



LIGHTCOUNTING

MARKETS FOR AUTOMOTIVE LIDAR AND VCSELS USED FOR 3D SENSING IN SMARTPHONES – NOVEMBER 2021

Recalibrating the Expectations



Table of Contents

RECALIBRATING THE EXPECTATIONS.....	1
TABLE OF CONTENTS	2
ABSTRACT.....	5
EXECUTIVE SUMMARY	6
LOWER EXPECTATIONS FOR FACE RECOGNITION IN SMARTPHONES.....	7
LIDAR MARKET HITS THE BOTTOM IN 2020-2021.....	8
CHAPTER 1: 3D SENSING IN SMARTPHONES	12
THE KINECT IS DEAD, LONG LIVE THE KINECT	12
IT TAKES TWO TO (GOOGLE) TANGO.....	13
APPLE POPULARIZES FACIAL RECOGNITION.....	15
A SHORT LIVED BOOM IN 3D SENSING	18
AR/VR: WHY 3D SENSING MATTERS TO CLOUD COMPANIES	19
CHAPTER 2: 3D SENSING IN AUTOMOTIVE MARKETS.....	22
AUTOMOTIVE DEFINITIONS AND ROADMAPS.....	22
IMPROVING ROAD SAFETY IS A MAJOR DRIVER FOR AUTOMATION	24
<i>Safety looms as both an attraction and a challenge.....</i>	25
AUTONOMOUS TRUCKING, ROBOTIC TAXIS, AND THE LIGHT VEHICLE MARKET SEGMENTS	26
<i>To hand off, or not hand off – that is the question.....</i>	26
<i>Autonomous trucking – the most likely near-term winner.....</i>	27
<i>Robotaxis attract media interest, but the opportunity is overhyped.....</i>	30
<i>Are Robotaxis real?.....</i>	33
<i>Light vehicles may be the largest market IN THE LONG RUN.....</i>	33
<i>other niche applications for autonomous driving.....</i>	34
THE CHINESE LANDSCAPE FOR AUTOMOTIVE LIDAR.....	35
LIDAR IS A CRUCIAL SENSOR IN AUTONOMOUS DRIVING	38
<i>Why lidar instead of radar or cameras?.....</i>	38
EXUBERANT INVESTMENT? THE LIDAR ‘GOLD RUSH’	42
CHAPTER 3: 3D SENSING AND LIDAR TECHNOLOGY TRENDS.....	43
THREE TYPES OF 3D SENSORS FOR SMARTPHONES.....	43
<i>Active stereo vision.....</i>	44
<i>Structured light.....</i>	45
<i>Time of flight camera.....</i>	47
TECHNOLOGY TRENDS.....	48
<i>VCSELs are a key building block for 3D sensing.....</i>	51
<i>From datacom lasers to 3D sensing is not a huge leap.....</i>	52
SUPPLY IS CONCENTRATED IN A FEW VCSEL PLAYERS	55
SIX-INCH WAFER MANUFACTURING WILL BE CRUCIAL TO SUCCESS	56
<i>Substantial six-inch foundry capacity is under construction.....</i>	56
LASER TECHNOLOGIES FOR LIDARS	57
CHAPTER 4: MARKET FORECAST FOR 3D SENSING VCSEL ARRAYS.....	59

FORECAST SCOPE AND PRODUCT DEFINITIONS.....	59
METHODOLOGY	59
VCSEL ARRAYS FOR 3D DEPTH SENSING – MARKET FORECAST	62
<i>Shipments of arrays for 3D depth sensing will reach 1.7 billion units in 2026.....</i>	62
<i>VCSEL array prices for 3D sensing applications will face strong pressure.....</i>	63
<i>Revenues return to growth in 2023.....</i>	64
CHAPTER 5: MARKET FORECAST FOR AUTOMOTIVE LIDAR	65
FORECAST SCOPE AND PRODUCT DEFINITIONS.....	65
METHODOLOGY	66
AUTOMOTIVE LIDAR FORECAST	67
<i>Lidar ready to move out of the slow lane.....</i>	67
<i>Lidar revenues will exceed \$750 Million in 2025.....</i>	68
<i>lidar shipments for autonomous vehicles will reach over 4 million units by 2025</i>	69
<i>Lidar for full autonomy commands higher prices.....</i>	71
APPENDIX A: SELECTED VENDOR PROFILES – OPTICS.....	73
II-VI, INC. (FINISAR).....	73
AMS (HEPTAGON)	73
BROADCOM CORP.....	75
HIMAX TECHNOLOGIES, INC.	76
HLJ TECHNOLOGY CO. LTD.....	77
LUMENTUM	78
TRUMPF (PHILIPS PHOTONICS)	78
APPENDIX B: SELECTED VENDOR PROFILES – 3D SENSOR MODULES.....	80
INFINEON TECHNOLOGIES AG	80
INTEL CORP. / REALSENSE	81
ORBEC 3D TECHNOLOGY INTERNATIONAL INC.	83
MANTIS VISION	83
MICROSOFT CORP.	84
PMD TECHNOLOGIES AG.....	84
STM MICROELECTRONICS.....	85
SONY DEPTHSENSING SOLUTIONS.....	86
APPENDIX C: SELECTED VENDOR PROFILES – AUTOMOTIVE LIDAR.....	88
AEYE	88
AEVA	88
AURORA	90
CONTINENTAL AG.....	90
INNOVIZ TECHNOLOGIES, LTD.	91
LEDDARTECH, INC.	92
LUMINAR TECHNOLOGIES, INC.	94
MOBILEYE	95
OUSTER, INC.....	95
QUANERGY SYSTEMS, INC.....	97
VALEO GROUP.....	98
VELODYNE LIDAR, INC.	98

APPENDIX D: SELECTED VENDOR PROFILES – CHINESE ELECTRIC CAR MAKERS	101
LI AUTO INC.....	101
XIAOPENG INC.....	101
NIO	103
CHANGAN AUTO.....	103
NEOLIX.....	104
APPENDIX E: SELECTED VENDOR PROFILES – CHINESE 3D SENSING VCSEL VENDORS	106
SINOSEMIC.....	106
SANAN-IC (SAIC)	106
WAFER CHINA (EPI-WAFER).....	107
DEPTRUM	107
RAYSEA (NINGBO).....	108
ZJ EAGLES COMSEMI	108
VERTILITE	109
BERXEL	110
APPENDIX F: SELECTED VENDOR PROFILES – CHINESE AUTOMOTIVE LIDAR VENDORS.....	111
ROBOSENSE.....	111
LEISHEN(LS) LIDAR	111
BENEWAKE.....	112
SURESTAR	113
NEUVITION.....	113
INNOVUSION	113
HESAI TECH.....	114
HUAWEI.....	115

Abstract

This report analyzes the new business opportunity for suppliers of optical components in the market for 3D depth sensors used in smartphones and automotive lidar. It reviews different 3D sensing technologies and the optics required, with a focus on vertical-cavity surface-emitting laser (VCSEL) arrays. The report includes historical data on shipments of these products in 2017-2021 and forecast for 2022-2026. It offers an analysis of the leading vendors and technical challenges faced by suppliers, and discusses likely future developments in the supply chain.

LightCounting Market Research

7726 Gunston Plaza, Unit 1480, Lorton, VA 22199
www.lightcounting.com

LightCounting is a market research company focused on the in-depth study of high speed interconnects for the datacom, telecom, and consumer communications markets. Our research covers the whole supply chain from optical and semiconductor components, to modules, sub- systems and their applications in telecom and datacom systems.

Our industry reputation was built by providing solid market data and objective analysis to help industry executives in making tactical and strategic business decisions see past all the market hype, rumors, press reports, blogs and other distortions that so often complicate and confuse many decision making processes.

This LightCounting market report contains material that is a confidential, privileged, company product for the sole use of the intended recipients being LightCounting clients and subscribers. Any review, reliance on or redistribution by others or forwarding without LightCounting's expressed permission is strictly prohibited.

For more information, go to: www.lightcounting.com

or follow us on Twitter at: www.twitter.com/lightcounting