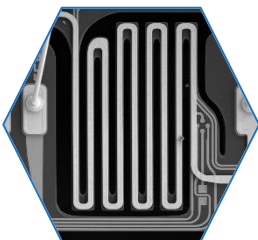
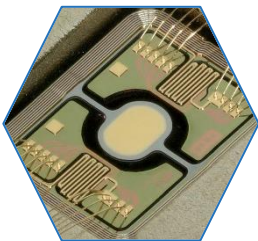




## Intel RealSense L515 MEMS-Based Solid-State LiDAR Camera

*A high-resolution LiDAR sensor featuring a bi-axial MEMS mirror scanner associated with an infrared laser and a RGB camera.*



The RealSense L515 is the third generation of 3D sensing camera from Intel and the first with a MEMS based solid-state LIDAR.

The 3D sensor has a minimum depth of 0.25m. It can scan environments up to 9m wide with a resolution depth of up to 1024x768 at 30 frames per second (fps). The system uses Application Specific Integrated Circuits (ASICs) from Intel for vision processing and MEMS control. This camera LIDAR with its machine vision processor is optimized for 3D scanning, smart building, and robotic applications.

The RealSense L515 integrates an intelligent USB-C powered solid-state LIDAR camera in a compact aluminium case. It combines a conventional red/green/blue (RGB) color sensor, a near infrared LIDAR for 3D sensing. The LIDAR is based on an Edge-Emitting Laser (EEL) for the light source, a MEMS micro-mirror to scan the environment, a photodiode to measure the time of flight and optical lenses to focus the beam. The bi-axial micro-mirror from STMicroelectronics is the core of the scanning mechanism.

System Plus Consulting proposes two reports featuring a complete teardown analysis of the RealSense L515. One report provides high definition pictures of

the electronics boards and the bill-of-material (BOM) and manufacturing cost of the LIDAR camera.

The second report includes detailed technical and cost analysis of the main devices. It presents detailed optical and Scanning Electron Microscope (SEM) images of the beam splitter, the micro-mirror, the EEL, the photodiode, and the main ICs. It also details the complete manufacturing cost calculation and estimates selling price. Finally, it includes a comparison of the L515 with previous generation LIDAR from Intel.

**Title:** Intel RealSense L515 MEMS-Based Solid-State LiDAR Camera

**Page:** 100 + 100

**Date:** September 2020

**Format:** PDF & Excel file

**Price:** EUR 3,990

**Reference:** SP20542

### COMPLETE TEARDOWN WITH

- Detailed teardown photos
- Components identification
- Optical and SEM images
- Manufacturing process flow
- Lens module, micro-mirrors, infrared EEL laser, photodiode, read-out IC, beam splitter manufacturing cost analysis
- Estimated cost and sales price
- Comparison with previous Intel RealSense generation

## TABLE OF CONTENTS

### Intel Company Profile

#### Module Physical Analysis

- Views and Dimensions of the Camera
- Camera Opening
- Vision Processor, 3D Sensing and RGB Sensor Boards

#### Detailed Physical Analysis

- Lens Module
  - ✓ Module views, disassembly and main block identification
  - ✓ Module cross-section
- Infrared EEL Laser Component
  - ✓ Package
  - ✓ EEL die view and dimensions
  - ✓ EEL die cross-section and process characteristics
- Magnetic Micro-Mirror
  - ✓ Micro-mirror dimensions
  - ✓ Micro-mirror cross section
- Photodiode
  - ✓ Photodiode overview and dimensions
  - ✓ Photodiode process and cross-section

### Manufacturing Process Flow

- NIR EEL Laser Die Front-End Process and Fabrication Unit
- Micro-Mirror Process Flow and Fabrication Unit
- Photodiode Wafer Process Flow and Fabrication Unit
- Readout IC Driver Die Front-End Process and Fabrication Unit

### Cost Analysis

- PCBs, Electronic Boards, Mechanical Parts and housing
- Component Yield Explanations and Hypotheses
  - ✓ NIR EEL laser
    - Wafer and die cost
  - ✓ Micro-mirror
    - Wafer and die cost
  - ✓ Photodiode die
    - Wafer and die cost
  - ✓ Readout circuit
  - ✓ Lens, optics and module

### Estimation of the Selling Price

## AUTHORS



*Sylvain Hallereau has been Project Manager at System Plus Consulting since 2000. He is in charge of costing analyses for Integrated Circuits, Power semiconductors and LEDs.*

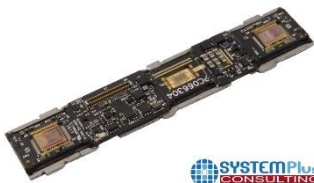


*David Le Gac has joined System Plus Consulting as a cost analyst in 2013. He is in charge of reverse costing with a focus on boards and systems. He previously worked for Lacroix Electronics.*



*Dr. Youssef El Gmili has joined System Plus Consulting's team in 2019 after ten years passed on high level research and development on microelectronics.*

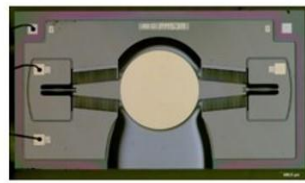
## RELATED REPORTS



### Intel RealSense D435 3D Active IR Stereo Depth Camera

*The 3D camera is using infrared active stereo depth and red/green/blue sensors, and a VCSEL projector.*

May 2018 - EUR 3,490\*



### Intel RealSense 3D Camera & STMicroelectronics IR Laser Projector

*Intel RealSense is an intelligent 3D camera equipped with a system of three components.*

September 2015 - EUR 3,290\*

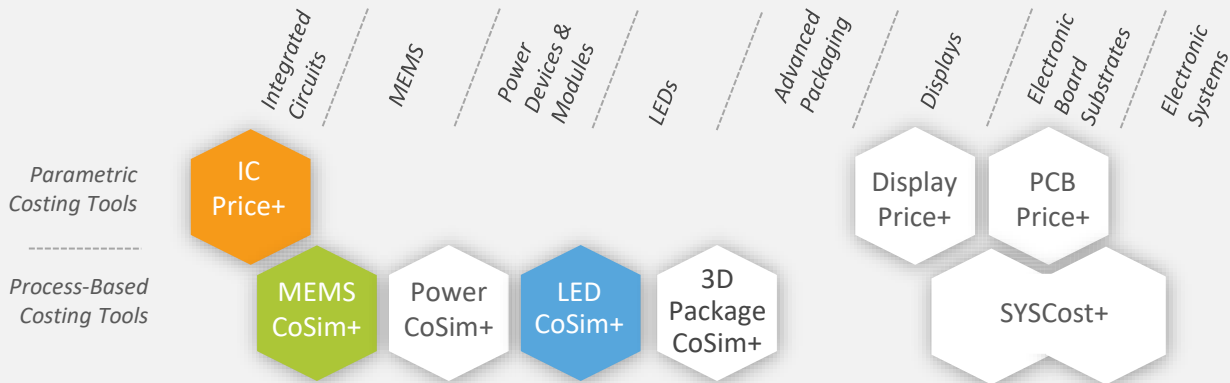


### Hamamatsu Photodiode and Laser in Livox's Horizon LiDAR

*Analysis of the six channels and 905nm pulsed laser and photodiode from Hamamatsu, in Livox's LiDAR for automotive ADAS.*

July 2020 - EUR 3,990\*

## COSTING TOOLS



Our analysis is performed with our costing tools IC Price+, MEMS CoSim+ and LED CoSim+.

System Plus Consulting offers powerful costing tools to evaluate any process or device, the production cost and selling price, from single chip to complex structures. All these tools are on sale under corporate license.

### IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, memories, DSP, smartpower...

### LED CoSim+

Process-based costing tool to design and evaluate the cost of any LED process flow.

### MEMS CoSim+

The costing tool is process-based to evaluate the manufacturing cost per wafer using your own inputs or using the pre-defined parameters included in the tool.

## WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



## CONTACTS

### Headquarters

22, bd Benoni Goullin  
Nantes Biotech  
44200 Nantes  
France  
+33 2 40 18 09 16  
sales@systemplus.fr

### Europe Sales Office

Lizzie LEVENEZ  
Frankfurt am Main  
Germany  
+49 151 23 54 41 82  
llevenez@systemplus.fr

### America Sales Office

Steven LAFERRIERE  
Western USA & Canada  
+1 310-600-8267  
laferriere@yole.fr

Chris YOUMAN  
Eastern USA & Canada  
+1 919-607-9839  
chris.youman@yole.fr

### Asia Sales Office

Takashi ONOZAWA  
Japan & Rest of Asia  
+81 80 4371 4887  
onozawa@yole.fr

Mavis WANG  
Greater China  
TW +886 979 336 809  
CN +8613661566824  
wang@yole.fr

Peter OK  
Korea  
+82 10 4089 0233  
peter.ok@yole.fr

## ABOUT SYSTEM PLUS CONSULTING

System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.

A complete range of services and costing tools to provide in-depth production cost studies and to estimate the objective selling price of a product is available.

Our services:

- **STRUCTURE & PROCESS ANALYSES**
- **TEARDOWN TRACKS**
- **CUSTOM ANALYSES**
- **COSTING SERVICES**
- **COSTING TOOLS**
- **TRAININGS**

www.systemplus.fr  
sales@systemplus.fr

# TERMS AND CONDITIONS OF SALES

## 1. INTRODUCTION

The present terms and conditions apply to the offers, sales and deliveries of services managed by System Plus Consulting except in the case of a particular written agreement.

Buyer must note that placing an order means an agreement without any restriction with these terms and conditions.

## 2. PRICES

Prices of the purchased services are those which are in force on the date the order is placed. Prices are in Euros and worked out without taxes. Consequently, the taxes and possible added costs agreed when the order is placed will be charged on these initial prices.

System Plus Consulting may change its prices whenever the company thinks it necessary. However, the company commits itself in invoicing at the prices in force on the date the order is placed.

## 3. REBATES and DISCOUNTS

The quoted prices already include the rebates and discounts that System Plus Consulting could have granted according to the number of orders placed by the Buyer, or other specific conditions. No discount is granted in case of early payment.

## 4. TERMS OF PAYMENT

System Plus Consulting delivered services are to be paid within 30 days end of month by bank transfer except in the case of a particular written agreement.

If the payment does not reach System Plus Consulting on the deadline, the Buyer has to pay System Plus Consulting a penalty for late payment the amount of which is three times the legal interest rate. The legal interest rate is the current one on the delivery date. This penalty is worked out on the unpaid invoice amount, starting from the invoice deadline. This penalty is sent without previous notice.

When payment terms are over 30 days end of month, the Buyer has to pay a deposit which amount is 10% of the total invoice amount when placing his order.

## 5. OWNERSHIP

System Plus Consulting remains sole owner of the delivered services until total payment of the invoice.

## 6. DELIVERIES

The delivery schedule on the purchase order is given for information only and cannot be strictly guaranteed. Consequently any reasonable delay in the delivery of services will not allow the buyer to claim for damages or to cancel the order.

## 7. ENTRUSTED GOODS SHIPMENT

The transport costs and risks are fully born by the Buyer. Should the customer wish to ensure the goods against lost or damage on the base of their real value, he must imperatively point it out to System Plus Consulting when the shipment takes place. Without any specific requirement, insurance terms for the return of goods will be the carrier current ones (reimbursement based on good weight instead of the real value).

## 8. FORCE MAJEURE

System Plus Consulting responsibility will not be involved in non execution or late delivery of one of its duties described in the current terms and conditions if these are the result of a force majeure case. Therefore, the force majeure includes all external event unpredictable and irresistible as defined by the article 1148 of the French Code Civil?

## 9. CONFIDENTIALITY

As a rule, all information handed by customers to system Plus Consulting are considered as strictly confidential.

A non-disclosure agreement can be signed on demand.

## 10. RESPONSABILITY LIMITATION

The Buyer is responsible for the use and interpretations he makes of the reports delivered by System Plus Consulting. Consequently, System Plus Consulting responsibility can in no case be called into question for any direct or indirect damage, financial or otherwise, that may result from the use of the results of our analysis or results obtained using one of our costing tools.

## 11. APPLICABLE LAW

Any dispute that may arise about the interpretation or execution of the current terms and conditions shall be resolved applying the French law.

If the dispute cannot be settled out-of-court, the competent Court will be the Tribunal de Commerce de Nantes.