AIXTRON 1. Capital Markets Day

CMD 2018 Presentation 3
(FSE: AIXA, ISIN DE000A0WMPJ6)
Optoelectronics & Laser Technology

-Focus: 3D Sensing & µLED-
Overview of AsP MOCVD Application

GaAs based IR LASER/LEDs
- (3D) Sensing
- Automotive / Mobile Phones
- Iris/3D Face Recognition
- Gesture Control
- Augmented Reality
- Industrial

InP based Laser Diodes
- Telecom, Next Gen Metro Networks
- Hyperscale Datacenters / Cloud Services
- Industrial

GaAs based Red LEDs
- Fine Pitch LED Displays
- Automotive
- Signage
- Medical
- ...

Photovoltaics
- Satellites
- Terrestrial Concentrator PV
- Thin Flexible III/V PV

+ Many Other Photonic Applications, Power/RF Devices

AIX 2800G4-TM is No. 1 For AsP Related Key Markets

© AIXTRON Investor Relations, February 2018
Major Growth Areas for Diode LASER Applications

3D Sensing in Smartphones

- Facial Recognition
- 3D Imaging
- 3D Gesture Control
- Auto Focus
- Virtual/ Augmented Reality
- New Distribution Models

AIX 2800G4-TM is No. 1 For 3D Sensing Related Markets
Market Forecast 3D Sensors

3D Imaging and Sensing revenue Forecast (M$)

- **Medical + Industrial Applications**
- **Era of Consumer Applications**

Key driver for market growth: Consumer Products

>9B USD in 2022

IR Imaging and Sensing – Exceptional Market Growth

source: Yole

© AIXTRON Investor Relations, February 2018
VCSEL Technology in Smartphones

Flood Illuminator – VCSEL array

Dot Projector - VCSEL array

1 x 0.8 mm

1 x 1.2 mm

2 large VCSEL array chips per FaceID device (+ small VCSEL for ToF)

~ 2 mm² / device

Source:
http://www.techinsights.com/about-techinsights/overview/blog/apple-iphone-x-teardown/
Apple’s Face ID in Operation

- Laser-Dot Matrix deformed by Object’s 3Dimensional Shape
- Camera + Intelligent Software calculate Object’s shape
- → Angular distribution of Dot Matrix must be very precise

Source: Jongdeng.com
http://www.jongdeng.net/post/19710

Array of VCSEL devices

Source: The Verge.com
The enabling solution

- **3D Imaging – Potential for Multiple Applications – Exceptional Opportunity**
  - Application requires large amounts of AlGaAs VCSEL light sources (arrays)
  - Consumer product: HVM with high sensitivity to yield, cost and productivity

- **Requirements to MOCVD System**
  - Best Deposition Uniformity Control – at Wafer Level
  - Lowest Particle Count
  - Highest Epi / Product Yield
  - Lowest Production Cost

Enabling Solution: **AIX 2800G4-TM**
the technology leading Reactor for HVM of LASER Devices
>90% market share over last 4 years
Optoelectronics & Laser Technology

μLED
Micro LED Technology - Introduction

- In a typical display, each pixel is constituted of Red, Green and Blue (RGB) sub pixels and controlled independently by a matrix of transistors. The idea of micro LED (mLED) is to use individual, small micron sized (ranging from 3-40 µm) LED chips as sub pixels.

- In most cases, the mLED chips are then positioned and connected to the transistor matrix via a Pick and Place or Optimized Transfer Process (parallel transfer developments ongoing).

Source: https://twitter.com/Yole_Dev/status/910081729188294657

© AIXTRON Investor Relations, February 2018
Micro LED technology - Singulation and Mass Transfer

Source Wafer

Populated Stamp

Patterned stamp

Non-native “Target” Substrate

Printing

Densely packed micro components

Dispersed micro components

1st transfer

2nd transfer

Source: x-celeprint Semicon West 2016
Samsung introduces The Wall Professional and 3D LED Cinema displays

Source: Samsung
The Enabling Solution - AIXTRON Planetary Technology

One Technology, Two Platforms, Three Primary Colors – enabling HVM of mLEDs

AIX 2800-G4TM

Micro LED Applications

© AIXTRON Investor Relations, February 2018
Optoelectronics & Laser Technology
Focus 3D Sensing
Market Opportunities
Adoption of 3D Sensing

Jan 30, 2018 Nikkei Asian Review

Apple to halve iPhone X output on weak holiday sales

TOKYO -- Apple will slash its production target for the iPhone X in the three-month period from January by half from the more than 40 million units envisaged at the time of its release in November.

The U.S. tech giant notified suppliers that it had decided to cut the first-quarter production target to around 20 million units, in light of slower-than-expected sales in the year-end holiday shopping season in key markets such as Europe, the U.S. and China.

• **2017: iPhone X**
  • Seen as strategic move to pave way for era of future AR/AI applications

• **2018: More Products expected**
  • 2H/18: iPad Pro and MacBooks,
  • Q3/18 3 new iPhone models
  • Android camp will follow (Huawei, Oppo, Xiaomi, Vivo, Samsung,...)

• **2019 Rear Sensor implementation**

Significant further Volume Adoption of 3D Sensing Expected