Technology - Asia Pacific (H/A)

mSAP for optical transceivers: tightness to persist despite brief relief in 2027

Industry Overview

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Equity
Asia Pacific
Technology

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For abbreviations, please refer to Exhibit 8

Tight supply, ASP upcycle; relief likely in 2027, but briefly

mSAP supply for optical transceivers remains a key focus for PCB, as demand is strong but supply is tight. The process was previously used mainly by Apple, and few suppliers are available. While 400G can still use ultra-thin HDI, 800G relies more on mSAP, and 1.6T is fully mSAP-based given its higher insertion-loss requirement. On specs, 1.6T adopts a 6/7-build-up HDI design with M8+ CCL, while 800G uses 4/5-build-up HDI with M7+ CCL. As a result, 1.6T generally has lower yield and consumes more capacity. The supply chain did not begin expanding mSAP capacity until early 2026. We expect 800G+ supply to remain tight this year, with a 2% demand/supply ratio, while the 1.6T gap is even wider at 14%. Our checks suggest 1.6T PCB ASP has risen to CNY250-300 currently from CNY200 in early 2026. Capacity expansion could bring brief relief in 2027, but supply could tighten again in 2028 as NPO takes off.

Demand: 1.6T shipments critical watch point

We highlight that the 2027 relief reflects a low 1.6T fulfillment rate rather than PCB over-supply. The supply chain expects global 800G and 1.6T demand to reach 90-100mn units each in 2027. But a DSP shortage means the industry is likely to ship only 60-70mn 1.6T transceivers. Against real demand, we still expect a wide demand/supply gap of 25% in 2027, and any better-than-expected DSP supply could tighten PCB supply.

Supply: equipment and yield are swing factors

Many suppliers are expanding mSAP capacity, with Zhen Ding, Kinwong, and Victory Giant among the more aggressive (Exhibit 7). We expect total supply to reach 153/199 million units in 2027/28. We see two key swing factors: (1) equipment lead times are long (2+ years), and some equipment is also used for substrates (SAP), which are in even tighter supply; and (2) mSAP is more complex than HDI/HLC and few suppliers have experience with it, so yield could become a bottleneck, especially given mSAP's much finer line/space (L/S) requirement.

Beyond 2027: new technologies and spec migration matter

The industry also expects NPO/2.4T/3.2T demand from late 2027 into 2028-29. Our checks suggest NPO requires higher layer counts and even finer L/S, consuming more capacity. We therefore expect supply to tighten again in 2028 as NPO volume rises. The industry is also discussing using BT substrate rather than PCB for 2.4T transceivers, a potential positive for substrate suppliers Unimicron, Shennan, Kinsus, and Zhen Ding.

Initiate Kinwong at Buy; Buy Zhen Ding/Unimicron/Shennan

We initiate coverage of Kinwong-H/-A at Buy (Initiation report) on its strong positioning in AI server/optical transceiver, and maintain Buy on Zhen Ding, Unimicron and Shennan on mSAP/substrate upside.

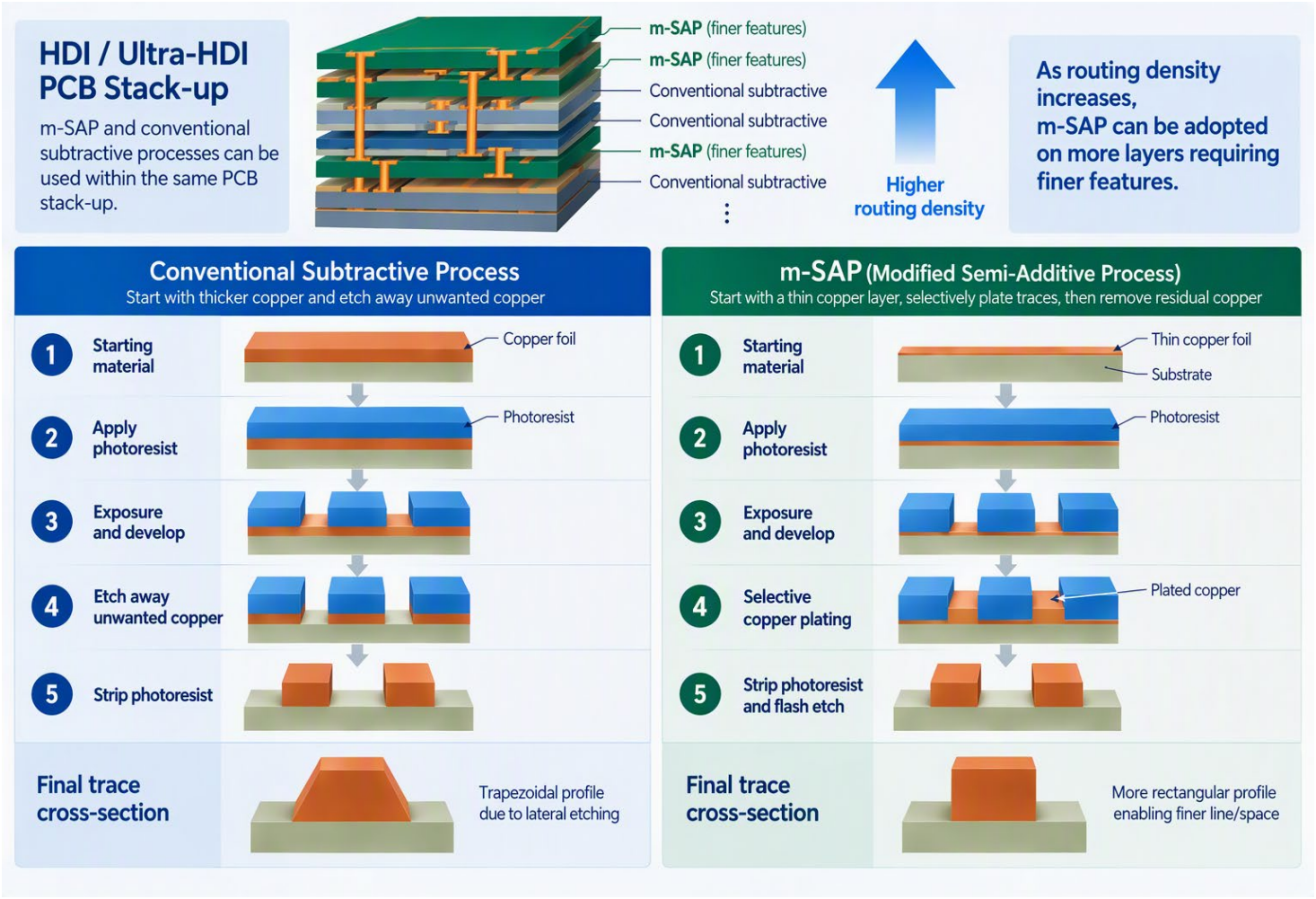
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Refer to important disclosures on page 10 to 13. Analyst Certification on page 7. Price

mSAP brief intro: more complex than HDI/HLC

Conventional PCBs (general HDI, MLPCB, etc.) use a subtractive process. mSAP is an advanced PCB fabrication technology that achieves finer L/S and higher routing density than conventional subtractive processing. As routing density rises, mSAP can be adopted on more of the layers that require finer features.

The key difference between mSAP and the subtractive process lies in how circuit traces are formed. Subtractive processing starts with copper-clad laminate and forms the circuitry by etching away unwanted copper. mSAP, by contrast, starts with thin copper foil, typically a few microns thick, and builds up traces through selective copper plating, followed by photoresist removal and flash etching of the residual base copper. The thinner starting copper reduces the amount that must be etched and allows tighter control of trace geometry, enabling finer L/S and higher routing density.

Exhibit 1: mSAP is an advanced PCB fabrication technology used to achieve finer line/space and higher routing density than subtractive process
PCB fabrication flow: mSAP vs subtractive process adopted in conventional PCBs (general HDI, MLPCB, etc.)



Source: BofA Global Research

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Exhibit 2: mSAP and SAP technologies enable the production of highly miniaturized PCBs with high yields
Three distinct PCB fabrication technologies: subtractive, mSAP, and SAP

Process	Starting Copper	Circuit Formation	Fine-Line Capability	Typical Applications
Subtractive	Thick copper foil, 12–35 µm	Etch away excess copper	≥30 µm	Conventional multilayer PCBs
mSAP	Ultra-thin copper foil, 1.5–5 µm	Pattern plating + flash etching of base copper	10–20 µm	Advanced HDI, substrate-like PCBs (SLP)

Exhibit 2: mSAP and SAP technologies enable the production of highly miniaturized PCBs with high yields
Three distinct PCB fabrication technologies: subtractive, mSAP, and SAP

Process	Starting Copper	Circuit Formation	Fine-Line Capability	Typical Applications
SAP	No copper foil (thin electroless Cu seed layer)	Pattern plating + seed-layer etching	≤2 μm	IC substrates (ABF)

Source: BofA Global Research

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Supply-demand dynamics in 2026-28E

We expect 800G+ supply to remain tight this year, with a 2% demand/supply ratio, while the 1.6T gap is even wider at 14%. Our checks suggest 1.6T PCB ASP has currently risen to CNY250-300 from CNY200 in early 2026. Capacity expansion could bring brief relief in 2027, but supply could tighten again in 2028 as NPO takes off.

Although the market is concerned about potential oversupply from 2027, we highlight several swing factors that could change the dynamics.

- **1.6T shipments:** our current shipment forecast is 40% below real end-demand due to the DSP shortage (based on TSMC's 3nm capacity allocation). Although the market sees DSP as the bottleneck least likely to ease given tight 3nm supply, any upside from other foundries (e.g., MaxLinear's DSP at Samsung) could lift shipments, which would in turn tighten mSAP supply.
- **mSAP equipment:** lead times are long at 2+ years, including for laser drilling and plating equipment. Some of this equipment is also used in SAP to make BT/ABF substrates, which are in even tighter supply. Despite the supply chain's aggressive expansion goals, we believe equipment could become a key bottleneck.
- **Yield:** few suppliers have mSAP experience, and the more complex process and stricter manufacturing requirements usually lead to lower yield. Given long equipment lead times, some suppliers have chosen to use low-end equipment for expansion, which could undermine yield and output.

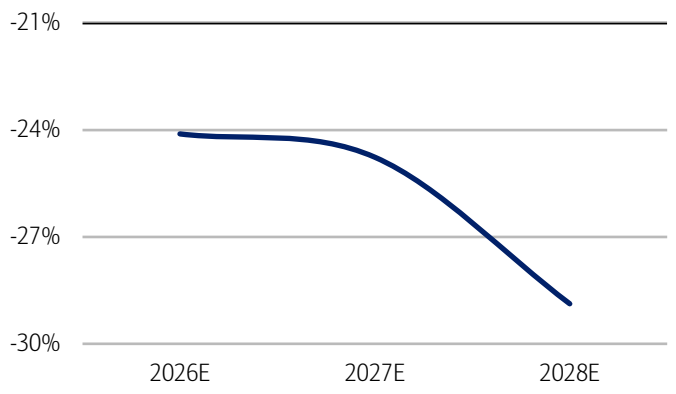
Exhibit 3: We expect pluggable transceiver demand for 800G+ to reach 200mn units
Optical transceiver demand/supply and mSAP output, 2026-28E

	2026E	2027E	2028E
Optical transceiver demand (mn units)			
800G	60	100	70
1.6T	30	100	150
2.4T		2	12
NPO		4	60
Total	**90**	**206**	**292**
Optical transceiver shipment (mn units)			
800G	50	85	65
1.6T	20	60	100
2.4T		0	10
NPO		4	40
Total	**70**	**149**	**215**
mSAP output (mn units)			
800G	53	84	70
1.6T/NPO	16	69	129
Total	**68**	**153**	**199**

Source: BofA Global Research estimates

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Exhibit 4: Compared with transceiver demand, we note big demand/supply gap at PCB side at over 20% in 2026-28E
Optical transceiver mSAP PCB demand/supply ratio vs. 800G+ transceiver demand, 2026-28E

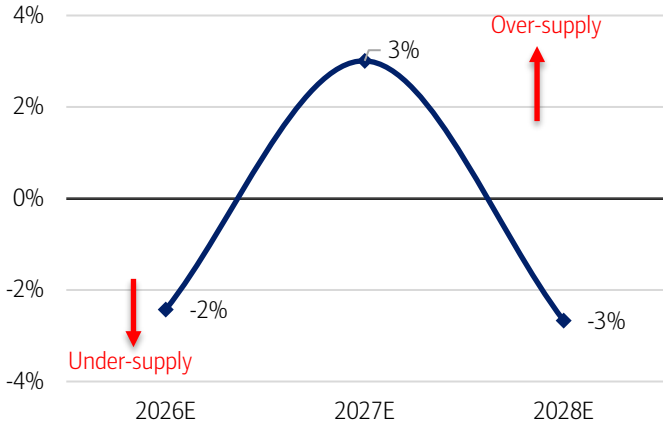


Source: BofA Global Research estimates

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Exhibit 5: Compared with transceiver shipment, we expect tight supply in 2026, and only a temporary relief in 2027

Optical transceiver mSAP PCB demand/supply ratio vs. 800G+ transceiver shipment (ex. 2.4T), 2026-28E

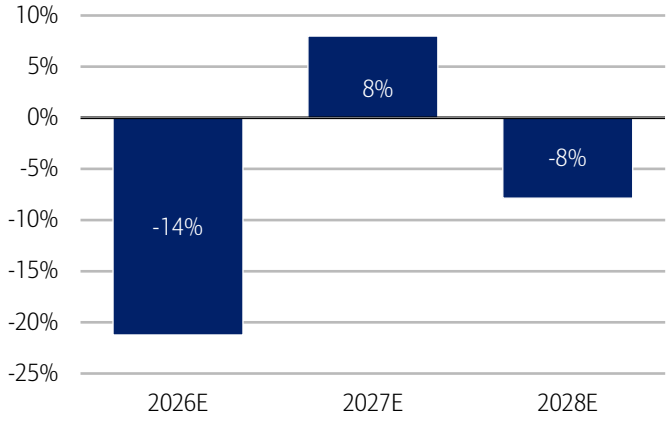


Source: BofA Global Research estimates

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Exhibit 6: We expect PCB supply for 1.6T/NPO to tighten again in 2028 following NPO deployment, 2026-28E

Optical transceiver mSAP PCB demand/supply ratio vs. 1.6T/NPO shipment, 2026-28E



Source: BofA Global Research estimates

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Exhibit 7: We expect mSAP PCB supply for 1.6T/NPO to reach 16/69/129mn units in 2026/27/28

Optical transceiver mSAP PCB – supply analysis, 2026-28E

	2026E	2027E	2028E
Monthly output - 800G equivalent			
Unimicron	2,550	3,570	4,675
Zhen Ding/Avary	1,200	3,800	5,000
Shennan	1,080	2,160	2,808
Kinwong	900	3,500	4,800
Victory Giant	200	600	1,000
Founder	90	600	1,000
Total (k)	**6,020**	**14,230**	**19,283**
Annual output (mn)	**72**	**171**	**231**
% 800G mix			
Unimicron	70%	50%	30%
Zhen Ding/Avary	50%	30%	20%
Shennan	90%	60%	40%
Kinwong	98%	70%	40%
Victory Giant	70%	60%	40%
Founder	0%	0%	0%
% 1.6T/NPO mix			
Unimicron	30%	50%	70%
Zhen Ding/Avary	50%	70%	80%
Shennan	10%	40%	60%
Kinwong	2%	30%	60%
Victory Giant	30%	40%	60%
Founder	100%	100%	100%
800G output			
Unimicron	1,785	1,785	1,403
Zhen Ding/Avary	600	1,140	1,000
Shennan	972	1,296	1,123
Kinwong	882	2,450	1,920
Victory Giant	140	360	400
Founder	0	0	0
Total (k)	**4,379**	**7,031**	**5,846**
Annual output (mn)	**53**	**84**	**70**
1.6T/NPO output - 80% yield of 800G			
Unimicron	612	1,428	2,618
Zhen Ding/Avary	480	2,128	3,200
Shennan	86	691	1,348
Kinwong	14	840	2,304

Exhibit 7: We expect mSAP PCB supply for 1.6T/NPO to reach 16/69/129mn units in 2026/27/28

Optical transceiver mSAP PCB – supply analysis, 2026-28E

	2026E	2027E	2028E
Victory Giant	48	192	480
Founder	72	480	800
Total (k)	**1,313**	**5,759**	**10,750**
Annual output (mn)	**16**	**69**	**129**

Source: Company data, BofA Global Research estimates

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Exhibit 8: Summary of abbreviations

Abbreviations

Abbreviation	
ABF	Ajinomoto Build-up Film
ASP	Average Selling Price
BT	Bismaleimide Triazine
CCL	Copper Clad Laminate
DSP	Digital Signal Processor
HDI	High-Density Interconnect
HLC	High Layer Count
MLPCB	Multi-Layer Printed Circuit Board
mSAP	Modified Semi-Additive Process
NPO	Near-Packaged Optics
PCB	Printed Circuit Board
SAP	Semi-Additive Process

Source: BofA Global Research

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Exhibit 9: Stocks mentioned

Ratings and prices summary

BofA Ticker	Bloomberg Ticker	Company name	Price	Rating
XENZF	3228 HK	Kinwong	53.65	C-1-7
XDENF	603228 CH	Kinwong	61.53	C-1-7
XFAGF	4958 TT	Zhen Ding Tech	433	C-1-7
UMCRF	3037 TT	Unimicron	888	C-1-7
XAMKF	002916 CH	Shennan Circuits	225.6	C-1-7

Source: BofA Global Research

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Investment Rationale

Kinwong

We have a Buy rating on Kinwong-A. We expect Kinwong to benefit from a strong revenue led by rising AI mix, while AI PCB's higher content value margin should support a faster earnings expansion. Meanwhile, auto PCB business will remain as a pillar on CCL cost pass-through near-term and rising ADAS penetration in the long-term.

Kinwong

We have a Buy rating on Kinwong-H. We expect Kinwong to benefit from a strong revenue led by rising AI mix, while AI PCB's higher content value margin should support a faster earnings expansion. Meanwhile, auto PCB business will remain as a pillar on CCL cost pass-through near-term and rising ADAS penetration in the long-term.

Price objective basis & risk

Kinwong (XDENF)
We set Kinwong-A PO at CNY98, which is at 40% share price premium to Kinwong-H's PO. 40% premium is in line with the average premium for dual-listed A/H hardware names. Our PO implies 17x 2027E P/E, at the higher-end of A-share listed PCB peers' trading range of 10-17x.

Downside risks: (1) weaker-than-expected end-market demand, led by various factors including macro slowdown, tariffs/ trade policy, weaker consumer confidence, etc., (2) weaker-than-expected customer/ product performance, (3) slower-than-expected technology upgrades amid rising competition, and (4) margin pressure from rising capex, manufacturing and supply chain risks.

Upside risks: (1) stronger-than-expected end-market demand, (2) outperformance of key customer/ products that drives order growth and project ramp-ups, (3) content value growth and share gain potential from faster technology upgrades and leading edge in competition, and (4) better capacity utilization and cost execution through disciplined capex spending and management.

Kinwong (XENZF)
We set Kinwong-H PO at HK$82 on 12x 2027E P/E. Our 12x P/E is in line with average P/E of HK/China PCB peers'. 12x is at a premium to Kinwong's H-share listed PCB peers, justified by more resilient earnings and better business visibility near-term.

Downside risks: (1) weaker-than-expected end-market demand, led by various factors including macro slowdown, tariffs/ trade policy, weaker consumer confidence, etc., (2) weaker-than-expected customer/ product performance, (3) slower-than-expected technology upgrades amid rising competition, and (4) margin pressure from rising capex, manufacturing and supply chain risks.

Upside risks: (1) stronger-than-expected end-market demand, (2) outperformance of key customer/ products that drives order growth and project ramp-ups, (3) content value growth and share gain potential from faster technology upgrades and leading edge in competition, and (4) better capacity utilization and cost execution through disciplined capex spending and management.

Shennan Circuits (XAMKF)
We set our PO at CNY409, based on 30x 2027E P/E. The 30x P/E is around historical trading average since IPO, justified by Shennan Circuit's strong earnings expansion led by AI datacenter from server/switch to memory/optical transceiver, and across China and US CSPs.

Downside risks are: (1) slower AI datacenter capex, (2) slower market share gain at US CSPs' AI server projects, (3) more severe competition, (4) worse than expected yield issue, and (6) intensified US/China disputes.

Upside risks to our PO are: (1) faster AI datacenter capex, (2) faster market share gain at US CSPs' AI server projects, (3) eased competition, (4) better than expected yield improvement, and (6) eased US/China disputes.

Unimicron (UMCRF)
Our PO of NT$1,650 is based on 35x 2H27-1H28E, which is roughly 1 standard deviation above the historical average of 20x since 2017. In our view, the multiple is appropriate, as we expect Unimicron's earnings to be supported by its high-end technology offerings, where end market demand seems more resilient.

Upside risks are (1) tighter ABF supply, (2) greater PC and regular server demand, and (3) lower competition pressure.

Downside risks are (1) greater ABF expansion from peers, (2) lower ASP content increase at AI server, and (3) bigger drop in the demand of consumer electronic products.

Zhen Ding Tech (XFAGF)
Our price objective of NT$630 is based on 25x 2027E EPS, which is at the company's historical high P/E level thanks to ongoing business transformation (rising AI sales mix vs. previously key exposure to consumer/communication business) and ongoing margin expansion to record high levels. Our multiple is set below its closest AI PCB and substrate peers (trading at an average of ca 27x) mainly due to ZDT's lower exposure to AI (i.e. relatively higher mix to consumer/communication business) and lighter margin profiles than peers. Our forecasts and valuation base mainly reflects ZDT's market leading position to benefit from AI and foldable iPhone demand, improving product mix (rising IC substrate/server/optical sales contribution), and expected margin expansion in 2026-28.

Downside risks to our PO: (1) weaker-than-expected Apple product (iPhone/iPad/MacBook) demand, (2) weaker macro that drags global Apple product purchases, (3) slower progress/investment in IC substrate and server business, and (4) higher upfront cost for new IC substrate and server capacity ramp-up.

Upside risks to our PO: (1) better-than-expected Apple product (iPhone/iPad/MacBook) demand, (2) stronger-than-expected Apple product momentum, (3) faster progress/investment in IC substrate and server business, and (4) lower upfront cost for new IC substrate and server capacity ramp-up.

Analyst Certification

We, Katherine Zhu, Doris Kao and Mike Yang, hereby certify that the views each of us has expressed in this research report accurately reflect each of our respective personal views about the subject securities and issuers. We also certify that no part of our respective compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

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	Advantech	ADTEF	2395 TT	Robert Cheng
	Asia Vital Components	AVMPF	3017 TT	Doris Kao
	Asustek	AKCPF	2357 TT	Robert Cheng
	BizLink	BIZLF	3665 TT	Doris Kao
	Chenbro	CEOMF	8210 TT	Doris Kao
	Cowell	CWLLF	1415 HK	Katherine Zhu
	Crystal-Optech	XMKAF	002273 CH	Katherine Zhu
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	Duksan Neolux	XDSXF	213420 KS	Simon Woo, CFA
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	Quanta Computer	QUCPF	2382 TT	Robert Cheng
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	Samsung SDI	SSDIF	006400 KS	Simon Woo, CFA
	Samsung SDS	XWPBF	018260 KS	Simon Woo, CFA
	Shennan Circuits	XAMKF	002916 CH	Katherine Zhu
	Taiwan Union Technology Corporation	TWUNF	6274 TT	Mike Yang
	Unimicron	UMCRF	3037 TT	Mike Yang
	Universal Display	OLED	OLED US	Simon Woo, CFA
	Victory Giant	XENEF	300476 CH	Katherine Zhu
	Wistron	WICOF	3231 TT	Doris Kao
	Wiwynn	XWIQF	6669 TT	Robert Cheng
	Xiaomi Corporation	XIACF	1810 HK	Robert Cheng
	Yageo	YGEQF	2327 TT	Robert Cheng
	Zhen Ding Tech	XFAGF	4958 TT	Doris Kao
	Zhongji Innolight	XZICF	300308 CH	Katherine Zhu
NEUTRAL				
	Auras Technology	AUTCF	3324 TT	Doris Kao
	BYD Electronic	BYDIF	285 HK	Katherine Zhu
	Delta Electronics (Thailand)	XLETF	DELTA TB	Suppapong Iemkongaek, CFA, CMT
	DS Precision	XBASF	002384 CH	Katherine Zhu
	E Ink Holdings	PVWIF	8069 TT	Doris Kao
	LG Innotek	XLGQF	011070 KS	Simon Woo, CFA
	Sunny Optical	SNPTF	2382 HK	Katherine Zhu

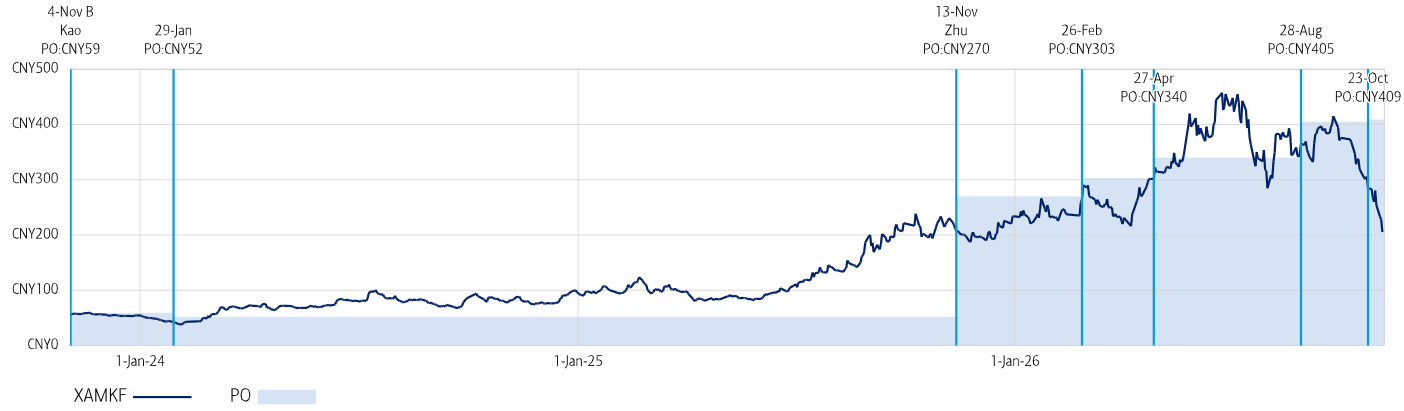
APR - Technology Hardware Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
UNDERPERFORM				
	Acer	ASIYF	2353 TT	Robert Cheng
	Catcher Tech	CHERF	2474 TT	Robert Cheng
	Compal Electron	XLCPF	2324 TT	Doris Kao
	Everwin Precision	XSHZF	300115 CH	Katherine Zhu
	Genius Electronic Optical	GNSEF	3406 TT	Robert Cheng
	Lens Tech	XLTGF	300433 CH	Katherine Zhu
	LG Display	LPHLF	034220 KS	Simon Woo, CFA
	LG Display-ADR	LPL	LPL US	Simon Woo, CFA
	Pegatron	PGTRF	4938 TT	Robert Cheng
	Sanan Opto	XEQYF	600703 CH	Katherine Zhu
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	Shengyi	DGUNF	600183 CH	Mike Yang
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Disclosures

Important Disclosures

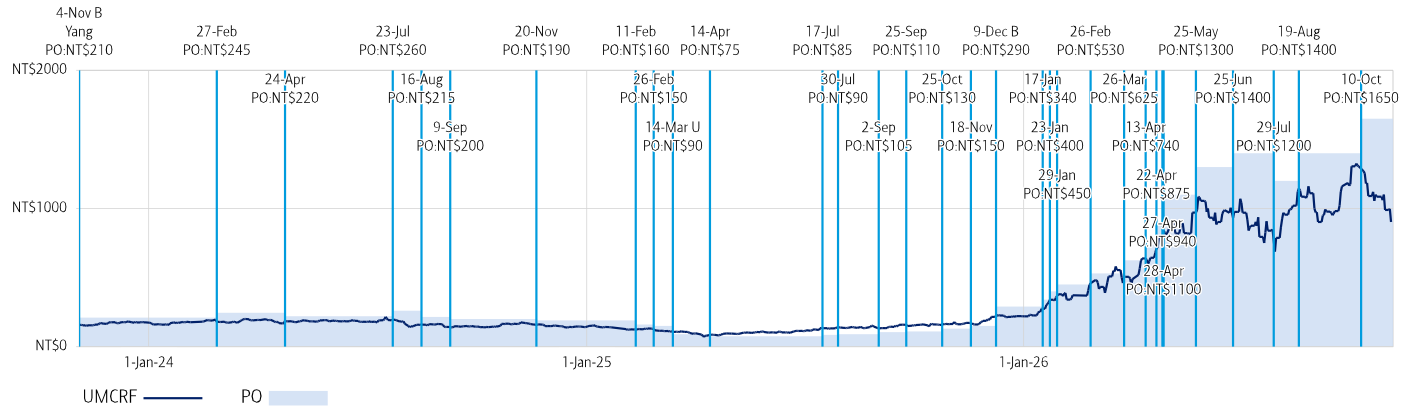
Shennan Circuits (XAMKF) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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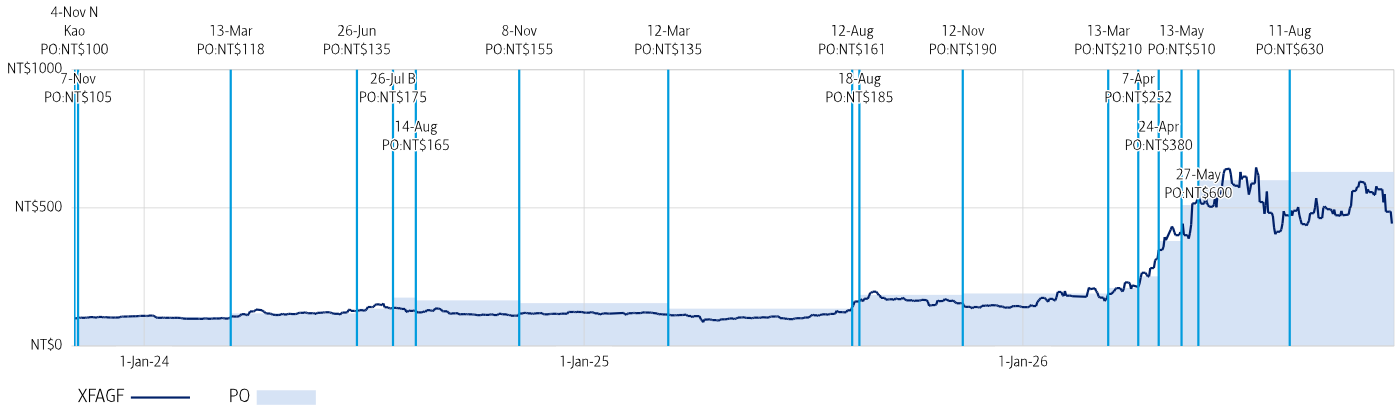
Unimicron (UMCRF) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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Zhen Ding Tech (XFAGF) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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Equity Investment Rating Distribution: Electronics Group (as of 30 Sep 2026)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	41	65.08%	Buy	20	48.78%
Hold	9	14.29%	Hold	1	11.11%
Sell	13	20.63%	Sell	7	53.85%

Equity Investment Rating Distribution: Technology Group (as of 30 Sep 2026)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	255	62.04%	Buy	157	61.57%
Hold	82	19.95%	Hold	46	56.10%
Sell	74	18.00%	Sell	31	41.89%

Equity Investment Rating Distribution: Global Group (as of 30 Sep 2026)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	2057	57.03%	Buy	1386	67.38%
Hold	806	22.35%	Hold	563	69.85%
Sell	744	20.63%	Sell	446	59.95%

[R1] Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster[R2]
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Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

[R2]Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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