PISEO
photonics.innovation.services

A2MAC1

VOLKSWAGEN ID3 HEADLAMP

IN-DEPTH TECHNICAL & PERFORMANCE ANALYSIS

2022 Product Brochure

TABLE OF CONTENTS (1/2)

TABLE OF CONTENTS (2/2)

AUTHORS OF THIS REPORT

Dr Olivier Andrieu – Innovation Leader and System Architect - PISÉO

Olivier ANDRIEU is in charge of technical expertise and innovation projects at PISÉO.

He holds a degree in Engineering and a PhD in Physics from the INPG Graduate School.

His career has allowed him the opportunity to innovate in the automotive sector in connection with sensors and battery management systems, as well as within Philips Lighting, where he acted as a System Architect.

Olivier has supervised the design of numerous photonic systems for different sectors that have been commercialized. He has also performed many technical analyses of photonic systems and published several reports in collaboration with Yole Group's teams.

Robin Fillet – Optical Engineer at PISÉO

Robin Fillet specializes in the design of industrial optical illumination systems.

He holds an Advanced Photonics Specialty Optical Engineering degree from Telecom Saint-Etienne.

Before joining PISÉO, he worked for five years as an Optical Engineer in the lighting division of the VALEO group. This experience led him to work on the front and rear LED lights of the world's largest car manufacturers.

Within PISÉO, Robin is able to contribute particularly to the optical design of systems integrating optical guides for morphological detection applications and control handles for construction machinery.

Vincent Keromnès – Performance Benchmarking Domain Leader at A2Mac1

Launched in 2019, the A2Mac1 Performance Benchmarking Domain takes care of all activities related to test and simulation of full vehicle or vehicle sub-assemblies' performance. Exterior Lighting Goniometry is one of the new and unique benchmarks that has been rolled-out to investigate and understand the real performance of automotive headlamps.

Prior to that, Vincent worked in the simulation software industry for 25 years, growing expertise in multiple fields such as multibody dynamics, finite element analysis, multiphase flow, aerodynamics, aero-acoustics, plastic injection, and more.

INTRODUCTION

- The integration of LED technologies has given automotive lighting manufacturers the opportunity for strong differentiation via new designs and functionalities. Automotive headlamps are subject to many technical and aesthetic constraints, allowing a multiplicity of architectures and optical solutions. Therefore, OEMs and Tier1/2s are looking for accurate technical and performance insights of commercialized devices in order to consolidate their own product strategies.

- This report is the very first of its kind and will help the community of people involved in headlamp design and manufacturing to better understand the solutions provided by the major automotive lighting actors.

- The uniqueness of this report, which relies on **PISÉO** and **A2MAC1's** respective capabilities, consists of delivering an in-depth analysis of the technical solutions that have been carried out by Varroc Lighting engineers, together with the associated lighting performance. To achieve this, the report is subdivided in two main parts:

    - The first part is dedicated to the analysis of the architecture, describing all the components and interfaces playing a role in the lighting functionalities. Thanks to the expertise of the authors and their technical means, it is possible to decrypt the system architecture, together with the technologies used.

    - The second part unveils the performance of the headlamp in relation to the system design and against the regulatory requirements.

- More reports will come soon, allowing comparisons of chosen technical solutions and related performance of LED-based headlamps.

OBJECTIVES OF THIS REPORT

Based on an **accurate and independent** analysis:

- To provide automotive lighting market players and teams with a **deep understanding of the solutions** which have been implemented in the analyzed device,
- To show how these solutions contribute to the **lighting performance and road-users' safety**,
- To **highlight the key findings** in relation to other state-of-the-art marketed products.

VW ID3 HEADLIGHT IN-DEPTH ANALYSIS: WHO DOES WHAT?

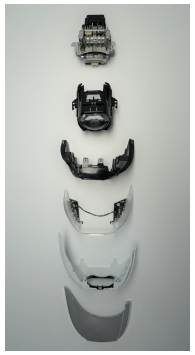
PISÉO
photonics.innovation.services

- Teardown and reverse engineering of the headlamp
- Cross analyses on engineering and performances
- Statement on product design and performances

A 2 M A C 1

- Provides the vehicle for headlamp characterization purpose
- Headlamp control set-up

ANALYSIS PROCESS



TEAR-DOWN AND REVERSE ENGINEERING
- Optics
- Mechanics
- Assembly
- Electronics
- Thermal management

CROSS ANALYSES

PERFORMANCE CHARACTERIZATION
- Characterization plan
- Headlamp control setup
- Measurements

STATEMENT ON PRODUCT DESIGN AND PERFORMANCE

KEY FINDINGS

- The analyses of both the architecture and the photometric performance confirm a high-quality product.
- Sophisticated optical solutions have been designed and implemented to meet strong performance and integration requirements.
- The ID3 headlamp embeds an ADB function whereby 1 to 11 LEDs are selected to extend the beam and cover more than the low beam. However, the resolution of the lit areas, being limited to 11 LEDs, appears low compared to other ADB headlamps installed on high-range vehicles, but it is a step up for this function.
- The optical devices of the ADB function are nicely designed and well assembled, resulting in good beam quality.
- Chromatic effects have been noted along the cut-off line of the low beam. This is due to the technical solution, which generates the cut-off line being unable to suppress the chromatic effect entirely.
- Electronic solutions are not fully optimized. The LED choice is valuable, but the implementation on the boards shows a considerable variation and a lack of optimization with basic process constraints.

WHAT'S IN THE REPORT

Key features

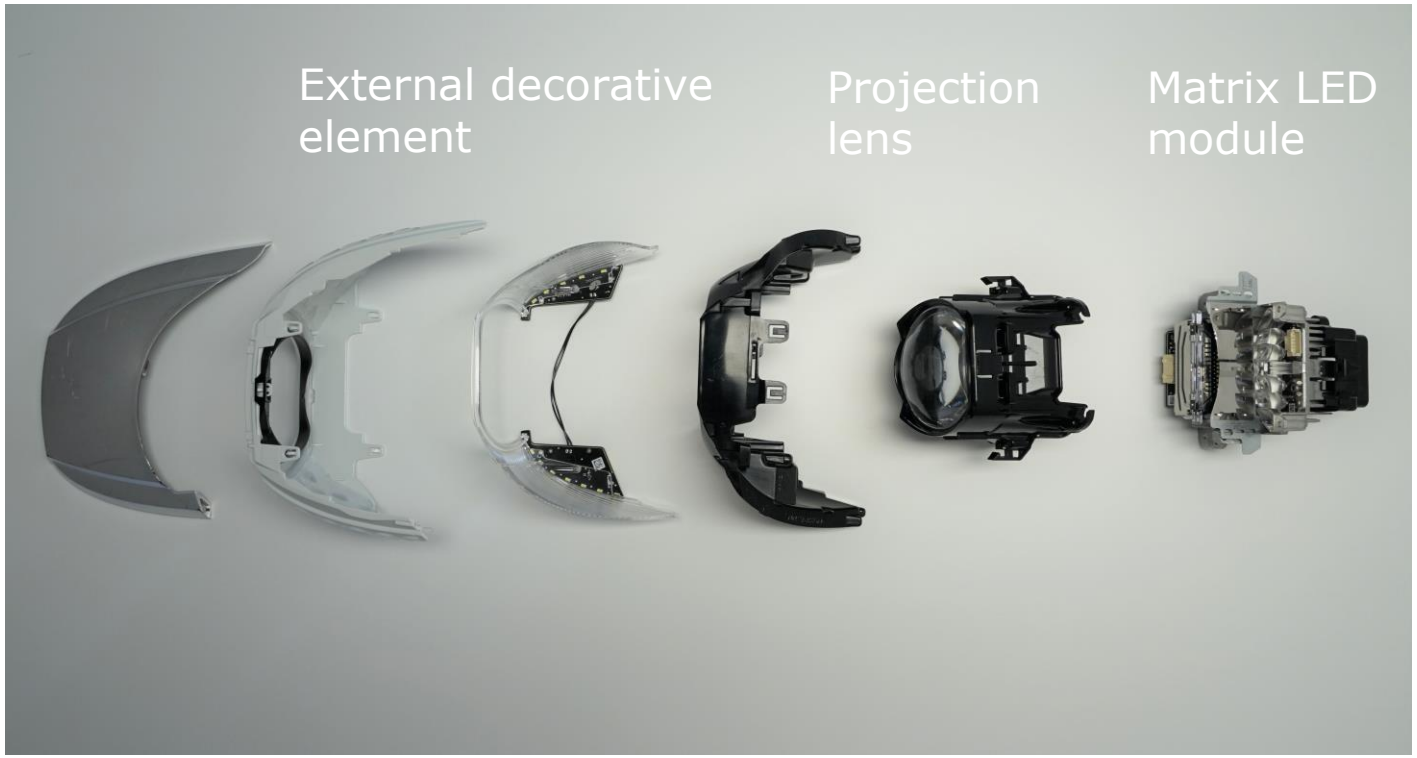
- Teardown of the VW ID3 headlamp,
- Analysis of the general architecture of the headlamp,
- Analysis of the architecture of the headlamp modules:
  optical, mechanical, assembly, electronics, thermal management,
- Performance characterization,
- Performance analysis,
- Regulatory compliance,
- Statement on product design and performance.

COMPANIES CITED IN THIS REPORT

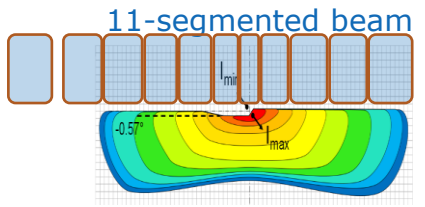
- Nichia
- OSRAM
- Plastic Omnium
- Varroc Lighting Systems
- Volkswagen

LOW BEAM – ADB MODULE

- This module is a complex part containing a matrix projection module associated with decorative illumination.
- The matrix module is a bi-functional module, supporting an LB stage with [redacted] LEDs and [redacted] ADB segments. The module includes primary optics for each LED, and a projection lens.
- A decorative lighting system giving an aesthetic overview of this module is located around the lens. This lighting system is attached to the position lamp function.
- All the elements are maintained and located in structural plastic parts.



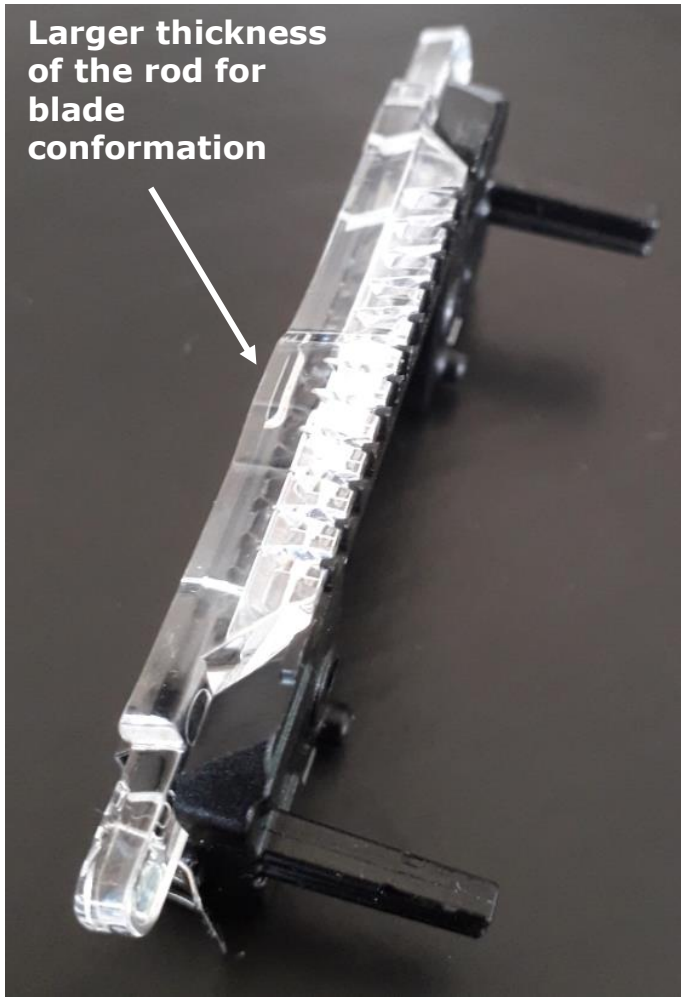
source: PISÉO



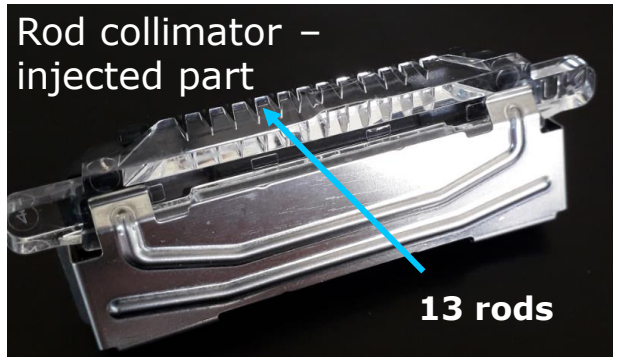
BI-MATRIX PROJECTION MODULE

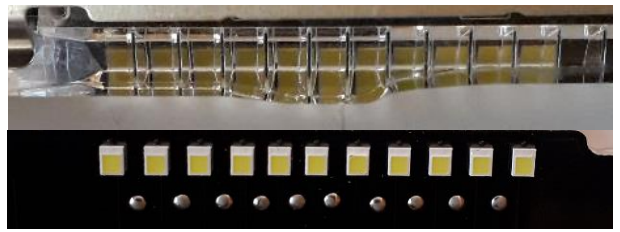
Bottom lighting structure

- The bottom lighting part creates a segmented beam covering the upper part of the low beam.
- The 11 LEDs are placed in front of individual light guides. These guides, having a rod shape, collimate the flux emitting by each LED in order to form a continuous light-emitting surface. The flux will be directed to the projection lens.
- The rods are shaped in a stand-alone injected part and separated by cavities injected in PC black plastic.
- This stand-alone part is located against the blade and conforms to it. Some rods have a different thickness in order to be in close contact with the blade.
- The optic parts hold 13 rods, for 11 LEDs only. Two of them, located at the same side, are not used. We suppose the optic part is designed to be used either on the right- or left-side configuration.



source: PISÉO



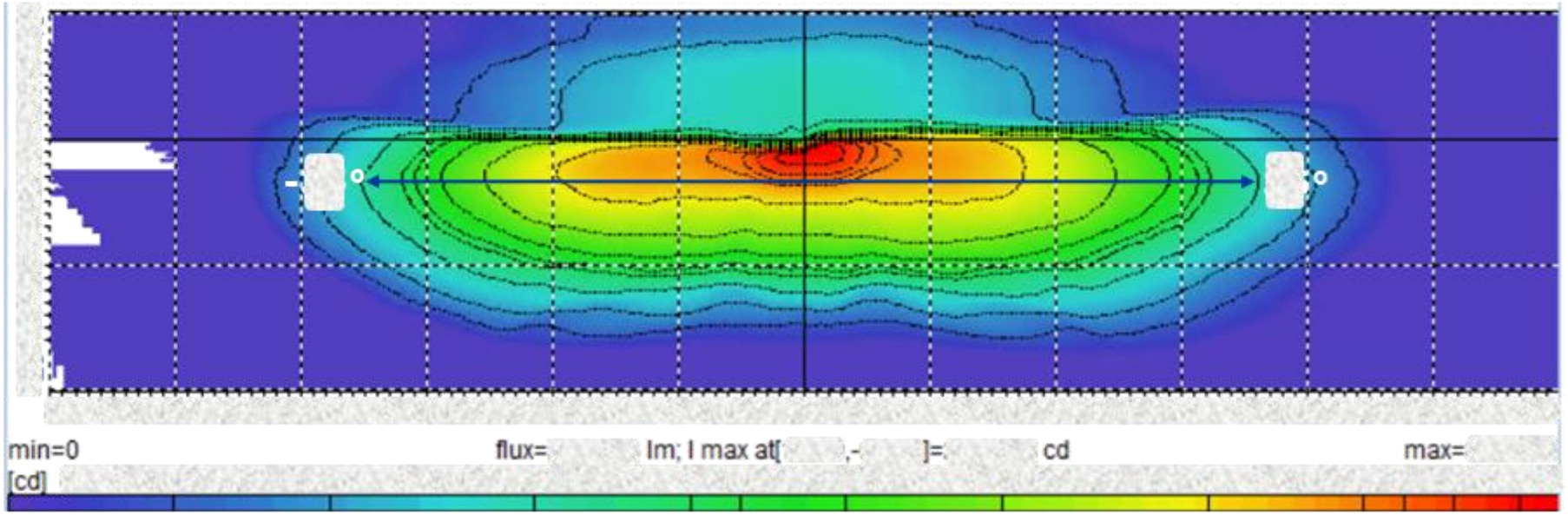


Continuous light-emitting surface

PERFORMANCE

Low beam right: RHT

- Flux: lm
- I max: cd => lux @ 25m
- Width: [- °; °]
  The threshold is taken at 0.4 lux (=250cd), which is a common practice for the evaluation of a beam width in automotive lighting. Large beam width is a good point for the driver's comfort.
- The sharpness and the shape of the kink are analyzed in the next slides through performance measurements and linked with the architecture.



source: PISÉO

ECE R112 REGULATION – LOW BEAM

Right

- The grid refers to homologation thresholds. All measured values comply with the homologation requirement, and therefore to the conformity requirements.
- The sharpness is measured at [redacted], which is a better performance than required by regulation or by general OEMs' specifications.

OK vs. conformity rq.

OK vs. homologation rq.

Fixed points – intensity check

Sharpness, gradient, and linearity

name	value OK [cd]	min/max % / %	min [cd]	max [cd]	test pos. [deg]	found pos. [deg]
B 50 L			--	350.0	-3.43, 0.57	
BR			--	1750.0	2.50, 1.00	
75R			10100	--	1.15,-0.57	
75L			--	10600	-3.43,-0.57	
50L			--	13200	-3.43,-0.86	
50R			10100	--	1.72,-0.86	
50V			5100.0	--	0.00,-0.86	
25L			1700.0	--	-9.00,-1.72	
25R			1700.0	--	9.00,-1.72	
HV			--	625.0	0.00, 0.00	
Z III			--	625.0	0.00, 0.00	
Z IV			2500.0	--	-5.15,-1.72 ; 5.15,-0.86	-4.15,-0.86
Z1<2*I50R			--	47146	-9.00,-4.00 ; 9.00,-1.72	-0.75,-1.72
P1+P2+P3			190.0	--	-8.00, 4.00 ; 0.00, 4.00 ;	8.00, 4.00
P4+P5+P6			375.0	--	-4.00, 2.00 ; 0.00, 2.00 ;	4.00, 2.00
P7			65.00	--	-8.00, 0.00	
P8			125.0	--	-4.00, 0.00	
grad H 5L-5R			0.08	--	-5.00,-0.20 ; 5.00,-0.20	0.50,-0.20
grad 2.5L			0.13	0.40	-2.50,-1.50 ; -2.50, 1.50	-2.50,-0.80
grad 1R			0.08	--	1.00,-2.00 ; 1.00, 2.00	1.00,-0.01
grad 2R			0.08	--	2.00,-2.00 ; 2.00, 2.00	2.00,-0.01
grad 3R			0.08	--	3.00,-2.00 ; 3.00, 2.00	3.00,-0.01
Linearity			--	0.20	-3.50,-5.00 ; -1.50, 5.00	

The light distribution is OK

source : PISÉO with LucidShape

YOLE GROUP OF COMPANIES RELATED PRODUCTS

Lighting for Automotive 2022

Automotive Semiconductor Trends 2021

Automotive Advanced Front-Lighting Systems 2019

PISÉO – INDEPENDENT INNOVATION PLATFORM

TOGETHER, LET'S LIGHT THE FUTURE OF PHOTONICS

OUR JOB:

Supporting your product and photonic system innovations and optimizations.

- DEDICATED EXPERT TEAM
- ELECTRO-OPTICAL ISO 17025 ACCREDITED LAB
- POWERFUL DESIGN AND SIMULATION MEANS: ZEMAX, LIGHTTOOLS, SOLIDWORKS, RHINO3D, OWN TOOLS AND MODELS…
- SOLID INDUSTRIAL ECOSYSTEM: MECHANICS, ELECTRONICS, SOFTWARE, AI, ASSEMBLY, TESTS…

sources: PISÉO, Olivier Ramonteu

PISÉO – INDEPENDENT INNOVATION PLATFORM

LET'S BRING YOUR PROJECTS INTO THE LIGHT

OUR OFFERS:

- **PRODUCT INNOVATION AND OPTIMIZATION**

ELECTRO-OPTICAL CHARACTERIZATION
OPTICAL RISKS

CRITICAL ANALYSES OF SYSTEMS AND IMPROVEMENT

DESIGN, INDUSTRIALIZATION OF INNOVATIVE SYSTEMS

TECHNOLOGICAL, MARKETS, REGULATION WATCH

TRAINING

- **PUBLICATION OF TECHNICAL REPORTS**

COMPONENTS

SYSTEMS

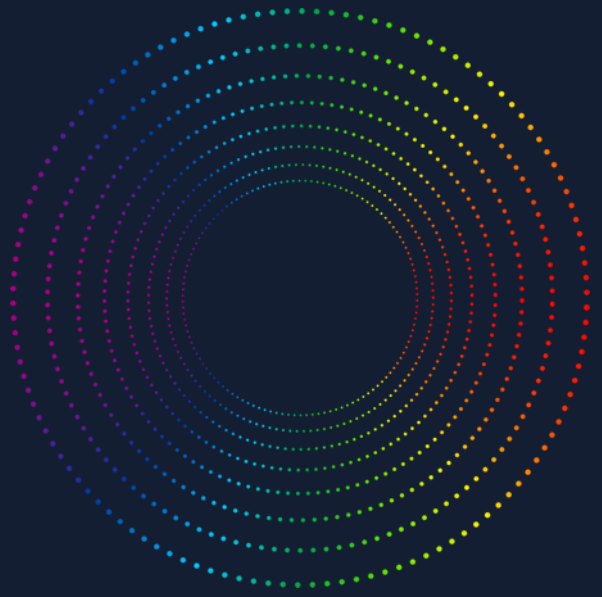
sources: PISÉO, Olivier Ramonteu

MARKETS AND PRODUCT TYPES

PISÉO – THE FACTS

- **10 years old**.
- **8 shareholders,** including Yole Développement, GIL-Syndicat du luminaire, Syndicat de l'éclairage, Serma Group, and Cluster Lumière.
- Electro-optical characterization **laboratory ISO 17025 accredited** by COFRAC (scope available on www.cofrac.fr).
- **150+ customers** (start-ups, SMEs, large groups) in France and abroad.
- **17 employees,** highly qualified from the industry.
- **5,000+** tests carried out.
- **300+** customer projects carried out.
- Based in **Lyon**, France.

CONTACT US:



Joël Thomé - CEO - thome.joel@piseo.fr - +33 (0) 6 68 62 49 06

Tristan Athanaze - Sales Engineer – athanaze.tristan@piseo.fr - +33 (0) 6 77 24 35 07

Marie-Eve Fraisse - Sales administration - commercial@piseo.fr - +33 (0) 4 26 83 02 25

PISEO

photonics.innovation.services