UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, DC 20549

FORM 10-Q

(MARK ONE)

☒ **QUARTERLY REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the quarterly period ended March 31, 2024

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from ___________ to

Commission file number 0-23621

MKS INSTRUMENTS, INC.

(Exact name of registrant as specified in its charter)

Massachusetts	**04-2277512**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification No.)**
2 Tech Drive, Suite 201, Andover, Massachusetts	**01810**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code (978) 645-5500

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, no par value	MKSI	Nasdaq Global Select Market

Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act:

Large accelerated filer	☒	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	☐
		Emerging growth company	☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☒

As of April 29, 2024, the registrant had 67,196,556 shares of common stock outstanding.

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PART I. FINANCIAL INFORMATION

ITEM 1. FINANCIAL STATEMENTS.

MKS INSTRUMENTS, INC.
CONDENSED CONSOLIDATED BALANCE SHEETS
(in millions, except per share data)
(Unaudited)

ASSETS	March 31, 2024	December 31, 2023
Current assets:		
Cash and cash equivalents	$ 845	$ 875
Short-term investments	1	—
Accounts receivable, net of allowance for doubtful accounts of $7 and $6 at March 31, 2024 and December 31, 2023, respectively	576	603
Inventories	971	991
Other current assets	268	227
Total current assets	2,661	2,696
Property, plant and equipment, net	766	784
Right-of-use assets, net	227	225
Goodwill	2,511	2,554
Intangible assets, net	2,501	2,619
Other assets	265	240
Total assets	$ 8,931	$ 9,118
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Short-term debt	$ 50	$ 93
Accounts payable	290	327
Other current liabilities	381	428
Total current liabilities	721	848
Long-term debt, net	4,692	4,696
Non-current deferred taxes	622	640
Non-current accrued compensation	148	151
Non-current lease liabilities	210	205
Other non-current liabilities	114	106
Total liabilities	6,507	6,646
Commitments and contingencies (Note 16)		
Stockholders' equity:		
Preferred stock, $0.01 par value per share, 2 shares authorized; no shares issued and outstanding	—	—
Common stock, no par value, 200 shares authorized; 67.1 and 66.9 shares issued and outstanding at March 31, 2024 and December 31, 2023, respectively	—	—
Additional paid-in capital	2,201	2,195
Retained earnings	373	373
Accumulated other comprehensive loss	(150)	(96)
Total stockholders' equity	2,424	2,472
Total liabilities and stockholders' equity	$ 8,931	$ 9,118

The accompanying notes are an integral part of the unaudited condensed consolidated financial statements.

MKS INSTRUMENTS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF OPERATIONS
AND COMPREHENSIVE INCOME (LOSS)
(in millions, except per share data)
(Unaudited)

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Net revenues:		
Products	$ 754	$ 712
Services	114	82
Total net revenues	868	794
Cost of revenues:		
Products	398	409
Services	55	50
Total cost of revenues (exclusive of amortization shown separately below)	453	459
Gross profit	415	335
Research and development	70	72
Selling, general and administrative	170	174
Acquisition and integration costs	1	6
Restructuring	3	1
Fees and expenses related to amendments to the Term Loan Facility	3	—
Amortization of intangible assets	62	81
Income from operations	106	1
Interest income	(6)	(3)
Interest expense	87	85
Loss on extinguishment of debt	9	—
Other (income) expense, net	(3)	(2)
Income (loss) before income taxes	19	(79)
Provision (benefit) for income taxes	4	(37)
Net income (loss)	$ 15	$ (42)
Other comprehensive income (loss), net of tax:		
Changes in value of financial instruments designated as cash flow hedges	$ 32	$ (15)
Foreign currency translation adjustments	(114)	45
Change in net investment hedge	20	(15)
Unrealized gain on investments	7	—
Net unrecognized pension gain (loss)	1	(2)
Total comprehensive loss	$ (39)	$ (29)
Net income (loss) per share:		
Basic	$ 0.22	$ (0.64)
Diluted	$ 0.22	$ (0.64)
Weighted average common shares outstanding:		
Basic	67.0	66.7
Diluted	67.4	66.7

The accompanying notes are an integral part of the unaudited condensed consolidated financial statements.

MKS INSTRUMENTS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(in millions, except per share data)
(Unaudited)

	Common Stock		Additional Paid-In Capital	Retained Earnings	Accumulated Other Comprehensive Loss	Total Stockholders' Equity
	Shares	Amount				
Balance at December 31, 2023	66.9	$ 0.1	$ 2,195	$ 373	$ (96)	$ 2,472
Net issuance under stock-based plans	0.2		(9)			(9)
Stock-based compensation			15			15
Cash dividend ($0.22 per common share)				(15)		(15)
Comprehensive income (loss) (net of tax):						
Net income				15		15
Other comprehensive loss					(54)	(54)
Balance at March 31, 2024	67.1	0.1	2,201	373	(150)	2,424

	Common Stock		Additional Paid-In Capital	Retained Earnings	Accumulated Other Comprehensive Income	Total Stockholders' Equity
	Shares	Amount				
Balance at December 31, 2022	66.6	$ —	$ 2,142	$ 2,272	$ 69	$ 4,483
Net issuance under stock-based plans	0.1		(6)			(6)
Stock-based compensation			18			18
Cash dividend ($0.22 per common share)				(15)		(15)
Comprehensive (loss) income (net of tax):						
Net loss				(42)		(42)
Other comprehensive income					13	13
Balance at March 31, 2023	66.7	—	2,154	2,215	82	4,451

The accompanying notes are an integral part of the unaudited condensed consolidated financial statements.

MKS INSTRUMENTS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF CASH FLOWS
(in millions)
(Unaudited)

	Three Months Ended March 31,	
	2024	2023
Cash flows from operating activities:		
Net income (loss)	$ 15	$ (42)
Adjustments to reconcile (loss) net income to net cash provided by operating activities:		
Depreciation and amortization	88	107
Unrealized loss on derivatives not designated as hedging instruments	3	13
Amortization of debt issuance costs and original issue discount	8	8
Loss on extinguishment of debt	9	—
Stock-based compensation	15	18
Provision for excess and obsolete inventory	11	18
Deferred income taxes	(36)	(10)
Other	2	—
Changes in operating assets and liabilities, net of effects of business acquired		
Accounts receivable	16	150
Inventories	(1)	(96)
Other current and non-current assets	(5)	(14)
Accounts payable	(32)	(55)
Accrued compensation	(30)	(34)
Income taxes payable	16	(49)
Other current and non-current liabilities	(12)	23
Net cash provided by operating activities	67	37
Cash flows from investing activities:		
Purchases of property, plant and equipment	(18)	(17)
Net cash used in investing activities	(18)	(17)
Cash flows from financing activities:		
Proceeds from borrowings	761	2
Payments of borrowings	(806)	(23)
Payments of deferred financing fees	(2)	—
Dividend payments	(15)	(15)
Net payments related to employee stock awards	(9)	(6)
Other financing activities	(1)	(1)
Net cash used in financing activities	(72)	(43)
Effect of exchange rate changes on cash and cash equivalents	(7)	(6)
Decrease in cash and cash equivalents	(30)	(29)
Cash and cash equivalents at beginning of period	875	909
Cash and cash equivalents at end of period	$ 845	$ 880

The accompanying notes are an integral part of the unaudited condensed consolidated financial statements

(1) Basis of Presentation

The terms "MKS" and the "Company" refer to MKS Instruments, Inc. and its subsidiaries. All intercompany accounts and transactions have been eliminated in consolidation. The interim financial data as of March 31, 2024, and for the three months ended March 31, 2024, are unaudited; however, in the opinion of MKS, the interim data includes all adjustments, consisting of normal recurring adjustments, necessary for a fair statement of the results for the interim periods. The condensed consolidated balance sheet presented as of December 31, 2023 has been derived from the consolidated audited financial statements as of that date. The unaudited condensed consolidated financial statements presented herein have been prepared in accordance with the instructions to Form 10-Q and do not include all of the information and note disclosures required by United States generally accepted accounting principles ("U.S. GAAP"). The unaudited condensed consolidated financial statements should be read in conjunction with the audited consolidated financial statements and notes thereto included in the MKS Annual Report on Form 10-K for the year ended December 31, 2023 filed with the U.S. Securities and Exchange Commission on February 27, 2024.

The preparation of these unaudited condensed consolidated financial statements requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent liabilities at the date of the unaudited condensed consolidated financial statements and the reported amounts of revenues and expenses during the reporting period. On an on-going basis, management evaluates its estimates and judgments, including those related to revenue recognition, inventory valuation, warranty costs, stock-based compensation, intangible assets, goodwill, other long-lived assets and income taxes. Management bases its estimates and judgments on historical experience and on various other factors that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions. As a result of rounding, there may be immaterial differences in amounts presented and certain calculations may not sum to the total number expressed in each category or tie to a corresponding schedule.

The Company has three reportable segments: the Vacuum Solutions Division ("VSD"), the Photonics Solutions Division ("PSD") and the Materials Solutions Division ("MSD") as described in Note 15. During the quarter ended March 31, 2024, the Company moved its Optical Sensing Products ("OSP") product line from the PSD segment to the VSD segment. The purpose of this realignment was to group the OSP products with related semiconductor products within the VSD segment. Prior periods have been recast to reflect this change. The Company reserves the right to make reclassifications between segments.

(2) Recent Accounting Pronouncements

<u>Segment Reporting (Topic 280): Improvements to Reportable Segment Disclosures</u>

In November 2023, the Financial Accounting Standards Board ("FASB") issued Accounting Standard Update ("ASU") No. 2023-07, Segment Reporting (Topic 280): Improvements to Reportable Segment Disclosures, which requires a public entity to disclose significant segment expenses and other segment items on an annual and interim basis and provide in interim periods all disclosures about a reportable segment's profit or loss and assets that are currently required annually. Additionally, it requires a public entity to disclose the title and position of the Chief Operating Decision Maker ("CODM"). The ASU does not change how a public entity identifies its operating segments, aggregates them, or applies the quantitative thresholds to determine its reportable segments. The new standard is effective for fiscal years beginning after December 15, 2023, and interim periods within fiscal years beginning after December 15, 2024, with early adoption permitted. A public entity should apply the amendments in this ASU retrospectively to all prior periods presented in the financial statements. The Company is currently evaluating the impact of this ASU on its disclosures within the consolidated financial statements.

<u>Income Taxes (Topic 740): Improvements to Income Tax Disclosures</u>

In December 2023, the FASB issued ASU No. 2023-09, Income Taxes (Topic 740): Improvements to Income Tax Disclosures, which focuses on the rate reconciliation and income taxes paid. ASU No. 2023-09 requires a public business entity ("PBE") to disclose, on an annual basis, a tabular rate reconciliation using both percentages and currency amounts, broken out into specified categories with certain reconciling items further broken out by nature and jurisdiction to the extent those items exceed a specified threshold. In addition, all entities are required to disclose income taxes paid, net of refunds received disaggregated by federal, state/local, and foreign and by jurisdiction if the amount is at least 5% of total income tax payments, net of refunds received. For PBEs, the new standard is effective for annual periods beginning after December 15, 2024, with early adoption permitted. An entity may apply the amendments in this ASU prospectively by providing the revised disclosures for the period ending December 31, 2025 and continuing to provide the pre-ASU disclosures for the prior periods, or may apply the amendments retrospectively by providing the revised disclosures for all period presented. The Company is currently evaluating the impact of this ASU on its consolidated financial statements and related disclosures.

(in millions, except per share data)

(3) Revenue from Contracts with Customers

Contract assets as of March 31, 2024 and December 31, 2023 were $22 and $26, respectively. A roll-forward of the Company's deferred revenue and customer advances is as follows:

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Beginning balance, January 1[1]	$ 79	$ 96
Additions to deferred revenue and customer advances	30	43
Amount of deferred revenue and customer advances recognized in income	(39)	(41)
Ending balance, March 31[2]	$ 70	$ 98

(1) Beginning balance as of January 1, 2024 included $77 of current deferred revenue and customer advances and $2 of non-current deferred revenue. Beginning balance as of January 1, 2023 included $94 of current deferred revenue and customer advances and $2 of non-current deferred revenue.

(2) Ending balance as of March 31, 2024 included $68 of current deferred revenue and customer advances and $2 of non-current deferred revenue. Ending balance as of March 31, 2023 included $96 of current deferred revenue and customer advances and $2 of non-current deferred revenue.

Revenue from certain custom products, including MSD plating equipment, and revenue from certain service contracts are recorded over time. Remaining product and services revenues are recorded at a point in time.

Disaggregation of Revenue

The following tables summarize product and service revenue from contracts with customers in MKS' three reportable segments.

	Three Months Ended March 31, 2024			
	VSD	PSD	MSD	Total
Net revenues:				
Products	$ 274	$ 214	$ 266	$ 754
Services	58	40	16	114
Total net revenues	$ 332	$ 254	$ 282	$ 868

	Three Months Ended March 31, 2023			
	VSD	PSD	MSD	Total
Net revenues:				
Products	$ 263	$ 159	$ 291	$ 712
Services	41	27	14	82
Total net revenues	$ 304	$ 186	$ 304	$ 794

The following table summarizes revenue from contracts with customers in the Company's three end markets: Semiconductor, Electronics and Packaging, and Specialty Industrial.

	Three Months Ended March 31,	
	2024	2023
Semiconductor	$ 351	$ 309
Electronics and Packaging	208	222
Specialty Industrial	309	263
	$ 868	$ 794

(4) Fair Value Measurements

In accordance with the provisions of fair value accounting, a fair value measurement assumes that the transaction to sell an asset or transfer a liability occurs in the principal market for the asset or liability or, in the absence of a principal market, the most advantageous market for the asset or liability and defines fair value based upon an exit price model.

The fair value measurement guidance establishes a fair value hierarchy which requires an entity to maximize the use of observable inputs and minimize the use of unobservable inputs when measuring fair value. The guidance describes three levels of inputs that may be used to measure fair value:

Level 1 Quoted prices in active markets for identical assets or liabilities as of the reporting date. Active markets are those in which transactions for the asset or liability occur in sufficient frequency and volume to provide pricing information on an ongoing basis.

Level 2 Observable inputs other than Level 1 prices, such as quoted prices for similar assets or liabilities; quoted prices in markets that are not active; or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities. Level 2 assets and liabilities include debt securities with quoted prices that are traded less frequently than exchange-traded instruments or securities or derivative contracts that are valued using a pricing model with inputs that are observable in the market or can be derived principally from or corroborated by observable market data.

Level 3 Unobservable inputs that are supported by little or no market activity and that are significant to the fair value of the assets or liabilities. Level 3 assets and liabilities include financial instruments whose value is determined using pricing models, discounted cash flow methodologies, or similar techniques, as well as instruments for which the determination of fair value requires significant management judgment or estimation.

In certain cases, the inputs used to measure fair value may fall into different levels of the fair value hierarchy. In such cases, the Company categorizes such assets and liabilities based on the lowest level input that is significant to the fair value measurement in its entirety. The Company's assessment of the significance of a particular input to the fair value measurement in its entirety requires judgment and considers factors specific to the asset or liability.

(in millions, except per share data)

Assets and liabilities of the Company are measured at fair value on a recurring basis as of March 31, 2024 and are summarized as follows:

		Fair Value Measurements at Reporting Date Using		
Description	March 31, 2024	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Cash equivalents:				
Money market funds	$ 370	$ 370	$ —	$ —
Time deposits	13	—	13	—
Available-for-sale securities:				
Time deposits and certificates of deposit	1	—	1	—
Group insurance contracts	6	—	6	—
Derivatives				
Foreign exchange forward contracts	6	—	6	—
Interest rate hedges - current	21	—	21	
Interest rate hedges - non-current	46	—	46	—
Pension and deferred compensation plan assets	19	—	19	—
Total assets	$ 482	$ 370	$ 112	$ —
Liabilities:				
Derivatives				
Foreign exchange forward contracts	$ 1	$ —	$ 1	$ —
Total liabilities	$ 1	$ —	$ 1	$ —
Reported as follows:				
Assets:				
Cash and cash equivalents[(1)]	$ 383	$ 370	$ 13	$ —
Short-term investments	1	—	1	—
Other current assets	27	—	27	—
Total current assets	$ 411	$ 370	$ 41	$ —
Other assets	$ 71	$ —	$ 71	$ —
Liabilities:				
Other current liabilities	$ 1	$ —	$ 1	$ —

[(1)] The cash and cash equivalents amount presented in the table above does not include cash of $462 as of March 31, 2024.

(in millions, except per share data)

Assets and liabilities of the Company are measured at fair value on a recurring basis as of December 31, 2023 and are summarized as follows:

		Fair Value Measurements at Reporting Date Using		
Description	December 31, 2023	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Cash equivalents:				
Money market funds	$ 356	$ 356	$ —	$ —
Time deposits	12	—	12	—
Available-for-sale securities:				
Group insurance contracts	6	—	6	—
Derivatives				
Foreign exchange forward contracts	2	—	2	—
Interest rate hedge - current	3	—	3	—
Interest rate hedge - non-current	41	—	41	—
Pension and deferred compensation plan assets	19	—	19	—
Total assets	$ 439	$ 356	$ 83	$ —
Liabilities:				
Derivatives				
Foreign exchange forward contracts	$ 5	$ —	$ 5	$ —
Total liabilities	$ 5	$ —	$ 5	$ —
Reported as follows:				
Assets:				
Cash and cash equivalents [1]	$ 368	$ 356	$ 12	$ —
Other current assets	5	—	5	—
Total current assets	$ 373	$ 356	$ 17	$ —
Other assets	$ 66	$ —	$ 66	$ —
Liabilities:				
Other current liabilities	$ 5	$ —	$ 5	$ —

[1] The cash and cash equivalents amount presented in the table above does not include cash of $507 as of December 31, 2023.

Other Fair Value Disclosures

The estimated carrying value and fair value of the Company's debt as of March 31, 2024 and December 31, 2023 are as follows:

	March 31, 2024		December 31, 2023	
	Carrying Value	Fair Value	Carrying Value	Fair Value
Outstanding debt	$ 4,891	$ 4,894	$ 4,953	$ 4,965

The estimated carrying value and fair value of the Company's debt was determined using available market information based on recent trades or activity of debt instruments with substantially similar risks, terms and maturities, which fall within Level 2 under the fair value hierarchy.

Pension and Deferred Compensation Plan Assets

The pension and deferred compensation plan assets represent investments in mutual funds, exchange traded funds, government securities and other time deposits. These investments are set aside for retirement benefits of certain of the Company's subsidiaries.

Derivatives

As a result of the Company's global operating activities and variable interest rate borrowings, the Company is exposed to market risks from changes in foreign currency exchange rates and interest rates, which may adversely affect its operating results and financial position. When deemed appropriate, the Company minimizes its risks from foreign currency exchange rate and interest rate fluctuations through the use of derivative financial instruments. The principal market in which the

(in millions, except per share data)

Company executes its foreign currency and interest rate contracts is the institutional market in an over-the-counter environment with a relatively high level of price transparency. The market participants are typically large commercial banks. The contracts are valued using broker quotations or market transactions.

(5) Derivatives and Net Investment Hedge

Foreign Exchange Forward Contracts

The Company hedges a portion of its forecasted foreign currency-denominated intercompany sales of inventory, over a maximum period of eighteen months, using foreign exchange forward contracts accounted for as cash-flow hedges. To the extent these derivatives are effective in offsetting the variability of the hedged cash flows, and otherwise meet the hedge accounting criteria, changes in the derivatives' fair value are not included in current earnings but are included in other comprehensive income ("OCI") in stockholders' equity. These changes in fair value will subsequently be reclassified into earnings, as applicable, when the forecasted transaction occurs. To the extent that a previously designated hedging transaction is no longer an effective hedge, any ineffectiveness measured in the hedging relationship is recorded in earnings in the period it occurs. The cash flows resulting from foreign exchange forward contracts are classified in the condensed consolidated statements of cash flows as part of cash flows from operating activities. The Company does not enter into derivative instruments for trading or speculative purposes.

The Company also enters into foreign exchange forward contracts to hedge against changes in the balance sheet for certain subsidiaries to mitigate the risk associated with certain foreign currency transactions in the ordinary course of business. These derivatives are not designated as cash flow hedging instruments and gains or losses from these derivatives are recorded immediately in other (income) expense, net.

The following tables summarize the primary net hedging positions and fair values of foreign exchange forward contracts outstanding as of March 31, 2024 and December 31, 2023:

	March 31, 2024	
Currency Hedged (Buy/Sell)	Net Notional Value	Fair Value Asset (Liability)
U.S. dollar/Japanese yen	$ 62	$ 3
U.S. dollar/South Korean won	65	1
U.S. dollar/Taiwan dollar	20	1
U.S. dollar/Singapore dollar	1	—
U.S. dollar/Chinese renminbi	5	—
Euro/U.S. dollar	77	—
Euro/Chinese renminbi	2	—
Euro/Canadian dollar	1	—
U.S. dollar/Mexican peso	4	—
U.K. pound sterling/U.S. dollar	24	—
Canadian dollar/U.S. dollar	1	—
Total	$ 262	$ 5

	December 31, 2023	
Currency Hedged (Buy/Sell)	Net Notional Value	Fair Value (Liability) Asset
U.S. dollar/Japanese yen	$ 65	$ —
U.S. dollar/South Korean won	70	(3)
U.S. dollar/Taiwan dollar	22	—
U.S. dollar/Singapore dollar	1	—
U.S. dollar/Chinese renminbi	8	—
Euro/U.S. dollar	71	—
Euro/Chinese renminbi	4	—
Euro/Canadian dollar	1	—
U.S. dollar/Mexican peso	5	—
U.K. pound sterling/U.S. dollar	19	—
Total	$ 266	$ (3)

(in millions, except per share data)

The following table summarizes the net gains (losses) on derivatives designated as cash flow hedging instruments:

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Foreign exchange forward contracts and interest rate hedges:		
Net gains (losses) recognized in accumulated OCI	$ 32	$ (15)
Net gains (losses) reclassified from accumulated OCI into income	$ —	$ 1

In the above table, the Company corrected for an immaterial presentation error in the prior period net gains (losses) reclassified from accumulated OCI into income. The net amount of existing gains as of March 31, 2024 expected to be reclassified from OCI into earnings within the next 12 months is immaterial.

Net Investment Hedges

On January 1, 2023, the Company designated certain Euro-denominated debt as a net investment hedge to hedge a portion of its net investments in certain of its entities with functional currencies denominated in the Euro. On January 22, 2024, the Company prepaid its USD Tranche A in full using, in part, a €250 incremental borrowing under its Euro Tranche B, each as defined and further described in Note 8. On January 22, 2024, the Company designated the additional €250 of its Euro Tranche B as a net investment hedge. As of March 31, 2024, the total outstanding under its Euro Tranche B was €840 and the entire balance was designated as a net investment hedge. As of December 31, 2023, the Company designated as a net investment hedge €593 of its Euro Tranche B. For these net investment hedges, the Company defers recognition of the foreign currency remeasurement gains and losses within the foreign currency translation adjustment component of OCI.

Interest Rate Agreements

The Company has various interest rate swap agreements that exchange a forward-looking term rate based on the variable secured overnight financing rate ("Term SOFR") paid on the outstanding balance of its Term Loan Facility, as defined and further described in Note 8, to a fixed rate. The Company acquired USD London Interbank Offered Rate ("LIBOR") interest rate cap agreements as a result of its acquisition of Atotech Limited ("Atotech") on August 17, 2022 (the "Atotech Acquisition") and had utilized these agreements to offset Term SOFR on its Term Loan Facility. Effective June 30, 2023, the Company's USD LIBOR based interest rate caps were converted to Term SOFR. The Company also had two USD LIBOR based swaps that were converted to Term SOFR, effective June 30, 2023. The conversions from USD LIBOR to Term SOFR did not have a material impact on the Company's results of operations.

The following table summarizes the terms and fair values of interest rate swaps and interest rate caps outstanding at March 31, 2024 and December 31, 2023:

Effective Date	Maturity	Fixed Rate	Notional Amount at Effective Date	Notional Amount at March 31, 2024	March 31, 2024 Fair Value Asset (Liability)	December 31, 2023 Fair Value Asset (Liability)
Interest Rate Swaps						
June 30, 2023	February 28, 2025	0.391 %	$ 200	$ 200	$ 8	$ 9
June 30, 2023	February 28, 2025	0.543 %	300	300	12	14
September 30, 2022	September 30, 2026	3.156 %	350	350	10	5
January 2, 2024	January 31, 2028	2.841 %	250	250	11	7
September 30, 2022	September 30, 2027	3.198 %	350	350	10	5
January 2, 2024	January 31, 2029	2.986 %	250	250	10	6
September 30, 2022	September 30, 2026	3.358 %	600	400	9	5
December 28, 2023	December 31, 2027	4.550 %	500	500	(3)	(10)
			2,800	2,600	67	41
Interest Rate Caps						
June 30, 2023	January 31, 2024	0.805 %	350	—	—	1
June 30, 2023	January 31, 2024	0.805 %	350	—	—	2
			700	—	—	3
		Total	$ 3,500	$ 2,600	$ 67	$ 44

(in millions, except per share data)

The interest rate swaps are recorded at fair value on the balance sheet and changes in the fair value are recognized in OCI. To the extent these arrangements are no longer effective hedges, the hedging relationship will be discontinued and changes in the fair value of the hedging instruments from the last assessment period that were effective up to the current period will be recorded immediately in earnings. Amounts previously recorded in OCI will remain in OCI and will be reclassified to earnings when the interest payments impact consolidated earnings. If the Company determines that the interest payments are unlikely to occur, amounts previously recorded in OCI will be reclassified to earnings immediately. Changes in the fair value of interest rate caps are recorded immediately in earnings, as the Company has not designated these instruments as hedges and therefore these instruments do not qualify for hedge accounting.

The following table summarizes the net losses on derivatives not designated as hedging instruments, consisting of balance sheet hedges and interest rate caps:

	Three Months Ended March 31,	
	2024	2023
Net gains (losses) recognized in income	$ (4)	$ (10)

In the above table, the Company corrected for an immaterial presentation error in the prior period net gains (losses) recognized in income.

(6) Inventories

Inventories consist of the following:

	March 31, 2024	December 31, 2023
Raw materials	$ 735	$ 740
Work-in-process	88	94
Finished goods	148	157
Total	$ 971	$ 991

(7) Goodwill and Intangible Assets

Goodwill

The Company’s methodology for allocating the purchase price of an acquisition is determined through established and generally accepted valuation techniques. Goodwill is measured as the excess of the cost of the acquisition over the sum of the amounts assigned to tangible and identifiable intangible assets acquired less liabilities assumed. The Company assigns assets acquired (including goodwill) and liabilities assumed to one or more reporting units as of the date of acquisition. If the products obtained in an acquisition are assigned to multiple reporting units, the goodwill is distributed to the respective reporting units as part of the purchase price allocation process.

Goodwill and intangible assets with indefinite useful lives are not amortized but are reviewed for impairment annually during the fourth quarter of each fiscal year or whenever events or changes in circumstances indicate that the carrying value of an asset may not be recoverable. To measure impairment, the Company compares the fair value of the reporting unit to its carrying amount, which includes goodwill. If the fair value of the reporting unit exceeds the carrying value of the reporting unit, no impairment exists. If the fair value of the reporting unit is less than the carrying value of the reporting unit, a goodwill impairment is recorded.

Amortizable intangible assets and other long-lived assets are also subject to an impairment test if there is an indicator of impairment. When the Company determines that the carrying value of intangible assets or other long-lived assets may not be recoverable based upon the existence of one or more indicators of impairment, the Company uses the projected undiscounted cash flow method to determine whether an impairment exists, and then measures the impairment using discounted cash flows.

The process of evaluating the potential impairment of goodwill, intangible assets and other long-lived assets requires significant judgment. The Company regularly monitors current business conditions and other factors, including, but not limited to, adverse industry or economic trends, restructuring actions and lower projections of profitability that may impact future operating results. The Company's stock price and any estimated control premium are factors affecting the assessment of the fair value of the Company's underlying reporting units for purposes of performing any goodwill impairment assessment.

(in millions, except per share data)

The changes in the carrying amount of goodwill and accumulated impairment loss during the three months ended March 31, 2024 were as follows:

	Gross Carrying Amount	Accumulated Impairment Loss	Net
Beginning balance, January 1, 2024	$ 4,387	$ (1,833)	$ 2,554
Foreign currency translation and measurement period adjustments	(43)	—	(43)
Ending balance, March 31, 2024	$ 4,344	$ (1,833)	$ 2,511

Intangible Assets

The Company's intangible assets are comprised of the following:

As of March 31, 2024:	Gross	Accumulated Impairment Charges	Accumulated Amortization	Foreign Currency Translation	Net
Completed technology	$ 1,268	$ (152)	$ (428)	$ (19)	$ 669
Customer relationships	2,072	(1)	(371)	(55)	1,645
Patents, trademarks, trade names and other	381	(63)	(121)	(10)	187
	$ 3,721	$ (216)	$ (920)	$ (84)	$ 2,501

As of December 31, 2023:	Gross	Accumulated Impairment Charges	Accumulated Amortization Charges	Foreign Currency Translation and Measurement Period Adjustments	Net
Completed technology	$ 1,268	$ (152)	$ (405)	$ (4)	$ 707
Customer relationships	2,072	(1)	(335)	(17)	1,719
Patents, trademarks, trade names and other	381	(63)	(118)	(7)	193
	$ 3,721	$ (216)	$ (858)	$ (28)	$ 2,619

Aggregate amortization expense related to acquired intangible assets for the three months ended March 31, 2024 and 2023 was $62 and $81, respectively. During the three months ended March 31, 2023, $9 of in-process research and development was written off to amortization expense as certain projects were cancelled.

Aggregate net amortization expense related to acquired intangible assets for future years is as follows:

Year	Amount
2024 (remaining)	$ 186
2025	247
2026	244
2027	242
2028	242
2029	240
Thereafter	1,044

The Company excluded from the above table intangible assets of $56 of indefinite-lived trademarks and trade names, which were not subject to amortization.

(in millions, except per share data)

(8) Debt

The Company's outstanding debt is as follows:

	March 31, 2024	December 31, 2023
Short-term debt:		
Term Loan Facility	$ 50	$ 93
Long-term debt, net:		
Term Loan Facility	$ 4,692	$ 4,696

Long-term debt is net of deferred financing fees, original issuance discount and repricing fees in the aggregate amount of $149 and $164 as of March 31, 2024 and December 31, 2023, respectively.

Credit Facilities

In connection with the completion of the Atotech Acquisition, on August 17, 2022 (the "Effective Date") the Company entered into a credit agreement with JPMorgan Chase Bank, N.A., as administrative agent and collateral agent, Barclays Bank PLC, and the lenders from time to time party thereto (the "Credit Agreement"). The Credit Agreement provided for (i) a senior secured term loan facility comprised of three tranches: a $1,000 loan (the "USD Tranche A"), a $3,600 loan (as further increased, refinanced and otherwise modified as described herein, the "USD Tranche B") and a €600 loan (as further increased and otherwise modified as described herein, the "Euro Tranche B" and together with the USD Tranche A and the USD Tranche B, the "Term Loan Facility"), each of which were borrowed in full on the Effective Date, and (ii) a senior secured revolving credit facility of $500 (as further increased and otherwise modified as described herein, the "Revolving Facility" and, together with the Term Loan Facility, the "Credit Facilities"), with the commitments under each of the foregoing facilities subject to increase from time to time subject to certain conditions. The proceeds of the Term Loan Facility were used on the Effective Date, among other things, to fund a portion of the consideration payable in connection with the Atotech Acquisition and to refinance the existing term loan and revolving credit facilities of the Company and certain indebtedness of Atotech.

Initially, borrowings under the Credit Facilities bore interest at a rate per annum equal to, at the Company's option, any of the following, plus, in each case, an applicable margin: (a) with respect to the USD Tranche A, the Revolving Facility and the USD Tranche B, (x) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the prime rate quoted in The Wall Street Journal, or (3) a forward-looking term rate based on Term SOFR (plus an applicable credit spread adjustment) for an interest period of one month, plus 1.00%; and (y) a Term SOFR rate (plus an applicable credit spread adjustment) for the interest period relevant to such borrowing, subject to a rate floor of (I) with respect to the USD Tranche B, 0.50% and (II) with respect to the USD Tranche A and the Revolving Facility, 0.0%; and (b) with respect to the Euro Tranche B, a Euro Interbank Offered Rate ("EURIBOR") rate determined by reference to the costs of funds for Euro deposits for the interest period relevant to such borrowing adjusted for certain additional costs, subject to a EURIBOR rate floor of 0.0%. Initially, the applicable margins for borrowings under the Credit Facilities were (i) under the USD Tranche A, 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings, (ii) under the USD Tranche B, 1.75% with respect to base rate borrowings and 2.75% with respect to Term SOFR borrowings, (iii) under the Euro Tranche B, 3.00% and (iv) under the Revolving Facility, 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings.

In addition to paying interest on outstanding principal under the Credit Facilities, the Company is required to pay a commitment fee in respect of the unutilized commitments under the Revolving Facility. The commitment fee is 0.375% per annum. The commitment fee is subject to downward adjustment based on the Company's first lien net leverage ratio as of the end of the preceding fiscal quarter. The Company must also pay customary letter of credit fees and agency fees.

On October 3, 2023 (the "First Amendment Effective Date"), the Company entered into the First Amendment to Credit Agreement (the "First Amendment"), which refinanced all of the $3,564 outstanding USD Tranche B to (i) decrease the applicable margin for the USD Tranche B to 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings and (ii) remove the credit spread adjustment applicable to Term SOFR borrowings of the USD Tranche B.

On January 22, 2024 (the “Second Amendment Effective Date”), the Company entered into the Second Amendment to Credit Agreement (the “Second Amendment”), pursuant to which the Company (i) borrowed additional USD Tranche B loans in an aggregate principal amount of $490 and additional Euro Tranche B loans in an aggregate principal amount of €250 (collectively, the “Incremental Tranche B Loans”) and (ii) used a portion of the proceeds of the Incremental Tranche B Loans to prepay the USD Tranche A in full in an aggregate principal amount of $744.

On February 13, 2024, the Company entered into the Third Amendment to Credit Agreement (the “Third Amendment”), pursuant to which the Company increased the available borrowing capacity under the Revolving Facility by $175 (the “Incremental Revolving Commitments”). As of March 31, 2024, the available borrowing capacity under the Revolving Facility was $675.

The USD Tranche A was issued with original issue discount of 0.25% of the principal amount thereof. The USD Tranche B and the Euro Tranche B were issued on the Effective Date with original issue discount of 2.00% of the principal amounts thereof. The USD Tranche B was issued on the First Amendment Effective Date with original issue discount of 0.25% of the principal amount thereof. The Incremental Tranche B Loans were issued with original issue discount of 0.25% of the principal amount thereof.

The Company incurred $242 of deferred financing fees and original issue discount related to the term loans under the Term Loan Facility funded on the Effective Date, which are included in long-term debt, net in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

The Company incurred $11 of deferred financing fees and original issue discount related to the USD Tranche B funded on the First Amendment Effective Date, of which $9 is included in long-term debt, net in the accompanying consolidated balance sheets and is being amortized to interest expense over the estimated life of the term loans using the effective interest method. The Company recorded an $8 loss on extinguishment of debt in connection with the First Amendment.

The Company incurred $5 of deferred financing fees and original issue discount related to the Incremental Tranche B Loans funded on the Second Amendment Effective Date, of which $2 is included in long-term debt, net in the accompanying consolidated balance sheets and is being amortized to interest expense over the estimated life of the term loans using the effective interest method. The Company recorded a $9 loss on extinguishment of debt in connection with the Second Amendment.

Under the Credit Agreement, the Company is required to prepay outstanding term loans, subject to certain exceptions, with portions of its annual excess cash flow as well as with the net cash proceeds of certain of its asset sales, certain casualty and condemnation events and the incurrence or issuances of certain debt. If at any time the aggregate amount of outstanding loans, unreimbursed letter of credit drawings and undrawn letters of credit under the Revolving Facility exceeds the aggregate commitments under the Revolving Facility, the Company is required to repay outstanding loans and/or cash collateralize letters of credit, with no reduction of the commitment amount.

The Company may voluntarily prepay outstanding loans under the Credit Facilities from time to time, subject to certain conditions, without premium or penalty other than customary “breakage” costs with respect to Term SOFR or EURIBOR loans; provided, however, that subject to certain exceptions, if on or prior to the date that is six months after the Second Amendment Effective Date, the Company prepays any loans under the USD Tranche B or the Euro Tranche B in connection with a repricing transaction, the Company must pay a prepayment premium of 1.00% of the aggregate principal amount of the loans so prepaid. Additionally, the Company may voluntarily reduce the unutilized portion of the commitment amount under the Revolving Facility.

Prior to the repayment in full of the USD Tranche A, the Company was required to make scheduled quarterly payments each equal to 1.25% of the original principal amount of the USD Tranche A. The Company is required to make scheduled quarterly payments each equal to approximately 0.25% of the aggregate principal amount of each of the Euro Tranche B and the USD Tranche B as of the Second Amendment Effective Date, in each case with the balance due thereunder on the seventh anniversary of the Effective Date.

There is no scheduled amortization under the Revolving Facility. Any principal amount outstanding under the Revolving Facility is due and payable in full on the fifth anniversary of the Effective Date.

All obligations under the Credit Facilities are guaranteed by certain of the Company’s wholly-owned domestic subsidiaries and are required to be guaranteed by certain of the Company’s future wholly-owned domestic subsidiaries, and are secured by substantially all of the Company’s assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

(in millions, except per share data)

Under the Credit Agreement, the Company has the ability to incur additional incremental debt facilities in an amount up to (x) the greater of (1) $1,011 and (2) 75% of consolidated earnings before interest, taxes, depreciation, and amortization ("EBITDA"), plus (y) an amount equal to the sum of all voluntary prepayments of term loans under the Term Loan Facility, plus (z) an additional unlimited amount subject to pro forma compliance with certain leverage ratio tests (based on the security and priority of such incremental debt).

Under the USD Tranche A and the Revolving Facility, so long as any USD Tranche A loans (or commitments in respect thereof) are outstanding as of the end of any fiscal quarter, the Company may not allow its total net leverage ratio as of the end of such fiscal quarter to be greater than 5.25 to 1.00 for the fiscal quarters ending December 31, 2023 through September 30, 2024, with an annual step-down of 0.25:1.00 and subject to a step-up of 0.50:1.00 for the four full fiscal quarter period following any material acquisition, not to exceed 5.50 to 1.00.

In addition, in the event there are no loans outstanding under the USD Tranche A, as of the end of any fiscal quarter of the Company when the aggregate amount of loans outstanding under the Revolving Facility (net of (a) all letters of credit (whether cash collateralized or not) and (b) unrestricted cash of the Company and its restricted subsidiaries) exceeds 35% of the aggregate amount of all commitments under the Revolving Facility in effect as of such date, the Company may not allow its first lien net leverage ratio as of the end of each such fiscal quarter to be greater than 6.00 to 1.00.

The USD Tranche B and the Euro Tranche B are not subject to financial maintenance covenants.

The Credit Agreement contains a number of negative covenants that, among other things and subject to certain exceptions, restrict the ability of the Company and each of its subsidiaries to: incur additional indebtedness; pay dividends on its capital stock or redeem, repurchase or retire its capital stock or its subordinated indebtedness; make investments, loans and acquisitions; create restrictions on the payment of dividends or other amounts to the Company from the Company's restricted subsidiaries or restrictions on the ability of the Company's restricted subsidiaries to incur liens; engage in transactions with its affiliates; sell assets, including capital stock of its subsidiaries; materially alter the business it conducts; consolidate or merge; incur liens; and engage in sale-leaseback transactions.

The Credit Agreement also contains customary representations and warranties, affirmative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the Credit Facilities will be entitled to take various actions, including the acceleration of amounts due under the Credit Facilities and all actions permitted to be taken by a secured creditor. As of March 31, 2024, the Company was in compliance with all covenants under the Credit Agreement.

The Company paid certain customary fees to and expenses of (i) JPMorgan Chase Bank, N.A., Barclays Bank PLC, BofA Securities, Inc., Citibank, N.A., HSBC Securities (USA) Inc. and Mizuho Bank, Ltd. in their respective capacities as lead arrangers and bookrunners in connection with the Credit Facilities on the Effective Date, (ii) JPMorgan Chase Bank, N.A. in its capacity as lead arranger in connection with each of the First Amendment, the Second Amendment and the Third Amendment and (iii) the lenders providing the Incremental Revolving Commitments pursuant to the Third Amendment.

As of March 31, 2024, the outstanding principal of the Term Loan Facility was $4,891 and the weighted average interest rate was 7.6%. The Revolving Facility has a maturity date in August 2027 while the Incremental Tranche B Loans have a maturity in August 2029. As of March 31, 2024, there were no borrowings under the Revolving Facility.

Lines of Credit and Borrowing Arrangements

Certain of the Company's Japanese subsidiaries have lines of credit and a financing facility with various financial institutions, many of which generally expire and are renewed at three-month intervals with the remaining having no expiration date. The lines of credit and financing facility provided for aggregate borrowings as of March 31, 2024 and December 31, 2023 of up to an equivalent of $20 and $14, respectively. There were no borrowings outstanding under these arrangements at March 31, 2024 and December 31, 2023.

Contractual maturities of the Company's debt obligations as of March 31, 2024 are as follows:

Year	Amount
2024 (remaining)	$ 38
2025	50
2026	50
2027	50
2028	50
2029	4,653

(in millions, except per share data)

(9) Product Warranties

The Company provides for the estimated costs to fulfill customer warranty obligations upon the recognition of the related revenue. The Company's warranty obligations are affected by shipment volume, product failure rates, utilization levels, material usage and supplier warranties on parts delivered to the Company. Should actual product failure rates, utilization levels, material usage, or supplier warranties on parts differ from the Company's estimates, revisions to the estimated warranty liability would be required. The Company engages in extensive product quality programs and processes, including actively monitoring and evaluating the quality of its component suppliers.

Product warranty activities were as follows:

	Three Months Ended March 31,	
	2024	2023
Beginning of period	$ 22	$ 27
Provision for product warranties	5	3
Charges to warranty liability	(6)	(3)
End of period	$ 21	$ 28

As of March 31, 2024, short-term product warranties of $16 and long-term product warranties of $5 were included within other current liabilities and other non-current liabilities, respectively, within the accompanying condensed consolidated balance sheet. As of March 31, 2023, short-term product warranties of $20 and long-term product warranties of $8 were included within other current liabilities and other non-current liabilities, respectively, within the accompanying condensed consolidated balance sheet.

(10) Other Current Liabilities

Other current liabilities consisted of the following:

	March 31, 2024	December 31, 2023
Accrued compensation and other employee-related obligations	$ 128	$ 159
Deferred revenue and customer advances	68	77
Income taxes payable	53	57
Lease liabilities	29	30
Other	103	105
Total other current liabilities	$ 381	$ 428

(11) Income Taxes

The Company's effective tax rate for the three months ended March 31, 2024 was 23.1%. The Company's effective tax rate for the three months ended March 31, 2024 was higher than the U.S. statutory tax rate mainly due to an expected increase in foreign withholding taxes and U.S. base erosion and anti-abuse tax, partially offset by the U.S. deduction for foreign derived intangible income ("FDII") and research and development credits.

The Company's effective tax rate for the three months ended March 31, 2023 was 46.6%. The Company's effective tax rate for the three months ended March 31, 2023 was higher than the U.S. statutory tax rate mainly due to the geographic mix of income earned by the Company's international subsidiaries being taxed at higher rates than the U.S. statutory rate, offset by the U.S. foreign tax credit and the U.S. deduction for FDII.

(in millions, except per share data)

(12) Net Income (Loss) Per Share

The following table sets forth the computation of basic and diluted net income (loss) per share:

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Numerator:		
Net income (loss)	$ 15	$ (42)
Denominator:		
Shares used in net income (loss) per common share – basic	67.0	66.7
Effect of dilutive securities	0.4	—
Shares used in net income (loss) per common share – diluted	67.4	66.7
Net income (loss) per common share:		
Basic	$ 0.22	$ (0.64)
Diluted	$ 0.22	$ (0.64)

Basic earnings per share ("EPS") is computed by dividing income (loss) available to common stockholders by the weighted-average number of common shares outstanding during the period. The computation of diluted EPS is similar to the computation of basic EPS except that the denominator is increased to include the number of additional common shares that would have been outstanding (using the treasury stock method) if securities containing potentially dilutive common shares had been converted to such common shares, and if such assumed conversion is dilutive. In periods in which a net loss is recognized, the impact of restricted stock units ("RSUs") is not included as they are antidilutive.

For the three months ended March 31, 2024 and 2023, the Company had an immaterial quantity of RSUs that were antidilutive and were excluded from the computation of diluted weighted-average shares.

(13) Stock-Based Compensation

Prior to May 10, 2022, the Company granted RSUs to employees and directors under the 2014 Stock Incentive Plan (the "2014 Plan"). Following shareholder approval of the 2022 Stock Incentive Plan (the "2022 Plan" and, together with the 2014 Plan, the "Plans") on May 10, 2022, the Company discontinued granting RSUs to employees and directors under the 2014 Plan and began granting them under the 2022 Plan. The Plans are administered by the Compensation Committee of the Company's Board of Directors. The Plans are intended to attract and retain employees and directors, and to provide an incentive for these individuals to assist the Company to achieve long-range performance goals and enable these individuals to participate in the long-term growth of the Company.

The total stock-based compensation expense included in the Company's condensed consolidated statements of operations and comprehensive income (loss) was as follows:

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Cost of revenues	$ 1	$ 1
Research and development	2	1
Selling, general and administrative	12	16
Total stock-based compensation expense	$ 15	$ 18

(in millions, except per share data)

At March 31, 2024, the total compensation expense related to unvested stock-based awards granted to employees and directors under the Plans that had not been recognized was $41. Stock-based awards include (i) time-based RSUs, (ii) performance-based RSUs based on the achievement of adjusted EBITDA targets (the "Adjusted EBITDA RSUs"), (iii) performance-based RSUs based on the Company's total shareholder return relative to a group of peers over a three-year performance period (the "rTSR RSUs") and (iv) employee stock purchase plan rights. The Company determines the fair value of time-based RSUs based on the closing market price of the Company's common stock on the date of the award. The Company determines the original fair value of Adjusted EBITDA RSUs based upon the closing market price of the Company's stock on the date of the award, and adjusts the fair value quarterly during the first year based upon actual and forecasted results against Adjusted EBITDA targets. The Company estimates the fair value of rTSR RSUs using the Monte Carlo simulation model, which requires the use of highly subjective and complex assumptions, including the price volatility of the underlying stock. The Company estimates the fair value of employee stock purchase plan rights using the Black-Scholes valuation method. Such values are recognized as expense on a straight-line basis for time-based awards and rTSR RSUs and using the accelerated graded vesting method for Adjusted EBITDA RSUs, all over the requisite service periods.

The following table presents the activity for RSUs under the Plans:

	Three Months Ended March 31, 2024	
	Quantity	Weighted Average Grant Date Fair Value Per Share
RSUs – beginning of period	1.0	$ 98.36
Granted	0.1	$ 129.92
Vested or forfeited	(0.2)	$ 112.27
RSUs – end of period	0.9	$ 99.09

(14) Stockholders' Equity

Share Repurchase Program

On July 25, 2011, the Company's Board of Directors approved a share repurchase program for the repurchase of up to an aggregate of $200 of its outstanding common stock from time to time in open market purchases, privately negotiated transactions or through other appropriate means. The timing and quantity of any shares repurchased will depend upon a variety of factors, including business conditions, stock market conditions and business development activities, including, but not limited to, merger and acquisition opportunities. These repurchases may be commenced, suspended or discontinued at any time without prior notice. The Company has repurchased approximately 2.6 shares of common stock for approximately $127 pursuant to the program since its adoption. During the three months ended March 31, 2024 and 2023, there were no repurchases of common stock.

Cash Dividends

Holders of the Company's common stock are entitled to receive dividends when they are declared by the Company's Board of Directors. During the first quarters of 2024 and 2023, the Company's Board of Directors declared a cash dividend of $0.22 per share, each of which totaled $15.

On May 7, 2024, the Company's Board of Directors declared a quarterly cash dividend of $0.22 per share to be paid on June 7, 2024 to stockholders of record as of May 28, 2024.

Future dividend declarations, if any, as well as the record and payment dates for such dividends, are subject to the final determination of the Company's Board of Directors.

(15) Business Segment and Geographic Information

The Company has three reportable segments: VSD, PSD and MSD. The Company's CODM, which is the Company's Chief Executive Officer, utilizes financial information to make decisions about allocating resources and assessing performance for the entire Company, which is used in the decision-making process to assess performance and allocate resources to the three segments.

(in millions, except per share data)

Reportable Segments

VSD delivers foundational technology solutions to leading edge semiconductor manufacturing, electronics and packaging and specialty industrial applications. VSD products are derived from the Company's core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, temperature sensing, and vacuum technology.

PSD provides a full range of solutions including lasers, beam measurement and profiling, precision motion control, vibration isolation systems, photonics instruments, opto-mechanical components, optical elements, laser-based systems for flexible printed circuit board ("PCB") processing, and laser-based systems for high density interconnect PCB and package substrate manufacturing.

MSD develops leading process and manufacturing technologies for advanced surface modification, electroless and electrolytic plating, and surface finishing. Applying a comprehensive systems-and-solutions approach, MSD's portfolio includes chemistry, equipment, software, and services for innovative and high-technology applications in a wide variety of end markets.

The Company derives its segment results directly from the manner in which results are reported in its management reporting system. The accounting policies that the Company uses to derive reportable segment results are substantially the same as those used for external reporting purposes. The Company groups similar products within its three reportable segments.

During the quarter ended March 31, 2024, the Company moved its OSP product line from the PSD segment to the VSD segment. The purpose of this realignment was to better align the OSP products with semiconductor related products within the VSD segment. Prior periods have been recast to reflect this change.

The following table sets forth net revenues by reportable segment:

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
VSD	$ 332	$ 304
PSD	254	186
MSD	282	304
	$ 868	$ 794

The following table reconciles gross profit by reportable segment to net income (loss):

	Three Months Ended March 31, 2024	Three Months Ended March 31, 2023
Gross profit by reportable segment:		
VSD	$ 140	$ 113
PSD	118	75
MSD	157	147
Total gross profit by reportable segment	415	335
Operating expenses:		
Research and development	70	72
Selling, general and administrative	170	174
Acquisition and integration costs	1	6
Restructuring	3	1
Fees and expenses related to amendments to the Term Loan Facility	3	—
Amortization of intangible assets	62	81
Income from operations	106	1
Interest income	(6)	(3)
Interest expense	87	85
Loss on extinguishment of debt	9	—
Other (income) expense, net	(3)	(2)
Income (loss) before income taxes	19	(79)
Provision (benefit) for income taxes	4	(37)
Net income (loss)	$ 15	$ (42)

(in millions, except per share data)

Interest income, interest expense and income tax provision (benefit) are not presented by reportable segment because the necessary information is not classified within the segments nor used by the CODM.

The following table sets forth segment assets by reportable segment:

March 31, 2024	Accounts receivable, net	Inventories	Total
VSD	$ 173	$ 541	$ 714
PSD	172	275	447
MSD	231	155	386
Total segment assets	$ 576	$ 971	$ 1,547

December 31, 2023	Accounts receivable, net	Inventories	Total
VSD	$ 181	$ 553	$ 734
PSD	171	283	454
MSD	251	155	406
Total segment assets	$ 603	$ 991	$ 1,594

The following table reconciles total segment assets to total assets:

	March 31, 2024	December 31, 2023
Total segment assets	$ 1,547	$ 1,594
Cash and cash equivalents and short-term investments	846	875
Other current assets	268	227
Property, plant and equipment, net	766	784
Right-of-use assets, net	227	225
Goodwill and intangible assets, net	5,012	5,173
Other assets	265	240
Total assets	$ 8,931	$ 9,118

Geographic Area

Information about the Company's operations by geographic area is presented in the tables below. Net revenues from unaffiliated customers are based on the location in which the sale originated. Intercompany sales between geographic areas are at tax transfer prices and have been eliminated from consolidated net revenues.

	Three Months Ended March 31,	
Net revenues:	2024	2023
United States	$ 308	$ 254
China	157	147
Germany	73	73
South Korea	72	74
Japan	49	50
Other	209	196
	$ 868	$ 794

Long-lived assets include property, plant and equipment, net, right-of-use assets, net and certain other assets, and exclude goodwill, intangible assets and long-term tax-related accounts.

Long-lived assets:	March 31, 2024	December 31, 2023
United States	$ 461	$ 459
China	166	163
Germany	141	149
Other	317	326
	$ 1,085	$ 1,097

(in millions, except per share data)

Goodwill associated with each of the Company's reportable segments is as follows:

	VSD	PSD	MSD	Total
Reportable segment:				
Gross goodwill, at December 31, 2023	$ 359	$ 1,007	$ 3,021	$ 4,387
Foreign currency translation	(1)	(1)	(41)	(43)
Gross goodwill, at March 31, 2024	358	1,006	2,980	4,344
Accumulated goodwill impairment, at December 31, 2023 and March 31, 2024	(141)	(390)	(1,302)	(1,833)
Goodwill, net of accumulated impairment and foreign currency translation, at March 31, 2024	$ 217	$ 616	$ 1,678	$ 2,511

(16) Commitments and Contingencies

Litigation

The Company is subject to various legal proceedings and claims that have arisen in the ordinary course of business. In the opinion of management, the ultimate disposition of these matters will not have a material adverse effect on the Company's results of operations, financial condition or cash flows.

ITEM 2. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS.

This Quarterly Report on Form 10-Q contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995, Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934 regarding the future financial performance, business prospects and growth of MKS Instruments, Inc. ("MKS," the "Company," "our," or "we"). These statements are only predictions based on current assumptions and expectations. Any statements that are not statements of historical fact (including statements containing the words "will," "projects," "intends," "believes," "plans," "anticipates," "expects," "estimates," "forecasts," "continues" and similar expressions) should be considered to be forward-looking statements. Actual events or results may differ materially from those in the forward-looking statements set forth herein.

Among the important factors that could cause actual events to differ materially from those in the forward-looking statements that we make are the need to generate sufficient cash flows to service and repay the substantial indebtedness we incurred in connection with our acquisition of Atotech Limited ("Atotech" and such transaction, the "Atotech Acquisition"), which we completed in August 2022; the terms of our existing credit facilities under which we incurred such debt; our entry into the chemicals technology business through the Atotech Acquisition, in which we did not have previous experience and which may expose us to significant additional liabilities; the risk that we are unable to integrate the Atotech Acquisition successfully or realize the anticipated synergies, cost savings and other benefits of the Atotech Acquisition; legal, reputational, financial and contractual risks resulting from the ransomware event we identified in February 2023, and other risks related to cybersecurity, data privacy and intellectual property; competition from larger, more advanced or more established companies in our markets; the ability to successfully grow our business, including through growth of the Atotech business and growth of the Electro Scientific Industries, Inc. business, which we acquired in February 2019, and financial risks associated with those and potential future acquisitions, including goodwill and intangible asset impairments; manufacturing and sourcing risks, including those associated with limited and sole source suppliers and the impact and duration of supply chain disruptions, component shortages, and price increases; changes in global demand; the impact of a pandemic or other widespread health crisis; risks associated with doing business internationally, including geopolitical conflicts, such as the conflict in the Middle East, trade compliance, regulatory restrictions on our products, components or markets, particularly the semiconductor market, and unfavorable currency exchange and tax rate fluctuations, which risks become more significant as we grow our business internationally and in China specifically; conditions affecting the markets in which we operate, including fluctuations in capital spending in the semiconductor, electronics manufacturing and automotive industries, and fluctuations in sales to our major customers; disruptions or delays from third-party service providers upon which our operations may rely; the ability to anticipate and meet customer demand; the challenges, risks and costs involved with integrating or transitioning global operations of the companies we have acquired; risks associated with the attraction and retention of key personnel; potential fluctuations in quarterly results; dependence on new product development; rapid technological and market change; acquisition strategy; volatility of stock price; risks associated with chemical manufacturing and environmental regulation compliance; risks related to defective products; financial and legal risk management; and the other important factors described under the heading "Risk Factors" in Part I, Item 1A of our Annual Report on Form 10-K for the year ended December 31, 2023 filed with the U.S. Securities and Exchange Commission on February 27, 2024 ("Annual Report"). We are under no obligation to, and expressly disclaim any obligation to, update or alter these forward-looking statements, whether as a result of new information, future events or otherwise, even if subsequent events cause our views to change.

The Management's Discussion and Analysis of Financial Condition and Results of Operations describes principal factors affecting the results of operations, financial condition, cash flows and liquidity, as well as our critical accounting policies and estimates that require significant judgment and thus have the most significant potential impact on our condensed consolidated financial statements, and is intended to better allow investors to view the Company from management's perspective. This section focuses on material events and uncertainties known to management that are reasonably likely to cause reported financial information not to be necessarily indicative of our future operating results or our future financial condition. This section provides an analysis of our financial results for the three months ended March 31, 2024 compared to the three months ended December 31, 2023 and the three months ended March 31, 2023.

Overview

We enable technologies that transform our world. We deliver foundational technology solutions to leading edge semiconductor manufacturing, electronics and packaging, and specialty industrial applications. We apply our broad science and engineering capabilities to create instruments, subsystems, systems, process control solutions and specialty chemicals technology that improve process performance, optimize productivity and enable unique innovations for many of the world's leading technology and industrial companies. Our solutions are critical to addressing the challenges of miniaturization and complexity in advanced device manufacturing by enabling increased power, speed, feature enhancement and optimized connectivity. Our solutions are also critical to addressing ever-increasing performance requirements across a wide array of specialty industrial applications.

Segments

We have three divisions which are our reportable segments, Vacuum Solutions Division ("VSD"), Photonics Solutions Division ("PSD") and Materials Solutions Division ("MSD").

VSD delivers foundational technology solutions to leading edge semiconductor manufacturing, electronics and packaging and specialty industrial applications. VSD products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, temperature sensing and vacuum technology.

PSD provides a full range of solutions including lasers, beam measurement and profiling, precision motion control, vibration isolation systems, photonics instruments, opto-mechanical components, optical elements, laser-based systems for flexible printed circuit board ("PCB") processing, and laser-based systems for high density interconnect PCB and package substrate manufacturing. During the quarter ended March 31, 2024, we moved our Optical Sensing Products ("OSP") product line from the PSD segment to the VSD segment. The purpose of this realignment was to better align the OSP products with semiconductor related products within the VSD segment. Prior periods have been recast to reflect this change.

MSD develops leading process and manufacturing technologies for advanced surface modification, electroless and electrolytic plating, and surface finishing. Applying a comprehensive systems-and-solutions approach, MSD's portfolio includes chemistry, equipment, software, and services for innovative and high-technology applications in a wide variety of end markets.

Markets

Net Revenues by End Market

	Three Months Ended					
(dollars in millions)	March 31, 2024	% Total	December 31, 2023	% Total	March 31, 2023	% Total
Semiconductor	$ 351	40 %	$ 362	41 %	$ 309	39 %
Electronics and Packaging	208	24 %	226	25 %	222	28 %
Specialty Industrial	309	36 %	305	34 %	263	33 %
Total net revenues	$ 868	100 %	$ 893	100 %	$ 794	100 %

Semiconductor Market

MKS is a critical solutions provider for semiconductor manufacturing. Our products are used in major semiconductor processing steps, such as deposition, etching, cleaning, lithography, metrology, and inspection. The semiconductor industry continually faces new challenges, as products become smaller, more powerful and highly mobile. Ultra-thin layers, smaller critical dimensions, new materials, 3D structures, and the ongoing need for higher yield and productivity drive the need for tighter process measurement and control, all of which MKS supports. We believe we are the broadest critical subsystem provider in the wafer fabrication equipment ("WFE") ecosystem and address over 85% of the market. We have characterized our broad and unique offering as Surround the Wafer® to reflect the technology enablement we provide across almost every major process in semiconductor manufacturing today.

The semiconductor market is subject to rapid demand shifts, which are difficult to predict, and we cannot be certain as to the timing or extent of future demand or any future softening in the semiconductor capital equipment industry. In addition to these rapid demand shifts, the semiconductor capital equipment industry is subject to significant trade restrictions, especially in China.

For the three months ended March 31, 2024, net revenues in our semiconductor market decreased by $11 million, or 3%, compared to the prior quarter primarily due to softened demand for semiconductor capital equipment. Net revenues in our semiconductor market increased by $42 million, or 14%, compared to the same period in the prior year primarily due to lower net revenues in the prior year period as a result of lower order fulfillment due to the ransomware event. This incident had a material impact on our ability to process orders, ship products and provide service to our VSD and PSD customers in the first quarter of 2023.

Electronics and Packaging Market

MKS is a foundational solutions provider for the electronics and packaging market. Our portfolio includes photonics components, laser drilling systems, electronics chemistries and plating equipment that are critical for the manufacturing of PCBs and package substrates, and critical to wafer level packaging ("WLP") applications. Similar to the semiconductor industry, the PCB, package substrate and WLP industries demand smaller features, greater density, and better performance. In addition, the electronics and packaging market also includes sales of our vacuum and photonics solutions for display manufacturing applications. We characterize our complementary offering of laser systems and chemistry solutions as Optimize the Interconnect®, to reflect the unique technology enablement we provide at the Interconnect level within PCBs, package substrates and WLPs.

For the three months ended March 31, 2024, net revenues in our electronics and packaging market decreased by $18 million, or 8%, compared to the prior quarter and decreased by $14 million, or 6%, compared to the same period in the prior year. These decreases were primarily the result of continued softness in the consumer electronics market and lower demand in the PCB business. In addition, the decrease compared to the prior quarter was also due to seasonality related to a slowdown in production in China as a result of the Lunar New Year.

Specialty Industrial Market

MKS' strategy in the specialty industrial market is to leverage our domain expertise and proprietary technologies across a broad array of applications in industrial technologies, life and health sciences, and research and defense markets.

Industrial Technologies

Industrial technologies encompasses a wide range of diverse applications, including chemistries for functional coatings, surface finishing and wear resistance in the automobile industry, vacuum solutions for synthetic diamond manufacturing and photonics for solar manufacturing. Other applications include vacuum and photonics solutions for light emitting diode and laser diode manufacturing.

Life and Health Sciences

Our products for life and health sciences are used in a diverse array of applications, including bioimaging, medical instrument sterilization, medical device manufacturing, analytical, diagnostic and surgical instrumentation, consumable medical supply manufacturing and pharmaceutical production.

Research and Defense

Our products for research and defense are sold to government, university and industrial laboratories for applications involving research and development in materials science, physical chemistry, photonics, optics and electronics materials. Our products are also sold for monitoring and defense applications, including surveillance, imaging and infrastructure protection.

For the three months ended March 31, 2024, net revenues in our specialty industrial market increased by $4 million, or 1%, compared to the prior quarter.

For the three months ended March 31, 2024, net revenues in our specialty industrial market increased by $46 million, or 17%, compared to the same period in the prior year mainly due to lower revenue in the prior year period as a result of lower order fulfillment due to the ransomware event.

International Markets

A significant portion of our net revenues is from sales to customers in international markets. For the three months ended March 31, 2024 and 2023 and the three months ended December 31, 2023, international net revenues accounted for approximately 65%, 68%, and 67%, respectively, of our total net revenues. A significant portion of our international net revenues was from China, Germany, South Korea and Japan. We expect international net revenues will continue to account for a significant percentage of total net revenues for the foreseeable future.

Long-lived assets located outside of the United States accounted for approximately 58% of our total long-lived assets as of both March 31, 2024 and December 31, 2023. Long-lived assets include property, plant and equipment, net, right-of-use assets, net and certain other assets.

Critical Accounting Policies and Estimates

The preparation of our consolidated financial statements and related disclosures in conformity with accounting principles generally accepted in the United States requires management to make judgments, assumptions and estimates that affect the amounts reported. There have been no material changes in our critical accounting policies since December 31, 2023.

For further information about our critical accounting policies, please see the discussion of critical accounting policies in our Annual Report in the section captioned "Management's Discussion and Analysis of Financial Condition and Results of Operations — Critical Accounting Policies and Estimates."

Results of Operations

The following table sets forth, for the periods indicated, the percentage of total net revenues of certain line items included in our condensed consolidated statements of operations and comprehensive (loss) income data:

	Three Months Ended		
	March 31, 2024	December 31, 2023	March 31, 2023
Net revenues:			
Products	86.9 %	87.9 %	89.7 %
Services	13.1	12.1	10.3
Total net revenues	100.0	100.0	100.0
Cost of revenues:			
Cost of product revenues	45.9	47.4	51.4
Cost of service revenues	6.3	6.6	6.3
Total cost of revenues (exclusive of amortization shown separately below)	52.2	54.0	57.8
Gross profit	47.8	46.0	42.2
Research and development	8.1	7.8	9.0
Selling, general and administrative	19.6	17.9	22.0
Acquisition and integration costs	0.1	0.3	0.7
Restructuring	0.3	0.8	0.1
Fees and expenses related to amendments to the Term Loan Facility	0.3	0.2	—
Amortization of intangible assets	7.1	7.8	10.3
Goodwill and intangible asset impairments	—	8.4	—
Income from operations	12.2	2.7	0.1
Interest income	(0.7)	(0.8)	(0.3)
Interest expense	10.0	10.1	10.7
Loss on extinguishment of debt	1.0	0.9	—
Other (income) expense, net	(0.3)	1.3	(0.2)
Income (loss) before income taxes	2.2	(8.8)	(10.0)
Provision (benefit) for income taxes	0.5	(1.2)	(4.7)
Net income (loss)	1.7 %	(7.6 %)	(5.2 %)

Net revenues

(dollars in millions)	Three Months Ended		
	March 31, 2024	December 31, 2023	March 31, 2023
Products	$ 754	$ 785	$ 712
Services	114	108	82
Total net revenues	$ 868	$ 893	$ 794

For the three months ended March 31, 2024, net product revenues decreased $31 million compared to the prior quarter. This decrease was primarily due to continued softness in demand in our electronics and packaging and our semiconductor markets.

For the three months ended March 31, 2024, net product revenues increased $42 million compared to the same period in the prior year mainly due to lower net revenues in the prior year period as a result of lower order fulfillment in VSD and PSD due to the ransomware event. As a result of our inability to fulfill orders, we estimated the ransomware event negatively impacted our revenue in the first quarter of 2023 by approximately $160 million, substantially all of which was recovered in the second and third quarters of 2023, as we shipped orders that were delayed during the first quarter.

Net service revenues consisted mainly of fees for services related to the maintenance and repair of our products, sales of spare parts, and installation and training. For the three months ended March 31, 2024, net service revenues increased $6 million compared to the prior quarter mainly related to increased sales to customers in the semiconductor and electronics and packaging markets.

For the three months ended March 31, 2024, net service revenues increased $32 million compared to the same period in the prior year mainly due to lower net revenues in the prior year period as a result of lower service order fulfillment due to the ransomware event.

The following table sets forth our net revenues by reportable segment:

(dollars in millions)	Three Months Ended March 31, 2024	December 31, 2023	March 31, 2023
Net revenues:			
Vacuum Solutions Division	$ 332	$ 347	$ 304
Photonics Solutions Division	254	253	186
Materials Solutions Division	282	293	304
Total net revenues	$ 868	$ 893	$ 794

For the three months ended March 31, 2024, net revenues from VSD decreased $15 million compared to the prior quarter, primarily due to volume decreases in the semiconductor market. For the three months ended March 31, 2024, net revenues from VSD increased $28 million compared to the same period in the prior year mainly due to lower net revenues in the prior year period as a result of lower order fulfillment due to the ransomware event. The increase was mainly in the semiconductor and specialty industrial markets.

For the three months ended March 31, 2024, net revenues from PSD were flat compared to the prior quarter. For the three months ended March 31, 2024, net revenues from PSD increased $68 million compared to the same period in the prior year mainly due to lower net revenues in the prior year period as a result of lower order fulfillment due to the ransomware event. The increase was mainly in the semiconductor and specialty industrial markets.

For the three months ended March 31, 2024, net revenues from MSD decreased $11 million compared to the prior quarter, primarily due to a decrease in chemistry sales due to seasonality related to a slowdown in production in China as a result of the Lunar New Year. For the three months ended March 31, 2024, revenues from MSD decreased $22 million compared to the same period in the prior year primarily due to lower palladium prices and the negative impact of foreign currency.

Gross margin

	Three Months Ended March 31, 2024	December 31, 2023	% Points Change	March 31, 2023	% Points Change
Gross margin as a percentage of net revenues:					
Products	47.2 %	46.1 %	1.1 %	42.6 %	4.6 %
Services	52.1 %	45.3 %	6.8 %	38.7 %	13.4 %
Total gross margin	47.8 %	46.0 %	1.8 %	42.2 %	5.6 %

Gross margin for our products increased for the three months ended March 31, 2024, compared to the prior quarter as a result of favorable product mix, lower material costs and lower scrap expense, partially offset by lower revenue volumes and higher warranty costs.

Gross margin for our products increased for the three months ended March 31, 2024 compared to the same period in the prior year, primarily due to higher revenue volumes, higher factory utilization, favorable product mix, lower material costs and lower excess and obsolete inventory charges, partially offset by higher scrap costs.

Gross margin for our services increased for the three months ended March 31, 2024 compared to the prior quarter mainly as a result of favorable product mix, lower excess and obsolete charges and favorable direct labor and overhead absorption.

Gross margin for our services increased for the three months ended March 31, 2024 compared to the same period in the prior year primarily due to favorable product mix, higher revenue volumes, and lower direct labor and overhead costs.

The following table sets forth gross margin as a percentage of net revenues by reportable segment:

	Three Months Ended				
	March 31, 2024	December 31, 2023	% Points Change	March 31, 2023	% Points Change
Gross margin as a percentage of net revenues:					
Vacuum Solutions Division	42.3 %	40.8 %	1.5 %	37.1 %	5.2 %
Photonics Solutions Division	46.4 %	45.1 %	1.3 %	40.6 %	5.8 %
Materials Solutions Division	55.6 %	53.0 %	2.6 %	48.4 %	7.2 %
Total gross margin	47.8 %	46.0 %	1.8 %	42.2 %	5.6 %

Gross margin for VSD increased for the three months ended March 31, 2024, compared to the prior quarter, primarily due to higher factory utilization, lower material costs and lower freight and duty costs, partially offset by lower revenue volumes and unfavorable foreign exchange rates. Gross margin for VSD increased for the three months ended March 31, 2024, compared to the same period in the prior year, primarily due to higher revenue volumes, higher factory utilization, lower material costs and lower excess and obsolete inventory charges, partially offset by unfavorable product mix.

Gross margin for PSD increased for the three months ended March 31, 2024, compared to the prior quarter, primarily due to favorable product mix and lower freight and duty costs, partially offset by unfavorable factory utilization. Gross margin for PSD increased for the three months ended March 31, 2024, compared to the same period in the prior year, primarily due to higher revenue volumes, higher factory utilization, lower freight and duty costs and lower excess and obsolete inventory charges, partially offset by unfavorable product mix and higher scrap costs.

Gross margin for MSD increased for the three months ended March 31, 2024, compared to the prior quarter, primarily due to favorable product mix, lower palladium prices, favorable foreign exchange rates and lower excess and obsolete inventory charges, partially offset by higher warranty costs. Gross margin for MSD increased for the three months ended March 31, 2024, compared to the same period in the prior year, primarily due to lower palladium prices, favorable product mix and lower excess and obsolete inventory charges, partially offset by higher freight and duty charges.

Research and development

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Research and development	$ 70	$ 70	$ 72

For the three months ended March 31, 2024, research and development expenses were flat compared to the prior quarter, and decreased by $2 million, compared to the same period in the prior year, mainly due to lower test equipment costs.

Our research and development efforts are primarily focused on developing and improving our instruments, components, chemistry, subsystems, systems and process control solutions to improve process performance and productivity. We have thousands of products, and our research and development efforts primarily consist of a large number of projects related to these products, none of which is individually material to us. Projects typically have a duration of three to thirty-six months but may be extended for development of new products.

We continue to make product advancements designed to meet our customers’ evolving needs. We have developed, and continue to develop, new products designed to address industry trends, such as the shrinking of integrated circuit critical dimensions and technology inflections, and, in the flat panel display and solar markets, the transition to larger substrate sizes, which require more advanced processing and process control technology, the continuing drive toward more complex and accurate components and devices within the handset and tablet market, the transition to 5G for both devices and infrastructure, the growth in units and via counts in the high density interconnect PCB drilling market, and the transition from internal combustion to electric vehicles. In addition, we have developed, and continue to develop, products that support the migration to new classes of materials, ultra-thin layers, and 3D structures that are used in small geometry manufacturing. In our chemistry and equipment plating businesses, a majority of our research and development investment supports existing customers’ product improvement needs and their short-term research and development goals, which enables us to pioneer new high-value solutions while limiting commercial risk. Research and development expenses consist primarily of salaries and related expenses for personnel engaged in research and development, fees paid to consultants, material costs for prototypes and other expenses related to the design, development, testing and enhancement of our products.

We believe that the continued investment in research and development and ongoing development of new products are essential to the expansion of our markets. We expect to continue to make significant investment in research and development activities. We are subject to risks from products not being developed in a timely manner, as well as from rapidly changing customer requirements and competitive threats from other companies and technologies. Our success primarily depends on our products being designed into new generations of equipment for the semiconductor, electronics and packaging, and specialty industrial markets. We seek to develop products that are technologically advanced so that they are positioned to be chosen for use in each successive generation of semiconductor capital equipment and advanced markets applications. If our products are not chosen to be designed into our customers' products, our net revenues may be reduced during the lifespan of those products.

Selling, general and administrative

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Selling, general and administrative	$ 170	$ 160	$ 174

For the three months ended March 31, 2024, selling, general and administrative expenses increased $10 million, compared to the prior quarter, primarily due to increases of $8 million in compensation-related costs and $2 million in information technology costs.

For the three months ended March 31, 2024, selling, general and administrative expenses decreased $4 million, compared to the same period in the prior year, mainly as a result of a decrease of $7 million of net costs incurred as a result of the ransomware event and a decrease of $4 million in compensation related costs, partially offset by an increase of $3 million in consulting and professional fees and $3 million in information technology costs.

Acquisition and integration costs

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Acquisition and integration costs	$ 1	$ 3	$ 6

Acquisition and integration costs incurred during the three months ended March 31, 2024, December 31, 2023 and March 31, 2023 were related to consulting and professional fees related to the Atotech Acquisition.

Restructuring

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Restructuring	$ 3	$ 7	$ 1

Restructuring charges during the three months ended March 31, 2024 and December 31, 2023, primarily related to severance costs as a result of global cost saving initiatives implemented in the fourth quarter of 2023. Restructuring charges during the three months ended March 31, 2023 primarily related to severance costs as a result of a global cost saving initiative implemented in the first quarter of 2023.

Fees and expenses related to amendments to the Term Loan Facility

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Fees and expenses related to amendments to the Term Loan Facility	$ 3	$ 2	$ —

During the three months ended March 31, 2024, we recorded fees and expenses related to the Incremental Tranche B Loans incurred pursuant to the Second Amendment and, during the three months ended December 31, 2023, we recorded fees and expenses related to the refinancing of the USD Tranche B pursuant to the First Amendment, each as defined and described further below under "Credit Facilities."

Amortization of intangible assets

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Amortization of intangible assets	$ 62	$ 70	$ 81

For the three months ended March 31, 2024, amortization of intangible assets decreased by $8 million, compared to the prior quarter, primarily due to backlog related to MSD being fully amortized in the three months ended December 31, 2023. For the three months ended March 31, 2024, amortization of intangible assets decreased by $19 million, compared to the same period in the prior year, primarily due to backlog related to MSD being fully amortized in the three months ended December 31, 2023 and the write-off of completed technology at our Equipment Solutions Business ("ESB") reporting unit of PSD in the second quarter of 2023.

Goodwill and intangible asset impairments

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Goodwill and intangible asset impairments	$ —	$ 75	$ —

On October 31, 2023, we performed our annual goodwill and intangible asset impairment assessment. As a result of a higher weighted average cost of capital, mainly caused by overall higher market interest rates, we recorded non-cash goodwill impairment charges of $48 million at our Electronics ("EL") reporting unit of MSD and $13 million at our ESB reporting unit. In addition, we recorded a $14 million impairment of in-process research and development allocated to the EL reporting unit. There were no impairments at any of our other reporting units.

We will continue to monitor and evaluate the carrying value of goodwill and intangible assets. If market and economic conditions or business performance deteriorate, the likelihood that we would record an impairment charge would increase, which could materially and adversely affect our financial condition and operating results.

Interest expense, net

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Interest expense, net	$ 81	$ 83	$ 82

Interest expense for three months ended March 31, 2024 related to borrowings on the Term Loan Facility, as defined and described further below under "Credit Facilities." Amounts were comparable in each period reported.

Loss on extinguishment of debt

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Loss on extinguishment of debt	$ 9	$ 8	$ —

In connection with the amendments to our Credit Facilities, as defined and described further below under "Credit Facilities," we recorded losses on extinguishment of debt.

Other (income) expense, net

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Other (income) expense, net	$ (3)	$ 12	$ (2)

Other (income) expense, net, for the three months ended March 31, 2024, December 31, 2023, and March 31, 2023 consisted primarily of net foreign exchange and fair value gains and losses.

Provision (benefit) for income taxes

	Three Months Ended		
(dollars in millions)	March 31, 2024	December 31, 2023	March 31, 2023
Provision (benefit) for income taxes	$ 4	$ (11)	$ (37)

Our effective tax rates for the three months ended March 31, 2024, December 31, 2023, and March 31, 2023 were 23.1%, 14.2%, and 46.6%, respectively. Our effective tax rate for the three months ended March 31, 2024 was higher than the U.S. statutory tax rate, mainly due to an expected increase in foreign withholding taxes and U.S. base erosion and anti-abuse tax, partially offset by the U.S. deduction for foreign derived intangible income ("FDII") and research and development credits. Our effective tax rate for the three months ended December 31, 2023 was lower than the U.S. statutory tax rate primarily due to the impairment of goodwill and intangible assets. Our effective tax rate for the three months ended March 31, 2023 was higher than the U.S. statutory tax rate mainly due to the geographic mix of income earned by our international subsidiaries being taxed at higher rates than the U.S. statutory tax rate, offset by the U.S. foreign tax credit and the U.S. deduction for FDII.

On a quarterly basis, we evaluate both positive and negative evidence that affects the realizability of net deferred tax assets and assess the need for a valuation allowance. The future benefit to be derived from our deferred tax assets is dependent upon our ability to generate sufficient future taxable income in each jurisdiction of the right type to realize the assets.

Our future effective tax rate depends on various factors, including the impact of tax legislation, further interpretations and guidance from U.S. federal and state governments on the impact of proposed regulations issued by the Internal Revenue Service, further interpretations and guidance from foreign governments, the geographic composition of our pre-tax income, and changes in income tax reserves for unrecognized tax benefits. We monitor these factors and timely adjust our estimates of the effective tax rate accordingly. We expect the Atotech Acquisition will continue to have an unfavorable impact on our effective tax rate as MSD operates primarily in jurisdictions with tax rates higher than the U.S. statutory tax rate. However, the geographic mix of pre-tax income can change based on multiple factors, resulting in changes to the effective tax rate in future periods. While we believe we have adequately provided for all tax positions, amounts asserted by taxing authorities could materially differ from our accrued positions as a result of uncertain and complex application of tax law and regulations. Additionally, the recognition and measurement of certain tax benefits includes estimates and requires judgment by management. Accordingly, we may record additional provisions or benefits for U.S. federal, state, and foreign tax matters in future periods as new information becomes available.

Liquidity and Capital Resources

Cash and cash equivalents and short-term investments at March 31, 2024 and December 31, 2023 totaled $846 million and $875 million, respectively. The primary driver in our current and anticipated future cash flows is, and we expect will continue to be, cash generated from operations, consisting primarily of our net income (loss), excluding non-cash charges and changes in operating assets and liabilities. In periods when our sales are growing, higher sales to customers will result in increased trade receivables, and inventories will generally increase as we build products for future sales. This may result in lower cash generated from operations. Conversely, in periods when our sales are declining, our accounts receivable and inventory balances will generally decrease, resulting in increased cash from operations. We believe that our current cash and investments position and available borrowing capacity, together with the cash anticipated to be generated from our operations, will be sufficient to satisfy our estimated working capital, planned capital expenditure requirements, payments of debt, and any future cash dividends declared by our Board of Directors or share repurchases through at least the next 12 months and the foreseeable future.

Net cash provided by operating activities was $67 million for the three months ended March 31, 2024, resulting from a net income of $15 million, which included non-cash charges of $100 million, mainly the result of a $88 million of depreciation and amortization expense, offset by a net increase in working capital of $48 million. The net increase in working capital was primarily due to a decrease in accounts payable of $32 million, a decrease of $30 million in accrued compensation and a decrease of $12 million in other current and non-current liabilities. This net increase in working capital was partially offset by an increase in income taxes payable of $16 million and an increase in accounts receivable of $16 million.

Net cash used in investing activities was $18 million for the three months ended March 31, 2024, and consisted of $18 million in capital expenditures.

Net cash used in financing activities was $72 million for the three months ended March 31, 2024, primarily due to net proceeds from the Incremental Tranche B Loans in an aggregate principal amount of $761 million which were used in part to prepay the USD Tranche A in full in an aggregate principal amount of $744 million. In addition, there were normal quarterly debt payments and a voluntary prepayment that totaled $62 million and $15 million of dividend payments.

Holders of our common stock are entitled to receive dividends when they are declared by our Board of Directors. During each of the first quarters of 2024 and 2023, our Board of Directors declared a cash dividend of $0.22 per share, which totaled $15 million in each period, respectively. On May 7, 2024, our Board of Directors declared a quarterly cash dividend of $0.22 per share to be paid on June 7, 2024 to stockholders of record as of May 28, 2024. Future dividend declarations, if any, as well as the record and payment dates for such dividends, are subject to the final determination of our Board of Directors.

Credit Facilities

In connection with the completion of the Atotech Acquisition, on August 17, 2022 (the “Effective Date”) we entered into a credit agreement with JPMorgan Chase Bank, N.A., as administrative agent and collateral agent, Barclays Bank PLC, and the lenders from time to time party thereto (the “Credit Agreement”). The Credit Agreement provided for (i) a senior secured term loan facility comprised of three tranches: a $1.0 billion loan (the “USD Tranche A”), a $3.6 billion loan (as further increased, refinanced and otherwise modified as described herein, the “USD Tranche B”) and a €600 million loan (as further increased and otherwise modified as described herein, the “Euro Tranche B” and together with the USD Tranche A and the USD Tranche B, the “Term Loan Facility”), each of which were borrowed in full on the Effective Date, and (ii) a senior secured revolving credit facility of $500 million (as further increased and otherwise modified as described herein, the “Revolving Facility” and, together with the Term Loan Facility, the “Credit Facilities”), with the commitments under each of the foregoing facilities subject to increase from time to time subject to certain conditions. The proceeds of the Term Loan Facility were used on the Effective Date, among other things, to fund a portion of the consideration payable in connection with the Atotech Acquisition and to refinance our existing term loan and revolving credit facilities and certain indebtedness of Atotech.

Initially, borrowings under the Credit Facilities bore interest at a rate per annum equal to, at our option, any of the following, plus, in each case, an applicable margin: (a) with respect to the USD Tranche A, the Revolving Facility and the USD Tranche B, (x) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the prime rate quoted in The Wall Street Journal, or (3) a forward-looking term rate based on Term SOFR (plus an applicable credit spread adjustment) for an interest period of one month, plus 1.00%; and (y) a Term SOFR rate (plus an applicable credit spread adjustment) for the interest period relevant to such borrowing, subject to a rate floor of (I) with respect to the USD Tranche B, 0.50% and (II) with respect to the USD Tranche A and the Revolving Facility, 0.0%; and (b) with respect to the Euro Tranche B, a Euro Interbank Offered Rate (“EURIBOR”) rate determined by reference to the costs of funds for Euro deposits for the interest period relevant to such borrowing adjusted for certain additional costs, subject to a EURIBOR rate floor of 0.0%. Initially, the applicable margins for borrowings under the Credit Facilities were (i) under the USD Tranche A, 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings, (ii) under the USD Tranche B, 1.75% with respect to base rate borrowings and 2.75% with respect to Term SOFR borrowings, (iii) under the Euro Tranche B, 3.00% and (iv) under the Revolving Facility, 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings.

In addition to paying interest on outstanding principal under the Credit Facilities, we are required to pay a commitment fee in respect of the unutilized commitments under the Revolving Facility. The commitment fee is 0.375% per annum. The commitment fee is subject to downward adjustment based on our first lien net leverage ratio as of the end of the preceding fiscal quarter. We must also pay customary letter of credit fees and agency fees.

On October 3, 2023 (the “First Amendment Effective Date”), we entered into the First Amendment to Credit Agreement (the “First Amendment”), which refinanced all of the $3.56 billion outstanding USD Tranche B to (i) decrease the applicable margin for the USD Tranche B to 1.50% with respect to base rate borrowings and 2.50% with respect to Term SOFR borrowings and (ii) remove the credit spread adjustment applicable to Term SOFR borrowings of the USD Tranche B.

On January 22, 2024 (the “Second Amendment Effective Date”), we entered into the Second Amendment to Credit Agreement (the “Second Amendment”), pursuant to which we (i) borrowed additional USD Tranche B loans in an aggregate principal amount of $490 million and additional Euro Tranche B loans in an aggregate principal amount of €250 million (collectively, the “Incremental Tranche B Loans”) and (ii) used a portion of the proceeds of the Incremental Tranche B Loans to prepay the USD Tranche A in full in an aggregate principal amount of $744 million.

On February 13, 2024, we entered into the Third Amendment to Credit Agreement (the “Third Amendment”), pursuant to which we increased the available borrowing capacity under the Revolving Facility by $175 million (the “Incremental Revolving Commitments”).

The USD Tranche A was issued with original issue discount of 0.25% of the principal amount thereof. The USD Tranche B and the Euro Tranche B were issued on the Effective Date with original issue discount of 2.00% of the principal amounts thereof. The USD Tranche B was issued on the First Amendment Effective Date with original issue discount of 0.25% of the principal amount thereof. The Incremental Tranche B Loans were issued with original issue discount of 0.25% of the principal amount thereof.

We incurred $242 million of deferred financing fees and original issue discount related to the term loans under the Term Loan Facility funded on the Effective Date, which are included in long-term debt, net in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

We incurred $11 million of deferred financing fees and original issue discount related to the USD Tranche B funded on the First Amendment Effective Date, of which $9 million is included in long-term debt, net in the accompanying consolidated balance sheets and is being amortized to interest expense over the estimated life of the term loans using the effective interest method. We recorded an $8 million loss on extinguishment of debt in connection with the First Amendment.

We incurred $5 million of deferred financing fees and original issue discount related to the Incremental Tranche B Loans funded on the Second Amendment Effective Date, of which $2 million is included in long-term debt, net in the accompanying consolidated balance sheets and is being amortized to interest expense over the estimated life of the term loans using the effective interest method. We recorded a $9 million loss on extinguishment of debt in connection with the Second Amendment.

Under the Credit Agreement, we are required to prepay outstanding term loans, subject to certain exceptions, with portions of our annual excess cash flow as well as with the net cash proceeds of certain of our asset sales, certain casualty and condemnation events and the incurrence or issuances of certain debt. If at any time the aggregate amount of outstanding loans, unreimbursed letter of credit drawings and undrawn letters of credit under the Revolving Facility exceeds the aggregate commitments under the Revolving Facility, we are required to repay outstanding loans and/or cash collateralize letters of credit, with no reduction of the commitment amount.

We may voluntarily prepay outstanding loans under the Credit Facilities from time to time, subject to certain conditions, without premium or penalty other than customary "breakage" costs with respect to Term SOFR or EURIBOR loans; provided, however, that subject to certain exceptions, if on or prior to the date that is six months after the Second Amendment Effective Date, we prepay any loans under the USD Tranche B or the Euro Tranche B in connection with a repricing transaction, we must pay a prepayment premium of 1.00% of the aggregate principal amount of the loans so prepaid. Additionally, we may voluntarily reduce the unutilized portion of the commitment amount under the Revolving Facility.

Prior to the repayment in full of the USD Tranche A, we were required to make scheduled quarterly payments each equal to 1.25% of the original principal amount of the USD Tranche A. We are required to make scheduled quarterly payments each equal to approximately 0.25% of the aggregate principal amount of each of the Euro Tranche B and the USD Tranche B as of the Second Amendment Effective Date, in each case with the balance due thereunder on the seventh anniversary of the Effective Date.

There is no scheduled amortization under the Revolving Facility. Any principal amount outstanding under the Revolving Facility is due and payable in full on the fifth anniversary of the Effective Date.

All obligations under the Credit Facilities are guaranteed by certain of our wholly-owned domestic subsidiaries and are required to be guaranteed by certain of our future wholly-owned domestic subsidiaries, and are secured by substantially all of our assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

Under the Credit Agreement, we have the ability to incur additional incremental debt facilities in an amount up to (x) the greater of (1) $1,011 million and (2) 75% of consolidated EBITDA, plus (y) an amount equal to the sum of all voluntary prepayments of term loans under the Term Loan Facility, plus (z) an additional unlimited amount subject to pro forma compliance with certain leverage ratio tests (based on the security and priority of such incremental debt).

Under the USD Tranche A and the Revolving Facility, so long as any USD Tranche A loans (or commitments in respect thereof) are outstanding as of the end of any fiscal quarter, we may not allow our total net leverage ratio as of the end of such fiscal quarter to be greater than 5.25 to 1.00 for the fiscal quarters ending December 31, 2023 through September 30, 2024, with an annual step-down of 0.25:1.00 and subject to a step-up of 0.50:1.00 for the four full fiscal quarter periods following any material acquisition, not to exceed 5.50 to 1.00.

In addition, in the event there are no loans outstanding under the USD Tranche A, as of the end of any fiscal quarter when our aggregate amount of loans outstanding under the Revolving Facility (net of (a) all letters of credit (whether cash collateralized or not) and (b) unrestricted cash of us and our restricted subsidiaries) exceeds 35% of the aggregate amount of all commitments under the Revolving Facility in effect as of such date, we may not allow our first lien net leverage ratio as of the end of each such fiscal quarter to be greater than 6.00 to 1.00.

The USD Tranche B and the Euro Tranche B are not subject to financial maintenance covenants.

The Credit Agreement contains a number of negative covenants that, among other things and subject to certain exceptions, restrict our ability and each of our subsidiaries to: incur additional indebtedness; pay dividends on our capital stock or redeem, repurchase or retire our capital stock or our subordinated indebtedness; make investments, loans and acquisitions; create restrictions on the payment of dividends or other amounts to ourselves from our restricted subsidiaries or restrictions on the ability of our restricted subsidiaries to incur liens; engage in transactions with our affiliates; sell assets, including capital stock of our subsidiaries; materially alter the business we conduct; consolidate or merge; incur liens; and engage in sale-leaseback transactions.

The Credit Agreement also contains customary representations and warranties, affirmative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the Credit Facilities will be entitled to take various actions, including the acceleration of amounts due under the Credit Facilities and all actions permitted to be taken by a secured creditor. As of March 31, 2024, we were in compliance with all covenants under the Credit Agreement.

We paid certain customary fees to and expenses of (i) JPMorgan Chase Bank, N.A., Barclays Bank PLC, BofA Securities, Inc., Citibank, N.A., HSBC Securities (USA) Inc. and Mizuho Bank, Ltd. in their respective capacities as lead arrangers and bookrunners in connection with the Credit Facilities on the Effective Date, (ii) JPMorgan Chase Bank, N.A. in its capacity as lead arranger in connection with each of the First Amendment, the Second Amendment and the Third Amendment and (iii) the lenders providing the Incremental Revolving Commitments pursuant to the Third Amendment.

As of March 31, 2024, the outstanding principal of the Term Loan Facility was $4.89 billion and the weighted average interest rate was 7.6%. The Revolving Facility has a maturity date in August 2027 while the Incremental Tranche B Loans have a maturity in August 2029. As of March 31, 2024, there were no borrowings under the Revolving Facility.

Lines of Credit and Borrowing Arrangements

Certain of our Japanese subsidiaries have lines of credit and a financing facility with various financial institutions, many of which generally expire and are renewed at three-month intervals with the remaining having no expiration date. These lines of credit and financing facility provided for aggregate borrowings as of March 31, 2024 and December 31, 2023 of up to an equivalent of $20 million and $14 million, respectively. There were no borrowings under these arrangements at March 31, 2024 and December 31, 2023.

Derivatives

We enter into derivative instruments for risk management purposes only, including derivatives designated as hedging instruments and those utilized as economic hedges. We operate internationally, and in the normal course of business, are exposed to fluctuations in interest rates and foreign exchange rates. These fluctuations can increase the costs of financing, investing and operating the business. We have used derivative instruments, such as foreign exchange forward contracts and options, to manage certain foreign currency exposure, and interest rate swaps and caps to manage interest rate exposure.

By nature, all financial instruments involve market and credit risks. We enter into derivative instruments with major investment grade financial institutions and no collateral is required. We have policies to monitor the credit risk of these counterparties. While there can be no assurance, we do not anticipate any material non-performance by any of these counterparties.

Interest Rate Agreements

We have various interest rate swap agreements as described further in Note 5 to the Notes to the Condensed Consolidated Financial Statements that exchange the variable Term SOFR rate to a fixed rate in order to manage the exposure to interest rate fluctuations associated with the variable Term SOFR rate paid on the outstanding balance of the Term Loan Facility.

Contractual Obligations

There have been no changes outside the ordinary course of business to our contractual obligations as disclosed in our Annual Report.

Recent Accounting Pronouncements

Segment Reporting (Topic 280): Improvements to Reportable Segment Disclosures

In November 2023, the Financial Accounting Standards Board ("FASB") issued Accounting Standard Update ("ASU") No. 2023-07, Segment Reporting (Topic 280): Improvements to Reportable Segment Disclosures, which requires a public entity to disclose significant segment expenses and other segment items on an annual and interim basis and provide in interim periods all disclosures about a reportable segment's profit or loss and assets that are currently required annually. Additionally, it requires a public entity to disclose the title and position of the Chief Operating Decision Maker. The ASU does not change how a public entity identifies its operating segments, aggregates them, or applies the quantitative thresholds to determine its reportable segments. The new standard is effective for fiscal years beginning after December 15, 2023, and interim periods within fiscal years beginning after December 15, 2024, with early adoption permitted. A public entity should apply the amendments in this ASU retrospectively to all prior periods presented in the financial statements. We are currently evaluating the impact of this ASU on our disclosures within the consolidated financial statements.

Income Taxes (Topic 740): Improvements to Income Tax Disclosures

In December 2023, the FASB issued ASU No. 2023-09, Income Taxes (Topic 740): Improvements to Income Tax Disclosures, which focuses on the rate reconciliation and income taxes paid. ASU No. 2023-09 requires a public business entity ("PBE") to disclose, on an annual basis, a tabular rate reconciliation using both percentages and currency amounts, broken out into specified categories with certain reconciling items further broken out by nature and jurisdiction to the extent those items exceed a specified threshold. In addition, all entities are required to disclose income taxes paid, net of refunds received disaggregated by federal, state/local, and foreign and by jurisdiction if the amount is at least 5% of total income tax payments, net of refunds received. For PBEs, the new standard is effective for annual periods beginning after December 15, 2024, with early adoption permitted. An entity may apply the amendments in this ASU prospectively by providing the revised disclosures for the period ending December 31, 2025 and continuing to provide the pre-ASU disclosures for the prior periods, or may apply the amendments retrospectively by providing the revised disclosures for all period presented. We are currently evaluating the impact of this ASU on our consolidated financial statements and related disclosures.

ITEM 3. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK.

Information concerning market risk is contained in the section entitled “Quantitative and Qualitative Disclosures About Market Risk” contained in our Annual Report. As of March 31, 2024, there were no material changes in our exposure to market risk from December 31, 2023.

ITEM 4. CONTROLS AND PROCEDURES.

Evaluation of Disclosure Controls and Procedures

Our management, with the participation of our Chief Executive Officer (who serves as both our principal executive officer and principal financial officer), evaluated the effectiveness of our disclosure controls and procedures as of March 31, 2024. The term “disclosure controls and procedures,” as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended (the “Exchange Act”), means controls and other procedures of an issuer that are designed to ensure that information required to be disclosed by the issuer in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the Securities and Exchange Commission’s (“SEC”) rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by an issuer in the reports that it files or submits under the Exchange Act is accumulated and communicated to the issuer’s management, including its principal executive and principal financial officers, or persons performing similar functions as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on that evaluation, our Chief Executive Officer concluded that, as of March 31, 2024, our disclosure controls and procedures were effective to provide reasonable assurance that information required to be disclosed by us in reports that we file or submit under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in SEC rules and forms and is accumulated and communicated to our management, including our Chief Executive Officer, as appropriate to allow timely decisions regarding required disclosure.

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) during the quarter ended March 31, 2024 that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

PART II. OTHER INFORMATION

ITEM 1A. RISK FACTORS.

Information regarding risk factors affecting our business is discussed in the section entitled "Risk Factors" in our Annual Report on Form 10-K for the year ended December 31, 2023 filed with the U.S. Securities and Exchange Commission on February 27, 2024.

ITEM 5. OTHER INFORMATION.

The following table describes, for the quarterly period covered by this report, each trading arrangement for the sale or purchase of Company securities adopted or terminated by our directors and officers (as defined in Rule 16a-1(f) under the Exchange Act) that is either (1) a contract, instruction or written plan intended to satisfy the affirmative defense conditions of Rule 10b5-1(c) (a "Rule 10b5-1 trading arrangement") or (2) a "non-Rule 10b5-1 trading arrangement" (as defined in Item 408(c) of Regulation S-K):

Name (Title)	Action Taken (Date of Action)	Type of Trading Arrangement	Nature of Trading Arrangement	Duration of Trading Arrangement	Aggregate Number of Securities
Elizabeth A. Mora (Director)	Adoption (February 15, 2024)	Rule 10b5-1 trading arrangement	Sale	Until March 4, 2025, or such earlier date upon which all transactions are completed or expire without execution	Up to 1,100 shares

ITEM 6. EXHIBITS.

Exhibit No.	Exhibit Description
+3.1 (1)	Restated Articles of Organization of the Registrant
+3.2 (2)	Articles of Amendment to Restated Articles of Organization of the Registrant, as filed with the Secretary of State of Massachusetts on May 18, 2001
+3.3 (3)	Articles of Amendment to Restated Articles of Organization of the Registrant, as filed with the Secretary of State of Massachusetts on May 16, 2002
+3.4 (4)	Amended and Restated By-Laws of the Registrant
+10.1 (5)	Second Amendment to Credit Agreement, dated as of January 22, 2024, by and among the Registrant, as parent borrower, the other loan parties party thereto, JPMorgan Chase Bank, N.A., as administrative agent, and each lender party thereto
+10.2 (6)	Third Amendment to Credit Agreement, dated as of February 13, 2024, by and among the Registrant, as parent borrower, the other loan parties party thereto, JPMorgan Chase Bank, N.A., as administrative agent, and each lender and letter of credit issuer party thereto
+10.3(7)*	Form of Restricted Stock Unit Agreement for Employees under the 2022 Stock Incentive Plan for 2024 (Standard)
+10.4(7)*	Form of Restricted Stock Unit Agreement for Employees under the 2022 Stock Incentive Plan for 2024 (rTSR)
31.1	Certification of Principal Executive Officer and Principal Financial Officer pursuant to Rule 13a-14(a)/Rule 15d-14(a) of the Securities Exchange Act of 1934, as amended
32.1	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
101.INS	Inline XBRL Instance Document - the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document.
101.SCH	Inline XBRL Taxonomy Extension Schema with Embedded Linkbase Documents
104	Cover Page Interactive Data File (formatted as inline XBRL with applicable taxonomy extension information contained in Exhibits 101)

+ Previously filed

* Management contract or compensatory plan arrangement

(1) Incorporated by reference to the Registration Statement on Form S-4 (File No. 333-49738), filed with the Securities and Exchange Commission on November 13, 2000.

(2) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2001 (File No. 000-23621), filed with the Securities and Exchange Commission on August 14, 2001.

(3) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2002 (File No. 000-23621), filed with the Securities and Exchange Commission on August 13, 2002.

(4) Incorporated by reference to the Registrant's Current Report on Form 8-K (File No. 000-23621), filed with the Securities and Exchange Commission on May 6, 2014.

(5) Incorporated by reference to the Registrant's Current Report on Form 8-K (File No. 000-23621), filed with the Securities and Exchange Commission on January 22, 2024.

(6) Incorporated by reference to the Registrant's Current Report on Form 8-K (File No. 000-23621), filed with the Securities and Exchange Commission on February 14, 2024.

(7) Incorporated by reference to the Registrant's Annual Report on Form 10-K for the year ended December 31, 2023 (File No. 000-23621), filed with the Securities and Exchange Commission on February 27, 2024.

SIGNATURES

Pursuant to the requirements of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned thereunto duly authorized.

MKS INSTRUMENTS, INC.

Date: May 9, 2024	By:	/s/ John T.C. Lee
		John T.C. Lee
		President and Chief Executive Officer
		(Principal Executive Officer and Principal Financial Officer)

EXHIBIT 31.1

CERTIFICATION OF PRINCIPAL EXECUTIVE OFFICER AND PRINCIPAL FINANCIAL OFFICER
PURSUANT TO RULE 13a-14(a)/RULE 15d-14(a) OF THE
SECURITIES EXCHANGE ACT OF 1934, AS AMENDED

I, John T.C. Lee, certify that:

1. I have reviewed this quarterly report on Form 10-Q of MKS Instruments, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

   c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Dated: May 9, 2024

/s/ John T.C. Lee

John T.C. Lee
President and Chief Executive Officer
(Principal Executive Officer and Principal Financial Officer)

EXHIBIT 32.1

CERTIFICATION

PURSUANT TO 18 U.S.C. SECTION 1350,

AS ADOPTED PURSUANT TO

SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Quarterly Report on Form 10-Q of MKS Instruments, Inc. (the "Company") for the period ended March 31, 2024 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), the undersigned, John T.C. Lee, President and Chief Executive Officer of the Company, hereby certifies, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, based on his knowledge:

(1) The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

(2) The information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Dated: May 9, 2024

/s/ John T.C. Lee

John T.C. Lee
President and Chief Executive Officer
(Principal Executive Officer and Principal Financial Officer)