# Annual Technical Report 2018

FY2018 OITDA

Optoelectronics Industry and Technology Development Association

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# Message from OITDA

Yasuhisa Odani
President/Vice Chairman
Optoelectronics Industry and Technology
Development Association (OITDA)

It is my pleasure to issue "Annual Technical Report 2018" which outlines the result of our surveys and R&D activities in FY2018.

According to the "Optoelectronics Industry Trends Survey" conducted annually by OITDA, the total shipments of the optoelectronics industry recorded negative growth of ▲2.93％ to reach 13.6 trillion yen in FY 2018, down from +0.8% in FY 2017. Domestic production also showed ▲4.0% decrease to finish at 7,1 trillion yen in FY 2018, better than ▲6.1% in FY 2017. Looking at the increased segment of the growth rate, laser and optical processing: +10,0%, image sensor: + 7,4%, optical sensing device: +6,0%, LED lighting equipment: +5,0%, security camera & in-vehicle camera: +3,5%, optical transmission components: +3,5%. For the segment of photovoltaic power generation, the growth rate was ▲3,9% in FY2018 which seems bottomed out, while has worsened too much in three consecutive years due to the impact of the system change and price reduction.

For the segments which are growing, those were supported by the strong demand of material processing equipment for the automobile industry and the overseas semiconductor industry. And because of the technology innovation such as AI, IoT, Big Data Processing, Self-driving /Mobility Service, it is expected to expand further the market of optical transmission components used in data centers and transmission base stations, and various sensing devices and cameras used in information system and vehicle. In addition, LED lighting equipment will continue to grow aiming 100% replacing.

Above mentioned innovative technologies are essential for achieving the "Connected Industries" advocated by the Government of Japan. The key technologies are to collect, transmit and utilize the huge amount of data efficiently. Optoelectronics technology includes many important key technologies such as sensors for data collection, high-speed and large-capacity optical communication systems for data transmission and high-speed & low-power optoelectronic integrated circuits for information processing.

OITDA has been promoting the formulation of a research and development strategy and commercialization strategy through cooperation among industry, academia and government regarding the optoelectronics technologies. At the same time, OITDA has engaged in the following priority issues: survey and research on the optoelectronics technology and industry, promotion of technology development, promotion of standardization, creation of new business, and development of human resources. In FY 2018, we directed our efforts to these issues as in previous years, and based on the results of such efforts, also conducted dissemination and education, international exchange and cooperation, and provision of information on the optoelectronics technology and industry.

You can find the details of our activities in this report. So, I would like to point out noteworthy events in FY 2018. First, we have organized the committee named "Optoelectronics Technology Roadmap Formulation Committee for Next-Generation Network for Beyond 5G". In this committee, we have speculated the suitable optoelectronics network in the B5G era, developed the roadmaps of optical access technology and optical device technology for implementing such network. We have announced the roadmap at the "Optoelectronics Technology Symposium" in February 2019. I hope this roadmap will be useful in R&D activities in industry, academia and government.

With regard to standardization, we actively carried out international standardization activities at IEC, ISO, and other forums, primarily for the standardization of in-vehicle high-speed optical Ethernet, connectors for interconnection of optical fibers, and silicon photonics interconnect and optical switches through the governmental project.

In order to support the growth of optoelectronics industry and technology, OITDA will strengthen and enhance our activities in accordance with needs, under the guidance of the Ministry of Economy, Trade and Industry and other governmental organizations and with the understanding and cooperation of our supporting members and many other people from the business world and the academic community who are our important partners. We look forward to your continued guidance, support, and cooperation.

# Optoelectronics Industry Trends

## 1. Introduction

OITDA has conducted "Survey of Trends of the Optoelectronics Industry" annually since its foundation in 1980. The accumulated survey data of more than 30 years are highly regarded as the basic source for properly recognizing the trend of optoelectronics industry.

This year, we have set seven research sub-committee under the "Optoelectronic Industry Trends Investigation Committee" and have conducted survey for getting the statistical data from FY 2017 to FY 2019, including the shipment value and domestic production value of entire optoelectronic industry.

## 2. Total Shipments and Domestic Production for the Optoelectronics Industry

### 2.1 Survey Method

1)We have sent the questionnaire for actual results for FY 2016, estimated values for FY 2017, and qualitative projections for FY 2018 concerning total shipments and domestic production to the Japanese companies which produce optoelectronics-related products (optoelectronics equipment/systems, optical components).

2)In addition to the questionnaire survey, we also referred to the data of the Japan Photovoltaic Energy Association (JPEA), Japan Lighting Manufacturers Association (JLMA), Japan Electronics and Information Technology Industries Association (JEITA), Camera & Imaging Products Association (CIPA), and Fuji Chimera Research Institute, Inc. regarding the photovoltaic energy field, solid-state lighting field, display field, and I/O field.

3)Based on the results of the questionnaire, each sub-committee examined the validity of the data and analyzed industry trends. And the validity of the data and analysis results was reconfirmed by the "Optoelectronic Industry Trend Research Committee", and the total shipments value and domestic production value of the Japanese optoelectronic industry had been summarized.

In conducting the survey, we classified optoelectronics industry into the seven fields as described below.

| | |
|---|---|
| 1. Optical Communication: | Optical transmission equipment/systems, optical fiber fusion splicer, light emitting devices, photo detectors, optical passive components, optical fiber, optical connectors, etc. |
| 2. Optical Storage: | Optical disc equipment (read-only, recordable), optical disc media, laser diodes, etc. |
| 3. Input/Output (I/O): | Optical printers, multifunction printers, digital cameras, digital video cameras, camera mobile phones, image sensors, etc. |
| 4. Display and Solid-state Lighting: | Flat-panel display devices and equipment, projectors, solid-state lighting devices and equipment, LED (for lighting and displays), etc. |
| 5. Photovoltaic Energy: | Photovoltaic power generation systems, photovoltaic cells and modules |
| 6. Laser/Optical Processing: | Laser/Optical processing equipment, Lamp/LD lithography, additive manufacturing (3D printers), laser oscillators |
| 7. Sensing and Measuring: | Optical measuring instruments, optical sensing equipment |
| 8. Others: | Hybrid optical devices, etc. |

### 2.2 Overview of Survey Results of Total Shipments

Table 1 shows the results of FY 2017 (actual), FY 2018 (estimate) and FY 2019 (projections) for total shipments. The blue shaded sections in Table 1 represent optoelectronics equipment/systems, and the yellow sections represent optical components.

**● FY 2017 (actual): 14,045 billion yen, growth rate: 0.8%**

In FY 2017, total shipments (actual) for the optoelectronics industry amounted to 14,045 billion yen (growth rate: 0.8%). This breaks down as: 9,770 billion yen for optoelectronics equipment/systems (growth rate: 2.0%, component ratio: 69.6%) and 4,275 billion yen for optical components (growth rate: −1.9%, component ratio: 30.4%).

The shipments by field were:

502 billion yen for the optical communication field (growth rate: −3.9%, component ratio: 3.6%),

846 billion yen for the optical storage field (growth rate: −4.0%, component ratio: 6.0%),

3,679 billion yen for the I/O field (growth rate: 4.9%, component ratio: 26.2%),

5,618 billion yen for the display and solid-state lighting field (growth rate: 5.9%, component ratio: 40.0%),

2,334 billion yen for the photovoltaic energy field (growth rate: −17.6%, component ratio: 16.6%),

731 billion yen for the laser/optical processing field (growth rate: 13.0%, component ratio: 5.2%), and

224 billion yen for the sensing and measuring field (growth rate: 4.7%, component ratio: 1.6%).

**● FY 2018 (estimate): 13,635 billion yen, growth rate: −2.9%**

Total shipments for the optoelectronics industry in FY 2018 are estimated to remain roughly flat at 13,635 billion yen (growth rate: −2.9%). This breaks down as: 9,470 billion yen for optoelectronics equipment/systems (growth rate: −3.1%, component ratio: 69.5%) and 4,164 billion yen for optical components (growth rate: −2.6%, component ratio: 30.5%).

The shipments by field are estimated to be:

513 billion yen for the optical communication field (growth rate: 2.2%, component ratio: 3.8%),

781 billion yen for the optical storage field (growth rate: −7.6%, component ratio: 5.7%),

3,482 billion yen for the I/O field (growth rate: −5.4%, component ratio: 25.5%),

5,460 billion yen for the display and solid-state lighting field (growth rate: −2.8%, component ratio: 40.2%),

2,243 billion yen for the photovoltaic energy field (growth rate: −3.9%, component ratio: 16.4%),

804 billion yen for the laser/optical processing field (growth rate: 10.0%, component ratio: 5.9%), and

236 billion yen for the sensing and measuring field (growth rate: 5.4%, component ratio: 1.7%).

**● FY 2019 (projections): flat**

Total shipments are projected to be flat for the optoelectronics industry overall, as well as for optoelectronics equipment/systems and optical components in FY 2019.

By field, the optical communication field, the optical storage field, the I/O field and the photovoltaic energy field will remain steady, the display and solid-state lighting field, the laser/optical processing field and the sensing and measuring field will increase slightly.

### 2.3 Overview of Survey Results of Domestic Production

Table 2 shows the results of FY 2017 (actual), FY 2018 (estimate) and FY 2019 (projections) of domestic production.

The blue shaded sections in Table 2 represent optoelectronics equipment/systems, and the yellow sections represent optical components.

**● FY 2017 (actual): 7,389 billion yen, growth rate: −6.1%**

In FY 2017, the domestic production of the optoelectronics industry (actual) decreased slightly to 7,389 billion yen (growth rate: −6.1%). This breaks down as: 4,153 billion yen for optoelectronics equipment/

systems (growth rate: −7.8%, component ratio: 56.2%) and 3,236 billion yen for optical components (growth rate: −3.8%, component ratio: 43.8%).

The domestic production by field was:

403 billion yen for the optical communication field (growth rate: −8.5%, component ratio: 5.5%),

132 billion yen for the optical storage field (growth rate: −39.5%, component ratio: 1.8%),

1,074 billion yen for the I/O field (growth rate: −5.3%, component ratio: 14.5%),

2,986 billion yen for the display and solid-state lighting field (growth rate: −1.1%, component ratio: 40.3%),

1,823 billion yen for the photovoltaic energy field (growth rate: −17.1%, component ratio: 24.7%),

716 billion yen for the laser/optical processing field (growth rate: 13.9%, component ratio: 9.7%), and

177 billion yen for the sensing and measuring field (growth rate: 6.1%, component ratio: 2.4%).

● **FY 2018 (estimate): 7,097 billion yen, growth rate: −4.0%**

The domestic production of the optoelectronics industry in FY 2018 is estimated to be 7,097 billion yen (growth rate: −4.0%).

This breaks down as: 4,180 billion yen for optoelectronics equipment/systems (growth rate: 0.7%, component ratio: 58.9%) and 2,917 billion yen for optical components (growth rate: −9.9%, component ratio: 41.1%).

The domestic production by field was:

415 billion yen for the optical communication field (growth rate: 2.8%, component ratio: 5.8%),

133 billion yen for the optical storage field (growth rate: 0.4%, component ratio: 1.9%),

964 billion yen for the I/O field (growth rate: −10.3%, component ratio: 13.6%),

2,802 billion yen for the display and solid-state lighting field (growth rate: −6.2%, component ratio: 39.6%),

1,732 billion yen for the photovoltaic energy field (growth rate: −5.0%, component ratio: 24.4%),

783 billion yen for the laser/optical processing field (growth rate: 9.4%, component ratio: 11.0%), and

188 billion yen for the sensing and measuring field (growth rate: 6.1%, component ratio: 2.6%).

● **FY 2019 (projections): flat**

The domestic production of the optoelectronics industry in FY 2019 is projected to be flat. Both optoelectronics equipment/systems and optical components will be flat.

By field, the laser/optical processing field and the sensing and measuring field will increase slightly, while the optical storage field and the I/O field will decrease slightly. The optical communication field, the display and solid-state lighting field and the photovoltaic energy field will remain steady.

### 2.4 Trend in Optoelectronics Industry

Fig.1 and Fig.2 show changes in the total shipment value of the optoelectronics industry and trends in each field. Fig.3 and Fig.4 show changes in the domestic production value of the optoelectronics industry and changes by field. Fig.1 and Fig.3 show nominal GDP and electronic industry production in order to compare changes in the scale of the optoelectronics industry with those of the Japanese economy and other industries.

The optoelectronics industry in Japan had continued to grow for more than 20 years since 1980, which we had begun to conduct survey, even though there was a temporary decline due to the collapse of the IT bubble. The situation continued to be harsh since financial crisis in 2008 and Great East Japan Earthquake in 2011. After that, in terms of total shipments, growth rate turned to be positive due to the rapid growth of the photovoltaic energy field, but after the peak in FY 2014, this field began to decline significantly, and the optoelectronics industry as a whole decreased for two consecutive years in FY 2015 and FY 2016. In particular, the decrease in the display and solid-state lighting field and I/O field were huge in FY 2016, and both total shipments and domestic production decreased by more than 10%.

However, the results of the survey in FY 2018 has shown that the optoelectronics industry is estimated to be almost flat for three years from FY 2017 to FY 2019, which were signs of stop decreasing. But looking at each field, the laser/optical processing field and the sensing and measuring field continue to grow. The photovoltaic energy field, which has continued to decline significantly due to the impact of price declines, is finally showing signs of recovery. Below is a summary of the survey and analysis results of the latest survey.

**(1) FY 2017 (actual)**

Due to the solid investment primally in the semiconductor and automotive industry, total shipments and domestic production had increased in the laser/optical processing field and the sensing and measuring field.

In the display and solid-state lighting field, 4K TVs and LED lighting fixtures were firm, namely total shipments increased slightly and domestic production was almost flat.

In the I/O field, image sensors increased. I/O equipments, which decreased significantly in the previous year, recovered as a whole and total shipment increased slightly. But smartphone, printer and multifunction printer decreased drastically. As a result, total shipments decreased slightly.

On the other hand, in the optical communication field, optical transmission components for trunk/metro line and subscriber line declined. Parts such as light emitting device and photo detector, which were performing well until now, declined due to inventory adjustments. As a result, both total shipments and domestic production declined slightly.

In the optical storage field, total shipments decreased slightly due to continuous price and demand declines, and domestic production declined significantly due to the overseas transfer.

In the photovoltaic energy field, total shipments declined due to the decline in demand and lower prices.

In the optoelectronics industry as a whole, the total shipments was 14,045 billion yen (growth rate: 0.8%), and domestic production was 7,389 billion yen (−6.1%).

**(2) FY 2018 (estimate)**

Due to the solid investment primally in the semiconductor and automotive industry, total shipments and domestic production are estimated to increase steadily in the laser/optical processing field and the sensing and measuring field.

In the optical communications field, optical transmission components for trunk/metro line and subscriber line are estimated to increase due to domestic capital investments for communications, and a positive increase in total shipments and domestic production due to growing demand for overseas optical fibers and related components.

In the optical storage field, sales of optical discs for business use are estimated to increase, on the other hand, read-only devices continued to decline, as a result, total shipments will decrease and domestic production will be flat.

In the I/O field, total shipments and domestic production are expected to decrease slightly due to a decrease in demand for consumer devices such as smartphones and digital cameras.

In the display and solid-state lighting field, LED lighting fixtures are growing steadily and those of display equipment are flat, but display

## Table 1　Shipment of Optoelectronics Industry (Summary)

| | Product Items | FY 2016 Shipment Actual (in million yen) | | Growth Rate(%) | FY 2017 Shipment Estimate (in million yen) | | Growth Rate(%) | FY 2018 Shipment Estimate (in million yen) | | Growth Rate(%) | FY 2019 Shipment Projection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Optical Communications Field | 522,727 | | ▲ 0.4 | | 502,348 | ▲ 3.9 | | 513,378 | 2.2 | flat |
| Optical Equipment | Optical Transmission Equipment | 144,701 | | ▲ 15.7 | 134,030 | | ▲ 7.4 | 131,155 | | ▲ 2.1 | flat |
| | Truck Line and Metro Line | | 71,450 | ▲ 23.9 | | 54,204 | ▲ 24.1 | | 60,868 | 12.3 | flat |
| | Subscriber Line | | 38,621 | ▲ 11.1 | | 40,527 | 4.9 | | 34,538 | ▲ 14.8 | flat |
| | Router and Switch | | 27,335 | 8.3 | | 32,572 | 19.2 | | 28,395 | ▲ 12.8 | slight increase |
| | Optical Fiber Amplifier | | 7,295 | ▲ 19.7 | | 6,727 | ▲ 7.8 | | 7,354 | 9.3 | increase |
| Optical Component | Optical Transmission Components | 356,772 | | 8.2 | 346,897 | | ▲ 2.8 | 359,182 | | 3.5 | flat |
| | Optical Transmission Link | | 76,919 | ▲ 1.2 | | 80,563 | 4.7 | | 67,129 | ▲ 16.7 | flat |
| | Light Emitting Device | | 66,658 | 20.3 | | 54,995 | ▲ 17.5 | | 58,085 | 5.6 | slight increase |
| | Photo Detectors | | 25,328 | 48.3 | | 18,204 | ▲ 28.1 | | 19,697 | 8.2 | slight increase |
| | Optical Passive Component | | 26,237 | ▲ 2.3 | | 24,269 | ▲ 7.5 | | 24,022 | ▲ 1.0 | flat |
| | Optical Circuit Component | | 28,749 | 49.7 | | 29,670 | 3.2 | | 35,147 | 18.5 | slight increase |
| | Optical Fiber | | 98,002 | ▲ 1.6 | | 98,098 | 0.1 | | 110,110 | 12.2 | flat |
| | Optical Connector | | 23,227 | 0.0 | | 27,075 | 16.6 | | 30,917 | 14.2 | flat |
| | Others (Semiconductor Amplifying Device, etc.) | | 11,652 | 11.2 | | 14,023 | 20.3 | | 14,075 | 0.4 | flat |
| | Optical Fiber Fusion Splicer | 21,254 | | ▲ 9.1 | 21,421 | | 0.8 | 23,041 | | 7.6 | slight increase |
| | Optical Storage Field | 880,757 | | ▲ 6.7 | 845,832 | | ▲ 4.0 | 781,290 | | ▲ 7.6 | flat |
| Optical Equipment | Optical Disk | 862,777 | | ▲ 6.8 | 828,554 | | ▲ 4.0 | 765,024 | | ▲ 7.7 | flat |
| | Equipment | | 775,724 | ▲ 7.1 | | 732,914 | ▲ 5.5 | | 677,849 | ▲ 7.5 | flat |
| | Read-only (CD, DVD, BD) | | 512,050 | ▲ 6.3 | | 498,386 | ▲ 2.7 | | 442,165 | ▲ 11.3 | flat |
| | Recordable | | 263,674 | ▲ 8.5 | | 234,528 | ▲ 11.1 | | 235,684 | 0.5 | flat |
| | Media | | 36,395 | ▲ 0.3 | | 47,778 | 31.3 | | 42,909 | ▲ 10.2 | slight decrease |
| | Others (Optical Head, etc.) | | 50,658 | ▲ 7.1 | | 47,862 | ▲ 5.5 | | 44,266 | ▲ 7.5 | slight decrease |
| | Laser Diode | | 17,980 | ▲ 0.9 | | 17,278 | ▲ 3.9 | | 16,266 | ▲ 5.9 | slight decrease |
| | Input/Output Field | 3,385,544 | | ▲ 16.6 | 3,679,198 | | 4.9* | 3,481,656 | | ▲ 5.4 | flat |
| Optical Equipment | Optical I/O Equipment | 2,706,794 | | ▲ 22.3 | 2,844,913 | | 0.3* | 2,585,448 | | ▲ 9.1 | flat |
| | Optical Printer・Multifunction Printer | | 720,809 | ▲ 6.3 | | 720,661 | 0.0 | | 693,770 | ▲ 3.7 | flat |
| | Imaging equipment | | 914,593 | ▲ 16.3 | | 1,072,988 | - | | 993,808 | ▲ 7.4 | flat |
| | Digital Camera, Digital Video Camera | | 914,593 | ▲ 16.3 | | 943,896 | 3.2 | | 860,236 | ▲ 8.9 | slight decrease |
| | Security camera, Car-mounted camera * | | - | - | | 129,092 | - | | 133,572 | 3.5 | slight increase |
| | Camera Mobile Phone | | 977,123 | ▲ 35.2 | | 968,956 | ▲ 0.8 | | 825,702 | ▲ 14.8 | flat |
| | Others (Barcode Reader, Image Scanner, etc.) | | 94,269 | ▲ 16.5 | | 82,308 | ▲ 12.7 | | 72,168 | ▲ 12.3 | decrease |
| | Image Sensor | 678,750 | | 17.6 | 834,285 | | 22.9 | 896,208 | | 7.4 | slight increase |
| | Display and Solid-state Lighting Field | 5,303,298 | | ▲ 17.2 | 5,618,363 | | 5.9 | 5,460,469 | | ▲ 2.8 | slight increase |
| Optical Equipment | Display Equipment | 2,350,655 | | ▲ 22.9 | 2,703,493 | | 15.0 | 2,683,883 | | ▲ 0.7 | slight increase |
| | Flat Panel Display | | 2,064,792 | ▲ 24.2 | | 2,392,381 | 15.9 | | 2,379,422 | ▲ 0.5 | slight increase |
| | Projector | | 249,341 | ▲ 11.0 | | 274,123 | 9.9 | | 265,402 | ▲ 3.2 | flat |
| | Others (Large-scale LED Display, OELD TV, etc.) | | 36,522 | ▲ 3.9 | | 36,989 | 1.3 | | 39,059 | 5.6 | slight increase |
| | Display Device | 1,912,719 | | ▲ 18.9 | 1,870,349 | | ▲ 2.2 | 1,702,100 | | ▲ 9.0 | slight decrease |
| | Solid-state Lighting | 672,607 | | 5.8 | 693,618 | | 3.1 | 716,301 | | 3.3 | slight increase |
| | LED Device | | 598,063 | 8.0 | | 628,578 | 5.1 | | 660,141 | 5.0 | slight increase |
| | LED Lamp | | 74,544 | ▲ 9.0 | | 65,040 | ▲ 12.7 | | 56,160 | ▲ 13.7 | slight decrease |
| | LED | 367,317 | | 2.7 | | 350,903 | ▲ 4.5 | | 358,185 | 2.1 | flat |
| | Photovoltaic Energy Field | 2,831,220 | | ▲ 24.2 | 2,333,842 | | ▲ 17.6 | 2,242,594 | | ▲ 3.9 | flat |
| | Photovoltaic Power System | | 1,983,736 | ▲ 26.3 | | 1,660,001 | ▲ 16.3 | | 1,598,068 | ▲ 3.7 | flat |
| | Photovoltaic Cell/Module | | 847,484 | ▲ 18.6 | | 673,841 | ▲ 20.5 | | 644,526 | ▲ 4.4 | flat |
| | Laser/Optical Processing Field | 646,853 | | 16.0 | 731,093 | | 13.0 | 804,354 | | 10.0 | slight increase |
| Optical Equipment | Laser and Optical Processing Equipment | 579,372 | | 19.7 | | 659,432 | 13.8 | | 731,180 | 10.9 | slight increase |
| | $CO_2$ Laser | | 50,957 | ▲ 20.9 | | 54,338 | 6.6 | | 47,814 | ▲ 12.0 | slight decrease |
| | Solid State Laser | | 40,209 | 8.7 | | 44,095 | 9.7 | | 47,693 | 8.2 | flat |
| | Fiber Laser | | 57,082 | 37.0 | | 63,031 | 10.4 | | 75,355 | 19.6 | slight increase |
| | Semiconductor Laser Direct Processing Equipment | | 3,145 | 26.5 | | 3,536 | 12.4 | | 4,236 | 19.8 | increase |
| | Excimer Laser | | 151,136 | 21.8 | | 140,711 | ▲ 6.9 | | 169,737 | 20.6 | flat |
| | Lamp/LD Exposure Machine | | 274,573 | 30.0 | | 350,630 | 27.7 | | 383,589 | 9.4 | flat |
| | Additive Manufacturing (3D Printer) | | 2,270 | ▲ 26.7 | | 3,091 | 36.2 | | 2,756 | ▲ 10.8 | increase |
| | Oscillator | 67,481 | | ▲ 8.2 | | 71,661 | 6.2 | | 73,174 | 2.1 | flat |
| | Optical Sensing and Measurement Field | 257,895 | | 2.5 | 224,187 | | 4.7* | 236,381 | | 5.4 | slight increase |
| | Optical Measuring Instrument | | 12,705 | 3.4 | | 12,331 | ▲ 2.9 | | 11,735 | ▲ 4.8 | flat |
| | Optical Sensing Equipment | | 245,190 | 2.5 | | 211,856 | 5.3* | | 224,646 | 6.0 | slight increase |
| | Others Field | | 110,831 | 10.7 | | 110,253 | ▲ 0.5 | | 114,646 | 4.0 | flat |

| Product Items | FY 2016 Shipment Actual (in million yen) | Growth Rate(%) | FY 2017 Shipment Estimate (in million yen) | Growth Rate(%) | FY 2018 Shipment Estimate (in million yen) | Growth Rate(%) | FY 2019 Shipment Projection |
|---|---|---|---|---|---|---|---|
| Sub Total for Optoelectronics Equipment | 9,579,791 | ▲ 18.2 | 9,769,649 | 2.0 | 9,470,481 | ▲ 3.1 | flat |
| Sub Total for Optoelectronics Components | 4,359,334 | ▲ 10.5 | 4,275,467 | ▲ 1.9 | 4,164,287 | ▲ 2.6 | flat |
| Total for Optoelectronics Products | 13,939,125 | ▲ 15.9 | 14,045,116 | 0.8 | 13,634,768 | ▲ 2.9 | flat |

## Table 2 Domestic Production of Optoelectronics Industry (Summary)

| | Product Items | FY 2016 Shipment Actual (in million yen) | | Growth Rate(%) | FY 2017 Shipment Actual (in million yen) | | Growth Rate(%) | FY 2018 Shipment Estimate (in million yen) | | Growth Rate(%) | FY 2019 Shipment Projection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Optical Communications Field | 440,950 | | ▲ 1.1 | 403,380 | | ▲ 8.5 | 414,550 | | 2.8 | flat |
| Optical Equipment | Optical Transmission Equipment | 132,538 | | ▲ 16.8 | 124,187 | | ▲ 6.3 | 123,480 | | ▲ 0.6 | flat |
| | Truck Line and Metro Line | | 70,727 | ▲ 23.4 | | 53,599 | ▲ 24.2 | | 60,183 | 12.3 | flat |
| | Subscriber Line | | 37,300 | ▲ 10.8 | | 46,114 | 23.6 | | 40,201 | ▲ 12.8 | flat |
| | Router and Switch | | 18,451 | 3.8 | | 19,146 | 3.8 | | 17,208 | ▲ 10.1 | slight increase |
| | Optical Fiber Amplifier | | 6,060 | ▲ 17.0 | | 5,328 | ▲ 12.1 | | 5,888 | 10.5 | increase |
| Optical Component | Optical Transmission Components | 287,158 | | 9.0 | 257,772 | | ▲ 10.2 | 268,029 | | 4.0 | flat |
| | Optical Transmission Link | | 50,406 | 3.1 | | 38,338 | ▲ 23.9 | | 32,546 | ▲ 15.1 | flat |
| | Light Emitting Device | | 43,482 | 17.9 | | 31,869 | ▲ 26.7 | | 30,676 | ▲ 3.7 | slight increase |
| | Photo Detectors | | 18,230 | 65.1 | | 11,761 | ▲ 35.5 | | 12,098 | 2.9 | slight increase |
| | Optical Passive Component | | 23,712 | ▲ 6.1 | | 22,777 | ▲ 3.9 | | 22,489 | ▲ 1.3 | flat |
| | Optical Circuit Component | | 26,435 | 48.5 | | 23,815 | ▲ 9.9 | | 28,090 | 18.0 | increase |
| | Optical Fiber | | 94,382 | 0.5 | | 92,713 | ▲ 1.8 | | 100,460 | 8.4 | flat |
| | Optical Connector | | 19,005 | ▲ 1.0 | | 22,528 | 18.5 | | 26,638 | 18.2 | flat |
| | Others (Semiconductor Amplifying Device, etc.) | | 11,506 | 11.2 | | 13,971 | 21.4 | | 15,032 | 7.6 | flat |
| | Optical Fiber Fusion Splicer | 21,254 | | ▲ 9.1 | 21,421 | | 0.8 | 23,041 | | 7.6 | flat |
| | Optical Storage Field | 218,837 | | ▲ 7.1 | 132,320 | | ▲ 39.5 | 132,881 | | 0.4 | slight decrease |
| Optical Equipment | Optical Disk | 214,714 | | ▲ 7.7 | 128,385 | | ▲ 40.2 | 128,291 | | ▲ 0.1 | slight decrease |
| | Equipment | | 203,408 | ▲ 5.4 | | 116,936 | ▲ 42.5 | | 117,009 | 0.1 | slight decrease |
| | Media | | 11,306 | ▲ 36.1 | | 11,449 | 1.3 | | 11,282 | ▲ 1.5 | flat |
| | Laser Diode | | 4,123 | 47.3 | | 3,935 | ▲ 4.6 | | 4,590 | 16.6 | slight decrease |
| | Input/Output Field | 1,121,434 | | 0.9 | 1,074,423 | | ▲ 5.3* | 963,820 | | ▲ 10.3 | slight decrease |
| Optical Equipment | Optical I/O Equipment | 534,613 | | ▲ 15.6 | 466,204 | | ▲ 15.0* | 436,184 | | ▲ 6.4 | slight decrease |
| | Optical Printer・Multifunction Printer | | 87,993 | ▲ 24.4 | | 58,469 | ▲ 33.6 | | 61,531 | 5.2 | flat |
| | Imaging equipment | | 264,133 | ▲ 6.7 | | 273,771 | - | | 268,119 | ▲ 2.1 | flat |
| | Digital Camera, Digital Video Camera | | 264,133 | ▲ 6.7 | | 261,893 | ▲ 0.8 | | 254,707 | ▲ 2.7 | slight decrease |
| | Security camera, Car-mounted camera * | | - | - | | 11,878 | - | | 13,412 | 12.9 | slight increase |
| | Camera Mobile Phone | | 144,448 | ▲ 24.1 | | 109,521 | ▲ 24.2 | | 85,800 | ▲ 21.7 | slight decrease |
| | Others (Barcode Reader, Image Scanner, etc.) | | 38,039 | ▲ 13.8 | | 24,443 | ▲ 35.7 | | 20,734 | ▲ 15.2 | decrease |
| | Image Sensor | 586,821 | | 22.7 | 608,219 | | 3.6 | 527,636 | | ▲ 13.2 | slight increase |
| | Display and Solid-state Lighting Field | 3,017,867 | | ▲ 9.9 | 2,985,841 | | ▲ 1.1 | 2,801,579 | | ▲ 6.2 | flat |
| Optical Equipment | Display Equipment | 534,901 | | ▲ 1.5 | 524,902 | | ▲ 1.9 | 516,758 | | ▲ 1.6 | flat |
| | Flat Panel Display | | 476,660 | ▲ 1.1 | | 465,702 | ▲ 2.3 | | 454,977 | ▲ 2.3 | flat |
| | Projector | | 21,719 | ▲ 7.4 | | 22,211 | 2.3 | | 22,722 | 2.3 | flat |
| | Others (Large-scale LED Display, OELD TV, etc.) | | 36,522 | ▲ 3.9 | | 36,989 | 1.3 | | 39,059 | 5.6 | slight increase |
| | Display Device | 1,705,267 | | ▲ 18.1 | 1,655,049 | | ▲ 2.9 | 1,435,562 | | ▲ 13.3 | slight decrease |
| | Solid-state Lighting | 429,556 | | 7.9 | 458,781 | | 6.8 | 478,642 | | 4.3 | slight increase |
| | LED Device | | 418,647 | 8.0 | | 446,846 | 6.7 | | 469,284 | 5.0 | slight increase |
| | LED Lamp | | 10,909 | 5.3 | | 11,935 | 9.4 | | 9,358 | ▲ 21.6 | slight decrease |
| | LED | 348,143 | | 6.3 | | 347,109 | ▲ 0.3 | | 370,617 | 6.8 | flat |
| | Photovoltaic Energy Field | 2,198,132 | | ▲ 26.9 | 1,822,669 | | ▲ 17.1 | 1,732,217 | | ▲ 5.0 | flat |
| | Photovoltaic Power System | | 1,907,821 | ▲ 26.6 | | 1,607,320 | ▲ 15.8 | | 1,574,970 | ▲ 2.0 | flat |
| | Photovoltaic Cell/Module | | 290,311 | ▲ 28.9 | | 215,349 | ▲ 25.8 | | 157,247 | ▲ 27.0 | flat |
| | Laser/Optical Processing Field | 628,398 | | 15.5 | 715,841 | | 13.9 | 783,036 | | 9.4 | slight increase |
| Optical Equipment | Laser and Optical Processing Equipment | 562,440 | | 19.3 | | 644,913 | 14.7 | | 711,165 | 10.3 | slight increase |
| | $CO_2$ Laser | | 47,125 | ▲ 24.8 | | 52,682 | 11.8 | | 46,971 | ▲ 10.8 | slight decrease |
| | Solid State Laser | | 34,298 | 4.5 | | 38,695 | 12.8 | | 42,303 | 9.3 | flat |
| | Fiber Laser | | 52,824 | 36.0 | | 55,679 | 5.4 | | 62,128 | 11.6 | slight increase |
| | Semiconductor Laser Direct Processing Equipment | | 3,519 | 59.0 | | 3,449 | ▲ 2.0 | | 3,681 | 6.7 | increase |
| | Excimer Laser | | 147,831 | 22.4 | | 140,687 | ▲ 4.8 | | 169,737 | 20.6 | flat |
| | Lamp/LD Exposure Machine | | 274,573 | 30.0 | | 350,630 | 27.7 | | 383,589 | 9.4 | flat |
| | Additive Manufacturing (3D Printer) | | 2,270 | ▲ 26.7 | | 3,091 | 36.2 | | 2,756 | ▲ 10.8 | increase |
| | Oscillator | 65,958 | | ▲ 9.0 | | 70,928 | 7.5 | | 71,871 | 1.3 | flat |
| | Optical Sensing and Measurement Field | 165,725 | | 2.4 | 177,049 | | 6.1* | 187,857 | | 6.1 | slight increase |
| | Optical Measuring Instrument | | 11,186 | 9.2 | | 10,932 | ▲ 2.3 | | 10,599 | ▲ 3.0 | flat |
| | Optical Sensing Equipment | | 154,539 | 2.0 | | 166,117 | 6.8* | | 177,258 | 6.7 | slight increase |
| | Others Field | | 76,432 | ▲ 1.0 | | 77,933 | 2.0 | | 81,046 | 4.0 | flat |

| Product Items | FY 2016 Shipment Actual (in million yen) | Growth Rate(%) | FY 2017 Shipment Actual (in million yen) | Growth Rate(%) | FY 2018 Shipment Estimate (in million yen) | Growth Rate(%) | FY 2019 Shipment Projection |
|---|---|---|---|---|---|---|---|
| Sub Total for Optoelectronics Equipment | 4,503,562 | ▲ 13.8 | 4,153,162 | ▲ 7.8 | 4,180,388 | 0.7 | flat |
| Sub Total for Optoelectronics Components | 3,364,213 | ▲ 9.5 | 3,236,294 | ▲ 3.8 | 2,916,598 | ▲ 9.9 | flat |
| Total for Optoelectronics Products | 7,867,775 | ▲ 11.9 | 7,389,456 | ▲ 6.1 | 7,096,986 | ▲ 4.0 | flat |

*Security camera and car-mounted camera were moved from the sensing and measurement field to the I/O field. Growth rate of each field was calculated excluding security camera and car-mounted camera.

device are decreasing due to competition with overseas manufacturers, and total shipments and domestic production are estimated to decrease slightly.

In the photovoltaic energy field, although the impact of continuous price declines, the significant downward trend accompanying the change in the FIT system has finally been put to a halt, and total shipments and domestic production are estimated to decrease slightly.

In the optoelectronics industry as a whole, the total shipments (13,635 billion yen, growth rate: −2.9%) and domestic production (7,097 billion yen, growth rate: −4.0%) are expected to decrease slightly.

**(3) FY 2019 (projections)**

In the laser/optical processing field and the sensing and measuring field, where industrial applications such as fiber laser processing machines and FA image sensing equipment are forecasted to be robust both for total shipments and domestic production.

In the display and solid-state lighting fields, 4K TV and OLED TV will increase due to the progress of new 4K/8K satellite and Tokyo Olympics. Total shipments will increase slightly and domestic production will be flat.

In the optical communications field, optical components will increase due to overseas demand for optical fiber, but trunk and subscriber optical transmission equipment will remain flat, and the total shipments and domestic production will remain flat.

In the photovoltaic energy field, although demand will increase, total shipments and domestic production will remain flat due to price declines.

In the I/O field, due to lack of favorable factors, the total shipments will be flat and domestic production will continue decreasing slightly.

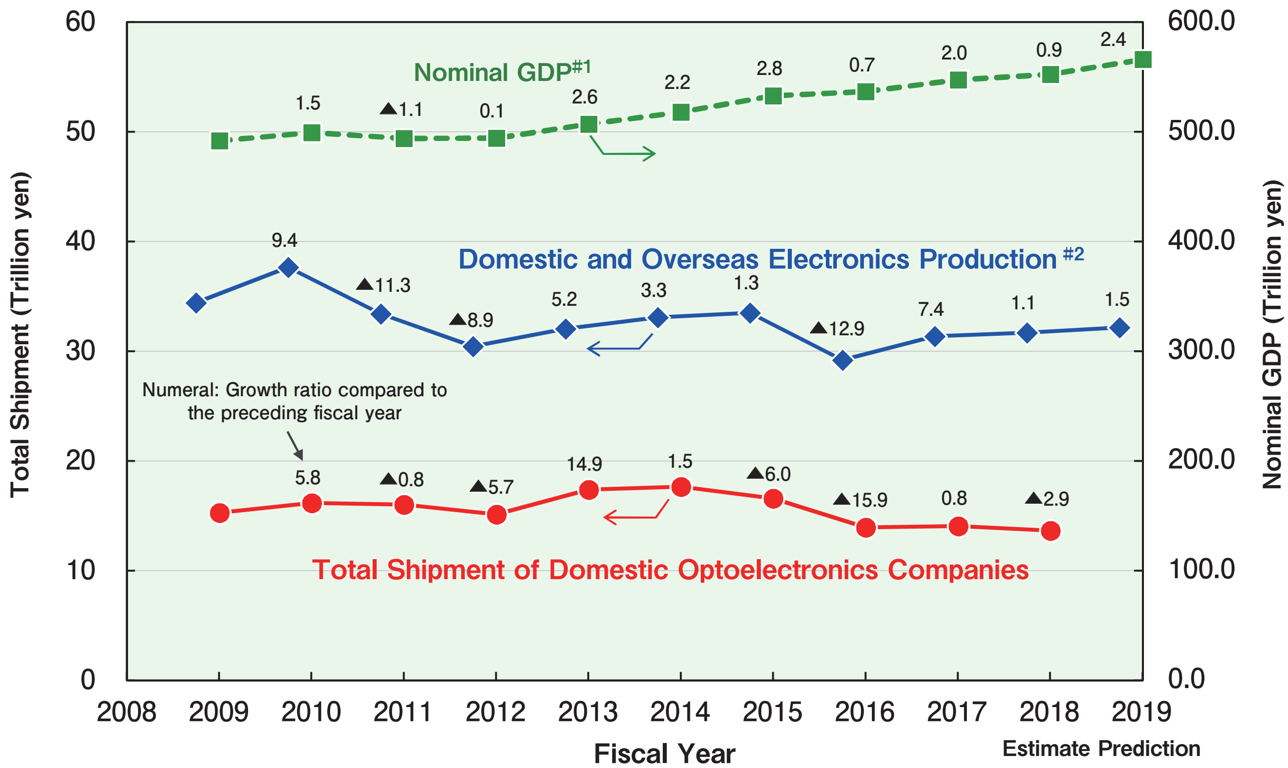
In the optical storage field, there will be certain demand for commercial use and 4K video, the total shipments will be flat, and domestic production will decrease slightly.

In the entire optoelectronics industry, total shipments and domestic production will be flat.

## 3. International Optoelectronics Association

OITDA was established in 1980 with the aim of promoting the optoelectronics industry for the first time in the world. In the 1990s, similar organizations had been established around the world. In July 1996, OITDA had organized the world conference on optoelectronics industry in collaboration with OIDA (US), PIDA (Taiwan) and SOA (Scotland), which had been established already at that time, in accordance with the international exhibition "interOpto" organized by OITDA. After that, it was decided to be held yearly and named it the IOA (International Optoelectronics Association). There are 9 organizations participating. Fig.5 shows the names and locations of the member organizations.

The optoelectronics industry in the world, as a whole, showed a tendency to be almost stable. Under such circumstances, M & A are also on the rise, seeking the next move. In addition, in order to create innovations, light-related projects have been proposed in each country and region, and the efforts to the government have been strengthened.




#1 Cabinet Office: National Accounts for 2017/Fiscal 2019 Economic Outlook (Jan. 28, 2019 [Cabinet Decision] )

#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2018

Fig.1 Total Optoelectronics Shipment, Nominal GDP, and Domestic & Overseas Electronics Production

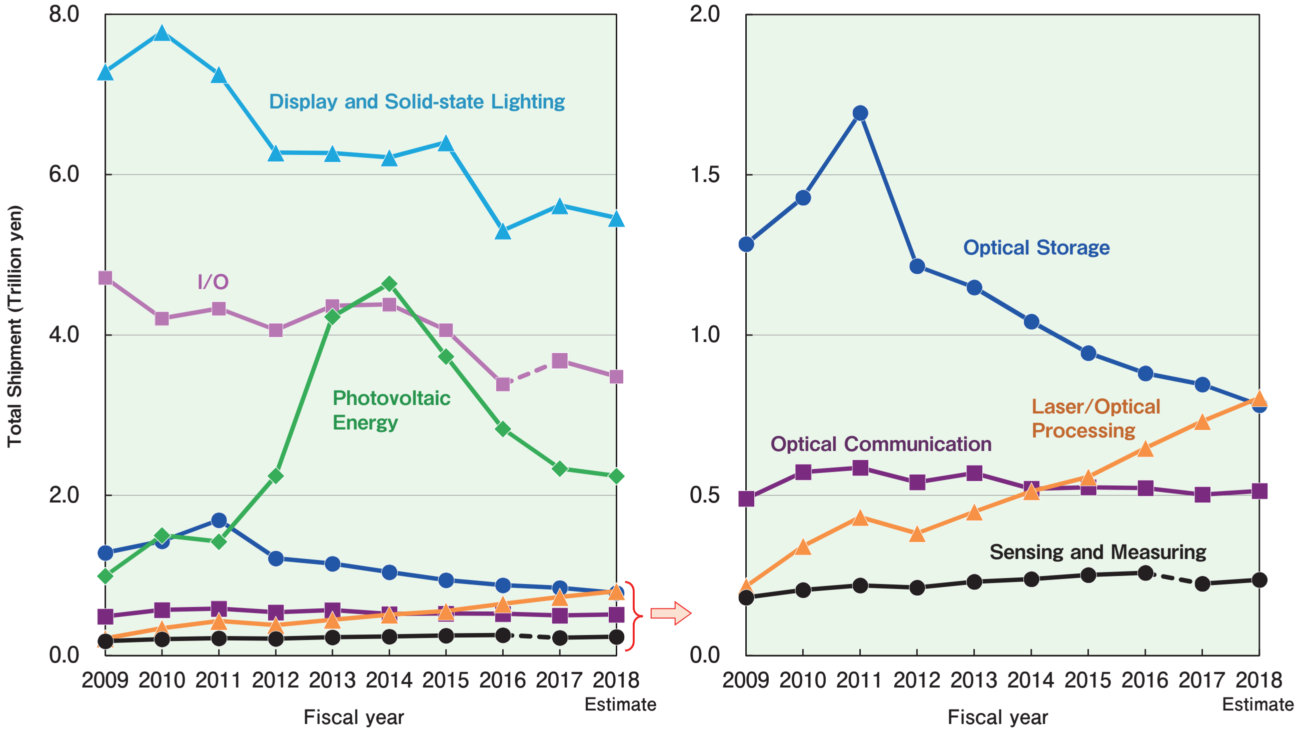
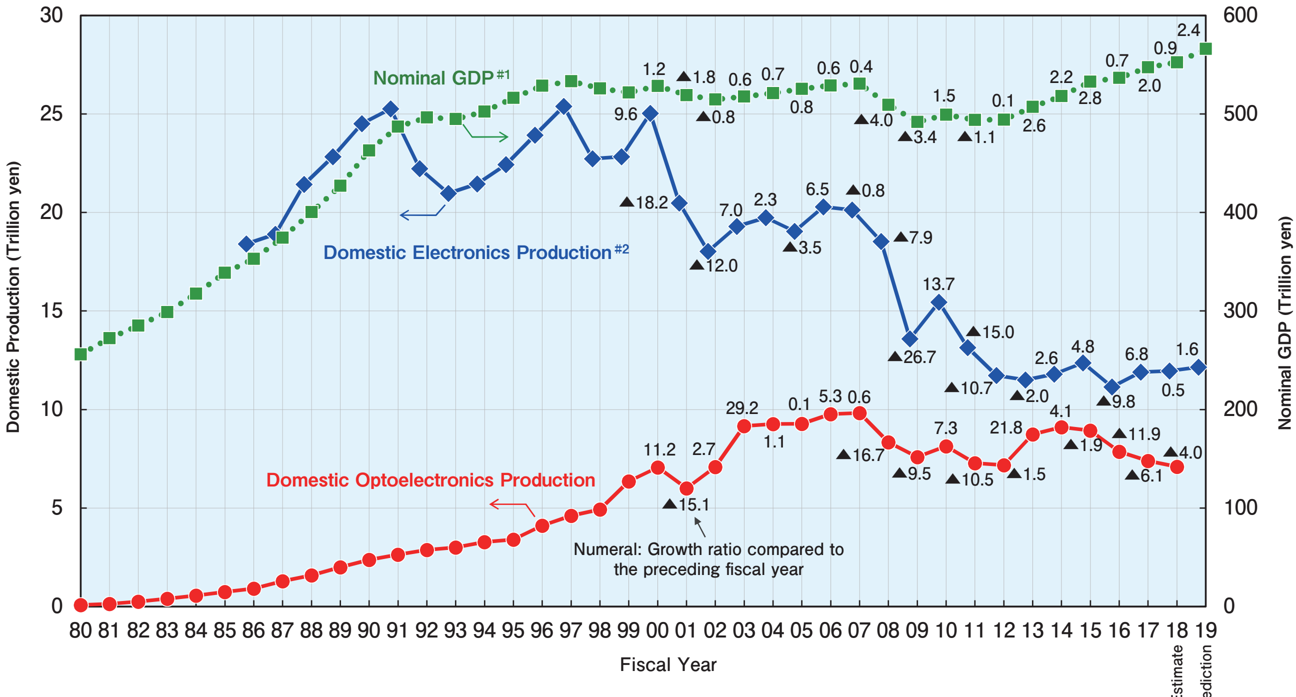



Fig.2 Shipment by Product Field




#1 Cabinet Office: National Accounts for 2017/Fiscal 2019 Economic Outlook (Jan. 28, 2019 [Cabinet Decision] )
#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2018

Fig.3 Domestic Optoelectronics Production, Nominal GDP, and Domestic Electronics Production

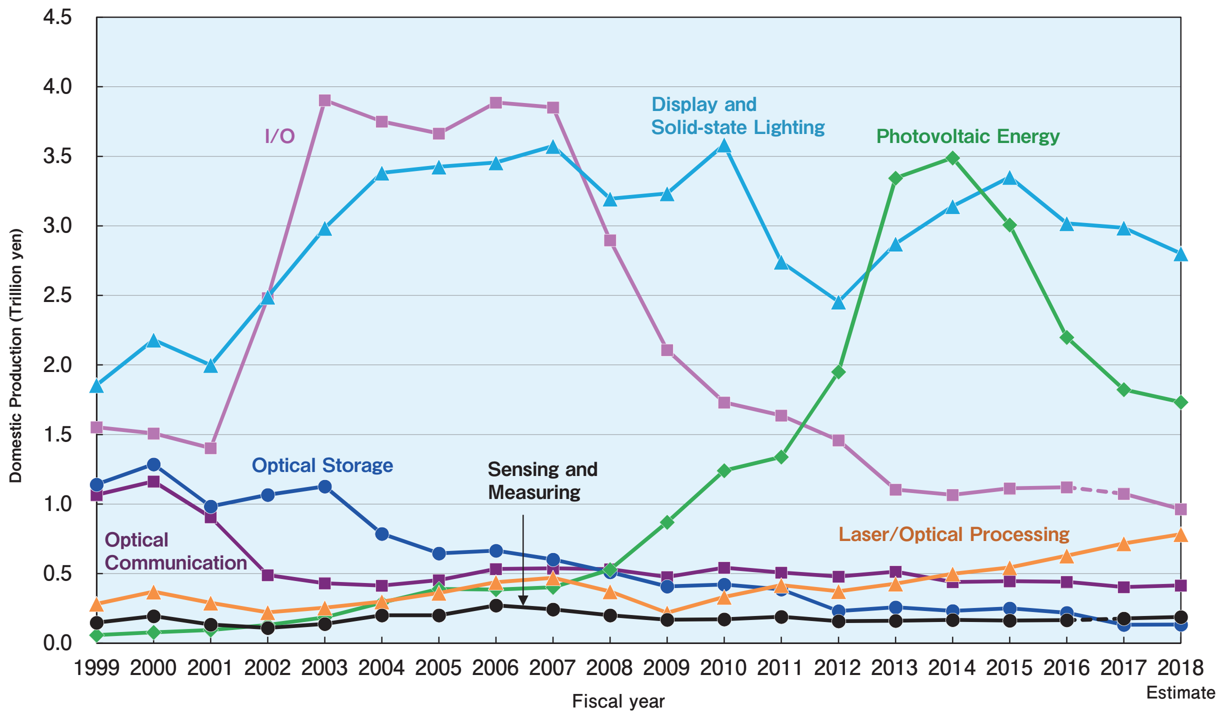



Fig.4 Domestic Optoelectronics Production by Product Field


| | | |
|---|---|---|
| ■ Canada | CPIC | Canadian Photonic Industry Consortium |
| ■ EU | EPIC | European Photonics Industry Consortium |
| ■ Korea | KAPID | Korean Association for Photonics Industry Development |
| ■ Germany | OptecNet | |
| ■ Japan | OITDA | Optoelectronic Industry and Technology Development Association |
| ■ U.S.A | OIDA | Optoelectronic Industry Development Association |
| ■ Taiwan | PIDA | Photonics Industry and Technology Development Association |
| ■ Scotland | SOA | Scottish Optoelectronics Association |
| ■ Switzerland | Swissphotonics | |

Fig.5 IOA Members (as of 2018)

# Technological Strategy Development

## 1. Introduction

OITDA has been developing “Optical Technology Roadmap” since 1996 with the aim of identifying the future technologies of the optical industry for directing the R&D. This activity has contributed widely to the development of optical industry as one of the key factors of many national R&D projects in the fields of information and telecommunication, recording of information, display device, optical energy and optical processing. This year, we have developed the “Optical technology roadmap of next generation network for Beyond 5G” based on that the 5G mobile communication system will be already scheduled to introduce in 2020, so we should focus on the future generation.

## 2. Optical technology roadmap

In developing the roadmap, firstly, we have speculated the suitable optical network in the B5G era. And secondly, we picked up the potential issues in the B5G era. And thirdly, conducted the trend survey of R&D which might be capable of solving those issues.

### 2.1 Speculation of the network in the B5G era

In the B5G era, the number of terminals connected to the network will increase drastically for providing the wide variety of service. Consequently, network will be used in various situation and purpose. Especially in the access area, small cells will be minimized: picocells/femtocells (<100 m), and spatial multiplicity by Massive MIMO (Multiple-Input and Multiple-Output) will also increase (multiplicity>100). In addition, the mobile edge computing will be spreading widely in order to achieve extremely low latency of applications. Due to the increase of access traffic, the capacity of the backbone network will be expected to accelerate (> 100 Gbps@MFH, > Tb/s@MMH/MBH, MFH: Mobile Fronthaul, MMH: Mobile Midhaul , MBH: Mobile Backhaul).

### 2.2 Technical challenges for B5G

In B5G, PON (Passive Optical Network) can be considered as one of the key technologies to cover countless small cells most economically. By applying N-branch PON, the number of required fibers can be reduced to 1 / N. On the other hand, there are some challenges for introducing full-scale deployment. Firstly, TDM (Time Division Multiplexing)-PON requires bandwidth allocation. Therefore the capacity should be increased to 100 Gbps/ λ and more, and latency should be reduced. Furthermore, a power budget as high as 29 dB is required to allow for the optical loss associated with the N branch. With regard to large capacity and low latency, it can be partially resolved by applying WDM (Wavelength Division Multiplexing)-PON and TWDM (Time and Wavelength Division Multiplexing)-PON, but reducing the cost of tunable transceivers will be the challenge.

In order to develop such a network, there must have high requirements for optical transceivers. For the Ethernet standards which are discussed in IEEE802.3, the Intensity Modulation Direct Detection (IMDD) system has been used until now. But in order to achieve the Tbps-class transmission capacity required for B5G, digital coherent technology is expected to become mainstream even at relatively short distances. In that case, cost reduction of the coherent optical transceiver might be the most important. The IMDD system might continue to be used in the communication distance below 10 km. But increasing the transmission rate to several hundred Gbps/ λ will be the challenge in future.

### 2.3 Optical access technology for B5G

As the technology for drastically reducing the traffic of data transmission of the MFH, RoF (Radio Over Fiber) technology, that transmits a radio waveform as an analog light intensity signal, is one of the candidates. In this method, an increase of transmission band can be avoided because waveform is not digitized. Due to the extremely simplified antenna site, power saving and space saving can also be achieved. Furthermore, RoF technology is expected to be applicable as a radio signal relay. On the other hand, high linearity is required for both the modulation and light receiving components for generating and receiving RoF/IFoF signals. Another technical challege is how to suppress signal quality degradation due to multiple reflections in the transmission path.

The PON technology is considered to achieve large transmission capacity, low latency and high power budget. Firstly, PON can reduce latency drastically by using fixed bandwidth allocation or latency dynamic bandwidth allocation even though conventional TDM-PON has issue in latency. In addition, it is likely that 100 Gbps/ λ class can be achieved by applying equivalent technologies using machine learning. Furthermore, by using TWDM-PON, which is an extension of TDM-PON, it is expected to be able to control the bandwidth dynamically and flexibly and provide various services required for B5G. On the other hand, in the B5G era, as the number of cells increases, further expansion of the power budget is required. Coherent PON is considered to be the key technology for achieving this. By coherently detecting the complex amplitude of light, dispersion compensation using a DSP (Digital Signal Processor) is possible, and a large capacity exceeding 100 Gbps/ λ can be achieved while securing a power budget of more than 29 dB.

Coherent PON is satisfactory in terms of performance, but low power consumption and cost reduction of optical transceivers are the challenges for actual implementation.

### 2.4 Optical device technology for B5G

For MFH, IMDD device of 100 Gbps/ λ and more is considered necessary. As a transmission device, EML has advantage in terms of modulation bandwidth, but in recent years, the bandwidth of DML (Directly Modulated Laser) using photon resonance effect has been expanding, and the bandwidth exceeding 50 GHz has been demonstrated. On the other hand, as a receiving device, there is a trade-off between bandwidth and sensitivity. In addition to conventional compound semiconductors and pin PD (Photodiode) using SiGe, new materials such as graphene has gotten attention from industry. Furthermore, the switching speed of APD (Avalanche Photodiode) is also increasing. 100 Gbps (50 GBd PAM4, PAM4: 4-level Pulse Amplitude Modulation) or more has been demonstrated.

For MBH, a coherent scheme is expected to be applied. In terms of bandwidth, InP-type modulation elements have advantage and a bandwidth of 60 GHz has been demonstrated. As a result, it is probable that the optical transmitter of 800 Gps/ λ and more is shown by the polarization multiplexing 16QAM (Quadrature Amplitude Modulation) method. On the other hand, the Si-type modulation is also accelerated, and a band of 40 GHz has been demonstrated. In order to develop a compact optical transceiver of 10 Tbps class for B5G, it is required that such transmitter will be wavelength-multiplexed in a compact manner as well as that III-V and Si hybrid integration technology.

For applying the RoF technology, high-speed EO/OE conversion components is also under development. As an EO conversion component with excellent linearity, LN (Lithium Niobate) material has advantage to apply. Particularly, there is a report that 100 GHz has been demonstrated by using a modulator which use a thin film LN substrate that has become available in recent years. On the other hand, modulation components using organic EO materials, which is pointed out reliability issue, have solved it in recent years. So, it is expected to be downsized and highly integrated by integrating with Si photonics elements. From the viewpoint of downsizing, InP-type high-speed modulator is considered to be high potential, but linearity will be an issue. On the other hand, as an OE conversion element, there will be huge potential in a THz wave generation component using UTC-PD (Uni-Travelling

Carrier Photodiode).

We have gotten suitable characteristics from that element such as wide band operation in 650 GHz band and flat response from DC to 110 GHz. On the other hand, the biggest challenge of UTC-PD is high power output. In future, integration of optical and wireless technologies such as integrated h high-frequency amplifiers will be important.

## 3. Summary

Finally, our committee “Optical Technology Strategy Formulation Committee 2018” would like to point out one thing in conjunction with enter the B5G era.

In the process of research and discussion through the development of this roadmap, it became clear that our R&D especially for high-speed optical transceiver devices are leading the world.

We should accelerate R&D to strengthen international competitiveness as well as intensify the strategies for cost reduction and developing international standard. And link them to global business through industry-academia-government collaboration.

# Standardization

## 1. Introduction

Standardization has been one of OITDA's major activities since its establishment and has been promoted broadly across the optoelectronics industry. OITDA's standardization efforts are mainly focused on the optical communication (IEC/TC 86), but they also include several optical applications (ISO/IEC JTC 1/SC 32) and lasers (IEC/TC 76 and ISO/TC 172/SC 9).

Besides, working for domestic standardization (JIS, OITDA standards and Technical papers), OITDA is also working on international standardization such as IEC and ISO through field-specific sub-meetings in order to respond rapid change of industrial structure and technologies.

Outlined below are the results and trends of standardization activities in FY 2018, as well as two international standardization projects commissioned by the Ministry of Economy, Trade and Industry.

## 2. Fiber Optics (IEC/TC 86)

IEC/TC 86 had held its annual meeting in 2018 in conjunction with the 81st General Meeting in Busan (Korea). Each working group held an interim meeting.

### 2.1 Fiber Optic Test Equipment Calibration (WG 4)

At the Busan meeting, it was reported that CDV for IEC 62129-3 Ed.1.0 (Optical frequency meter internally referenced to a frequency combs) had been voted and approved. This standard was proposed by Japan at the Gwangju meeting in 2015 and Japan was in charge of the project leader (PL).

The observations to the IEC Central Secretariat comments on this CDV were drafted by the Optical Measuring Instrument Standardization Meeting in OITDA and approved by the IEC/TC 86 Japan National Committee.

At the Busan meeting, it was agreed to reflect the comments and proceed to FDIS.

The result of CDV vote for IEC 61315 Ed.3 (Calibration of fibre-optic power meter) was reported to be approved to proceed to IS.

### 2.2 Fibers and Cables (SC 86A)

#### 2.2.1 Fibers and Associated Measuring Methods (WG 1)

Ed.4 of IEC 60793-2-40 (Sectional specification for category A4 MMF) was approved to proceed at the Busan meeting.

Japan shared the contents of MCF (Multi-core Optical Fiber connector) measurement and interface standard proposed by SC 86B. Since it is also related to optical fiber and cable test methods and cable product standards, it should be discussed at SC 86A at the same time. It was recognized that the longitudinal uniformity of optical fibers and the manufacturability should be focused on.

#### 2.2.2 Cables (WG 3)

At the Busan meeting, regarding the IEC 60794-1-215 (Cable external freezing test, method F15) and IEC 60794-1-23 (Cable element test methods), there were discussions for resolving the comments on CD and finally approved to proceed to CDV.

International Conference on Plastic Optical Fibers 2018 was held in Seattle. There were 53 presentations including 19 poster sessions. Regarding the optical wiring in buildings, there was an presentation on the actual application of gigabit home networks using SI-POF in Europe.

#### 2.2.3 Future Tasks

- Strengthen the support to SC 86A/WG 1 for all-plastic multimode optical fiber. In relation to the IEC 60793-2-40, examine the test methods to adjust to JIS C 6837.
- Strengthen the support to SC 86A / WG 3 for F15B freezing tests in IEC 60794-1-215.

### 2.3 Fiber Optic Interconnecting Devices and Passive Components (SC 86B)

SC 86B held meetings in Milan and Busan in 2018.

#### 2.3.1 Standard Tests and Measurement Methods for Fiber Optic Interconnecting Devices and Passive Components (WG 4)

The latest change of the IEC 61300 series was investigated and made comparison with JIS. There is only one provision which is provided by JIS C 5961 but not provided by JIS C 61300 series.

There are three revised standards under development. Namely, IEC 61300-3-7 (Measurements–Wavelength dependence of attenuation and return loss of single mode components), IEC 61300-3-21 (Measurements–Switching time) and IEC 61300-3-53 (EAF measurement method based on two-dimensional far-field data from SI multimode waveguide).

#### 2.3.2 Standards and Specifications for Fiber Optic Interconnecting Devices and Related Components (WG 6)

(1) Study on individual fiber optic connector standards

In response to the newly published two IEC standards which are replacing conventional MPO connector standard, OITDA has decided to revise the corresponding JIS.

(2) Study on fiber optic connector interface standards

Followed by the publishment of F13 type fiber optic connector interface standard in IEC, OITDA has decided to establish the corresponding JIS.

#### 2.3.3 Standards and Specifications for Fiber Optic Passive Components (WG 7)

As of February 2018, there are two circulated documents, namely IEC 61977 (Fibre optic fixed filters–Generic specification) and IEC 61753-061-2 (Fibre optic isolators for category C).

### 2.4 Fiber Optic Systems and Active Devices (SC 86C)

SC 86C held meetings in San Diego and Busan in 2018.

#### 2.4.1 Fiber Optic Communications Systems and Sub-systems (WG 1)

WG 1 deals with the physical layer of optical communication systems and establishes optical system design guidelines and test methods for digital systems, optical cable equipment and optical links.

Members were dispatched to the meeting at San Diego and Busan.

#### 2.4.2 Fiber Optic Sensors (WG 2)

(1) Contents of deliberation at IEC meeting

Table 3 summarizes the entire documents deliberated by WG2.

Table 3 Deliberation documents at IEC meeting in 2018

| Date / Location | Deliberation documents |
|---|---|
| October 18, 2018 / Busan (Korea) | • IEC 61757-1-1 Fiber optic sensors-Part 1-1: Strain measurement – Strain sensors based on fibre Bragg gratings<br>• IEC 61757-1-2 Fibre optic sensors Part 1-2: train measurement - Distributed sensing |
| March 9, 2019 / San Diego (USA) | • IEC 61757-2-1 Fibre optic sensors Part 2-1: Temperature measurement – Temperature sensors based on fibre Bragg gratings<br>• IEC 61757-2-2 Fiber optic sensors-Part 2-2: Temperature measurement – Distributed sensing<br>• IEC 61757-3-2 Fibre optic sensors Part 3-2: Distributed acoustic sensing<br>• IEC 61757-4-3 Fibre optic sensors Part 4-2: Electric current measurement – Polarimetric method |

(2) Proposal of IEC 61757-4-3 (Fibre optic sensors–Electric current measurement–Polarimetric method)
- TC 38 (instrument transformer) pointed out that the contents were duplicated, but the problem was resolved by clarifying the scope and appointing the liaison. Proceed to CDV was approved at the Busan meeting.
- At the San Diego meeting, we submitted countermeasures for the comments to the CDV.

(3) Future plans

Preparation of international standard will be accelerated because industry will actively introduce optical fiber sensor. In response to this situation, international standard for optical fiber current sensors had been initiated by Japan. Other related NP had also be proposed by European countries.

In conjunction with this movement, Fiber optic sensors submeeting will continue to keep track of the status in IEC and join the discussion actively.

### 2.4.3 Optical Amplifiers (WG 3)

R&D of erbium-doped fiber amplification technology has been conducted rapidly since early 1990s and international standardization activities in IEC and CCITT (currently ITU-T) started in 1991 and 1992, respectively. In 2001, the scope of IEC deliberation has been expanded to include Raman fiber amplifiers, semiconductor optical amplifiers and waveguide optical amplifiers and has reached today.

(1) Study of IEC draft
- Publication of IEC TR 61292-8 (High-power optical amplifiers)
- Publication of IEC 61290-4-4 (Test method for gain transient parameters–Single channel optical amplifiers in output power control)
- Revision of IEC TR 61292-3 (Design guides–Classification, characteristics and applications)
- Revision of IEC TR 61292-4 (Maximum permissive optical power for thedamage-free and safe use of optical amplifiers)
- Revision of IEC 61290-1-1 (Test methods–Power and gain parameters–Optical spectrum analyzer method)

(2) Trend survey of IEC standard and cooperation for IEC activities

#### ［Status of the existing documents］

(1) IEC 61290-1 Ed.1 (Test Methods–Power and gain parameters): currently under deliberation for sub-part (IEC 61290-1-1). SD is extended for 2 years.

(2) IEC 61290-1-3 Ed.3 (Test Methods–Power and gain parameter–Optical power meter method): Agreed to make amendments to correct errors related to the measurement of the maximum total optical power.

(3) IEC 61290-4-2 Ed.1 (Test Methods–Gain transient parameters–Broadband source method): SD extended for 2 years.

(4) IEC TR 61292-6 Ed.1 (Optical Amplifiers–Distributed Raman amplification): SD is extended for 2 years.

(5) IEC TR 61292-9 Ed.1 (Optical Amplifiers–Semiconductor optical amplifiers): SD extended for 2 years.

#### ［Status of the new work items］

- Remote Optically Pumped Amplifier (ROPA)
- The new optical amplification technologies for spatial multiplexing optical fiber communication
- Broadband optical amplifier (C + L-band, O-band)
- Pluggable amplifier (XFP, CFP)
- Burst mode EDFA

In particular, regarding the new optical amplification technologies such as optical amplifiers for spatial multiplexing optical fiber transmission, Japan has been in charge of creating new technical reports (TR).

### 2.4.4 Fiber Optic Active Components and Devices (WG 4)

For preparing the revision of IEC TR 62572-4:2013 (Guideline for optical connector end-face cleaning methods for receptacle style optical transceivers), we had conducted manufacturer hearing of three domestic companies who are conducting cleaning of MPO optical connector. The result was also reflected to the related standard of OITDA/TP 12 which was published in 2019.

Regarding the gain ripple test measurement method for semiconductor optical amplifiers, we had drafted up the standard in collaboration with the Japan National Committee of WG 3 and WG 4 as well as the Optical Amplifier Standardization Meeting in OITDA, and submitted to SC 86C.

### 2.4.5 Dynamic Modules and Devices (WG 5)

(1) Situation of International standardization
- At the San Diego meeting, we deliberated the performance standards of IEC 62343-1 (General conditions), the reliability qualification of IEC 62343-2-1 (Test template), and the performance specification templates of IEC 62343-3-3 (Wavelength selective swithes) and IEC 62343-3-4 (Multicast optical swithes).
- At the Busan meeting, we had deliberated IEC 62343-1 CDV, IEC 62343-2-1 CD, IEC 62343-3-3 CD and IEC TR 62343-6-11 CD.
- As of March 2019, status of each standard is

  IEC 62343-1: IS
  IEC 62343-2-1: CDV
  IEC 62343-3-3: CDV
  IEC 62343-3-4: IS
  TR 62343-6-11: CD2

(2) Future activities
- While dynamic modules were introduced in ROADM systems steadily, optical amplifiers which is deliberated in WG 3 (Optical amplifier) are also introduced to the line cards.
- In order to stimulate discussions across both groups, SC 86C decided to integrate WG 5 into WG 3 and operate as a group after the San Diego meeting.
- In accordance with this movement, the related meetings of OITDA will continue to provide support to the Japan National Committee.

## 3. Optical Radiation Safety and Laser Equipment (IEC/TC 76)

TC76 meeting was held in Kista (Sweden) in 2019. An interim meeting was also held in Orlando (USA) for WG 1 and WG 8.

### 3.1 Optical Radiation Safety (WG 1)

There were new proposals presented at the meeting and considered as amendments to IEC 60825-1 Ed.3 as well as publishing as an independent IS or TS.

- Moving platform: the position of the measurement aperture around the moving body including the laser device depending on the speed
- Virtual Protective Housing: sensor detects the human body into the beam and reduces the risk of exposure
- Ad hoc committee for intentional beam irradiation for the eye and face was established.
- Ad hoc meeting for laser products for distance measurement was established. This meeting is aiming at deliberating the reference value according to the ambient brightness.
- The corneal injury threshold in the infrared region were reviewed to reflect IEC 60825-1 in Ed.4.

### 3.2 Laser Radiation Mesurement (WG 3)

It was confirmed to revise TR 60825-13 Ed.2 (Measurement for classification of laser products ). The CD will be circulated in 2019 and comments was scrutinized at the next annual meeting.

### 3.3 Safety of Medical Laser Equipment (WG 4)

We reviewed comments for CD of IEC TR 62471-3 (Guidelines for the safe use of IPL source on human) which will be integrated into IEC TR 60825-8 (Guidelines for safe use of laser beams on human) for the next edition.

There was a proposal for IEC 60601-2-57 (Particular requirements for the basic safety and essential performance of non-laser light source equipment intended for therapeutic, diagnostic, monitoring and cosmetic/aesthetic use) that the risk group equivalent to laser class 1C was needed to be defined.

ISO TR 22463 was conducted jointly with JWG 12.

### 3.4 Safety of Fiber and Free Space Optical communication systems (WG 5)

Japan is contributing the deliberation of IEC 60825-2 and IEC 60825-12 by providing the project leaders.

IEC 60825-2 (Safety of optical fiber communication systems) Ed.4 was approved to proceed to CDV after reviewing the 2CD circular comments at Kista meeting.

IEC 60825-12 (Safety of optical wireless communication systems for information transmission) Ed.2 was issued in 2019. WG 5 continued to deliberate on the content of the amendment for Ed.2.

Regarding the "Laser Safety in High Power Optical Communication Systems", JAG 10 (Joint Advisory Group 10) was established under TC 86. The kick-off meeting was held in conjunction with the SC 86C interim WG meeting.

### 3.5 High Power Lasers (WG 7)

Regarding the IEC 60825-4 (Safety of laser products–Laser guards) CDV of Ed.3, technical comments were remained and discussed again at the Kista meeting.

Regarding the IEC 60825-18 (Beam Delivery System), CD draft will be created by reflecting the comments to the NP and circulated in WG 7 in 2019.

### 3.6 Develpopment and Maintenance of Basic Standards (WG 8)

Revised draft of IEC TR 60825-3 (Guidance for laser displays and shows) Ed.3 was discussed at the Kista meeting.

IEC TR 60825-5 (Manufacturer's checklist for IEC 60825-1) Ed.3 has been approved for publication after the DTR circulation has been completed.

Regarding the IEC TR 60825-14 Safety of laser products–A user's guide) Ed.2, CD draft was deliberated at the Kista meeting, and calculation examples and contingency plans applied to Class 3B and Class 4 were added.

European standard EN 50689 (Particular requirements for consumer laser products) will be issued by the European Electrical Standardization Committee (CENELEC) in connection with the European directive "Safety to which consumer laser equipment should comply" promulgated in 2014). Progress was presented at Kista meeting and ILSC (Laser Safety International Conference) 2019. The draft European standard only allows Class 1, Class 2 and Class 3R that meet specific requirements for consumer laser equipment.

### 3.7 Non Coherent Sources (WG 9)

At the Kista meeting, discussions were held on how to proceed with deliberation of IEC TR 62471-4 (measurement method) and IEC 62471-6 (UV lamp system) in IEC.

According to IEC TR 62471-4, the basic part of the evaluation method of lamps and lamp systems is described in IEC 62471-1, and 4CD is prepared while making adjustment.

Similarly, IEC 62471-6 should be deliberated after discussion of IEC 62471-1. Regarding the evaluation method of the UV lamp system, there was a discussion that the average value of the exposure dose was important and the evaluation distance should be closer than 1m.

### 3.8 Special Joint TC for IEC 62471-1 (JTC 5)

The work to revise CIE S009/IEC 62471 (photobiological safety of lamps and lamp systems) as CIE S009/IEC 62471-1 has been conducted by CIE Div.2 and Div.6 and IEC Joint Technical Committee 5 (TC 34 and TC 76) since 2013.

At the Kista meeting, the draft was discussed, and Japanese opinions (such as the description that "Classification of GLS is not applicable" should be deleted, the image projector sould be clearly shown as an application example of the classification distance of 1 m, and only RG 3 should require a label) were accepted. In addition, the assignment and delivery date for the annex were clarified.

### 3.9 Safety of Lasers and Laser Equipment in an Industrial Materials Processing Environment (JWG 10)

JWG 10 is conducting jointly with ISO/TC 172/SC 9/JWG 3 and deliberated on ISO/IEC 11553 standards at Kista meeting.

Regarding the revision of ISO/IEC 11553-2 (Safety requirements for handheld laser processing devices) Ed.2, project was withdrawn because there was no PL.

### 3.10 Eye and Face Protection against Laser Radiation (JWG 12)

JWG 12 is conducting jointly with ISO/TC 94/SC 6/ JWG 1. ISO 19818 (Requirements for eye and face protection from laser radiation) Ed.1 is circulated again as NP.

The 2nd DTR of ISO TR 22463 (patient and client eye protectors for use during laser or ILS procedures-Guidance) was deliberated together with WG 4 at the Kista meeting.

## 4. Laser and Electro-Optical Systems (ISO/TC 172/SC 9)

### 4.1 Terms and Test Methods of Electro-optic System (WG 1)

There was progress on each standard as below.

- ISO 13696: Registered as an approved work item (AWI) and revised without changing the scope.
- ISO 13142: Change the title and reflect the deliberations to circulate the committee draft (CD).
- ISO 21254-1, ISO 21254-2, ISO 21254-3: Three projects were canceled because they could not develop within the target date. So, those were newly registered as preliminary items (PWI).
- ISO 19986: CD circulation reflecting the contents discussed.
- ISO 12005: 2003: Periodic review (SR) was approved, and it was decided that Japan would become new PL and it was registered as a preliminary item.
- ISO 11146-1: 2005, ISO 11146-2: 2005: Revised without changing the scope.

### 4.2 Medical Applied Laser System (WG 4)

- Deliberated in WG1.
- ISO 22248: CD circulation reflecting the contents discussed.

### 4.3 Electro-optic System Other than Laser (WG 7)

- ISO 11807-1, ISO 11807-2: Proceed to DIS.
- ISO 14881: The circulation period will be extended to 48 months and CD circulation was conducted.
- ISO 14880-1: Within 3 weeks after the meeting, PL completed the

Table 4 List of ISO/TC 172/SC 9 deliberated standards

| Section | WG | Standard No. | Standard name |
|---|---|---|---|
| 4.1 | WG 1 | ISO 13696 | Optics and Photonics--Test methods for radiation scattered by optical components |
| | | ISO/CD 13142 | Optics and photonics--Lasers and laser-related equipment--Cavity ring-down method for high-reflectance and transmittance measurements |
| | | ISO/AWI 21254-1, ISO/AWI 21254-2 and ISO/AWI 21254-3 | Lasers and laser-related equipment--Test methods for laser-induced damage threshold<br>--Part 1: Definitions and general principles<br>--Part 2: Threshold determination<br>--Part 3: Assurance of laser power (energy) handling capabilities |
| | | ISO/WD 19986 | Lasers and laser-related equipment--Test method for angle-resolved scattering |
| | | ISO 12005:2003 | Lasers and laser-related equipment – Test methods for laser beam parameters – Polarization |
| | | ISO 11146-1:2005, ISO 11146-2:2005 | Lasers and laser-related equipment--Test methods for laser beam widths, divergence angles and beam propagation ratios<br>--Part 1: Stigmatic and simple astigmatic beams<br>--Part 2: General astigmatic beams |
| 4.2 | WG 4 | ISO/AWI 22248 | Laser and laser-related equipment--Test methods for laser-induced damage threshold--Classification of medical beam delivery systems |
| 4.3 | WG 7 | ISO/CD 11807-1, ISO/CD 11807-2 | Integrated optics--Vocabulary<br>--Part 1: Basic terms and symbols<br>--Part 2: Terms used in classification |
| | | ISO/AWI 14881 | Integrated optics--Interfaces--Parameters relevant to coupling properties |
| | | ISO/DIS 14880-1 | Optics and photonics--Microlens arrays--Part 1: Vocabulary and general properties |
| | | ISO 15902:2004 | Optics and photonics--Diffractive optics--Vocabulary |
| 4.4 | JWG 3 | ISO/DIS 11553-1 | Safety of machinery--Laser processing machines--Part 1: General safety requirements |
| 4.5 | SR | ISO 11252:2013 | Lasers and laser-related equipment--Laser device--Minimum requirements for documentation |

document and submit it to Secretary for FDIS voting.

- ISO 15902: 2004: Decided to handle with minor modifications. Secretary completes the document and submits it to the CS.

### 4.4 Safety of Laser Equipment (JWG 3)

- ISO 11553-1: Revised to be the type B standard defined in ISO 12100.

### 4.5 Systematic Review

- ISO 11252: 2013: Review after revision of ISO 11146-1: 2005 and ISO 12005: 2003.

## 5. Digitally Recorded Media for Information Interchange and Storage (ISO/IEC JTC 1/SC 23)

ISO/IEC JTC 1/SC 23 is coping with optical disc related technology. There are two submeetings.

### 5.1 Media Submeeting

This meeting is responsible for all optical disks (magneto-optical disks, phase-change optical disks, recordable optical disks, and ROM-type optical disks).

As of March 2019, ISO/IEC JTC 1/SC 23 revision project for the international standard for BD discs is in progress, and Amendment was expected to be issued in early 2019.

### 5.2 Format Submeeting

This meeting is responsible for volume and format of optical disc.

Table 5 Progress of international standardization

| Standard No. | Proposed to | Ultimate goal (~FY2019) | Results in FY2018 | Future schedule |
|---|---|---|---|---|
| ISO 21111-3 | ISO/TC 22/ SC 31/WG 3 | Document publication | The description method of the standard will be reviewed, and the description of the document will be revised accordingly. | Create a DIS circulation document reflecting CD comments. |
| ISO 21111-4 | ISO/TC 22/ SC 31/WG 10 | Document publication | Discuss comments collected by CD voting, create DIS ballot document and send it to ISO secretariat. | Aggregate DIS voting results and promptly implement FDIS voting and IS. |
| ISO 21111-X | ISO/TC 22/ SC 32/WG 10 | Committee draft Registration approval | Prior confirmation experiment confirmed that multimode optical fiber can be applied to 10 Gigabit in-vehicle Ethernet. | Perform NWIP proposal. |
| IEC 62228-5 | IEC/TC 47/ SC 47A/WG 9 | Voting Committee Draft circulation | CD proposal completed after deliberation of WD from Germany. | Reflection of Japanese opinions on the EMC evaluation of electrical Ethernet tranceivers, and additional proposals for EMC evaluation of the power souece for optical Ethernet tranceivers. |
| IEC 61300-3-53 | IEC/TC 86/ SC 86B/WG 4 | International standard draft Registration | Originally proposed in the revision of 61300-1, but received an instruction from the WG4 Convenor to be included in the 61300-3-53 revision, the 61300-3-53 ed2 draft was created, and the CD was circulated. | Comments on the CD circulation will be discussed at the IEC Delft meeting in April. |
| IEC 60793-2-40 | IEC/TC 86/ SC 86A/WG 1 | Voting Committee Draft circulation | Amendments including changes in the sub-category A4a.2 NA standard scope were approved at the SC 86A/ WG 1 Busan meeting in October, and the CD was circulated. | The SC 86A/WG 1 meeting in April 2019 will deal with comments and proceed to CDV circulation. |

(1) Development of large file system

We are developing a large-capacity file system in collaboration with Ecma TC31.

(2) Development of ISO 9660 Amd.2.

Regarding the ISO 9660 which defines the logical format of the CD-ROM, we began to deliberate for developing Amd.2.

## 6. Evaluation methods of EMC and related Characteristics of High-Speed In-Vehicle Ethernet Physical Layer

### 6.1 Objective

Capacity of in-vehicle communication is expected to increase drastically due to the development of the advanced driving support systems and autonomous driving, but the in-vehicle Ethernet standards that strength

en real-time performance, fail-safe function and high reliability are required as communication backbone and sensor network.

Regarding the EMC chatacteristics, reliable in-vehicle communication system can be achived by implementing the optical harness which is neither generate electromagnetic noise nor EMC vulnerable.

This is three-year project since 2017 aiming to propose the international standards related to the optical communication and EMC.

### 6.2 Progress of International Standardization

**Table 5** summarizes this year's progress and future plan.

## 7. Reliability of Narrow-Pitch Multi-Fiber Optic Connectors

### 7.1 Objective

Optical connectors, which was originated from Japan, such as SC connectors, MU connectors, MT connectors and MPO connectors have been internationally standardized and used in the global market.

In recent years, the amount of information processing and communication in the data center has increased due to the expansion of cloud computing. So, the reduction of energy consumption became one of the key issues. In order to solve this problem, this project proposes the high-density optical interconnectors which will be applied to servers and routers in data centers.

This project is aiming at developing the international standard of narrow-pitch multi-fiber optical connector which is thinner than the conventional one.

### 7.2 Progress

- This year is the second year of the three-year plan, and we have compiled domestic opinions on the international standardization of narrow-pitch multi-fiber optical connectors based on the results of technical studies such as technical surveys and prototype experiments. Then, we attended the IEC meeting and proposed PWI to IEC/TC 86.
- At the IEC Busan meeting in 2018, NP draft of IEC 62496-4-XXX (Interface standards–Terminated waveguide OCB assembly using a single-row thirty-two-channel symmetric PMT connector) was proposed in TC 86/JWG 9 (optical wiring board), then agreed to proceed. At the next meeting in 2019, RVN will be deliberated.
- In order to show that the proposed PMT connector has suitable characteristics, we measured the connection characteristics of MT ferrules with Ø80μm thin fiber and PMT connectors as well as random connection characteristics between PMT connectors.
- In COBO (Consortium for On-Board Optics), we submitted white paper on data center application of narrow-pitch multi-fiber optical connectors for enhancing the collaboration with related organizations other than IEC.

# Educational and Public Relations Activities

## 1. FY 2018 Symposium on the Optoelectronics Industry and Technology

The FY 2018 Symposium on the Optoelectronics Industry and Technology was held at the Rihga Royal Hotel Tokyo on Wednesday, February 20, 2019. The event was jointly sponsored by OITDA and the Photonics Electronics Technology Research Association (PETRA), with support from the Ministry of Economy, Trade and Industry. Under the theme of "Photonics technology that supports the Beyond 5G society", six important lectures were given as shown in Table 4. with more than 300 participants.

## 2. InterOpto 2018

InterOpto 2018, an international exhibition of cutting-edge optoelectronics technology, was held at Makuhari Messe for three days from Wednesday, October 17 to Friday, October 19, with support and cooperation from the Ministry of Economy, Trade and Industry and many other organizations.

The event this year was held concurrently with CEATEC JAPAN 2018 as well as LED JAPAN 2018, Imaging Japan 2018, and MEMS Sensing & Network System 2018, in an effort to showcase all the latest technologies and products ranging from device components to the hottest IoT, AI, and automotive applications together, so that visitors could gather information more efficiently and effectively, while opportunities for collaboration between exhibitors were dramatically increased.

Covering a wide range of exhibition categories, including laser/light sources, optical devices/modules, materials, optical equipment/instruments, and services/software related to the optoelectronics industry, InterOpto exhibited a broad range of technologies from optoelectronics-related materials to optical application systems.

InterOpto alone featured 119 booths set up by 103 exhibitors from in and outside Japan, including optoelectronics manufacturers and trading companies. The total number of exhibitors and booths for the four exhibitions excluding CEATEC was 297 and 294, respectively. As tickets for each exhibition included admission to the others, many CEATEC visitors dropped by the other exhibitions, with the bustling exhibition


Table 4 FY 2018 Symposium on the Optoelectronics Industry and Technology

| | | |
|---|---|---|
| 10:00 － 10:05 | Opening Remarks | Mr. Yasuhisa Odani<br>President / Vice Chairman, OITDA |
| 10:05 － 10:15 | Guest Greeting | Mr. Jingo Kikukawa<br>Director, IT Industry Division, Commerce and Information Policy Bureau, METI |
| 10:15 － 11:15 | Keynote Speech:<br>Creation of 'New Excitement' in 5G, Beyong 5G Society | Dr. Masashi Usami<br>Administrative Officer Exective Director, Technology Planning, KDDI Corporation |
| 11:15 － 12:00 | In-vehicle system and Road-to-vehicle cooperation in 5G Era | Mr. Koichi Takayama<br>General Manager, Vehicle System Department, Advanced Automotive Systems R&D Center, Sumitomo Electric Industries, Ltd. |
| 13:00 － 13:45 | Optical Access Network in Beyond 5G Era | Mr. Seiji Kozaki<br>Information Technology R&D Center, Mitsubishi Electric Corporation |
| 13:45 － 14:30 | Photonics Technology Roadmap for Beyond 5G Network | Dr. Takuo Tanemura<br>Associate Professor, Department of Electrical Engineering and Information Systems, The University of Tokyo |
| 14:45 － 15:30 | Research and Development of High Speed and Low Power Data Transfer System Using Photonic & Electronic Hybrid Switch for Next Generation Datacenter with Disaggregation Architecture | Dr. Takashi Saida<br>Photonics Electronics Technology Research Association (PETRA) |
| 15:30 ～ 16:15 | Integrated Photonics-Electronics Convergence System Technology<br>－ Optpelectronic Interposer using Polymer Waveguide－ | Dr. Takeru Amano<br>Photonics Electronics Technology Research Association (PETRA) |
| 16:20 － 17:00 | The Award Ceremony of 34th Kenjiro Sakurai Memorial Prize | |
| 17:00 － 19:00 | Get-together | |

halls holding several times as many visitors as last year.

A "Notable Optoelectronics Technology and Special Exhibit Zone" was set up in the Exhibition Hall. In this zone, eight companies recommended by the working groups of OITDA's Optoelectronics Technology Trend Committee exhibited their technologies and products. A Notable Optoelectronics Technology Seminar was also held for two days from October 18 to 19 at the seminar site in the Exhibition Hall.

In the Seminar Room of the International Conference Hall, seminars on technological trends in seven optoelectronics technology fields were held on October 18. On October 19, seminars on optoelectronics industry trends in seven product fields and overview trends were presented. These seminars attracted large audiences and stimulated exchanges of opinions among audience members.

The next interOpto will be held for three days from January 29 to 31st, 2020, with the venue moved to Tokyo Big Sight.

## 3. 34th Kenjiro Sakurai Memorial Prize

The Kenjiro Sakurai prize was established as a memorial to the late Dr. Kenjiro Sakurai, a former director of OITDA who played a major role in developing the optoelectronics industry. Its purpose is to promote the technological development of the industry. The prize has been given out 33 times to 24 individuals and 39 groups, for a total of 154 awardees.

This year, the Kenjiro Sakurai Memorial Prize was awarded to two groups out of 10 applications for their pioneering achievements in the optoelectronics industry and technology since 2008.

One prize was awarded to Dr. Masamichi Yamanishi, Dr. Tadataka Edamura, Dr.Kazuue Fujita and Mr. Naota Akikusa of Hamamatsu Photonics K.K. for their "Research and Development of High Performance Quantum-Cascade Lasers and their Commercialization" The other prize was awarded to Dr. Yoshihito Hirano, Mr. Takayuki Yanagisawa, Mr. Shuhei Yamamoto and Mr. Takeshi Sakimura of Mitsubishi Electric Corporation for their "Development of compact high power planar waveguide lasers and application to the wind sensing LIDAR"

The award ceremony was held on February 20, 2019 following the FY 2018 Symposium on the Optoelectronics Industry and Technology. At the ceremony, Prof. Yasuhiko Arakawa (The University of Tokyo), who is the chairperson of the Kenjiro Sakurai Memorial Prize Committee, reported on the selection process and results. This was followed by the presentation of certificates, medals, and extra prizes to the awardees.

Awardees of the 34th Kenjiro Sakurai Memorial Prize
Back row, from left: Mr. Sakimura, Mr. Yamamoto, Dr. Fujita, Mr.Akikusa
Front row, from left: Mr. Yanagisawa, Dr. Hirano, Dr. Yamanishi, Dr. Edamura

## Supporting Members

(As of March 31, 2019)

[Chemistry]

Fujifilm Corporation

Mitsubishi Chemical Holdings Corporation

Nissan Chemical Corporation

Shin-Etsu Chemical Co., Ltd.

Sumitomo Bakelite Co., Ltd.

Yamamoto Kogaku Co., Ltd.

[Glass & Ceramics]

AGC Inc.

Corning International K.K.

Nippon Sheet Glass Co., Ltd.

Sumitomo Osaka Cement Co., Ltd.

Technical Co., Ltd.

Toyo Seikan Group Holdings, Ltd.

[Electric Wire & Cable]

Fujikura Ltd.

Fujikura Dia Cable Ltd.

Furukawa Electric Co., Ltd.

Okano Electric Wire Co., Ltd.

Sumitomo Electric Industries, Ltd.

SWCC Showa Holdings Co., Ltd.

[Electronics & Electronic Appliances]

Anritsu Corporation

Enplas Laboratories Inc.

Fujitsu Limited

Hamamatsu Photonics K.K.

Hirose Electric Co., Ltd.

Hitachi, Ltd.

HondaTsushin Kogyo Co., Ltd.

Huawei Technologies Japan K.K.

Japan Aviation Electronics Industry, Ltd.

Kyocera Corporation

Oclaro Japan, Inc.

Mitsubishi Electric Corporation

Murata Mfg. Co., Ltd.

NEC Corporation

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Oki Electric Industry Co., Ltd.

Panasonic Corporation

Pioneer Corporation

Santec Corporation

Sanwa Denki Kogyo Co., Ltd.

Seiwa Electric Mfg. Co., Ltd.

Sharp Corporation

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Taiyo Yuden Co., Ltd.

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Ushio Inc.

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Nikon Corporation

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Ricoh Company, Ltd.

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Seiko Instruments Inc.

Sigma Koki Co., Ltd.

Suruga Seiki Co., Ltd.

Topcon Corporation

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Hakuto Co., Ltd.

JTB Communication Design, Inc.

Marubun Corporation

The Optronics Co., Ltd.

[Electric Power]

Central Research Institute of Electric Power Industry

[Other Manufacturing]

Adamant Namiki Precision Jewel Co., Ltd.

Dai Nippon Printing Co., Ltd.

Iwasaki Electric Co., Ltd.

Optoquest Co., Ltd.

[Others]

Granopt Ltd.

Institute for Laser Technology

Japan Optomechatronics Association

KDDI Research, Inc.

Nippon Telegraph and Telephone Corporation

NTT Advanced Technology Corporation

Photonics Electronics Technology Research Association (PETRA)

TOYOTA Central Research and Development Labs., Inc.

UL Japan, Inc.

1-20-10, Sekiguchi, Bunkyo, Tokyo, Japan, 112-0014
Phone: +81 3 5225 6431
URL: http://www.oitda.or.jp