

VCSEL Market by Type (Single-mode and Multimode), Material (GaAs, InP, GaN), Wavelength, Application (Sensing, Data Communication, Industrial Heating & Printing, Emerging), Data Rate, Industry and Region - Global Forecast to 2028

Market Report | 2023-02-07 | 221 pages | MarketsandMarkets

AVAILABLE LICENSES:

- Single User \$4950.00
- Multi User \$6650.00
- Corporate License \$8150.00
- Enterprise Site License \$10000.00

Report description:

The global VCSEL market is projected to grow from USD 1.6 billion in 2023, to USD 2.9 billion by 2028, at a CAGR of 13.6% between 2023 and 2028. One of the factors driving the growth of the VCSEL market high preference for adopting 3D sensing technologies, and integration of the Internet of Things (IoT) across buildings, utilities, manufacturing, logistics, retail, and healthcare.

VCSELS are made of gallium arsenide (GaAs) and indium phosphide (InP) with single-mode and multimode functionality. VCSELS are highly efficient and cost-effective for applications, such as data communication, industrial heating, and 3D sensing & gesture recognition. They are widely used in consumer electronics, data centers, automobiles, commercial & industrial applications, as well as healthcare and military industries.

"VCSEL for red wavelength is the second largest segment of VCSEL market during the forecast period"

Red VCSELS offer benefits, such as improved performance and low power consumption, and are used in applications that include laser printing, optical mouse, and low-cost, high-speed interconnects based on plastic optical fiber (POF). However, material design challenges make it more difficult to achieve the desired performance than at the well-developed wavelength of 850 nm. Ams-OSRAM (Austria) is one of the market players offering VCSELS in the red band segment.

"Emerging and other application segment is the fastest growing segment of VCSEL market during forecast period"

This segment includes VCSELS for emerging applications, such as LiDAR, driver monitoring/gesture recognition, 3D sensing in vehicles, security & night vision systems/cameras, pulse oximeter, and OCT. The growth in the emerging and other application segments is closely tied to the use of VCSELS in automotive LiDARs. For instance, in August 2020, automotive LiDAR specialist Ibeo Automotive Systems (Germany) announced that it would deploy VCSELS in LiDAR for 'Level 3' semi-autonomous driving in cars built by the automotive manufacturer Great Wall Motors (China). Hence, VCSEL-based solid-state LiDAR systems show great

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

potential as the next evolution in LiDAR technology, which can replace traditional bulky and expensive mechanical spinning and microelectromechanical systems (MEMs) that are currently in use. The size of VCSELS also makes it easier to integrate photonic and electronic components in a LiDAR system. These factors are projected to contribute to the high growth rate of emerging and other applications.

"Above 25 Gbps segment is the fastest growing segment of VCSEL market by 2028"

With the growing adoption of 5G network and smart city developments, data traffic is increasing at a significant rate. This is increasing the connectivity load on data centers, wherein a faster data transmission medium for a short distance is required. Hence, many hyperscale data center operators, such as Facebook (US), Apple (US), Microsoft (US), Amazon (US), and Google (US), as well as government institutions, are focusing on the adoption of high-speed transceivers and AOCs, which operate at 100G, 200G, and 400G data rates. These optical transceivers initially used edge-emitting lasers (EELs) that are now being quickly replaced by VCSELS. VCSELS capable of 25 Gbps data rate are the most widely deployed type due to their lower cost. However, it is expected that VCSELS with data rates above 25 Gbps will be adopted at a faster rate due to the increase in traffic on data communications worldwide.

"Automotive segment is the fastest growing application of VCSEL market by 2028"

Surge in the adoption of VCSELS in automobiles for driver monitoring and infotainment systems results in the high growth in the automotive segment for VCSEL market. VCSELS are finding increased applications in systems, such as advanced driver assistance systems (ADAS), due to the evolution of autonomous vehicles. LiDAR is one of the latest technology used in automotive safety developments and solutions that are being used to make solid-state LiDARs using VCSELS. This evolution toward the adoption of autonomous vehicles in the long term is projected to drive the growth of the automotive segment.

"North America is the second fastest growing market for VCSEL market by 2028"

North America is one of the major markets for VCSELS due to applications, such as consumer electronics, data centers, and commercial & industrial segments. Lumentum (US), II-VI Incorporated (US), and Broadcom (US) are some of the major players operating in this region. Chipmakers and OEM buyers of VCSELS are expected to face the impacts of the recession and the resultant decrease in demand for consumer electronics such as laptops, PCs, and smartphones. These factors are likely to lead to a decline in the growth of the VCSEL market in 2023. The market is expected to register moderate growth in the next 2-3 years in North America.

Breakdown of the profiles of primary participants:

-□By Company Type: Tier 1 - 40%, Tier 2 - 30%, and Tier 3 - 30%

-□By Designation: C-level Executives - 40%, Directors - 40%, and Others - 20%

-□By Region: North America - 40%, Europe - 30%, Asia Pacific - 20%, and RoW - 10%

The VCSEL market is dominated by a few globally established players such as Lumentum (US), Coherent Corporation (US), ams-OSRAM (Austria), TRUMPF (Germany), Broadcom (US), Leonardo Electronics (US), MKS Instruments (US), Santec (Japan), VERTILAS (Germany), Vertilite (China), Alight Technologies (Denmark), Inneos (US), IQE (UK), Thorlabs (UK), TT Electronics (UK), Ushio America (US), WIN Semiconductors (Taiwan), and Frankfurt Laser Company (Germany).

Research Coverage

The report segments the VCSEL market and forecasts its size, by value and volume, based on region (Asia Pacific, Europe, North America, and RoW), type (multi-mode, single mode), wavelength (red, NIR, SWIR), material (GaAs, InP, other), data rate, application, and industry (consumer electronics, data center, automotive, commercial & industrial, healthcare, and military). The report also provides a comprehensive review of market drivers, restraints, opportunities, and challenges in the VCSEL market. The report also covers qualitative aspects in addition to the quantitative aspects of these markets.

Key Benefits of Buying the Report:

The report will help the leaders/new entrants in this market with information on the closest approximations of the revenue numbers for the overall market and the sub-segments. This report will help stakeholders understand the competitive landscape and gain more insights to better position their businesses and plan suitable go-to-market strategies. The report also helps stakeholders understand the pulse of the VCSEL market and provides them information on key market drivers, restraints,

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

challenges, and opportunities.

Table of Contents:

1	INTRODUCTION	27
1.1	STUDY OBJECTIVES	27
1.2	MARKET DEFINITION	27
1.2.1	INCLUSIONS AND EXCLUSIONS	28
1.3	STUDY SCOPE	29
FIGURE 1	VCSEL MARKET: SEGMENTATION	29
1.3.1	YEARS CONSIDERED	30
1.4	CURRENCY CONSIDERED	30
1.5	UNITS CONSIDERED	30
1.6	STAKEHOLDERS	30
1.7	LIMITATIONS	31
1.8	SUMMARY OF CHANGES	31
2	RESEARCH METHODOLOGY	32
2.1	RESEARCH DATA	32
FIGURE 2	VCSEL MARKET: RESEARCH DESIGN	32
2.1.1	SECONDARY AND PRIMARY RESEARCH	33
2.1.1.1	Key industry insights	34
2.1.2	SECONDARY DATA	34
2.1.2.1	List of key secondary sources	34
2.1.2.2	Key data from secondary sources	35
2.1.3	PRIMARY DATA	35
2.1.3.1	Breakdown of primaries	36
2.1.3.2	Key data from primary sources	37
2.2	MARKET SIZE ESTIMATION	37
2.2.1	BOTTOM-UP APPROACH	38
2.2.1.1	Approach to arrive at market size using bottom-up analysis (demand side)	38
FIGURE 3	MARKET SIZE ESTIMATION METHODOLOGY: BOTTOM-UP APPROACH	39
FIGURE 4	MARKET SIZE ESTIMATION METHODOLOGY: (DEMAND SIDE)- DEMAND FOR VCSELS	39
2.2.2	TOP-DOWN APPROACH	40
2.2.2.1	Approach to obtain market size using top-down analysis (supply side)	40
FIGURE 5	MARKET SIZE ESTIMATION METHODOLOGY: TOP-DOWN APPROACH	40
FIGURE 6	MARKET SIZE ESTIMATION METHODOLOGY: (SUPPLY-SIDE)-IDENTIFICATION OF REVENUES GENERATED BY COMPANIES FROM VCSEL MARKET	41
2.3	MARKET BREAKDOWN AND DATA TRIANGULATION	42
FIGURE 7	DATA TRIANGULATION	42
2.4	RESEARCH ASSUMPTIONS	43
2.4.1	ASSUMPTIONS	43
2.5	PARAMETERS CONSIDERED TO ANALYZE IMPACT OF RECESSION	43
2.5.1	RISK ASSESSMENT	44
3	EXECUTIVE SUMMARY	45
3.1	RECESSION IMPACT ANALYSIS	45
FIGURE 8	GDP GROWTH PROJECTION TILL 2023 FOR MAJOR ECONOMIES	46
FIGURE 9	RECESSION IMPACT ON VCSEL MARKET	46
FIGURE 10	MULTIMODE SEGMENT TO CAPTURE HIGHER MARKET SHARE IN 2023	47

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

FIGURE 11 □ GAAS SEGMENT TO HOLD LARGEST MARKET SHARE DURING FORECAST PERIOD □ 48

FIGURE 12 □ NIR SEGMENT TO DOMINATE MARKET DURING FORECAST PERIOD □ 48

FIGURE 13 □ 10.1 TO 25 GBPS SEGMENT TO ACCOUNT FOR LARGEST MARKET SHARE DURING FORECAST PERIOD □ 49

FIGURE 14 □ EMERGING AND OTHER APPLICATIONS SEGMENT TO GROW AT HIGHEST CAGR DURING FORECAST PERIOD □ 49

FIGURE 15 □ AUTOMOTIVE SEGMENT TO REGISTER HIGHEST CAGR DURING FORECAST PERIOD □ 50

FIGURE 16 □ VCSEL MARKET IN ASIA PACIFIC TO GROW AT HIGHEST CAGR DURING FORECAST PERIOD □ 51

4 □ PREMIUM INSIGHTS □ 52

4.1 □ ATTRACTIVE OPPORTUNITIES FOR VCSEL MARKET PLAYERS □ 52

FIGURE 17 □ ADVANTAGES OF SOLID-STATE TECHNOLOGY, COMPACT DESIGN, AND ROBUSTNESS TO DRIVE VCSEL MARKET □ 52

4.2 □ VCSEL MARKET, BY TYPE □ 52

FIGURE 18 □ MULTIMODE SEGMENT TO LEAD MARKET DURING FORECAST PERIOD □ 52

4.3 □ VCSEL MARKET, BY MATERIAL □ 53

FIGURE 19 □ GAAS SEGMENT TO ACCOUNT FOR LARGEST MARKET SHARE DURING FORECAST PERIOD □ 53

4.4 □ VCSEL MARKET, BY WAVELENGTH □ 53

FIGURE 20 □ NIR SEGMENT TO CAPTURE LARGEST MARKET SHARE DURING 2023-2028 □ 53

4.5 □ VCSEL MARKET, BY DATA RATE □ 54

FIGURE 21 □ 10.1 TO 25 GBPS SEGMENT TO DOMINATE MARKET DURING 2023-2028 □ 54

4.6 □ VCSEL MARKET, BY APPLICATION □ 54

FIGURE 22 □ SENSING APPLICATION TO ACCOUNT FOR LARGEST MARKET SHARE DURING FORECAST PERIOD □ 54

4.7 □ NORTH AMERICA: VCSEL MARKET, BY INDUSTRY AND COUNTRY □ 55

FIGURE 23 □ CONSUMER ELECTRONICS AND US TO BE LARGEST SHAREHOLDERS OF VCSEL MARKET IN NORTH AMERICA IN 2028 □ 55

4.8 □ VCSEL MARKET, BY COUNTRY □ 55

FIGURE 24 □ VCSEL MARKET TO RECORD HIGHEST CAGR IN ASIA PACIFIC IN 2028 □ 55

5 □ MARKET OVERVIEW □ 56

5.1 □ INTRODUCTION □ 56

5.2 □ MARKET DYNAMICS □ 56

FIGURE 25 □ IMPACT OF DRIVERS ON VCSEL MARKET □ 56

FIGURE 26 □ IMPACT OF OPPORTUNITIES ON VCSEL MARKET □ 57

FIGURE 27 □ IMPACT OF RESTRAINTS AND CHALLENGES ON VCSEL MARKET □ 57

5.2.1 □ DRIVERS □ 58

5.2.1.1 □ Growing adoption of 3D sensing applications in smartphones □ 58

5.2.1.2 □ Increasing application of VCSELS in data communication □ 58

5.2.1.3 □ Increased market investment for VCSEL manufacturing □ 58

5.2.2 □ RESTRAINTS □ 59

5.2.2.1 □ Limited data transmission range □ 59

5.2.2.2 □ Limitations of semiconductor materials hampering performance of VCSELS □ 59

5.2.3 □ OPPORTUNITIES □ 59

5.2.3.1 □ Use of VCSELS in LiDAR systems for automotive applications □ 59

5.2.3.2 □ Growing IoT market and data processing across commercial and government sectors □ 60

5.2.3.3 □ Growing adoption of VCSELS in consumer electronic devices □ 60

5.2.4 □ CHALLENGES □ 60

5.2.4.1 □ Manufacturing defects in VCSELS □ 60

5.2.4.2 □ Recession impact on smartphone market □ 61

5.3 □ TARIFFS AND REGULATIONS □ 61

5.3.1 □ TARIFF RELATED TO VCSELS □ 61

5.4 □ REGULATIONS □ 62

5.4.1 □ GLOBAL □ 62

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 5.4.1.1 International Electrotechnical Commission (IEC) 62
- 5.4.2 EUROPE 62
 - 5.4.2.1 Restriction of Hazardous Substances (RoHS) 62
 - 5.4.2.2 European Standards (EN) 62
- 5.4.3 US 63
 - 5.4.3.1 American National Standards Institute (ANSI) 63
 - 5.4.3.2 Food and Drug Administration (FDA) 64
- 5.5 CASE STUDY ANALYSIS 64
 - 5.5.1 AMS-OSRAM PROVIDED VCSEL ARRAY FOR USE IN XIAOMI MI8 EXPLORER EDITION 64
 - 5.5.2 OSRAM AND CHRONOPTICS COOPERATED ON DEVELOPMENT OF 3D TOF CAMERA KIT 64
 - 5.5.3 AMBARELLA, LUMENTUM, AND ON-SEMICONDUCTOR COLLABORATED ON AI PROCESSING-BASED 3D SENSING FOR NEXT-GEN AIOT DEVICES 65
 - 5.5.4 LUMENTUM SHOWCASED PHOTONIC SOLUTIONS AT ECOC 2020 65
 - 5.5.5 LEONARDO ELECTRONICS OFFERS LIDAR SYSTEMS LEVERAGING COMPANY VCSELS 65
 - 5.5.6 ALIGHT TECHNOLOGIES DEVELOPING 10 GBPS 1,300 NM VCSEL 65
 - 5.5.7 INNEOS DEVELOPED VCSELS FOR USE IN SATELLITES 65
 - 5.5.8 IQE REACHED KEY MILESTONES WITH IQDN-VCSEL TECHNOLOGY 65
 - 5.5.9 WIN SEMICONDUCTORS SUPPLIES VCSELS TO APPLE 66
- 5.6 AVERAGE SELLING PRICE OF VCSELS FOR VARIOUS END PRODUCTS 66
 - TABLE 1 ASP OF VCSELS USED IN VARIOUS END PRODUCTS 66
 - FIGURE 28 AVERAGE SELLING PRICE FORECAST OF VCSELS, 2020-2026 (USD) 66
 - TABLE 2 AVERAGE SELLING PRICE FORECAST OF VCSELS, 2020-2026 (USD) 67
- 5.7 VALUE CHAIN ANALYSIS 68
 - FIGURE 29 VALUE CHAIN ANALYSIS OF VCSEL ECOSYSTEM: R&D AND MANUFACTURING PHASES CONTRIBUTE MAXIMUM VALUE 68
- 5.8 ECOSYSTEM/MARKET MAP 70
 - FIGURE 30 VCSEL MARKET ECOSYSTEM 70
- 5.8.1 MANUFACTURERS 70
- 5.8.2 SUPPLIERS 70
- 5.8.3 DISTRIBUTORS 71
- 5.8.4 OEMS 71
- 5.9 TECHNOLOGY ANALYSIS 71
 - 5.9.1 KEY TECHNOLOGIES 71
 - 5.9.1.1 3D camera 71
 - 5.9.1.2 LiDAR 71
 - 5.9.2 ADJACENT TECHNOLOGY 72
 - 5.9.2.1 Edge emitter lasers (EELs) 72
- 5.10 TECHNOLOGY ANALYSIS 72
 - 5.10.1 NEW MATERIALS USED IN MANUFACTURING OF VCSELS 72
 - 5.10.2 MINIATURIZATION OF VCSELS 72
 - 5.10.3 UNDER-DISPLAY VCSELS 72
- 5.11 PATENT ANALYSIS 73
 - FIGURE 31 PATENT APPLICATION TRENDS FOR VCSELS, 2016-2020 75
- 5.12 TRADE DATA 75
 - 5.12.1 TRADE DATA FOR HS CODE 854140 75
 - TABLE 3 IMPORT DATA FOR HS CODE 854140, BY COUNTRY, 2016-2020 (USD BILLION) 76
 - TABLE 4 EXPORT DATA FOR HS CODE 854140, BY COUNTRY, 2016-2020 (USD BILLION) 76
- 5.13 PORTER'S FIVE FORCES ANALYSIS 77

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

TABLE 5 □ VCSEL MARKET: PORTER'S FIVE FORCES ANALYSIS □ 77

5.13.1 □ INTENSITY OF COMPETITIVE RIVALRY □ 77

5.13.2 □ BARGAINING POWER OF SUPPLIERS □ 77

5.13.3 □ BARGAINING POWER OF BUYERS □ 77

5.13.4 □ THREAT OF SUBSTITUTES □ 78

5.13.5 □ THREAT OF NEW ENTRANTS □ 78

5.14 □ VCSEL MARKET: SUPPLY CHAIN □ 78

5.15 □ TRENDS AND DISRUPTIONS IMPACTING CUSTOMER BUSINESS □ 79

FIGURE 32 □ REVENUE SHIFTS FOR VCSEL MARKET □ 79

6 □ VCSEL FABRICATION METHODS □ 80

6.1 □ INTRODUCTION □ 80

6.2 □ SELECTIVE OXIDIZATION □ 80

6.2.1 □ LEADS TO PRODUCTION OF STRONG ELECTRICAL AND OPTICAL CONFINEMENT □ 80

6.3 □ ION IMPLANTATION □ 80

6.3.1 □ PROVIDES HIGHLY CONTROLLED APERTURE THAT LEADS TO HIGHER AND MORE STABLE PRODUCTIVITY OF VCSELS □ 80

7 □ APPLICATIONS OF VCSEL TECHNOLOGY IN SMARTPHONES □ 81

7.1 □ INTRODUCTION □ 81

7.2 □ DOT PROJECTOR □ 81

7.2.1 □ ENABLES FACIAL RECOGNITION FEATURE IN SMARTPHONES □ 81

7.3 □ TIME-OF-FLIGHT (TOF) □ 81

7.3.1 □ TOF MODULES USE VCSELS TO RELEASE INFRARED LIGHT □ 81

7.3.2 □ PROXIMITY SENSING □ 82

7.4 □ FLOOD ILLUMINATOR □ 82

7.4.1 □ VCSELS USED BY FLOOD ILLUMINATORS TO PROJECT INFRARED LIGHT USED TO ILLUMINATE FACE OF USERS □ 82

8 □ VCSEL MARKET, BY TYPE □ 83

8.1 □ INTRODUCTION □ 84

FIGURE 33 □ MULTIMODE SEGMENT TO HOLD LARGER MARKET SHARE DURING FORECAST PERIOD □ 84

TABLE 6 □ VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) □ 84

TABLE 7 □ VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) □ 84

8.2 □ SINGLE-MODE □ 85

8.2.1 □ SINGLE-MODE VCSELS USED FOR LOW-POWER APPLICATIONS □ 85

TABLE 8 □ SINGLE-MODE: VCSEL MARKET, BY MATERIAL, 2018-2022 (USD MILLION) □ 85

TABLE 9 □ SINGLE-MODE: VCSEL MARKET, BY MATERIAL, 2023-2028 (USD MILLION) □ 85

TABLE 10 □ SINGLE-MODE: VCSEL MARKET, BY WAVELENGTH, 2018-2022 (USD MILLION) □ 86

TABLE 11 □ SINGLE-MODE: VCSEL MARKET, BY WAVELENGTH, 2023-2028 (USD MILLION) □ 86

8.3 □ MULTIMODE □ 86

8.3.1 □ MULTIMODE VCSELS USED FOR HIGH-POWER APPLICATIONS □ 86

TABLE 12 □ MULTIMODE: VCSEL MARKET, BY MATERIAL, 2018-2022 (USD MILLION) □ 86

TABLE 13 □ MULTIMODE: VCSEL MARKET, BY MATERIAL, 2023-2028 (USD MILLION) □ 87

TABLE 14 □ MULTIMODE: VCSEL MARKET, BY WAVELENGTH, 2018-2022 (USD MILLION) □ 87

TABLE 15 □ MULTIMODE: VCSEL MARKET, BY WAVELENGTH, 2023-2028 (USD MILLION) □ 87

9 □ VCSEL MARKET, BY WAVELENGTH □ 88

9.1 □ INTRODUCTION □ 89

FIGURE 34 □ NIR SEGMENT TO HOLD LARGEST MARKET SHARE DURING FORECAST PERIOD □ 89

TABLE 16 □ VCSEL MARKET, BY WAVELENGTH, 2018-2022 (USD MILLION) □ 89

TABLE 17 □ VCSEL MARKET, BY WAVELENGTH, 2023-2028 (USD MILLION) □ 89

9.2 □ RED □ 90

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

9.2.1 VCSELS IN RED BAND HAVE WAVELENGTHS IN BETWEEN 650 NM AND 750 NM 90
 TABLE 18 RED: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 90
 TABLE 19 RED: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 90
 9.3 NEAR-INFRARED (NIR) 91
 9.3.1 VCSELS IN NIR BAND HAVE WAVELENGTHS BETWEEN 750 NM AND 1,400 NM 91
 TABLE 20 NIR: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 91
 TABLE 21 NIR: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 91
 9.4 SHORTWAVE INFRARED (SWIR) 92
 9.4.1 VCSELS IN SWIR BAND HAVE WAVELENGTHS BETWEEN 1,400 NM AND 3,000 NM 92
 TABLE 22 SWIR: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 92
 TABLE 23 SWIR: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 92
 10 VCSEL MARKET, BY MATERIAL 93
 10.1 INTRODUCTION 94
 FIGURE 35 GAAS-BASED VCSEL TO DOMINATE MARKET DURING FORECAST PERIOD 94
 TABLE 24 VCSEL MARKET, BY MATERIAL, 2018-2022 (USD MILLION) 94
 TABLE 25 VCSEL MARKET, BY MATERIAL, 2023-2028 (USD MILLION) 94
 10.2 GALLIUM ARSENIIDE (GAAS) 95
 10.2.1 GAAS-BASED VCSELS TO REGISTER HIGHEST CAGR DURING FORECAST PERIOD 95
 TABLE 26 GAAS: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 95
 TABLE 27 GAAS: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 95
 10.3 INDIUM PHOSPHIDE (INP) 96
 10.3.1 MORE EXPENSIVE THAN GAAS DUE TO MATERIAL COSTS AND SMALL WAFER SIZE 96
 TABLE 28 INP: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 96
 TABLE 29 INP: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 96
 10.4 OTHERS 97
 10.4.1 VCSELS IN THE SWIR BAND HAVE WAVELENGTH BETWEEN 1,400 NM AND 3,000 NM 97
 TABLE 30 OTHERS: VCSEL MARKET, BY TYPE, 2018-2022 (USD MILLION) 97
 TABLE 31 OTHERS: VCSEL MARKET, BY TYPE, 2023-2028 (USD MILLION) 97
 11 VCSEL MARKET, BY APPLICATION 98
 11.1 INTRODUCTION 99
 FIGURE 36 SENSING SEGMENT TO HOLD LARGEST SHARE OF VCSEL MARKET DURING FORECAST PERIOD 99
 TABLE 32 VCSEL MARKET, BY APPLICATION, 2018-2022 (USD MILLION) 99
 TABLE 33 VCSEL MARKET, BY APPLICATION, 2023-2028 (USD MILLION) 100
 11.2 SENSING 100
 11.2.1 3D SENSING 101
 11.2.1.1 ToF camera 101
 11.2.1.1.1 Proximity sensing 101
 11.2.1.1.1.1 Proximity sensing widely used in smartphones 101
 11.2.1.2 Structured light illumination 101
 11.2.1.2.1 Increasing adoption of face recognition technologies in smart devices to create lucrative opportunities 101
 11.2.1.3 Facial & gesture recognition 102
 11.2.1.3.1 Increase in adoption of biometric technologies in smart devices to drive market 102
 11.2.2 GAS SENSING 102
 11.2.2.1 Single-mode VCSELS used for gas sensing in industrial environments 102
 11.2.3 OPTICAL MICE 102
 11.2.3.1 VCSEL-based optical mouse enables operations on various surfaces 102
 11.3 DATA COMMUNICATION 102

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 11.3.1 OPTICAL TRANSCEIVERS & ACTIVE OPTICAL CABLES 103
 - 11.3.1.1 Growing adoption of high data rate optical components in data centers to propel market 103
- 11.4 INDUSTRIAL HEATING & LASER PRINTING 103
 - 11.4.1 ADDITIVE MANUFACTURING 103
 - 11.4.1.1 VCSEL heating reduces thermal gradient in additive manufacturing 103
 - 11.4.2 LASER PRINTING 104
 - 11.4.2.1 Laser printing requires low-cost, single-mode VCSELs 104
 - 11.5 EMERGING & OTHER APPLICATIONS 104
 - 11.5.1 LIDAR 104
 - 11.5.1.1 Developments in autonomous vehicles to create opportunities for applications of VCSELs in automotive LiDARs 104
 - 11.5.2 IN-CABIN SENSING 104
 - 11.5.2.1 Innovations in vehicle infotainment systems to boost demand for VCSELs 104
 - 11.5.3 ATOMIC CLOCK & GPS 105
 - 11.5.3.1 VCSELs make for compact and low-cost solutions for use in atomic clocks 105
 - 11.5.4 MAGNETOMETER 105
 - 11.5.4.1 Highly accurate detection of magnetic fields made possible with use of VCSEL-based magnetometers 105
 - 11.5.5 INFRARED ILLUMINATION FOR SURVEILLANCE 105
 - 11.5.5.1 VCSELs improve performance and visibility in security & surveillance applications 105
 - 11.5.6 PULSE OXIMETRY 106
 - 11.5.6.1 VCSELs provide benefits of narrower spectral linewidth emission for pulse oximetry applications 106
 - 12 VCSEL MARKET, BY DATA RATE 107
 - 12.1 INTRODUCTION 108
 - FIGURE 37 ABOVE 25 GBPS SEGMENT TO GROW AT HIGHEST CAGR DURING FORECAST PERIOD 108
 - TABLE 34 VCSEL MARKET FOR DATA COMMUNICATION, BY DATA RATE, 2018-2022 (USD MILLION) 108
 - TABLE 35 VCSEL MARKET FOR DATA COMMUNICATION, BY DATA RATE, 2023-2028 (USD MILLION) 109
 - 12.2 UP TO 10 GBPS 109
 - 12.2.1 VCSELS WITH DATA RATES UP TO 10 GBPS USED IN DATA COMMUNICATION APPLICATIONS 109
 - TABLE 36 VCSELS WITH DATA RATE UP TO 10 GBPS 110
 - 12.3 10.1 TO 25 GBPS 110
 - 12.3.1 VCSELS WITH DATA RATE OF 10.1 TO 25 GBPS DOMINATED MARKET IN 2022 110
 - TABLE 37 VCSELS WITH DATA RATE OF 10.1 TO 25 GBPS 111
 - 12.4 ABOVE 25 GBPS 111
 - 12.4.1 VCSELS WITH DATA RATE ABOVE 25 GBPS TO RECORD HIGHEST GROWTH DURING FORECAST PERIOD 111
 - TABLE 38 VCSELS WITH DATA RATE ABOVE 25 GBPS 112
 - 13 VCSEL MARKET, BY INDUSTRY 113
 - 13.1 INTRODUCTION 114
 - FIGURE 38 CONSUMER ELECTRONICS INDUSTRY TO BE LARGEST SHAREHOLDER OF VCSEL MARKET DURING FORECAST PERIOD 114
 - TABLE 39 VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION) 114
 - TABLE 40 VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION) 115
 - 13.2 CONSUMER ELECTRONICS 116
 - 13.2.1 CONSUMER ELECTRONICS HELD DOMINANT MARKET SHARE IN 2022 116
 - TABLE 41 CONSUMER ELECTRONICS: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 116
 - TABLE 42 CONSUMER ELECTRONICS: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 116
 - TABLE 43 CONSUMER ELECTRONICS: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD MILLION) 117
 - TABLE 44 CONSUMER ELECTRONICS: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD MILLION) 117
 - TABLE 45 CONSUMER ELECTRONICS: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD MILLION) 117
 - TABLE 46 CONSUMER ELECTRONICS: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD MILLION) 118

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

TABLE 47 CONSUMER ELECTRONICS: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD MILLION) 118

TABLE 48 CONSUMER ELECTRONICS: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD MILLION) 118

TABLE 49 CONSUMER ELECTRONICS: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD MILLION) 119

TABLE 50 CONSUMER ELECTRONICS: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD MILLION) 119

13.3 DATA CENTER 119

13.3.1 INCREASE IN DATA BANDWIDTH IN DATA CENTERS TO DRIVE DEMAND FOR VCSELS 119

TABLE 51 DATA CENTER: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 120

TABLE 52 DATA CENTER: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 120

TABLE 53 DATA CENTER: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD MILLION) 120

TABLE 54 DATA CENTER: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD MILLION) 121

TABLE 55 DATA CENTER: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD MILLION) 121

TABLE 56 DATA CENTER: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD MILLION) 121

TABLE 57 DATA CENTER: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD MILLION) 122

TABLE 58 DATA CENTER: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD MILLION) 122

TABLE 59 DATA CENTER: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD MILLION) 122

TABLE 60 DATA CENTER: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD MILLION) 123

13.4 AUTOMOTIVE 123

13.4.1 ADOPTION OF VCSELS IN AUTOMOTIVE LIDAR TO BOOST MARKET IN REST OF THE WORLD 123

TABLE 61 AUTOMOTIVE: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 123

TABLE 62 AUTOMOTIVE: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 124

TABLE 63 AUTOMOTIVE: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD THOUSAND) 124

TABLE 64 AUTOMOTIVE: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD THOUSAND) 124

TABLE 65 AUTOMOTIVE: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD THOUSAND) 125

TABLE 66 AUTOMOTIVE: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD THOUSAND) 125

TABLE 67 AUTOMOTIVE: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD THOUSAND) 125

TABLE 68 AUTOMOTIVE: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD THOUSAND) 126

TABLE 69 AUTOMOTIVE: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD THOUSAND) 126

TABLE 70 AUTOMOTIVE: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD THOUSAND) 126

13.5 COMMERCIAL & INDUSTRIAL 127

13.5.1 ADOPTION OF VCSELS ACROSS VARIOUS INDUSTRIAL APPLICATIONS TO FAVOR MARKET 127

TABLE 71 COMMERCIAL & INDUSTRIAL: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 127

TABLE 72 COMMERCIAL & INDUSTRIAL: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 128

TABLE 73 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD MILLION) 128

TABLE 74 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD MILLION) 128

TABLE 75 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD MILLION) 129

TABLE 76 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD MILLION) 129

TABLE 77 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD MILLION) 129

TABLE 78 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD MILLION) 130

TABLE 79 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD THOUSAND) 130

TABLE 80 COMMERCIAL & INDUSTRIAL: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD THOUSAND) 130

13.6 HEALTHCARE 131

13.6.1 VCSELS USED FOR SCANNING AND IMAGING APPLICATIONS IN HEALTHCARE INDUSTRY 131

TABLE 81 HEALTHCARE: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 131

TABLE 82 HEALTHCARE: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 131

TABLE 83 HEALTHCARE: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD MILLION) 132

TABLE 84 HEALTHCARE: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD MILLION) 132

TABLE 85 HEALTHCARE: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD MILLION) 132

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

TABLE 86 HEALTHCARE: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD MILLION) 133

TABLE 87 HEALTHCARE: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD MILLION) 133

TABLE 88 HEALTHCARE: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD MILLION) 133

TABLE 89 HEALTHCARE: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD THOUSAND) 134

TABLE 90 HEALTHCARE: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD THOUSAND) 134

13.7 MILITARY 134

13.7.1 VCSELS USED FOR TACTICAL SURVEILLANCE AND OBSTACLE DETECTION IN MILITARY TASKS 134

TABLE 91 MILITARY: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 134

TABLE 92 MILITARY: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 135

TABLE 93 MILITARY: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2018-2022 (USD MILLION) 135

TABLE 94 MILITARY: VCSEL MARKET IN NORTH AMERICA, BY COUNTRY, 2023-2028 (USD MILLION) 135

TABLE 95 MILITARY: VCSEL MARKET IN EUROPE, BY COUNTRY, 2018-2022 (USD MILLION) 136

TABLE 96 MILITARY: VCSEL MARKET IN EUROPE, BY COUNTRY, 2023-2028 (USD MILLION) 136

TABLE 97 MILITARY: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2018-2022 (USD MILLION) 136

TABLE 98 MILITARY: VCSEL MARKET IN ASIA PACIFIC, BY COUNTRY, 2023-2028 (USD MILLION) 137

TABLE 99 MILITARY: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2018-2022 (USD THOUSAND) 137

TABLE 100 MILITARY: VCSEL MARKET IN REST OF THE WORLD, BY REGION, 2023-2028 (USD THOUSAND) 137

14 VCSEL MARKET, BY REGION 138

14.1 INTRODUCTION 139

FIGURE 39 VCSEL MARKET IN ASIA PACIFIC TO GROW AT HIGHEST CAGR DURING FORECAST PERIOD 139

TABLE 101 VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION) 139

TABLE 102 VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION) 140

14.2 NORTH AMERICA 140

14.2.1 RECESSION IMPACT ON NORTH AMERICA 140

FIGURE 40 NORTH AMERICA: VCSEL MARKET SNAPSHOT 141

TABLE 103 NORTH AMERICA: VCSEL MARKET, BY COUNTRY, 2018-2022 (USD MILLION) 141

TABLE 104 NORTH AMERICA: VCSEL MARKET, BY COUNTRY, 2023-2028 (USD MILLION) 142

TABLE 105 US: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION) 142

TABLE 106 US: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION) 142

TABLE 107 CANADA: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION) 143

TABLE 108 CANADA: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION) 143

TABLE 109 MEXICO: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND) 143

TABLE 110 MEXICO: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND) 144

14.2.2 US 144

14.2.2.1 US to dominate global VCSEL market during forecast period 144

14.2.3 CANADA 144

14.2.3.1 Data communication applications to drive market 144

14.2.4 MEXICO 145

14.2.4.1 Automotive industry to provide opportunities for market growth 145

14.3 EUROPE 145

14.3.1 RECESSION IMPACT ON EUROPE 145

FIGURE 41 EUROPE: VCSEL MARKET SNAPSHOT 146

TABLE 111 EUROPE: VCSEL MARKET, BY COUNTRY, 2018-2022 (USD MILLION) 146

TABLE 112 EUROPE: VCSEL MARKET, BY COUNTRY, 2023-2028 (USD MILLION) 147

TABLE 113 UK: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND) 147

TABLE 114 UK: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND) 147

TABLE 115 GERMANY: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION) 148

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

TABLE 116	GERMANY: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION)	148
TABLE 117	FRANCE: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND)	148
TABLE 118	FRANCE: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND)	149
TABLE 119	REST OF EUROPE: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND)	149
TABLE 120	REST OF EUROPE: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND)	149
14.3.2	GERMANY	150
14.3.2.1	Germany to hold largest share of VCSEL market in Europe during forecast period	150
14.3.3	UK	150
14.3.3.1	Consumer electronics and communications sectors to drive market in UK	150
14.3.4	FRANCE	150
14.3.4.1	Demand from automotive industry to substantiate market growth	150
14.3.5	REST OF EUROPE	150
14.4	ASIA PACIFIC	151
14.4.1	RECESSION IMPACT ON ASIA PACIFIC	151
FIGURE 42	ASIA PACIFIC: VCSEL MARKET SNAPSHOT	152
TABLE 121	ASIA PACIFIC: VCSEL MARKET, BY COUNTRY, 2018-2022 (USD MILLION)	152
TABLE 122	ASIA PACIFIC: VCSEL MARKET, BY COUNTRY, 2023-2028 (USD MILLION)	153
TABLE 123	CHINA: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION)	153
TABLE 124	CHINA: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION)	153
TABLE 125	JAPAN: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION)	154
TABLE 126	JAPAN: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION)	154
TABLE 127	SOUTH KOREA: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND)	154
TABLE 128	SOUTH KOREA: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND)	155
TABLE 129	REST OF ASIA PACIFIC: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD MILLION)	155
TABLE 130	REST OF ASIA PACIFIC: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD MILLION)	155
14.4.2	CHINA	156
14.4.2.1	China to account for largest share of VCSEL market in Asia Pacific during forecast period	156
14.4.3	JAPAN	156
14.4.3.1	Demand from consumer electronics and data center verticals to drive VCSEL market	156
14.4.4	SOUTH KOREA	156
14.4.4.1	VCSEL market in South Korea dominated by consumer electronics and telecommunications industries	156
14.4.5	REST OF ASIA PACIFIC	157
14.5	REST OF THE WORLD	157
14.5.1	RECESSION IMPACT ON REST OF THE WORLD	157
TABLE 131	REST OF THE WORLD: VCSEL MARKET, BY REGION, 2018-2022 (USD MILLION)	157
TABLE 132	REST OF THE WORLD: VCSEL MARKET, BY REGION, 2023-2028 (USD MILLION)	157
TABLE 133	SOUTH AMERICA: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND)	158
TABLE 134	SOUTH AMERICA: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND)	158
TABLE 135	MIDDLE EAST & AFRICA: VCSEL MARKET, BY INDUSTRY, 2018-2022 (USD THOUSAND)	158
TABLE 136	MIDDLE EAST & AFRICA: VCSEL MARKET, BY INDUSTRY, 2023-2028 (USD THOUSAND)	159
14.5.2	SOUTH AMERICA	159
14.5.2.1	South America to hold larger share of VCSEL market in RoW during forecast period	159
14.5.3	MIDDLE EAST AND AFRICA	159
14.5.3.1	VCSEL market in Middle East & Africa at nascent stage	159
15	COMPETITIVE LANDSCAPE	160
15.1	OVERVIEW	160
15.2	STRATEGIES ADOPTED BY KEY PLAYERS	160

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

TABLE 137	OVERVIEW OF STRATEGIES DEPLOYED BY VCSEL MANUFACTURERS	160
15.2.1	PRODUCT PORTFOLIO	160
15.2.2	REGIONAL FOCUS	160
15.2.3	MANUFACTURING FOOTPRINT	161
15.2.4	ORGANIC/INORGANIC GROWTH STRATEGIES	161
15.3	MARKET SHARE ANALYSIS: VCSEL MARKET, 2022	161
TABLE 138	DEGREE OF COMPETITION, 2022	161
15.4	FIVE-YEAR COMPANY REVENUE ANALYSIS	162
FIGURE 43	FIVE-YEAR REVENUE ANALYSIS OF TOP FOUR PLAYERS IN VCSEL MARKET	162
15.5	COMPANY EVALUATION QUADRANT	162
15.5.1	STARS	162
15.5.2	EMERGING LEADERS	163
15.5.3	PERVASIVE PLAYERS	163
15.5.4	PARTICIPANTS	163
FIGURE 44	VCSEL COMPANY EVALUATION QUADRANT, 2022	164
15.5.5	COMPANY FOOTPRINT	165
TABLE 139	OVERALL COMPANY FOOTPRINT	165
TABLE 140	COMPANY PRODUCT TYPE FOOTPRINT	166
TABLE 141	COMPANY INDUSTRY FOOTPRINT	167
TABLE 142	COMPANY REGION FOOTPRINT	168
15.6	START-UP/SME EVALUATION MATRIX	169
TABLE 143	LIST OF START-UP/SME COMPANIES IN VCSEL MARKET	169
15.6.1	PROGRESSIVE COMPANIES	170
15.6.2	RESPONSIVE COMPANIES	170
15.6.3	DYNAMIC COMPANIES	170
15.6.4	STARTING BLOCKS	170
FIGURE 45	VCSEL MARKET, START-UP/SME EVALUATION MATRIX, 2022	171
15.7	COMPETITIVE SCENARIOS AND TRENDS	172
15.7.1	PRODUCT LAUNCHES	172
TABLE 144	PRODUCT LAUNCHES, 2019-2022	172
15.7.2	DEALS	175
TABLE 145	DEALS, 2019-2022	175
16	COMPANY PROFILES	178
16.1	KEY PLAYERS	178
(Business Overview, Products Offered, Recent Developments, MnM View, Right to win, Strategic choices made, Weaknesses and competitive threats)*		
16.1.1	COHERENT CORP.	178
TABLE 146	COHERENT: BUSINESS OVERVIEW	178
FIGURE 46	COHERENT: COMPANY SNAPSHOT	179
16.1.2	LUMENTUM	184
TABLE 147	LUMENTUM: BUSINESS OVERVIEW	184
FIGURE 47	LUMENTUM: COMPANY SNAPSHOT	185
16.1.3	AMS-OSRAM	188
TABLE 148	AMS-OSRAM: BUSINESS OVERVIEW	188
FIGURE 48	AMS-OSRAM: COMPANY SNAPSHOT	189
16.1.4	TRUMPF	193
TABLE 149	TRUMPF: BUSINESS OVERVIEW	193

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

FIGURE 49 TRUMPF: COMPANY SNAPSHOT 194
16.1.5 BROADCOM 197
TABLE 150 BROADCOM: BUSINESS OVERVIEW 197
FIGURE 50 BROADCOM: COMPANY SNAPSHOT 198
16.1.6 MKS INSTRUMENTS 200
TABLE 151 MKS INSTRUMENTS: BUSINESS OVERVIEW 200
FIGURE 51 MKS INSTRUMENTS: COMPANY SNAPSHOT 201
16.1.7 SANTEC 203
TABLE 152 SANTEC: BUSINESS OVERVIEW 203
FIGURE 52 SANTEC: COMPANY SNAPSHOT 204
16.1.8 LEONARDO ELECTRONICS 206
TABLE 153 LEONARDO ELECTRONICS: BUSINESS OVERVIEW 206
16.1.9 VERTILAS 208
TABLE 154 VERTILAS: BUSINESS OVERVIEW 208
16.1.10 VERTILITE 209
TABLE 155 VERTILITE: BUSINESS OVERVIEW 209
16.2 OTHER KEY PLAYERS 210
16.2.1 ALIGHT TECHNOLOGIES 210
16.2.2 TELEDYNE FLIR 211
16.2.3 INNEOS 212
16.2.4 IQE 213
16.2.5 THORLABS 214
16.2.6 TT ELECTRONICS 215
16.2.7 USHIO AMERICA 216
16.2.8 WIN SEMICONDUCTORS 217
16.2.9 FRANKFURT LASER COMPANY 218
16.2.10 INPHENIX, INC. 218
*Details on Business Overview, Products Offered, Recent Developments, MnM View, Right to win, Strategic choices made, Weaknesses and competitive threats might not be captured in case of unlisted companies.
17 APPENDIX 219
17.1 DISCUSSION GUIDE 219
17.2 KNOWLEDGESTORE: MARKETSDMARKETS' SUBSCRIPTION PORTAL 223
17.3 CUSTOMIZATION OPTIONS 225
17.4 RELATED REPORTS 225
17.5 AUTHOR DETAILS 226

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

VCSEL Market by Type (Single-mode and Multimode), Material (GaAs, InP, GaN), Wavelength, Application (Sensing, Data Communication, Industrial Heating & Printing, Emerging), Data Rate, Industry and Region - Global Forecast to 2028

Market Report | 2023-02-07 | 221 pages | MarketsandMarkets

To place an Order with Scotts International:

- Print this form
- Complete the relevant blank fields and sign
- Send as a scanned email to support@scotts-international.com

ORDER FORM:

Select license	License	Price
	Single User	\$4950.00
	Multi User	\$6650.00
	Corporate License	\$8150.00
	Enterprise Site License	\$10000.00
		VAT
		Total

*Please circle the relevant license option. For any questions please contact support@scotts-international.com or 0048 603 394 346.

** VAT will be added at 23% for Polish based companies, individuals and EU based companies who are unable to provide a valid EU Vat Numbers.

Email*	<input type="text"/>	Phone*	<input type="text"/>
First Name*	<input type="text"/>	Last Name*	<input type="text"/>
Job title*	<input type="text"/>		
Company Name*	<input type="text"/>	EU Vat / Tax ID / NIP number*	<input type="text"/>
Address*	<input type="text"/>	City*	<input type="text"/>
Zip Code*	<input type="text"/>	Country*	<input type="text"/>

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

Date

2026-03-10

Signature

A large, empty rectangular box with a thin black border, intended for a signature.

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com