Asia Technology | Asia Pacific

AI supply chain tracker – Expectations on B100 GPU timing and HBM specs

We see more CoWoS capacity and progress on B100 GPU.

AI semi supply chain:

- The total H100 GPU module supply in 4Q23 may reach 800-900k units (vs. around 500k in 3Q23), and then stay above 1 million units in 1Q24 and onwards, thanks to more CoWoS capacity allocation.
- NVIDIA will get 2-3k wafers of CoWoS capacity from OSAT, and 5-6k from TSMC, which is more than half of TSMC's limited outputs.
- The new B100 GPU next year is likely to be at TSMC 4nm process, with chip size almost 2x vs. H100, by connecting two GPU dies and 8 HBM chips. The potential HBM3e chip vendors now include Hynix and Micron.
- Backend foundry supply chain in general expects 500-600k units of L40s chip production in 2H23. There is no forecast yet of L40s for 2024.

Alternative AI semis

- The Tesla D1 power module supply chain now sees 50-100k units in 2023, and the rest of the production should be in 2024. Tesla is building the Dojo supercomputer system, and it would require 300k units of D1 chips to achieve 100 ExaPOD capacity by 2024 (link).
- We expect more "AI on PC" Arm-based processors to come in 2024, such as Qualcomm's Oryon, and it remains to be seen if MediaTek will introduce a new Chromebook processor with AI computing unit in 2024 (link).

AI downstream supply chain:

- Our checks suggest that between Unimicron and Ibiden, Unimicron should have majority ABF substrate share for L40S.
- The potential ABF substrate partners to AMD's MI300 could be Ibiden and AT&S, while the potential ABF substrate partners to Intel's Gaudi could be Kyocera and Unimicron.
- The chances are higher for B100 designing with cold plate (liquid cooling) as heat dissipation solution, different from 3D VC (air cooling) for H100.
- Our checks indicate that there is no pushout for Chroma's 2023 SLT equipment orders, pointing to meaningful pick up in the remaining months.

Alternative AI

- Our checks suggest that Unimicron could be the ABF substrate vendor for Tesla's D1 chip.

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GREATER CHINA TECHNOLOGY HARDWARE

Asia Pacific

Industry View   **In-Line**

GREATER CHINA TECHNOLOGY SEMICONDUCTORS

Asia Pacific

Industry View   **Attractive**
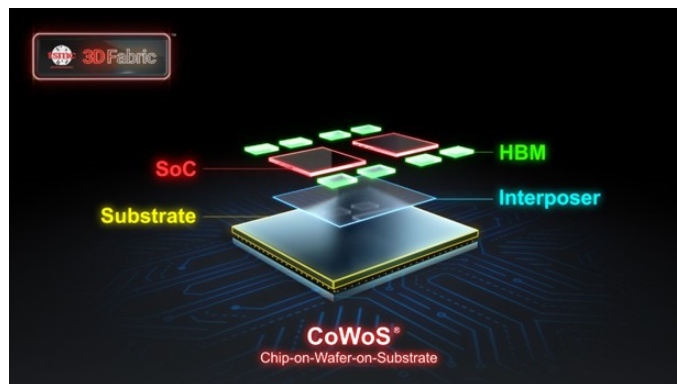
Supply chain tracker – AI semis

Major supply bottleneck – CoWoS capacity trend

Exhibit 1: CoWoS capacity expansion by vendor

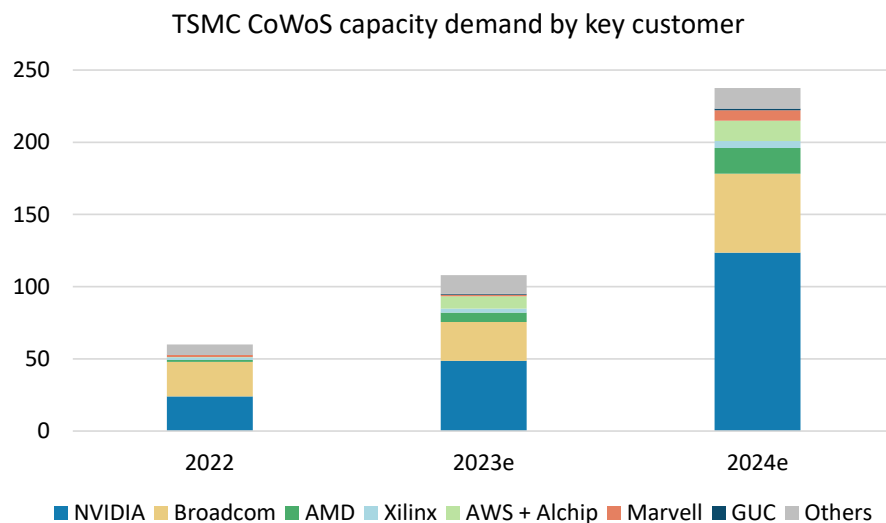CoWoS supply capacity breakdown
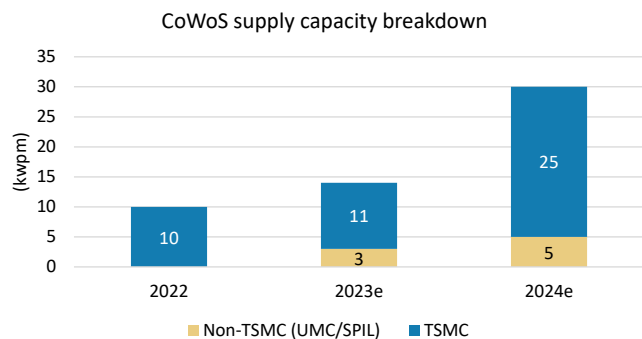
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 2: What is CoWoS? Chip on Wafer (interposer) on Substrate

Source: TSMC

Exhibit 3:

TSMC's CoWoS consumption by customer

TSMC CoWoS capacity demand by key customer

Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 4: NVIDIA AI GPU revenue implied CoWoS demand – double booking at foundries?

	CY23e	CY24e	CY25e	CY26e
NVIDIA calculation				
NVIDIA AI GPU revenue (US$ mn)	30,735	52,741	53,646	57,249
Y/Y %	*128%*	*72%*	*2%*	*7%*
AI GPU ASP (US$)	22,080	26,122	25,638	35,225
AI GPU volume (k units)	1,392	2,019	2,092	1,625
Y/Y %	*23%*	*45%*	*4%*	*-22%*
Chip cost calculation				
# of gross die per wafer	65	63	47	38
Production yield	60%	65%	70%	70%
# of good die per wafer	39	41	33	27
TSMC blended wafer price for NVIDIA AI GPU	16,000	16,500	17,000	17,500
Wafer die revenue to TSMC per chip	412	400	521	658
CoWoS revenue to TSMC per chip	200	200	211	336
Total revenue to TSMC per chip	612	601	733	994
NVIDIA AI GPU implications to TSMC				
Demand for TSMC CoWoS capacity				
k wafer per annum	49	70	77	93
k wafer per month	4	6	6	8
Demand for TSMC 4nm/7nm capacity				
k wafer per annum	36	49	64	61
k wafer per month	3	4	5	5
Revenue contribution to TSMC (US$ mn)	**852**	**1,212**	**1,533**	**1,616**
Y/Y %	*56%*	*42%*	*26%*	*5%*
Revenue contribution % of TSMC	**1.2%**	**1.4%**	**1.5%**	**1.3%**

Source: Company data, Morgan Stanley Research (e) estimates
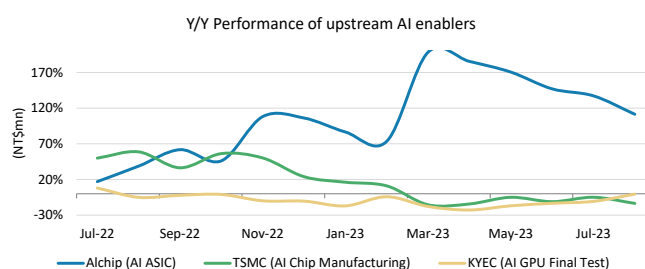
Monthly sales of Taiwan's AI semi supply chain

Exhibit 5: Key AI upstream enablers: Alchip, KYEC and TSMC – monthly sales

Monthly sales of upstream AI enablers
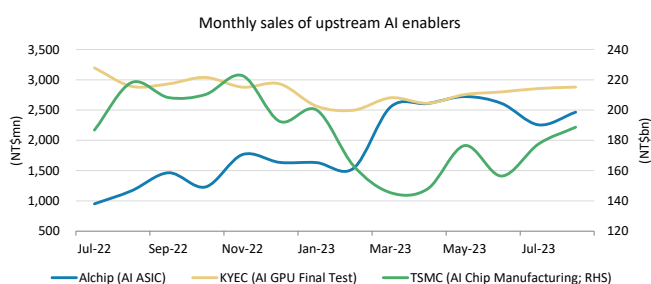
Source: Company data, TEJ, Morgan Stanley Research

Exhibit 6: Key AI upstream enablers are also showing Y/Y increases

Y/Y Performance of upstream AI enablers

Source: Company data, TEJ, Morgan Stanley Research
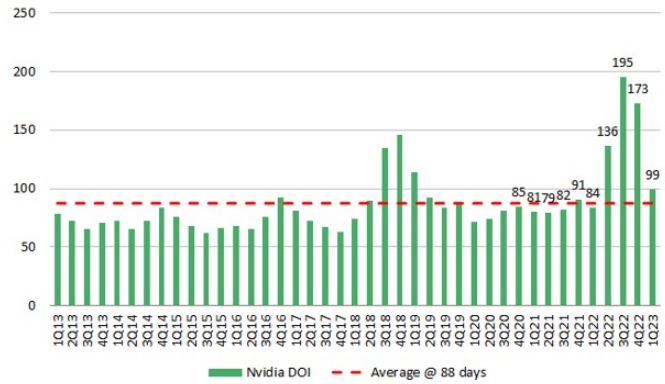
Major AI GPU vendors – NVIDIA sales and inventory trend

Exhibit 7: General purpose AI chip quarterly revenue

Data center/HPC semi revenue: NVIDIA + AMD/Xilinx

Legend: NVIDIA | AMD | Xilinx | Data center/HPC semi sales Y/Y (RHS)
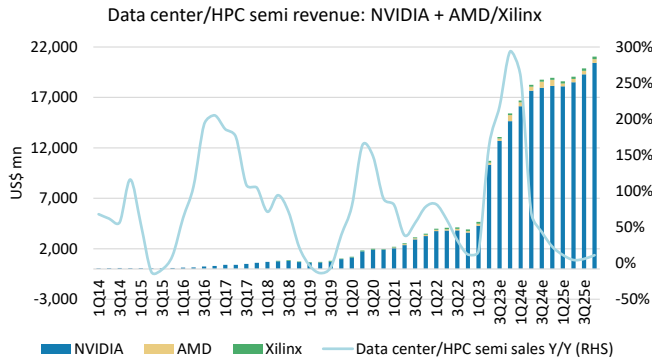
Source: Company data, Refinitiv, Morgan Stanley Research (e) estimates

Exhibit 8: NVIDIA's inventory days/level
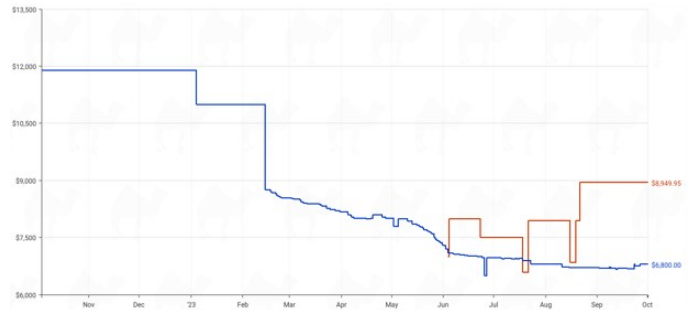

Legend: Nvidia DOI | Average @ 88 days

Source: Company data, Refinitiv, Morgan Stanley Research

Exhibit 9: NVIDIA H100 GPU Pricing
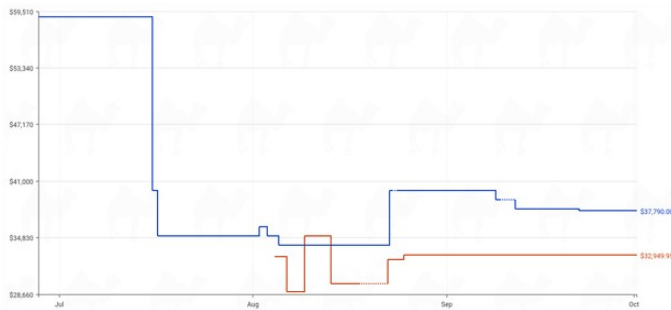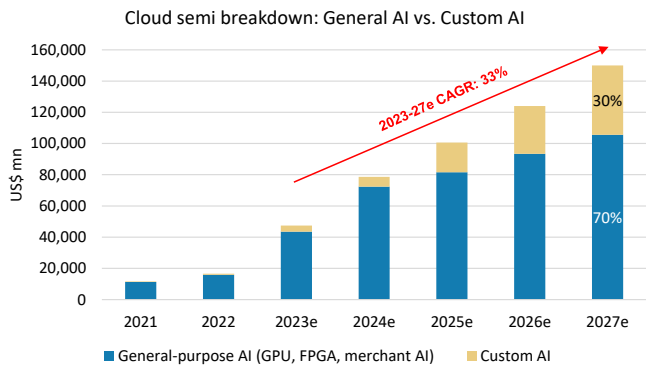

Source: Camelcamelcamel, Morgan Stanley Research

Exhibit 10: NVIDIA A100 GPU Pricing

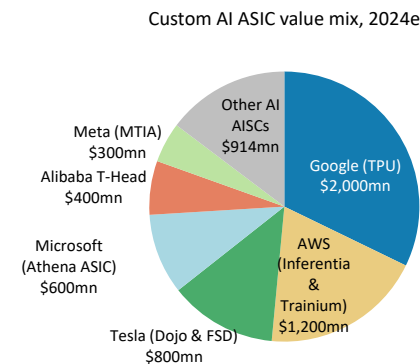

Source: Camelcamelcamel, Morgan Stanley Research

AI semi alternatives – custom chips (ASIC)

Exhibit 11: We expect custom AI chips (ASICs) to outgrow GPUs and potentially take up to 30% of the cloud AI semi market in 4-5 years

Cloud semi breakdown: General AI vs. Custom AI

Legend: General-purpose AI (GPU, FPGA, merchant AI) | Custom AI

Source: Morgan Stanley Research (e) estimates

Exhibit 12: We estimate custom AI ASIC will represent ~US $6.2bn of market value in 2024e

Custom AI ASIC value mix, 2024e

Google (TPU) $2,000mn
AWS (Inferentia & Trainium) $1,200mn
Tesla (Dojo & FSD) $800mn
Microsoft (Athena ASIC) $600mn
Alibaba T-Head $400mn
Meta (MTIA) $300mn
Other AI AISCs $914mn

Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 13:

Major custom AI chip projects
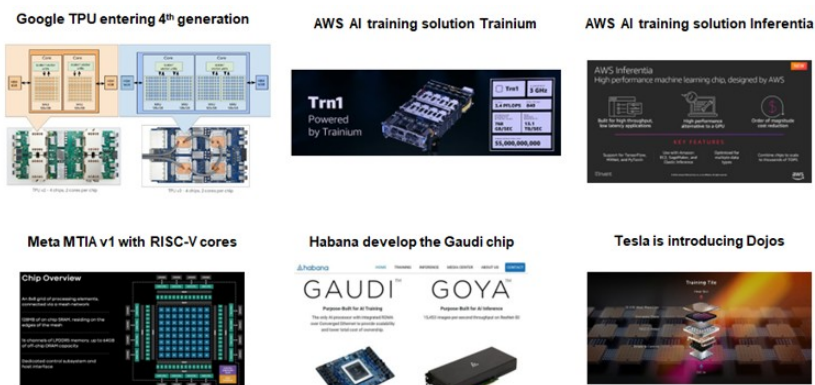
Source: Google, AWS, Meta, Intel, Tesla

Exhibit 14: Data center companies' custom AI chip strategy

|	First official announcement for AI ASIC	AI ASIC project	ASIC partners	ASIC's benefits vs. merchant solutions	Chip sourcing strategies
Google	2016	TPU	Broadcom	2-3x greater energy efficiency	Google started to increase in-house custom chip (TPU) adoption since 2017. Currently, most of the internal training and inference workloads are now completed by TPUs, while NVIDIA's solutions are also available for Google's cloud customers.
AWS	2018	Inferentia Trainium	Alchip, Marvell	50% greater performance per watt	AWS uses multiple sources of chips to support customers' different workloads. For example, custom ASICs (Trainium/Inferentia AI chips, Gravaton CPU) and GP CPU/ GPUs (Intel, NVIDIA and AMD).
Tesla	2018	D1 (Dojo supercomputer) FSD (on-car AD/ADAS)	Alchip, Samsung	33% of cost savings	Tesla started to incorporate its in-house custom chips (D1 and FSD) since 2019 to replace NVIDIA's general-purpose solutions.
Microsoft	2023	Project Athena	GUC, Alchip, MediaTek	*(to be announced)*	Microsoft's Athena project adopts AI solutions from multiple sources, such as in-house ASIC, AMD's/NVIDIA's GPUs, d-Matrix's AI chip, etc. We expect its own custom chips to enter volume production in early 2024.
Meta	2023	MTIA MSVP	N/A	2x performance	Meta uses in-house ASIC for AI inference workload, but sticks with NVIDIA's A100 for its training supercomputer. Its custom accelerator (MTIA) adopts RISC-V cores.

Source: Company data, Morgan Stanley Research estimates

Supply chain tracker – AI tech hardware

## AI server and baseboard shipments

With NVIDIA's strong beat in July quarter results and strong guidance for the October quarter, our NVIDIA analyst, Joe Moore, raised his earnings outlook in this report: NVIDIA Corp.: NVDA reports another exceptional quarter as AI spending surges (24 Aug 2023). He also raised his data center GPU estimates 49% for 2023, 89% for 2024, and 78% for 2025. These more upbeat numbers have not been reflected across our coverage for downstream tech.

Exhibit 15: NVIDIA HGX/DGX unit assumptions, 2023-25E

Nvidia HGX/DGX unit assumptions, 2023-25E
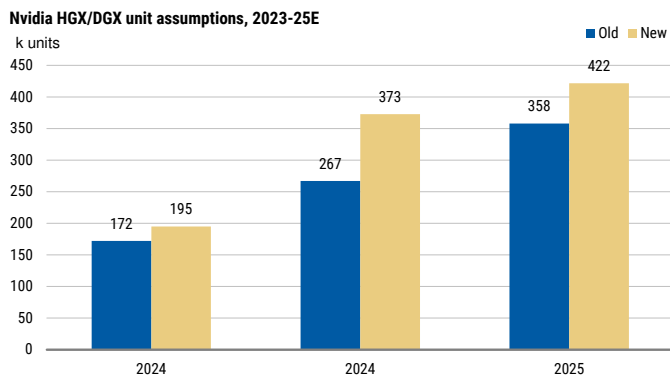
Source: Company data, Morgan Stanley Research (E) estimates

Exhibit 16: NVIDIA AI server unit share, 2023
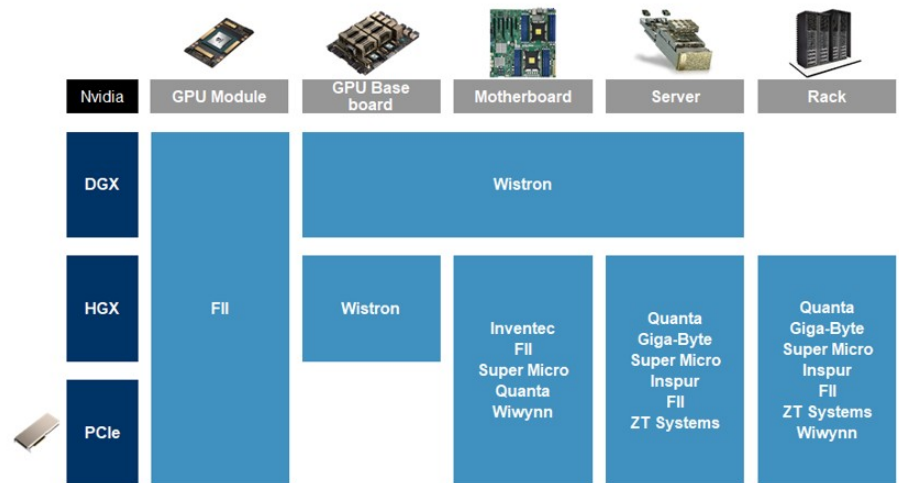

AI server unit share, 2023e
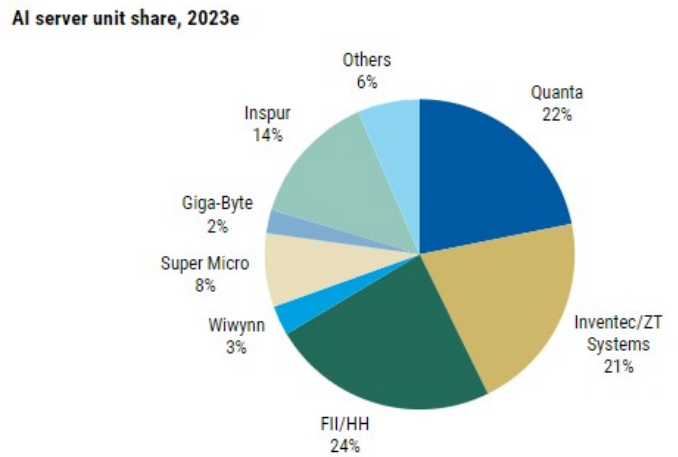
Source: Company data, Morgan Stanley Research (e) estimates

AI hardware supply chain

Exhibit 17: NVIDIA AI server supply chain

Source: Company data, Morgan Stanley Research

Exhibit 18: AI tech hardware revenue and profit contribution

Company	Ticker	AI revenue mix			AI profit mix			P/E		PEG
		2023e	2024e	2025e	2023e	2024e	2025e	2024e	2025e	2024e
Wistron	3231.TW	4%	6%	6%	11%	17%	17%	16.9x	13.2x	0.22x
Wiwynn	6669.TW	7%	28%	49%	4%	16%	32%	16.0x	12.1x	0.56x
Quanta	2382.TW	14%	28%	31%	9%	18%	21%	20.1x	16.4x	0.66x
Giga-Byte	2376.TW	20%	40%	46%	17%	30%	32%	17.1x	13.4x	0.28x
Gold Circuit	2368.TW	4%	8%	9%	5%	11%	12%	16.1x	11.9x	0.23x
FII	601138.SS	10%	15%	19%	16%	24%	30%	13.3x	12.0x	0.37x
Asustek	2357.TW	0%	11%	19%	0%	8%	9%	11.3x	10.1x	0.11x
Delta	2308.TW	2%	3-5%	3-5%	2%	3-5%	3-5%	21.0x	18.2x	1.19x
Lite-on Tech	2301.TW	5%	6%	8%	5%	7%	8%	14.5x	12.6x	0.73x
Chroma	2360.TW	13%	18%	21%	15-20%	20-30%	25-35%	18.9x	17.9x	1.01x
AVC	3017.TW	4%	7%	8%	8%	13%	15%	18.3x	15.9x	0.64x
Sunon	2421.TW	6%	8%	10%	7%	12%	14%	16.0x	14.1x	1.00x

Source: Morgan Stanley Research (e) estimates

Exhibit 19: Server revenue contribution comparison of major power supply companies

Company name	Delta Electronics	Lite-on Tech
Ticker	2308.TW	2301.TW
2024e total revenue (NT$ mn)	471,304	184,443
Server power supply as % of total revenue	17-18%	~20%
2024e server power supply revenue (NT$ mn)	84,835	36,889
AI server power supply as % of total revenue	2%	5%
2024e AI power supply revenue (NT$ mn)	9,426	9,222

Source: Company data, Reuters Eikon, Morgan Stanley Research (e) estimates. Data as of 2Q23.

Exhibit 20: Server revenue contribution comparison of major thermal companies

Company name	AVC	Sunonwealth	Auras
Ticker	3017.TW	2421.TW	3324.TWO
2024e total revenue (NT$ mn)	69,450	15,332	15,018
Server revenue as % of total revenue	35%	29%	24%
2024e server related revenue (NT$ mn)	24,402	4,496	3,642
AI server thermal solution as % of total revenue	4%	6%	2%
2024e AI server thermal solution revenue (NT$ mn)	3,010	852	364

Source: Company data, Reuters Eikon, Morgan Stanley Research (e) estimates. Data as of 2Q23.

Demand tracker – AI capex

1. We estimate total AI capex of US$40bn for 2023 and US$77bn for 2024, indicating 92% Y/Y growth (Exhibit 21).
2. We factor in the enterprise and on-premise sector AI server shipments into our model, with the assumptions of L40S being the main adopted tools. We thus expect total AI server shipments (including L40S) to be 214k and 450k units in 2023e and 2024e, respectively. (Exhibit 22)
3. The top four US hyperscalers' capex totaled US$33.6bn in 2Q, -2% Q/Q. Commentary on AI spending was all positive, but non-AI spending was mixed (Exhibit 28).

Exhibit 21: AI capex within cloud spending
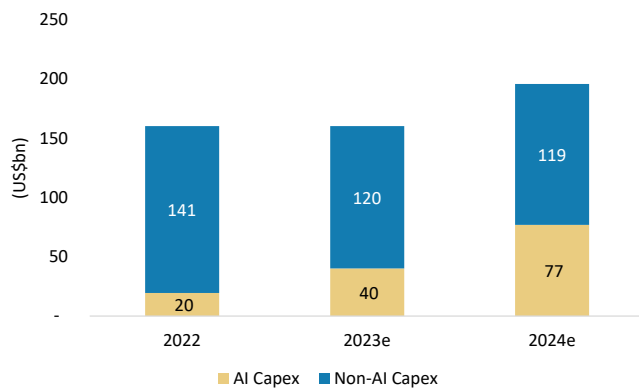
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 22: Total AI server shipments (including L40S from enterprise and on-premise demand)
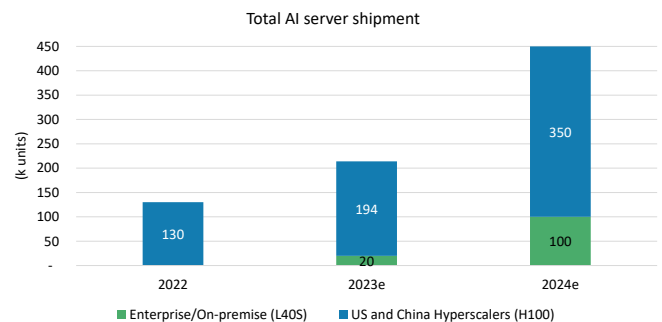
Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 23: AI Capex calculation and assumptions

|	2022	2023	2024
Total Cloud capex (USD bn)	160	160	196
US/China hyperscalers cloud capex	160	159	189
Enterprise/On-premise AI capex		1	7
AI capex mix	12%	25%	39%
Total AI capex (USD bn)	20	40	77
H100 AI Server ASP (USD k)	150	200	200
L40S GPU Server ASP (USD k)		70	70
Global AI server shipment (k)	130	214	450
US/China hyperscalers (H100)		194	350
Enterprise/On-premise (L40S)		20	100

Source: Company data, Morgan Stanley Research (e) estimates

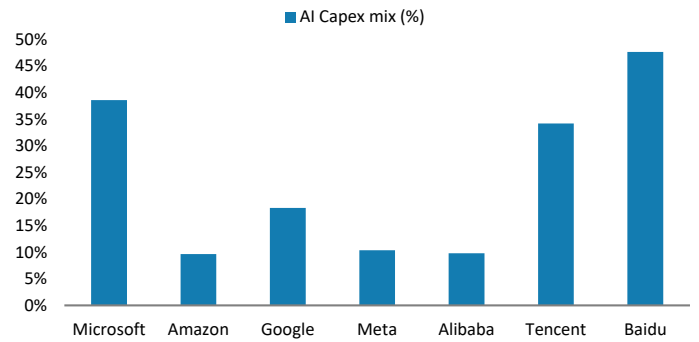**Exhibit 24:** Total US cloud capex long-term trend
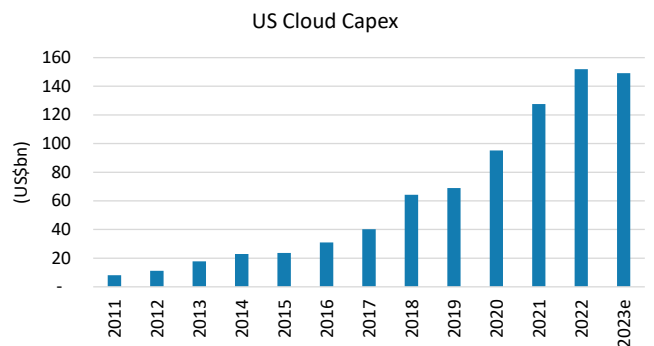
Source: Company data, Morgan Stanley Research (e) estimates.
Note: Companies are Microsoft, Meta, Amazon, and Google.

Exhibit 25: AI server procurement share in 2023e
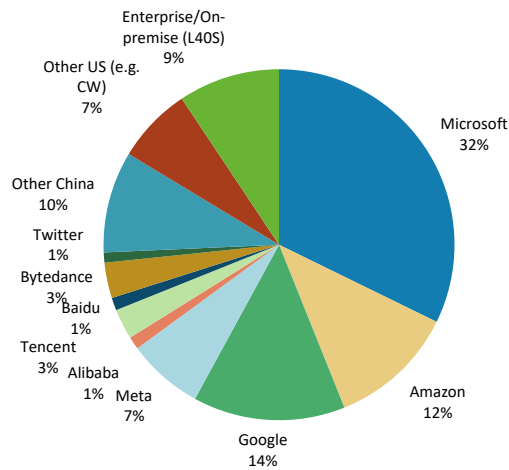
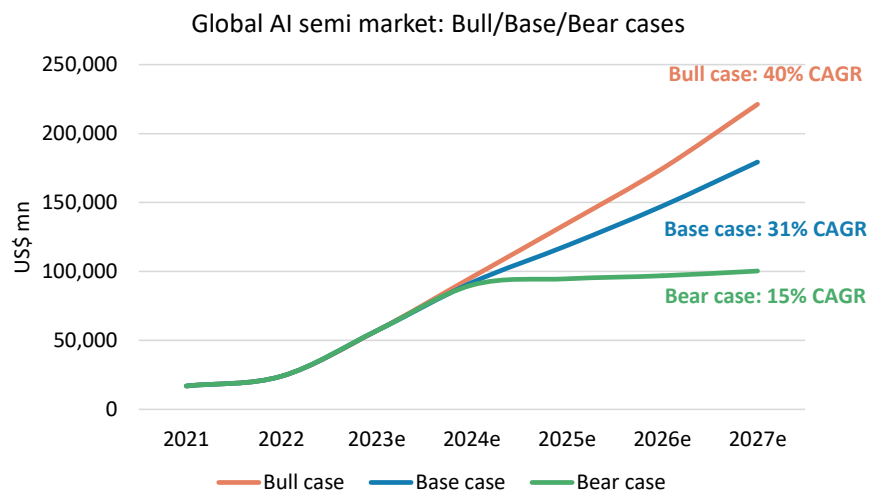Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 26: AI capex mix for hyperscalers in 2023e

Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 27:

In our base case, we assume 31% AI semi industry growth during 2023-27e, based on current AI capex trends

Global AI semi market: Bull/Base/Bear cases

Source: Morgan Stanley Research (e) estimates. Note: CAGRs refer to growth during 2023-27e.

Exhibit 28: Comments on AI/Cloud capex trends

Company	Date	2Q23 Cloud Capex Quotes
Microsoft	7/25/2023	"At a total company level, revenue growth from our commercial business will continue to be driven by the Microsoft Cloud and will again outpace the growth from our consumer business. Even with strong demand and a leadership position, **growth from our AI services will be gradual as Azure AI scales and our copilots reach general availability dates**. So, for FY24, the impact will be **weighted towards H2.**" "To support our Microsoft Cloud growth and demand for our AI platform, we will accelerate investment in our cloud infrastructure. We expect **capital expenditures to increase sequentially each quarter through the year** as we scale to meet demand signals." "First of all, both in Q4 and then talking about Q1 [capex], the acceleration is really quite broad. It's both on the **datacenters** and the physical basis, plus **CPUs** and **GPUs**, and **networking equipment**. Think of it in a broad sense as opposed to a narrow sense. It's overall increases of acceleration of overall capacity."
Google	7/25/2023	"We expect elevated levels of investment in our technical infrastructure, **increasing through the back half of 2023 and continuing to grow in 2024**. The primary driver is to support the opportunities we see in AI across Alphabet, including **investments in GPUs and proprietary TPUs,** as well as **data center capacity.**" "We provide the widest choice of AI supercomputer options with Google TPUs and advanced Nvidia GPUs, and recently launched new A3 AI supercomputers powered by Nvidia's H100. This enables customers like AppLovin to achieve nearly **two times** better price performance than industry alternatives." "we are particularly excited about the customer interest in our AI-optimized infrastructure, our large language models, our AI platform services, and our new generative AI offerings such as Duet AI for Google Workspace, although we are still clearly in the early days."
Meta	7/26/2023	"We expect capital expenditures to be in the range of **$27 billion to $30 billion**, lowered from our prior estimate of $30 billion to $33 billion. The reduced forecast is due to both **cost savings**, **particularly on non-AI servers** as well as **shifts in CapEx into 2024** from delays in projects and equipment deliveries rather than a reduction in overall investment plans." "Looking ahead, while we continue to refine our plans as we progress throughout the year, we currently expect total capital expenditures to **grow in 2024**, driven by our investments across both **data centers** and **servers**, particularly in **support of our AI work.**" "We expect both data center spend to grow in '24 as we ramp up construction on sites with the new data center architecture that we announced late last year. And then we certainly also expect to invest more in servers in 2024 for both **AI workloads** to support all of the AI work that we've talked about across the core AI ranking recommendation work along with the next-gen AI efforts. And then, of course, also our **non-AI workloads** as we **refresh some of our servers** and **add capacity** just to support continued growth across the site." "We think these are both going to be compelling investment opportunities and some of the AI capacity is **fungible**, so if we don't end up needing some of the capacity for our gen AI work, we'll be able to allocate it to our core AI work, supporting ads and engagement. But we're really still working on our '24 plans. We will have a clearer and more quantitative outlook as those plans shape up. But we are mindful of our intention to **reduce the capital intensity of these investments over time.** " "one of the things that we're debating heavily when thinking through the amount of AI CapEx to bring online because the reality is we just don't know **how quickly these will scale**. And we want to have the capacity in place in case they scale very quickly..... It's actually quite hard to forecast."
Amazon	8/3/2023	"Looking ahead to the full year 2023, we expect capital investments to be **slightly more than $50 billion**, compared to $59 billion in 2022. We expect fulfillment and transportation CapEx to be down year-over-year, partially offset by **increased infrastructure CapEx to support growth of our AWS business**, including **additional investments related to generative AI** and **large language model** efforts." "how much generative AI may impact the capital expense spend, included in that number is a pretty **significant amount of capital expense in the AWS business for large language models** and **for generative AI**. And we have quite a bit of demand right now." "And so it's -- like in AWS in general, one of the interesting things in AWS, and **this has been true from the very earliest days**, which is the more demand that you have, **the more capital you need to spend** because you invest in **data centers** and **hardware** upfront and then you monetize that over a long period of time." " We think of large language models in generative AI as having 3 key layers, all of which are very large in our opinion and all of which **AWS is investing heavily in**. At the lowest layer is **the compute required to train foundational models and new inference or make predictions.**" "Customers are excited by Amazon EC2 P5 instances powered by NVIDIA H100 GPUs to train large models and develop generative AI applications. However, to date, there's only been 1 viable option in the market for everybody and supply has been scarce." " We're optimistic that a lot of large language model training and inference will be run on **AWS' Trainium and Inferentia chips** in the future." "We think of the middle layer as being **large language models as a service**." "Top layer is where a lot of the attention of focus, and these are **the actual applications that run on top of these large language models**. As I mentioned, **ChatGPT** is an example."

Source: Company data, Morgan Stanley Research

# Chinese hyperscalers BAT in 2QCY – increased capex for AI investment

Tencent and Baidu – C2Q23 cloud capex Y/Y turned positive. (Exhibit 32). Server BMC chip vendor Aspeed recently turned more positive on the 2H outlook.

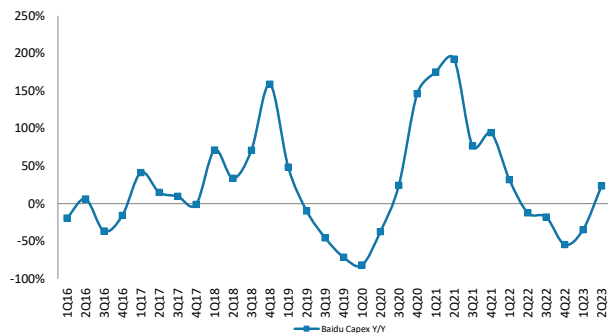**Exhibit 29:** Alibaba – up to -46% Y/Y in calendar 2Q23, from -62% Y/Y in 1Q23
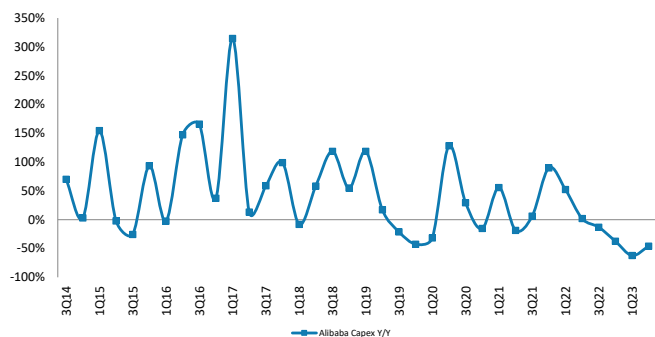
Source: Company data, Morgan Stanley Research

Exhibit 30: Tencent – up to +43% Y/Y in calendar 2Q23 from -81% Y/Y in 1Q23
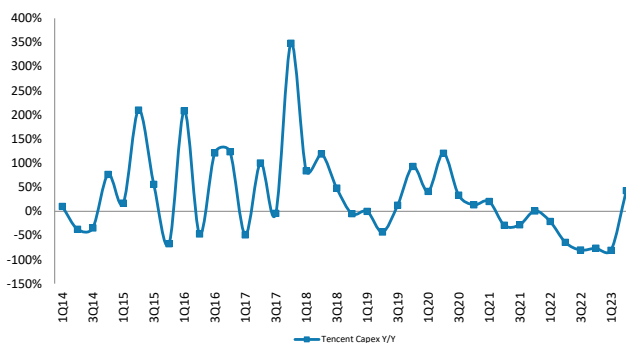
Source: Company data, Morgan Stanley Research

Exhibit 31: Baidu – up to +24% Y/Y in 2Q23, from -35% in 1Q23

Source: Company data, Morgan Stanley Research

Exhibit 32:

Chinese Hyperscalers: 2Q23 commentary

Company	Date	2Q23 Cloud Capex Quote
Alibaba	8/10/2023	"Third, we will **continue to invest in AI** . It is our conviction that technology creates commercial value: Taobao and Tmall have the largest collection of merchants and of merchandise on the Internet, and are the most fertile soil anywhere on the Internet to explore AI application." "In the past quarter, we have received **strong demand for model training and related AI services on cloud infrastructure** , which were only partially fulfilled due to the near-term supply chain constraints globally." "We believe that the **technology evolution brought by AI is not a short-term opportunity but the beginning of a new era** . As one of the world's leading cloud service providers, we will continue to invest in forming a full-stack product and technology leadership across IAAS, PAAS and MAAS layer." "We will leverage and expand this advantage when serving the needs of our customers, including the training and service needs of large language model startups, as well as industry demands for customized models and vertical models.... Over the long term, Alibaba Cloud will **benefit from the application of AI in all industries** " "as a cloud service provider, our best monetization model is to have all the AI companies, all the models using Alibaba cloud infra, our high-performance, low-cost computing power to do their AI."
Tencent	8/16/2023	"Within [2Q23CY] total CapEx, operating CapEx was RMB 3 billion, up 43% year-on-year, driven by **increasing investment in GPUs and servers.** " "AI can enhance efficiency and the quality of our user to user services and at the same time, facilitate the improvement in terms of our ad targeting, data targeting and also cost-efficient production of a lot of our content" "[Tencent is] E16building our own proprietary foundation model, and that is actually progressing very well. The training is actually on track and making very good progress. We have started internal testing in our different businesses, including games, ads cloud, FinTech for them to start testing the model and start working on the integration. "we are also on the cloud side, providing **MaaS solution for enterprises** . So basically providing a marketplace so that different enterprise clients can choose different types of open source large models for them to customize for their own use with their own data.... And we believe this is going to be a pretty high value added and high margin product for the enterprise clients." " [Many different platforms, many different types of inventories, and a very large coverage of user base and with a lot of data] and all these things make it actually very complicated for us to target customers based on just rule-based or CPU-based targeting system, which was actually what we have been deploying. A key change is that we have deployed a lot of GPUs, so **moving from CPUs to GPUs and we have built a very large neural network to basically accept all these different complexities and be able to come up with the optimal solution** ."
Baidu	8/22/2023	"CapEx in Q2 have increased over last year. The increase is mainly due to **the hardware purchase to support all AI campaigns such as ERNIE and ERNIE bot** ." "For Baidu Search, AI has played an important role for many years in driving innovation and improving user experience, resulting in a consistent increase in the percentage of search queries satisfied by one short search results." "we introduced an AI assistant within InfoFlow, Baidu's self-developed enterprise communication and collaboration platform. The AI assistant automates various workflows such as summarizing meeting notes, chat histories and workplace content...., applying for vacation days and conducting data analysis using natural language." "Baidu AI Cloud stands out as our AI optimized cloud infrastructure makes us a top performing platform for training and serving foundation models, including large lending model."

Source: Company data, Refinitiv, Morgan Stanley Research

Key featured reports on AI supply chain

AI supply chain trackers

Asia Technology: AI supply chain tracker - Smooth ramp in 2H23 (25 Sep 2023)

Asia Technology: AI supply chain tracker: Tesla Dojo AI server ramping (18 Sep 2023)

Asia Technology: AI supply chain tracker: NVDA L40S GPU server design spec (11 Sep 2023)

Asia Technology: AI supply chain tracker: NVIDIA's L40S production ramping up (4 Sep 2023)

Asia Technology: AI supply chain tracker: positive read-across from NVIDIA's October quarter guidance (28 Aug 2023)

Asia Technology: AI supply chain tracker: GPU/server outputs seen up in Sep. (21 Aug 2023)

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Global Technology: Correction: AI – A New Era for Advanced Packaging (20 Sep 2023)

ASMPT Ltd: Advancing the packaging technology with TCB; keep OW (20 Sep 2023)

Global Technology: Correction: More aggressive AI custom chip designs from hyperscalers (12 Sep 2023)

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Greater China Technology Hardware: AI - Assessing Downstream Hardware AI Enablers (11 Jul 2023)

Global Technology: Data Center Technology and Supply Chain: What's Built Into Price for AI? (10 Jul 2023)

Global Technology: Cloud Optimization: Short Term Pain for Long Term Gains (12 Apr 2023)

Telecom & Networking Equipment: AI Workloads: A Look at the Networking Opportunity (2 Mar 2023)

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Greater China Semiconductors: Cloud semis: what's happening amid AI supply constraint (7 Aug 2023)

Greater China Semiconductors: Cloud Semis: Who will buy more AI servers? (8 Jun 2023)

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Aspeed Technology: Read-across from MSFT's C2Q23 Earnings – Sequential capex increase on AI infrastructure (26 Jul 2023)

Greater China Technology Hardware: Implications from Meta's CapEx (27 Jul 2023)

Greater China Technology Hardware: Positive implications from Microsoft and Google's capex commentary (26 Jul 2023)

Tech Hardware Pulse: What Investors Are Asking: What Is the AI Opportunity For Hardware Companies? (24 Feb 2023)

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Greater China Semiconductors: ASIC design service – Google TPU project dynamics (21 Sep 2023)

Global Unichip Corp: Taiwan AI Forum Feedback (5 Sep 2023)

Aspeed Technology: Taiwan AI Forum Feedback (5 Sep 2023)

Alchip Technologies Ltd: Taiwan AI Forum Feedback (5 Sep 2023)

King Yuan Electronics Co Ltd: Asia Tech conference key takeaways (31 Aug 2023)

King Yuan Electronics Co Ltd: Testing the AI upside; keep OW (28 Aug 2023)

MediaTek: Edge AI Sentiment Strengthening; Move to EW (28 Aug 2023)

Greater China Technology Semiconductors: Positive read across to AI semi supply chain from NVIDIA Q2 FY24 earning call (23 Aug 2023)

TSMC: AI semi demand outshines; keep OW (20 Jul 2023)

Alchip Technologies Ltd: Greater confidence in AI revenue growth; reiterate OW (18 Aug 2023)

NVIDIA Corp.: Upgrading to OW as large language model enthusiasm is transforming cloud capex (16 Mar 2023)

Advanced Micro Devices: AI opportunity looks to be multiples of our initial assessment (11 May 2023)

Aspeed Technology: AI shows more upside, but non-AI weakness likely extends to 3Q (5 Jul 2023)

King Yuan Electronics Co Ltd: Taiwan Discovery Forum: Spotlight on AI Feedback (18 Aug 2023)

King Yuan Electronics Co Ltd: Resilient gross margin continues; keep OW (4 Aug 2023)

Andes Technology Corp: Expecting a strong business recovery in 2H23; OW (18 Aug 2023)

ASMPT Ltd: More progress in TCB amid muted near-term outlook; OW (26 Jul 2023)

Key Downstream AI supply chain companies

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UPDATE

Gold Circuit Electronics Ltd.: Taiwan AI Forum Feedback (5 Sep, 2023)

Unimicron: Taiwan AI Forum Takeaways (5 Sep, 2023)

Lite-On Technology: Taiwan AI Forum Takeaways - Migrating to Total Solution Offerings (5 Sep, 2023)

Auras Technology Co Ltd: Taiwan AI Forum Takeaways - Business Recovery in 2H23 (4 Sep, 2023)

Greater China Technology Hardware: Taiwan AI Forum Takeaways - Inventec's views on NB and Server (4 Sep, 2023)

Giga-Byte Technology Co. Ltd.: Taiwan AI Forum Takeaways (4 Sep, 2023)

Asia Vital Components Co. Ltd.: Total Solution Offerings + New Capacity = Profit Upside Risk (14 Aug, 2023)

Quanta Computer Inc.: Stronger AI server drives Quanta to raise guidance (11 Aug 2023)

Giga-Byte Technology Co. Ltd.: 2Q Preview; July Dragged by Component Constraints (9 Aug 2023)

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Sunonwealth Electric Machine Industry Co: Margin Uptrend Just Started; Up to OW (7 Aug, 2023)

Lite-on Technology: AI Sever Power Supply Leads Profit Uptrend; Up to OW (30 July, 2023)

Chroma Ate Inc.: Potential Upside from SLT Business Driven by AI Server (6 July 2023)

Greater China Technology Hardware: Looking Beyond 2023 Earnings; Valuations Still Demanding Even with Earnings Rise in 2024e (6 July 2023)

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AI upstream semis – order of preference

Exhibit 33: Preference Table

	Andes 6533.TW	TSMC 2330.TW	MediaTek 2454.TW	GUC 3443.TW	ASMPT 0522.HK	KYEC 2449.TW	Alchip 3661.TW	VeriSilicon 688521.SS	Aspeed 5274.TWO	Silergy 6415.TW
Rating	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Equal-Weight	Equal-Weight	Underweight
Trading Currency	TWD	TWD	TWD	TWD	HKD	TWD	TWD	CNY	TWD	TWD
Price Target	**560.0**	**718.0**	**1,000.0**	**1,800.0**	**88.0**	**88.0**	**2,880.0**	**85.0**	**2,300.0**	**215.0**
Current Price (as of 10/2/2023)	404.0	533.0	745.0	1,410.0	70.1	78.8	2,730.0	60.0	2,765.0	310.0
Upside/(Downside) (%)	**39%**	**35%**	**34%**	**28%**	**26%**	**12%**	**5%**	**42%**	**-17%**	**-31%**
Market Cap (in USD mm)	635.4	428,801.9	36,179.4	5,889.5	3,559.4	3,028.3	6,360.4	4,087.1	3,221.7	3,818.7
Avg Daily Traded Vol (in USD mm)	50.6	502.7	143.6	213.4	9.9	18.5	204.9	47.5	41.7	38.5
Street View: Ratings										
Buy/Overweight	|||||||||| 67%	|||||||| 54%	|||||||| 57%	|||||||| 53%	|||||||| 56%	||||||||	|||||||| 8:	||||||| 50%	|||| 19%	
Hold/Equal-weight	||||| 33%	|| 7%	||||| 38%	|||| 29%	||||| 47%	||||| 44%	|| 8%	|| 9%	||||| 36%	||||| 38%
Sell/Underweight	0%	0%	|| 8%	||| 14%	0%	0%	0%	|| 9%	||| 14%	|||||| 44%
FY23 MSe vs. Consensus Mean										
Sales	-3.5%	-0.1%	0.5%	1.6%	-2.5%	-1.4%	3.9%	-12.2%	-5.9%	-1.2%
EBITDA	-281.5%	-1.9%	2.5%	-3.5%	-30.2%	-2.4%	14.2%	-43.5%	-11.6%	236.2%
EBIT	8.4%	-1.4%	-1.3%	-0.1%	-23.6%	-2.9%	10.7%	NA	-5.0%	-130.8%
EPS	303.3%	-0.1%	-0.6%	-1.4%	-25.5%	-3.3%	7.9%	4.9%	0.4%	351.8%
FY24 MSe vs. Consensus Mean										
Sales	-1.3%	0.3%	-1.5%	4.3%	-4.3%	-0.2%	14.8%	-12.0%	-5.6%	-0.3%
EBITDA	-21.1%	0.2%	-10.0%	2.6%	-21.5%	1.1%	16.5%	-19.3%	-14.8%	28.3%
EBIT	35.2%	-1.0%	-12.1%	7.9%	-13.1%	5.0%	18.8%	NA	-8.8%	61.4%
EPS	9.6%	-0.8%	-11.1%	6.5%	-14.7%	4.6%	19.0%	4.9%	-12.8%	5.5%
Valuation Multiples at Last Close										
FY23e										
P/E	-248.5x	17.8x	17.8x	57.2x	29.6x	18.1x	54.3x	188.6x	97.8x	80.9x
EV/EBIT	-87.7x	15.3x	15.7x	47.3x	17.5x	15.4x	43.7x	175.9x	97.1x	650.6x
EV/EBITDA	-105.2x	9.4x	12.5x	43.7x	14.6x	6.7x	31.3x	146.0x	97.1x	212.6x
EV/Sales	16.2x	6.3x	2.4x	6.9x	1.6x	3.3x	6.4x	10.3x	34.1x	7.1x
FCF Yield	-0.6%	2.6%	11.9%	1.7%	9.0%	7.8%	3.1%	2.5%	1.5%	2.0%
FY24e										
P/E	87.1x	14.7x	15.8x	36.6x	16.4x	13.1x	36.4x	123.4x	61.6x	41.2x
EV/EBIT	75.6x	12.1x	13.0x	29.6x	10.2x	10.8x	28.4x	92.9x	49.9x	30.9x
EV/EBITDA	66.0x	7.3x	10.7x	28.1x	9.0x	5.5x	22.6x	83.8x	49.9x	27.8x
EV/Sales	10.8x	5.1x	2.1x	5.0x	1.4x	2.7x	4.7x	8.0x	21.1x	5.3x
FCF Yield	0.8%	5.0%	5.2%	2.0%	3.6%	5.5%	1.7%	0.8%	1.3%	1.8%

Source: Morgan Stanley Research, Thomson Reuters (consensus mean). e = Morgan Stanley Research estimates

Note: Past performance is no guarantee of future results. Results shown do not include transaction costs.

Source: Morgan Stanley Research, Refinitiv (consensus mean). e = Morgan Stanley Research estimates.

Note: Past performance is no guarantee of future results. Results shown do not include transaction costs. Priced as of 2 October 2023.

AI semis – P/E multiple and exposure

Exhibit 34: P/E multiple trend of AI semis
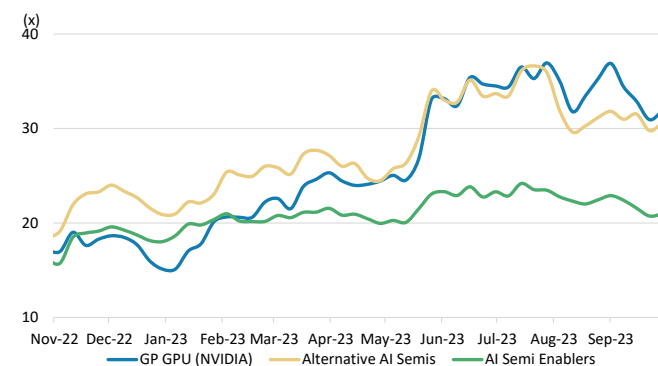
Alternative AI semis group: AMD, Alchip, GUC, Andes, Marvell, Broadcom.
AI semi enablers group: TSMC, Synopsys, Cadence, ASML, BESI, ASMPT, Ibiden, KYEC, Advantest.
Source: Company data, Morgan Stanley Research.

Exhibit 35: Greater China AI semi revenue exposure as of 2023e

Greater China semis: AI revenue exposure
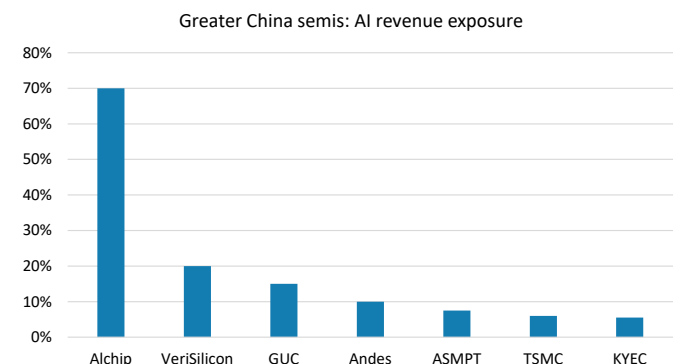
Source: Morgan Stanley Research (e) estimates

AI downstream tech – order of preference

Exhibit 36: Preference Table

	Lite-on 2301.TW	FII 601138.SS	Delta 2308.TW	Sunonwealth 2421.TW	Asustek 2357.TW	Chorma 2360.TW	Wistron 3231.TW	AVC 3017.TW	GCE 2368.TW	Quanta 2382.TW
Rating	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight	Overweight
Trading Currency	TWD	CNY	TWD	TWD	TWD	TWD	TWD	TWD	TWD	TWD
Price Target	**192.0**	**28.5**	**450.0**	**160.0**	**475.0**	**350.0**	**135.0**	**380.0**	**225.0**	**240.0**
Current Price	125.5	19.7	335.5	122.0	372.5	281.5	111.0	342.5	215.5	254.5
Upside/(Downside) (%)	**53%**	**45%**	**34%**	**31%**	**28%**	**24%**	**22%**	**11%**	**4%**	**-6%**
Market Cap (in USD mm)	8,897.5	50,674.3	27,039.3	949.8	8,584.5	3,715.5	9,742.7	4,073.3	3,454.2	30,495.0
Avg Daily Traded Vol (in USD mm)	61.1	227.9	69.6	23.0	37.6	13.3	131.9	67.9	49.1	138.6
Street View: Ratings										
Buy/Overweight	100%	100%	94%	100%	53%	89%	90%	83%	89%	94%
Hold/Equal-weight	0%	0%	6%	0%	40%	11%	10%	17%	11%	6%
Sell/Underweight	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%
Bull Case Value	269.0	40.7	550.0	229.0	920.0	490.0	186.0	532.0	323.0	343.0
Upside (%)	114%	107%	64%	88%	147%	74%	68%	55%	50%	35%
Bear Case Value	125.0	15.5	252.0	96.0	340.0	165.0	90.0	228.0	136.0	146.0
Downside (%)	0%	-21%	-25%	-21%	-9%	-41%	-19%	-33%	-37%	-43%
Risk/Reward Skew	287.0	5.0	2.6	4.1	16.8	1.8	3.6	1.7	1.4	0.8
Morgan Stanley Estimates										
FY23e	TWD	CNY	TWD	TWD	TWD	TWD	TWD	TWD	TWD	TWD
Sales	159,182	463,056	423,575	13,677	449,692	22,724	861,705	59,780	30,619	1,178,699
EBITDA	21,387	26,518	65,938	2,272	7,933	6,721	36,254	8,543	6,047	52,259
EBIT	16,939	21,526	44,346	1,708	6,819	6,038	24,921	6,827	5,173	41,179
EPS	6.89	1.10	13.30	5.90	15.44	11.77	3.39	12.60	7.28	8.67
FY24e										
Sales	184,443	555,288	471,304	15,322	498,715	25,548	1,002,634	69,450	40,465	1,603,340
EBITDA	26,315	34,540	76,970	2,700	27,048	7,744	46,653	10,673	9,610	68,039
EBIT	21,778	29,530	53,549	2,080	25,933	7,051	35,064	8,957	8,665	55,981
EPS	8.25	1.50	15.65	6.85	31.70	13.97	6.05	16.22	12.47	11.30
FY23 MSe vs. Consensus Mean										
Sales	0.0%	-15.6%	1.1%	0.6%	-8.3%	3.6%	-2.3%	1.6%	0.4%	-0.1%
EBITDA	1.5%	-9.9%	1.1%	-0.3%	2.5%	0.6%	-5.1%	-4.2%	0.1%	0.4%
EBIT	5.0%	-13.4%	-0.2%	-2.8%	-14.6%	0.6%	0.2%	-2.6%	1.1%	-0.9%
EPS	5.1%	-8.2%	-1.4%	-2.2%	3.1%	-1.3%	-5.9%	-4.6%	-0.5%	-5.0%
FY24 MSe vs. Consensus Mean										
Sales	1.0%	-11.9%	-0.6%	-0.4%	-8.5%	0.8%	1.1%	0.5%	2.9%	3.6%
EBITDA	-1.4%	-2.9%	0.3%	-2.1%	14.3%	0.3%	-11.1%	-3.6%	1.9%	1.2%
EBIT	5.5%	-1.5%	-1.9%	-5.5%	20.1%	-0.6%	-4.1%	-5.1%	2.1%	1.4%
EPS	3.9%	3.2%	-4.3%	-4.0%	9.3%	-2.1%	-4.8%	-6.5%	-1.0%	-4.5%
Valuation Multiples at Last Close										
FY23e										
P/E	18.2x	17.9x	25.2x	20.7x	24.1x	23.9x	32.7x	27.2x	29.6x	29.4x
EV/EBIT	13.2x	13.1x	19.1x	16.7x	26.6x	19.1x	12.7x	17.4x	21.0x	24.5x
EV/EBITDA	10.4x	10.6x	12.8x	12.5x	22.9x	17.2x	8.8x	13.9x	17.9x	19.3x
EV/Sales	1.4x	0.6x	2.0x	2.1x	0.4x	5.1x	0.4x	2.0x	3.5x	0.9x
FCF Yield	6.0%	16.1%	2.5%	5.6%	15.2%	4.0%	18.9%	4.2%	3.4%	4.7%
FY24e										
P/E	15.2x	13.2x	21.4x	17.8x	11.8x	20.2x	18.3x	21.1x	17.3x	22.5x
EV/EBIT	10.0x	8.7x	15.6x	13.3x	6.7x	16.0x	9.1x	12.8x	12.2x	18.5x
EV/EBITDA	8.3x	7.5x	10.8x	10.3x	6.4x	14.6x	6.8x	10.8x	11.0x	15.2x
EV/Sales	1.2x	0.5x	1.8x	1.8x	0.3x	4.4x	0.3x	1.7x	2.6x	0.6x
FCF Yield	7.0%	3.8%	4.3%	5.7%	8.6%	5.1%	3.2%	4.9%	3.4%	-0.1%
Implied Multiples on MS Price Target										
FY23e										
P/E	47.2x	25.9x	33.8x	27.1x	30.8x	29.7x	39.8x	30.2x	30.9x	27.7x
EV/EBIT	28.22	20.73	25.77	22.25	37.80	23.93	15.53	19.54	21.83	23.18
EV/EBITDA	27.12	16.83	17.33	16.72	32.49	21.50	10.68	15.62	18.67	18.26
EV/Sales	5.45	0.96	2.70	2.78	0.57	6.36	0.45	2.23	3.69	0.81
FY24e										
P/E	41.9x	19.0x	28.8x	23.4x	15.0x	25.1x	22.3x	23.4x	18.0x	21.2x
EV/EBIT	28.86	19.85	22.33	19.77	13.94	21.64	11.17	16.72	13.82	17.10
EV/EBITDA	27.81	16.97	15.54	15.23	13.36	19.71	8.40	14.04	12.46	14.07
EV/Sales	5.46	1.06	2.54	2.68	0.72	5.97	0.39	2.16	2.96	0.60
Stock Price Performance										
1 Month	(6.7%)	(7.3%)	(3.0%)	(5.1%)	(6.9%)	3.5%	1.8%	4.1%	7.2%	5.8%
3 Month	21.3%	(21.8%)	(2.6%)	31.2%	18.4%	12.4%	22.2%	26.4%	47.6%	67.4%
1 Year	96.7%	131.2%	32.6%	238.4%	59.2%	56.4%	318.1%	211.8%	132.2%	230.5%
YTD	96.7%	114.6%	17.1%	185.7%	38.7%	55.5%	277.6%	210.5%	148.3%	252.0%

Source: Morgan Stanley Research, Refinitiv (consensus mean). e = Morgan Stanley Research estimates.
Note: Past performance is no guarantee of future results. Results shown do not include transaction costs. Prices as of 2 Oct., 2023.

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Analyst Certification

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Stock Rating Category	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1350	37%	281	43%	21%	608	39%
Equal-weight/Hold	1673	46%	303	46%	18%	709	46%
Not-Rated/Hold	3	0%	0	0%	0%	1	0%
Underweight/Sell	608	17%	68	10%	11%	225	15%
Total	3,634		652			1543	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

Analyst Stock Ratings

Overweight (O). The stock's total return is expected to exceed the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Equal-weight (E). The stock's total return is expected to be in line with the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Not-Rated (NR). Currently the analyst does not have adequate conviction about the stock's total return relative to the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Underweight (U). The stock's total return is expected to be below the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.

Unless otherwise specified, the time frame for price targets included in Morgan Stanley Research is 12 to 18 months.

Analyst Industry Views

Attractive (A): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be attractive vs. the relevant broad market benchmark, as indicated below.

In-Line (I): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be in line with the relevant broad market benchmark, as indicated below.

Cautious (C): The analyst views the performance of his or her industry coverage universe over the next 12-18 months with caution vs. the relevant broad market benchmark, as indicated below.

Benchmarks for each region are as follows: North America - S&P 500; Latin America - relevant MSCI country index or MSCI Latin America Index; Europe - MSCI Europe; Japan - TOPIX; Asia - relevant MSCI country index or MSCI sub-regional index or MSCI AC Asia Pacific ex Japan Index.

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INDUSTRY COVERAGE: Greater China Technology Hardware

COMPANY (TICKER)	RATING (AS OF)	PRICE* (09/29/2023)
Andy Meng, CFA		
AAC Technologies Holdings (2018.HK)	E (08/10/2023)	HK$13.40
Accelink Technologies Co. Ltd. (002281.SZ)	U (05/12/2022)	Rmb32.26
BYD Electronics (0285.HK)	O (04/28/2023)	HK$35.70
China TransInfo Technology Co Ltd (002373.SZ)	E (07/18/2023)	Rmb11.94
Dahua Technology Co. Ltd. (002236.SZ)	U (07/18/2023)	Rmb22.27
Eoptolink Technology Inc Ltd (300502.SZ)	U (04/20/2023)	Rmb46.00
Genius Electronic Optical Co. Ltd. (3406.TW)	O (05/16/2023)	NT$374.00
Gosuncn Technology Group Co Ltd (300098.SZ)	U (11/07/2022)	Rmb3.69
HIKVision Digital Technology (002415.SZ)	O (11/02/2015)	Rmb33.80
Largan Precision (3008.TW)	O (05/16/2023)	NT$2,145.00

LianChuang Electronic Technology Co Ltd (002036.SZ)	E (05/16/2023)	Rmb9.51
OFILM Group Co Ltd (002456.SZ)	E (11/04/2021)	Rmb6.40
Q Technology (Group) Company Ltd (1478.HK)	O (01/09/2023)	HK$3.21
Quectel Wireless Solutions Co Ltd (603236.SS)	O (11/07/2022)	Rmb45.66
Shenzhen Transsion Holdings Co Ltd (688036.SS)	E (04/20/2023)	Rmb145.74
Sunny Optical (2382.HK)	O (05/16/2023)	HK$54.70
Suzhou TFC Optical Communication Co Ltd. (300394.SZ)	U (04/20/2023)	Rmb95.00
Wingtech Technology Co Ltd (600745.SS)	O (05/18/2022)	Rmb43.65
Xiaomi Corp (1810.HK)	O (04/14/2021)	HK$12.34
Yangtze Optical Fibre and Cable JSC Ltd (601869.SS)	U (10/13/2021)	Rmb33.77
Yangtze Optical Fibre and Cable JSC Ltd (6869.HK)	E (04/20/2023)	HK$10.76
Yongxin Optics Co Ltd (603297.SS)	E (11/15/2022)	Rmb86.85
YuTong Optical Technology Co Ltd (300790.SZ)	E (04/05/2022)	Rmb14.24
Zhejiang Crystal-Optech Co Ltd (002273.SZ)	O (11/15/2022)	Rmb11.16
Zhongji Innolight Co Ltd (300308.SZ)	E (12/01/2022)	Rmb115.80
ZTE Corporation (0763.HK)	O (06/20/2019)	HK$23.65
ZTE Corporation (000063.SZ)	U (07/02/2021)	Rmb32.68

Derrick Yang

Advantech (2395.TW)	O (01/20/2021)	NT$344.50
AirTAC International (1590.TW)	E (08/04/2022)	NT$1,005.00
AU Optronics (2409.TW)	U (09/06/2023)	NT$16.05
BOE Technology (000725.SZ)	O (09/06/2019)	Rmb3.86
BOE Varitronix Ltd (0710.HK)	O (06/20/2023)	HK$7.26
Chroma Ate Inc. (2360.TW)	O (10/05/2021)	NT$281.50
E Ink Holdings Inc. (8069.TWO)	O (05/17/2023)	NT$181.50
Ennoconn Corporation (6414.TW)	O (01/20/2021)	NT$268.50
Ennostar Inc (3714.TW)	U (09/23/2022)	NT$44.15
GIS Holding Limited (6456.TW)	E (05/06/2023)	NT$58.70
Hiwin Technologies Corp. (2049.TW)	E (08/11/2023)	NT$209.00
Innolux (3481.TW)	E (09/06/2023)	NT$13.00
Lens Technology (300433.SZ)	E (07/22/2020)	Rmb12.28
Leyard Optoelectronic Co Ltd (300296.SZ)	E (11/03/2020)	Rmb6.53
Radiant Opto-Electronics Corporation (6176.TW)	O (12/01/2020)	NT$123.50
Sanan Optoelectronics (600703.SS)	U (08/21/2023)	Rmb15.42
TCL Corp. (000100.SZ)	E (06/11/2019)	Rmb4.08
Tianma Microelectronics (000050.SZ)	U (01/24/2018)	Rmb9.22
Visionox Technology Inc (002387.SZ)	E (02/18/2020)	Rmb7.73
Wuhan Jingce Electronic Group Co Ltd (300567.SZ)	E (11/26/2021)	Rmb90.63
Wuhu Token Science Co. Ltd. (300088.SZ)	U (06/20/2023)	Rmb6.15

Howard Kao

Accton Technology Corporation (2345.TW)	E (11/12/2021)	NT$500.00
Acer Inc. (2353.TW)	E (05/01/2023)	NT$37.15
Asustek Computer Inc. (2357.TW)	O (08/01/2023)	NT$372.50
Compal Electronics (2324.TW)	E (05/01/2023)	NT$30.90
Flexium (6269.TW)	E (04/27/2018)	NT$88.60
Giga-Byte Technology Co. Ltd. (2376.TW)	O (12/15/2022)	NT$290.00
Gold Circuit Electronics Ltd. (2368.TW)	O (10/06/2022)	NT$215.50
Guangdong Fenghua Adv. Tech. (Hldg) Co (000636.SZ)	E (05/12/2021)	Rmb14.69
Inspur Electronic Information (000977.SZ)	E (08/28/2023)	Rmb37.61
Kinsus Interconnect Tech. (3189.TW)	U (12/21/2022)	NT$108.00
Lenovo (0992.HK)	O (05/01/2023)	HK$8.07
Lotes Co. Ltd. (3533.TW)	O (10/06/2022)	NT$840.00
Nan Ya PCB (8046.TW)	U (12/21/2022)	NT$267.50
Pegatron Corporation (4938.TW)	E (03/07/2022)	NT$76.60
Quanta Computer Inc. (2382.TW)	O (05/01/2023)	NT$254.50

Shengyi Technology Co Ltd. (600183.SS)	E (05/26/2022)	Rmb15.36
Shennan Circuits Co Ltd (002916.SZ)	E (08/24/2023)	Rmb66.57
Unimicron (3037.TW)	U (02/22/2023)	NT$178.50
Wistron Corporation (3231.TW)	O (07/12/2023)	NT$111.00
Wiwynn Corp (6669.TW)	O (07/12/2023)	NT$1,640.00
Yageo Corp. (2327.TW)	O (01/04/2022)	NT$533.00
Zhen Ding (4958.TW)	E (08/02/2022)	NT$99.80
Sharon Shih		
Asia Vital Components Co. Ltd. (3017.TW)	O (05/04/2023)	NT$342.50
Auras Technology Co Ltd (3324.TWO)	E (05/04/2023)	NT$330.00
BizLink Holding Inc (3665.TW)	O (02/20/2023)	NT$268.00
Catcher Technology (2474.TW)	U (04/23/2021)	NT$183.50
Cubic Sensor and Instrument Co Ltd (688665.SS)	E (08/18/2022)	Rmb74.74
Delta Electronics Inc. (2308.TW)	O (07/13/2017)	NT$335.50
Foxconn Industrial Internet Co. Ltd. (601138.SS)	O (07/10/2019)	Rmb19.70
Foxconn Technology (2354.TW)	E (08/16/2016)	NT$57.60
GoerTek Inc (002241.SZ)	E (12/05/2022)	Rmb15.78
Guangzhou Shiyuan Electronic Tech Co Ltd (002841.SZ)	E (10/28/2021)	Rmb50.69
Hon Hai Precision (2317.TW)	E (01/09/2023)	NT$104.50
LandMark Optoelectronics Corporation (3081.TWO)	U (04/27/2023)	NT$126.00
Lingyi Itech Guangdong Co (002600.SZ)	E (08/28/2023)	Rmb5.72
Lite-On Technology (2301.TW)	O (07/31/2023)	NT$125.50
Luxshare Precision Industry Co., Ltd. (002475.SZ)	O (10/24/2016)	Rmb29.82
SDI Corporation (2351.TW)	E (04/26/2023)	NT$107.50
Sunonwealth Electric Machine Industry Co (2421.TW)	O (08/07/2023)	NT$122.00
Tong Hsing (6271.TW)	E (03/18/2019)	NT$144.50
Visual Photonics Epitaxy Co Ltd (2455.TW)	E (09/11/2023)	NT$150.00

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* Historical prices are not split adjusted.

INDUSTRY COVERAGE: Greater China Technology Semiconductors

COMPANY (TICKER)	RATING (AS OF)	PRICE* (10/02/2023)
Charlie Chan		
ACM Research Inc (ACMR.O)	O (03/07/2023)	US$18.11
Advanced Micro-Fabrication Equipment Inc (688012.SS)	U (02/22/2023)	Rmb150.55
Alchip Technologies Ltd (3661.TW)	O (05/14/2021)	NT$2,730.00
Andes Technology Corp (6533.TW)	O (08/04/2022)	NT$404.00
ASE Technology Holding Co. Ltd. (3711.TW)	O (07/07/2023)	NT$111.00
Jiangsu Changjiang Electronics Tech (600584.SS)	E (07/07/2023)	Rmb30.50
Maxscend Microelectronics Co Ltd (300782.SZ)	U (01/11/2021)	Rmb116.70
MediaTek (2454.TW)	O (09/12/2023)	NT$745.00
Nanya Technology Corp. (2408.TW)	E (10/04/2022)	NT$67.60
Phison Electronics Corp (8299.TWO)	O (04/11/2023)	NT$466.50
Silergy Corp. (6415.TW)	U (05/20/2021)	NT$310.00
SMIC (0981.HK)	U (02/22/2023)	HK$20.05
TSMC (2330.TW)	O (02/07/2022)	NT$533.00
UMC (2303.TW)	O (09/14/2020)	NT$45.75
Universal Scientific Ind. (Shanghai) (601231.SS)	O (08/04/2015)	Rmb14.59
Vanguard International Semiconductor (5347.TWO)	U (09/21/2022)	NT$69.10
Will Semiconductor Co Ltd Shanghai (603501.SS)	O (07/07/2023)	Rmb93.06
WIN Semiconductors Corp (3105.TWO)	U (02/04/2021)	NT$134.50
Daisy Dai, CFA		
Empyrean Technology Co Ltd (301269.SZ)	O (06/26/2023)	Rmb104.92
Hangzhou Silan Microelectronics Co. Ltd. (600460.SS)	O (07/07/2023)	Rmb24.36

Shanghai Anlogic Infotech Co Ltd (688107.SS)	E (11/01/2022)	Rmb41.41
Shanghai Fudan Microelectronics (1385.HK)	E (10/18/2022)	HK$16.80
Unigroup Guoxin Microelectronics Co Ltd (002049.SZ)	U (01/10/2023)	Rmb87.20
Yangjie Technology (300373.SZ)	O (06/10/2022)	Rmb34.96
Zhejiang Tony Electronic Co Ltd (603595.SS)	U (09/18/2023)	Rmb33.21
Daniel Yen, CFA		
3Peak (688536.SS)	U (11/01/2022)	Rmb182.00
AP Memory Technology Corp (6531.TW)	O (09/04/2023)	NT$396.00
ASMedia Technology Inc (5269.TW)	E (05/30/2023)	NT$1,135.00
Aspeed Technology (5274.TWO)	E (07/07/2023)	NT$2,765.00
Bestechnic Shanghai Co Ltd (688608.SS)	O (04/23/2021)	Rmb116.65
Chipsea Technologies Shenzhen Corp (688595.SS)	U (05/15/2023)	Rmb28.86
Egis Technology Inc (6462.TWO)	U (04/23/2020)	NT$82.90
Espressif Systems (688018.SS)	O (05/15/2023)	Rmb101.60
GigaDevice Semiconductor Beijing Inc (603986.SS)	E (08/14/2023)	Rmb98.60
Macronix International Co Ltd (2337.TW)	U (10/19/2021)	NT$31.70
Montage Technology Co Ltd (688008.SS)	E (05/04/2023)	Rmb49.70
Novatek (3034.TW)	E (02/22/2023)	NT$428.00
Nuvoton Technology Corporation (4919.TW)	O (07/19/2021)	NT$126.00
Parade Technologies Ltd (4966.TWO)	E (07/21/2023)	NT$972.00
Realtek Semiconductor (2379.TW)	O (02/22/2023)	NT$398.50
Shenzhen Goodix Technology Co Ltd (603160.SS)	E (07/07/2023)	Rmb61.20
Sino Wealth Electronic (300327.SZ)	O (07/19/2021)	Rmb25.15
Winbond Electronics Corp (2344.TW)	O (03/02/2023)	NT$25.60
WPG Holdings (3702.TW)	U (04/09/2021)	NT$60.00
Dylan Liu		
ASMPT Ltd (0522.HK)	O (06/12/2023)	HK$70.10
Chipbond Technology Corp (6147.TWO)	E (06/20/2023)	NT$68.70
Faraday Technology Corp (3035.TW)	O (04/06/2023)	NT$312.50
Global Unichip Corp (3443.TW)	O (05/04/2023)	NT$1,410.00
King Yuan Electronics Co Ltd (2449.TW)	O (03/03/2023)	NT$78.80
M31 Technology Corp (6643.TWO)	O (06/26/2023)	NT$811.00
VeriSilicon Microelectronics Shanghai (688521.SS)	E (04/06/2023)	Rmb59.95
Ray Wu, CFA		
Advanced Wireless Semiconductor Co (8086.TWO)	O (09/11/2023)	NT$109.50
China Resources Microelectronics Limited (688396.SS)	U (07/08/2022)	Rmb54.09
Episil Technologies Inc (3707.TWO)	O (06/05/2023)	NT$74.00
GlobalWafers Co Ltd (6488.TWO)	E (02/22/2023)	NT$463.00
Hua Hong Semiconductor Ltd (1347.HK)	O (02/04/2022)	HK$19.84
NAURA Technology Group Co Ltd (002371.SZ)	E (11/23/2022)	Rmb241.30
Powerchip Semiconductor Manufacturing Co (6770.TW)	U (07/12/2021)	NT$26.60
RichWave Technology Corp. (4968.TW)	E (07/12/2022)	NT$145.00
SG Micro Corp. (300661.SZ)	E (09/27/2022)	Rmb77.77
Shanghai Awinic Technology (688798.SS)	U (09/27/2022)	Rmb66.05
SICC Co Ltd (688234.SS)	O (09/18/2023)	Rmb54.90
Silicon Motion (SIMO.O)	E (08/12/2021)	US$51.25
StarPower Semiconductor Ltd (603290.SS)	O (03/01/2022)	Rmb179.64
Suzhou Novosense Microelectronics Co Ltd (688052.SS)	U (04/25/2023)	Rmb118.83
UPI Semiconductor Corp. (6719.TW)	E (04/18/2023)	NT$244.50
Wafer Works Corp (6182.TWO)	E (11/07/2022)	NT$45.00

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