VD6283 Mechanical and Industrial Design Guide

Version 2.1

Product concerned: VD6283

Agenda

|			
#	Scope	#	Ideal Optical & Mechanical Design
#	Module dimension	#	ID (mechanical) Design requirements
#	Active sensing array	#	Optical stack specifications
#	Interest of optical stack	#	History & Glossary

VD6283 Guidelines | Scope

- Provide guidelines for mechanical (industrial) and optical design and how to assess cover window quality.

- In this document, ST shares recommendations on optical and mechanical design requirements for "Best in Class" application.
  - If the industrial design and optical stack quality deviates from ST's recommended ''Best In Class'' recommendation, the system performance can be negatively impacted. It is the integrator's responsibility to perform the system study and define their own system specification.

- Expected performance level of an optimized optical stack and optimized ID design.

|	Symbol	Nominal	Min.	Max.
			μm	
Package Body Dimension X	A	1832	1807	1857
Package Body Dimension Y	B	1008	983	1033
Package Height	C	555	495	615
Ball Height	C1	120	90	150
Package Body Thickness	C2	435	390	480
Thickness of Glass surface to wafer	C3	305	285	325
Ball Diameter	D	200	170	230
Total Pin Count	N	6		
Pin Count X axis	N1	3		
Pin Count Y axis	N2	2		
Pins Pitch X axis	J1	450		
Pins Pitch Y axis	J2	450		
Edge to Pin Center Distance along X	S1	466	436	496
Edge to Pin Center Distance along Y	S2	279	249	309

Notch

Mechanical Diagram
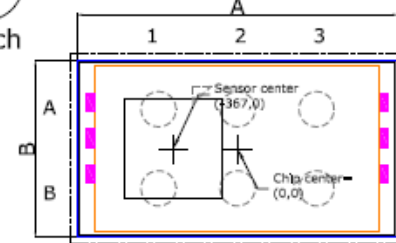
Top View (Bumps Down)
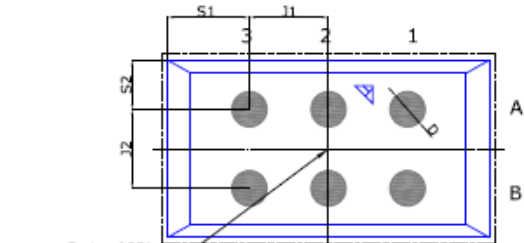
Bottom View (Bumps Up)

Side View

Lead & BGA Formation

VSS   VDD
SDA   GPIO
SCL   CLKIN
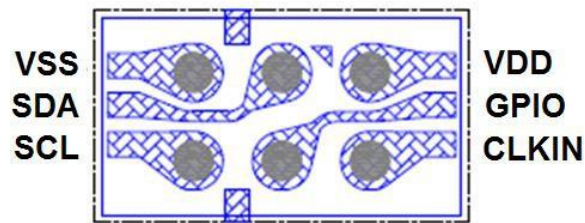
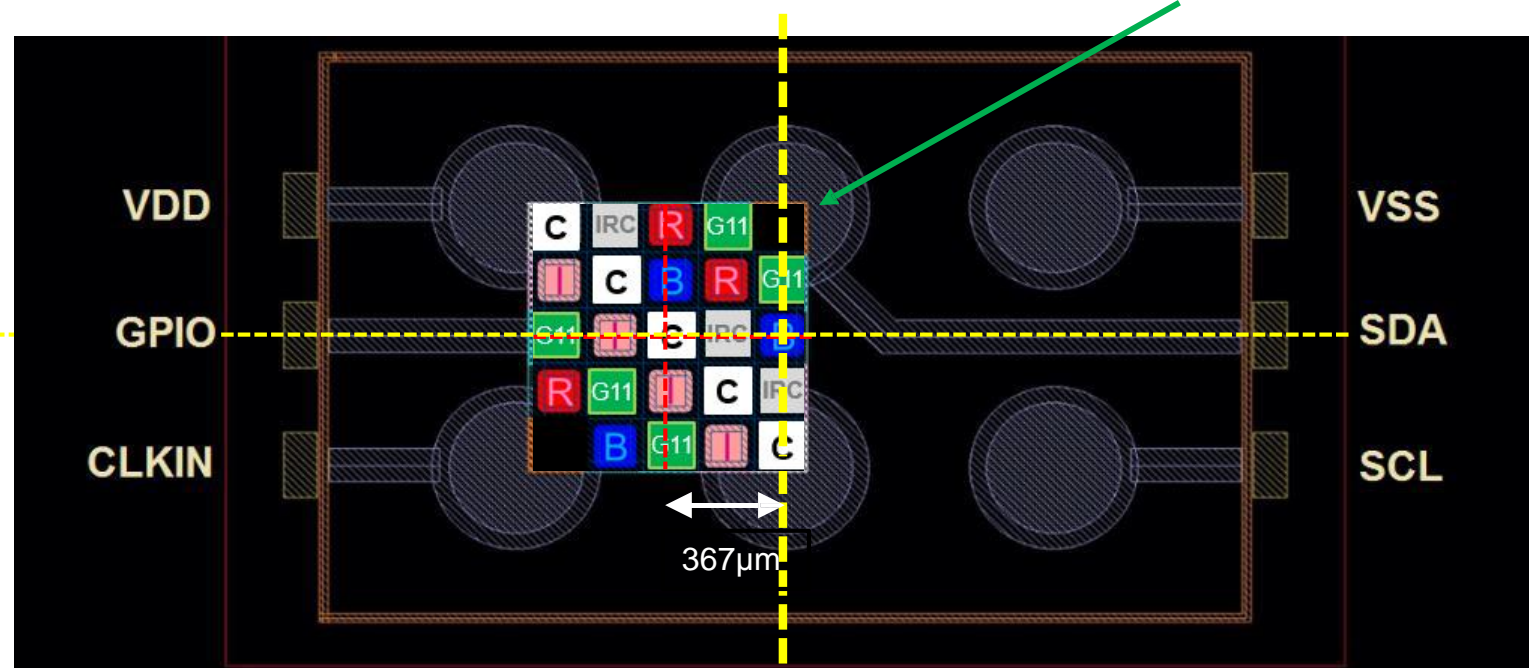Bottom View (Bumps Up)
Package Size : 1832 × 1008 um
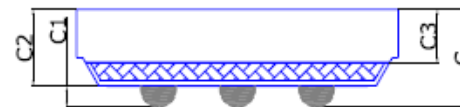
Anti-rotation check
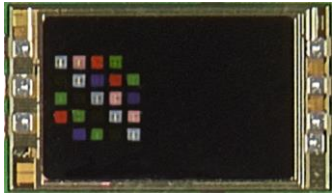
- Sensing Matrix size (without dummies around photodiodes) : **437.3 µm x 437.3 µm**

Sensing array center

Silicon center

367µm
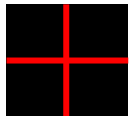
- Vertical centering : **0µm** (identical between Matrix and silicon)
- Horizontal centering : Sensing matrix offset by **- 367 µm** on the left versus silicon center

VD6283 Guidelines | Interest of an optical stack

- Generally speaking, an optical stack can be:
  - Glass or plastic material (PMMA/PC/OLED…) with or without color filtering
  - Diffuser film typically used with & between a cover glass & sensor and that has great transmissive properties
  - Diffuser plate which hardness allows to use directly as a cover window

- The optical stack serves three main purposes:
  - To provide physical protection of the device, including prevention of dust ingress.
  - To provide optical filtering for the sensor (for selected use cases)
  - In the case of a diffuser, to create an uniform lighting for the sensor to reduce angular dependency

- The cover glass will normally be opaque, with one circular aperture to allow the reception of light into the sensor's field of view.

VD6283 Guidelines | Ideal Optical & Mechanical Design

- An ideal **Optical stack** has:
  - No structural defects in the glass or plastic material
  - Good transmittance >5% to guarantee high lux/CCT accuracy when IR channels needed
  - Outer coatings (anti-fingerprint or anti-reflective) that do not degrade immunity to fingerprint.

- An ideal **ID design** has:
  - Small air gap of 0.05mm, up to a maximum of 2.95mm
  - Thin transparent cover that has almost the same response across the spectrum of VD6283
  - No expected limitation on window tilt
    - By theory, only a very severe tilt on top of the sensor will affect performance if refractive index of the material in the window is very high compared to air
  - Tight assembly tolerances as measurement can impact aperture/FoV
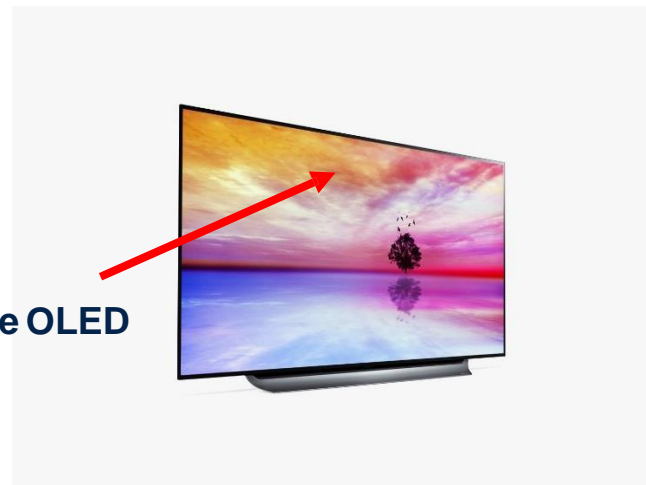
ID (mechanical) Design requirements

VD6283 Guidelines | Compatible ID designs

- Few existing examples of cover glass placement

Behind flash glass

Behind Low Transmissive displays down to 5% Tr

Under display like OLED

**Behind pinhole glass or narrow bezel**

VD6283 Guidelines | Ideal Optical & Mechanical Design

- If the application is not able to desynchronize a light source from a neighborhood IC during data sampling from VD6283, it may lead to noise to the data.
- Therefore, need to
  - Either position polluting components such as Flash/IR light sources away from VD6283
  - Or use of gasket to reduce unwanted light emitted from other components
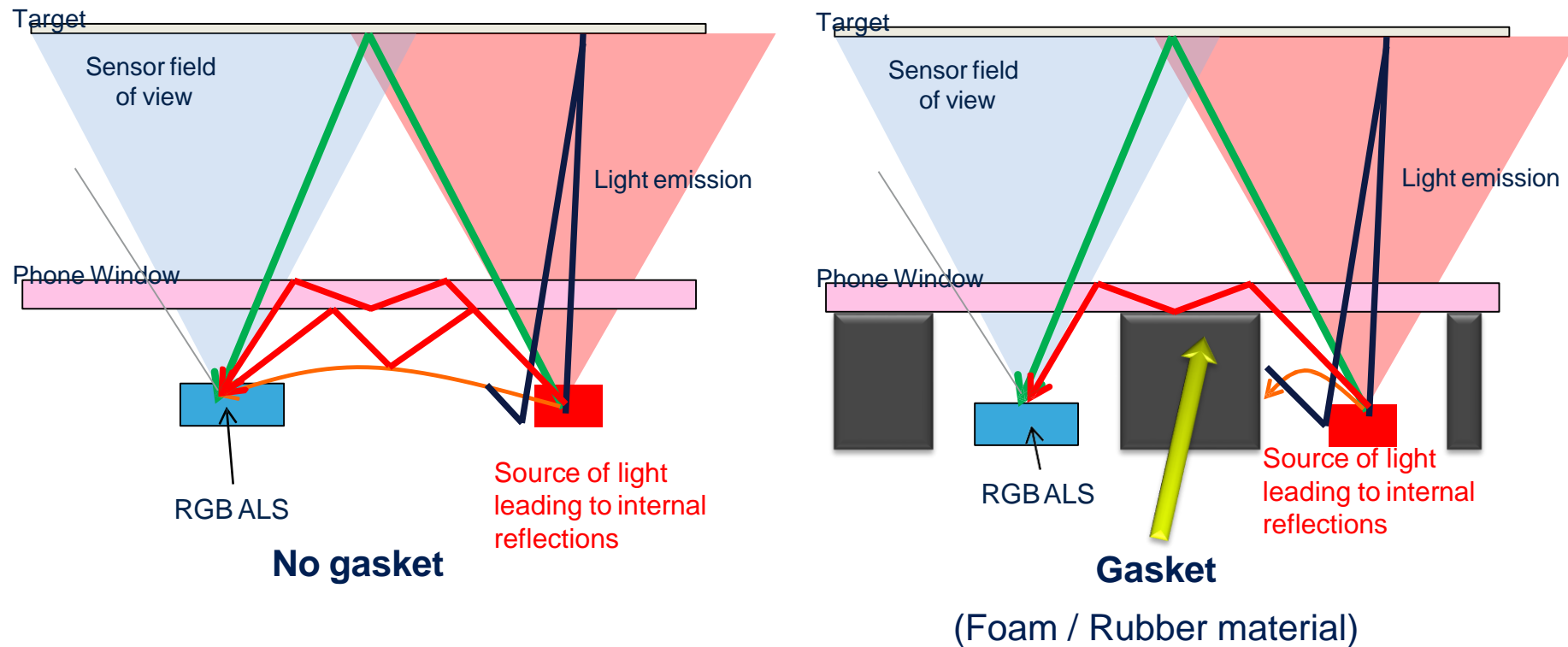
VD6283 Guidelines | ID design recommendations

- It is the Integrator responsibility to comply with Industrial Design (ID) and cover glass recommendations from ST:
  - A small air gap: (A),
  - thin cover glass (B) with high transmittance is best.
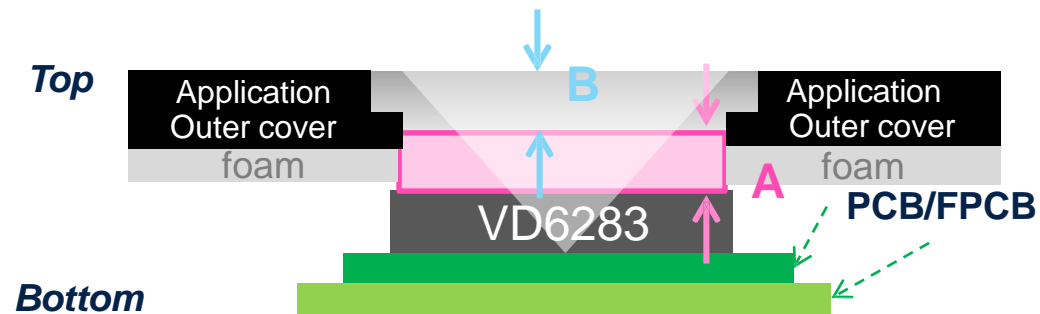
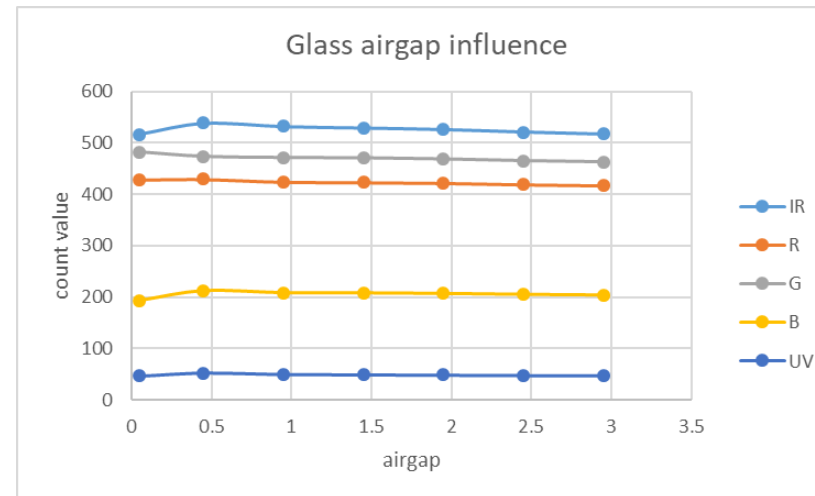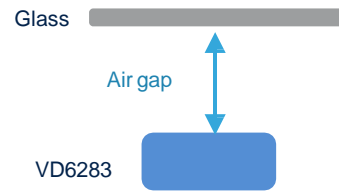# VD6283 Guidelines | Optical stack thickness
Impact on measurement

- From ST's study, thickness of material is not significant.

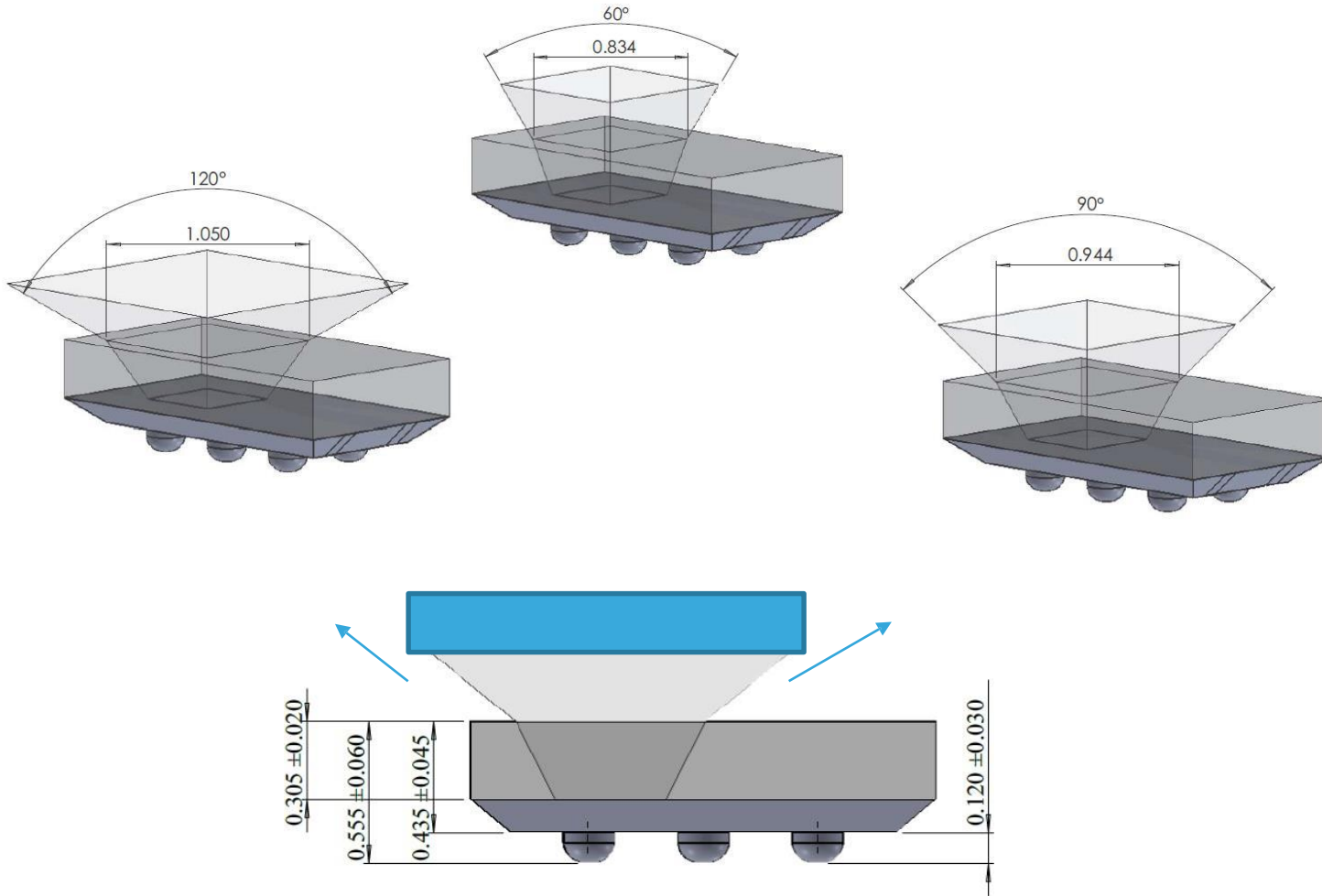- As far as market requirement have been shared with ST, 0.5mm is standard and leads to good behavior.

- Air gap is between glass and sensor

- Findings: The Air-gap between glass and sensor reduces the light slightly, air-gap below 2.95mm is ok.

	Opening Circle (60°)	Opening Circle (90°)	Opening Circle (120°)
Air Gap + window thickness	Diameter (mm)	Diameter (mm)	Diameter (mm)
0	0.834	0.944	1.050
0.05	0.892	1.044	1.223
0.1	0.949	1.144	1.396
0.15	1.007	1.244	1.570
0.2	1.065	1.344	1.743
0.3	1.180	1.544	2.089
0.4	1.296	1.744	2.436
0.5	1.411	1.944	2.782
0.6	1.527	2.144	3.128
0.7	1.642	2.344	3.475
0.8	1.758	2.544	3.821
0.9	1.873	2.744	4.168
1	1.989	2.944	4.514
1.1	2.104	3.144	4.861
1.2	2.220	3.344	5.207
1.3	2.335	3.544	5.553
1.4	2.451	3.744	5.900
1.5	2.566	3.944	6.246
1.6	2.682	4.144	6.593
1.7	2.797	4.344	6.939
1.8	2.912	4.544	7.285
1.9	3.028	4.744	7.632
2	3.143	4.944	7.978
2.5	3.721	5.944	9.710

VD6283 Guidelines | FoV / Aperture selection

- The optimum performance of the sensor is achieved with 120degrees FoV
  - If FoV is smaller than 120degrees, VD6283 is still functional but might have degraded performance

- It is to expect following tolerances for assembly of VD6283 sensors form ST into phone, watch, Laptop
  - Tilt: +/-6degrees
  - x,y placement tolerances +/-200um (phone/PC) and +/-300um (smartwatches)
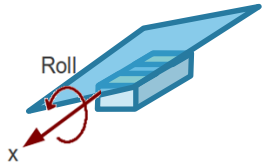
- Definition: Roll, yaw, pitch are the 3 forms of tilt.

- Findings;
  - No impact of tilt seen with tilts of up to 10 degrees (Pitch and Roll).
  - No impact of Yaw on the sensor performance
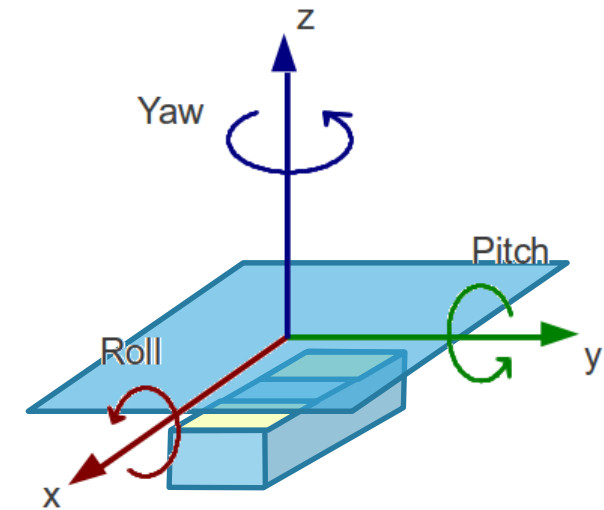
VD6283 Guidelines | Influence of EMI & Temperature

- For EMI, no impact to common antenna RF used in current wireless market is expected.

- Components that generate heat (e.g. Flash, camera, AP…) higher than 50degrees should be placed few millimeters away from VD6283 as it may affect its performance in low lux values where KT noise in CMOS sensors is worst case.

Optical stack specifications

VD6283 Guidelines | 2 examples of use case impact on ID design

- UV measurement is needed
  - This requires a very transparent material because 80% transmission in UV is needed which means >80% in visible

- Behind low transmissive optical stack
  - UV measurement is not possible
  - Example: 5% visible & IR
  - Common for front facing RGB-ALS in wireless (phone, tablet…)

VD6283 Guidelines | Quality control ST & Window vendors

- ST's RGB-ALS sensors measure below key parameter to monitor window quality:
  - Channel counts of environment lighting (transmittance + Haze)

- Cover glass vendors are responsible to control the material quality to ensure it is free of surface and structural defects and in line with the transmittance requirements across the spectrum 350nm-900nm
  - Cover glass vendors shall be able to measure the transmittance of the final window and control/monitor the parameter quality in production
  - Cover glass vendors are responsible for tolerance in material thickness

VD6283 Guidelines | Optical & mechanical requirement summary

	Parameter	ST's current recommendation for System performance	Description of the parameter	Contribution to performance	Measurement control
Optical	Material	PMMA, PC, OLED, …	Transmission, Hardness	Medium	n/a
	Window Transmission (%)	*For the best performance from each individual channel:* UV >80%, IR >50, Visible >5%	Optical system transmission	Major	At glass vendor in production or by characterization
	Window shape	Flat	-	Low	At Glass vendor
	Thickness of cover window	Limited impact. No specific requirement	-	Low	Tolerance control in glass vendor
	Window ink coating or embedded filter	Optional but related to transmission	-	Medium	At glass vendor
Mechanical	Window Tilt (deg)	Yaw: N/A Roll and pitch: No specific requirement as long as Aperture is not reduced by tilt	Angle of window versus the VD6283 sensor	Low	At customer
	Air gap	Up to 2.95mm	Distance between the window to the top of sensor	Medium	Tolerance control In assembly
	Air gap: + window thickness	Up to 3.45mm	Optical path	Medium	Tolerance control In assembly

History version & Glossary

VD6283 Guidelines | History

Version	Date	Release Notes
1.0	March 2019	Initial version
1.1	June 2019	Minor updates
1.2	November 2019	Minor updates. Added diagrams
1.3	August 2020	Updated for VD6283
1.4	September 2020	Add of Active sensing array
2.0	January 2024	Template udpate and release
2.1	January 2024	Update for st.com release

- ALS = Ambient Light Sensot
- ID = Industrial Design often referring to Mechanical Design
- FoV = Field of View

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