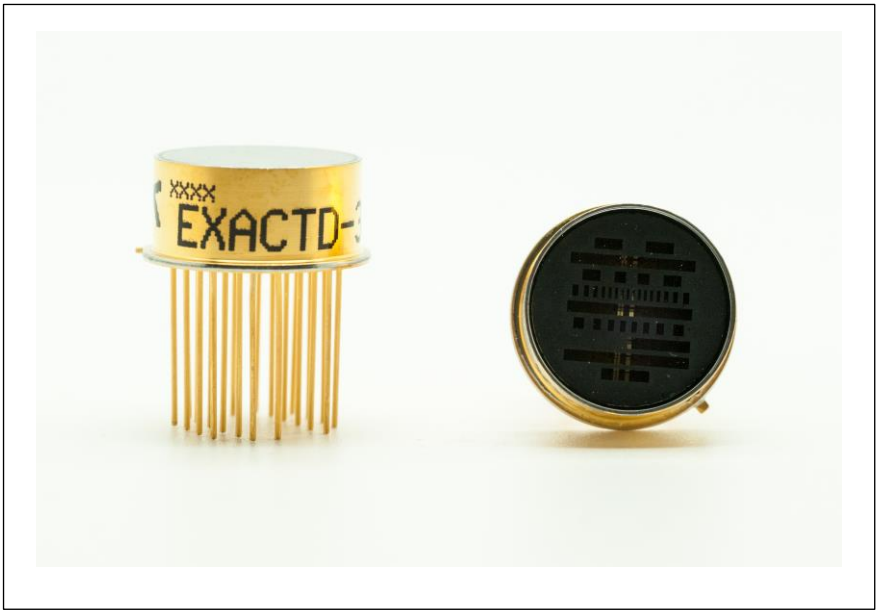
EXACTD® Series, EXACTD-362 Module

Excelitas Angular Continuous Threat Detector



Excelitas' EXACTD-362 Module detects and provides highly-precise AoA information from laser range finders, laser target designators and active E.O. systems for driving effective countermeasures.

Key Features and Benefits

- Spectral sensitivity range of 500 – 1650 nm
- 6-bit design for precise AoA encoding
- ±0.8˚ AoA accuracy - in either azimuth or elevation
- FOV is ±45˚ for both azimuth and elevation angles.
- Low- and High-sensitivity channels for wide dynamic range
- Three reference channels are provided in each photodiode array for baseline signal level determination.
- Manufactured using fully-automated robotic technology

Applications

- Laser Warning Receiver Systems
- Position determining systems
- Direction aids

Excelitas' EXACTD® platform is designed for use in Laser Warning Receiver Systems to detect and provide precise angle-of-arrival (AoA) information from direct and indirect scattered light from laser range finders, target designators, and active laser Electro-Optic (E.O.) systems.

The EXACTD-362 Module makes use of 9-element Si and InGaAs detector arrays assembled in a sandwich configuration, in conjunction with a 6-bit digital Gray code mask use to convert the incident laser beam AoA into a 6-bit digital pattern, as detailed in Table 2 and represented for a subset of four channels (bits) in Figure 1.

The Si and InGaAs detector arrays have a combined spectral sensitivity range of 500 - 1650 nm. Each module features two isolated arrays providing individual High- and Low-sensitivity channels. The first array exhibits high quantum efficiency over the full wavelength range, while the optical signal is attenuated optically before reaching the second array by about 15 dB, further extending the dynamic range for detection of high power laser pulses.

The 6-bit Gray code design allows encoding of incident AoA with an angular resolution of ±0.8°, in either azimuth or elevation depending on the module's orientation, over the ±45° field-of-view (FoV). Three reference channels, illuminated for all incident angles, are provided in each array for baseline signal level determination.

When coupled with a suitable readout circuitry, comprised of front-end amplifiers for the individual photocurrents, threshold detectors and comparators between bits and reference channels, the EXACTD-362 becomes the core of a high-precision stationary Laser Warning System able to give troops more time to deploy countermeasures, perform evasive manoeuvers, or aim precisely to fight back and defeat the incoming threats.

Figure 1. Principle of Operation – EXACTD®. Shows varying binary code as a function of incident angle

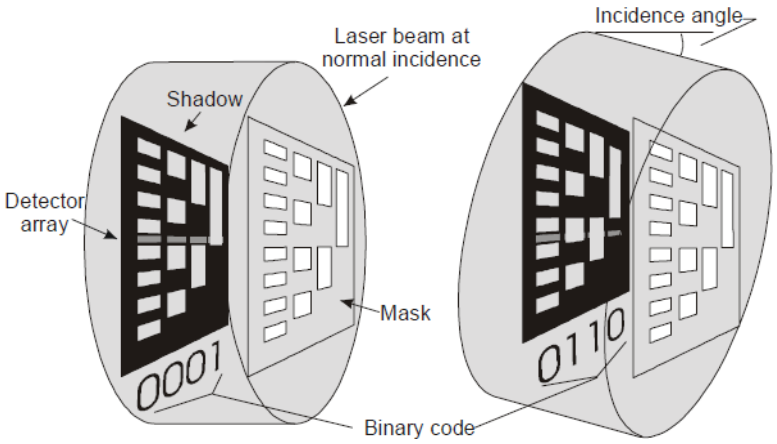


Table 1. High-sensitivity Array Specifications, EXACTD-362 (Test conditions: Case temperature = 22˚C)

Parameter	Min	Typical	Max	Unit	Remarks / Conditions
Junction area (total)		0.5		mm²	
Photosensitive area (per element)		0.075		mm²	
Bias voltage (common)		12		V	
Breakdown voltage		25		V	
Spectral range	500		1650	nm	
Responsivity at 500 nm at 900 nm at 1064 nm at 1540 nm		 0.2 0.4 0.5 0.7		 A/W A/W A/W A/W	
Wavelength band recognition through High-sensitivity Reference Channel 3					Si illumination detection through Pin H10 InGaAs illumination detection through Pin H8 1064 nm illumination through both detectors
Dark current (per element)			20	nA	
Noise current (per element)			0.5	pA/√Hz	
Capacitance (per element)		12		pF	Silicon and InGaAs elements
Rise and fall time		5		ns	
Guard ring dark current			200	nA	
Dynamic range		60		dB	In conjunction with low-sensitivity channels
Signal ratio		12		dB	Illuminated to shadowed elements
Attenuation of low sensitivity channel		15		dB	Relative to high-sensitivity channels
Field of view (FoV)			±45	˚	For either azimuth or elevation angles
Angle-of-arrival (AoA) accuracy (RMS error) (σ)		0.8	1.0	˚	Not including pointing error
Pointing error (μ)			1.0	˚	

Figure 2. Typical Spectral Responsivity of combined Si and InGaAs elements, EXACTD-362

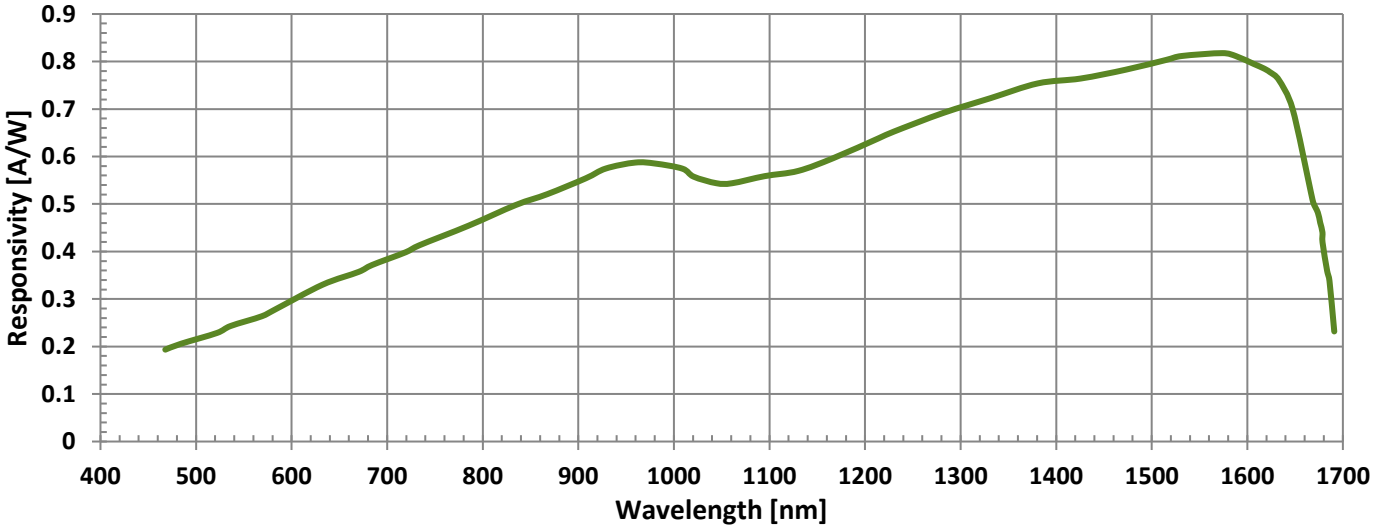


Figure 3. Mechanical Characteristics, EXACTD-362 (Reference dimensions shown in inches)

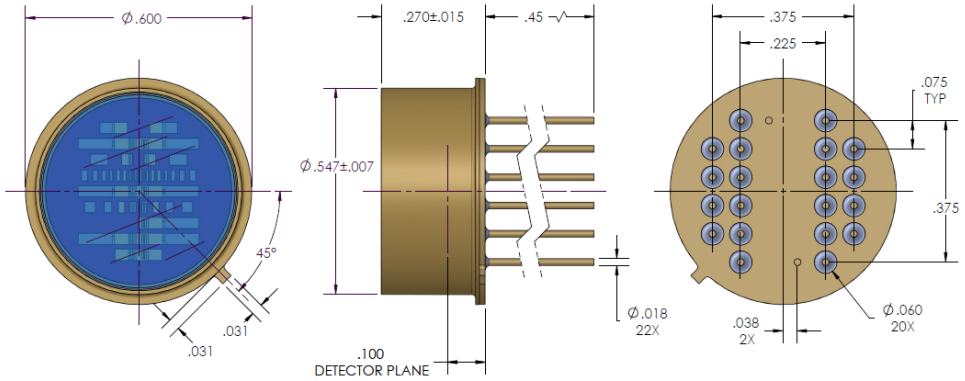
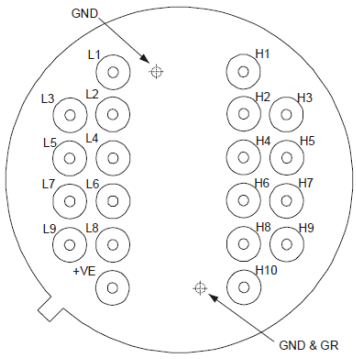


Figure 4. Pin Layout (Bottom View), EXACTD-362



Pin ID	Function
H1, L1	Bit 3
H2, L2	Reference Channel 1
H3, L3	Bit 4
H4, L4	Bit 6
H5, L5	Reference Channel 2
H6, L6	Bit 5
H7, L7	Bit 1
L8	Low-sensitivity Reference Channel 3
H8	High-sensitivity InGaAs Reference Channel 3 (Note 1)
H9, L9	Bit 2
H10	High-sensitivity Si Reference Channel 3 (Note 1)
GND & GR	Case Ground and Guard Ring

Note:

1. Separate pins connect to the high-sensitivity InGaAs and Silicon Reference Channel 3. This enables coarse wavelength-band identification. When both detectors respond, the incident laser beam is likely in the spectral transition region, specifically around 1064 nm.

Legend:
L – Low-sensitivity H – High-sensitivity GND – Ground GR – Guard Ring +VE – Common bias voltage (+12V)

Table 2. Angle-of-Arrival (AoA) Encoding for High- and Low-sensitivity Channels, EXACTD-362

High Sensitivity AoA (˚)	Low Sensitivity AoA (˚)	AoA encoding						High Sensitivity AoA (˚)	Low Sensitivity AoA (˚)	AoA encoding					
		Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6			Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6
52.1	46.8	1	0	0	0	0	0	5.5	-7.0	0	1	0	0	0	0
50.7	45.1	1	0	0	0	0	1	3.9	-8.6	0	1	0	0	0	1
49.3	43.3	1	0	0	0	1	1	2.3	-10.1	0	1	0	0	1	1
47.9	41.6	1	0	0	0	1	0	0.7	-11.6	0	1	0	0	1	0
46.5	39.8	1	0	0	1	1	0	-0.8	-13.2	0	1	0	1	1	0
45.0	38.0	1	0	0	1	1	1	-2.5	-14.7	0	1	0	1	1	1
43.6	36.3	1	0	0	1	0	1	-4.1	-16.2	0	1	0	1	0	1
42.2	34.5	1	0	0	1	0	0	-5.7	-17.7	0	1	0	1	0	0
40.8	32.8	1	0	1	1	0	0	-7.3	-19.2	0	1	1	1	0	0
39.4	31.1	1	0	1	1	0	1	-9.0	-20.6	0	1	1	1	0	1
38.0	29.3	1	0	1	1	1	1	-10.6	-22.1	0	1	1	1	1	1
36.6	27.6	1	0	1	1	1	0	-12.3	-23.6	0	1	1	1	1	0
35.1	25.8	1	0	1	0	1	0	-13.9	-25.0	0	1	1	0	1	0
33.7	24.1	1	0	1	0	1	1	-15.6	-26.5	0	1	1	0	1	1
32.3	22.4	1	0	1	0	0	1	-17.3	-28.0	0	1	1	0	0	1
30.8	20.7	1	0	1	0	0	0	-19.0	-29.4	0	1	1	0	0	0
29.4	19.0	1	1	1	0	0	0	-20.7	-30.8	0	0	1	0	0	0
28.0	17.3	1	1	1	0	0	1	-22.4	-32.3	0	0	1	0	0	1
26.5	15.6	1	1	1	0	1	1	-24.1	-33.7	0	0	1	0	1	1
25.0	13.9	1	1	1	0	1	0	-25.8	-35.1	0	0	1	0	1	0
23.6	12.3	1	1	1	1	1	0	-27.6	-36.6	0	0	1	1	1	0
22.1	10.6	1	1	1	1	1	1	-29.3	-38.0	0	0	1	1	1	1
20.6	9.0	1	1	1	1	0	1	-31.1	-39.4	0	0	1	1	0	1
19.2	7.3	1	1	1	1	0	0	-32.8	-40.8	0	0	1	1	0	0
17.7	5.7	1	1	0	1	0	0	-34.5	-42.2	0	0	0	1	0	0
16.2	4.1	1	1	0	1	0	1	-36.3	-43.6	0	0	0	1	0	1
14.7	2.5	1	1	0	1	1	1	-38.0	-45.0	0	0	0	1	1	1
13.2	0.8	1	1	0	1	1	0	-39.8	-46.5	0	0	0	1	1	0
11.6	-0.7	1	1	0	0	1	0	-41.6	-47.9	0	0	0	0	1	0
10.1	-2.3	1	1	0	0	1	1	-43.3	-49.3	0	0	0	0	1	1
8.6	-3.9	1	1	0	0	0	1	-45.1	-50.7	0	0	0	0	0	1
7.0	-5.5	1	1	0	0	0	0	-46.8	-52.1	0	0	0	0	0	0

Notes:

1. All angles are with respect to the package axis.
2. The specified angle in each case is at the center of a typical ±0.8° range.
3. Shaded angles are outside the nominal field of view.
4. RMS Error for encoded angle-of-arrival (AoA) may increase at extreme elevation angles for azimuth encoding. If the EXACTD-362 is oriented for elevation encoding, the RMS error would increase for extreme azimuth angle, and vice-versa.

Table 3. Absolute Maximum Ratings, Limiting Values, EXACTD-362

Parameter	Min	Typical	Max	Units	Comments
Case temperature while operating, T_A	-40		85	˚C	
Maximal incident power		1.2		kW/cm²	Power used in standard testing, with 1060 nm, pulse width of 12 ns and pulse repetition rate of 2 kHz.
Damage threshold	100			kW/cm²	Theoretical evaluation, no systematic test at this power level.

Quality and Reliability

The EXACTD-362 Module is compact and rugged, and has been designed to meet a full range of military specifications. The following MIL-STD-883 criteria have been met:

1. Acceleration testing, method 2001.
2. Mechanical shock and sine vibration, method 2002 and 2007, respectively.
3. Temperature cycling, method 1010.

Ordering information

For EXACTD-362 pricing, availability and customization for specific military requirements, please contact Excelitas Technologies.

Export controls

The EXACTD-362 may be subject to international export controls and may not be exported without official authorization.

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 over 7,000 employees in North America, Europe and Asia, serving customers across the world.

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