

**IR UNIT & MEDICAL
STANDARDS (IEC-60825-1 &
ANSI Z136.1)**

Ocular Response Analyzer:

The **Ocular Response Analyzer (ORA)** is a **non-contact** device used to measure **INTRAOCULAR PRESSURE (IOP)** and **BIOMECHANICAL PROPERTIES** of the cornea.

Unlike traditional tonometry methods (e.g., Goldmann applanation tonometry), which primarily measure IOP based on corneal flattening, the ORA offers a more comprehensive analysis by considering the **corneal biomechanics**.

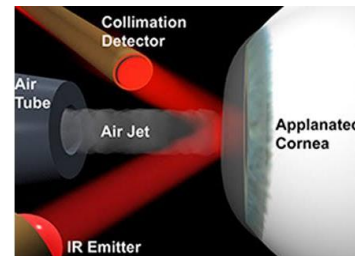
How it Differs from an Air-puff Tonometer?

The **air-puff tonometer** measures IOP by using a puff of air to flatten (applanate) the cornea. The device detects the force or timing at which the cornea flattens, and from this, it calculates the intraocular pressure. It only uses **one applanation event** (the point where the cornea flattens due to the air puff) to calculate IOP.

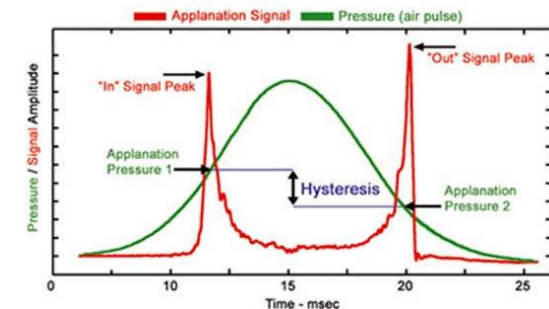
The **ORA** uses an air puff to flatten the cornea, measuring two applanation events: one during inward movement and another as the cornea returns to its original shape. It calculates **corneal hysteresis (CH)**—the cornea's ability to absorb and dissipate energy—by analyzing the difference between these points. It also provides two IOP measurements: Goldmann-correlated IOP (IOPg) and corneal-compensated IOP (IOPcc).



ORA



Applanation



corneal hysteresis

Feature	Air-puff Tonometer	Ocular Response Analyzer (ORA)
Primary Measurement	IOP	IOP (IOPg and IOPcc) + Corneal Hysteresis
Applanation Events	Single Applanation	Dual Applanation (Inward & Outward)
Corneal Compensation	No	Yes (IOPcc accounts for corneal properties)
Biomechanical Measurement	No	Yes (Corneal Hysteresis - CH)
Use Cases	Routine IOP Screening	Glaucoma Management, Corneal Biomechanics
Corneal Abnormality Accuracy	Less accurate	More accurate due to IOPcc and CH
Non-Contact	Yes	Yes

We have choose the method of Ocular Response Analyzer ,which can be achieved in a Miniature model with High accuracy

So,

It requires a **Reliable IR unit** ,which should **adapt** with the **Medical Standards** because it will be directly used on the Eye and should be **highly faster** in terms of **Measurements**.

Why Infrared light?

In the Electromagnetic Spectrum range of Near Infrared (700 to 1400 nm) can **penetrate the cornea deeply and efficiently, minimizes light scattering**, provides **clear signal detection**, and **enhances patient comfort** by being **non-visible**. The use of NIR light allows for **accurate, non-invasive, and reliable measurements of IOP** and corneal biomechanics, such as corneal hysteresis (CH), making it an optimal choice for this device.

INFRARED-EMITTER:

Specs of IR emitter ,we have choose for Our **Tono_Lite**:

Feature	IR-LED
Wavelength	860 nm
Radiant Intensity	500 mW/sr
Beam Angle	6 degree
Rise & Fall Time	12ns
Mounting Style	Through Hole



- *Fastest IR Emitter (12ns)
- * 860nm is ideally used in Air-puff tonometer and ORA ,due to better reflection by cornea.
- *IR needs to focus on the center of the cornea (11mm) to get the accurate Results ,So the IR beam we have choose (6 deg) covers $2.17 < 11\text{mm}$,which can accurately Emit the IR wave to the center of the cornea.

How it Meets the **Medical Standards** Guidelines ?

Irradiance :

Irradiance refers to the power of electromagnetic radiation (like light) per unit area incident on a surface, typically measured in watts per square meter (W/m²). In the context of an **IR (infrared) emitter**, irradiance measures how much infrared energy (in terms of power) hits a specific area.

Irradiance (E) Calculation for the specified IR emitter:

$$E = I / d^2$$

Where:

E = irradiance (mW/cm²)

I = radiant intensity (mW/sr) (500mW/sr)

d = distance from the emitter in centimeters (cm) (d=2.5)

So,

Calculated **E= 84.22mW/cm²**.

Medical Standard (IEC-60825-1 & ANSI Z136.1) :

*IEC-60825-1 & ANSI Z136.1 :

It is the Medical Guideline should be followed to ensure eye safety when the exposure Light is IR laser (narrow beam)

Maximum Exposure Time (t) = (Irradiance / (MPE coefficient × C₄ × C₆))^{1.33}

Irradiance = **84.22mW/cm²**

MPE coefficient = 2.7 × 10⁴

C₆=1

C₄=3.16 (above all ideal for Wavelength of 860nm from the guidelines)

By substituting all the values,

Finally ,MPE (t) = 42 ms

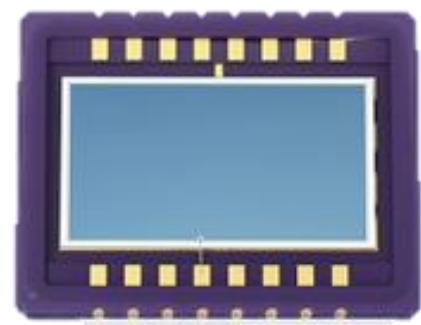
Time taken by the Total applanation and rebound time is 20 to 25 ms
(The Maximum Permissible Exposure time is **more than enough** for our application)

Table 6 - Maximum permissible exposure (MPE) at the cornea for direct exposure to laser radiation $\lambda > 0.7 \mu\text{m}$									
Exposure time, t (s)	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	10^0	10^1	10^2	10^3
Wavelength, λ (μm)	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	10^0	10^1	10^2	10^3
0.700 to 0.705									
0.705 to 0.715									
0.715 to 0.725									
0.725 to 0.735									
0.735 to 0.745									
0.745 to 0.755									
0.755 to 0.765									
0.765 to 0.775									
0.775 to 0.785									
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Photo-Diode:

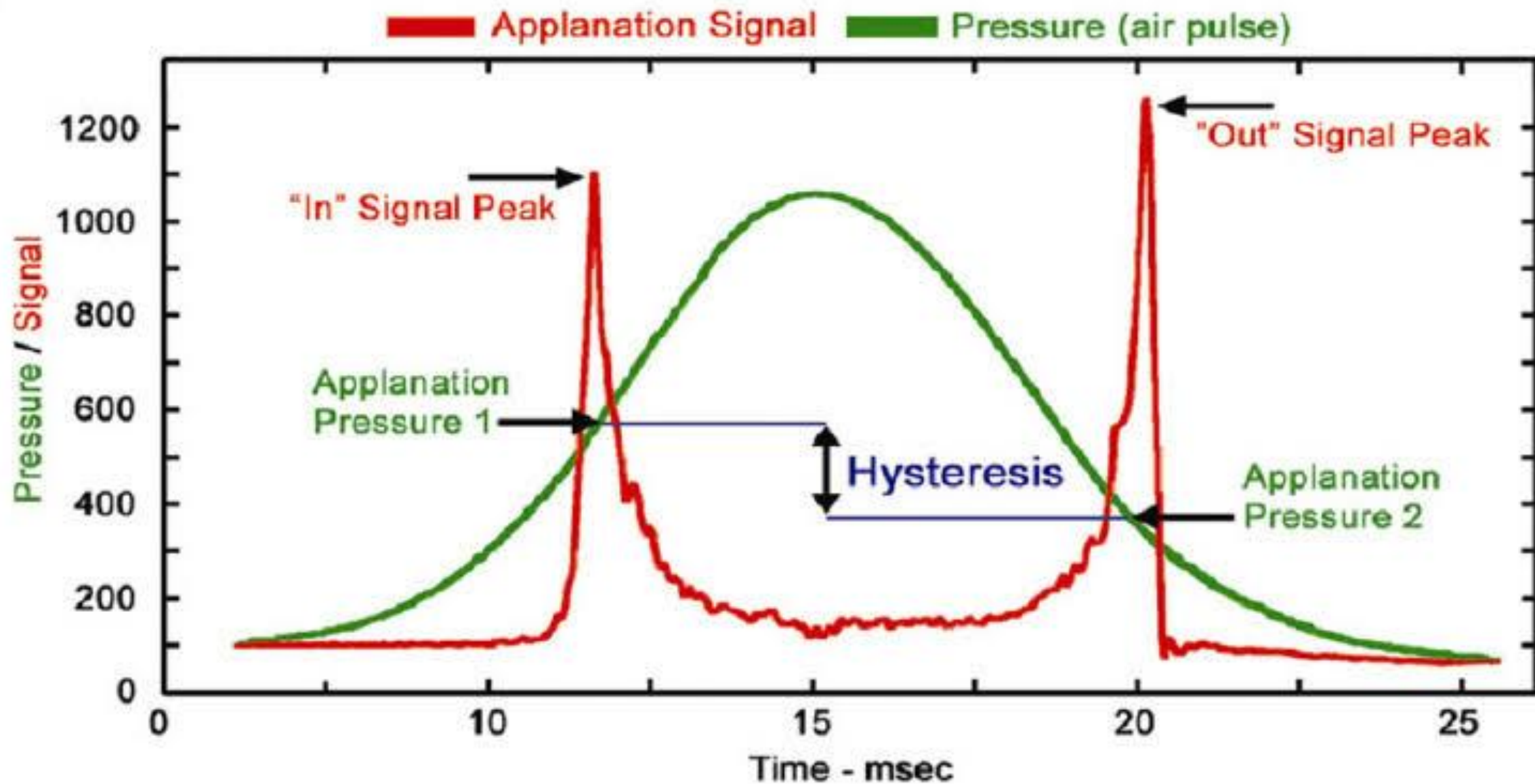
Feature	Photodiode
Wavelength	320 to 1100 nm
Type	Si-PIN
Photosensitivity	0.72 A/W
Response Time	0.5ns
Mounting Style	SMT
Dark-Current	10000 pA
Photo-sense Area	11 × 6 mm
Least Irradiance Detection	0.0417 mW/cm ²

Ta=25 °C, Typ., Photosensitivity: $\lambda=\lambda_p$, Dark current: $V_R=10$ V, Cutoff frequency: $V_R=10$ V, Terminal capacitance: $V_R=10$ V, $f=1$ MHz, Noise equivalent power: $V_R=10$ V, $\lambda=\lambda_p$, unless otherwise noted



Due to its **High Sensitive and Rapid Response Time** ,it will be ideal for our application

Finally with **the corneal hysteresis analysis and CCT** value ,Controller unit determines the IOP without any miscalculation.



corneal hysteresis