

# VCSEL

## Patent Landscape Analysis

November 2018



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# THE AUTHORS



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## ABOUT KNOWMADE

Specialized in analysis of patents and scientific information, **Knowmade** provides Technology Intelligence and IP strategy consulting services. The company supports R&D organizations, industrial companies and investors in their business development by offering them a deep understanding of their IP environment and the technology trends.

**Knowmade** operates in the following industrial sectors: Compound Semiconductors, Power & RF/microwave Electronics, LED/OLED Lighting & Display, Photonics, Memories, MEMS & Sensors, Manufacturing & Advanced packaging, Batteries & Energy management, Biotechnology, Pharmaceuticals, Medical Devices, Medical Imaging, Agri-Food & Environment.

**Knowmade's** experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence and freedom-to-operate analysis. In parallel the company proposes litigation/licensing support, technology scouting and IP/technology watch service. **Knowmade's** analysts combine their technical and patent expertise by using powerful analytics tools and proprietary methodologies to deliver relevant patent analyses and scientific reviews.

# Scope of the report

**REPORT SAMPLE**

### SCOPE OF THE REPORT

- This report provides a detailed picture of the patent landscape for VCSEL.
- This report covers patents published worldwide up to August 2018. We have selected and analyzed more than 10,500 patents and patent applications grouped in more than 4,200 patent families relevant to the scope of this report.

Example	Selected patents		
	VCSEL devices and systems	VCSEL applications	Excluded
Patents related to VCSEL or VECSEL manufacturing and process	X		
Patents related to VCSEL or VECSEL array	X		
Patents claiming systems and devices that specifically use VCSEL (Lidar, Printing, etc.)		X	
Patents describing VCSEL, VECSEL or VCSEL array as the preferred solution to perform an operations		X	
Patents describing a systems and devices that can use either edge emitting laser or VCSEL			X
Patents related to edge emitting laser (EEL)			X
Patent related or describing a surface emitting laser with a horizontal cavity			X
Patent claiming an optical element (lens, diffractive element, etc.) that can be used with a VCSEL/VECSEL			X

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### SCOPE OF THE REPORT

Examples of patents included in the report

Included in the report as LIDAR devices and systems

VCSEL manufacturing      VCSEL array      VCSEL in applications

**US8783893**  
Surface mount packaging for high-speed vertical cavity surface emitting lasers  
PRINCETON OPTONICS

**US5478774**  
Method of fabricating patterned-mirror vcsels using selective growth  
MOTOROLA

**DE202018001341**  
Vcsel with improved optical and electrical limiting  
APPLE

**US7957447**  
Vcsel array device and method for manufacturing the vcsel array device  
FUJII XEROX

**US6259121**  
A monolithic multiple wavelength vcsel array  
AGILENT TECHNOLOGIES  
AVAGO TECHNOLOGIES  
HP

**KR0117861**  
Optical source and detector using vertical cavity surface emitting laser diode  
SAMSUNG ELECTRONICS

**EP3301477**  
System for determining a distance to an object  
XENOMATIX

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### SCOPE OF THE REPORT

Examples of patents excluded of the report

Not included in the report

**CN207518050**  
Semiconductor laser direct frequency doubling the size of the blue laser  
ZHONGKE & LIGHT APPLIED LASER TECHNOLOGY RESEARCH INSTITUTE

**US20180109071**  
Matching drive device for multi-beam optoelectronic arrays  
TRILUMINA

**US20170365982**  
Edge-emitting semiconductor laser and method for operating a semiconductor laser  
OSRAM

**US20180172988**  
Display device having integrated metamaterial lens  
INTEL

**EP32597105**  
Driver circuit for a laser diode  
STMICROELECTRONICS

**US9830937**  
Horizontal cavity surface emitting laser assembly features for heat assisted magnetic recording  
SEAGATE TECHNOLOGY

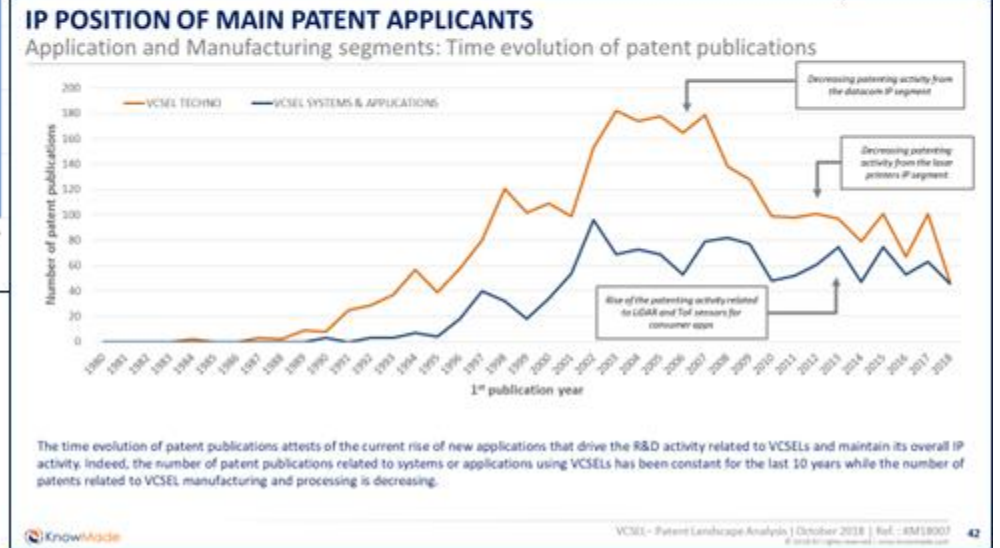
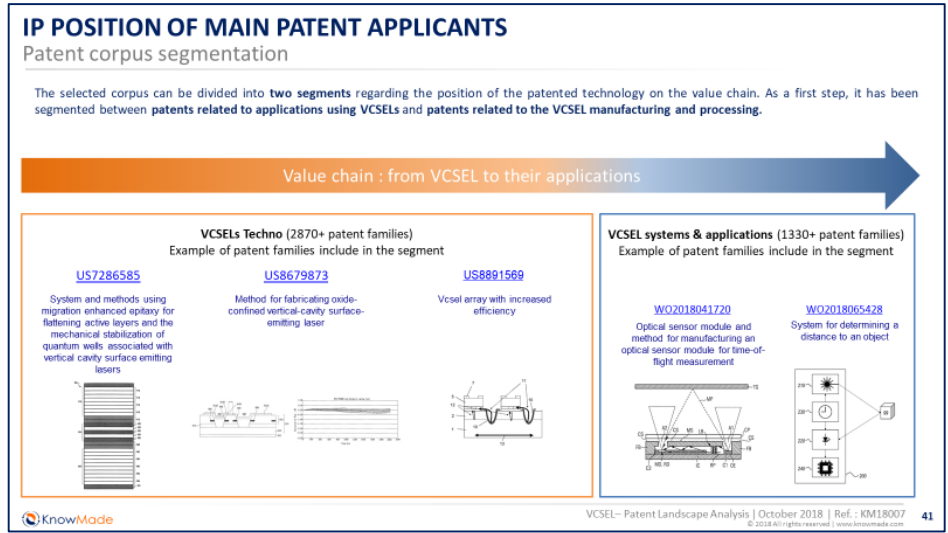
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# Understanding the main technological approach

Corpus segmentation by material, valued chain position and patented technologies

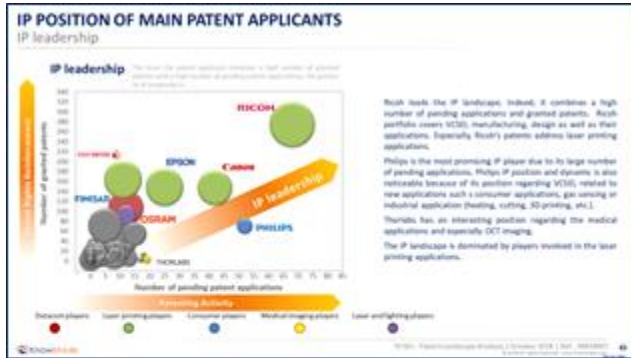
REPORT SAMPLE



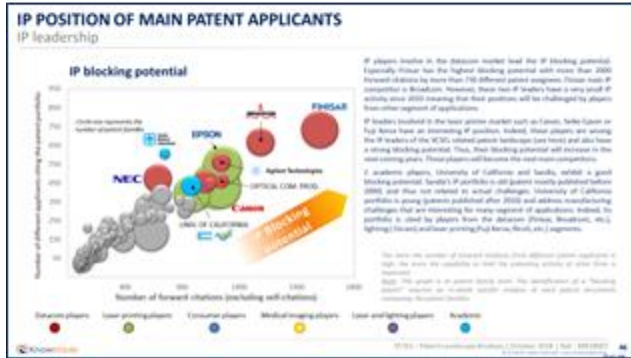
# Comparison of IP players

Portfolios analysis and ranking: who has the strongest IP position and why?

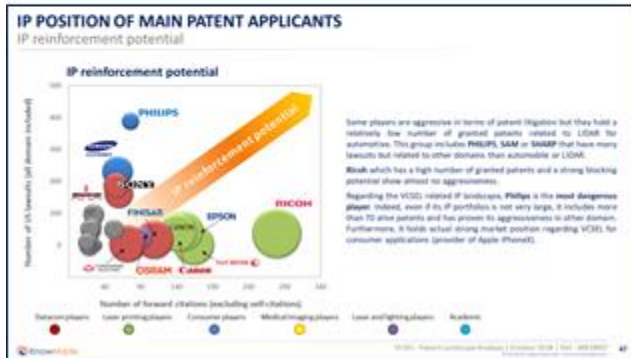
REPORT  
SAMPLE



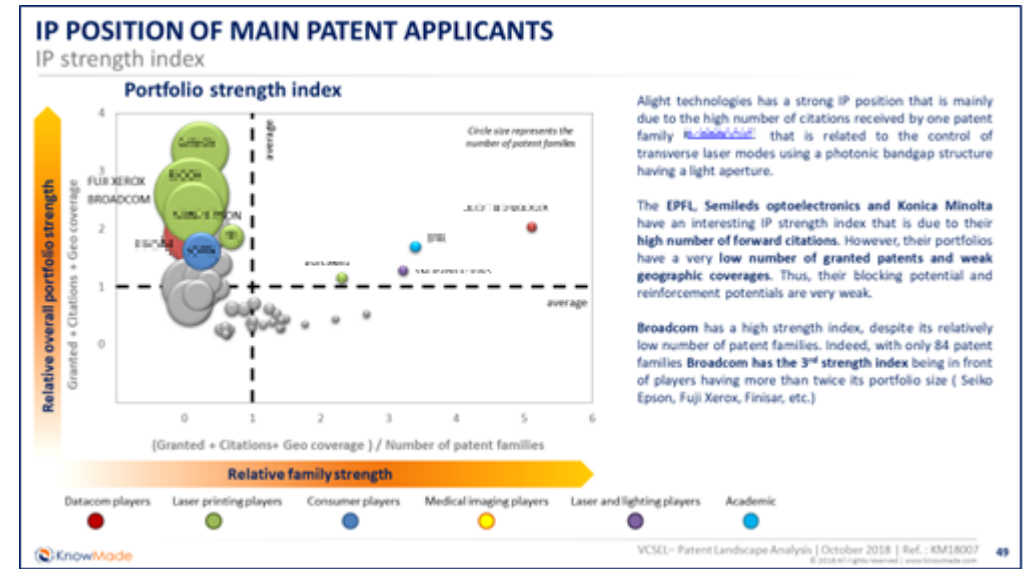
IP leadership



Blocking potential



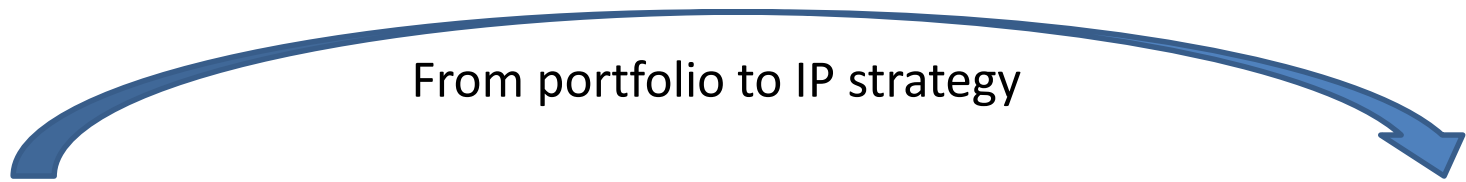
Reinforcement potential



# Understanding the key players IP strategies

## Key player portfolio analysis

REPORT SAMPLE



From portfolio to IP strategy

### KEY IP PLAYERS

RICOH : company presentation

**Company Overview**

Name: RICOH  
Creation: 1936  
Headquarter: Ōta, Tokyo, Tokyo, Japan  
Website: <https://www.ricoh.com/>  
Employees: 220  
Revenue: \$10.9 B (¥ 2.2 T)

**KEY IP PLAYERS**

RICOH : IP portfolio overview

**Time evolution of patent publications**

**Main applicants citing Ricoh portfolio**

CANON	70
FUJI XEROX	35
FURUKAWA ELECTRIC	31
SEIKO EPSON	21
SONY	45
SUMITOMO ELECTRIC INDUSTRIES	37
SAMSUNG ELECTRONICS	36
TOSHIBA	30

**KEY IP PLAYERS**

RICOH : key patents

Ricoh is the IP leader and has a strong IP position regarding the laser printing segment. Despite that, Ricoh is not recognized as a VCSEL player on the market. Even if its main segment remains the laser printing, Ricoh has started to enlarge its patent portfolio by mentioning and asserting VCSEL devices for new trending applications such as atomic clocks, automotive LIDAR and image forming but also for some specific ones like ignition device for internal combustion engine. On the technological side, Ricoh has recently filed numerous patents related to VCSEL array manufacturing and their related issues (thermal dissipation, light and wavelength uniformity, power consumption, etc.)

**KEY PATENT FAMILIES RELATED TO VCSEL TECHNO**

<p><b>US6785232</b> 1<sup>st</sup> publication date: 2003-01-09 Method of fabricating a semiconductor light-emitting device Status: Granted (US, JP)</p>	<p><b>US6902701</b> 1<sup>st</sup> publication date: 2005-12-22 Surface emitting laser and light transmission system Status: Granted (JP)</p>	<p><b>US7211891</b> 1<sup>st</sup> publication date: 2011-09-19 Surface emitting laser device, surface emitting laser array, optical scanning device, and image forming apparatus Status: Granted (JP, US)</p>	<p><b>US2017082</b> 1<sup>st</sup> publication date: 2014-06-05 Surface emitting laser device and atomic oscillator Status: Granted (JP, US)</p>
<p><b>US6803604</b> 1<sup>st</sup> publication date: 2002-09-20 Semiconductor optical modulator, an optical amplifier and an integrated semiconductor light-emitting device Status: Granted (JP, US)</p>	<p><b>US7268458</b> 1<sup>st</sup> publication date: 2005-12-08 Surface emitting laser diode and its manufacturing method Status: Granted (JP, US, EP)</p>	<p><b>US7291800</b> 1<sup>st</sup> publication date: 2006-08-03 Vertical cavity surface-emitting semiconductor laser device, optical transmission module, optical transmission device, and optical switching method Status: Granted (JP, US)</p>	<p><b>US9399698</b> 1<sup>st</sup> publication date: 2013-06-06 Surface-emitting laser element, method for manufacturing a surface-emitting laser element, and atomic oscillator Status: Granted (RU, US, JP), Pending (EP, IN, BR)</p>
<p><b>US6134823</b> 1<sup>st</sup> publication date: 2001-02-14 Laser diode and semiconductor light-emitting device producing visible-wavelength radiation Status: Granted (US)</p>	<p><b>US7245147</b> 1<sup>st</sup> publication date: 2004-05-13 Surface-emission laser diode operable in the wavelength band of 1.3-1.7 micrometers and optical telecommunication system using such a laser diode Status: Granted (US)</p>	<p><b>US6959025</b> 1<sup>st</sup> publication date: 2004-09-09 Array of surface-emitting laser diodes having reduced device resistance and capable of performing high output operation and method of fabricating the surface-emitting laser diode Status: Granted (US, JP)</p>	<p><b>US7180100</b> 1<sup>st</sup> publication date: 2005-02-24 Semiconductor light-emitting device, surface-emission laser diode, and production apparatus thereof, production method, optical module and optical telecommunication system Status: Granted (US)</p>

**Legal status**

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### KEY IP PLAYERS

Main player of the 3D sensing or LIDAR have stopped their other IP activity related to VCSEL

**Publication year of patents mentioning the application**

**KEY IP PLAYERS**

IP Position of main market and IP players

Diversification → R&D developments or IP acquisitions

**Strengthening IP position**  
(extension, new patents, granted, etc.)

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# Key patents identification

What are the strongest, most blocking, promising ... patents?

## GRANTED PATENTS NEAR EXPIRATION

### Most relevant patents

In the following part, Knowmade has identified the most relevant patents that will expire in the first trimester of 2019 . Among these patents a manual selection of the most relevant blocking patents (granted patents) , seminal patents (most cited patents) and promising patents has been done.

Near expiration most relevant patents related to VCSEL

## PATENTS INVOLVED IN LITIGATIONS

### Optical Communication Products vs Finisar Corporation

The 03/07/2011, Optical communication products filed a complaint against Finisar corp. for patent infringement. The complaint specifically aim at Finisar product that relates to the design of lasers and their components. For example, technology at issue here relates to how Vertical-Cavity Surface Emitting Lasers ("VCSELs") work.

Optical communication products filed a complaint against Finisar corp. for patent infringement. The complaint specifically aim at Finisar product that relates to the design of lasers and their components. For example, technology at issue here relates to how Vertical-Cavity Surface Emitting Lasers ("VCSELs") work.

The 01/10/2011

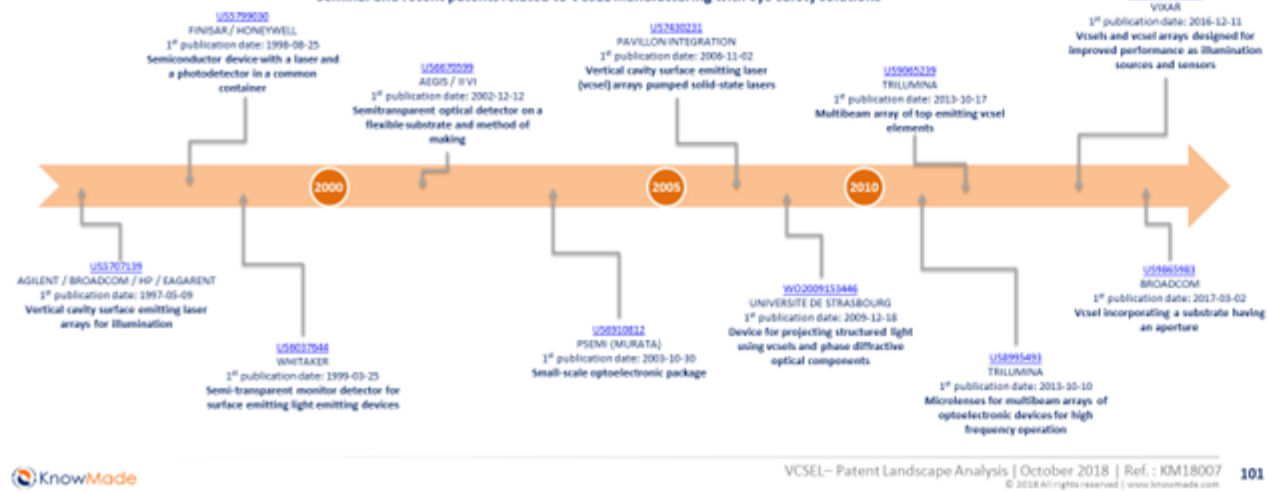
## KEY PATENTS RELATED TO MANUFACTURING ISSUES

### Key patents related to eyes safety

The development of new markets and applications have boost the development and R&D activity related to their manufacturing. Because the laser is can now be in direct contact with an human eye, VCSELS for consumer and LIDAR applications have to be safe and harmless for eyes as defined by each government policies.

40 patent families directly mentioned eye safety concerns in their description.

### Seminal and recent patents related to VCSEL manufacturing with eye safety solutions



## Key patent analysis

## KEY PATENTS RELATED TO MANUFACTURING ISSUES

### Key patents related to yield improvement

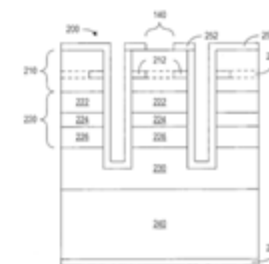
[US20060013276](#)  
**Vcsele having an air gap and protective coating**  
 Assignee: BROADCOM  
 1<sup>st</sup> publication date: 2006-01-16  
 Status: Pending (TW), Abandoned (CN, US JP, DE, KR)

#### Abstract

A VCSEL includes a gap in a mirror stack and a protective layer sealing an end of the gap. The gap defines a boundary of the aperture of the VCSEL without introducing the stresses that oxide regions in oxide VCSELS can cause, and the protective layer, which can be a thin dielectric layer, shields the mirror stack from environmental damage. The VCSEL can thus achieve high reliability. A fabrication process for the VCSEL forms an oxidation hole, oxidizes a portion of an aluminum-rich layer in a mirror stack of the VCSEL exposed in the hole, and then removes all or some of the resulting oxide to form the desired gap. The protective layer can then be deposited to seal an end of the gap.

#### Part of the description related to yield improvement

In accordance with an aspect of the invention, a vertical cavity surface emitting laser (VCSEL) having a gap defining the boundaries of an aperture and a thin protective layer protecting the gap provides high reliability. **Manufacturing techniques for such VCSELS provide a high yield of devices that pass industry standard reliability tests such as the 85/85 stress test.**



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# Patent database

Excel file containing all the patents analyzed in this report with technology segments



This Excel database allows multi-criteria searches and includes patent publication number, hyperlinks to the original documents, priority date, title, abstract, patent assignees, legal status and technical segment for each patent families.

Questel unique family ID (FAN)	Publication numbers	Title	Abstract	Earliest application date	Earliest publication date	Expected expiry dates	Current assignees	Inventors	Legal status (Pending, Granted, Revoked,	Original document	VCSEL applications	VCSEL Techno
81524222	IN2279/CHENP/2006	6CN02279)Optical pick-up	distribution of the emissio	2006-06-22	2007-06-08	2017-06-08	HILIPS ELECTRONICS ((NL	aria ((FR))VAN DER LEE Al	LAPSED	Open	X	
81523237	IN2345/CHENP/2006	N02345)Improved optical	ted by an information car	2006-06-26	2007-07-06	2017-07-06	HILIPS ELECTRONICS ((NL	aria ((FR))VAN DER LEE Al	LAPSED	Open		
81474514	DE202018001341	l with improved optical a	R stack.At least the third	2017-12-14	2018-06-21	2028-06-21	APPLE ((US))		GRANTED	Open		
81474514	US20180287345	with improved optical and	s an upper DBR stack.At l	2017-12-14	2018-06-21	2037-12-14	APPLE	G)DRADER MARC ((CA))V	PENDING	Open		
81474514	WO2018186996	with improved optical and	s an upper DBR stack (48)	2017-12-14	2018-06-21	2020-10-04	APPLE ((US))	)DRADER MARC ((CA))VE	PENDING	Open		
81452769	USD379542	D379542)Flexible flashlig		1996-02-07	1997-05-27	2011-05-27	SANYO ELECTRIC ((JP))	Egashira Teruaki ((JP))	EXPIRED	Open	X	
81163208	2006105249WO20061052	bilized vertical extended	ventional frequency cont	2006-03-30	2006-10-05	2008-09-30	NOVALUX ((US))	ICHEGROV ANDREI V ((US	LAPSED	Open	X	
81163208	KR20080003386	bilized vertical extended	ventional frequency cont	2006-03-30	2006-10-05	2011-04-30	NOVALUX ((US))	ICHEGROV ANDREI V ((RU	LAPSED	Open	X	
81163208	CN101180778	ilized vertical extended	ventional frequency cont	2006-03-30	2006-10-05	2010-08-25	NOVALUX		LAPSED	Open	X	
81163208	JP2008535263	bilized vertical extended	uency control elements,	2006-03-30	2006-10-05	2012-11-20	BARAKKUSU ROYALTY DE	Shugurovu Andrei Vee	REVOKED	Open		
81163208	JP2008538163	bilized vertical extended	uency control elements,	2006-03-30	2006-10-05	2012-03-21	BARAKKUSU ROYALTY DE	ansen MichaelDato Rene	REVOKED	Open	X	
81163208	75566EP1875566EP18755	ilized vertical extended ca	ventional frequency cont	2006-03-30	2006-10-05	2026-03-30	INTELLECTUAL PROPERTY	ICHEGROV ANDREI V ((US	GRANTED	Open	X	
80941187	WO2015011983	ertical-cavity surface-em	series wires (61) respect	2014-05-27	2015-01-29	2017-01-22	RATA MANUFACTURING ((P))	KONA TAKAYUKI ((JP))	LAPSED	Open		X
80941187	DE112014003371	4003371)Oberflächenem	inny connect every two VCSE	2014-05-27	2015-01-29	2034-05-27	RATA MANUFACTURING ((P))	KONA TAKAYUKI ((JP))	PENDING	Open		X
80941187	TW201512680TWI569026	l resonant surface illum	series wires (61) respect	2014-05-27	2015-01-29	2034-05-27	RATA MANUFACTURING ((P))	KONA TAKAYUKI ((JP))	GRANTED	Open		X
80941187	WO2015011983JP6137318	tical cavity surface emitti	connect every two VCSE	2014-05-27	2015-01-29	2034-05-27	MURATA MANUFACTURING	subaraTakayuki HanalWAT	GRANTED	Open		X

Patent information

Segments

# ORDER FORM

## VCSEL – Vertical Cavity Surface Emitting Laser

Patent Landscape Analysis – November 2018

Ref.:KM18007



### SHIP TO

Name (Mr/Ms/Dr/Pr):

Job Title:

Company:

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City:

State:

Postcode/Zip:

Country:

VAT ID Number for EU members:

Tel:

Email:

Date:

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KnowMade S.A.R.L.  
2405 route des Dolines  
06902 Valbonne Sophia Antipolis  
FRANCE

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Payee: KnowMade S.A.R.L.  
Bank: Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var, France  
IBAN: FR76 1460 7003 6360 6214 5695 139  
BIC/SWIFT: CCBPFRPPMAR

#### Paypal

In order to pay your invoice via PAYPAL, you must first register at [www.paypal.com](http://www.paypal.com). Then you can send money to the KnowMade S.A.R.L. by entering our E-mail address [contact@knowmade.fr](mailto:contact@knowmade.fr) as the recipient and entering the invoice amount.

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- €6,490 – Corporate license  
 €5,990 – Single user license\*

For price in dollars, please use the day's exchange rate. For French customer, add 20% for VAT.

All reports are delivered electronically in pdf format at payment reception.

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*I hereby accept Knowmade's Terms and Conditions of Sale*

**Signature:**

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“Products”: Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

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1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. ANY ADDITIONAL, DIFFERENT, OR CONFLICTING TERMS AND CONDITIONS IN ANY OTHER DOCUMENTS ISSUED BY THE BUYER AT ANY TIME ARE HEREBY OBJECTED TO BY THE SELLER, SHALL BE WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions “I hereby accept Knowmade’s Terms and Conditions of Sale”. This results in acceptance by the Buyer.

1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer’s address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

## 2. MAILING OF THE PRODUCTS

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or

- within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be

sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer’s risk.

## 3. PRICE, INVOICING AND PAYMENT

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to Knowmade, PayPal or by electronic transfer to the following account:

Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var, France

BIC or SWIFT code: CCBPFRPPMAR

IBAN: : FR76 1460 7003 6360 6214 5695 139

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

## 4. LIABILITIES

4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller’s website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of

saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

## 5. FORCE MAJEURE

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

## 6. PROTECTION OF THE SELLER’S IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

- Information storage and retrieval systems;

- Recordings and re-transmittals over any network (including any local area network);

- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;

- Posting any Product to any other online service (including bulletin boards or the Internet);

- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

## 7. TERMINATION

7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

## 8. MISCELLANEOUS

All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

## 9. GOVERNING LAW AND JURISDICTION

9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Grasse, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.



[www.knowmade.com](http://www.knowmade.com)

[contact@knowmade.fr](mailto:contact@knowmade.fr)

KnowMade S.A.R.L., 2405 route des Dolines, CS 10065, 06902 Sophia Antipolis, France

# WHAT WE DO

Knowmade helps customers to understand the **competitive landscape**, follow **technology trends**, and find out **opportunities** and **threats** in terms of **technology** and **patents**.

- Interpreting the **competitive landscape** and **technology developments** throughout **patents** and **scientific information**.
- Turning **patents** and **scientific information** into **business intelligence tools** that give you the capability to
  - Understand your **competitive environment**
  - Be ahead of **technology trends**
  - Identify patent & technology **opportunities**
  - Assess patent & technology **risks**
  - Define your **IP** and **R&D strategy**
  - Monetize your **technologies** and know-how
  - Defend your **business**
- Strong **technology expertise** with an in-depth **knowledge of patents**.
- Highly **specialized** analysts in the following sectors:
  - Electronics, Telecommunications and Photonics**  
Compound semiconductors, Power electronics, Batteries, Memories, RF electronics, Wireless communications, Solid-state lighting & display, Photonics, MEMS Sensors & Actuators, Semiconductor manufacturing, Packaging & Assembly.
  - Life Sciences, Healthcare and Agri-Food**  
Medical devices, Medical imaging, Microfluidics, Biotechnology, Pharmaceuticals, Food-processing

Patents  
Technologies  
Prior art  
Scientific findings  
Opportunities  
Partners  
Competitors  
Newcomers  
M&A targets



Patent landscape analysis  
Scientific review  
IP portfolio assessment  
Patent valuation  
Freedom-to-operate analysis  
Litigation & licensing support  
Patents linked to products  
Technology scouting  
Technology trends  
Competitive IP landscape  
Market trends  
Reverse engineering

Make strategic decisions  
Sustain competitive advantages  
Speed R&D and enhance innovation process  
Align R&D and IP with key business objectives  
Strengthen IP portfolio and acquire technologies  
Anticipate risks and defend core businesses  
Explore new opportunities and monetize IP



# WHAT WE PROPOSE



**Dedicated analyses**

Tailor-made analyses to meet your business needs and budgetary constraints

**Off the shelf reports and analyses**



- Patent Landscape Analysis
- Patent-to-Product Mapping
- Patent Portfolio Analysis
- Patent Watch



**Workshops and trainings**

Taylor made to respond your requests  
Direct interaction between your team and our experts at your site



# WHAT IS OUR ADDED VALUE

## Patent Search

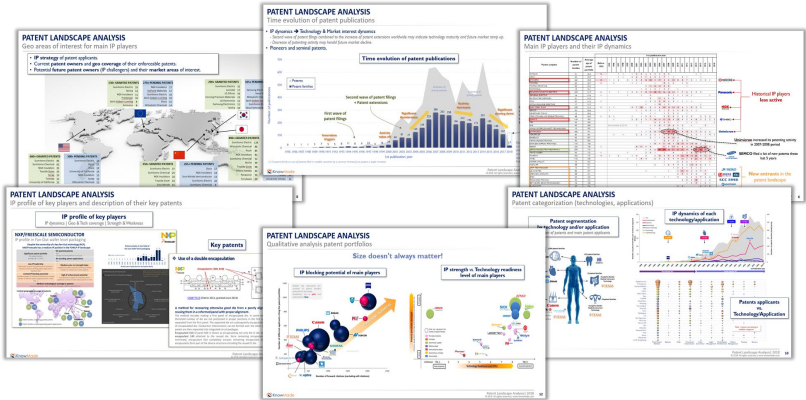
- ✓ **Strong technical expertise of our analysts with PhD degree**
  - Comprehensive search queries and keywords
  - Manual selection of relevant and related patents
  - Manual segmentation by technology & application

## Analytics

- ✓ **State of the art statistical tools**
- ✓ **Innovative methodologies to deliver relevant IP analysis**
- ✓ **Business oriented data representation and graphics**

## Results Analysis

- ✓ **Technical expertise**
  - Highly specialized analysts in your field
  - Benefit from knowledge capitalization
- ✓ **In-depth IP analysis combined with market data and reverse engineering \***
- ✓ **Customer support**



\* Our partners





# CUSTOM STUDY & CONSULTING

## Tailor-made analysis to meet your needs and budgetary constraints

### Prior art search

Evaluate the patentability of your invention in the course of a patent filing.

Invalidate competitor's patents in the course of patent litigation or in anticipation of one.

Make third-party observations concerning the patentability of competitor's inventions.

### Patent landscape analysis

Understand the competitive environment and the technology trends from a patent perspective.

Identify key players, their IP strategy and their key patents.

Know IP collaborations, licensing agreements and litigation history.

### Freedom-to-operate analysis

Assess the risks to infringe third-party patents.

Ensure that your products/processes can be safely manufactured, sold and used in specific countries without infringing patents held by others.

### Litigation and licensing support

Evidence of infringement/non-infringement for offensive/defensive support.

Defend your position in licensing negotiation or patent litigation.



### Patent assessment

Identify most valuable patents prior to patent acquisition/sales, licensing agreement, capital fundraising process, M&A or IP due diligence.

Estimate the financial value of your patent portfolio.

### IP due diligence

Assess the patent portfolio of a company and reveal the SWOT matrix prior to patent acquisition/sale, licensing agreement or M&A.

### Scientific literature analysis

Pinpoint key research findings and new emerging research fields, key laboratories and scientific experts, industrial/academic research collaborations, and identify prospective R&D partners.

### Technology scouting

Identify, qualify and get access to external innovation.

### IP & Technology watch service

Follow IP/technology trends, keep a watch on your competitors and identify new entrants, anticipate the changes, early detect business opportunities and mitigate the risks.

# OFF THE SHELF REPORTS

## « Pre-packaged » analysis

Knowmade team of experts work all year long to collect patent and scientific information, identify and analyze the trends, the challenges, the emerging technologies, the competitive environments, and turn it into results to give you a complete picture of your industry landscape.

Every year, Knowmade publishes a comprehensive collection of reports in various technology fields. These fact-based analyses can provide you with the reliable information you need to advance your business and your competitive position.

**PATENT LANDSCAPE ANALYSIS**  
Geo areas of interest for main IP players

- IP strategy of patent applicants.
- Current patent owners and geo coverage of their enforceable patents.
- Potential future patent owners (IP challengers) and their market areas of interest.

**PATENT LANDSCAPE ANALYSIS**  
Time evolution of patent publications

- IP dynamics → Technology & Market interest dynamics
- Second wave of patent filings combined to the increase of patent extensions worldwide may indicate technology maturity and future market ramp up.
- Decrease of patenting activity may herald future market decline.
- Pioneers and seminal patents.

**PATENT LANDSCAPE ANALYSIS**  
Main IP players and their IP dynamics

**PATENT LANDSCAPE ANALYSIS**  
IP profile of key players and description of their key patents

**PATENT LANDSCAPE ANALYSIS**  
Patent segmentation by technology and/or application

**PATENT LANDSCAPE ANALYSIS**  
Qualitative analysis patent portfolios

**PATENT LANDSCAPE ANALYSIS**  
Patent categorization (technologies, applications)

# STANDARD REPORTS

## 2018 reports collection

### COMPOUND SEMICONDUCTORS

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- **Status of the GaN IP** - Patent Activity 2018 + Patent Watch 2019\*
- **VCSEL** - Patent Landscape 2018
- **RF GaN** - Patent Landscape 2018\*
- **Power SiC** - Patent Landscape 2018\*
- **GaN** - Patent Watch 2018
- **Patent Trolls in the Semiconductor Market** - Litigation Risk and Potential Targets 2017
- **GaN Devices for Power Electronics** - Patent Landscape 2015
- **GaN-on-Silicon Substrate** - Patent Landscape 2014
- **GaN Substrate** - Patent Landscape 2014
- **FD-SOI** - Patent Landscape 2014

### POWER ELECTRONICS

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- **Power SiC** - Patent Landscape 2018\*
- **Wireless Power Charging** - Patent Landscape 2017
- **GaN Devices for Power Electronics** - Patent Landscape 2015

### RF DEVICES & TECHNOLOGIES

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- **RF GaN** - Patent Landscape 2018\*
- **RF Front End Module** - Patent Landscape 2018
- **RF Acoustic Wave Filters** - Patent Landscape 2017

### LED/OLED LIGHTING & DISPLAYS

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- **MicroLED Display** – Patent Landscape 2018
- **Phosphors and QDs for LED Applications** - Patent Landscape 2015
- **Nanowire LED** - Patent Landscape 2014

### MEMORY

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- **3D Non-Volatile Memories** - Patent Landscape 2018
- **Patent Trolls in the Semiconductor Market** - Litigation Risk and Potential Targets 2017
- **TSV Stacked Memories** - Patent Landscape 2016
- **ReRAM and Memristor Technologies** – Patent Landscape 2015
- **Emerging Non-Volatile Memories (eNVM)** - Patent Landscape 2014

### BATTERY AND ENERGY MANAGEMENT

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- **Solid-state Batteries** - Patent Landscape 2018\*
- **Status of the Battery IP** - Patent Activity 2017
- **Battery** - Patent Watch 2018
- **NMC Li-ion Batteries** - Patent Landscape 2017
- **Microbattery** - Patent Landscape 2016

### IMAGING

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- **VCSEL** - Patent Landscape 2018
- **iPhone X Proximity Sensor and Flood Illuminator** - Patent-to-Product Mapping 2018
- **LiDAR for Automotive** - Patent Landscape 2018
- **MicroLED Display** - Patent Landscape 2018
- **Consumer Physics SCiO Molecular Sensor** - Patent-to-Product Mapping 2017
- **Biomedical Photoacoustic Imaging** - Patent Landscape 2015
- **Honeywell Microbolometer** - Patent Portfolio Analysis 2015
- **Capsule Endoscopy** - Patent Landscape 2014

\* Coming soon

Complete list of reports on [www.knowmade.com](http://www.knowmade.com)

# STANDARD REPORTS

## 2018 reports collection

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### ADVANCED PACKAGING

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- **3D Non-Volatile Memories** - Patent Landscape 2018
- **Fan-Out Wafer Level Packaging** - Patent Landscape 2016
- **TSV Stacked Memories** - Patent Landscape 2016

### MEMS & SENSORS

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- **MEMS Microphone** - Patent Landscape 2018\*
- **LiDAR for Automotive** - Patent Landscape 2018
- **iPhone X Proximity Sensor and Flood Illuminator** - Patent-to-Product Mapping 2018
- **RF Acoustic Wave Filters** - Patent Landscape 2017
- **Pumps for Microfluidics** - Patent Landscape 2017
- **Knowles MEMS Microphones in Apple iPhone 7 Plus** - Patent-to-Product Mapping 2017
- **Microfluidic Technologies for Diagnostic Applications** - Patent Landscape 2017
- **Consumer Physics SCiO Molecular Sensor** - Patent-to-Product Mapping 2017
- **Miniaturized Gas Sensors** - Patent Landscape 2016
- **MEMS Microphone** - Patent Infringement Risk Analysis 2015
- **Capacitive Fingerprint Sensors** - Patent Landscape 2015
- **Capacitive Fingerprint Sensors** - Patent Infringement Risk Analysis 2015
- **Honeywell Microbolometer** - Patent Portfolio Analysis 2015
- **9-Axis MEMS IMU** - Patent Infringement Risk Analysis 2014
- **Emerging MEMS** - Patent Landscape 2014

### MEDTECH

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- **CTC Isolation** - Patent Landscape 2018\*
- **Nanopore Sequencing** - Patent Landscape 2018\*
- **OCT Medical Imaging** - Patent Landscape 2018
- **Fluidigm** - Patent Portfolio Analysis 2017
- **Pumps for Microfluidics** - Patent Landscape 2017
- **Microfluidic Technologies for Diagnostic Applications** - Patent Landscape 2017
- **3D Cell Culture Technologies** - Patent Landscape 2016
- **Miniaturized Gas Sensors** - Patent Landscape 2016
- **Non-Invasive Glucose Monitoring** - Patent Landscape 2015
- **Biomedical Photoacoustic Imaging** - Patent Landscape 2015
- **Capsule Endoscopy** - Patent Landscape 2014

\* *Coming soon*

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