

Global Semiconductors

Q4 inventory recap: Semis inventories still on the path to CY24E normalization

Industry Overview

Inventories elevated but set to normalize through '24E

We analyze inventory/sales trends for ~80 companies to assess the global semi supply chain post-Q4 results. Semis (ex-mem) inventory days of 120 are 23 days above the 5-yr median (97), vs 27 days above the median in Q3, as inventories begin to slowly normalize from still elevated levels. In Q4, chip vendors reiterated prior comments on inventory normalization continuing through CY24E, with improvements weighted to 2H (pages 2-6 for mgmt. commentary). Notably, semis ex-mem 2H23 inventory days were down 10% from 1H23, weighted to smartphones (-20% HoH) and compute (-15% HoH).

Diversified, smartphone most elevated, foundry least

There is dispersion between end-markets, with: (1) **Diversified (auto/industrial)** inventory days the most elevated at 158 days, +10 days QoQ and 44 days above the 5-yr median, with elevated inventory days across Texas Instruments (76 days above 5-yr median), Infineon (79 days above), and Analog Devices (62 days above); (2) **Compute** inventory days (using estimates for AVGO/MRVL who have yet to report) (at 101, -5 days QoQ) are 12 days above the 5-yr median (89 days), with elevation at AMD (45 days above, likely Xilinx related); (3) **Smartphone** inventory days (111, -19 days QoQ) are 33 days above the 5-yr median (78 days), due mostly to QCOM/SWKS (60/27 days above) as well as CRUS (22 days above); (4) Additionally, we highlight **Foundry** inventory days (82, -10 day QoQ), are also elevated, at 11 days above the 5-year median (71 days); (5) **Memory** inventory days (139 days, -7 days QoQ) at 33 days above 5-yr median (106 days); (6) **OEM** inventory days (59, -8 days QoQ) 14 days above 44 day 5-year median; (7) **Distribution** days (64, -1 day QoQ) 15 days above historical median (49 days); and, (8) **EMS** inventory days (80, -2 days QoQ) 27 days above historical median (53 days).

Upstream Q4 inventory more elevated than Downstream

Upstream inventory days (memory/storage, semis, foundry) were 27 days above the 5-year median (118 days vs 91 l-t avg, -6 days QoQ). Levels are most elevated at memory vendors (139 days in Q4), 33 days above the 106 day 5-yr median. With regards to downstream (OEMs, Distribution, EMS (electronic manufacturing services)), inventory days (60, -7 days QoQ) were also above the 5-yr median (45 days). Inventory levels are elevated at Distribution (15 days above 5-yr avg), OEMs (14 above), and EMS (27 above).

Diversified inventory days increase, smartphones fall

Core semis inventory days fell 3% QoQ in Q4 vs -6% QoQ in Q3. Diversified was the only segment to increase days QoQ, +7% vs Q3, likely the result of auto/industrial product build (often long-lived inventory) as diversified suppliers bring new capacity online. Smartphone inventories fell the most (-15% QoQ), in line with vendor suggestions that the worst of the downcycle is past.

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Refer to important disclosures on page 25 to 26.

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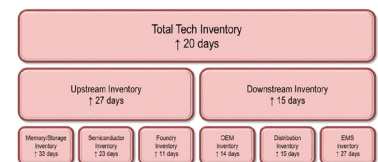
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Exhibit 1: Inventory Overview

Summary of tech supply chain



Source: BofA Global Research, FactSet

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Recent inventory comments

Avnet: “We’ve been working through an inventory correction on a global basis over the past couple of quarters. In addition, we’re also facing weak and uncertain economic conditions, which began in Asia, including China, and are now present in the West. This economic softness has resulted in lower demand with some of our customers, which is being magnified by elevated inventory levels across the supply chain.

In the quarter, demand was mixed across the diverse end markets we serve. Defense and transportation markets continued to show relative strength, while demand in the industrial, consumer, and communications verticals was relatively soft.”

MediaTek: “For the first quarter of 2024, we expect revenue to grow strongly year over year to reflect a more normalized inventory situation and to decline slightly sequentially.”

HP: “Making progress in optimizing our operational inventory. Channel inventory for the business is in a very healthy position.”

Arista: “Seeing higher enterprise shipments and better supply chain costs, somewhat offset by the need for additional inventory reserves as customers refine their forecast product mix.

We will continue to work to reduce our working capital investments and drive some further reduction in inventory as we move through the year.”

Arrow: “We saw excess inventory throughout the supply chain leading to softer demand in our components business and a mixed IT spending environment for our enterprise computing solutions business.

Taking a closer look at our components business, the industry-wide inventory correction appears to be taking longer than anticipated when compared to prior cycles. This is likely due to the breadth and magnitude of the shortages that precipitated the inventory buildup, along with continued softness for components in many industrial markets. However, we do believe markets will eventually improve and see gradual signs of normalizing trends. Our book-to-bill ratios have stabilized overall.”

Micron: “Inventories for memory and storage are at or near normal levels for most customers across PC, mobile, auto, and industrial end markets. Consequently, the demand that we see from customers in these markets is closer to their end-market demand. Data center customer inventory of memory and storage is improving, and we continue to expect customer inventory to approach normal levels in this market sometime in the first half of calendar 2024. Across our data center and PC markets, we are ahead of the industry in our transition to D5 and we expect to cross over our D5 volume from D4 in early calendar 2024.”

SK Hynix: “Anticipating a recovery in demand this year, we expect gradual adjustments to production cost aligning with the normalization of industry inventory level. However, overall production growth will be constrained as focus moves toward high-demand premium products requiring advanced processes while production of legacy products continues to decline.”

Western Digital Corp: “In Flash we have been managing inventory proactively. We will continue our disciplined approach to dynamically managing our inventory, capacities and capital expenditures to keep our supply aligned with end customer demand. Although Flash pricing has started to increase, our profitability and cash generation continue to be well below the level that justify an increase in capital investments. We anticipate wafer equipment spending will remain at historic lows in the near-term and Flash to be undersupplied for an extended period of time.”

Seagate: "From a demand standpoint, gradual recovery within the U.S. cloud market has started to take shape, reflecting solid progress and consuming excess inventory along with more stable end-market behavior. Enterprise OEM demand trends have also stabilized within the U.S. markets."

The inventory situation is much better than it was six months ago, it's basically cleaned up at this point."

Intel: "Demand reflected a normalized inventory environment with sustained strength in gaming and commercial."

While Mobileye is experiencing a sharp inventory correction in Q1, we are encouraged by their improving forecast throughout 2024.

Customer inventory levels have normalized, and 2023 PC consumption was in line with our 270-million-unit forecast.

We feel our inventory positions are healthy."

Nvidia: "Trying to immediately ship inventory as it builds, and customers appreciate our ability to meet the schedules that we've looked for."

AMD: "Embedded demand will remain soft through the first half of the year, as customers continue to focus on normalizing their inventory levels."

In the Gaming segment, as we enter the fifth year of what has been a very strong gaming cycle and given current customer inventory levels, we expect revenue to decline by a significant double-digit percentage."

Marvell: "We're going through what would be kind of a normal inventory correction cycle. It's taking a little bit longer than we thought, if you went back to the beginning of the year, but I also think the macro and the environment has deteriorated more than we would have anticipated at that time. And so we see it down and we see that having to work through that issue for the next couple quarters."

Realtek: "We anticipate a further decline in inventory days over the next few quarters, although at a slow pace. The slightly higher-than-normal inventory is to respond to the many rush orders we have received since December, a phenomenon we expect to continue."

Texas Instruments: "Our results reflect increasing weakness in industrial and a sequential decline in automotive as customers work to reduce their inventory levels."

We continue to have an upward bias on inventory as we continue to build the right buffers for the right parts to be ready on the other side of the cycle."

broadly speaking, our inventory targets have not changed over the last six, nine months through this cycle, so we still have some ways to go, clearly less than we did six months ago, but we still have some ways to go on that front."

At one point, I talked about \$4 billion to \$4.5 billion worth of inventory, so that's in the ballpark, and we just finished just shy of \$4 billion, but as far as when the underutilization bottoms, that's going to depend on revenue expectations, and at this point, we're only -- as always, we only give one quarter at a time. So we'll see where we are in 90 days from now, and we'll tell you about that."

Infineon: "Against a lackluster economic environment and generally high inventory levels, the demand picture across applications remains mixed. We see continued strength in key parts of automotive, and on the other hand, inventory digestion in industrial, as well as an extended sluggishness in consumer computing, communication and IoT."

STM: "In Industrial, where we are seeing a strong inventory correction, we have a much lower backlog than when we entered in 2023.

For the full year 2024, it will be impacted in the first half by the significant inventory correction in Industrial with an expected significant sequential revenue growth in the second half. We expect this will be driven by a strong rebound in Industrial and in Computer Peripherals, continued growth in Automotive and in Communication Equipment, and the usual seasonality in Personal Electronics."

NXP Semiconductors: "From a channel perspective, we maintained distribution inventory at a tight 1.5-month level, well below our long-term target of 2.5 months. In addition, we continue to partner with our direct customers on the normalization of their on-hand inventory.

We have intentionally undershipped fundamental end demand in order to limit inventory build in the channel and at our direct customers.

Continued desire to enable the normalization of on-hand inventories at our direct customers. And we will continue to hold channel inventory in a tight range."

Onsemi: "We expect continued softness across all end markets through a period of inventory digestion and slowing end demand. The bottom line is that we will weather 2024 with substantially better financial performance than in prior downturns.

We expect to replenish the channel in 2024 to service the long-tail of customers and expect inventory to start to normalize with increase in inventory levels between seven and nine weeks over the next few quarters."

Analog Devices: "The inventory rationalization at our customers that began during the middle of 2023 is expected to continue through our second quarter. Encouragingly, first quarter bookings improved sequentially, growing our confidence that inventory-related headwinds will largely subside this quarter. That said, the macro situation remains challenging and the shape and timing of a second half recovery will be governed by underlying demand."

Microchip: "We also continue to invest in building inventory for long-lived, high-margin products whose manufacturing capacity is being end-of-life by our supply chain partners.

With no major supply constraints, coupled with very short lead times, and a weak macro environment, we believe there is inventory destocking underway at multiple levels; at our direct customers and distributors who buy from us, our indirect customers who buy through our distributors, and in some cases, our customers' customers."

Qualcomm: "As we've said previously, as we entered fiscal '24, our view was that Android channel inventory had largely normalized. And so, as we go through the year, we'd typically see normal build-bleed cycle around handset launches."

Skyworks: "Excess supply conditions are abating and inventory levels in the distribution channel and at the OEM level are normalizing. Customers are starting to restock inventory, albeit gradually, as supply and demand dynamics improve and new phones are introduced into the market. Moreover, we've made strategic investments in product development, positioning us to compete for design wins and share gains focusing on highly integrated platforms for the leading mobile OEMs."

Qorvo: "In the cellular base station market, inventories continue to be consumed and we expect demand conditions to remain soft through calendar year '24.

During the quarter we continue to bring channel inventories down and now our shipments are more closely aligned with end-market demand."

Cirrus: "Looking ahead, in Q4 fiscal '24, we expect inventory dollars to increase slightly from the prior quarter. We continue to actively manage our inventory position to meet customer demand while still fulfilling our purchase commitments."

TSMC: "Entering 2024, we forecast fabless semiconductor inventory to have returned to a healthier level, exceeding 2023. However, macroeconomic weakness and geopolitical uncertainties persist, potentially further weighing on consumer sentiment and market demand. Having said that, our business has bottomed out on a year-over-year basis and we expect 2024 to be a healthy growth year for TSMC, supported by continued strong ramp of our industry-leading 3 nanometer technologies, strong demand for the 5 nanometer technologies, and robust AI-related demand."

Global Foundries: "We're continuing to collaborate closely with these customers to support the acceleration of their inventory depletion, while seeking to preserve the economic value of our long-term agreements."

Q4 tech supply chain inventory monitor

Our global tech supply chain monitor tracks historical sales, inventories, and costs for most major semiconductor companies as well as other companies in the global technology supply chain. Our database currently includes approximately 80 companies, of which 50% are upstream companies and 50% are downstream companies. For upstream, we break down the sector into memory/storage, semiconductors (compute, smartphone, diversified), and foundry. For downstream, we break down the sector into OEM, distribution, and EMS.

Since the middle of 2020, the supply chain picture has materially changed. We note (1) relative to the 5-year median, total tech inventory is 20 days above the 5-year median, less elevated than CY23 Q3 (21 days above); (2) upstream inventory is well above the 5-yr median (27 days above 5-year median (vs 31 days above in Q3)), with downstream inventory days 15 days above the 5-yr median (vs 16 days above in Q3); (3) semiconductor inventory days are now 23 days above the 5-year median (vs 27 days above in Q3); (4) Memory/storage inventory days are 33 days above the 5-year median (vs 43 days above in Q3); and (5) Foundry inventory days are 11 days above the 5-year median (vs 26 days above in Q3).

Exhibit 2: Summary of inventory across the supply chain

Upstream inventory days are elevated, 27 days above the 5-yr median. Downstream days are also elevated, 15 days above 5-yr median



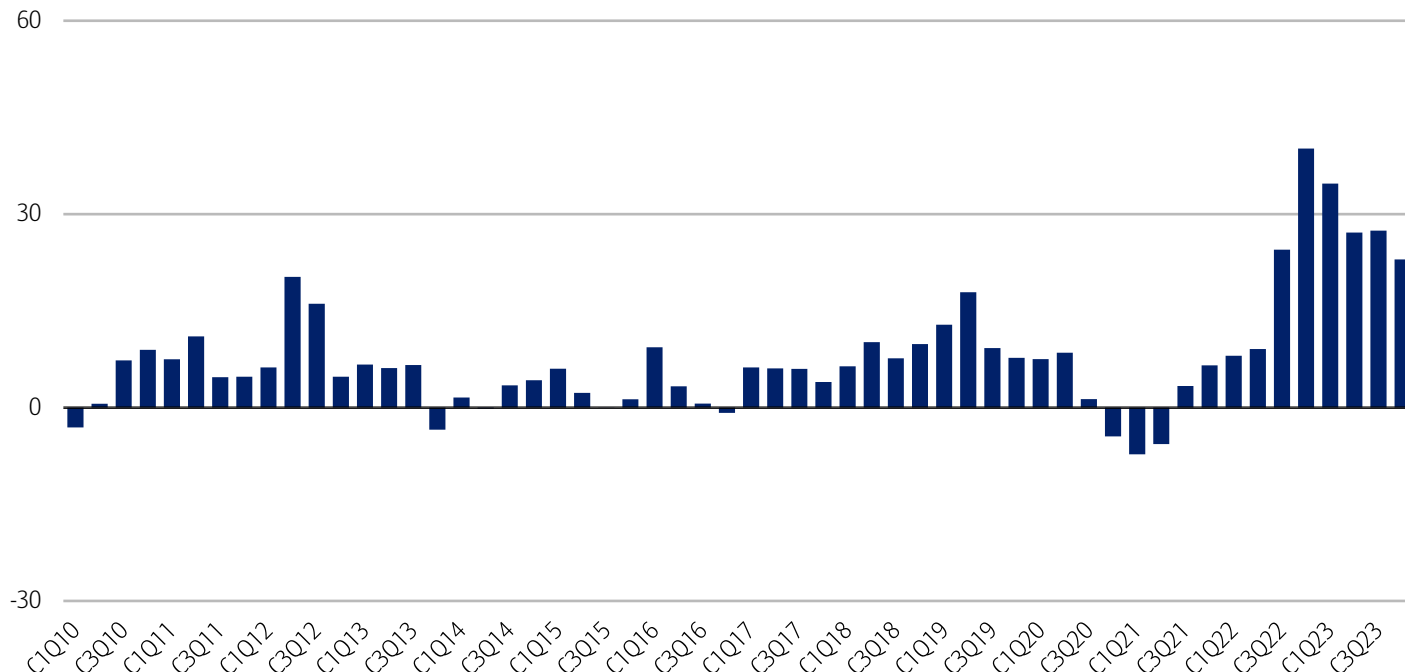
Source: BofA Global Research, FactSet

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As mentioned, semiconductor inventory days are 23 days above the 5-year median. Still, not all areas of the semiconductor supply chain are experiencing similar inventory dynamics. Compute inventory days are healthier, at 12 days above 5-yr median (vs 16 above in Q3), while diversified are more elevated at 44 days above (vs 36 days above in Q3). Smartphone inventories have improved, now 33 days above historical levels, vs 47 above in Q3.

Exhibit 3: Semiconductor inventory days relative to the 5-year median

Semiconductor inventory days are 24 days above the 5-year median



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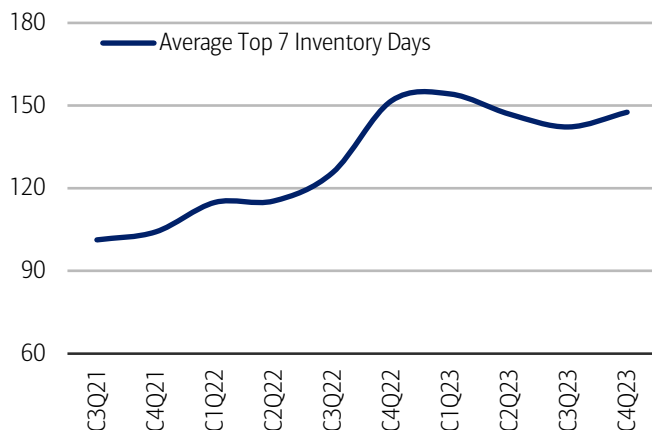
Source: BofA Global Research, FactSet

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Looking at the 7 major semiconductor vendors that account for roughly 60% of industry inventory ex-memory (INTC, (Intel) TXN (Texas Instruments), Infineon, STMicro, QCOM (Qualcomm), ON, NVDA (Nvidia)), we highlight: (1) Average inventory days for the top 7 of 148 days (up 6 days QoQ) are now 42 days above the historical 5-yr median; (2) Infineon inventory days are the highest above historical levels (79 days above), with INTC/NVDA the least above historicals at 11 days above/1 day below; (3) Looking at FCF margins in conjunction with inventory trends, Top 7 TTM FCF margins have decreased 242bps YoY while inventory days have fallen nearly 3% YoY.

Exhibit 4: Top 7 average inventory days

Average inventory days are now at 148

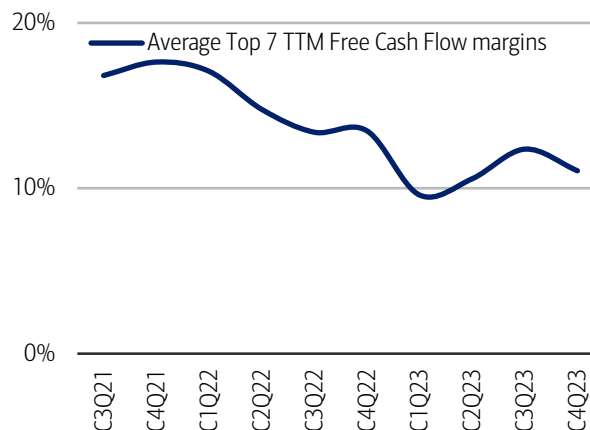


Source: BofA Global Research, FactSet

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Exhibit 5: Top 7 average FCF margins

Average FCF margins fell in Q4



Source: BofA Global Research, FactSet

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Exhibit 6: Summary of inventory changes across Top 7 semiconductor inventory holders

Top 7 semiconductor inventory holders inventory days were down 2.7% YoY in 4Q23 on average

Inventory Days	C3Q21	C4Q21	C1Q22	C2Q22	C3Q22	C4Q22	C1Q23	C2Q23	C3Q23	C4Q23	YoY (%)	3-Yr Change	5-Yr Change
INTC	106	103	114	117	123	127	125	115	110	107	-15.9%	19.7%	19.7%
5-Yr Median	99	89	102	102	100	96	103	102	100	96			
TXN	114	118	128	126	135	159	198	210	208	222	39.5%	77.7%	43.6%
5-Yr Median	133	136	138	136	133	136	138	136	135	146			
Infineon	111	114	122	128	119	148	147	151	151	193	30.1%	73.5%	74.6%
5-Yr Median	99	111	100	111	111	111	117	127	111	114			
STMicro	96	92	104	98	96	103	123	126	113	105	1.2%	23.4%	16.7%
5-Yr Median	98	90	98	105	96	90	104	105	96	92			
QCOM	76	83	90	104	121	159	153	162	153	134	-15.8%	96.7%	80.4%
5-Yr Median	63	68	76	81	73	68	76	86	76	74			
ON	119	124	139	136	129	136	159	163	166	179	31.9%	49.0%	49.6%
5-Yr Median	128	120	125	122	119	120	128	136	128	123			
NVDA	87	94	106	98	156	229	176	101	96	94	-59.2%	7.6%	-32.8%
5-Yr Median	75	83	97	86	87	87	97	89	88	94			
Average	101	104	115	115	126	152	154	147	142	148	-2.7%	50.7%	32.9%
5-Yr Median	100	98	100	102	101	104	113	115	105	106			

Source: BofA Global Research, company reports, FactSet

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Exhibit 7: Summary of FCF margins across Top 7 semiconductor inventory holders

Top 7 semiconductor inventory holders FCF margins were down 242bps YoY on average and down 399bps over the last 5 years

TTM FCF Margin	C3Q21	C4Q21	C1Q22	C2Q22	C3Q22	C4Q22	C1Q23	C2Q23	C3Q23	C4Q23	YoY	3-Yr Change	5-Yr Change
INTC	20.8%	16.7%	14.0%	-0.9%	-18.6%	-15.3%	-35.6%	-31.0%	-19.7%	-26.3%	-1108	-4183	-3954
TXN	31.2%	30.6%	31.6%	30.1%	29.3%	29.6%	22.6%	16.9%	9.1%	7.7%	-2187	-2007	-1257
Infineon	16.3%	16.3%	13.0%	11.9%	13.4%	10.3%	9.6%	8.0%	7.0%	2.3%	-799	-2076	-1053
STMicro	11.6%	9.6%	8.0%	8.1%	16.3%	17.2%	17.2%	16.7%	16.8%	17.2%	-3	515	787
QCOM	16.5%	14.8%	14.2%	15.8%	15.5%	18.8%	16.7%	17.8%	27.5%	27.2%	847	133	-1292
ON	10.8%	16.2%	18.0%	17.3%	21.0%	19.5%	16.9%	14.0%	6.8%	4.9%	-1468	13	68
NVDA	10.6%	19.3%	20.6%	21.1%	16.9%	14.1%	19.7%	31.6%	39.0%	44.4%	3024	3752	3905
Average	16.8%	17.6%	17.1%	14.8%	13.4%	13.5%	9.6%	10.6%	12.4%	11.1%	-242	-551	-399

Source: BofA Global Research, company reports, FactSet

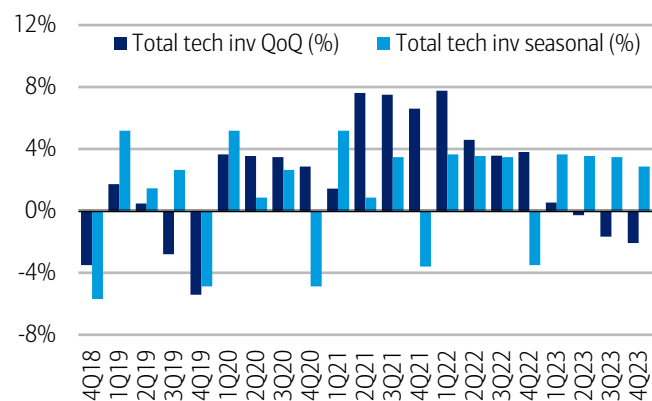
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Inventory days for tech above 5-year median

For all of tech, inventory dollars decreased -2.1% QoQ, below the seasonal increase of +2.9%. Total tech inventory days were 72 days, down 7 days QoQ and about 20 days above the 5-year median of 52 days.

Exhibit 8: Total tech inventory dollars QoQ (%) vs. seasonality (%)

Total tech inv dollars decreased 2%, below the 3% seasonal increase

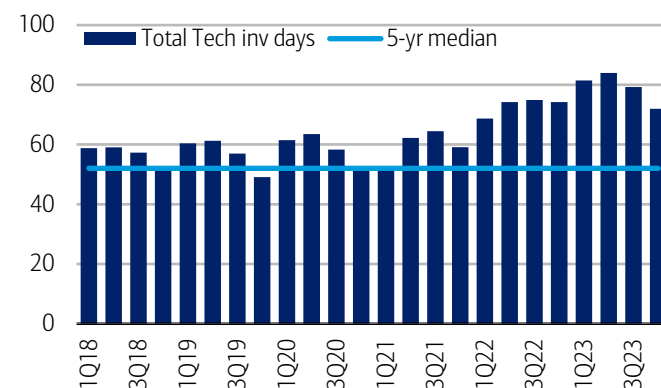


Source: BofA Global Research estimates, FactSet

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Exhibit 9: Total tech inventory days compared to 5-year median

Total tech inv days (72) are now 20 days above the 5-year median



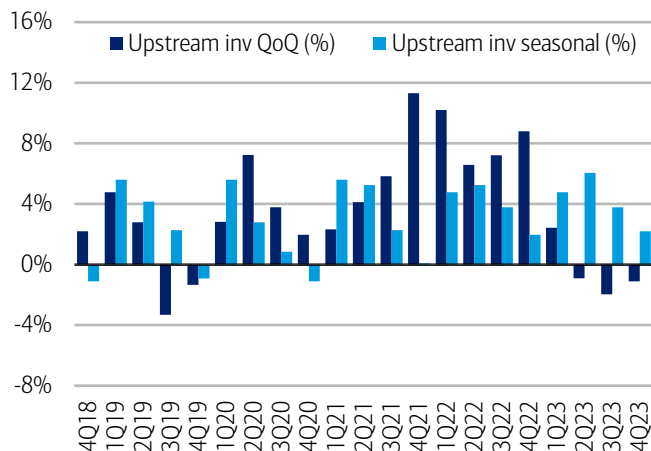
Source: BofA Global Research estimates, FactSet

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For the upstream part of the supply chain, inventory dollars decreased 1% QoQ compared to the seasonal trends of up 2% QoQ. Upstream inventory days were 118 days, down 6 days QoQ and above the 5-year median of 91 days (driven by memory, diversified inventory).

Exhibit 10: Upstream inventory dollars QoQ (%) vs. seasonality (%)

Total upstream inv dollars decreased 1%, below seasonal trends



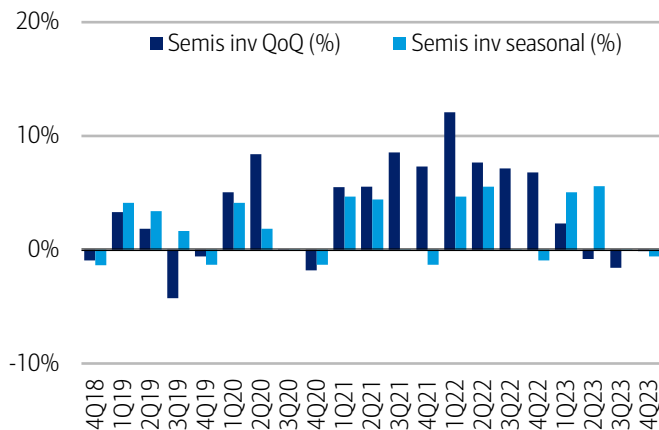
Source: BofA Global Research estimates, FactSet

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Semis inventory dollars were flat QoQ, above seasonal trends of -1% QoQ. Semi inventory days were 120 days, above the 5-year median of 97 days, and down from Q1's historical peak (139 days).

Exhibit 12: Semis inventory dollars QoQ (%) vs. seasonality (%)

Total semis inv dollars were flat QoQ, vs -1% QoQ seasonally



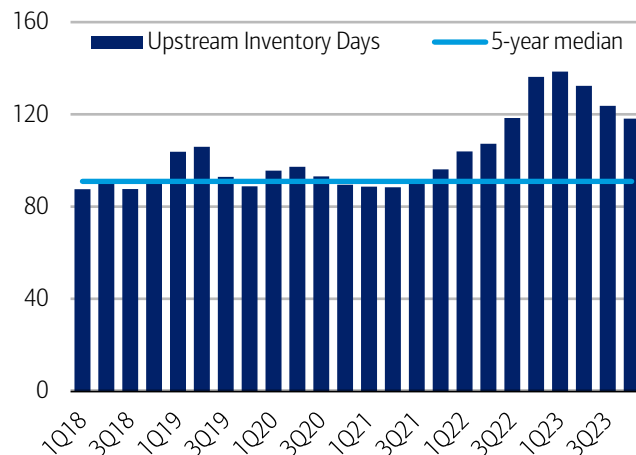
Source: BofA Global Research estimates, FactSet

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Downstream inventory dollars were down 3% QoQ vs. a seasonal increase of 2%. Downstream inventory days were 60 days, down 7 days QoQ and above the 5-year median of 45 days.

Exhibit 11: Upstream inventory days compared to 5-year median

Total upstream inv days (118) are now 27 days above the 5-year median

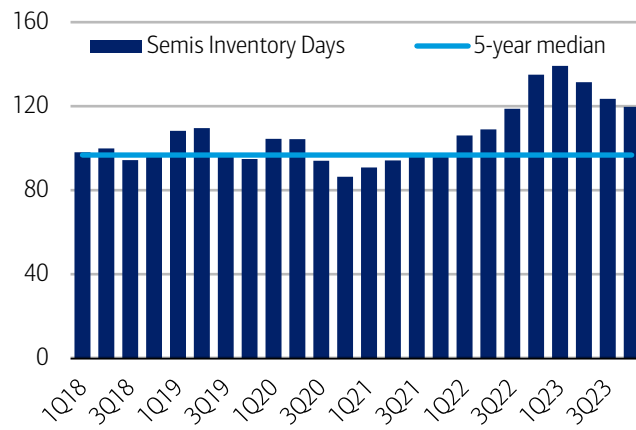


Source: BofA Global Research estimates, FactSet

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Exhibit 13: Semis inventory days compared to 5-year median

Total semis inv days (120) are now 23 days above the 5-year median

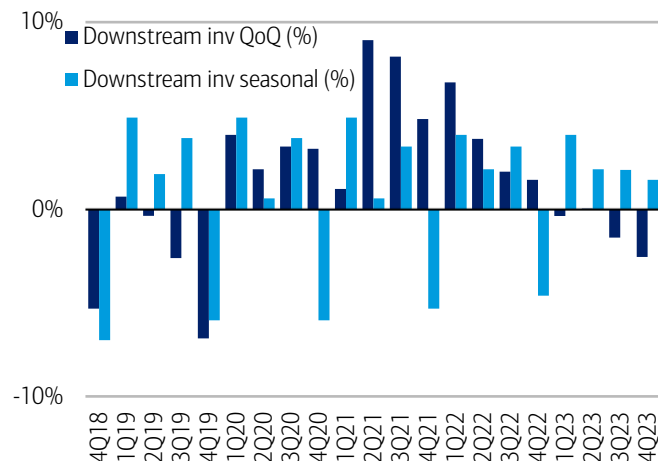


Source: BofA Global Research estimates, FactSet

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Exhibit 14: Downstream inventory dollars QoQ (%) vs. seasonality (%)

Total downstream inv dollars were down 3% vs. 2% seasonal increase

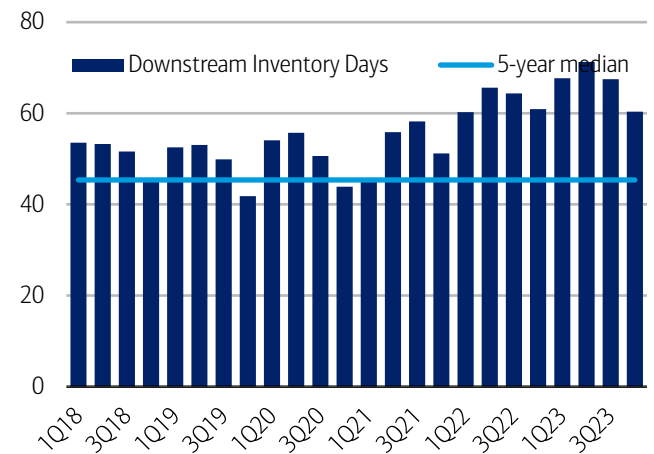


Source: BofA Global Research estimates, FactSet

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Exhibit 15: Downstream inventory days compared to 5-year median

Total downstream inv days (60) are 15 days above the 5-year median



Source: BofA Global Research estimates, FactSet

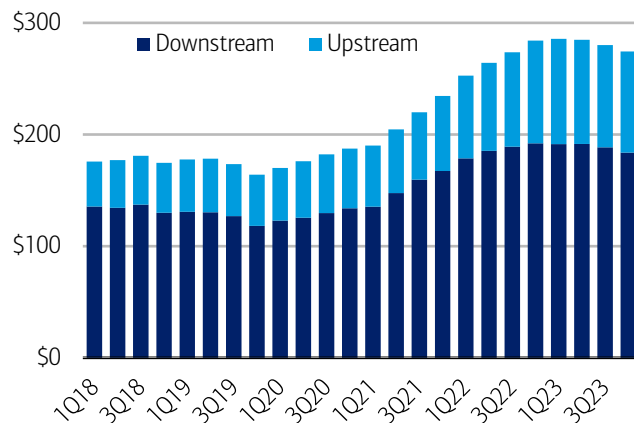
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Upstream and Downstream inventory days both elevated

As previously noted, overall tech supply chain inventory dollars finished below seasonal trends (-2% QoQ vs seasonally up 3%), with upstream (semiconductors, foundry, memory/storage) inventory dollars down 1% QoQ exiting Q4 and downstream dollars down 3% QoQ vs seasonally +2% QoQ).

Exhibit 16: Upstream and Downstream total inventory dollars (\$bn)

Overall tech inventory decreased 2% QoQ in 4Q23

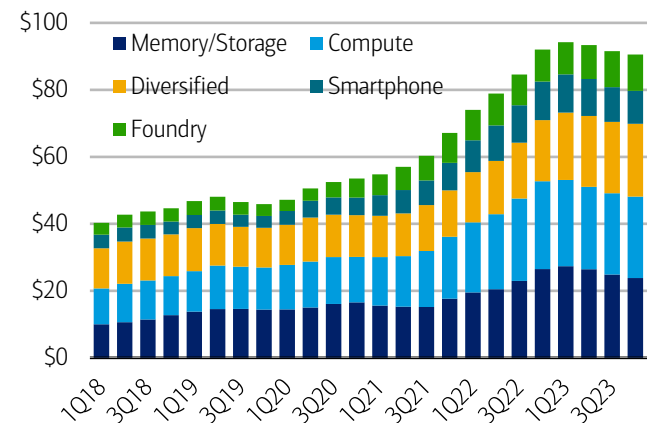


Source: BofA Global Research estimates, FactSet

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Exhibit 17: Upstream inventory dollars breakdown (\$bn)

Upstream inventory dollars are down 1% QoQ



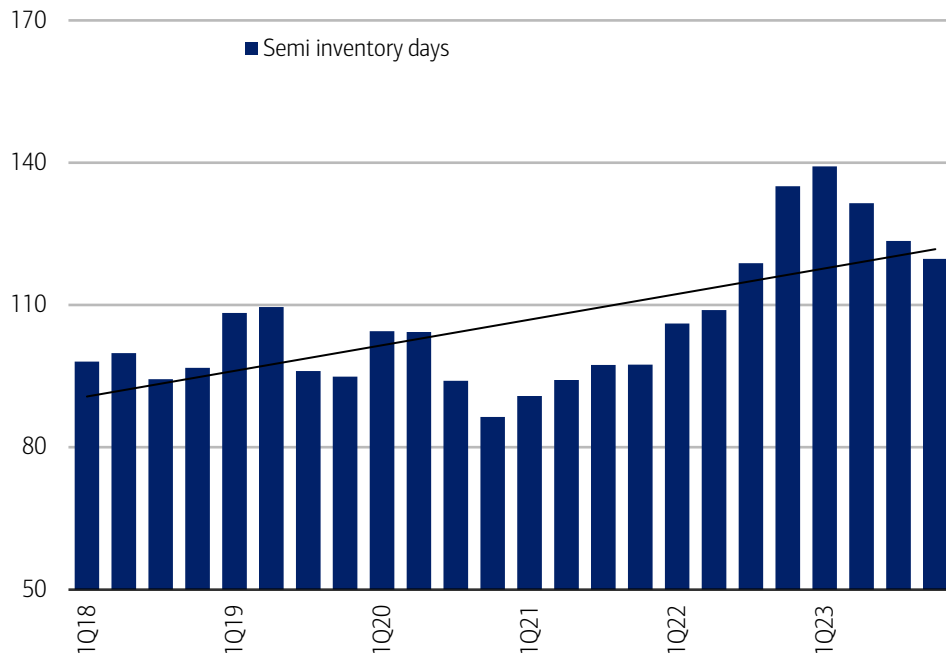
Source: BofA Global Research estimates, FactSet

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Historical 5-year median data has not been a great indicator of overall inventory health, as the general trend is increasing over time. Days have gradually increased for semis from an average of 73 in 2000-2006, to 79 in 2007-2013, and 100 since 2014.

Exhibit 18: Semi inventory days are falling sequentially

Semi inventory days are now 23 days above the 5-year median



Source: BofA Global Research estimates, FactSet

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On the downstream side, inventory dollars across Distribution/OEM companies were down over 2% QoQ, with EMS inventories down 4% QoQ. On the upstream side, semis (ex-memory) inventory dollars were flat QoQ, while memory/smartphone inventory dollars decreased 4%/5% QoQ.

Exhibit 19: Summary of overall segment inventory dollars, inventory days, and sales

Upstream/Downstream inventory days are 27/15 days above the long-term median

	% of tech inventory	Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
		Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
OEM	53.9%	-2.4%	1.6%	-4.0%	-3.0%	0.0%	-3.0%	-12.2%	-13.3%	1.1%	59	44	14
Distribution	8.0%	-2.4%	-1.4%	-1.1%	-5.1%	-9.8%	4.7%	-2.3%	-6.9%	4.5%	64	49	15
EMS	5.1%	-4.0%	2.7%	-6.7%	-15.5%	-9.3%	-6.2%	-1.8%	-4.6%	2.8%	80	53	27
Total Downstream	67.0%	-2.5%	1.6%	-4.1%	-4.3%	-1.3%	-3.1%	-10.5%	-12.1%	1.6%	60	45	15
Memory/Storage	8.7%	-4.2%	11.3%	-15.6%	-10.0%	21.1%	-31.1%	-5.1%	12.6%	-17.8%	139	106	33
Compute	8.8%	0.0%	-0.1%	0.1%	-7.5%	56.3%	-63.8%	-4.8%	-1.2%	-3.6%	101	89	6
Diversified	7.9%	2.3%	-0.3%	2.6%	19.3%	-7.9%	27.2%	7.1%	1.7%	5.4%	158	114	44
Smartphones	3.6%	-5.3%	1.4%	-6.7%	-14.8%	8.4%	-23.2%	-14.6%	6.6%	-21.2%	111	78	33
Foundry	3.9%	0.6%	4.1%	-3.5%	13.5%	-4.1%	17.6%	-10.7%	9.2%	-19.9%	82	71	11
Total Upstream	33.0%	-1.1%	2.2%	-3.3%	-1.6%	18.2%	-19.9%	-5.0%	3.8%	-8.8%	118	91	27

Source: BofA Global Research, FactSet

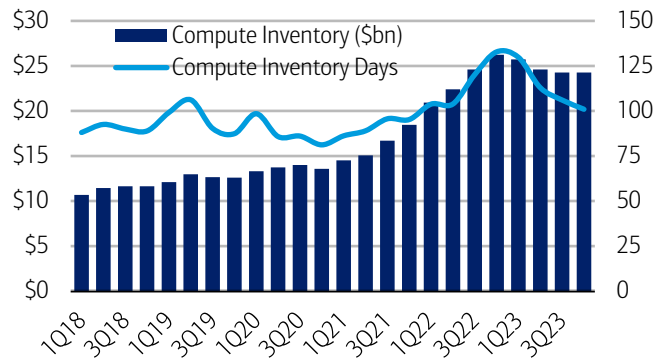
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Compute inventory dollars flat in DecQ

Compute inventory dollars were flat QoQ, in line with seasonality. Inventory days decreased 5% QoQ to 101 days, above the 5-year median of 89 days. Compute inventory dollars decreased 8% YoY, while sales were up 56% YoY.

Exhibit 20: Compute inventory dollars vs. inventory days

Compute inventory dollars are flat QoQ

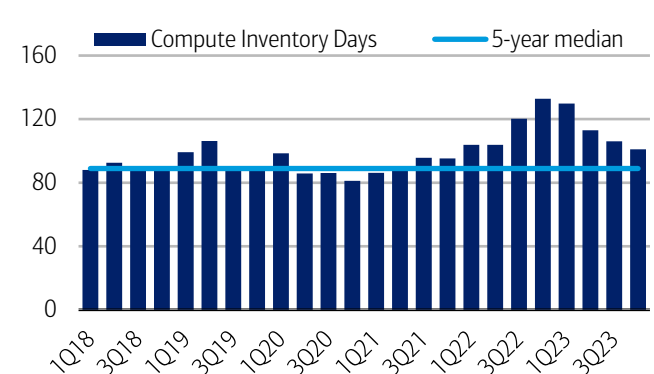


Source: BofA Global Research estimates, FactSet; INTC, AMD, NVDA, MRVL, AVGO, XLNX, IPHI, Realtek

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Exhibit 21: Compute inventory days compared to 5-year median

Compute inventory days are still above the 5 year median



Source: BofA Global Research estimates, FactSet; INTC, AMD, NVDA, MRVL, AVGO, XLNX, IPHI, Realtek

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- Intel (INTC):** INTC inventory dollars decreased 3% QoQ, vs a 1% seasonal increase. Mgmt sees inventory levels as healthy and gaining momentum. Noted an FPGA inventory correction, while client compute inventory levels have normalized.
- Advanced Micro Devices (AMD):** AMD inventory dollars were down 2% QoQ in the December quarter (vs up 7% QoQ seasonally). Mgmt expects Embedded demand to remain soft through 1H24E as customers work down inventory, and Gaming to decline in 1H on corrections.
- Nvidia (NVDA):** NVDA inventory dollars were up 11% QoQ, vs +16% QoQ seasonally. Inventory days of 94 were in line with historical levels.

Exhibit 22: Summary of compute segment inventory dollars, inventory days, and sales

Inventory days for the group are 14 days above the 5-yr median

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Compute:														
INTC	45.8%	4.1%	-3.0%	1.2%	-4.2%	-15.9%	9.7%	-25.6%	-3.0%	-4.1%	1.1%	107	96	11
NVDA	21.8%	1.9%	10.5%	15.8%	-5.3%	2.4%	265.3%	-262.9%	-2.5%	17.8%	-20.3%	94	94	-1
AMD	19.1%	1.7%	-2.0%	7.3%	-9.3%	14.3%	10.2%	4.1%	-7.9%	-5.2%	-2.7%	129	85	45
MRVL	3.9%	0.3%	-0.2%	3.6%	-3.7%	-12.0%	0.1%	-12.1%	19.5%	-2.1%	21.6%	118	78	41
AVGO	7.8%	0.7%	0.1%	-1.4%	1.5%	0.1%	29.8%	-29.8%	-16.9%	-0.6%	-16.3%	60	59	1
Realtek	3.9%	0.1%	-16.4%	5.9%	-22.2%	-53.9%	2.2%	-56.1%	3.4%	12.9%	-9.4%	86	79	7
Total Compute	100.0%	8.8%	0.0%	-0.1%	0.1%	-7.5%	56.3%	-63.8%	-4.8%	-1.2%	-3.6%	101	89	12

Source: BofA Global Research, FactSet

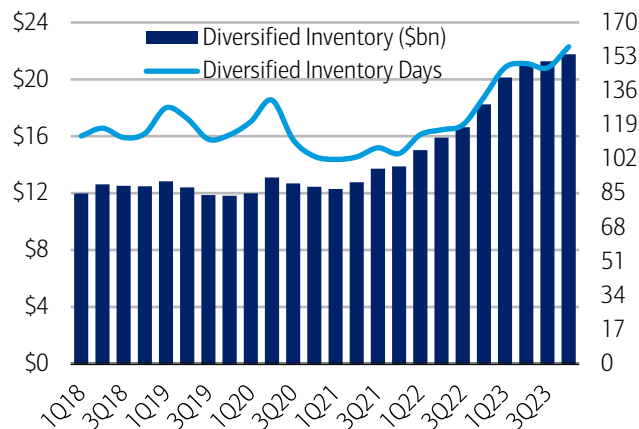
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Diversified inventory days remain above historical levels

Diversified inventory dollars were up 2% QoQ versus seasonally flat QoQ. On a days' basis, inventory increased 7% QoQ to 158 days, above the 114 day 5-year median. Diversified inventory dollars were up 19% YoY while sales decreased 8% YoY, as auto/industrial customers continued to work through excess inventory.

Exhibit 23: Diversified inventory dollars vs. inventory days

Diversified inventory days grew 7% QoQ

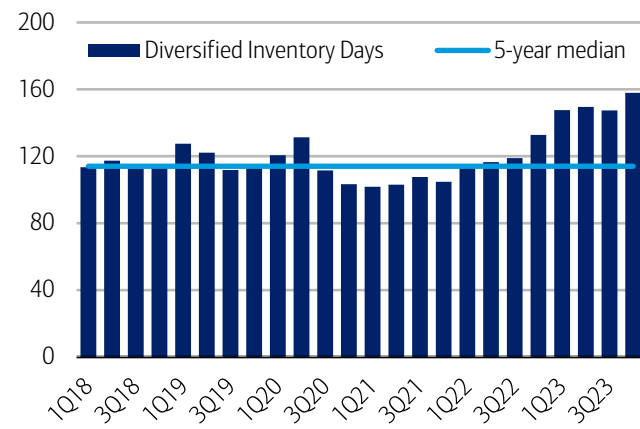


Source: BofA Global Research estimates, FactSet; TXN, ADI, ON, NXPI, Renesas, Infineon, MCHP, STMicro, MTSI, Novatek, Rohm, AMBA

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Exhibit 24: Diversified inventory days compared to 5-year median

Diversified inventory days are above the 5-year median



Source: BofA Global Research estimates, FactSet; TXN, ADI, ON, NXPI, Renesas, Infineon, MCHP, STMicro, MTSI, Novatek, Rohm, AMBA

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- 1. Texas Instruments (TXN):** Texas Instruments (TXN): TXN inventory dollars were up 2% QoQ (vs. seasonally +3% QoQ), while inventory days were up 7% QoQ. TXN continues to invest in 300mm inventory, while customers continue to rebalance their inventories. Expect to have an upward bias on the inventory for at least one more quarter on long-lived parts.
- 2. STMicro (STM):** STM inventory dollars were down 6% QoQ, with inventory days down 7% QoQ vs down 6% seasonally. In 2024 mgmt expects to see significant inventory correction in Industrial.
- 3. Infineon (IFNNY):** Infineon inventory dollars grew at 14% QoQ vs 5% QoQ seasonally, with inventory days up 28% QoQ vs up about 12% QoQ seasonally. Mgmt is seeing a prolonged inventory digestion period and a recovery only in 2H24E for some end markets.
- 4. Microchip (MCHP):** Inventory dollars ended DecQ down 2% QoQ vs up 1% seasonally, with inventory days +11% QoQ, vs flat QoQ seasonally. Mgmt states that they weren't able to reduce inventory dollars as much as desired, and expect to invest in building inventory for long-lived high-margin products.
- 5. Analog Devices (ADI):** ADI's inventory dollars decreased 5% QoQ, vs +1% QoQ seasonal increase, while days fell +2% QoQ vs +2% seasonally. Mgmt states: "The inventory rationalization at our customers that began during the middle of 2023 is expected to continue through our second quarter."
- 6. ON Semiconductor (ON):** In the DecQ, ON's inventory dollars grew +1% QoQ vs up 3% QoQ seasonally, while days grew 8% QoQ vs up 3% QoQ seasonally. Inventory levels to normalize between 7-9 weeks over the next few Qs.

- 7. NXP Semiconductor (NXPI):** In Q4, NXPI saw inventory dollars flat QoQ, below seasonal trends of up 1% QoQ. “We have entered the multi-Q inventory correction phase with our direct customers starting in 2H23.”

Exhibit 25: Summary of diversified segment 4Q23 inventory dollars, inventory days, and sales

Diversified inventory days (158) are now 44 days above the 5-year median

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Diversified:														
TXN	18.4%	1.5%	2.3%	2.5%	-0.2%	45.0%	-12.7%	57.7%	6.7%	3.7%	3.0%	222	146	76
Infineon	22.0%	1.7%	13.7%	5.1%	8.6%	38.4%	-1.2%	39.6%	28.1%	11.7%	16.3%	193	114	79
STM	12.4%	1.0%	-6.0%	-1.5%	-4.5%	4.5%	-3.2%	7.7%	-7.1%	-5.9%	-1.2%	105	92	12
NXPI	9.8%	0.8%	-0.3%	1.4%	-1.6%	19.8%	3.3%	16.4%	0.6%	1.6%	-1.0%	138	103	35
Renesas	5.3%	0.4%	-3.0%	-5.3%	2.3%	-18.8%	-11.4%	-7.4%	-0.8%	-12.5%	11.7%	83	72	11
ON	9.7%	0.8%	1.3%	2.0%	-0.8%	30.6%	-4.1%	34.7%	8.3%	3.4%	4.9%	179	123	57
ADI	7.1%	0.6%	-5.4%	1.2%	-6.6%	2.0%	-22.7%	24.7%	-1.7%	1.9%	-3.6%	182	120	62
MCHP	6.0%	0.5%	-1.5%	0.7%	-2.2%	12.5%	-18.6%	31.1%	10.8%	-0.2%	11.0%	187	130	57
Other	9.2%	0.7%	6.2%	2.9%	3.3%	4.1%	-2.9%	7.0%	9.7%	9.1%	0.6%	162	123	39
Total Diversified	100.0%	7.9%	2.3%	-0.3%	2.6%	19.3%	-7.9%	27.2%	7.1%	1.7%	5.4%	158	114	44

Source: BofA Global Research estimates, FactSet

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Smartphone inventory days well above historical levels

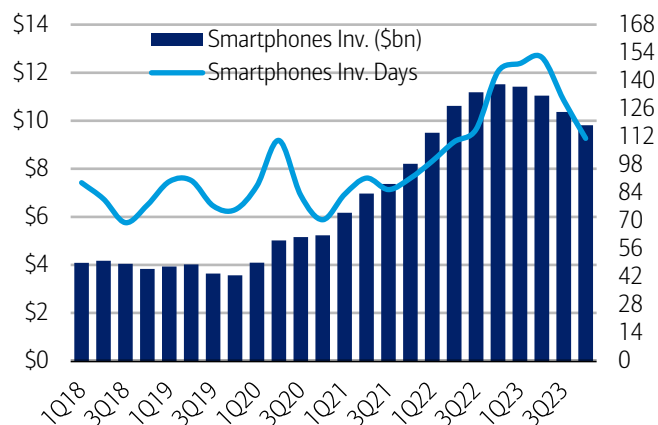
Smartphone inventory dollars decreased -5% QoQ versus a seasonal increase of 1%.

Inventory days decreased 15% QoQ to 111, now 33 days above the 5-year median.

Smartphone inventory dollars decreased 15% YoY while sales increased 8% YoY.

Exhibit 26: Smartphone inventory dollars vs. inventory days

Inventory dollars were down -5% QoQ

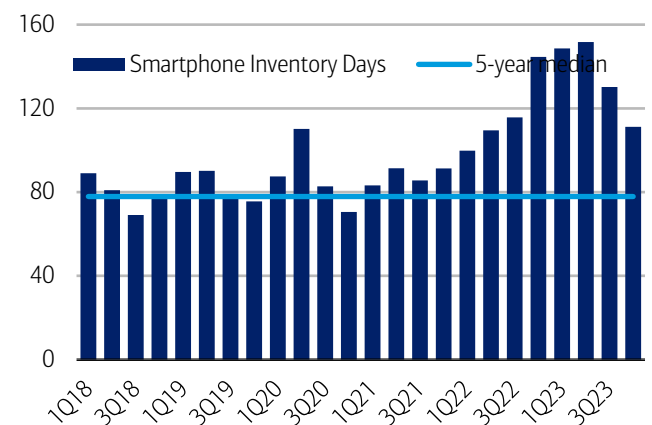


Source: BofA Global Research estimates, FactSet; SWKS, CRUS, QCOM, QROV, Mediatek

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Exhibit 27: Smartphone inventory days compared to 5-year median

Smartphone inventory days (111) are above the 5-year median



Source: BofA Global Research estimates, FactSet; SWKS, CRUS, QCOM, QROV, Mediatek

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- 1. Skyworks (SWKS):** SWKS saw inventory dollars decrease 17% QoQ in the DecQ (vs -1% QoQ seasonally), and days fell 17% QoQ, vs down 9% QoQ seasonally. Customers are starting to restock inventory, albeit gradually. In consumer IoT we are past the bottom as inventory levels in the channel have normalized.
- 2. Qorvo (QRVO):** QRVO inventory dollars were down 14% QoQ, vs up 1% QoQ seasonally. Days were down 17% QoQ vs up 5% QoQ seasonally. In the cellular base station market, inventories continue to be consumed and mgmt. expects demand conditions to remain soft through CY24E.
- 3. Cirrus (CRUS):** CRUS inventory dollars decreased 22% QoQ, well below typical 7% seasonal decrease, with inventory days down 39% QoQ vs down 15% QoQ seasonally. Mgmt expects inventory dollars to increase slightly this Q.

4. **Qualcomm (QCOM):** QCOM decreased inventory dollars 3% QoQ, vs up 1% QoQ seasonally. IoT and Android inventory have largely normalized (per mgmt.).

Exhibit 28: Summary of smartphone segment 4Q23 inventory dollars, inventory days, and sales

Smartphone inventory days are now 47 days above the 5-year median

	Inventory as a % of Segment		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Total tech		Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Smartphones:														
QCOM	63.7%	2.3%	-2.7%	1.4%	-4.2%	-9.9%	4.9%	-14.8%	-12.3%	9.2%	-21.5%	134	74	60
Mediatek	16.9%	0.6%	0.0%	-7.9%	7.9%	-28.0%	17.9%	-45.9%	-12.2%	10.5%	-22.7%	67	72	-5
SWKS	9.4%	0.3%	-17.2%	-0.9%	-16.4%	-27.2%	-9.6%	-17.6%	-17.3%	-8.8%	-8.4%	131	104	27
QRVO	7.4%	0.3%	-13.5%	0.5%	-14.0%	-15.2%	44.5%	-59.7%	-17.1%	5.3%	-22.4%	110	99	11
CRUS	2.6%	0.1%	-22.0%	-7.4%	-14.6%	68.4%	4.8%	63.6%	-39.3%	-15.1%	-24.2%	78	56	22
Total Smartphones	100.0%	3.6%	-5.3%	1.4%	-6.7%	-14.8%	8.4%	-23.2%	-14.6%	6.6%	-21.2%	111	78	33

Source: BofA Global Research estimates, FactSet

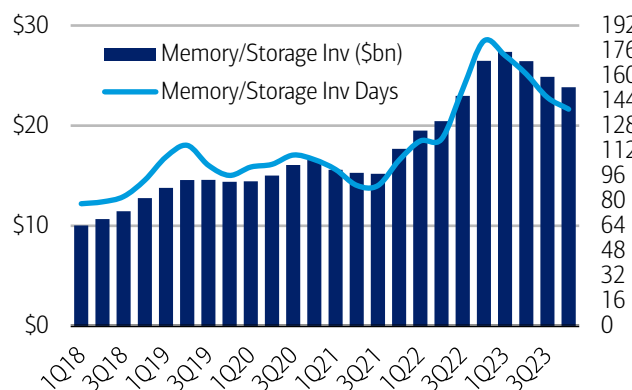
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Memory/Storage inventory dollars fall QoQ

Memory/storage inventory dollars decreased 4% QoQ vs. a seasonal increase of 11%. Inventory days were down 5% QoQ to 139, still well above the 5-year median of 106 days. Memory/storage inventory dollars decreased 10% YoY, while sales increased over 21% YoY.

Exhibit 29: Memory/storage inventory dollars vs. inventory days

Memory/storage inventory dollars decreased 4% QoQ

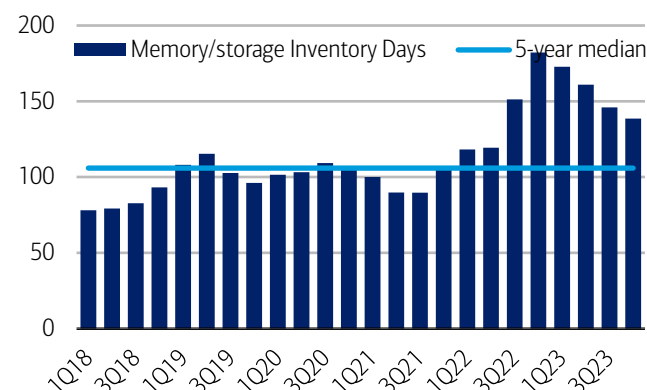


Source: BofA Global Research estimates, FactSet; Hynix, MU, Qimonda, Nanya, Powerchip, STX, WDC

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Exhibit 30: Memory/storage inv days compared to 5-year median

Inventory days (139) are well above the 5-year median (106)



Source: BofA Global Research estimates, FactSet; Hynix, MU, Qimonda, Nanya, Powerchip, STX, WDC

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1. **Micron (MU):** MU inventory dollars were down 1% QoQ in DecQ vs up 8% QoQ seasonally. Inventory days were down 8% QoQ vs seasonally up 8% QoQ. Inventories for memory and storage are at or near normal levels for most customers across PC, mobile, auto, and industrial end markets.
2. **Western Digital (WDC):** Inventory dollars were down 8% QoQ, vs up 3% seasonally. Mgmt states that in Flash, we have been able to navigate business cycles by managing inventory proactively.
3. **Seagate (STX):** Inventory dollars flat QoQ (vs. flat seasonally) while inventory days grew 10% QoQ vs seasonally up 6% QoQ. Mgmt states that from a demand standpoint, gradual recovery within the US cloud market has started to take shape, reflecting excess inventory consumption.
4. **SK Hynix:** Inventory dollars decreased 6% QoQ vs up 19% QoQ seasonally. Days fell 6% QoQ vs up 12% QoQ seasonally. Mgmt expects industry inventory levels to decline throughout the year.

Exhibit 31: Summary of memory segment 4Q23 inventory dollars, inventory days, and sales

Memory inventory days are 33 days above the 5-year median

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Memory/Storage:														
MU	34.7%	3.0%	-1.3%	7.6%	-8.9%	-1.0%	15.7%	-16.7%	-7.9%	7.5%	-15.4%	159	119	39
Hynix	43.9%	3.8%	-5.5%	19.3%	-24.8%	-15.5%	51.5%	-67.0%	-5.7%	11.6%	-17.3%	139	104	35
WDC	13.5%	1.2%	-8.0%	2.9%	-10.9%	-14.8%	-2.4%	-12.3%	-5.3%	6.1%	-11.4%	115	104	11
STX	4.4%	0.4%	0.1%	-0.4%	0.5%	-11.8%	-17.6%	5.8%	9.5%	6.4%	3.1%	81	54	26
Nanya	3.5%	0.3%	-5.3%	7.6%	-12.9%	8.1%	7.7%	0.3%	-6.9%	20.0%	-26.9%	242	139	103
Total Memory/Storage	100.0%	8.7%	-4.2%	11.3%	-15.6%	-10.0%	21.1%	-31.1%	-5.1%	12.6%	-17.8%	139	106	33

Source: BofA Global Research estimates, FactSet

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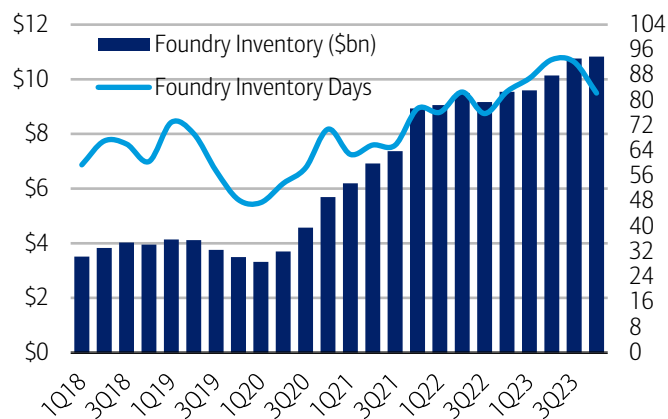
Foundry inventory days decrease sequentially

Foundry inventory dollars increased 1% QoQ compared to a seasonal increase of +4%.

On a days' basis, inventory decreased 11% QoQ to 82 days vs. the normal seasonal pattern of +9% QoQ and is 11 days above the 5-year median of 71 days.

Exhibit 32: Foundry inventory dollars vs. inventory days

Foundry inventory dollars increased 1% QoQ

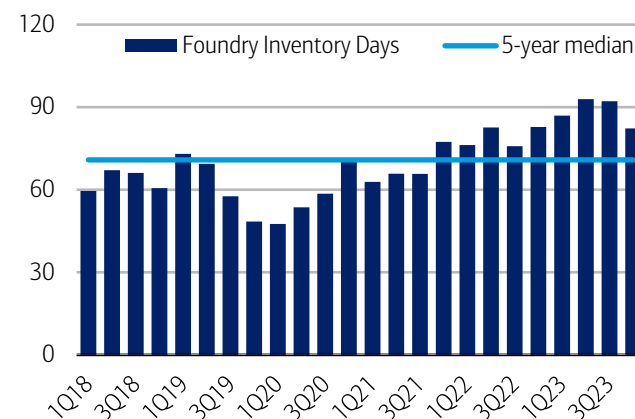


Source: BofA Global Research estimates, FactSet; TSMC, UMC, SMIC

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Exhibit 33: Foundry inventory days compared to 5-year median

Foundry inventory days (82) are well above 5-year median (71)



Source: BofA Global Research estimates, FactSet; TSMC, UMC, SMIC

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TSMC (Taiwan Semiconductor) accounts for 70%+ of the inventory in the foundry segment. Mgmt believes fabless semi inventories have returned to more normal levels.

Exhibit 34: Summary of foundry segment 4Q23 inventory dollars, inventory days, and sales

Inventory days are 11 days above historical levels

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Foundry:														
TSMC	75.5%	3.0%	0.7%	4.6%	-3.9%	13.7%	-1.6%	15.2%	-13.4%	3.7%	-17.1%	79	73	5
SMIC	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UMC	10.7%	0.4%	2.7%	2.8%	-0.1%	15.1%	-20.2%	35.4%	1.1%	0.4%	0.7%	89	57	32
Total Foundry	100.0%	3.9%	0.6%	4.1%	-3.5%	13.5%	-4.1%	17.6%	-10.7%	9.2%	-19.9%	82	71	11

Source: BofA Global Research estimates, FactSet

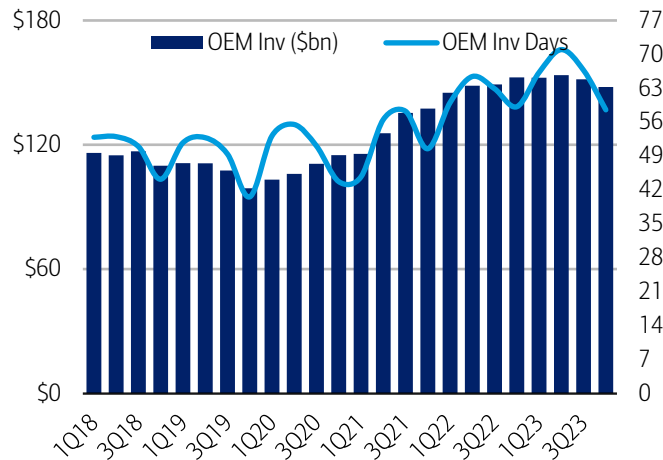
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OEM inventory days above historical trends

OEM inventory dollars were down 2% QoQ vs. the seasonal increase of 2%. Inventory days were down 12% QoQ to 59 days, 14 days above the 5-year median of 44 days. Inventory dollars decreased 3% YoY, with sales flat YoY.

Exhibit 35: OEM inventory dollars vs. inventory days

OEM inventory dollars were down 2% QoQ

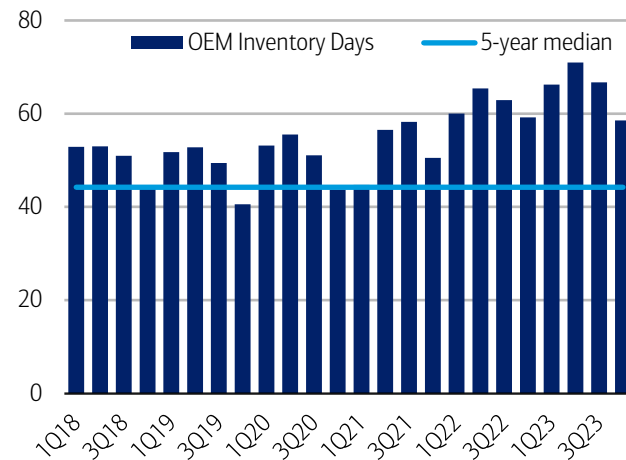


Source: BofA Global Research estimates, FactSet; AAPL, HTC, LG, Motorola, BB, Samsung, TCL Comms, Alcatel, CSCO, Ericsson, JNPR, Viavi, Nokia, ZTE, Acer, Asustek, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, Konka, Nikon, Nintendo, Skyworth, Sony, TCL Multimedia, Hisense, BorgWarner, Continental, Denso, ABB, Emerson, GE, HON, JCI, Legrand, Siemens, Toshiba

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Exhibit 36: OEM inventory days compared to 5-year median

OEM inventory days now 14 days above 5-year median



Source: BofA Global Research estimates, FactSet; AAPL, HTC, LG, Motorola, BB, Samsung, TCL Comms, Alcatel, CSCO, Ericsson, JNPR, Viavi, Nokia, ZTE, Acer, Asustek, HPQ, HPE, IBM, Lenovo, Nidec, Positivo, Konka, Nikon, Nintendo, Skyworth, Sony, TCL Multimedia, Hisense, BorgWarner, Continental, Denso, ABB, Emerson, GE, HON, JCI, Legrand, Siemens, Toshiba

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Apple inventory dollars increased 3% QoQ vs. overall OEM inventory dollars down 2% QoQ. Inventory days of 9 were 2 says above historical median.

Exhibit 37: Summary of OEM segment 4Q23 inventory dollars, inventory days, and sales

OEM inventory days 14 days above historical levels

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
OEM:														
Samsung	27.1%	14.6%	-2.1%	3.0%	-5.1%	-2.9%	-1.1%	-1.8%	-0.4%	5.9%	-6.3%	104	78	26
GE	11.2%	6.0%	-2.9%	-5.6%	2.7%	-5.0%	-11.0%	5.9%	-13.1%	-12.2%	-0.8%	105	90	15
Siemens	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SONY	7.8%	4.2%	-16.6%	-9.9%	-6.6%	4.2%	5.0%	-0.8%	-33.0%	-28.9%	-4.1%	62	40	22
HPQ	4.7%	2.5%	1.0%	-3.3%	4.3%	-5.7%	-1.9%	-3.8%	6.2%	6.0%	0.2%	61	49	12
LG	4.8%	2.6%	-3.9%	-5.2%	1.3%	-4.6%	8.7%	-13.3%	-17.9%	-13.8%	-4.1%	47	49	-3
Toshiba	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AAPL	4.4%	2.4%	2.8%	22.5%	-19.6%	-4.5%	2.1%	-6.6%	-22.1%	-27.2%	5.1%	9	8	2
ZTE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lenovo	4.3%	2.3%	0.0%	-3.3%	3.3%	-15.1%	3.0%	-18.0%	-9.4%	-6.1%	-3.2%	44	36	8
IBM	0.8%	0.4%	-17.0%	-11.1%	-5.9%	-25.2%	4.1%	-29.3%	-21.5%	-18.4%	-3.1%	15	17	-2
Other	34.9%	18.8%	-23.3%	-0.5%	-22.8%	-24.7%	37.5%	-62.2%	-52.2%	-13.4%	-38.9%	86	136	-50
Total OEM	100.0%	53.9%	-2.4%	1.6%	-4.0%	-3.0%	0.0%	-3.0%	-12.2%	-13.3%	1.1%	59	44	14

Source: BofA Global Research estimates, FactSet

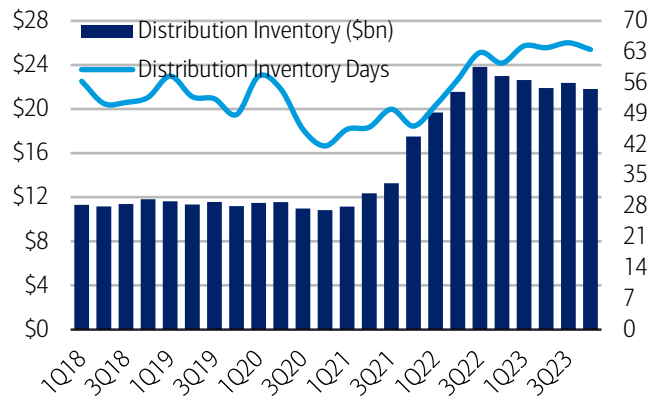
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Distribution days above 5-year median

Distribution inventory dollars decreased 2% QoQ, vs seasonally down 1% QoQ. Inventory days of 64 are still above the 49 day 5-year median. On a YoY basis, inventory dollars are down 5% YoY with sales down 10% YoY.

Exhibit 38: Distribution inventory dollars vs. inventory days

Distribution inventory dollars decreased 2% QoQ

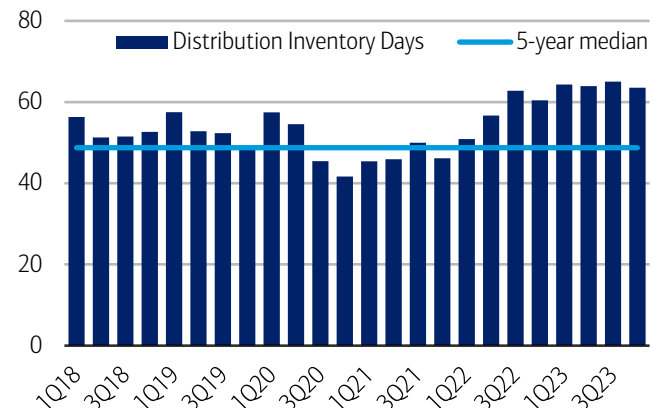


Source: BofA Global Research estimates, FactSet; Arrow, Avnet, WPG, Ingram Micro (Tianjin Tianhai), Synnex, Edom

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Exhibit 39: Distribution inventory days compared to 5-year median

Inventory days (64) are above the 5-year median (49)



Source: BofA Global Research estimates, FactSet; Arrow, Avnet, WPG, Ingram Micro (Tianjin Tianhai), Synnex, Edom

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Arrow mgmt. has stated that the components inventory correction is taking longer than expected.

Exhibit 40: Summary of distribution segment 4Q23 inventory dollars, inventory days, and sales

Distribution inventory days are 15 days above the 5-year median

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
Distribution:														
IM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arrow	23.8%	1.9%	-10.7%	4.2%	-14.8%	-2.5%	-15.8%	13.3%	-8.5%	-1.4%	-7.0%	69	49	20
Avnet	28.0%	2.2%	6.3%	-2.6%	8.9%	23.0%	-7.6%	30.6%	8.0%	-1.9%	9.9%	101	66	35
WPG	15.5%	1.2%	0.8%	-4.9%	5.7%	-7.2%	2.1%	-9.3%	3.7%	-4.2%	7.9%	56	45	11
Synnex	32.7%	2.6%	-4.2%	-5.2%	1.0%	-21.2%	-11.3%	-9.9%	-7.0%	-14.3%	7.3%	48	41	7
Edom	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Distribution	100.0%	8.0%	-2.4%	-1.4%	-1.1%	-5.1%	-9.8%	4.7%	-2.3%	-6.9%	4.5%	64	49	15

Source: BofA Global Research estimates, FactSet

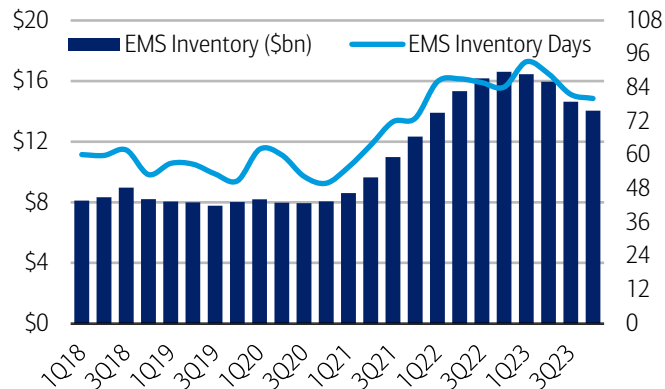
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EMS inventory days above 5-year median

EMS inventory dollars decreased 4% QoQ vs. seasonally up 3%. On a days' basis, inventory is 27 days above the 5-year median (53). Inventory dollars were down 16% YoY and sales decreased 9% YoY.

Exhibit 41: EMS inventory dollars vs. inventory days

Inventory dollars decreased 4% QoQ

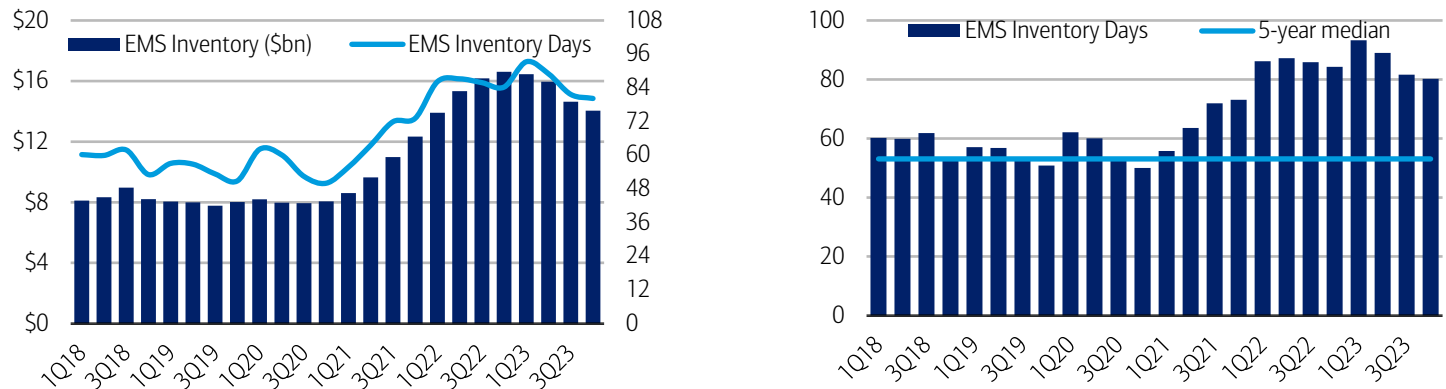


Source: BofA Global Research estimates, FactSet; Flextronics, Jabil, Sanmina, Hon Hai, Celestica
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Flextronics mgmt. expects further reductions in inventory, with cloud and automotive fairly strong.

Exhibit 42: EMS inventory days compared to 5-year median

Inventory days (80) are well above the 5-yr median (53)



Source: BofA Global Research estimates, FactSet; Flextronics, Jabil, Sanmina, Hon Hai, Celestica
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Exhibit 43: Summary of EMS segment 4Q23 inventory dollars, inventory days, and sales

Inventory days are 27 days above the 5-year median

	Inventory as a % of		Inventory \$s QoQ			Inventory \$s YoY vs. Sales			Inventory days QoQ			Inventory days vs. 5-year median		
	Segment	Total tech	Reported	Seasonal	Delta	Inventory	Sales	Delta	Reported	Seasonal	Delta	Reported	5Y median	Delta
EMS:														
Hon Hai	NA	NA	NA	-14.3%	NA	NA	NA	NA	NA	-33.6%	NA	NA	34	NA
Flextronics	48.5%	2.5%	-4.9%	1.4%	-6.3%	-13.1%	-8.4%	-4.6%	0.6%	-4.9%	5.5%	97	56	41
Jabil	36.5%	1.9%	-1.6%	4.9%	-6.5%	-20.3%	-13.0%	-7.3%	-0.5%	-3.3%	2.8%	61	49	12
Sanmina	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Celestica	15.0%	0.8%	-6.9%	1.1%	-7.9%	-10.4%	4.8%	-15.2%	-10.8%	1.5%	-12.2%	100	77	22
Total EMS	100.0%	5.1%	-4.0%	2.7%	-6.7%	-15.5%	-9.3%	-6.2%	-1.8%	-4.6%	2.8%	80	53	27

Source: BofA Global Research estimates, FactSet

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Appendix for Inventory analysis

Exhibit 44: Summary of inventory day trends

Semis inventory days QoQ were below seasonality

	4Q20	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	3Q23	4Q23
Inventory Days													
OEM	44	45	57	58	51	60	65	63	59	66	71	67	59
Distribution	42	45	46	50	46	51	57	63	60	64	64	65	64
EMS	50	56	64	72	73	86	87	86	84	93	89	82	80
Memory/storage	106	100	90	90	106	118	119	151	182	173	161	146	139
Semi ex-memory	86	91	94	97	97	106	109	119	135	139	131	123	120
Foundry	71	63	66	66	77	76	83	76	83	87	93	92	82
5 Year Median													
OEM	41	52	53	51	43	52	53	51	44	53	56	51	44
Distribution	49	56	52	51	49	56	52	51	49	56	53	52	49
EMS	53	57	59	56	53	57	60	59	53	60	60	62	53
Memory/storage	70	78	79	83	93	100	90	90	96	102	103	103	106
Semi ex-memory	91	98	100	94	91	98	100	94	95	104	104	96	97
Foundry	48	48	54	58	48	60	66	59	61	63	67	66	71
QoQ (%)													
OEM	-14%	2%	26%	3%	-13%	19%	9%	-4%	-6%	12%	7%	-6%	-12%
Distribution	-8%	9%	1%	9%	-8%	10%	11%	11%	-4%	6%	-1%	2%	-2%
EMS	-5%	11%	14%	13%	2%	18%	1%	-2%	-2%	11%	-5%	-8%	-2%
Memory/storage	-3%	-6%	-10%	0%	18%	12%	1%	27%	20%	-5%	-7%	-9%	-5%
Semi ex-memory	-8%	5%	4%	3%	0%	9%	3%	9%	14%	3%	-6%	-6%	-3%
Foundry	21%	-11%	5%	0%	18%	-2%	8%	-8%	9%	5%	7%	-1%	-11%
Seasonality (%)													
OEM	-19%	28%	2%	-4%	-18%	24%	2%	-4%	-14%	19%	4%	-4%	-13%
Distribution	2%	18%	-8%	-2%	-5%	15%	-6%	-1%	-7%	10%	-5%	0%	-7%
EMS	-6%	8%	0%	-2%	-5%	8%	0%	0%	-5%	11%	0%	-2%	-5%
Memory/storage	0%	12%	2%	-5%	-3%	12%	2%	0%	0%	12%	2%	4%	13%
Semi ex-memory	-1%	11%	0%	-6%	-1%	10%	1%	-6%	-1%	9%	2%	-6%	0%
Foundry	-8%	14%	13%	-1%	-8%	14%	13%	0%	-4%	-2%	8%	-1%	9%
YoY (%)													
OEM	8%	-16%	2%	14%	16%	34%	16%	8%	17%	10%	8%	6%	-1%
Distribution	-15%	-21%	-16%	10%	11%	12%	24%	26%	31%	26%	13%	4%	5%
EMS	-2%	-10%	6%	37%	46%	55%	37%	19%	15%	8%	2%	-5%	-5%
Memory/storage	10%	-2%	-13%	-18%	0%	18%	33%	69%	72%	46%	35%	-3%	-24%
Semi ex-memory	-9%	-13%	-10%	4%	13%	17%	16%	22%	39%	31%	21%	4%	-11%
Foundry	46%	32%	23%	12%	9%	21%	26%	15%	7%	14%	12%	22%	-1%

Source: BofA Global Research estimates, FactSet

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Exhibit 45: Upstream vs. downstream inventory days

Upstream and downstream inventory days finished down 5%/11% QoQ

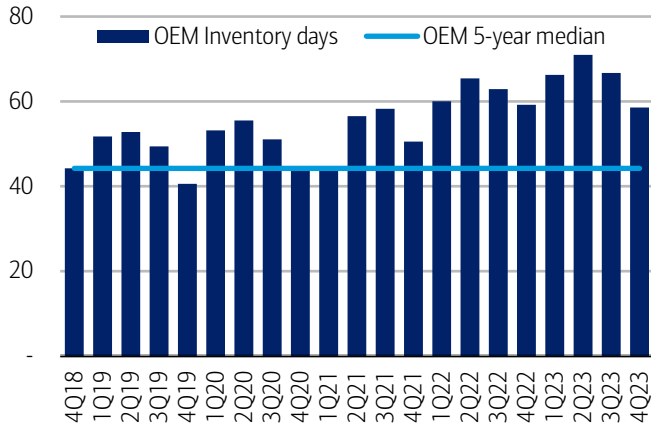
	4Q20	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	3Q23	4Q23
Sales QoQ (%)													
Upstream	7%	3%	8%	7%	5%	2%	0%	-3%	-9%	-8%	7%	9%	10%
Downstream	22%	-10%	-1%	3%	19%	-11%	-5%	2%	8%	-11%	-4%	3%	11%
Inventory Days													
Upstream	89	89	88	90	96	104	107	118	136	139	132	124	118
Downstream	44	45	56	58	51	60	66	64	61	68	71	67	60
5-Year Median													
Upstream	79	88	90	88	89	89	90	90	89	96	97	93	91
Downstream	42	53	53	51	44	53	53	52	44	54	56	52	45
Inv. Days QoQ (%)													
Upstream	-4%	-1%	0%	2%	7%	8%	3%	10%	15%	2%	-4%	-7%	-5%
Downstream	-13%	3%	23%	4%	-12%	18%	9%	-2%	-5%	11%	5%	-5%	-11%
Inv. Days Seasonality (%)													
Upstream	-2%	11%	2%	-4%	-2%	10%	2%	-4%	-2%	8%	2%	-3%	4%
Downstream	-17%	26%	1%	-3%	-16%	23%	1%	-3%	-13%	18%	3%	-3%	-12%
Inv. Days YoY (%)													
Upstream	1%	-7%	-9%	-3%	7%	17%	21%	31%	42%	33%	23%	4%	-13%
Downstream	5%	-16%	0%	15%	17%	33%	17%	11%	19%	12%	9%	5%	-1%

Source: BofA Global Research estimates

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Exhibit 46: OEM inventory days and 5-year median of inventory days

Inventory days (59) are above the 5-year median

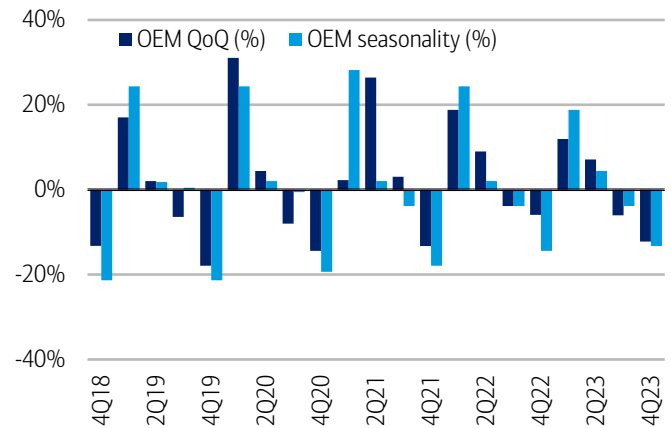


Source: BofA Global Research estimates, FactSet

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Exhibit 47: OEM QoQ inventory days (%) vs. seasonality (%)

Inventory days down 12% QoQ vs seasonally down 13%

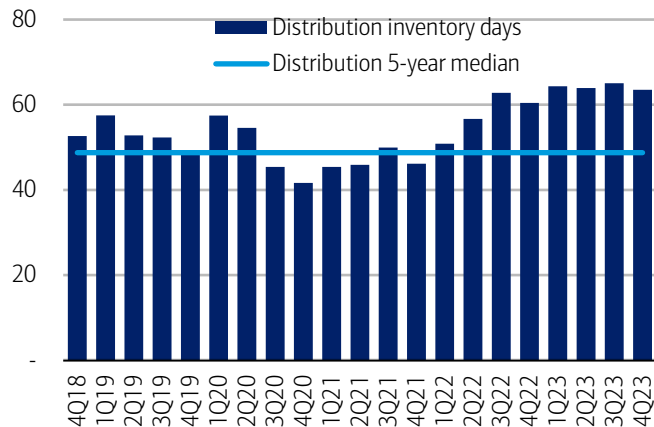


Source: BofA Global Research estimates, FactSet

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Exhibit 48: Distribution inv days and 5-year median of inv. days

Inventory days (64) are above the 5-year median (49)

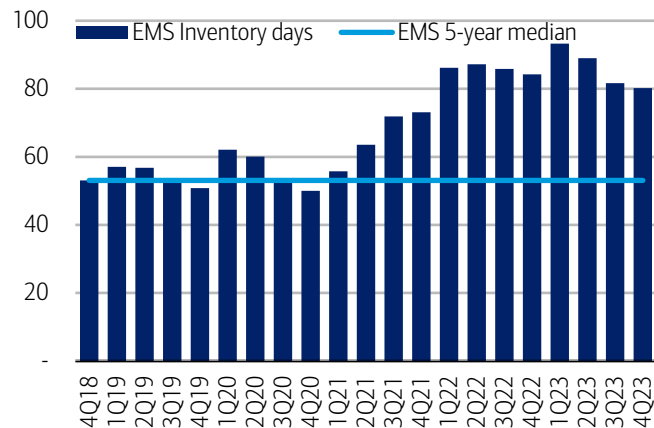


Source: BofA Global Research estimates, FactSet

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Exhibit 50: EMS inventory days and 5-year median of inventory days

Inventory days (80) are above the 5-year median (53)

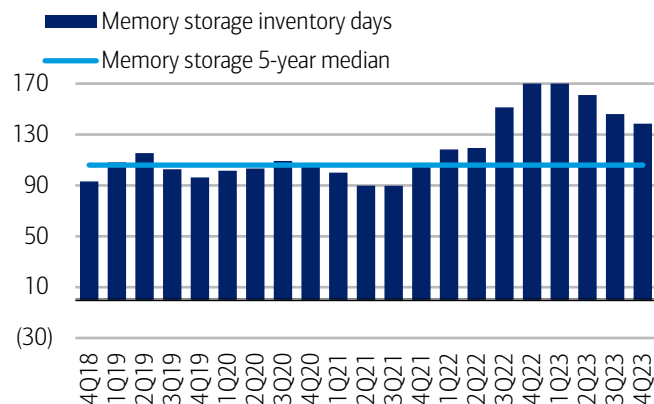


Source: BofA Global Research estimates, FactSet

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Exhibit 52: Memory/storage inv days and 5-yr median of inv. days

Inventory days (139) are above the 5-year median (106)

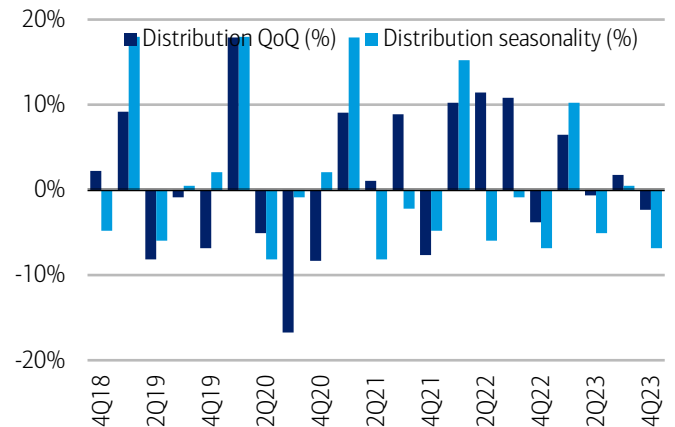


Source: BofA Global Research estimates, FactSet

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Exhibit 49: Distribution QoQ inventory days (%) vs. seasonality (%)

Inventory days decreased 2% QoQ vs seasonally down 7% QoQ

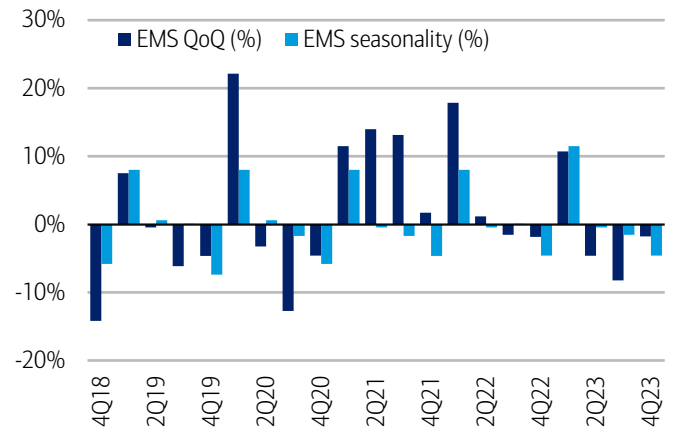


Source: BofA Global Research estimates, FactSet

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Exhibit 51: EMS QoQ inventory days (%) vs. seasonality (%)

Inventory days decreased about 2% QoQ vs seasonally down 5%

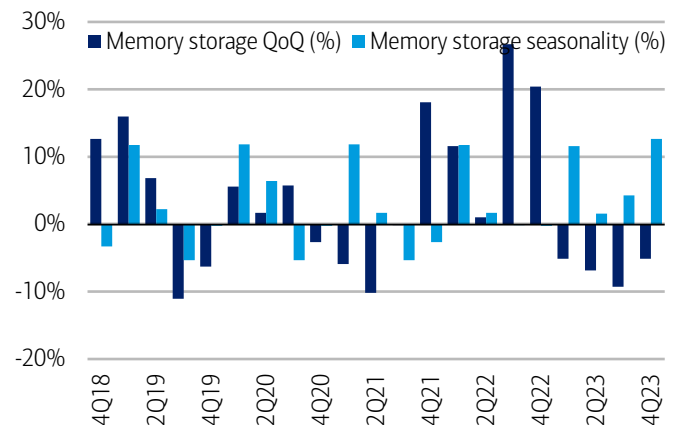


Source: BofA Global Research estimates, FactSet

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Exhibit 53: Memory/storage QoQ inv days (%) vs. seasonality (%)

Inventory days decreased 5% QoQ vs seasonally up 13%

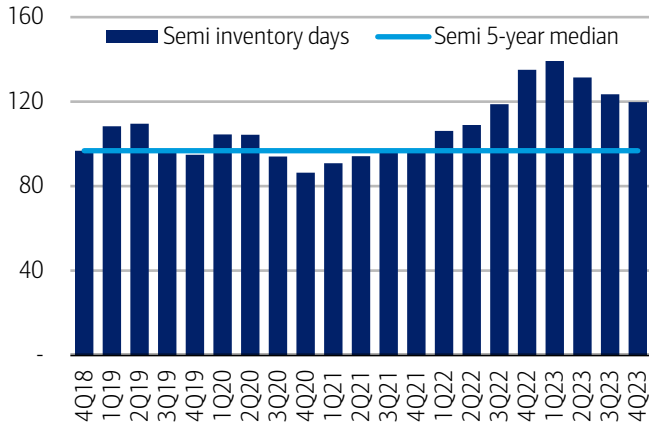


Source: BofA Global Research estimates, FactSet

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Exhibit 54: Semi inv days and 5-year median of inventory days

Inventory days (120) are above the 5-year median (97)

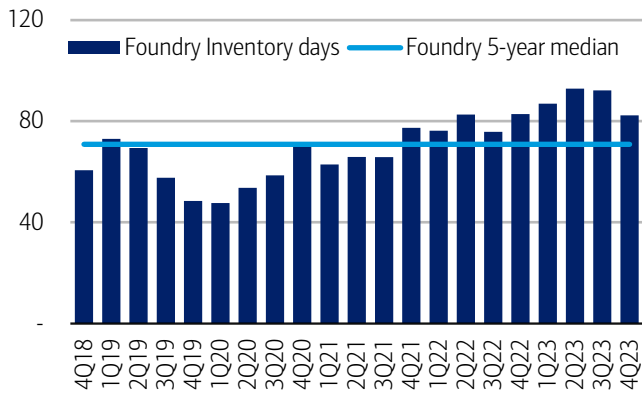


Source: BofA Global Research estimates, FactSet

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Exhibit 56: Foundry inv days and 5-year median of inventory days

Inventory days (82) are above the 5-year median (71)

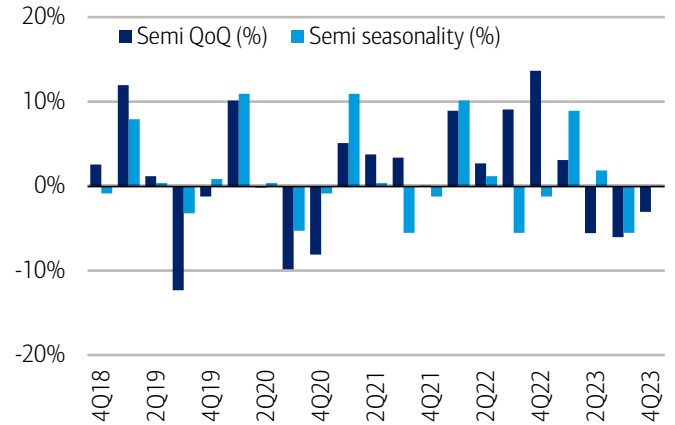


Source: BofA Global Research estimates, FactSet

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Exhibit 55: Semi QoQ inventory days (%) vs. seasonality (%)

Inventory days were down 2% QoQ vs seasonally flat

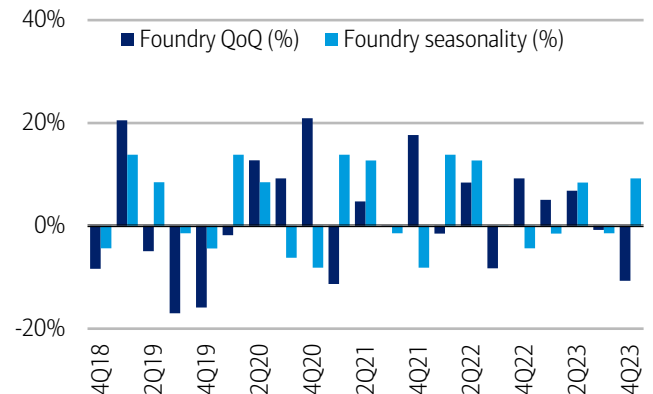


Source: BofA Global Research estimates, FactSet

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Exhibit 57: Foundry QoQ inventory days (%) vs. seasonality (%)

Inventory days decreased 11% QoQ vs seasonally up 9%



Source: BofA Global Research estimates, FactSet

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