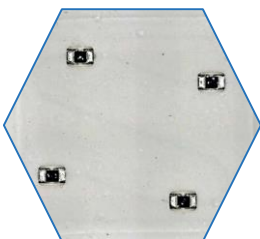
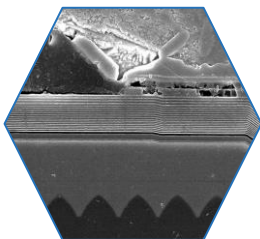


## MiniLED Backlight Unit in the 2021 Apple iPad Pro

*In-depth technical and cost analysis of the first consumer miniLED backlight unit and its assembly.*



**Title:** MiniLED backlight unit in the 2021 Apple iPad Pro

**Pages:** 81

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After more than three years of hype, excitement, and unfulfilled promises, miniLED backlights are finally ready for prime time. MiniLED monitors and laptops have been available since late 2020 and most leading TV brands are adopting miniLED backlights in their 2021 flagship models. The highly anticipated miniLED Apple iPad pro was officially announced in April 2021.

Properly designed miniLED backlights allow LCD displays to reach contrast performance close to that of OLEDs, while maintaining the high brightness characteristics of LCDs. All of this while offering reduced power consumption, a very thin form factor (thickness), and cost/price competitiveness with OLED. With this newest iPad Pro, Apple is really bringing this newer display technology to the consumer. As many different supply chain and technology choices are not settled yet, this System Plus Consulting teardown report provides great insights into the choices Apple is bringing to the table.

In this report, System Plus Consulting provides a full reverse costing study of the miniLEDs and their assembly in the backlight unit of the display in the 12.9-inch 2021 iPad Pro.

The new backlighting system is composed of 10,384 miniLEDs divided into 2,596 local dimming zones.

- The miniLEDs, which are GaN-based dies on patterned sapphire substrate, have an engineered light-emission pattern using dedicated top and back dielectric reflectors. We estimate that they are manufactured by Epistar in Taiwan.
- The chip-on-board assembly of the more than 10,000 miniLEDs is believed to be done by TSMC in Taiwan. The miniLEDs are mounted in flip-chip configuration.
- The miniLEDs are driven by nine drivers from STMicroelectronics. These drivers are wafer-level chip-scale packaged.

This report provides insights regarding technology data, manufacturing cost, and selling price of the BLU, with a focus on the miniLEDs and their drivers. Also included is an estimated manufacturing cost of all the BLU's components and a selling price analysis.

### COMPLETE TEARDOWN WITH

- Detailed optical and SEM photos
- Precise measurements
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Estimated selling price

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## RELATED ANALYSES



### APPLE iPad Pro 12.9-inch (5th Generation)

Teardown analysis of the fifth generation of Apple iPad Pro 12.9-inch.

May 2021



### APPLE Ipad pro 11" 2nd gen

Teardown analysis of the second generation of Apple iPad Pro 11inch.

March 2020

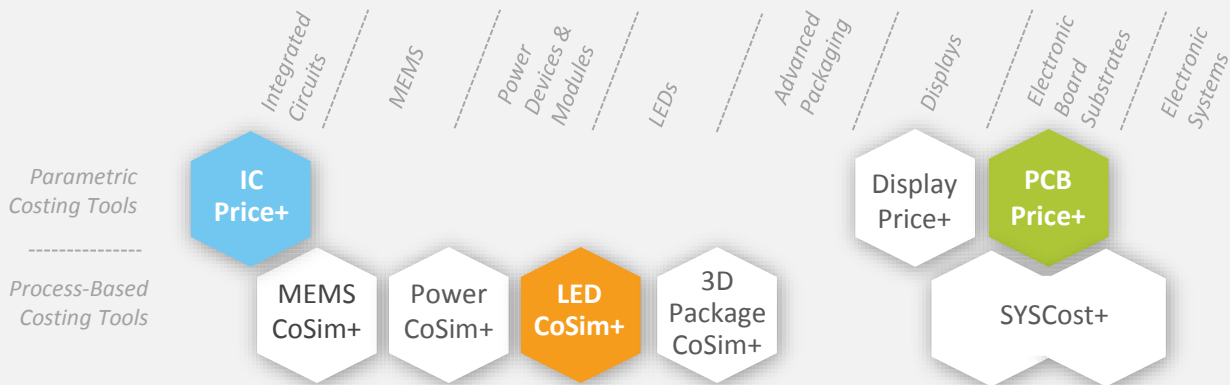


### MicroLED Displays – Market, Industry and Technology Trends 2021

Strong momentum for MicroLED with progress on all fronts. Cost is the biggest challenge, but Apple and Samsung are carving paths toward the consumer.

August 2021

## COSTING TOOLS



Our analysis is performed with our costing tools IC Price+, PCB Price+ 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, DSP, memories, smartpower...

### LED CoSim+

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

### PCB Price+

Calculation of the real price impacts. From layer count, copper thickness, to change of manufacturing country, or the increasing of raw material costs.

## 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.



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## 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**
- **TEARDOWNS**
- **CUSTOM ANALYSES**
- **COSTING SERVICES**
- **COSTING TOOLS**
- **TRAININGS**

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# TERMS AND CONDITIONS OF SALES

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## 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.

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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.

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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).

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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?

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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.

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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.