Annual Technical Report 2021

FY2021 OITDA

Optoelectronics Industry and Technology Development Association

— CONTENTS —

Message from OITDA

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It is my pleasure to issue Annual Technical Report 2021 that outlines the result of our surveys and R&D activities in FY2021.

In FY2021, the repeated epidemics of COVID-19 forced us all to lead uncomfortable lives following FY2020. Under such a circumstance, OITDA successfully celebrated its 40th anniversary in June 2021. It is truly the fruit of your collaboration and efforts.

You can find the details of our activities in this report. So, I would like to point out noteworthy events in FY2021.

First, we established a specialized subcommittee under the Technology Strategy Development Committee to build the "Human Communication Technology Roadmap for Cyber-Physical Society Using Optoelectronics" toward the post-pandemic era.

To promote standardization through the projects commissioned by the Ministry of Economy, Trade and Industry, we have developed international standardization activities at IEC, ISO, IEEE, and various forums, centered on standards for in-vehicle ethernet systems, optical discs for archive management, and optical connectors for multi-core fibers.

OITDA has been continuing to promote the formulation of a research and development strategy and commercialization strategy through cooperation among the industry, academia, and government regarding the optoelectronics technologies in this fiscal year. At the same time, OITDA has engaged in the priority issues such as survey and research on the optoelectronics technologies and industry, and promotion of technology development and standardization. In order to support the growth of the optoelectronics industry and technologies, 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 wish you safe from COVID-19 and look forward to your continued guidance, support, and cooperation to our activities.

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 40 years are highly regarded as the basic source for properly recognizing the trend of optoelectronics industry.

This year, we have set seven research subcommittee under the "Optoelectronic Industry Trends Investigation Committee" and have conducted survey for getting the statistical data from FY 2020 to FY 2022, 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

We conducted a questionnaire survey of the domestic companies producing optical-related products (optical equipment/systems and components) on the results of FY2020 (actual), FY2021 (estimate), and FY2022 (qualitative projections) for total shipments (including overseas production) and the domestic production. The questionnaires were sent to 259 companies in October 2021 and were collected between December 2021 and February 2022. Responses were obtained from 88 companies. Regarding the projections for the next fiscal year, a quantitative survey was conducted until FY2010, but it was considered that the accuracy and reliability were not sufficient. Therefore, it was changed to a qualitative survey from FY2011. Specifically, the evaluation was made on a five-point scale: increase, slight increase, unchanged, slight decrease, and decrease, compared to the previous year.

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. re-garding the photovoltaic energy field, solid-state lighting field, display field, and I/O field.

Based on these results, we have compiled the total shipments and domestic production in the optical industry in Japan as a whole by conducting data validity examinations and industrial trend analysis by each specialized subcommittee for each product field under the Optoelectronic Industry Trends Investigation Committee and by rechecking the validity of the data and analysis results by the Committee.

For the survey, we classified the optoelectronics industry, together with relevant optical equipment/systems and com-ponents, into the seven fields shown 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, surveillance cameras, and car-mounted cameras
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 2020 (actual), FY 2021 (estimate) and FY 2022 (projections) for total shipments.

● FY 2020 (actual): 11,696 billion yen, growth rate: －8.3%

In FY2020, total shipments (actual) for the optoelectronics industry amounted to 11,696 billion yen (growth rate: －8.3%). This breaks down as: 7, 981 billion yen for optoelectronics equipment/systems (growth rate: －8.5%; component ratio: 68.2%) and 3,716 billion yen for optical components (growth rate: －8.0%; component ratio: 31.8%)

The shipments by field were:

533 billion yen for the optical communication field (growth rate: 5.2%; component ratio: 4.6%), 515 billion yen for the optical storage field (growth rate: －19.9%; component ratio: 4.4%), 2,923 billion yen for the I/O field (growth rate: －12.2%; component ratio: 25.0%), 4, 678 billion yen for the display and solid-state lighting field (growth rate: －7.1%; component ratio: 40.0%), 2,075 billion yen for the photovoltaic energy field (growth rate: －5.8%; component ratio: 17.7%), 612 billion yen for the laser/optical processing field (growth rate: －9.7%; component ratio: 5.2%), and 268 billion yen for the sensing and measuring field (growth rate: 0.2%; component ratio: 2.3%).

● FY 2021 (estimate): 11,859 billion yen, growth rate: 1.4%

Total shipments for the optoelectronics industry in FY2021 are estimated to be 11,859 billion yen (growth rate: 1.4%). This breaks down as: 8,004 billion yen for optoelectronics equipment/systems (growth rate: 0.3%; component ratio: 67.5%) and 3,855 billion yen for optical components (growth rate: 3.8%; component ratio: 32.5%).

The shipments by field are estimated to be 545 billion yen for the optical communication field (growth rate: 2.3%; component ratio: 4.6%), 437 billion yen for the optical storage field (growth rate: －15.2%; component ratio: 3.7%), 3,113 billion yen for the I/O field (growth rate: 6.5%; component ratio: 26.2%), 4,852 billion yen for the display and solid-state lighting field (growth rate: 3.7%; component ratio: 40.9%), 1,764 billion yen for the photovoltaic energy field (growth rate: －15.0%; component ratio: 14.9%), 774 billion yen for the laser/optical processing field (growth rate: 26.3%; component ratio: 6.5%), and 274 billion yen for the sensing and measuring field (growth rate: 2.3%; component ratio: 2.3%).

● FY 2022 (projections): slight increase

The total shipments of the optoelectronic industry in FY2022 is expected to slightly increase. The shipments for optical equipment/systems are expected to remain unchanged, and the shipments for optical components are expected to slightly increase.

The shipment values by field are expected as follows: slight increase for optical communication field, I/O field, laser/optical processing field, and sensing and measuring field; unchanged for display and solid-state lighting field and photovoltaic energy field; slight decrease for optical storage field.

2.3 Overview of Survey Results of Domestic Production

Table 2 shows the results of FY 2020 (actual), FY 2021 (estimate) and FY 2022 (projections) for Domestic Production.

● FY 2020 (actual): 5,841 billion yen, growth rate: －6.4%

In FY2020, the domestic production of the optoelectronics industry (actual) was 5,841 billion yen (growth rate: －6.4%). This breaks down as 3,558 billion yen for optoelectronics equipment/systems (growth rate: －7.4%; component ratio: 60.9%) and 2,283 billion yen for optical components (growth rate: －4.8%; component ratio: 39.1%).

The domestic production by field was:

413 billion yen for the optical communication field (growth rate: 9.3%; component ratio: 7.1%), 40 billion yen for the optical storage field (growth rate: −45.0%; component ratio: 0.7%), 936 billion yen for the I/O field (growth rate: 1.8%; component ratio: 15.6%), 2,250 billion yen for the display and solid-state lighting field (growth rate: −3.9%; component ratio: 16.0%), 1,503 billion yen for the photovoltaic energy field (growth rate: −7.1%; component ratio: 25.7%), 586 billion yen for the laser/optical processing field (growth rate: −11.4%; component ratio: 10.0%), and 208 billion yen for the sensing and measuring field (growth rate: −0.2%; component ratio: 3.6%).

● **FY 2021 (estimate): 5,884 billion yen, growth rate: 0.7%**

The domestic production of the optoelectronics industry in FY2021 is estimated to be 5,884 billion yen (growth rate: 0.7%). This breaks down as 3,444 billion yen for optoelectronics equipment/systems (growth rate: −3.2%; component ratio: 58.5%) and 2,440 billion yen for optical components (growth rate: 6.8%; component ratio: 41.5%).

The domestic production by field was 423 billion yen for the optical communication field (growth rate: 2.4%; component ratio: 7.2%), 26 billion yen for the optical storage field (growth rate: −36.3%; component ratio: 0.4%), 984 billion yen for the I/O field (growth rate: 5.1%; component ratio: 16.7%), 2,202 billion yen for the display and solid-state lighting field (growth rate: 5.7%; component ratio: 37.4%), 1,212 billion yen for the photovoltaic energy field (growth rate: −19.3%; component ratio: 20.6%), 746 billion yen for the laser/optical processing field (growth rate: 27.3%; component ratio: 12.7%), and 212 billion yen for the sensing and measuring field (growth rate: 1.7%; component ratio: 3.6%).

● **FY 2022 (projections): slight increase**

The domestic production of the optoelectronic industry in FY2022 is expected to slightly increase. The production for optical equipment/systems is expected to slightly increase, and the production optical components is expected to slightly increase.

The production values by field are expected as follows: slight increase for optical communication field, I/O field, laser/optical processing field, and sensing and measuring field; unchanged for display and solid-state lighting field and photovoltaic energy field; slight decrease for optical storage field.

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, respectively. Fig. 3 and Fig. 4 show changes in the domestic production value of the optoelectronics industry and changes by field, respectively. 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.

Japan's optoelectronic industry has continued to grow for a long period of more than 20 years since the survey started in FY1980, although there was a temporary decline due to the burst of the dot-com bubble. However, it has become negative due to the impact of the financial crisis in FY2008. In addition, the tough situation has continued due to the impact of the Great East Japan Earthquake in FY2011. After that, it turned to be positive due to the rapid growth in the photovoltaic energy field. However, after peaking in FY2014, the photovoltaic energy field showed a significant downward trend, and the production of the entire optoelectronic industry decreased in FY2015 and FY2016 for the second consecutive year. In FY2017, it was expected to be almost unchanged and bottomed out, but the downward trend continued after FY2018. Moreover, in FY2020, the optoelectronic industry suffered a great damage due to the COVID-19 pandemic.

In FY2021, there is an overall recovery trend, and it is expected that there will be a slight positive growth.

The following is a summary of the survey results of this year and analysis for financial year.

● **FY2020 (actual)**

In the optical communication field, both the total shipments and domestic production slightly increased because the results of the long-haul and metro systems significantly increased due to the capital investment for the domestic 5G system. In the sensing and measuring field, which had less impact of COVID-19, both the total shipments and domestic production were unchanged. On the other hand, both the total shipments and domestic production in the other five fields became negative due to the impact of the restrained capital investment and pullbacks in spending involved with the spread of COVID-19 infection. In the I/O field, the total shipments and domestic production slightly decreased due to pullbacks in spending of printers/multifunction machines for offices and imaging devices as well as the sales decline of image sensors caused by US-China trade war. In the display and solid-state lighting field, both the total shipments and domestic production slightly decreased because of the price decline and the slight decrease in LED lighting fixtures due to the delayed period of construction-related work although the sales volume of high-value-added TVs has increased thanks to stay-at-home consumption. In the photovoltaic energy field, both the total shipments and domestic production slightly decreased due to the delayed work period in the second half of the year and the price decline although the positive growth has been expected. In the laser/optical processing field, both the total shipments and domestic production have become negative for the second consecutive year because sales of fiber lasers, which had been strong so far, decreased and sales of excimer lasers decreased in reaction to the significant increase in the previous year. In the optical storage field, both the total shipments and domestic production decreased because the demand has continuously decreased.

In the entire optoelectronic industry, the total shipments amounted to 11,696.2 billion yen (growth rate: −8.3%) and the domestic production was 5,841.4 billion yen (growth rate: −6.4%).

● **FY 2021 (estimate)**

In the optical communication field, both the total shipments and domestic production are expected to slightly increase due to the impact of the supply shortage of semiconductors although components such as light-emitting elements and optical fibers are favorable with an increase in the network demand in addition to continued capital investment for domestic 5G systems. In the I/O field, both the total shipments and domestic production are expected to slightly increase because the sales of printers/multifunction machines, imaging devices, image sensors, and others showed recovery as a reaction from the previous year. In the display and solid-state lighting field, both the total shipments and domestic production are expected to slightly increase, since the results of high-definition and large-screen TVs have been strong because of the increased demand due to Olympic Games and stay-at-home consumption and the results of display components, which had continued negative growth, have been slightly increased with an increase in demand for 5G devices. With the recovery of capital investment centered on semiconductors and automobiles, both the total shipments and domestic production in the laser/optical processing field and in the sensing and measuring field are expected to significantly increase and slightly increase, respectively. In the photovoltaic energy field, both the total shipments and domestic production are expected to decrease due to the price decline and the impact of the supply shortage of power semiconductor devices. In the optical storage field, both the total shipments and domestic production are expected to decrease because the demand for commercial products would continuously decrease. Although the entire optoelectronic industry is on a recovery trend, both the total shipments and domestic production are expected to slightly

Table 1　Shipment of Optoelectronics Industry

Product Items	FY 2019 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2021 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2022 Shipment Prediction
Optical Communications Field	5,065		4.0	5,330		**5.2**	5,453		**2.3**	slight increase
Optical Transmission Equipment	1,558		14.4	1,905		**22.3**	1,785		▲ 6.3	slight increase
Truck Line and Metro Line		728	12.2		1,016	**39.6**		962	▲ 5.3	slight increase
Subscriber Line		431	14.0		473	**9.7**		429	▲ 9.3	flat
Router and Switch		241	▲ 7.7		193	▲ 19.9		198	**2.6**	slight increase
Optical Fiber Amplifier		158	113.5		223	**41.1**		196	▲ 12.1	increase
Optical Transmission Components	3,323		0.8	3,220		▲ 3.1	3,446		**7.0**	slight increase
Optical Transmission Link		381	▲ 31.1		324	▲ 15.0		341	**5.2**	slight increase
Light Emitting Device		670	23.4		764	**14.0**		819	**7.2**	flat
Photo Detectors		158	▲ 11.7		154	▲ 2.5		136	▲ 11.7	flat
Optical Passive Component		227	▲ 3.8		235	**3.5**		210	▲ 10.6	flat
Optical Circuit Component		289	3.2		253	▲ 12.5		250	▲ 1.2	increase
Optical Fiber		1,097	1.6		1,020	▲ 7.0		1,187	**16.4**	flat
Optical Connector		321	18.0		312	▲ 2.8		338	**8.3**	slight increase
Others (Semiconductor Amplifying Device, etc.)		180	16.1		158	▲ 12.2		165	**4.4**	flat
Optical Fiber Fusion Splicer	184		▲ 12.8	205		**11.4**	222		**8.3**	slight increase
Optical Storage Field	6,428		▲ 12.5	5,149		▲ 19.9	4,368		▲ 15.2	slight decrease
Optical Disk	6,345		▲ 12.5	5,088		▲ 19.8	4,326		▲ 15.0	slight decrease
Equipment		6,042	▲ 12.3		4,797	▲ 20.6		4,074	▲ 15.1	slight decrease
Read-only (CD, DVD, BD)		3,805	▲ 18.9		2,835	▲ 25.5		2,448	▲ 13.7	slight decrease
Recordable		2,237	1.7		1,962	▲ 12.3		1,626	▲ 17.1	slight decrease
Media		303	▲ 15.6		291	▲ 4.0		252	▲ 13.4	flat
Laser Diode		83	▲ 17.8		61	▲ 26.5		42	▲ 31.1	decrease
Input/Output Field	33,289		▲ 1.3	29,226		▲ 12.2	31,126		**6.5**	slight increase
Optical I/O Equipment	22,517		▲ 10.3	19,806		▲ 12.0	20,951		**5.8**	flat
Optical Printer・Multifunction Printer		6,924	▲ 3.4		6,173	▲ 10.8		6,674	**8.1**	flat
Imaging equipment		8,604	▲ 12.7		7,071	▲ 17.8		7,479	**5.8**	slight increase
Digital Camera, Digital Video Camera		6,721	▲ 18.1		5,517	▲ 17.9		5,892	**6.8**	slight increase
Security camera, Car-mounted camera *		1,883	14.3		1,554	▲ 17.5		1,587	**2.1**	slight increase
Camera Mobile Phone		6,258	▲ 15.9		5,717	▲ 8.6		5,944	**4.0**	flat
Others (Barcode Reader, Image Scanner, etc.)		731	16.0		845	**15.6**		854	**1.1**	flat
Image Sensor	10,772		24.7	9,420		▲ 12.6	10,175		**8.0**	increase
Display and Solid-state Lighting Field	50,336		▲ 5.2	46,782		▲ 7.1	48,520		**3.7**	flat
Display Equipment	25,695		▲ 1.8	24,280		▲ 5.5	25,090		**3.3**	flat
Flat Panel Display		22,849	▲ 3.2		22,212	▲ 2.8		22,786	**2.6**	flat
Projector		196	8.9		180	▲ 8.2		174	▲ 3.3	flat
Large-scale LED Display		2,650	10.8		1,888	▲ 28.8		2,130	**12.8**	slight increase
Display Device	14,290		▲ 12.4	12,965		▲ 9.3	13,075		**0.8**	flat
Solid-state Lighting	6,843		▲ 1.4	6,252		▲ 8.6	6,528		**4.4**	slight increase
LED Device		6,406	▲ 0.2		5,856	▲ 8.6		6,144	**4.9**	slight increase
LED Lamp		437	▲ 15.6		396	▲ 9.4		384	▲ 3.0	slight decrease
LED	3,508		▲ 3.8		3,285	▲ 6.4		3,827	**16.5**	slight increase
Photovoltaic Energy Field	22,035		▲ 3.3	20,753		▲ 5.8	17,637		▲ 15.0	flat
Photovoltaic Power System		15,211	▲ 7.1		14,178	▲ 6.8		11,562	▲ 18.5	flat
Photovoltaic Cell/Module		6,824	6.5		6,575	▲ 3.6		6,075	▲ 7.6	flat
Laser/Optical Processing Field	6,785		▲ 8.0	6,124		▲ 9.7	7,735		**26.3**	slight increase
Laser and Optical Processing Equipment	6,177		▲ 7.4		5,412	▲ 12.4		6,837	**26.3**	slight increase
CO_2 Laser		300	▲ 35.6		506	**68.7**		692	**36.8**	flat
Solid State Laser		461	▲ 3.8		393	▲ 14.8		432	**9.9**	slight increase
Fiber Laser		802	9.3		615	▲ 23.3		652	**6.0**	increase
Semiconductor Laser Direct Processing Equipment		31	▲ 20.5		31	**0.0**		31	**0.0**	flat
Excimer Laser		2,010	33.4		1,329	▲ 33.9		1,474	**10.9**	slight increase
Lamp/LD Exposure Machine		2,551	▲ 25.3		2,479	▲ 2.8		3,495	**41.0**	increase
Additive Manufacturing (3D Printer)		22	▲ 21.4		59	–		61	**3.4**	slight increase
Oscillator	608		▲ 13.6		712	**17.1**		898	**26.1**	slight increase
Optical Sensing and Measurement Field	2,675		5.3	2,680		**0.2**	2,741		**2.3**	slight increase
Optical Sensing Equipment		2,536	4.8		2,528	▲ 0.3		2,581	**2.1**	slight increase
Optical Measuring Instrument		139	16.8		152	**9.4**		160	**5.3**	flat
Others Field		981	▲ 10.5	918		▲ 6.4	1,014		**10.5**	flat

ProductItems	FY2019 ShipmentActual (in100millionyen)		GrowthRate(%)	FY2020 ShipmentActual (in100millionyen)		GrowthRate(%)	FY2021 ShipmentEstimate (in100millionyen)		GrowthRate(%)	FY 2022 Shipment Prediction
Sub Total for Optoelectronics Equipment	87,205		▲ 5.8	79,806		▲ 8.5	80,042		**0.3**	flat
Sub Total for Optoelectronics Components	40,389		0.4	37,156		▲ 8.0	38,552		**3.8**	slight increase
Total for Optoelectronics Products	127,594		▲ 3.9	116,962		▲ 8.3	118,594		**1.4**	slight increase

Table 2 Domestic Production of Optoelectronics Industry

Product Items	FY 2019 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2021 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2022 Shipment Prediction
Optical Communications Field	3,782		▲ 2.7	4,132		**9.3**	4,230		**2.4**	slight increase
Optical Transmission Equipment	1,383		17.1	1,734		**25.4**	1,600		▲ 7.7	slight increase
Truck Line and Metro Line		708	12.7		999	**41.1**		941	▲ 5.8	slight increase
Subscriber Line		419	13.9		441	**5.3**		393	▲ 10.9	flat
Router and Switch		121	▲ 3.2		104	▲ 14.0		100	▲ 3.8	slight increase
Optical Fiber Amplifier		135	125.0		190	**40.7**		166	▲ 12.6	increase
Optical Transmission Components	2,226		▲ 11.1	2,197		▲ 1.3	2,412		**9.8**	slight increase
Optical Transmission Link		100	▲ 67.4		160	**60.0**		179	**11.9**	slight increase
Light Emitting Device		327	18.1		358	**9.5**		398	**11.2**	slight increase
Photo Detectors		58	▲ 24.7		58	**0.0**		56	▲ 3.4	flat
Optical Passive Component		200	▲ 7.0		194	▲ 3.0		174	▲ 10.3	flat
Optical Circuit Component		237	4.4		201	▲ 15.2		189	▲ 6.0	increase
Optical Fiber		936	▲ 7.2		855	▲ 8.7		1,001	**17.1**	flat
Optical Connector		208	▲ 15.8		200	▲ 3.8		230	**15.0**	slight increase
Others (Semiconductor Amplifying Device, etc.)		160	10.3		171	**6.9**		185	**8.2**	flat
Optical Fiber Fusion Splicer	173		▲ 14.8	201		**16.2**	218		**8.5**	slight increase
Optical Storage Field	731		▲ 19.1	402		▲ 45.0	256		▲ 36.3	slight decrease
Optical Disk	706		▲ 19.5	380		▲ 46.2	234		▲ 38.4	slight decrease
Laser Diode	25		▲ 7.4	22		▲ 12.0	22		**0.0**	flat
Input/Output Field	9,741		1.8	9,357		▲ 3.9	9,835		**5.1**	slight increase
Optical I/O Equipment	4,440		▲ 3.8	4,218		▲ 5.0	4,103		▲ 2.7	flat
Optical Printer・Multifunction Printer		779	28.3		637	▲ 18.2		691	**8.5**	flat
Imaging equipment		2,304	15.6		2,190	▲ 4.9		2,072	▲ 5.4	flat
Digital Camera, Digital Video Camera		1,869	▲ 18.0		1,825	▲ 2.4		1,675	▲ 8.2	flat
Security camera, Car-mounted camera *		435	32.2		365	▲ 16.1		397	**8.8**	slight increase
Camera Mobile Phone		1,076	▲ 6.5		1,091	**1.4**		1,021	▲ 6.4	flat
Others (Barcode Reader, Image Scanner, etc.)		281	13.8		300	**6.8**		319	**6.3**	flat
Image Sensor	5,301		6.9	5,139		▲ 3.1	5,732		**11.5**	increase
Display and Solid-state Lighting Field	22,494		▲ 12.3	20,823		▲ 7.4	22,015		**5.7**	flat
Display Equipment	4,014		▲ 17.7	3,343		▲ 16.7	3,399		**1.7**	flat
Flat Panel Display		3,658	▲ 18.8		3,092	▲ 15.5		3,125	**1.1**	flat
Projector		196	8.9		180	▲ 8.2		174	▲ 3.3	flat
Large-scale LED Display		160	▲ 16.7		71	▲ 55.6		100	**40.8**	slight increase
Display Device	11,819		▲ 14.8	11,141		▲ 5.7	11,676		**4.8**	flat
Solid-state Lighting	4,611		▲ 3.5	4,423		▲ 4.1	4,636		**4.8**	slight increase
LED Device		4,526	▲ 3.2		4,357	▲ 3.7		4,571	**4.9**	slight increase
LED Lamp		85	▲ 17.5		66	▲ 22.4		65	▲ 1.5	slight decrease
LED	2,050		▲ 3.8		1,916	▲ 6.5		2,304	**20.3**	slight increase
Photovoltaic Energy Field	16,184		▲ 7.7	15,027		▲ 7.1	12,120		▲ 19.3	flat
Photovoltaic Power System		14,973	▲ 7.0		14,022	▲ 6.4		11,529	▲ 17.8	flat
Photovoltaic Cell/Module		1,211	▲ 15.4		1,005	▲ 17.0		591	▲ 41.2	decrease
Laser/Optical Processing Field	6,610		▲ 7.6	5,859		▲ 11.4	7,457		**27.3**	slight increase
Laser and Optical Processing Equipment	6,022		▲ 6.9	5,178		▲ 14.0		6,609	**27.6**	slight increase
CO_2 Laser		280	▲ 35.8		456	**62.9**		607	**33.1**	flat
Solid State Laser		393	▲ 6.9		324	▲ 17.6		391	**20.7**	slight increase
Fiber Laser		736	18.3		501	▲ 31.9		549	**9.6**	increase
Semiconductor Laser Direct Processing Equipment		30	▲ 16.7		30	**0.0**		32	**6.7**	flat
Excimer Laser		2,010	33.4		1,329	▲ 33.9		1,474	**10.9**	slight increase
Lamp/LD Exposure Machine		2,551	▲ 25.3		2,479	▲ 2.8		3,495	**41.0**	increase
Additive Manufacturing (3D Printer)		22	▲ 21.4		59	–		61	**3.4**	slight increase
Oscillator	588		▲ 14.2		681	**15.8**		848	**24.5**	slight increase
Optical Sensing and Measurement Field	2,086		3.2	2,081		▲ 0.2	2,116		**1.7**	slight increase
Optical Sensing Equipment		1,963	2.7		1,946	▲ 0.9		1,973	**1.4**	slight increase
Optical Measuring Instrument		123	12.8		135	**9.8**		143	**5.9**	flat
Others Field		757	▲ 2.1		733	▲ 3.2		810	**10.5**	flat

Product Items	FY 2019 Shipment Actual (in 100 million yen)	Growth Rate(%)	FY 2020 Shipment Actual (in 100 million yen)	Growth Rate(%)	FY 2021 Shipment Estimate (in 100 million yen)	Growth Rate(%)	FY 2022 Shipment Prediction
Sub Total for Optoelectronics Equipment	38,408	▲ 6.6	35,580	▲ 7.4	34,444	▲ 3.2	slight increase
Sub Total for Optoelectronics Components	23,977	▲ 9.1	22,834	▲ 4.8	24,395	**6.8**	slight increase
Total for Optoelectronics Products	62,385	▲ 7.6	58,414	▲ 6.4	58,839	**0.7**	slight increase

increase due to the impact of the supply shortage of components involved with the spread of COVID-19 infection.

In the entire optoelectronic industry, the total shipments amounted to 11,859.4 billion yen (growth rate: 1.4%) and the domestic production was 5,883.9 billion yen (growth rate: 0.7%).

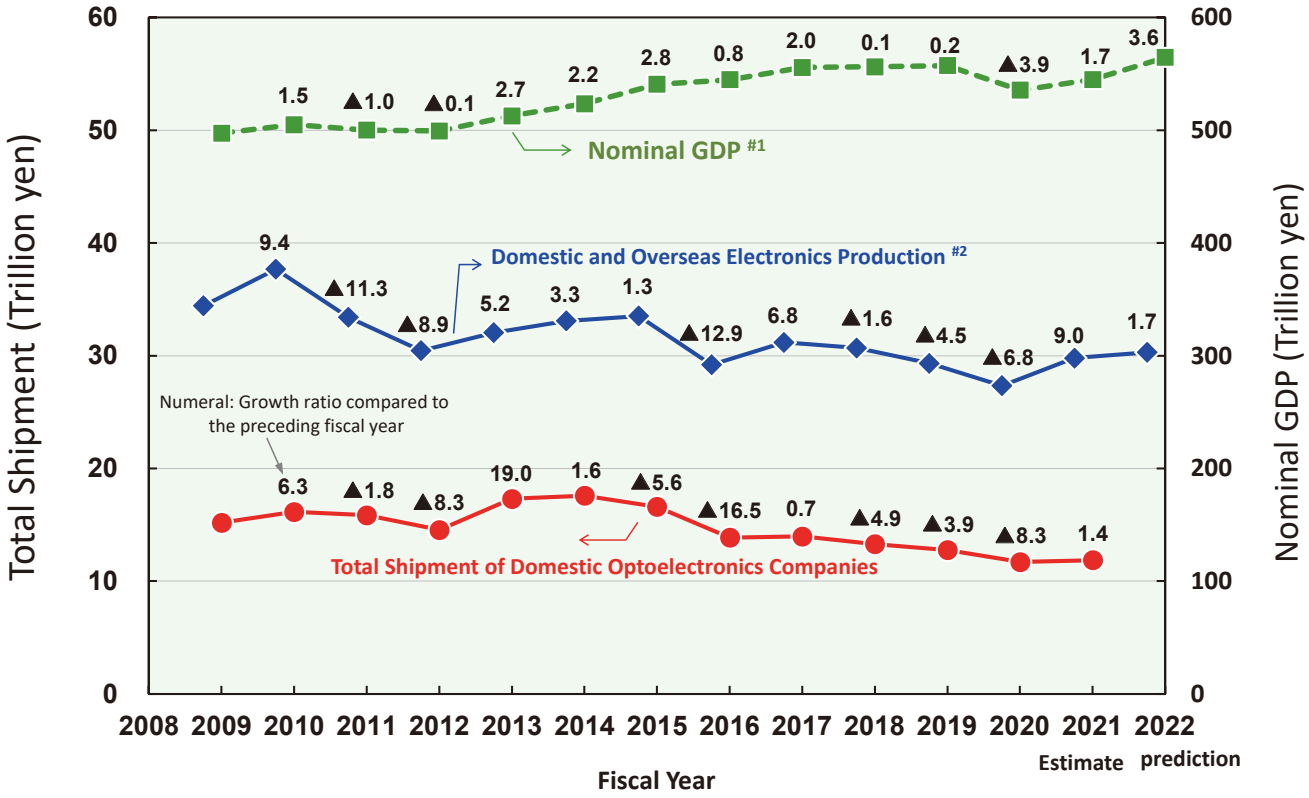
● **FY 2022 (projections)**

In the optical communication field, both the total shipments and domestic production are expected to slightly increase because the demand for the network and data center would continuously increase. In the I/O field, both the total shipments and domestic production are expected to slightly increase due to an increase in demand for imaging devices and image sensors. In the laser/optical processing field and sensing and measuring field, both the total shipments and domestic production are expected to slightly increase on the back of the strong capital investment for semiconductors and automobiles. In the display and solid-state lighting field, both the total shipments and domestic production are expected to be unchanged because the demand created by the Olympic Games has passed its peak. In the photovoltaic energy field, both the total shipments and domestic production are expected to be unchanged due to a lack of favorable factors. In the optical storage field, both the total shipments and domestic production are expected to slightly decrease because the demand would continuously decrease. The outlook for the global economy remains uncertain. However, the entire optoelectronic industry is expected to continue its recovery from COVID-19, and both the total shipments and domestic production are expected to slightly increase.

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 association in collaboration with OIDA (US), PIDA (Taiwan) and SOA (Scotland), which were 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.



#1 Cabinet Office： National Accounts for 2020／Fiscal 2022 Economic Outlook (Jan. 17, 2022 [Cabinet Decision])
#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2021

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

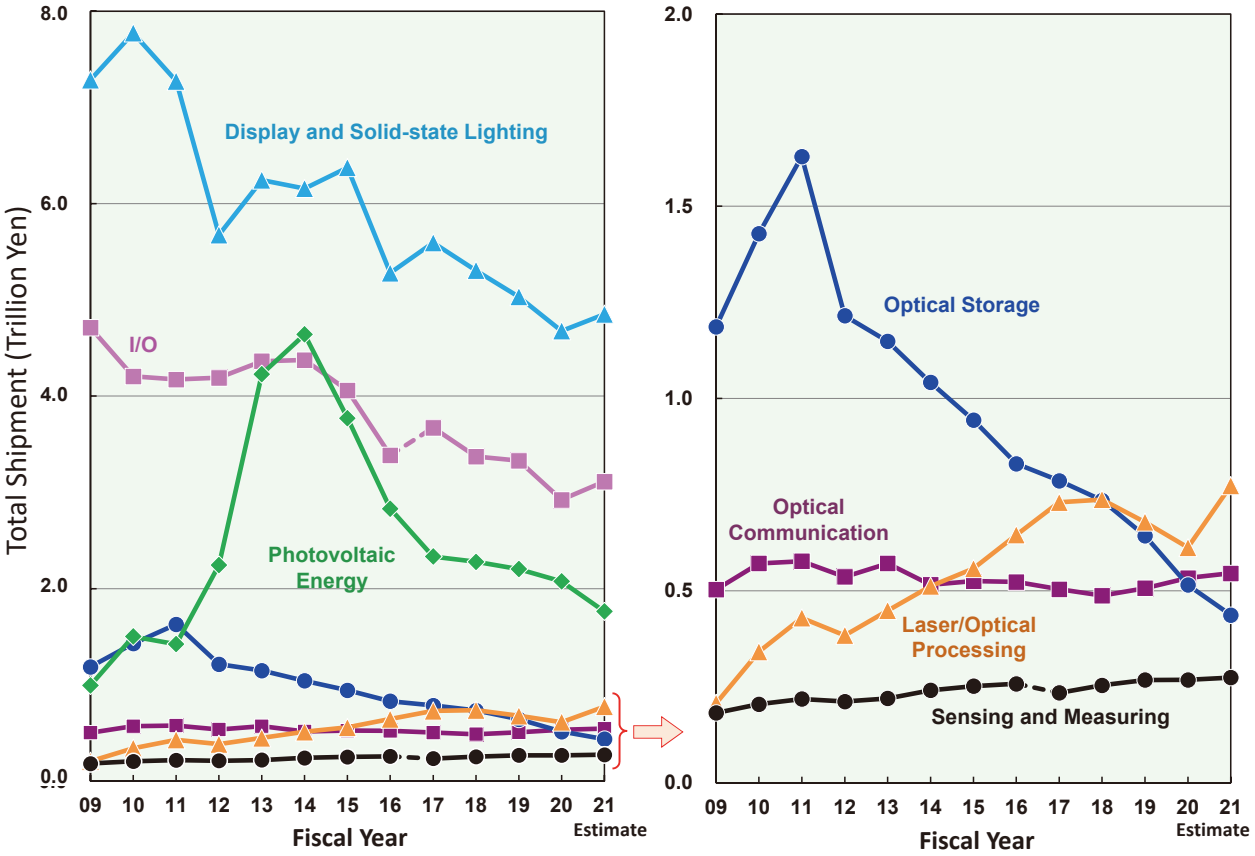
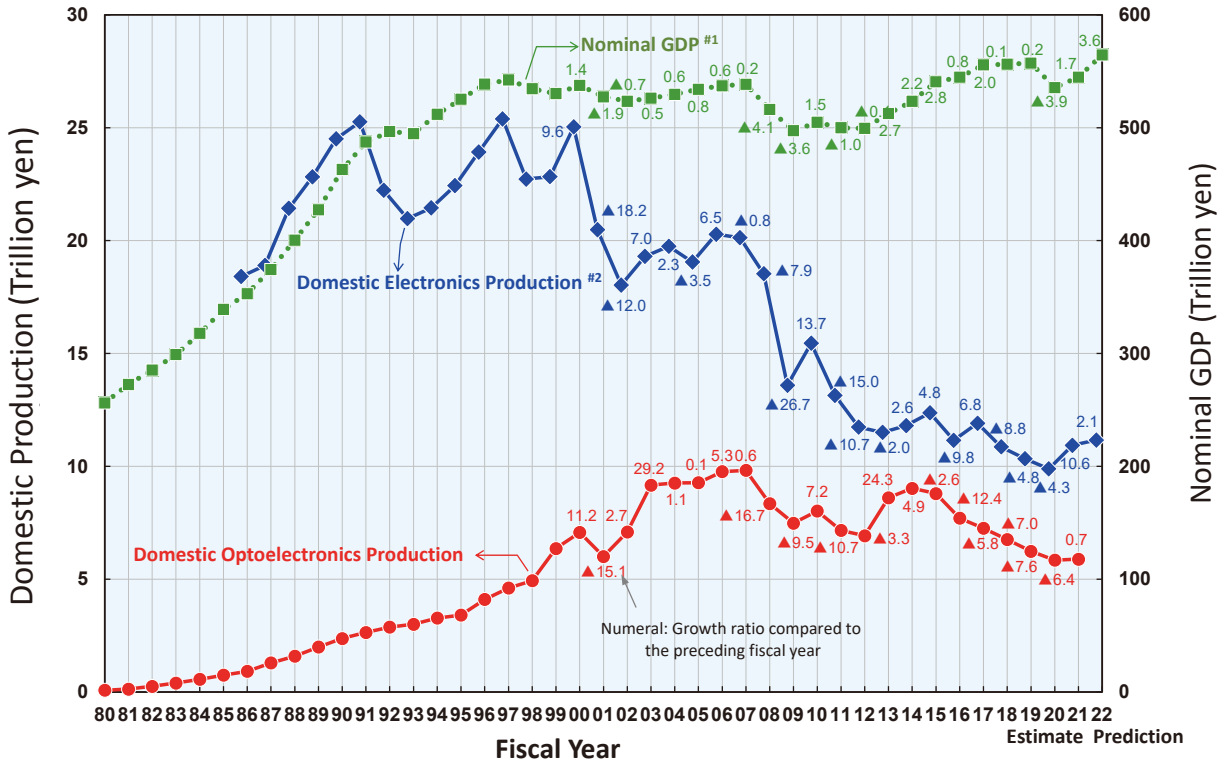


Fig.2 Shipment by Product Field

[Note] The data between FY2016 and FY2017 in the sensing and measuring field and the I/O field are shown by the dotted lines because surveillance cameras and car-mounted cameras have been moved from the sensing and measuring field to the I/O field.



#1 Cabinet Office： National Accounts for 2020/Fiscal 2022 Economic Outlook (Jan. 17, 2022 [Cabinet Decision])
#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2021

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

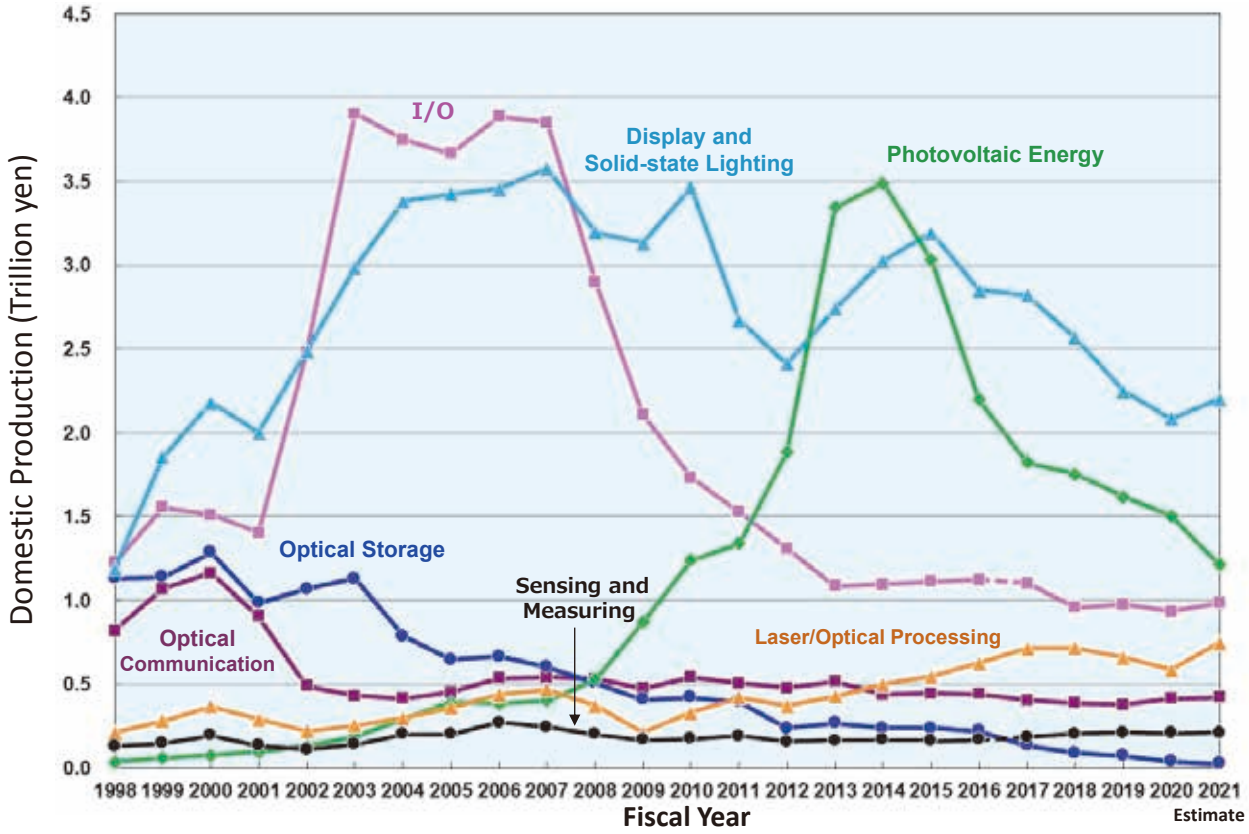


Fig.4　Domestic Optoelectronics Production by Product Field

Fig.5　IOA Members (as of 2021)

■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	OPTICA	formerly OIDA
■Taiwan	PIDA	Photonics Industry and Technology Development Association
■Scotland	SOA	Scottish Optoelectronics Association
■Switzerland	Swissphotonics	

Technological Strategy Development

1. Introduction

OITDA has been developing Optical Technology Roadmap since 1996 with the aim of identifying the future growth of the optoelectronics industry and directing the research and development of optical technologies.

In FY2021, we developed a roadmap entitled "Optoelectronics Technologies for Human Communication in Cyber-physical Society" for the development of non-contact and immersive communication based on new social images and social values after the COVID-19 pandemic.

2. Optical technology roadmap

In the coming era toward 2040, the rapid progress of online will lead to a society where people are not in contact with each other. In order to respond to such rapid changes in the social environment, we have to not only solve various problems toward online systems, but also overcome many challenges including realization of multi-communication in a complicated environment where real and virtual systems are fused and coexist, creation of a virtual space indistinguishable from the reality, and creation of a new space beyond the reality.

Taking COVID-19 as a trigger, we have clarified the future image of four application fields from the viewpoint of communication that varies drastically with changes in the values of Japanese society, and summarized the roadmap of the major technological fields related to realization of the applications.

2.1 Application areas

(1) Social communication

Social communication covers a wide range of communication in the living space, from casual dialogue to decision-making, collaborative work, and life support in a society where the cyber and physical spaces are integrated together.

Developments in automatic translation and related technologies will enable communication beyond languages, and communication costs approach zero. Automatic speech technology is expected to be realized, and our avatars will be in charge of communication on our behalf. The fusion of metaverse and the real world will realize a cyber-physical mixed environment. Advances in display technologies and high-speed high-capacity communications will enable avatars to communicate in the real world. Moreover, the robot will work not only as a substitute for humans but also as an extension of humans. With the realization of private space travel, social communication will significantly change physically. The outer space will also be included in the communication world, causing qualitative changes in society and culture.

(2) Healthcare

Healthcare covers a wide range of activities to maintain healthy and comfortable lives for our body and mind, such as health maintenance, disease prevention, recovery, and rehabilitation in an environment where even the human condition is digitized.

It will be possible to get any kind of daily lifelogs including device usage history, actual behaviors, and biological signals. And with development of the multimodal deep learning technology using various big data, it will be possible not only to detect lifestyle diseases and mental illnesses, but also to predict the risk of occurrence with high accuracy. As AI technology for voice recognition, dialogue processing, and human state recognition has been highly sophisticated, not only providing users with current health conditions and future prediction results, but also conducting routine medical examinations and counseling by a healthcare physician tailored to each user through the dialogue will be achieved.

(3) Education

Education covers an advanced ICT environment that does not require face-to-face or online awareness, enriched lifelong learning and skill improvement, and necessary flexible community formation and communication.

An educational environment will be realized in which anyone can enjoy similar communication from anywhere in an environment optimized for individual characteristics. In the educational environment, information sensing utilizing IoT and big data, information analysis utilizing knowledge of AI technology and other fields, media expression utilizing audiovisual technology and HCI (Human Computer Interaction) will play important roles. For information sensing, it is important to sense and record unconscious actions, lines of sight, emotions, and others in a non-contact manner from the outside. For information analysis, it is important how fast and flexible the analysis and judgment on a huge amount of data updated in real time through sensing can be processed with machine learning, etc. For media expression technology, the cross-modal reproduction method that appropriately converts and reproduces sensory information and complements multiple senses mutually will play important roles.

(4) Shopping/Entertainment

Shopping/entertainment covers next-generation experiences that enrich our lives focusing on mental aspects such as shopping, travel, sports, entertainment, and gourmet in a new era transcending distance, time, and space.

The space/object reproduction technology will be realized with high accuracy by 2030. However, out of the five-sense/multimodal reproduction technologies, reproduction of the sense of smell and taste and the reproduction of human thoughts and behaviors will be actually applied to various fields after 2030. In the expression of the five senses and multimodal sensations, the comprehensive sensations and impressions are controlled by the coordination of each modal and the optimization. However, since this technology has a highly subjective expression and reproduction technique, the expression method taking into account situations and individual differences should be established based on the analysis of a huge number of scenes by utilizing AI. In the spatiotemporal reproduction, it will be possible to achieve the more advanced spatiotemporal expression by conducting spatiotemporal interpolation using AI with a method that faithfully reproduces the acquired data only and performing flexible and highly impressive reproduction in consideration of the user's situation and personal preference.

2.2 Technical field

(1) Virtual mapping

Virtual mapping covers a spatial mapping technology that digitizes many objects and movements in a large living space and appropriately matches them as spatial information in cyberspace.

In the virtual mapping on a city scale, mapping with measurement information from autonomous driving system users will be used frequently. The captured images and telemetry data while driving are used for learning the autonomous driving model. In the virtual mapping on a city scale and indoor scale, 3D information is stored as high-definition 3D data using photogrammetry technology that can restore 3D data from a large number of photos and sensors such as LiDAR. It will also be possible to generate 3D data by easily mapping the physical space with smartphone applications. In addition, in order to link the physical space with the cyberspace more frequently and densely, an inexpensive permanent device dedicated to virtual mapping will be developed so that the influence of both the physical and cyberspaces can be immediately considered.

(2) XR (AR/MR/VR)

XR covers the reproduction technology that effectively feeds back the results of the effective fusion of cyberspace and physical space to the perception of human senses such as sight and hearing.

Sensing technologies such as measurement of dimensions of physical space and things and detection of surface attributes will advance. Regarding the measurement of dimensions of space and things, 3D scanners using LiDAR and depth sensors will evolve, thereby accelerating utilization. In the feedback to the visual sense, in addition to the basic performance as an image display such as spatial/temporal resolution and color reproduction, the function of improving the sense of presence with natural stereoscopic vision will be the key point in the perceptual feedback. Research and development of contact lens-enabled wearable display devices that do not affect the appearance of a wearer will also advance. Cross-modal sensory reproduction, including hearing, touch, smell, and taste, as well as research on reproduced substances in the materials science field will also advance.

(3) Telexistence

Telexistence covers transmission technologies for remotely and accurately communicating a high sense of presence and reality through robots, avatars, actuators, and so on.

People in remote areas will use telepresence robots to participate in conferences instead of attending conferences through a teleconferencing system. Furthermore, not only will they participate in conferences using telepresence robots, but they will be able to be in the office for casual communication even when there is no conference. The displays to be used must have a high resolution such as 4K or 8K. And mounting a 360-degree camera that can look around on the telepresence robot enables to obtain a more immersive telepresence robot experience. After that, initiatives for 3D video communication using depth cameras will shift into a new era for 3D video communication. A resolution that can reproduce human vision including peripheral vision requires about 17 times the resolution of the current 8K. Voice communication for achieving a high sense of presence also encompasses three-dimensional elements such as the direction and pitch of sound.

(4) Sensing (camera/distance sensor)

Sensing covers not only geometric and optical model bases, but also flexible and high-speed sensing technologies for next generation such as spatial reconstruction algorithms and asynchronous sensing incorporating new methods, including machine learning.

Multi-viewpoint image/spatial information acquisition technology using multiple RGB image sensors, spatial information acquisition with an approach different from conventional CCD and CMOS image sensors, and invisible light sensors will be developed. The importance of spatial reconstruction algorithm, which reconstructs spatial information from sensor information with high accuracy, will increase by utilizing the following: methods of generating multi-viewpoint videos under asynchronous/non-aligned situations and images with a different focal distance from a monocular RGB image with machine learning; an event-driven camera that asynchronously detects changes in the brightness of each pixel and reconstructs the image using a convolutional neural network; developed and improved polarized cameras, multispectral cameras, and hyperspectral cameras; and machine learning represented by deep learning.

(5) Information display

Information display covers a wide variety of display technologies such as new information presentation in cooperation with processing technology, new non-contact display devices, and non-wearable AR presentation, in addition to the evolution of device technologies.

In order to live with actual reality in the metaverse space, stealth displays will become popular as 2D displays that integrate and display images without a sense of presence as a display device in the real space. The 3D display will provide sightseeing experience beyond time and space in a space that is as large as a public telephone booth but feels spacious due to an immersive video space technology, and an interface that allows you to interact with a person's superimposed image without glasses in a real space. At present, since goggles and eyeglasses that people have to be aware of wearing equipment have evolved in the near-to-eye display, it will be possible to display images that cover the entire visual field via contact lenses.

(6) Low-latency network

Low-latency network covers not only comfortable communication due to non-compression and low latency, but also total network up to terminal processing with direct end-to-end connection with ultra-low latency.

It will be possible to easily connect at 100 or 200 Gbit/sec per wavelength between long-distance bases. In addition, the openness will make it easier to add application functions to transmission devices and to perform integrated control and monitoring from the outside, enabling remote production of live programs such as sporting events in the broadcasting and video production industry and popularization of new low-latency transmission applications such as remote monitoring and medical care. By reducing the delay of electrical processing on routers and switches in IP networks and transmitting information optically as much as possible, the end-to-end delay will be reduced to 1/200 of the conventional one.

3. Summary

Here is a summary of what will be required for interpersonal communication around 2040.

1) In both cyber and physical societies, a person who becomes a user is at the center, and the person-centered concept is the key from sensing a person to presenting things to a person.
2) In order to closely link cyberspace and physical space, it is a challenge for us how to manage the dynamic information in the physical space by converting it into data flexibly in real time.
3) It is not only possible to easily use 3D models at any time, but it is also necessary to realize flexible models in vast spaces, such as guessing and estimating objects that are difficult to observe, including the past and the universe.
4) In addition to the evolution of device technology, such as algorithms that predict the future in the next few seconds, a close fusion of advanced processing technology and optical device technology is important.

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, but they also include several optical applications and lasers. Besides, working for domestic standardization (JIS), OITDA is also working on international standardization such as IEC and ISO through field-specific sub-committees in order to respond to rapid changes of industrial structure and technologies.

Three international standardization projects are underway based on the commission from the Ministry of Economy, Trade and Industry.

Outlined below are the standardization activities that have been carried out by the standardization committees.

2. Fiber Optics Standardization Committee

The Fiber Optics Standardization Committee plays a vital role in planning and promoting standardization by coordinating the integrity and overall direction of the other committee's activities.

Partly because remote work was strongly recommended as a deterrent measure against the spread of COVID-19 starting from the beginning of 2020, demand and expectations for the IT-related communication infrastructure have been increasing, and the cloud technologies and home information appliances have been developing.

In addition, there is a movement to reduce power consumption by replacing the information processing that has been performed using electricity with fiber optics, as a solution to the increase in power consumption and heat generation in electrical equipment in data centers and routers caused by the rapid increase in information circulation. Furthermore, the use of infrastructure that is considered to be socially important has been expanding in the sensing with fiber optics. Thus, the scope of application for fiber optics-related technologies has further expanded. At the same time, standardization for fiber optics has also become important. It is important to constantly review the purpose and target, identify the items to be standardized, and develop a standardization vision for clarifying the ideal form of standardization.

Based on this awareness of problems, we are promoting research and study on fiber optics in general, and are focusing on improving problems and formulating strategies for JIS and IEC international standardization.

3. Optical Fiber Standardization Committee

This committee proceeds with review of the JIS to ensure harmonization with various testing methods and product standards in the IEC and ITU-T. And this committee also conducts survey and research activities to respond to new technologies so that it can precisely recognize the domestic and international circumstances and deliberate or revise a draft of JIS in a timely manner.

4. Fiber Optic Interconnecting Device Standardization Committee

It is anticipated that communication networks such as backbone networks, metro networks, and access networks to data center networks will dramatically grow in capacity and scale. For fiber optic interconnecting device, which interconnects the optical fiber cords/cables in the infrastructure equipment in the networks, different types of interconnecting device are supplied by different manufacturers. Therefore, it is required to ensure product compatibility. This committee has been promoting harmonization between the JIS and the corresponding international standards such as IEC standards in accordance with the WTO agreement on Technical Barriers to Trade (TBT Agreement).

5. Optical Passive Components Standardization Committee

This committee prepares drafts of new JIS, revises of existing JIS as well as deliberates on the common rules and testing/measuring methods by conducting the surveys on the trend of international standardization.

6. Optical Active Device Standardization Committee

This committee develops and improves JIS based on the rule of adopting a harmonized standard system of IEC.

In the formulation of standards related to optical active devices by IEC, a draft standard for the devices such as small optical transceivers for 40 Gb/s optical transmission, surface emitting lasers, semiconductor optical amplifiers, tunable laser modules, and packages for optical integrated circuits have been currently proposed and deliberated, with a view to the development of new optical transmission systems such as WDM-PON, digital coherent transmission, and high-speed LAN. In addition to the standardization of individual optical active device, discussions on the standardization of such devices as integrated functional devices have been developing, including package and performance standards for mobile fronthaul analog optical transceivers and photonic integrated circuits (PIC). This committee has been proceeding with activities while collecting information on these trends.

7. Optical Amplifier and Dynamic Module Standardization Committee

In response to the IEC's decision to integrate TC 86/SC 86C/WG 3 with WG 5, Optical Amplifier Standardization Committee and Dynamic Module Committee under Fiber Optics Standardization Committee were integrated and Optical Amplifier and Dynamic Module Standardization Committee has been established. The main activities of the committee are (1) preparing a draft JIS in corresponding to the IEC standards and the circumstance in Japan and (2) grasping the trends in international standardization and making proposals as appropriate via the domestic committee.

8. Optical Subsystem Standardization Committee

IEC/TC 86/SC 86C/WG 1 addresses the standardization for the physical layers of optical communication systems and subsystems and proceeds with the establishment of design guidelines and the standardization of testing methods for optical systems (general systems, digital systems, optical cable equipment, and optical links). This committee has been supporting the standardization activities of SC 86C/WG 1 and proceeded with the development of JIS based on the IEC standards according to the needs in Japan. This committee also aids the survey on new technologies and the preparation of proposal documents to promote the technologies, in which Japan is ahead of other countries, to IEC.

9. Optical Measuring Instrument Standardization Committee

This committee examines revisions of JIS for testing methods for measuring optical attenuators, optical return loss meters, calibration methods for optical power meters, and light sources for optical fibers.

10. TC 76/Laser Safety Standardization Committee

This committee have functions as a domestic deliberation committee for IEC/TC 76, the international electrotechnical committee for standardization regarding optical radiation safety and laser equipment, as well as a draft creation committee that develops relevant JIS. In this fiscal year, this committee participated in the deliberations for standardization of the following:

1 Measurements for classification of laser products
2 Particular requirements for the basic safety and essential performance of non-laser light source equipment intended for therapeutic, diagnostic, monitoring and cosmetic/aesthetic use
3 Laser guards

4 Guided beam delivery systems
5 Photobiological Safety of Ultraviolet Lamp Products
6 Eye and face protection - Protection against laser radiation - Part 1: Requirements and test methods

11. ISO/TC 172/SC 9 Standardization Committee

This committee conducts various activities such as collecting domestic opinions and reviewing draft international standards proposed by ISO/TC 172/SC 9.

In FY2021, the committee reviewed the following draft standards.

1 Lasers and laser-related equipment — Test methods for laser beam parameters — Polarization
2 Optics and photonics — Laser and laser-related equipment — Photothermal technique for absorption measurement and mapping of optical laser components
3 Optics and photonics — Test method for total scattering by optical components
4 Lasers and laser-related equipment — Test methods for laser beam parameters — Beam positional stability
5 Optics and photonics — Lasers and laser-related equipment — Measurement of phase retardation of optical components for polarized laser radiation
6 Safety of machinery — Laser processing machines — Part 2: Safety requirements for hand-held laser processing devices

12. Optical Disc Standardization Committee

This committee specializes in the standardization of optical disc-related technologies. Its main tasks are to prepare drafts of domestic standards and to survey and research the trends in the related technologies.

In FY2021, the following JIS revisions were implemented in response to the revision of the ISO/IEC international standards.

- JIS X 6230 to 6233 (base standards: ISO/IEC 30690 to 30693)
- JIS X 6255 (base standard: ISO/IEC 29121)

13. International Standardization Committee on System Integrity of In-vehicle Ethernet

While in-vehicle communication is expected to increase drastically due to the development of the advanced driving support systems and autonomous driving, the in-vehicle Ethernet standards, which strengthen the real-time performance and fail-safe function, require in-vehicle communication systems to ensure high reliability as a communication backbone and sensor network that connect between base units for self-driving vehicles. Regarding EMC characteristics, a reliable in-vehicle communication system can be achieved by combining a communication board having excellent EMC characteristics with an optical harness that neither generates electromagnetic noise nor has EMC vulnerability. In FY2020, the 4th term project (three years) was launched to proceed with (1) development of the evaluation method for in-vehicle communication systems to ensure the system integrity and (2) preparation for establishment of testing/certification organization and (3) development of IEC, ISO, and IEEE standards.

14. International Standardization Committee on Quality Evaluation Method for Optical Discs for Long-term Data Storage and Method of Operating Systems for Long-term Storage

Optical discs are expected to promote the creation of the archive market as a strategic storage medium for digital data with the rapid progress of information explosion in recent years. This project has formulated media grading, which indicates the initial performance of the optical disc itself, and established evaluation criteria for an optical disc archive system, including consistency with drives to ensure the recording quality of digital data, based on the physical standards and life estimation standards for each optical disc product (such as CD, DVD, and BD). Currently, we are implementing the following two things with the goal of expanding the data storage infrastructure globally and strengthening the international competitiveness of optical disc archiving systems and media: (1) JIS revision to address new challenges clarified through operation; and (2) development of international standards.

15. International standardization of connector optical interface for multicore fiber

In order to meet the ever-growing demand for communications, the practical application of Space Division Multiplexing (SDM) technology aimed at increasing transmission capacity has become an urgent issue. A system using Multi-Core Fiber (MCF) has been developed as a method to realize SDM technology, and an optical connector for MCF is indispensable to realize this system. On the other hand, when used in an optical network, standardization regarding optical interoperability, which is an interface necessary for performance assurance when optical connectors of a plurality of manufacturers are connected to each other, is required. Therefore, we aim to expand the market worldwide in the future through the rapid spread of new technologies for optical connectors for MCF, which has been developed in Japan. This project is a three-year project from FY2021. At the IEC meeting, the technical presentation had been made for the international standardization of optical connectors for MCF, and a draft international standard for optical interoperability of optical connectors for MCF will be prepared. We propose the above to IEC/TC86/SC86B and work toward the target of registering it as an international standard NP (New Work Item Proposal) by February 2024.

Educational and Public Relations Activities

1. The 40th Anniversary Symposium of OITDA

With the support of the Ministry of Economy, Trade and Industry, the 40th Anniversary Symposium of OITDA entitled "Light Innovation toward a New Era" was held at Rihga Royal Hotel Tokyo on Monday, June 14, 2021.

The four speeches listed in Table 3 were given on the day. There were about 140 participants in the symposium after taking all possible measures to prevent the spread of COVID-19, which is close to 50% of the venue capacity.

Table 3 The 40th Anniversary Symposium of OITDA

10:30 ～ 10:35	Opening Remarks	Mr. Yasuhisa Odani President / Vice Chairman, OITDA
10:35 ～ 10:45	Guest Greeting	Mr. Masaki Tone Director, Device Industry & Semiconductor Strategy Office Commerce and Information Policy Bureau, METI
10:45 ～ 11:45	Special invited lecture: Seeking ground breaking materials	Dr. Hideo Hosono Honorary Professor, Tokyo Institute of Technology
13:00 ～ 13:50	Invited lecture: Innovative evolutions of integrated optical devices based on magneto-optical materials	Dr. Tetsuya Mizumoto Executive Vice President for Education, Tokyo Institute of Technology
13:50 ～ 14:40	Invited lecture: Scalable optical transport technologies	Dr. Yutaka Miyamoto Fellow, NTT Network Innovation Laboratories
14:40 ～ 15:30	Invited lecture: Photonics-electronics convergence technology to open up tomorrow - Looking back on 10 years of PETRA -	Dr. Shuichi Tahara Executive Director, Photonics Electronics Technology Research Association (PETRA)

2. FY 2021 Symposium on the Optoelectronics Industry and Technology

The FY 2021 Symposium on the Optoelectronics Industry and Technology was held at the Rihga Royal Hotel Tokyo on Wednesday, February 16, 2022. The event was jointly sponsored by OITDA and the Photonics Electronics Technology Research Association (PETRA), with support of the Ministry of Economy, Trade and Industry. Under the theme of "Optoelectronics Technologies Pioneering Cyber-Physical Society", six important presentations were given as shown in Table 4 with around 90 participants.

Table 4 FY 2021 Symposium on the Optoelectronics Industry and Technology

10:00 ～ 10:05	Opening Remarks	Mr. Yasuhisa Odani President / Vice Chairman, OITDA
10:05 ～ 10:15	Guest Greeting	Mr. Kazumi Nishikawa Director, IT Industry Division, Commerce and Information Policy Bureau, METI
10:15 ～ 11:15	Keynote Speech: Pioneering the Future of Cyber Physical Society by Optics Technologies	Dr. Kiyoshi Kiyokawa Professor, Nara Institute of Science and Technology
11:15 ～ 12:00	New display technologies linking cyber and physical spaces	Dr.Yasuhir Takaki Professor, Tokyo University of Agriculture and Technology Faculty of Technology Department of Electrical and Electronical Engineering
13:00 ～ 13:45	R&D for the digitization of humans to enhance humanity	Dr. Shingo Kinoshita Vice President, Head of NTT Human Informatics Laboratories NIPPON TELEGRAPH AND TELEPHONE CORPORATION
13:45 ～ 14:30	Roadmap of Optoelectronics Technologies for Human Communication in Cyber-physical Society	Dr. Hideaki Takada Professor, School of Information and Data Sciences Nagasaki University
14:45 ～ 15:30	Highlight of Ten-Years in Integrated Photonics-Electronics Convergence System Technology	Dr. Takahiro Nakamura Photonics Electronics Technology Research Association (PETRA)
15:30 ～ 16:15	Development of Ultra-wide-band Digital Coherent Transceiver using Heterogeneous Material Integration Technology toward Distributed Computing	Dr. Nobuhiko Nishiyama Photonics Electronics Technology Research Association (PETRA)
16:20 ～ 17:00	The Award Ceremony of 37th Kenjiro Sakurai Memorial Prize	

3. interOpto

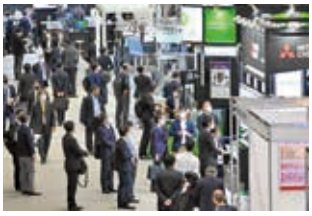
interOpto 2021, an international exhibition of cutting-edge optoelectronics technology, was held at Tokyo Big Sight for three days from October 27th to October 29th, 2021, with support and cooperation from the Ministry of Economy, Trade and Industry and many other organizations.

Rebranding in light of social conditions and market trends, interOpto took place as the "Optical & Next Generation Application Network System Exhibition", as part of the Total Solution Exhibition for Electronic Equipment, with the "JPCA Show".

The Concurrent Exhibition had 12 exhibitions including optical-related "LED JAPAN" and "Imaging Japan", "JPCA Show" that was a general exhibition for electronics equipment, devices, and mounting equipment, "Smart Sensing" and "Edge Computing." At Tokyo Big Sight, the entire Concurrent Exhibition took place across South Halls 1 to 3 while interOpto at South Hall 2. In terms of scale, interOpto alone had 33 exhibitors with 33 booths while the three optical-related exhibitions had 38 exhibitors with 38 booths in total. During the three days, the total number of visitors registered to the Total Solution Exhibition for Electronic Equipment was 16,699.

In the exhibition hall, setting up the annual "Notable Optoelectronics Technology/Special Exhibit Zone", two organizations recommended by the subcommittee of OITDA's Optoelectronic Technology Trend Research Committee exhibited their technologies and products.

At the OITDA booth, we conducted public relations activities, such as providing the latest information and exhibiting panels, research reports of optical industry and technology and distributing Annual Technical Report for free.



4. 37th Kenjiro Sakurai Memorial Prize

The Kenjiro Sakurai Memorial Prize, was established in 1985 and celebrates the great achievements of the late Kenjiro Sakurai, who promoted the development of the optoelectronics industry and served as a board member of OITDA.

It awards individuals and groups who have made pioneering contributions to the optoelectronics industry and technological development.

By 2021, 69projects (175 people) have been awarded.

In 2021, one project was awarded.

The prize was awarded to Mr. Motohiro Furuki, Mr. Kouji Futamura, Mr. Shingo Imanishi, Mr. Takeshi Yamasaki at Sony Corporation, which had made development and commercialization of spectral flow cytometer.

The winners developed and commercialized the world's first spectrum analysis flow cytometer. This realization was achieved by a combination of an independently voltage-controlled 32ch linear array photomultiplier tube and a weighted least squares algorithm, developed originally. This equipment significantly increases the number of detected fluorescence by using a spectral unmixing method, and overcomes the lack of reproducibility about fluorescence intensity compensation, which is caused by using a conventional flow cytometer equipment. As a result, they succeeded in realizing more than 44 colors of fluorescence detection as the world's highest performance with 7 laser excitation. Since this equipment has very high resolution, it is used in advanced medical research institutes in Japan and overseas, and it greatly contributes to cancer immunology and infectious disease research. The realization of new optical equipment contributes greatly to society in the medical and life science research field.

The award ceremony was held on February 16th, 2022 following the FY 2021 Symposium on the Optoelectronics Industry and Technology.

At the ceremony, Dr. 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 37th Kenjiro Sakurai Memorial Prize
From left: Mr. Shingo Imanishi, Mr. Motohiro Furuki,
Mr. Kouji Futamura, Mr. Takeshi Yamasaki

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(As of March 31, 2022)

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