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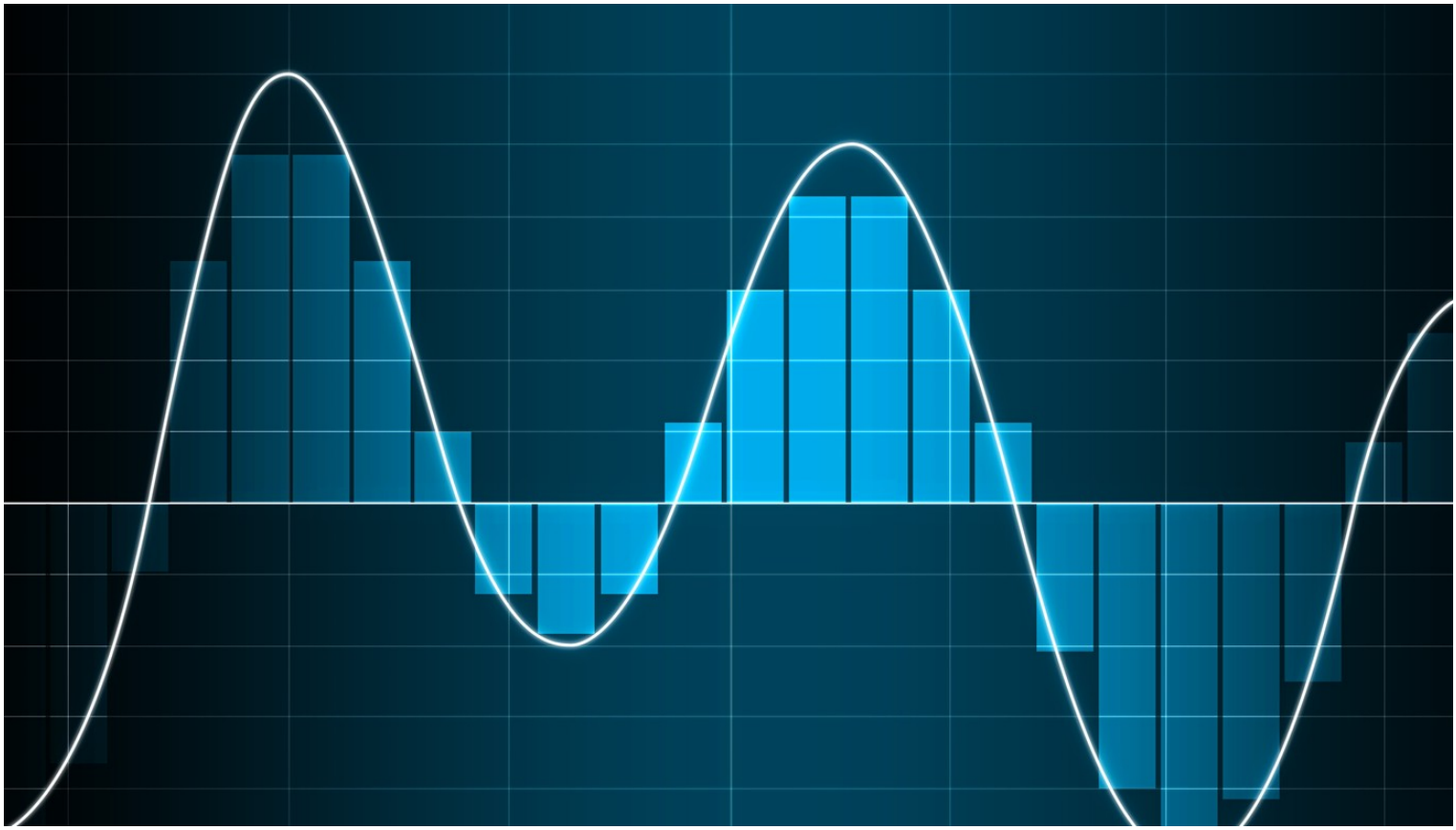
China's Localization

Analog IC: Identifying the long-term beneficiaries

China's localization is a clear trend in the analog IC market. We forecast the TAM to more than triple by 2028. We initiate on Novosense at OW for its growth potential and differentiated business model to capture this trend. We also initiate on Awinic at UW and SG Micro at EW.



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Analog IC: Identifying the long-term beneficiaries

China's analog IC market is dominated by global leaders – room for self-sufficiency to expand: Analog ICs include power management ICs (PMIC) and signal chain ICs. In China, the space is currently dominated by TI, ADI, and NXP, among others. The larger local analog IC design houses, such as Silergy (<2%), SG Micro (1%), Awinic (<1%), and Novosense (<1%) all have less than 5% market share.

INDUSTRY VIEW
Greater China Technology Semiconductors | Asia Pacific
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According to World Semiconductor Trade Statistics (WSTS), China's analog IC market was US$29bn in 2021, and we expect this to grow to US$47bn by 2025 and US$59bn by 2028. China's analog self-sufficiency ratio was only 6% back in 2017 (according to CSIA), and we estimate it expanded to 14% in 2021. As we expect China's analog self-sufficiency ratio will continue to expand to 20% in 2025 and 23% in 2028, this would imply local analog players' sales will expand from US$4.1bn in 2021 to US$9.4bn in 2025 and US$13.8bn in 2028.

We expect China's analog self-sufficiency ratio to further expand, as 1) the technology gap with leading global players is shrinking, 2) Covid-related supply-chain disruptions have opened a window for high-end customers to adopt locally made analog IC chips, and 3) local vendors enjoy the benefit of proximity and can provide customized design/services to meet customer demand.

We believe those analog IC companies that focus on application-specific areas such as industrial and automotive will become long-term winners, thanks to the high entry barriers in those areas. China's application-specific analog IC market is growing faster than the commodity analog IC market with high demand from the local supply chain as a growing number of industrial and auto brands opt to supply their key analog components locally. We believe the companies that invest their R&D resources for industrial and automotive applications will become the long-term winners, as it takes years to develop components that command higher margins and face less competition.

OW on Novosense; a rising star dedicated to industrial and auto applications: These applications require long-term investments as it takes years for qualification and design. Novosense has 60% revenue exposure to the industrial sector, which benefits from tailwinds from solar, server, base station, and industrial automation localization demand. Novosense has another 20% revenue exposure to autos, where we see significant room for its auto business to grow.

Exhibit 1: We expand our analog IC coverage and initiate on Novosense, SG Micro, and Awinic

Ticker	Company	Rating		Price Target		Price Close	Upside/downside %
		New	Old	New	Old		
688052.SS	Novosense	OW	na	420.00	na	290.50	45%
300661.SZ	SG Micro	EW	na	170.00	na	136.52	25%
688536.SS	3Peak	EW	EW	313.00	382.55	253.50	23%
6415.TW	Silergy	UW	UW	430.00	508.00	450.00	-4%
6719.TW	uPI	UW	UW	230.00	230.00	252.00	-9%
688595.SS	Chipsea	UW	UW	33.00	38.00	37.19	-11%
688798.SS	Awinic	UW	na	75.00	na	90.54	-17%

Source: Refinitiv, Morgan Stanley Research estimates. Note: Prices in the report are as of the market close on September 23, 2022, unless otherwise indicated. Prices above are in local currency.

UW on Awinic; faces greater headwinds than peers: Awinic has 60-65% revenue exposure to China smartphones (including OppO, Xiaomi, Vivo), where competition is high, especially as we enter a weaker smartphone cycle. Awinic's main source of growth was unit shipments as opposed to price hikes as it gained market share. We believe volume products may face stronger headwinds during a weaker cycle. The company is expanding into industrial and autos, but we believe the initial revenue contribution will be low in the next few years.

EW on SG Micro; we see upside potential to the iPhone business, but the analog cycle is our primary concern: SG Micro is dedicated to investing in R&D, evidenced by its SKU portfolio, which is the most comprehensive among the Greater China analog IC companies under coverage. Apple has been adding more China suppliers to its supply list, and iPhone 14 marks the first time Apple has adopted SG Micro's analog product. We forecast Apple will account for 2-4% of SG Micro's revenue in 2022, expanding to over 10% in 2024 as Apple increases the analog content sourced from SG Micro.

Be selective as TI competition is another concern: TI may regain share in PMIC with its new 12-inch fab. It might be more difficult for Greater China analog companies to gain market share as they face pricing pressure from PMIC. We hold a cautious view on Silergy (UW; covered by Charlie Chan) and uPI (UW) as they might need to cut prices in 2H22 or 2023 to secure market share in PCs and consumer PMICs.

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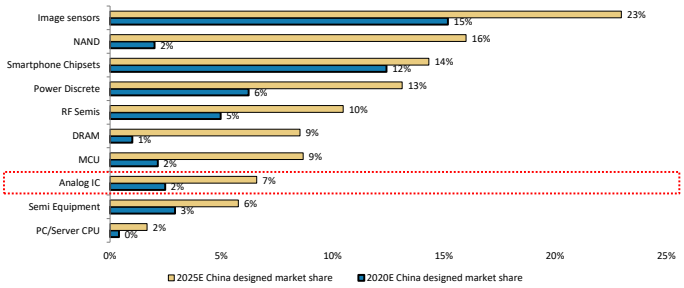
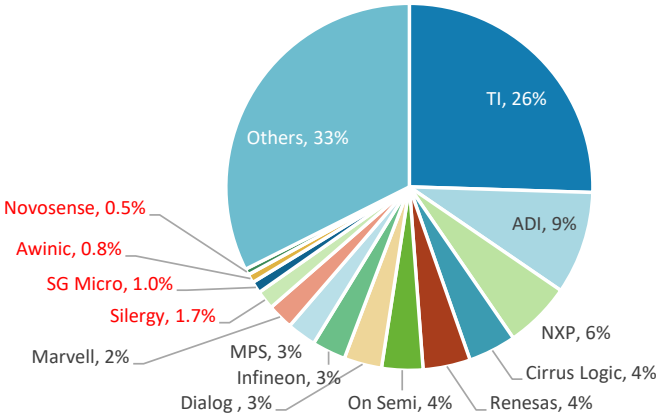
Key charts

Exhibit 2: China-designed semis' market share – we forecast China's global market share to grow from 2% in 2020 to 7% in 2025e



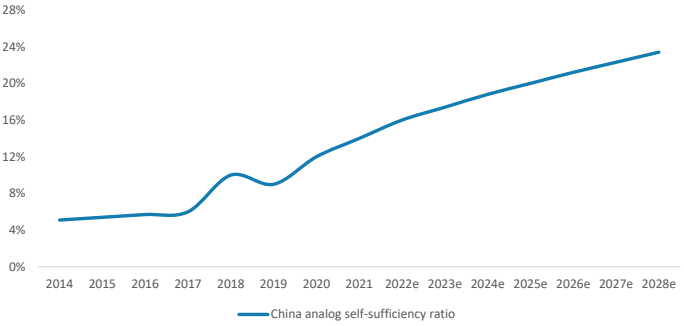
Source: Gartner, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 3: Asia analog market share (2021)



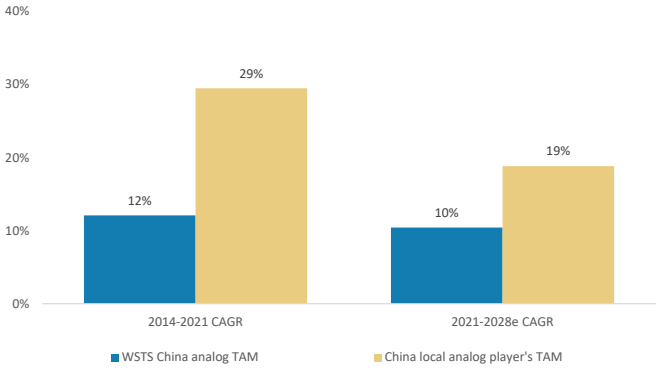
Source: Omdia.

Exhibit 4: China analog self-sufficiency ratio



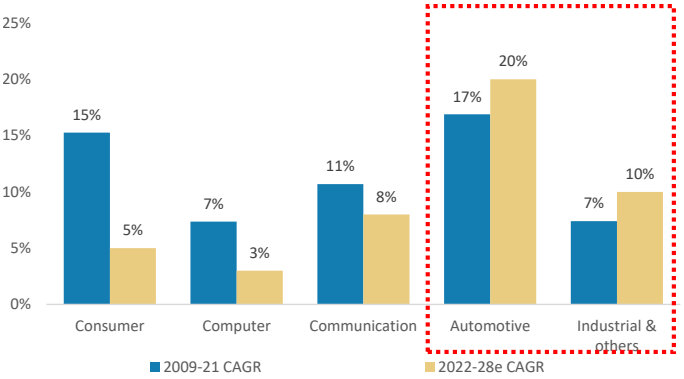
Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 5: We expect China local analog players' TAM to achieve a CAGR of 19% during 2021-28e



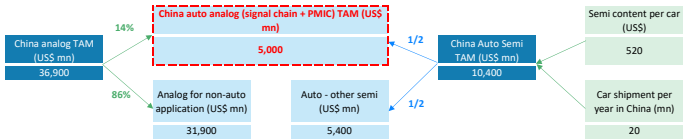
Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 6: China application-specific analog growth by application (2009-21 CAGR vs. 2022-28e CAGR)



Source: Omdia, Morgan Stanley Research. E = Morgan Stanley Research estimates. Note: Underlying metric: revenue.

Exhibit 7: Quantifying China's auto analog semi business opportunity



Source: Morgan Stanley Research estimates.

Order of preference

Exhibit 8: Order of preference – Greater China technology power semiconductor companies

	Novosense 688052.SS	SG Micro 300661.SZ	3Peak 688536.SS	Silergy 6415.TW	uPI 6719.TW	Chipsea 688595.SS	Awinic 688798.SS
Rating	**Overweight**	**Equalweight**	Equal-weight	Underweight	Underweight	Underweight	**Underweight**
Trading Currency	CNY	CNY	CNY	TWD	TWD	CNY	CNY
Price Target	420.0	170.0	313.0	430.0	230	33.0	75.0
Current Price	290.50	136.52	253.50	450.00	252.00	37.19	90.54
Upside/(Downside) (%)	45%	25%	23%	-4%	-9%	-11%	-17%
Market Cap (in USD mm)	4,206.2	6,965.9	4,329.2	5,512.2	681.3	745.9	2,153.3
Avg Daily Traded Vol (in USD mm)	49.8	85.0	49.7	106.8	26.0	23.2	12.9
Street View: Ratings							
Buy/Overweight	100%	95%	93%	67%	50%	83%	78%
Hold/Equal-weight	0%	0%	7%	13%	25%	0%	22%
Sell/Underweight	0%	5%	0%	20%	25%	17%	0%
FY22 MSe vs. Consensus Mean							
Sales	7.1%	-0.3%	9.1%	-1.8%	-0.6%	-5.1%	-10.1%
EBITDA	-7.6%	4.4%	4.2%	-8.0%	-5.7%	-89.7%	-31.3%
EBIT	-9.7%	9.9%	8.1%	-6.6%	NA	-93.6%	-23.0%
EPS	7.4%	8.3%	0.4%	-6.2%	-8.5%	-53.1%	-19.1%
FY23 MSe vs. Consensus Mean							
Sales	20.4%	-4.6%	2.5%	-6.8%	-7.4%	-9.9%	-29.0%
EBITDA	11.8%	5.9%	-5.7%	-17.5%	-16.7%	-65.9%	-44.3%
EBIT	12.4%	14.9%	-3.0%	-16.7%	NA	-61.4%	-40.0%
EPS	26.3%	-1.4%	-17.5%	-19.0%	-19.5%	-53.8%	-36.6%
Valuation Multiples at Last Close							
FY22e							
P/E	66.9x	41.2x	57.5x	26.3x	15.9x	85.2x	51.0x
EV/EBIT	62.6x	38.7x	50.0x	22.7x	12.8x	601.8x	49.6x
EV/EBITDA	62.6x	38.7x	48.4x	21.7x	12.2x	312.9x	49.6x
EV/Sales	16.1x	13.5x	11.8x	6.3x	2.9x	5.7x	5.0x
FCF Yield	2.1%	2.0%	1.4%	3.9%	6.4%	0.0%	-7.7%
FY23e							
P/E	36.5x	33.0x	42.5x	26.6x	19.1x	53.5x	44.7x
EV/EBIT	31.8x	28.5x	31.9x	21.3x	14.2x	81.6x	41.5x
EV/EBITDA	31.8x	28.5x	31.2x	20.3x	13.4x	72.5x	41.5x
EV/Sales	9.8x	9.9x	8.6x	5.6x	2.8x	4.5x	4.6x
FCF Yield	1.7%	2.6%	1.8%	3.6%	4.7%	0.5%	1.7%

Source: Refinitiv, Morgan Stanley Research estimates. Note: Prices are as of the market close on September 23, 2022.

China's analog IC localization trend – An overview

Key assumptions driving our view

- The World Semiconductor Trade Statistics (WSTS) forecasts the global analog IC TAM to be US$90bn in 2022e, with China's analog IC TAM at US$37bn (or 41% of the global analog IC TAM). Considering China's analog IC self-sufficiency ratio is currently low, we see room for this to grow.
- According to WSTS, China's analog IC market was US$29bn in 2021, and we forecast the market to grow to US$47bn by 2025 and US$59bn by 2028. China's analog self-sufficiency ratio was only 6% back in 2017 (according to CSIA), and we estimate it expanded to 14% in 2021. As we expect China's analog self-sufficiency ratio will continue to expand to 20% in 2025 and 23% in 2028, it would imply local analog players' TAM would expand from US$4.1bn in 2021 to US$9.4bn in 2025 and US$13.8bn in 2028.
- China's analog IC market is dominated by the global leaders such as TI, ADI, and NXP, among others. The larger China analog IC design houses such as Silergy (<2%), SG Micro (~1%), Awinic (<1%), and Novosense (<1%) all have less than 5% market share.
- We believe local analog IC players will continue to increase China's self-sufficiency, as: 1) the technology gap with the global leading players is shrinking, 2) Covid-related supply-chain disruption has opened a window for high-end customers to adopt locally made analog IC chips, and 3) local vendors enjoy the benefit of proximity and can provide customized design/services to meet customer demand.
- We like those companies that are expanding more of their business into application-specific analog areas, and believe that those companies will become long-term beneficiaries of the localization trend in the analog IC market.
- In the past decade, China analog IC companies have gained share from general purpose (commodity) analog ICs as TI had exited the low-margin market, which then made it easier for the China analog IC companies to penetrate into the general purpose analog IC market.
- But, going forward, we suggest investors focus on analog IC companies that are working on application-specific markets, as those areas still have low self-sufficiency ratios, and thus generally have more room to grow, with better margin and higher entry barriers.
- We believe China analog IC players will increase their market share in the application-specific analog market, this is mainly because: 1) it is a fast-growing market; 2) there is greater demand for analog localization; and 3) a growing number of China analog IC companies are investing their R&D resources for industrial and automotive applications.
- Automobiles are a key application area for analog semis. We estimate that 15% of China's analog semiconductor consumption comes from the automotive industry. China's annual auto shipments are around 20mn, and we estimate semiconductor content per car is around US$520. This implies a China auto semi TAM of US$10.4bn. Usually one-half of auto semis are analog semis, as we assume analog per car is US$200-300, yielding a China auto analog semi TAM of US$5.20bn.

Our thoughts on Greater China analog IC share prices

What has been driving analog IC share prices YTD? How do Greater China analog IC companies stack up vs. their broader semi peers performance-wise?

Most Greater China analog IC companies' share prices have heavily corrected YTD (Silergy down 59%, uPI down 65%, Awinic down 52%, SG Micro down 30%, vs. TAIEX down 21% and Shanghai SEC Index down 14%). This is mainly due to these analog companies downward earnings revisions given weaker consumer electronic demand and lower ASP assumptions as analog ICs have turned into a buyer's market.

The magnitude of the share price pullback YTD is in-line with that of most other Greater China tech companies such as Mediatek (down 44% YTD), ASMedia (down 55%), Parade (down 65%), RichWave (down 58%).

What's currently in the price for Greater China analog IC companies?

We believe their share prices already price in the weaker consumer electronic cycle and the weaker analog IC pricing environment.

What's not priced in for Greater China analog IC companies? Where are we different from sell-side and buy-side consensus?

For the companies that work on general use purpose products, we think the market has not priced in the more severe pricing environment as well as the risk of inventory write-offs as the inventory level remains high.

For companies in application-specific areas, we think the market has not priced in the potential for self-sufficiency ratio expansion and for industrial/auto demand to grow.

Where could we be wrong?

1) worse-than-expected analog IC price competition

2) weaker-than-expected industrial and auto demand

Key stock calls

1) Initiate on Novosense at Overweight

- Novosense is dedicated to investing in application-specific areas
- Industrial (60% revenue contribution in 1H22) - tailwinds from solar, server, base station, and industrial automation localization demand
- Automotive (18% revenue contribution in 1H22) - large room for auto analog localization with high entry barriers

2) Initiate on Awinic at Underweight

- Awinic has 60-65% revenue exposure to smartphones
- Awinic's key growth driver is volume instead of value
- Lack of business momentum and relatively low investment in application-specific areas

3) Initiate on SG Micro at Equal-weight

- SG Micro is dedicated to investing in R&D, with the most comprehensive SKU portfolio among Greater China analog companies under our coverage
- We see upside potential from the iPhone business

1) Initiate on Novosense at OW – a rising star dedicated to industrial and auto applications

Novosense is dedicated to investing in application-specific areas: These areas include industrials and auto, which require long-term investments as it takes years for qualification and design. These areas have provided strong business growth opportunities for Novosense.

Industrials (60% revenue contribution in 1H22) – tailwinds from solar, server, base station, and industrial automation localization demand: The company provides analog IC products for power systems (customers here include server power and base station power companies), solar-related systems, and industrial control systems (customers here include Inovance).

Automotive (18% revenue contribution in 1H22) – large room for auto analog localization with a high entry barrier: Automotive has been a fast-growing business line for Novosense. Novosense stated during its 2Q22 analyst meeting that its analog IC product for autos is currently Rmb400 per car (vs. the current market opportunity for auto analog ICs at Rmb1,000 per car). In the long term, we expect the analog content value per car to expand to Rmb2,000-4,000 with higher EV adoption.

For further details see our initiation discussion here: Novosense: A rising star dedicated to industrial and auto applications; initiate at OW .

2) Initiate on Awinic at UW – Faces greater headwinds than peers

Awinic has 60-65% exposure to smartphones: Awinic's business is mostly from China smartphone brands, including OppO, Xiaomi, and Vivo. Although the smartphone market remains a large TAM, competition is also high, and the segment is entering a weaker cycle.

Awinic's key growth driver is volume, rather than value: Unit shipment is Awinic's main driver, not ASP hikes; the company is gaining market share by providing attractive pricing. We believe volume products could face stronger headwinds during a weaker cycle.

Lack of business momentum and relatively low investment in application-specific areas.

For further details, see our initiation discussion here: Awinic: Faces greater headwinds than peers; initiate at UW .

3) Initiate on SG Micro at EW – iPhone business leads to upside, but the analog cycle is our primary concern

SG Micro maintains strong investment in R&D, and has the most comprehensive SKU portfolio among Greater China analog companies: SG Micro has ~4,000 SKUs – much higher than levels at other China analog IC companies, such as Silergy (2,000-3,000), 3Peak (1,400), Novosense (1,100), and Awinic (800). The company targets to add an additional 400-500 SKUs per year going forward.

iPhone business creates business upside potential: Apple has been adding more China suppliers to its supply list, and iPhone 14 marks the first time that Apple has adopted SG Micro's analog product. SG Micro has been working on pin-to-pin product with Apple's existing analog IC supplier. We expect this effort will contribute 2-4% of SG Micro's total revenue in 2022. Apple's contribution to SG's revenue could grow to 10%+ in 2024 if Apple were to increase analog content value sourced from SG Micro from US$0.5-0.6 to US$2-3.

For further details see our initiation discussion here: SG Micro: iPhone business creates upside potential, but the analog cycle is our primary concern; initiate at EW .

We prefer Greater China analog companies with more exposure to application-specific areas

In the analog IC segment, we prefer companies that are expanding into the application-specific analog market; we expect such enterprises to achieve long-term success.

Within the Greater China analog IC companies that we cover:

- **Novosense (OW):** Has 60% revenue exposure to the industrial segment and 18% exposure to the automotive industry. We believe the company will enjoy a high entry barrier, as well as business tailwinds from the solar, server, base station, industrial automation, and EV segments.
- **SG Micro (EW):** Has 60-70% revenue exposure to the consumer electronics segment. Although the iPhone business might serve as a new business tailwind, SG Micro might not be immune to potentially weak end-demand.
- **Awinic (UW):** Has 60-65% revenue exposure to smartphones and 30% exposure to AIOT. We believe the company will face more competition during the weaker consumer electronics cycle.
- **Silergy (UW):** Has 60% revenue exposure to consumer electronics. In addition to the sluggishness in the overall consumer electronics segment, servers are also experiencing weaker demand.
- **uPI (UW):** uPI has a lot of exposure to PCs (60% of sales in 2021) and smartphones (10-15%). The weakness in consumer electronics demand leads to a vulnerable business outlook.

Exhibit 9: Greater China analog IC company revenue exposure

		By product			By end application						
Analog companies	Ticker	PMIC	Signal chain	Others	PC	Smartphone	TV	Server	Industrial	Auto	Others
Taiwan companies											
Silergy	6415.TW	90%	10%	0%	25%	5%	8%	3%	20%	5%	34%
uPI	6719.TW	70%	0%	30%	58%	12%	0%	18%	0%	0%	12%
Richtek	Under MTK (2454.TW)	60%	20%	20%	33%	43%	15%	1%	0%	0%	8%
GMT	8081.TW	100%	0%	0%	70%	0%	9%	0%	0%	0%	21%
Anpec	6138.TW	50%	0%	50%	73%	6%	8%	0%	0%	0%	13%
China companies											
SG Micro	300661.CH	68%	32%	0%	30%	30%	5%	0%	18%	4%	13%
Novosense	688052.CH	2%	98%	1%	8%	8%	0%	0%	60%	18%	6%
Awinic	688798.CH	35%	65%	0%	8%	65%	6%	0%	1%	1%	19%
3Peak	688536.CH	22%	78%	0%	0%	0%	0%	0%	35%	5%	60%
Chipsea	688595.CH	0%	18%	82%	5%	11%	5%	0%	36%	1%	42%
Chipown	688508.CH	100%	0%	0%	16%	16%	10%	0%	16%	0%	42%
Joulwatt	Private	Mainly	na	na	na	na	na	na	na	na	na
ChipOne	Private	Mainly	na	na	na	na	na	na	na	na	na
SouthChip	Private	Mainly	na	na	na	na	na	na	na	na	na
Global companies											
Texas Instrument	TI.O	na	na	na	23%	11%	1%	6%	36%	21%	2%
Analog Devices	ADI.O	na	na	na	13%	21%	0%	0%	50%	16%	0%
NXP	NXPI.O	na	na	na	0%	13%	0%	0%	22%	50%	15%

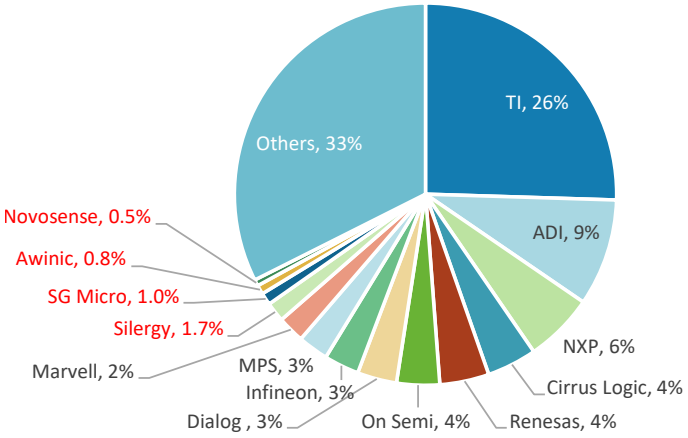
Source: Morgan Stanley Research. Note: Data as of 2022.

Exhibit 10: Greater China analog company valuation table

Ticker	Company	Closing Price	Rating	Price Target (LC)	Market Cap (US$mn)	EPS 2020	EPS 2021	EPS 2022e	EPS 2023e	EPS 2024e	P/E 2020	P/E 2021e	P/E 2022e	P/E 2023e	P/E 2024e	ROE 2020	ROE 2021e	ROE 2022e	ROE 2023e	ROE 2024e	Trading Volume (US$ mn)
China Companies																					
688052.SS	**Novosense**	290.50	**O**	**420.00**	4,148	0.7	2.9	4.3	8.0	12.7	427.2	98.5	66.9	36.5	22.9	23.3	50.9	74.1	88.7	71.3	47
300661.SZ	**SG Micro**	136.52	**E**	**170.00**	6,871	1.9	3.0	3.3	4.1	5.8	73.4	45.9	41.2	33.0	23.6	21.7	35.3	38.2	37.9	38.6	88
688536.SS	3Peak	253.50	E	313.00	4,282	2.8	5.5	4.4	6.0	7.0	89.6	46.0	57.5	42.5	36.1	13.2	15.4	15.4	17.8	17.8	52
688595.SS	Chipsea	37.19	U	33.00	735	1.1	0.9	0.4	0.7	1.1	33.8	39.6	85.2	53.5	35.4	15.8	10.4	5.6	9.3	12.7	24
688798.SS	**Awinic**	90.54	**U**	**75.00**	2,124	0.8	2.1	1.8	2.0	2.9	110.6	43.3	51.0	44.7	31.2	28.9	14.0	9.0	9.8	12.9	14
688508.SS	Chipown	56.00	NC	NA	895	0.9	1.6	2.2	3.2	4.3	63.5	34.6	24.7	17.2	12.8	11.3	12.5	14.6	17.2	19.1	28
Average											**133.0**	**51.3**	**54.4**	**37.9**	**27.0**	**19.0**	**23.1**	**26.1**	**30.1**	**28.7**	**42**
Taiwan Companies																					
6415.TW	Silergy	450.00	U	430.00	5,416	33.8	58.7	17.1	16.9	20.4	13.3	7.7	26.3	26.6	22.1	19.3	27.3	26.3	24.5	25.7	104
6719.TW	uPI	266.50	U	230.00	625	6.2	14.6	15.9	13.2	16.8	42.8	18.2	16.8	20.2	15.9	28.4	47.7	39.1	25.6	26.7	26
6138.TWO	Anpec	119.00	NC	NA	279	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29
8081.TW	GMT	131.50	NC	NA	359	11.4	25.5	26.9	17.1	NA	10.8	4.8	4.6	7.2	NA	20.4	42.7	NA	NA	NA	6
Average											**22.3**	**10.2**	**15.9**	**18.0**	**19.0**	**22.7**	**39.2**	**32.7**	**25.1**	**26.2**	**41**
Global Companies																					
6723.T	Renesas	1,305.00	O	2,000.00	17,703	64.9	120.4	198.1	185.8	219.6	20.1	10.8	6.6	7.0	5.9	7.4	14.3	22.4	18.2	18.8	102
NXPI.O	NXP	152.94	E	183.00	40,162	6.1	10.8	13.7	13.6	15.5	24.9	14.2	11.2	11.3	9.8	0.3	23.7	39.8	35.7	45.4	493
ADI.O	Analog Devices Inc.	154.18	E	173.00	72,995	5.0	6.5	9.5	9.4	9.7	30.6	23.9	16.3	16.5	16.0	10.3	5.6	6.9	6.7	7.0	602
ON.O	ON Semi	63.31	E	65.00	27,428	0.9	2.9	5.1	4.7	4.9	74.4	21.6	12.4	13.6	12.8	6.8	24.9	37.8	27.1	22.0	426
TXN.O	Texas Instrument	170.74	U	160.00	147,372	5.3	8.3	9.3	8.4	8.7	32.4	20.7	18.3	20.3	19.6	61.8	69.0	64.1	52.1	47.9	955
IFXGn.DE	Infineon	22.97	NC	NA	29,499	0.6	1.1	1.9	1.9	2.1	37.4	20.4	12.1	12.0	11.1	7.7	13.4	20.7	16.5	16.4	161
Average											**36.6**	**18.6**	**12.8**	**13.4**	**12.6**	**15.7**	**25.1**	**32.0**	**26.1**	**26.2**	**457**

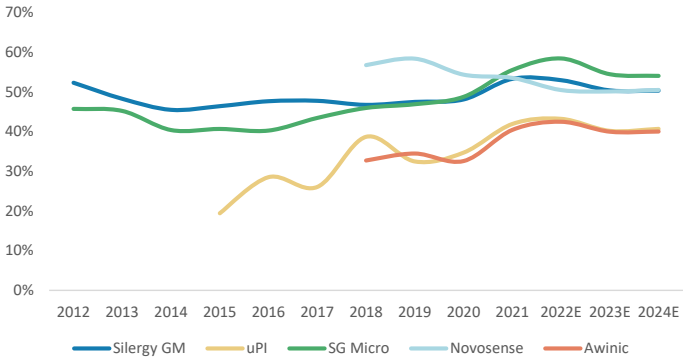
Source: Refinitiv, Morgan Stanley Research. E = Morgan Stanley Research estimates, Refinitiv consensus for noncovered ("NC") companies. Note: Prices are as of the market close on September 23, 2022.

Exhibit 11: Asia analog market share (2021)



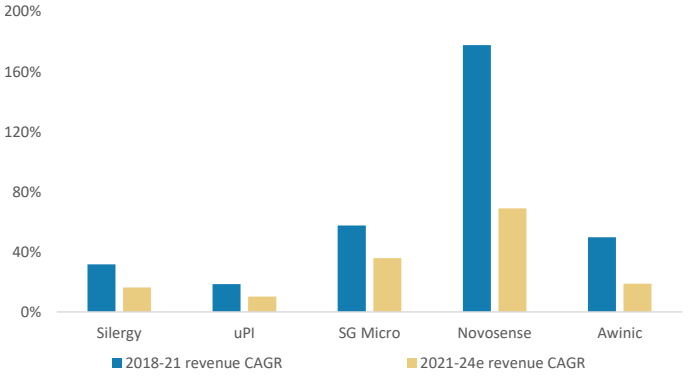
Source: Omdia, Morgan Stanley Research estimates.

Exhibit 12: GM comparison: Silergy, SG Micro and Novosense enjoy higher GM



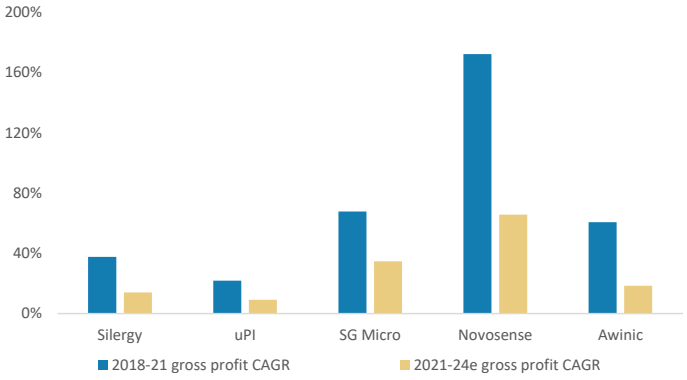
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 13: Revenue growth rate: We expect Novosense, SG Micro to enjoy stronger growth rates relative to peers during 2021-24



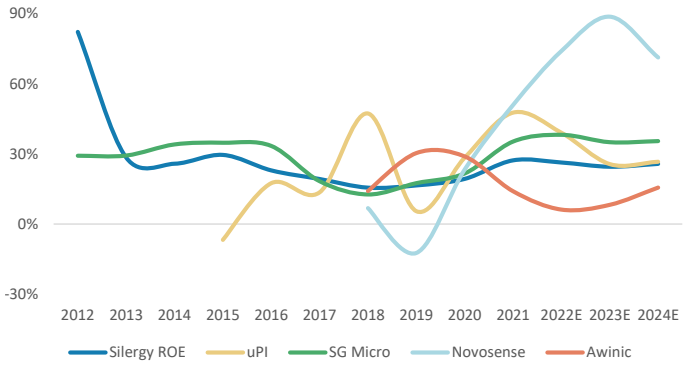
Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 14: Gross profit CAGRs



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 15: ROE comparison among Greater China analog companies



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

PEG valuation justifies our ratings

While our valuation methodology for our analog IC coverage is based on residual income models, we also believe PEG can help assess growth potential of IC design companies and their P/E valuation multiples (Exhibit 18).

The average PEG of Greater China IC design houses was roughly 1x in 2018-21. Looking into 2022 and 2023, we believe using 1x PEG is justified given our expectation that Greater China analog IC companies' earnings will achieve CAGRs of 30-50%.

Our price targets for Novosense (OW), SG Micro (EW), and Awinic (UW) are based on our RI (residual income) valuation methodology, and PE/PEG provides a cross-check for comparison across stocks and their history.

Novosense (OW; PT Rmb420) is trading at only 0.6x PEG: We expect Novosense's earnings to grow at a 71% CAGR, 2022-24, and its 2023e P/E is now 41x (based on our EPS estimate) – at the low end of its historical P/E band of 40-70x.

SG Micro (EW; PT Rmb170) is trading at 1.2x PEG: We expect SG Micro's earnings to grow at a 32% CAGR, 2022-24, and its 2023e P/E is now 38x (based on our EPS estimate) – at the middle of its historical P/E band of 20-80x.

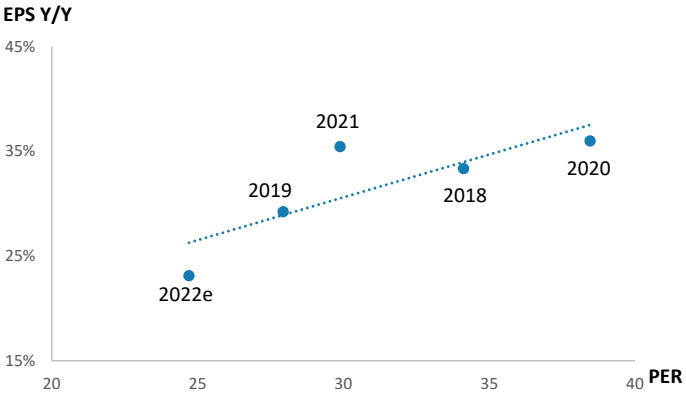
Awinic (UW; PT Rmb75) is trading at 1.8x PEG: We expect Awinic's earnings to grow at a 28% CAGR, 2022-24, and its 2023e P/E is now 51x (based on our EPS estimate) – at the low end of its historical P/E band of 50-150x. Although it is already at the low end, we believe the company will continue to de-rate.

Exhibit 16: Greater China IC design houses' historical average P/E multiple vs. average EPS growth

Greater China IC Design house	2018	2019	2020	2021	2022e
P/E	34	28	38	30	25
EPS Y/Y	33%	29%	36%	35%	23%
PEG	1.0	1.0	1.1	0.8	1.1

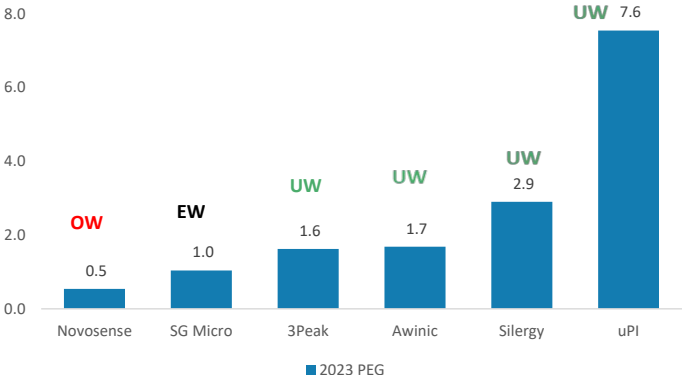
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 17: Greater China IC design houses' historical average P/E multiple vs. average EPS growth



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 18: Greater China analog company valuation table



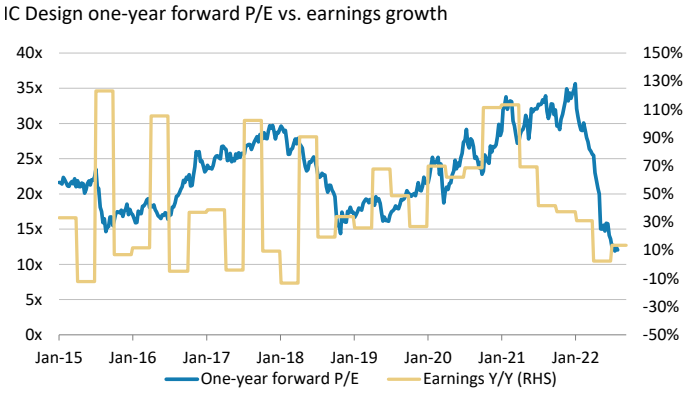
Source: Morgan Stanley Research. Note: Data as of September 23, 2022.

Most Greater China IC design house stocks have de-rated

Greater China IC design house P/E multiple is sensitive to earnings growth momentum and gross margin trend. Most Greater China IC design house stocks have de-rated over the past six months as a result of continuous downward earnings revisions and disappointing gross margin outlooks.

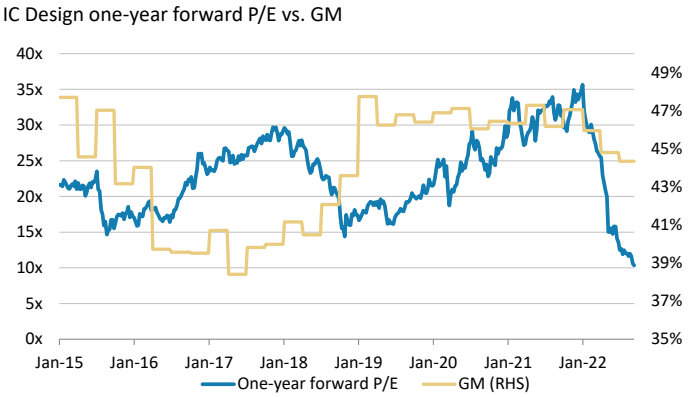
For fast-growing Greater China analog IC companies, we believe PEG ratios are instructive indicators of value. We believe that a 1x PEG should be sustainable, long term, as Greater China analog IC companies' earnings should grow at CAGRs of 30-50% – so 30-50x P/E multiples should be justifiable for these companies.

Exhibit 19: Greater China IC design – forward P/E vs. earnings growth



Source: Company data, Morgan Stanley Research estimates.

Exhibit 20: Greater China IC design – forward P/E vs. gross margin trend



Source: Company data, Morgan Stanley Research estimates.

Important note regarding economic sanctions. This research note references securities of entities named in Executive Order 14032 issued on June 3, 2021, amending Executive Order 13959. Executive Order 14032 may prohibit U.S. persons from buying certain securities of entities named in this note. The data set forth in this report is for informational purposes and does not represent Morgan Stanley's view as to whether or not any of the instruments discussed in this note are subject to sanctions. Any references in this report to entities, debt or equity instruments that may be covered by such sanctions should not be read as recommending or advising as to any investment activities in relation to such entities or instruments. Users of this report are solely responsible for ensuring that their investment activities in relation to any sanctioned entities and/or securities are carried out in compliance with applicable sanctions.

Important note regarding export controls. This note references entities named on the Entity List maintained by the U.S. Department of Commerce Bureau of Industry and Security (BIS). The Entity List may prohibit export, re-export or transfer (in-country) of certain items covered by the Export Administration Regulations (EAR). This disclaimer does not represent Morgan Stanley's view as to whether or not the export, re-export or transfer (in-country) of any items is subject to export controls laws. Investors are solely responsible for ensuring that their investment activities in relation to any entities are carried out in compliance with applicable export controls laws.

Analog ICs at a glance

An analog integrated circuit (IC) is a basic component in most electronic devices, the most basic circuit that is a part of a larger electronic circuit. Examples of analog integrated circuits are operational amplifiers, power management circuits, and sensors.

Analog ICs typically display long lifecycles, stable pricing, and use a mature node process.

- **Long lifecycle:** Unlike digital ICs, which often incorporate new designs for short lifecycle consumer electronics, analog IC products have long lifecycles (e.g., most of TI's product lifecycles are typically 10 to 15 years, and often extend longer). This is because analog IC function generally does not change dramatically over time; they are designed for long lifecycles and reliability, and therefore product quality is important.
- **Stable pricing:** As with logic circuits, analog lifecycles tend to be long, thereby fostering stable pricing vs. digital ICs (which might have very strong demand whenever there is a tech migration, or massive adoption for a certain smartphone model, etc.) and memory ICs (for which visibility is often lower than one quarter).
- **Requires experienced engineer:** The mindset of analog IC developers prioritizes long-term investment, as the analog IC product lifecycle is much longer than that of digital ICs. Analog IC R&D requires experienced engineers to convert real world signals into digital form. Analog IC players should continue to expand their product lines by investing in different applications and expanding SKUs.
- **Mature process nodes, mainly:** Analog ICs don't necessarily need to adopt the most advanced node semiconductor process (unlike digital chips, which do migrate for higher power efficiency, higher performance, smaller die size, etc). As such, most analog ICs rely on mature node foundry processes.

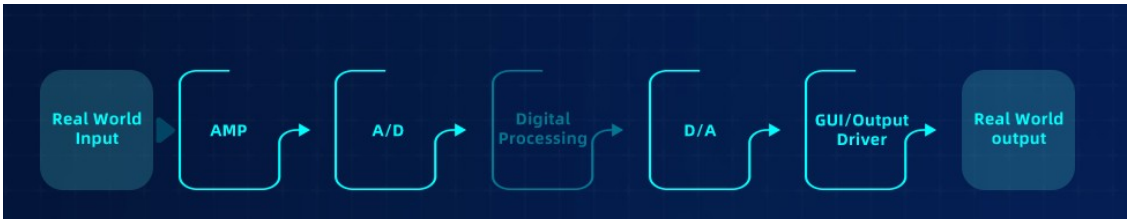
The key function for analog ICs is converting an analog signal to digital form. This introduces a low-level quantization noise into the signal due to finite resolution of digital systems, but, once in digital form, the signal can be transmitted, stored, or processed without introducing significant additional noise or distortion. An analog integrated circuit involves an output signal that follows a continuous input signal (Exhibit 21).

Analog can be classified into: 1) signal chain, and 2) power management ICs (PMIC)

According to WSTS, global analog ICs contributed 13.3% of the global semiconductor TAM in 2021. We expect the market to grow to US$94bn into 2023. We note two primary subdivisions within the analog sector: signal chain and PMIC:

- **Signal chain:** Signal chain ICs are integrated circuits that can receive, transmit, amplify, and filter analog signals. These are mainly used for complex applications that require the ability to service the longer lifecycles of some products. Please see Appendix (II): Signal Chain Industry.
- **PMIC:** Power management ICs are used to manage the power requirements of a host system, and such ICs include a wide range of chips. At the most basic level, PMICs take an input current/voltage and transform it into a required output to deliver the precise power needed to run a specific semiconductor. Please see Appendix (III): PMIC industry.

Exhibit 21: How does analog work?



Source: Morgan Stanley Research.

Exhibit 22: How does the analog process (signal chain and PMIC) work?

	Signal	Voltage	Function
Signal chain	Weaker signal	<6V	Information saving, signal receive and transact
PMIC	Higher voltage signal	220V	Power control and management

Source: Morgan Stanley Research.

Theme #1: China analog IC localization

We expect to see accelerating analog IC consumption in China. According to the WSTS, China's analog IC market was US$29bn in 2021, and we expect the market to grow to US$47bn by 2025 and US$59bn by 2028. China's analog self-sufficiency ratio was only 6% in 2017 (according to CSIA), and we estimate that it expanded to 14% in 2021. If we assume China's analog self-sufficiency ratio will continue to expand to 20% in 2025 and 23% in 2028, that implies China local analog players' TAM will expand from US$4.1bn in 2021 to US$9.4bn in 2025 and US$13.8bn in 2028.

China's analog IC market is still dominated by global leaders (e.g., TI, ADI, NXP); larger China analog IC design houses such as Silergy (<2%), SG Micro (~1%), Awinic (<1%), and Novosense (<1%) all have less than 5% market share in China. Covid-related supply-chain disruption has opened a window for high-end customers to adopt locally made analog IC chips.

We believe local analog IC players will continue to increase China's self-sufficiency, as:

- **The technology gap with global leading players is shrinking**
- **Covid-related supply-chain disruption has opened a window for high-end customers to adopt locally made analog IC chips**
- **Key component players enjoy market proximity, and can provide customized design/services to meet customer demand**

Why is China analog IC localization unique?

There are multiple semiconductor segments that benefit from China semiconductor localization demand, including semiconductor equipment, CPU, RF, power semi, MCU, and FPGA. Here, we highlight analog is because, in the past two years, analog IC demand has been strong, and global leading analog IDM players were suffering amid the Covid-induced production disruption. This has led to a faster rate of China analog IC companies garnering more business opportunities to expand to new customers. The top 5 China analog IC players are also continuing to invest in R&D to expand into niche markets.

We also think that high-end markets, such as industrial and automotive, are likely to continue to use more China local analog suppliers, as most China local industry and automotive companies are willing to adopt more components from the local supply chain, and those local analog IC players are improving their product quality to meet the requirements of such potential customers.

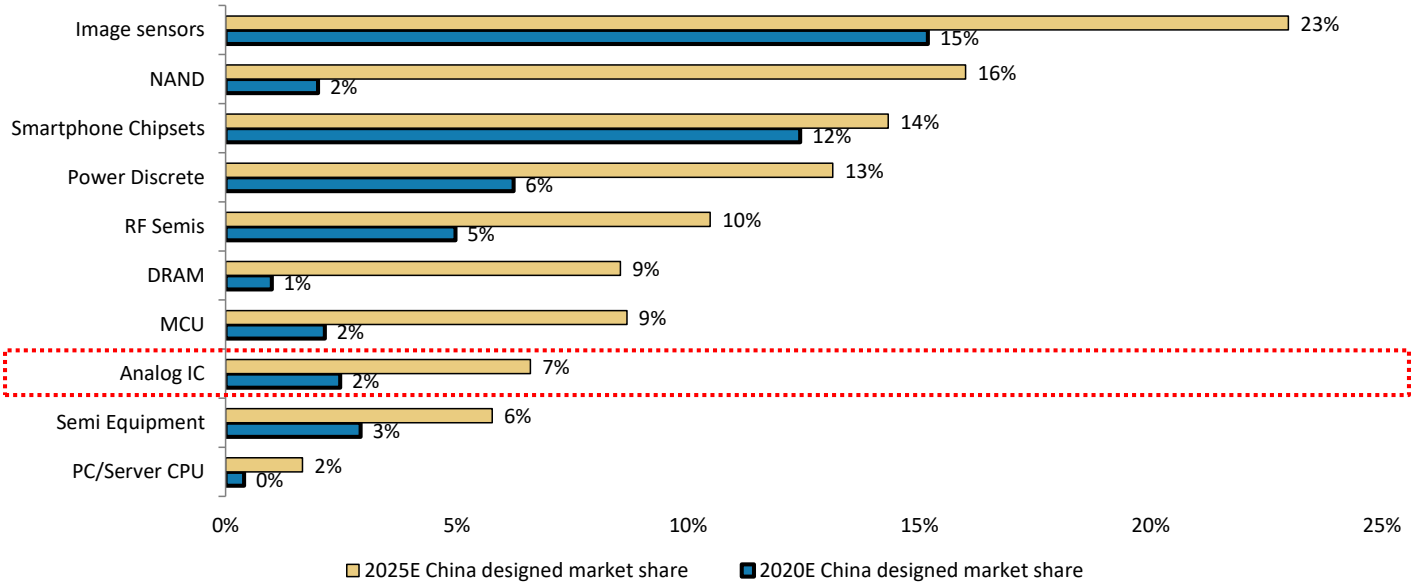
China analog IC players to grow faster than the local market

Local China analog IC self-sufficiency ratio was 10-14% in 2018-21: According to CSIA, China's analog self-sufficiency ratio was only 6% in 2017, and it expanded to 14% in 2021. We expect China's analog self-sufficiency ratio to further expand to 21% by 2028 (Exhibit 27).

We estimate analog IC demand in China was US$29bn in 2021 (Exhibit 24). However, similar to markets for many other semi devices, locally designed analog IC accounted for only 2-3% of the overall market, and the local sufficiency ratio was 10-14%. Chinese analog IC supply still relies heavily on overseas vendors, suggesting a large gap to achieve local self-sufficiency.

The China market represented 40% of global analog IC demand in 2021: According to WSTS, the global analog IC TAM is US$90bn in 2022e, and the China analog IC TAM is US$37bn (or 41% of the global level). Currently, China's analog IC self-sufficiency ratio remains low. Thus, we see room to increase China's self-sufficiency ratio (Exhibit 24).

Exhibit 23: China-designed semis' market share, 2020 vs. 2025 – We expect China's global market share to grow from 2% in 2020 to 7% in 2025



Source: Gartner, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 24: Global analog IC TAM

Global analog TAM (US$ bn)	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e
Total analog	**44.4**	**45.2**	**47.8**	**53.1**	**58.8**	**53.9**	**55.7**	**74.1**	**89.9**	**94.4**	**99.1**	**104.1**	**109.3**	**114.7**	**120.5**
General purpose analog	**18.2**	**18.6**	**19.5**	**21.8**	**23.6**	**22.5**	**23.2**	**30.1**	**36.9**	**38.7**	**40.6**	**42.7**	**44.8**	**47.0**	**49.4**
Amplifiers/ comparators (signal conditioning)	2.9	2.8	2.9	3.2	3.5	3.3	3.3	4.3							
Interface	2.0	2.0	2.1	2.1	2.2	1.9	2.1	2.8							
Power management	10.8	11.0	11.2	12.7	14.3	13.8	14.4	19.0							
Signal conversion	2.5	2.9	3.3	3.8	3.6	3.4	3.4	3.9							
Application specific analog	**26.2**	**26.6**	**28.3**	**31.3**	**35.2**	**31.5**	**32.5**	**44.0**	**53.0**	**55.7**	**58.5**	**61.4**	**64.5**	**67.7**	**71.1**
Consumer	1.9	1.8	2.2	2.3	2.4	2.0	2.1	2.9							
Computer	2.4	2.1	1.9	2.2	2.5	2.0	2.1	2.8							
Communication	12.8	13.9	14.1	15.5	17.6	15.3	16.5	22.9							
Automotive	6.6	6.6	7.7	8.6	9.6	9.5	8.9	11.7							
Industrial & others	2.5	2.1	2.5	2.6	3.1	2.8	2.8	3.7							

China analog TAM (US$ bn)	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e
Total analog	13.3	13.8	16.2	18.5	21.8	21.3	23.3	29.5	36.9	40.2	43.4	46.9	50.6	54.7	59.0
General purpose analog	6.3	6.8	8.0	8.6	9.7	10.4	11.4	14.4	18.1	19.7	21.3	23.0	24.8	26.8	28.9
Amplifiers/ comparators (signal conditioning)	.9	.9	12.3	1.0	1.2	1.3	1.4	1.7							
Interface	.6	.6	.8	.8	.9	.9	1.0	1.3							
Power management	4.1	4.6	5.2	5.8	6.6	7.1	7.7	10.2							
Signal conversion	.7	.7	.9	1.0	1.1	1.1	1.3	1.3							
Application specific analog	6.9	7.0	8.2	10.0	12.1	10.9	11.9	15.1	18.8	20.5	22.1	23.9	25.8	27.9	30.1
Consumer	.7	.7	1.0	1.1	1.4	1.3	1.3	1.8							
Computer	.7	.6	.7	.8	.8	.7	.8	1.1							
Communication	3.9	3.9	4.4	5.8	7.4	6.5	7.0	7.9							
Automotive	1.1	1.2	1.5	1.6	1.9	1.8	2.0	3.1							
Industrial & others	.6	.5	.6	.6	.6	.6	.7	1.0							

China market share	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023	2024e	2025e	2026e	2027e	2028e
China total analog global market share	**30%**	**30%**	**34%**	**35%**	**37%**	**40%**	**42%**	**40%**	**41%**	**43%**	**44%**	**45%**	**46%**	**48%**	**49%**
China general purpose analog market share	**35%**	**37%**	**41%**	**39%**	**41%**	**46%**	**49%**	**48%**	**49%**	**51%**	**52%**	**54%**	**55%**	**57%**	**59%**
Amplifiers/ comparators (signal conditioning)	31%	33%	426%	32%	33%	40%	41%	40%							
Interface	31%	32%	36%	36%	40%	46%	48%	46%							
Power management	38%	42%	47%	46%	46%	51%	54%	53%							
Signal conversion	27%	24%	28%	26%	30%	32%	38%	32%							
China application specific analog market share	**26%**	**26%**	**29%**	**32%**	**34%**	**35%**	**37%**	**34%**	**35%**	**37%**	**38%**	**39%**	**40%**	**41%**	**42%**
Consumer	36%	40%	45%	50%	57%	65%	63%	64%							
Computer	30%	30%	37%	35%	33%	35%	38%	40%							
Communication	30%	28%	31%	37%	42%	43%	42%	35%							
Automotive	16%	18%	19%	19%	19%	19%	23%	27%							
Industrial & others	24%	23%	23%	23%	21%	23%	25%	27%							

Source: WSTS, Morgan Stanley Research. E = Morgan Stanley Research estimates.

China's analog IC market is still dominated by global leaders (e.g., TI, ADI, NXP); larger China analog IC design houses, such as Silergy (<2%), SG Micro (~1%), Awinic (<1%), and Novosense (<1%), each have less than 5% market share in China: There are several global IDM vendors in the China market, including TI, ADI, NXP, Renesas, On Semi, and Infineon. Overall, China's self-sufficiency level is less than 15% (Exhibit 26).

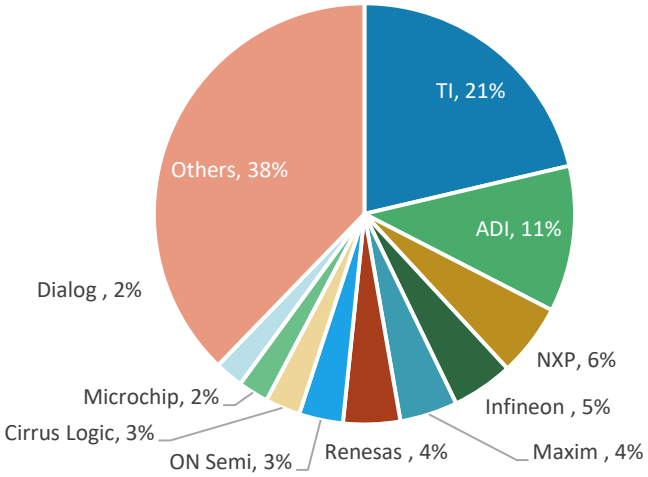
The China market, especially the high-end segment, is still dominated by overseas vendors because designing chips with high analog content is influenced by process technology and device structure, and most advanced analog chips today are made by overseas IDMs. On the other hand, most wafer foundry vendors previously focused on the logic side and can only provide general-purpose analog processes. Therefore, it would be more challenging for fabless analog IC design companies to differentiate their products and achieve better efficiency against IDMs.

That is a key reason why the high-end market is dominated by IDM players for analog ICs (including power management IC and signal chain). It was relatively difficult for fabless Chinese vendors to directly replace current analog ICs in the high-end analog segment (e.g., base stations and automotive) that require longer qualification periods and a strong foundry process. For other Chinese IDMs, most vendors also lack self-design capabilities in high-end chips.

However, we believe local analog IC players will continue to increase China's self-sufficiency, as:

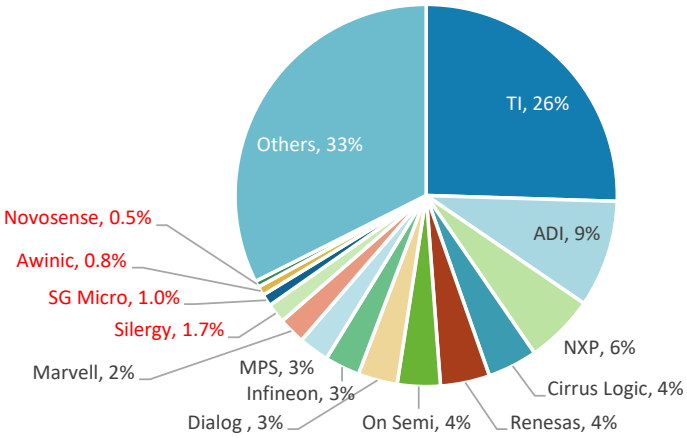
1. **The technology gap with global leading players is shrinking:** Chinese companies are already gaining share in midrange to low-end analog IC products, and we believe they will gain share in high-end applications, too, as their technology catches up.
2. **COVID-19 supply chain disruption opened a window for high-end customers to adopt China local analog IC chips:** Challenges have mounted since 2019 due to COVID-19, where supply chain disruption and shipping difficulties have increased, and supply and demand are mismatched. As such, global leading IDM players are not able to fully supply China local demand, and thus China-based OEMs and tier-1 players are more willing to source key components within China, as this should make it easier to procure such components in the future.
3. **Key component players enjoy market proximity, and can provide customized design/services to meet customer demand:** Local analog IC players can provide faster time-to-market service.

Exhibit 25: Global analog market share (2021)



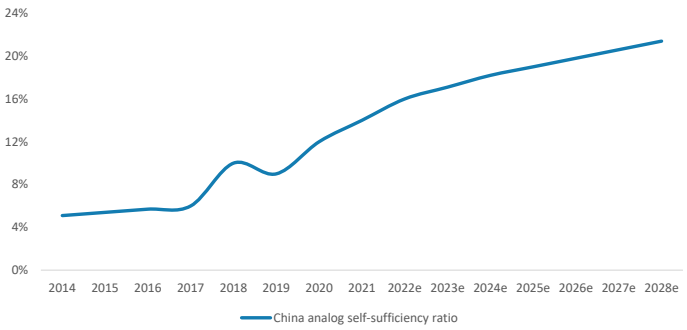
Source: Omdia, Morgan Stanley Research estimates.

Exhibit 26: Asia analog market share (2021)



Source: Omdia, Morgan Stanley Research estimates.

Exhibit 27: China analog self-sufficiency ratio

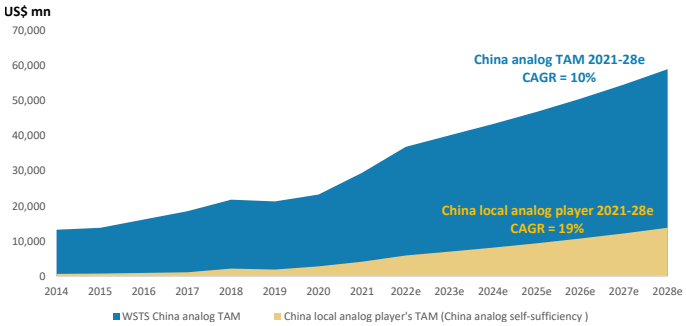


Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

As such, we believe China's power semi self-sufficiency rate will pick up, and we thus expect locally-designed power discrete semi market share to expand to 19% by 2025, up from 14% in 2021 (Exhibit 27).

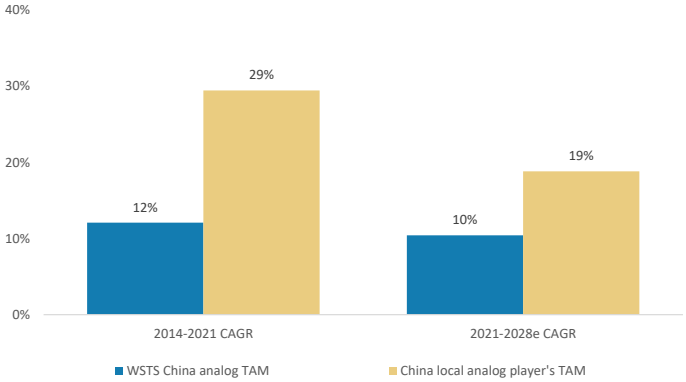
China local analog players to achieve a 19% revenue CAGR, 2021-28e: China's analog self supply ratio was less than 15% in 2021, and we expect it to reach 23% by 2028. This means that although the China analog TAM is expand at a 10% CAGR, 2021-28, China local analog players, because of the increasing self-supply ratio, should be able to enjoy a 19% revenue CAGR, 2021-2028e (Exhibit 28).

Exhibit 28: China local analog player's TAM: China local analog player's addressable market to enjoy a 19% CAGR, 2021-28e



Source: CSIA, WSTS, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 29: We expect China local analog players' TAM to rise at a 19% CAGR, 2021-28e



Source: CSIA, WSTS, Morgan Stanley Research. E = Morgan Stanley Research estimates.

What is driving the higher self-sufficiency rate? China's government's "new infrastructure" stimulus and booming China industrial and auto industries should boost local power semi demand:

The "new infrastructure" initiative introduced by China's government is likely to serve as a tailwind for power semi demand. The government announced that it would accelerate "new infrastructure" projects to offset the economic impact caused by COVID-19. This includes projects in emerging areas such as 5G base stations, the industrial internet of things (IIoT), artificial intelligence, data centers, ultra-high voltage, intercity high-speed railways and rail transit, and electrical vehicle charging stations. We expect all of these to increase the demand for analog ICs and create incremental addressable markets for the local analog IC supply chain.

On the other hand, China's booming industrial and automotive industry also leads to larger demand for analog, with local industrial/auto brands being more willing to adopt analog IC components from the local supply chain to increase efficiencies.

China's self-sufficiency rate for local analog IC demand to reach 20% by 2025

Based on our proprietary framework, we estimate the deficit of Chinese analog IC supply and demand was 86%, or US$25bn, in 2021 (leaving just 14% supplied locally). This indicates that the addressable market for the China analog IC supply chain is indeed significant. We forecast that China's self-designed analog IC market penetration will rise from 6% in 2017 to 20% in 2025, thanks to the country's continued semi localization efforts across the supply chain. In a previous AlphaWise survey we noted that Chinese component vendors perceive complementary metal oxide semiconductors (CMOS) sensors and power discrete as the areas where it will be easiest to replace global vendors.

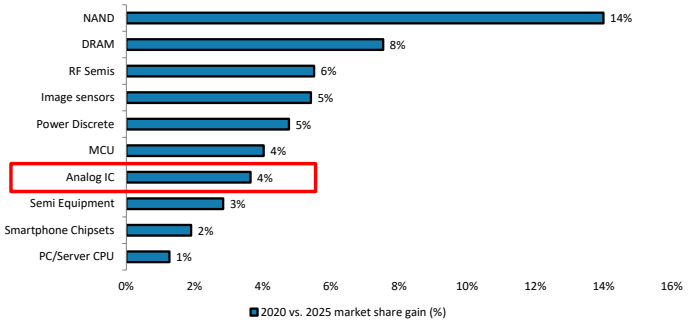
Given ongoing US-China trade tensions, we still expect China's local analog IC suppliers to gradually penetrate the market and gain share, starting from commodity parts, at least for the incremental demand, in the next couple of years. Given China's localization efforts, government-led infrastructure projects would most likely prefer Chinese vendors. China OEMs' in-sourcing could also gradually materialize, starting from the lower-end of the market, if the performance gap of local devices against global counterparts can be effectively narrowed.

China's analog IC supply chain

Despite a relatively low market share today, Chinese vendors should, we expect, gradually gain share, starting from lower-end commodity products, and further expand to the high-end applications, such as industrial and automotive. In fact, several local analog IC companies have established a footprint in some areas after their respective product performance proved reliable.

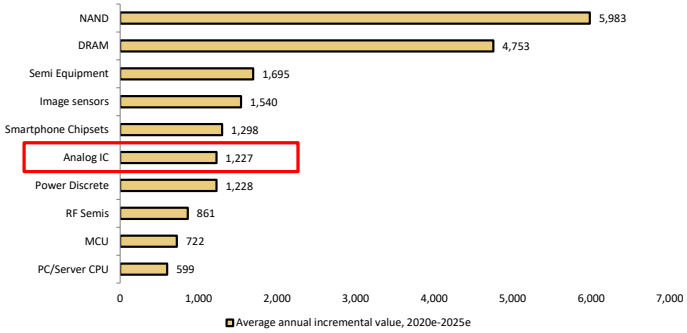
For analog IC, we forecast Chinese-designed analog IC to reach 9% global market share in 2025e. We forecast analog IC to rank as the seventh most disrupted semiconductor market by Chinese vendors' share gains through 2025 (Exhibit 30). Given the rising semi need to find local semi substitutes due to ongoing US-China trade tensions, we expect the most disruption to be in the NAND flash and DRAM markets, followed by RF semis, image sensors, power discretes, MCU, and analog IC. We forecast market share gains in analog IC to translate into an average US$1.2bn value shift per annum to Chinese vendors in 2020-25, which presents ample room for China's analog IC companies to grow over the next few years.

Exhibit 30: Gains in China-designed semi market share



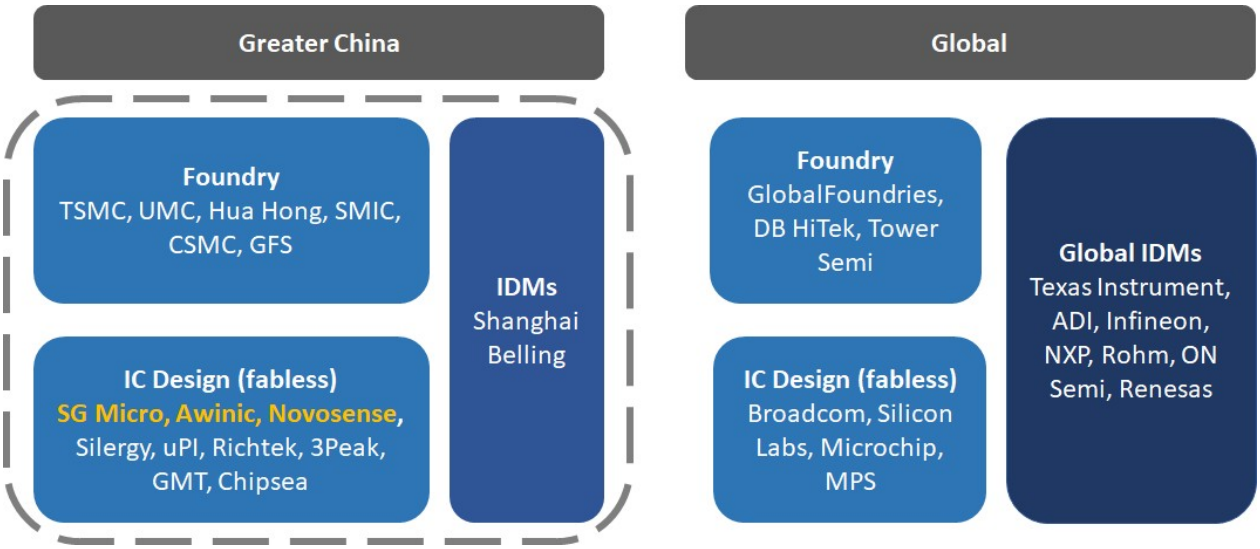
Source: Gartner, company data, Morgan Stanley Research estimates.

Exhibit 31: Average annual gains for China-designed semi by device (in US$mn)



Source: Gartner, company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 32: Analog supply chain



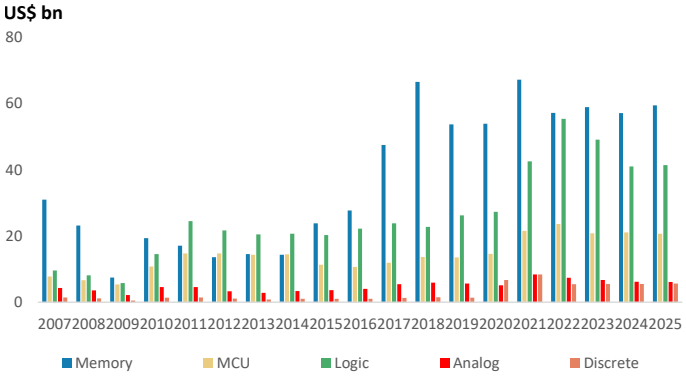
Source: Morgan Stanley Research.

China has been investing more in analog IC

According to Omdia, a third-party research firm, global analog IC capex is US$7.4bn in 2022, with US$1.4bn (or 19%) of this from China (Exhibit 35). China has a higher share in investing in the analog IC industry (China capex spending as a portion of global total capex spending by different end-application), vs. other semiconductor end-applications that have a relatively lower share of spending (for example, Memory is a leading capex in South Korea, while Logic leads in Taiwan).

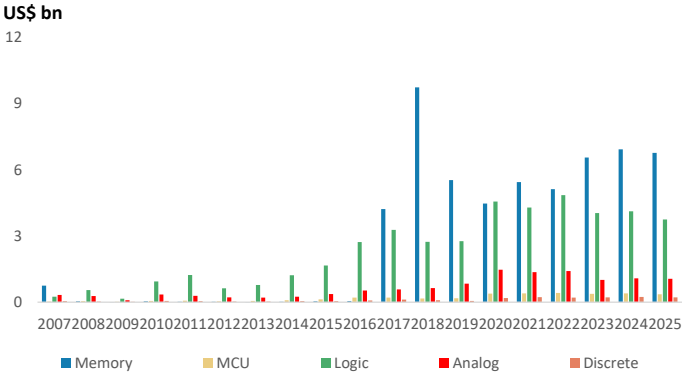
With a relatively high investment in the analog IC industry, we believe China's analog market should outgrow the global TAM, and thus the analog IC key players should grow at a faster speed.

Exhibit 33: Global semiconductor capex of US$149bn in 2022; US$7bn (or 5%) is for the analog industry



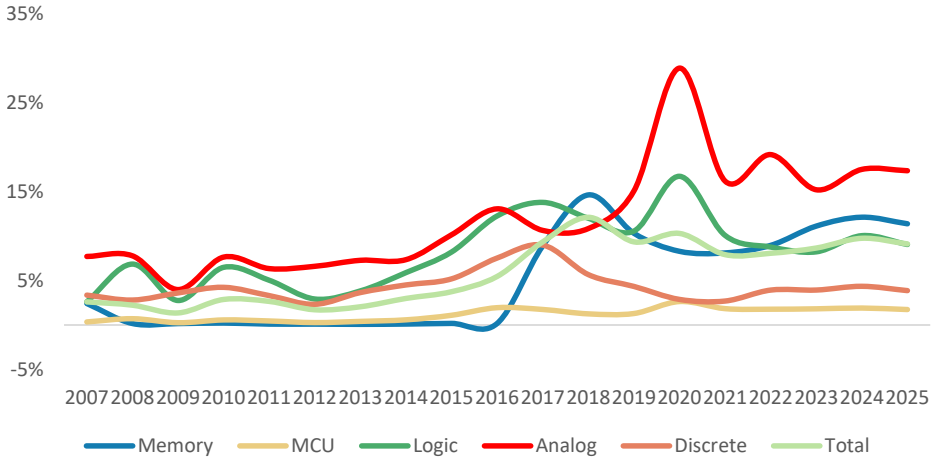
Source: Omdia, company data, Morgan Stanley Research estimates.

Exhibit 34: China semiconductor capex of US$12bn in 2022; US$1.4bn (or 12%) is for the analog industry



Source: Omdia, company data, Morgan Stanley Research estimates.

Exhibit 35: China has a higher share of investing in the analog IC industry (China capex spending as a percentage of global total capex spending, by different end-application), vs. other semiconductor end-applications that have a relatively lower share of spending



Source: Omdia, Morgan Stanley Research.

Theme #2: Focus on companies dedicated to application-specific areas, such as industrial or automotive

We prefer companies that are expanding into the application-specific analog market, and we believe those companies have greater success potential for the long term.

In the past decade, China analog IC companies have gained share from general purpose (commodity) analog ICs as TI had exited the low-margin market, which then made it easier for the China analog IC companies to penetrate into the general purpose analog IC market.

But, going forward, we suggest investors focus on analog IC companies that are working on application-specific markets, as those areas still have low self-sufficiency ratios, and thus generally have more room to grow, with better margin and higher entry barriers.

We believe China analog IC players will increase their market share in the application-specific analog segments, mainly because:

1. **application-specific analog market is fast growing;**
2. **there is more demand for analog localization; and**
3. **we see more China companies invest in R&D resources for industrial and automotive applications**

Be selective in Asia analog players: There are higher entry barriers for the automotive and industrial segments; we believe the breakthrough technologies at Asian analogs are creating new opportunities.

We believe that analog IC players dedicated to application-specific areas will thrive, long term

Global analog TAM to grow to US$121bn by 2028

Global analog TAM is around US$90bn in 2022, and we expect the global analog TAM to achieve a 5% CAGR, 2021-28, to US$121bn in 2028 (Exhibit 37). Within the total analog market, 41% is for general purpose analog and 59% is for application-specific analog.

Examining the application specific analog market, we see that automotive (2009-21 CAGR = 11%) and industrial (2009-21 CAGR = 7%) outgrow other application-specific analog business lines (Exhibit 38).

China is increasingly important for the global analog market

China has been increasingly important for global analog demand. The China market contributed only 30% of global analog demand in 2014, but reached 41% in 2022, and we expect it to further increase to 49% in 2028.

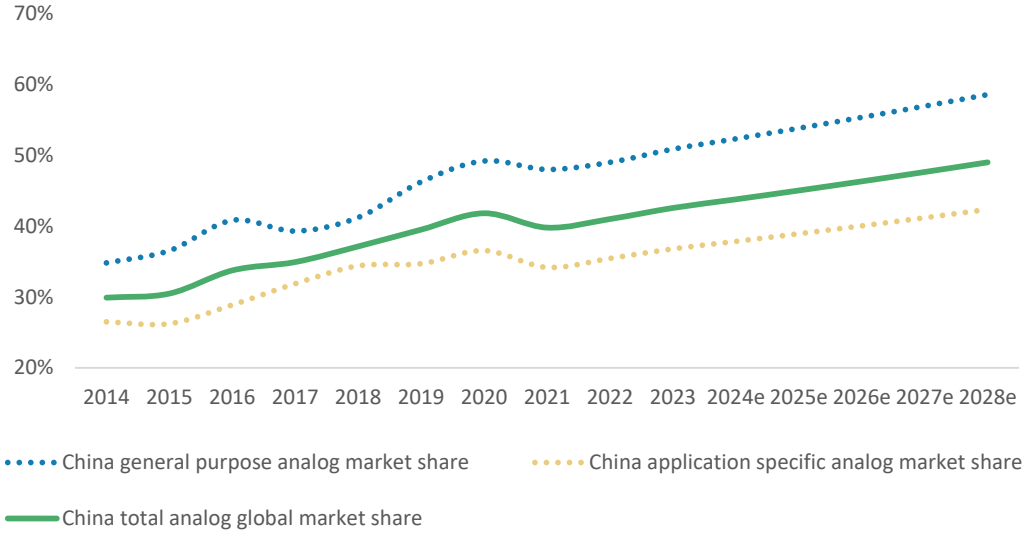
By segment, China has a higher market share in the general purpose analog market (Exhibit 36); this is because global leading Tier 1 analog companies (e.g., TI, ADI, NXP, Infineon, Maxim, ON Semi) have less focus on the lower-margin, general purpose segment – it is more like a commodity product with limited value-add, and the global leading Tier 1 analog players focus most of their resources to serve application-specific analog customers.

We believe that China analog IC players will increase their market share in the application-specific analog market

This is mainly because: 1) the application-specific analog market is fast growing, 2) there is more demand for analog localization, and 3) we see more China companies invest in R&D resources for industrial and automotive applications (Exhibit 36).

We prefer companies that are expanding into the application-specific analog market, and we believe those companies have greater success potential for the long term.

Exhibit 36: China is an increasingly important market for global analog industry



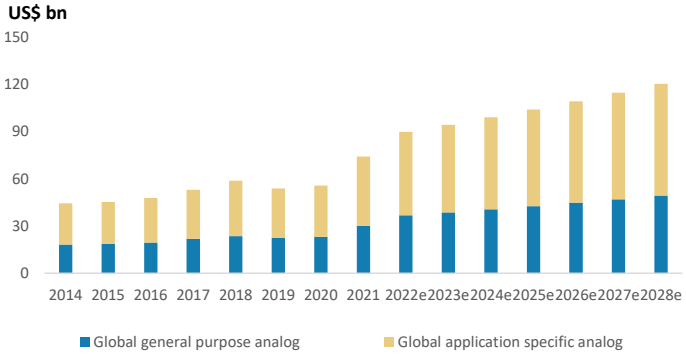
Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

China analog TAM to grow to US$59bn by 2028; we expect automotive and industrial to outgrow the China total analog market during 2022-28

The China analog TAM is around US$37bn in 2022 (or 40% of global market share), according to WSTS, and we forecast it achieve a 10% CAGR, 2021-28, to US$59bn in 2028 (Exhibit 39). Within the total China analog market, 49% is for general purpose analog and 51% is for application-specific analog.

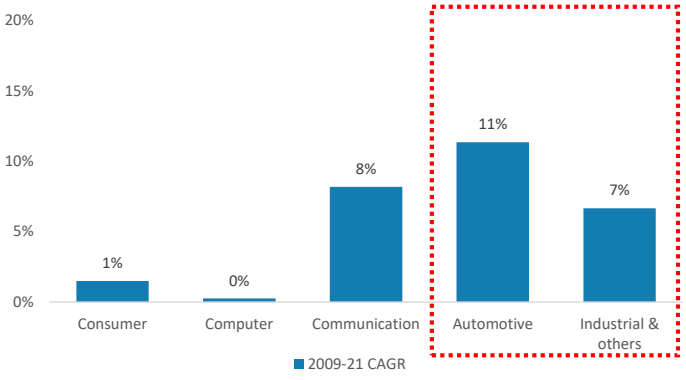
Examining China's application-specific analog market, we see that automotive (2009-21 CAGR = 17%) and industrial (2009-21 CAGR = 7%) demand has been strong; we believe automotive and industrial should continue to outgrow the market during 2022-28, as there is more analog localization demand from those high-end markets (Exhibit 40). Although the consumer and communication segments were also fast growing in 2009-21, that stemmed mainly from strong growth in China smartphone demand and base station infrastructure deployment; we think such growth will gradually slow, as those demands become saturated.

Exhibit 37: Global general purpose analog TAM vs. application-specific analog TAM



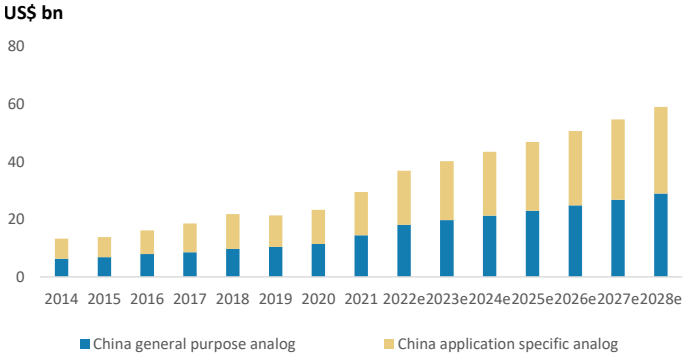
Source: Omdia, Morgan Stanley Research. E = Morgan Stanley Research estimates. Note: Underlying metric: revenue.

Exhibit 38: Global application-specific analog growth, by application (2009-21 CAGR)



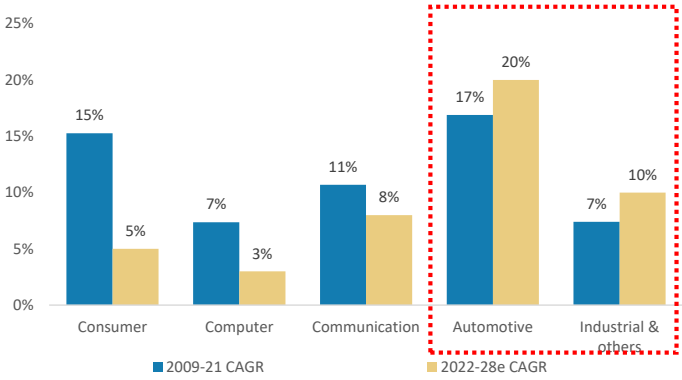
Source: Omdia, Morgan Stanley Research. Note: Data as of 2021. Underlying metric: revenue.

Exhibit 39: China general purpose analog TAM vs. application-specific analog TAM



Source: Omdia, Morgan Stanley Research. E = Morgan Stanley Research estimates. Note: Underlying metric: revenue.

Exhibit 40: China application-specific analog growth, by application (2009-2021 CAGR vs. 2022-28 CAGR)



Source: Omdia, Morgan Stanley Research. E = Morgan Stanley Research estimates. Note: Underlying metric: revenue.

We prefer companies with more exposure to automotive and industrial

Entry barriers are higher for automotive and industrial; we believe the breakthrough technologies at Asian analog IC makers are creating new opportunities

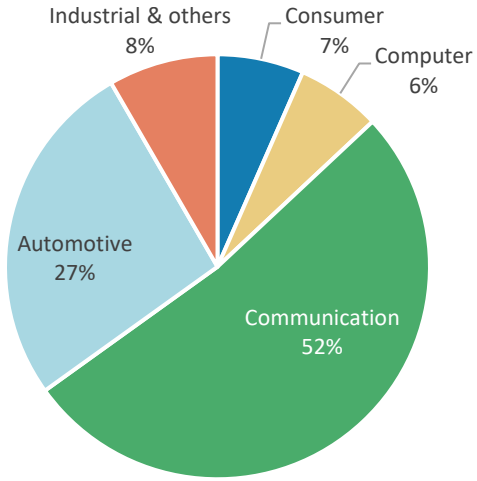
We believe automotive and industrial will continue to be the high margin markets with higher entry barriers for analog companies, as these segments require more R&D investment and tend to be more difficult spaces in which to qualify as a supplier. We believe the companies that dedicate investment in automotive and industrial applications are, in general, more likely to garner stronger success, long term. Application-specific analog should be the future key business development area, in our view, as clients in that segment tend to have higher stickiness with those analog IC suppliers.

We list (Exhibit 43) a table of those Greater China analog/ PMIC companies, with revenue breakdown by end-application. Novosense (OW) has the highest exposure to industrial and auto, while Awinic (UW) has most exposure to smartphones (Exhibit 43).

Be selective in Asian analog IC makers

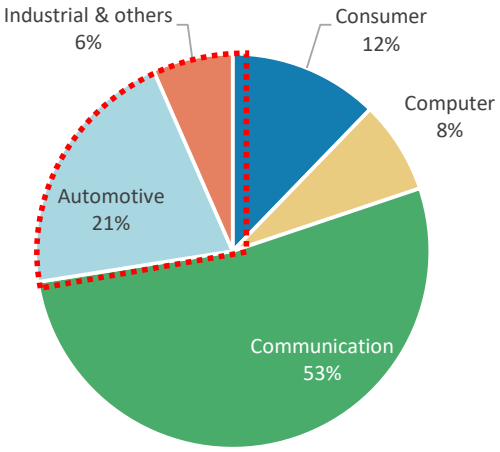
Competition in the analog IC industry remains tough, given the strength of the US IDMs. We believe the key factors for success for Asian analogs are: **1)** owning process technology, **2)** diversification from the PC-centric and smartphone-centric markets, and **3)** solid relationships with global OEMs and/or strength in the China market.

Exhibit 41: Global application-specific analog breakdown, by application



Source: Omdia, Morgan Stanley Research. Note: Data as of 2021. Underlying metric: revenue.

Exhibit 42: China application-specific analog breakdown, by application



Source: Omdia, Morgan Stanley Research. Note: Data as of 2021. Underlying metric: revenue.

Exhibit 43: Greater China analog IC company revenue exposure

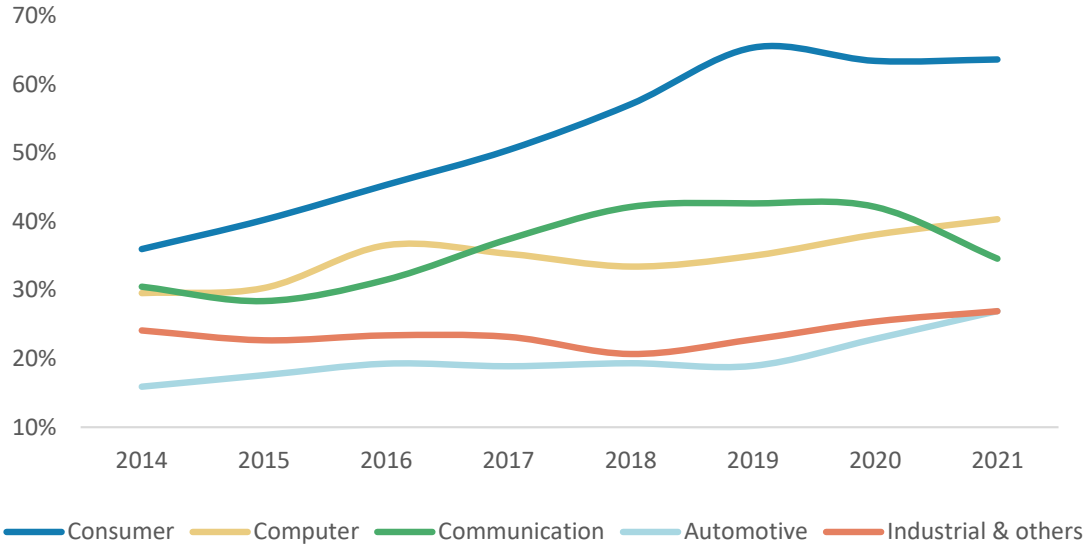
Analog companies	Ticker	By product			By end application						
		PMIC	Signal chain	Others	PC	Smartphone	TV	Server	Industrial	Auto	Others
Taiwan companies											
Silergy	6415.TW	90%	10%	0%	25%	5%	8%	3%	20%	5%	34%
uPI	6719.TW	70%	0%	30%	58%	12%	0%	18%	0%	0%	12%
Richtek	Under MTK (2454.TW)	60%	20%	20%	33%	43%	15%	1%	0%	0%	8%
GMT	8081.TW	100%	0%	0%	70%	0%	9%	0%	0%	0%	21%
Anpec	6138.TW	50%	0%	50%	73%	6%	8%	0%	0%	0%	13%
China companies											
SG Micro	300661.CH	68%	32%	0%	30%	30%	5%	0%	18%	4%	13%
Novosense	688052.CH	2%	98%	1%	8%	8%	0%	0%	60%	18%	6%
Awinic	688798.CH	35%	65%	0%	8%	65%	6%	0%	1%	1%	19%
3Peak	688536.CH	22%	78%	0%	0%	0%	0%	0%	35%	5%	60%
Chipsea	688595.CH	0%	18%	82%	5%	11%	5%	0%	36%	1%	42%
Chipown	688508.CH	100%	0%	0%	16%	16%	10%	0%	16%	0%	42%
Joulwatt	Private	Mainly	na	na	na	na	na	na	na	na	na
ChipOne	Private	Mainly	na	na	na	na	na	na	na	na	na
SouthChip	Private	Mainly	na	na	na	na	na	na	na	na	na
Global companies											
Texas Instrument	TI.O	na	na	na	23%	11%	1%	6%	36%	21%	2%
Analog Devices	ADI.O	na	na	na	13%	21%	0%	0%	50%	16%	0%
NXP	NXPI.O	na	na	na	0%	13%	0%	0%	22%	50%	15%

Source: Morgan Stanley Research. Note: Data as of 2022.

China's automotive and industrial market share remains low - substantial opportunity to gain share

For the application-specific analog market, China has high market share in the consumer segment, but lower market share in automotive and industrial; we believe there is significant market potential for analog IC companies that are willing to invest in the automotive and industrial arenas (Exhibit 44).

Exhibit 44: For the application-specific analog market, China has high market share in the consumer segment, but lower market share in automotive and industrial



Source: CSIA, Morgan Stanley Research estimates.

What is important for a successful analog IC provider? Which companies are more likely to see strength, long term?

Key success factors for analog IC makers: As analog IC competition remains intense, we think companies with the following features are the best positioned to be long-term winners:

1. Owning both analog process and design: It was fine for fabless analog IC companies to use standard process from wafer foundries. However, given the difficulty in achieving differentiation in just chip design, companies also need to own a process, in our view, although they don't necessarily need to own a fab.

2. Right end-market exposure – expanding into the application-specific market: Companies need to diversify away from the shrinking PC power IC, mobile device, LED, and battery management markets, in our view. We think exposure to industrial/automotive/server can support better growth, although the barriers to entry for some segments are also higher.

3. Access to top OEMs or to China market: Companies that can serve such top OEMs, such as Apple, Samsung, HP, and Dell, have greater potential to achieve a higher ASP and larger volume, in our view. We think proximity to China customers is also important today, as it is the largest end-market.

4. Low operating costs – leading to better cash flow and profitability: Companies based in Asia have some advantage in the cost of labor, utilities, and even tax. For US IDMs, pursuing a fab-lite model by outsourcing to Asian foundries is now a choice if the cost for a new fab is high.

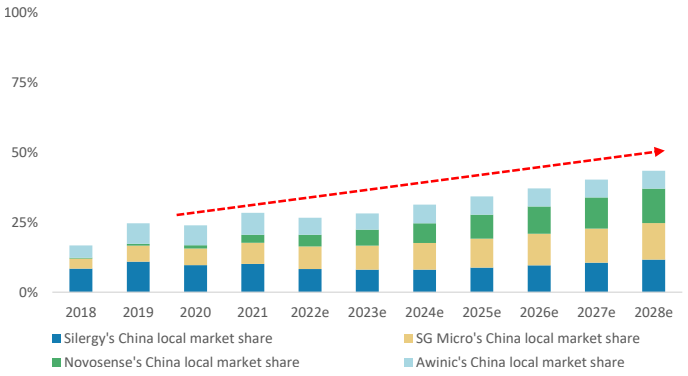
5. Better customer support: Customers need second or third sources for analog ICs – to reduce the risk of component shortage. Asian companies that don't have strong technology or competitive costs still have a chance to win projects by providing better customer support as the second or third source.

We believe China's leading analog players will continue to gain market share in the China domestic market in the long run

We project that China's analog IC TAM will achieve a 10% CAGR, 2021-28 (Exhibit 28), while, with the increasing China analog self-sufficiency ratio (expanding to 23% by 2028 from 16% in 2022, vs. 6% back in 2017; Exhibit 27), we expect the addressable market for those China local analog players' TAM to rise at a CAGR of 19%, 2021-28e.

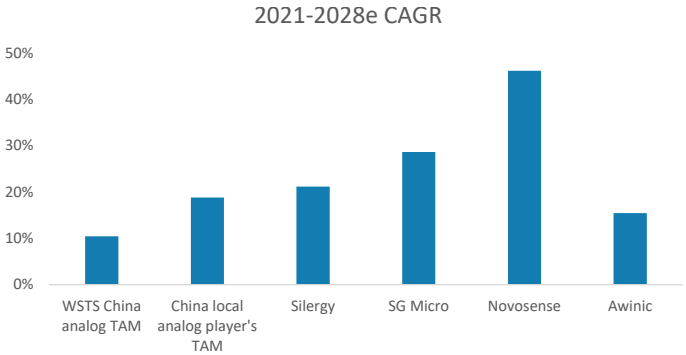
We expect key China local analog players to continue to gain market share in China. This is common in the analog industry – that the leading company dominates the market (ex: TI), as only the leading company can provide comprehensive solutions and SKUs to meet customer demand. The larger company also has more recourse to invest for new product lines. We expect key China analog players, such as Silergy, SG Micro, Novosense, to outgrow the China TAM (Exhibit 46), while Awinic might grow slower than the China local analog TAM, as it has high exposure to the slowing smartphone market.

Exhibit 45: We expect key China local analog players to continue to gain market share in China



Source: CSIA, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 46: 2021-2028 CAGR comparison for key China analog players



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Theme #3: China auto analog semi localization demand

Automobiles are a key application area for analog semis. We estimate that ~15% of China's analog semiconductor consumption comes from the automotive segment.

We expect the global auto semi TAM to rise at a 10% CAGR, 2020-26, mainly driven by a 7% CAGR in semi content per car – spurred by rising EV and autonomous driving penetration rates.

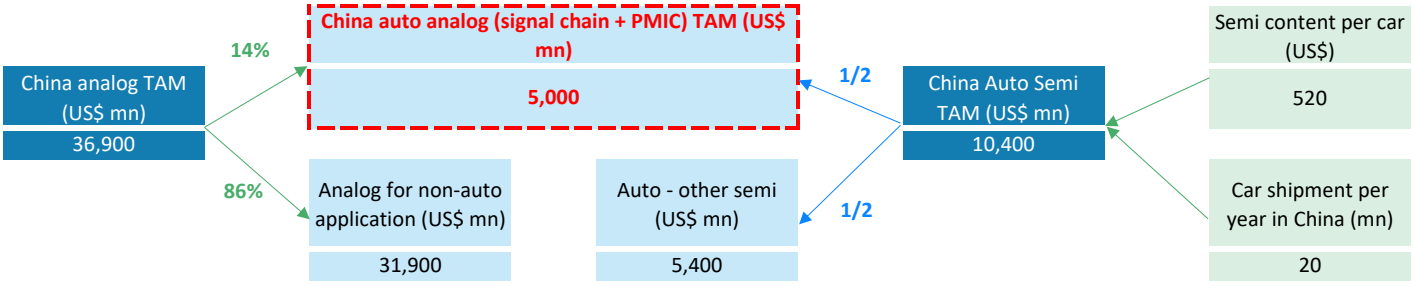
- **EVs require more high-voltage power management components**
- **Autonomous driving needs more semiconductor content to enhance performance**

China auto analog semi TAM of US$5.0bn

We estimate that ~15% of China's analog semis (including signal chain and PMIC) consumption is from automotive applications. As we estimate the China analog semi TAM should be around US$36.9bn in 2022 (Exhibit 24), this implies a China auto analog semi TAM of US$5.0bn (Exhibit 47).

China's annual auto shipments are around 20mn, and we estimate semiconductor content per car is around US$520. This implies a China auto semi TAM of US$10.4bn. Usually half of auto semis are analog semis, as we assume analog per car is US$200-300, yielding a China auto analog semi TAM of US$5.0bn.

Exhibit 47: Quantifying China's auto analog semi business opportunity

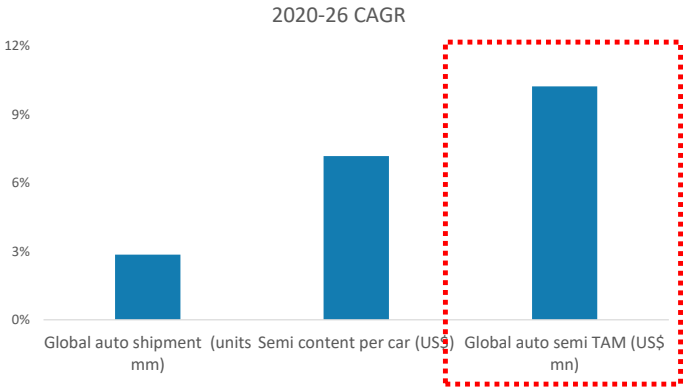


Source: Morgan Stanley Research estimates.

Auto semi TAM: Rising at a 10% CAGR, 2020-26

We expect the global auto semi TAM to rise at a 10% CAGR in 2020-26, mainly driven by increasing semi content per car (7% CAGR; Exhibit 48). We estimate semiconductor content per car will increase to US$784 by 2026, 52% higher than US$517 today. This is mainly driven by a faster EV penetration rate and a higher autonomous driving penetration rate.

Exhibit 48: We expect the global auto semi TAM to rise at a 10% CAGR in 2020-26, mainly driven by increasing semi content per car (7% CAGR during the period)



Source: IHS, Morgan Stanley Research estimates.

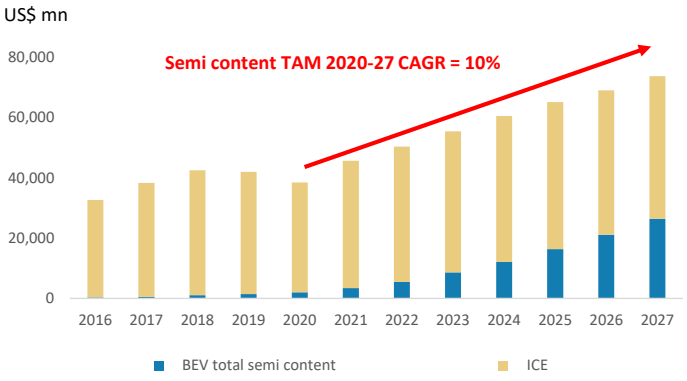
EV and autonomous driving require more power semis

Rising penetration rates of EVs and autonomous driving are boosting the semiconductor content per car. Power management IC and power discrete uses in the automotive segment include communication modules, infotainment, and ADAS systems. Our autos team estimates the battery electronic vehicle (BEV) penetration rate will reach 20% by 2027, up from 3% in 2020 (Exhibit 49). We also expect that 23% of auto shipments will be above level 3 autonomous driving by 2027, up from 3% in 2020 (Exhibit 52).

EVs require more high-voltage power management components: EV adoption is pushing power semiconductor levels per car higher, as there are now more high-voltage applications, including inverters, converters, on-board chargers, battery blocks, battery management systems, and charging infrastructure. These components drive additional demand for MOSFET, power management IC, and IGBT.

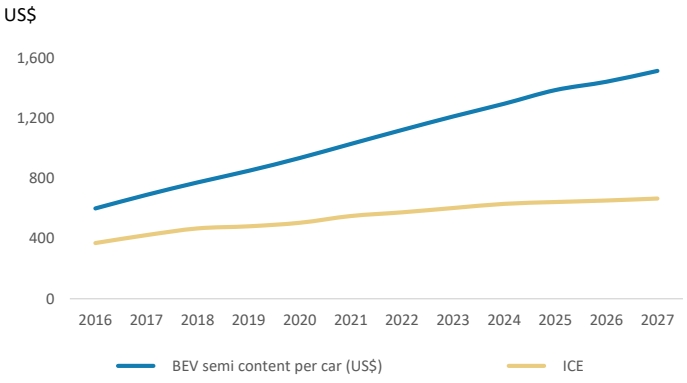
During its 4Q20 earnings call, Silergy's management team noted that current analog semiconductor content is US$200 per car, and it should reach US$600 for EVs by 2024, and thus global auto analog semiconductor TAM should expand from US$20bn to US$40bn over the next 3-5 years.

Exhibit 49: Global auto semi TAM breakdown, by BEV/ICE



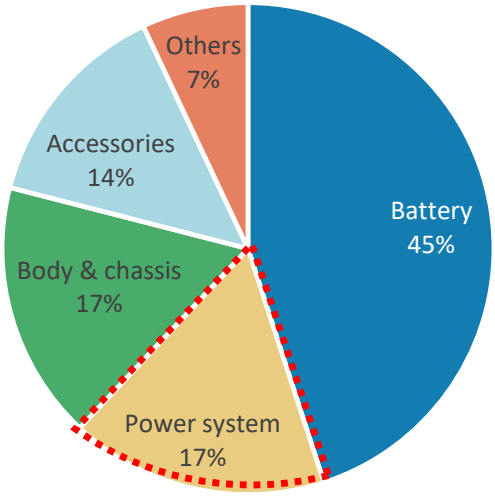
Source: IHS, Morgan Stanley Research estimates.

Exhibit 50: Semi content per car, by BEV/ICE



Source: IHS, Morgan Stanley Research estimates.

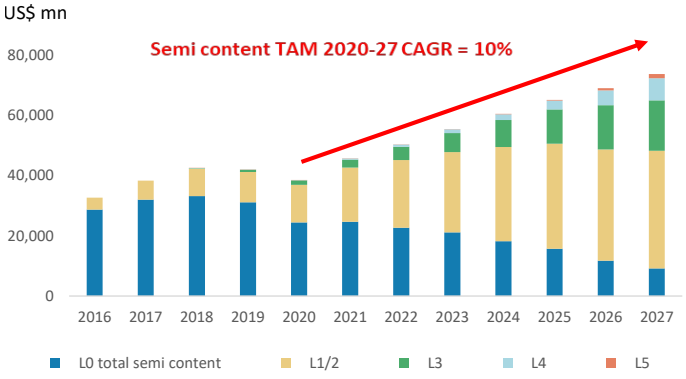
Exhibit 51: Power system accounts for 15-20% of an EV's BOM



Source: Company data, Morgan Stanley Research estimates. Note: Data as of 2022.

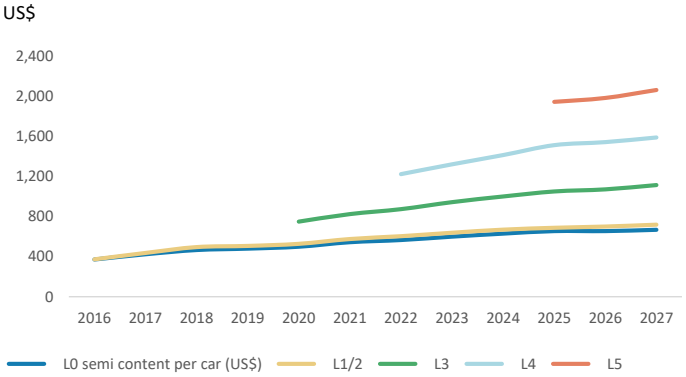
Autonomous driving requires more semiconductor content to enhance performance: To achieve higher levels of autonomous driving capability, more sensors, semiconductors, and software per car are necessary. Sensors include LiDAR, radar, and cameras. Semiconductors are also required for automated driver assistance systems (ADAS), control, monitoring, safety (ex. power steering), power-train for battery and motor system, infotainment (radio and entertainment systems, integrated cellular connectivity), and body (tire pressure monitors, wireless activated door locks). These areas require more power consumption and power management control. More sophisticated autonomous driving capability will also require higher semiconductor content per car (Exhibit 53).

Exhibit 52: Global auto semi TAM breakdown, by autonomous driving level



Source: IHS, Morgan Stanley Research estimates.

Exhibit 53: Semi content per car, by autonomous driving level



Source: IHS, Morgan Stanley Research estimates.

Comparison of leading China analog companies

We expect Novosense and SG Micro to enjoy the strongest revenue growth within the six key Greater China analog IC players under our coverage. Novosense should benefit from its high exposure to auto and industrial, and SG Micro has gained share in the iPhone business, along with its continued R&D investment for new products.

We believe Awinic and uPI's revenue should be muted in over 2023 and 2024, as they have high revenue exposure to consumer electronic products, such as PCs and smartphones. Within our analog IC coverage, they are likely to endure the weakest revenue momentum along with pricing pressure.

Exhibit 54: Greater China analog companies comparison

Ticker	Novosense 688052.CH	SG Micro 300661.CH	3Peak 688536.SS	Silergy 6415.TW	Awinic 688798.CH	uPI 6719.TW
Rating	OW	EW	EW	UW	UW	UW
MSe revenue CAGR (2022-2024e)	53%	34%	27%	16%	23%	10%
MSe profit CAGR (2022-2024e)	76%	38%	26%	17%	28%	3%
Gross Margin (2022e)	50%	58%	59%	53%	42%	43%
R&D Investment (US$ mn)	35	79	89	137	89	25
SKU	1,100	4,000	1,400	2,800	800	na

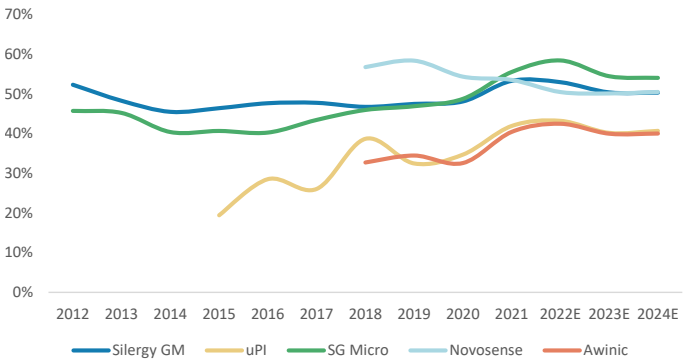
Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 55: Foundry allocation for worldwide analog IC players

		Foundry allocation											
Analog companies	Ticker	TSMC	UMC	SMIC	Vanguard	Hua Hong	PSMC	Nexchip	CSMC	DB HiTek	GFS	Tower Semi	Epson	Others
Taiwan companies														
Silergy	6415.TW	3%	80%	8%										9%
Anpec	6138.TW	20%	20%	10%	20%									30%
Richtek	private; under Mediatek (2454.TW)	60%	5%		5%								15%	15%
uPI	6719.TW		5%		17%		73%							5%
GMT	8081.TW	50%	50%											
China companies														
SG Micro	300661.CH	80%		7%						4%				
Chipown	688508.CH								30%	30%				40%
Chipsea	688595.CH					60%					40%			
Awinic	688798.CH	75%				8%			13%		1%	2%		
Novosense	688052.CH	2%		30%						20%				
3Peak	688536.SS			20%								80%		
Joulwatt	private							In house foundry						
ChipOne	private			20%	40%			30%						10%
SouthChip	private			40%		30%				20%				10%
Global companies														
Texas Instrument	TI.O							In house foundry						
Analog Devices	ADI.O	50%											50% (In house foundry)	
NXP	NXPI.O							In house foundry						

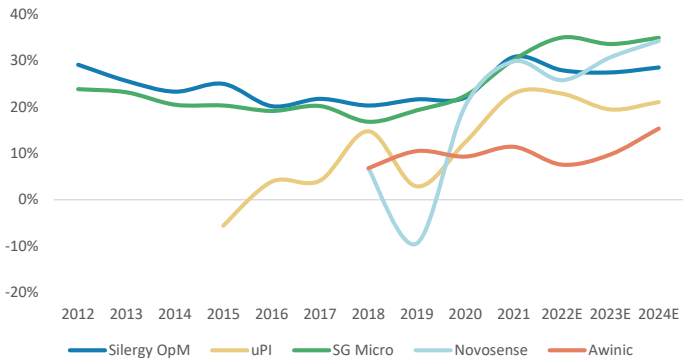
Source: Morgan Stanley Research.

Exhibit 56: GM comparison: Silergy, SG Micro and Novosense enjoy higher GM



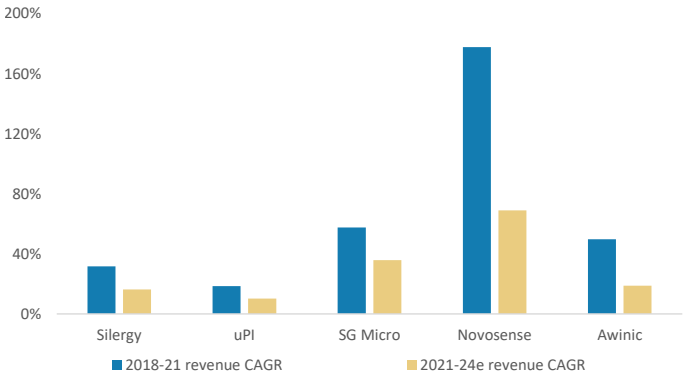
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 57: OpM comparison: Silergy, SG Micro and Novosense enjoy higher OpM thanks to operating leverage



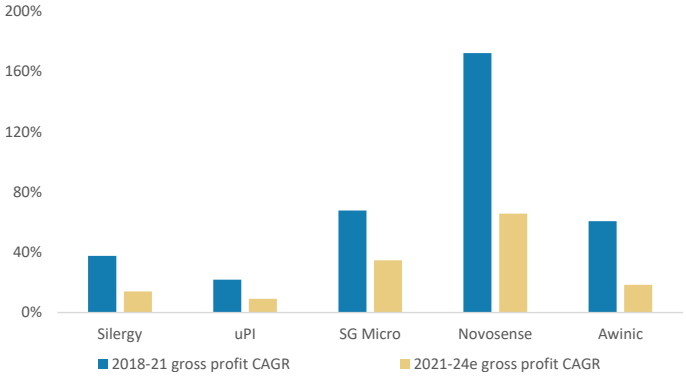
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 58: Revenue growth rate: We expect Novosense, SG Micro to enjoy stronger growth rate during 2021-24



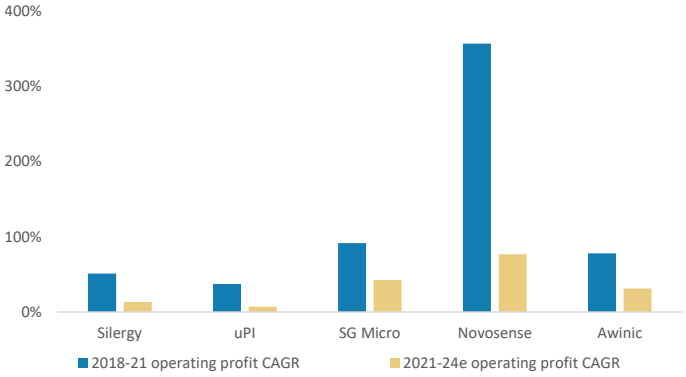
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 59: Gross profit 2021-24 CAGR comparison



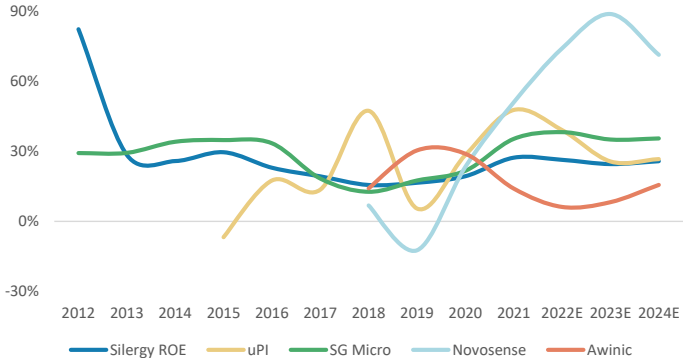
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 60: Operating profit 2021-24 CAGR comparison



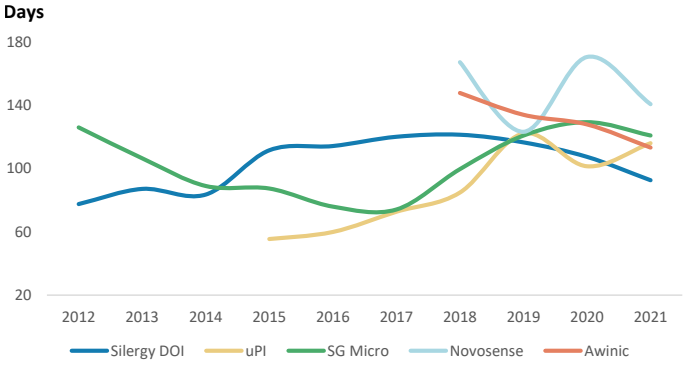
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 61: Greater China analog IC company ROE comparison



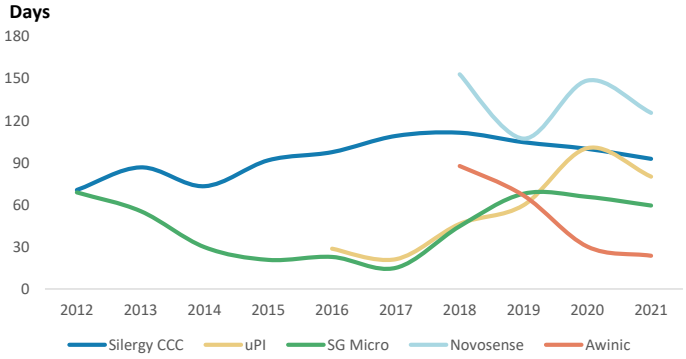
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 62: Greater China analog IC company DOI (days of inventory) comparison



Source: Company data, Morgan Stanley Research estimates.

Exhibit 63: Greater China analog IC company cash conversion cycle comparison



Source: Company data, Morgan Stanley Research estimates.

Where are we in the analog cycle?

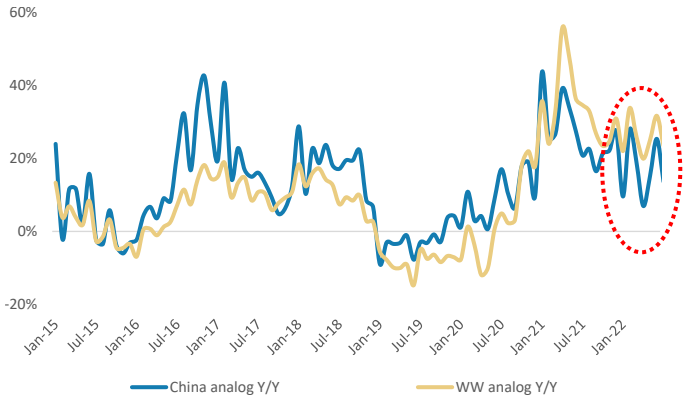
Be selective in the late cycle; we suggest that investors look for more defensive areas

As we are late in the analog cycle (Exhibit 64), and China demand is fading, we suggest that investors be more selective.

On the PMIC side, we see deteriorating business conditions ahead for Asia PMIC players. Asian PMIC companies' 3Q22 revenue could fall 15-20%+ Q/Q, we estimate, owing to weak end-demand. Some PMIC players are providing pre-Covid prices to customers, but this does not help Asian PMIC players sell more product to clients because those clients' inventories remain high. We do see high inventory levels for PMIC at distributors, and we expect Asia PMIC players' revenue to decline sequentially in 3Q22 and 4Q22, with gross margin erosion.

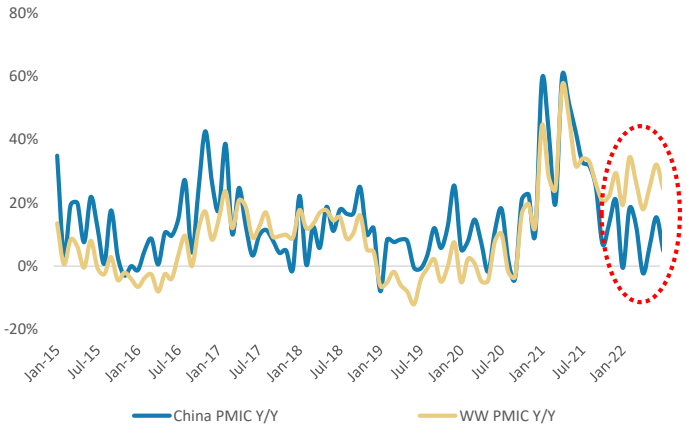
As for PMIC, we expect further mid-single-digit to high-single-digit price erosion into 4Q22: This is mainly due to weakening consumer electronic demand, along with the hiking inventory pressure at PMIC suppliers like Silergy, uPI, GMT...etc. For PMIC players with higher revenue exposure to consumer electronic applications like uPI, the 4Q22 PMIC price erosion might be in the high single digits to low teens Q/Q.

Exhibit 64: We are in the late cycle for analog – China demand is dropping faster. We suggest that investors be more selective



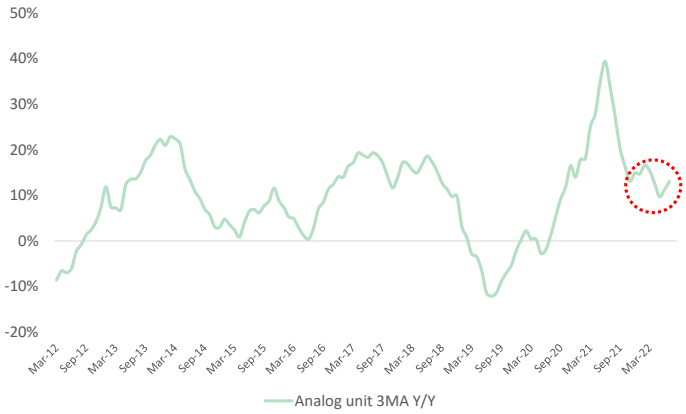
Source: CR Micro, Morgan Stanley Research estimates.

Exhibit 65: We are in the late cycle for PMIC – China demand is dropping faster. We suggest that investors be more selective



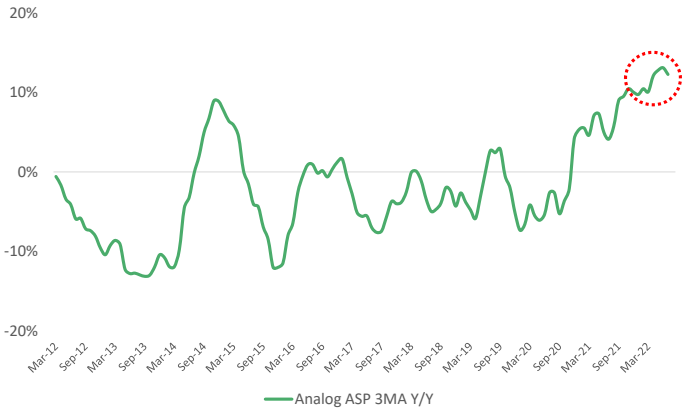
Source: CR Micro, Morgan Stanley Research estimates.

Exhibit 66: Global analog IC unit shipment 3MA Y/Y



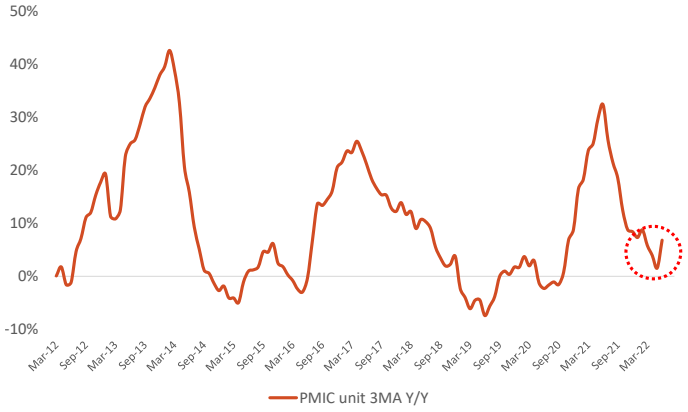
Source: WSTS, Morgan Stanley Research.

Exhibit 67: Global analog IC ASP 3MA Y/Y



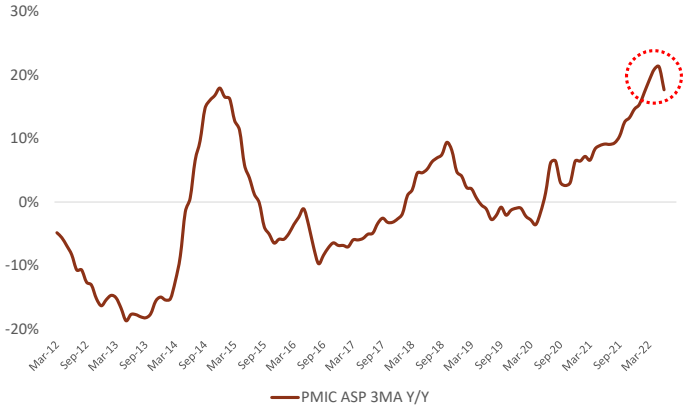
Source: WSTS, Morgan Stanley Research.

Exhibit 68: Global PMIC unit shipment 3MA Y/Y



Source: WSTS, Morgan Stanley Research.

Exhibit 69: Global PMIC ASP 3MA Y/Y



Source: WSTS, Morgan Stanley Research.

Novosense: A rising star dedicated to industrial and auto applications; initiate at OW

Novosense is dedicated to investing in application-specific areas: These areas include industrial and auto, which require long-term investments as it takes years for qualification and design. These areas have provided strong business growth opportunities for Novosense.

Industrial (60% revenue contribution in 1H22) - tailwinds from solar, server, base station, and industrial automation localization demand: Novosense provides products for power systems (clients here include server power, base station power companies), solar energy, and industrial controls (customers here include Inovance). We believe these are fast-growing areas with large potential for analog localization.

Automotive (18% revenue contribution in 1H22) - large room for auto analog localization with high entry barriers: Automotive has been a fast-growing business line for Novosense. Novosense stated in THE 2Q22 analyst meeting that its analog IC product for autos is currently Rmb400 per car (vs. the current market opportunity for auto analog ICs at Rmb1,000 per car). In the long term, we expect the analog content value per car to expand to Rmb2,000-4,000 with higher EV adoption.

Initiate at OW: We believe Novosense will become a long-term winner in the China analog IC market, as it is dedicated to investing in application-specific areas like industrial and auto that have high entry barriers. The company should also benefit from the business tailwinds in the solar, server, base station, industrial automation, and EV segments.

Key downside risks to our view: 1) Weaker-than-expected industrial business; 2) Weaker automotive business; 3) Stronger China analog IC price competition.

Reuters:688052.SS / Bloomberg: 688052:CH Greater China Technology Semiconductors	
Price target	Rmb420.00
Up/downside to price target (%)	45%
Shr price, close(Sep 23,2022)	Rmb290.50
52-Week Range	Rmb224.00-464.80
Sh out, dil, curr (mn)	122
Mkt cap, curr (mn)	Rmb35,297
EV, curr (mn)	Rmb35,297
Avg daily trading value (mn)	NA

Fiscal Year Ending	12/21	12/22e	12/23e	12/24e
ModelWare EPS(Rmb)	2.98	4.34	7.96	12.68
Consensus EPS(Rmb)§		4.05	6.30	9.28
Revenue, net (Rmb mn)	862	1,785	2,909	4,155
EBITDA (Rmb mn)	257	460	894	1,424
ModelWare net inc (Rmb mn)	224	412	805	1,282
P/E	-	66.9	36.5	22.9
P/BV	-	57.2	28.1	15.1
RNOA (%)	78.2	60.4	10234.8	332.4
ROE (%)	69.3	74.1	144.8	101.9
EV/EBITDA	-	75.5	38.4	23.6
Div yld (%)	-	0.4	0.8	0.0
FCF yld ratio (%)	-	2.4	1.7	3.2
Leverage (EOP) (%)	2.9	(98.8)	(74.4)	(71.9)

Unless otherwise noted, all metrics are based on Morgan Stanley ModelWare framework
§ = Consensus data is provided by Thomson Reuters Estimates
e = Morgan Stanley Research estimates

Company description

Founded in 2013, Novosense is an IC design company, mainly focusing on high quality signal chain and analog related segments. Major products include Signal and sensor interface IC, Isolator and interface IC, Driver and sampling IC.

Novosense: Thesis #1 - Strong position in industrial and auto segments provide long-term growth momentum

Dedicated to investing in application-specific areas

As we mentioned earlier in Theme #2: Focus on companies dedicated to application-specific areas, such as industrial or automotive , we appreciate analog companies that invest more in application-specific areas such as industrial or automotive.

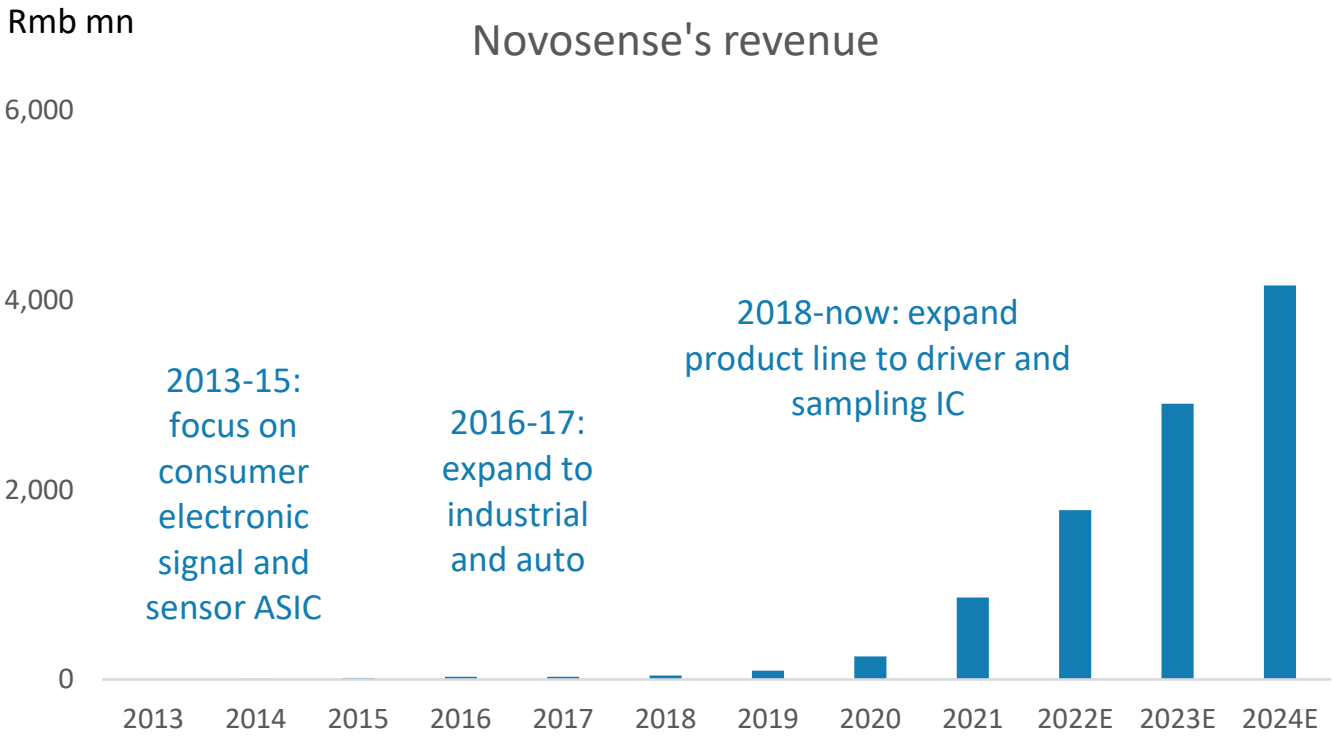
Novosense has been investing resource in application-specific areas. In 2013-15, it focused on consumer electronic signals and sensor ASIC. Novosense started to expand its business into industrial and auto in 2016-17, and since 2018, it expanded its product line to driver and sampling IC (Exhibit 70). These new areas have provided strong business growth opportunities for Novosense and should continue to do so.

High exposure to industrial and auto

Novosense continues to penetrate and grow in the industrial control and auto segments. These areas requires long-term investments as it takes years for qualification and design. For example, Novosense designed an automotive pressure sensor product in 2014. It has invested in higher entry-barrier products with solid reliability, which in turn have higher value.

Industrial (60% revenue contribution in 1H22; Exhibit 72) - tail-winds from solar, server, base station, and industrial automation localization demand: In 1H22, 60% of Novosense' revenue came from industrial control (vs. 32% in 1H21), mainly solar and energy saving systems, PC servers and EV charger modules. As the company invests more on R&D and products for this segment, we expect industrial will continue to be a strong growth driver for Novosense.

Exhibit 70: Novosense's business development



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Within industrial control, 60% is for power systems (customers here include server power and base station power companies), 22% is solar related (accounting for 12-13% of total revenue contribution), and 18% is for industrial related (customers here include Inovance).

Automotive (18% revenue contribution in 1H22) - large room for auto analog localization with high entry barriers: Automotive has been a fast-growing business line for Novosense. In 1H22, 18% of its total revenue came from this segment (vs. <7% in 1H21 vs. 10% in 2021).

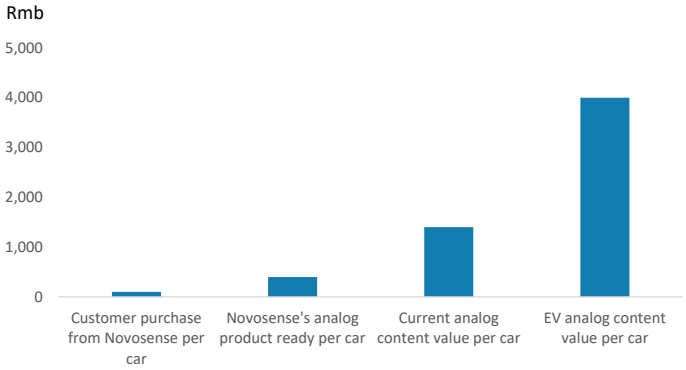
As we mentioned in Theme #3: China auto analog semi localization demand , we see significant opportunity for China analog IC companies to gain share, thanks to the localization trend. China automakers are diversifying their supply chain as new car models incur additional costs in order to pass qualification. On the other hand, China's analog IC companies require lower GM than their global IDM peers.

We believe autos will continue to be a key growth driver for Novosense, and the company will continue to invest its R&D resources for more products in the automotive industry. Novosense is targeting to become the main or second source of auto supplies for car brands.

Rmb1,000 per car content value per car opportunity: Novosense's stated in the 2Q22 analyst meeting that currently its analog auto product is Rmb400 per car, but most customers buy only Rmb10-100 from Novosense (Exhibit 71). Moreover, the current market opportunity for auto analog products is Rmb1,000 per car (if we assume US$520 auto semi per car, and 30% of the auto semi dollar amount are for analog). In the long term the company expects analog content value per car to expand to Rmb2,000-4,000 with higher EV adoption.

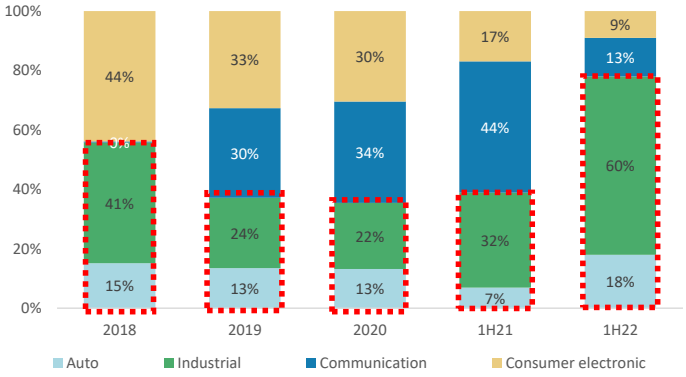
We believe the automotive business will continue to serve as a key growth driver for Novosense in the long term.

Exhibit 71: Novosense: Still significant room to grow in the auto analog space - raising content value



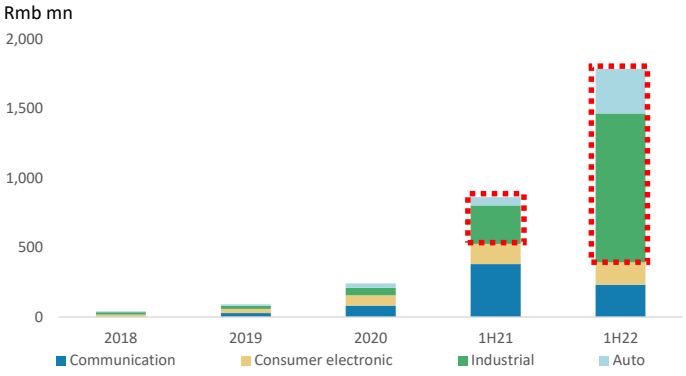
Source: Company data, Morgan Stanley Research.

Exhibit 72: Novosense: Revenue breakdown by product line



Source: Company data, Morgan Stanley Research.

Exhibit 73: Novosense has enjoyed strong growth momentum from industrial and auto



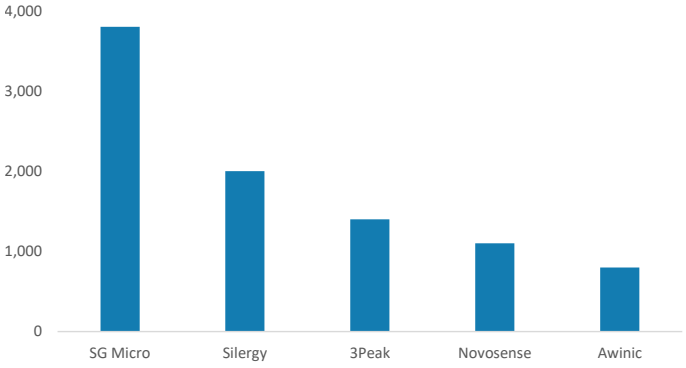
Source: Company data, Morgan Stanley Research.

Dedicated to R&D investments

The company continues to invest and expand in applications/areas where it can differentiate from other China analog IC peers. Its strategy is to invest in areas where there is long-term structural demand such as auto and industrial. The company is also expanding the common applications for its signal chain product (currently for high-end industrial, power-related customers). It plans to start shipping this product to customers by the end of 2022.

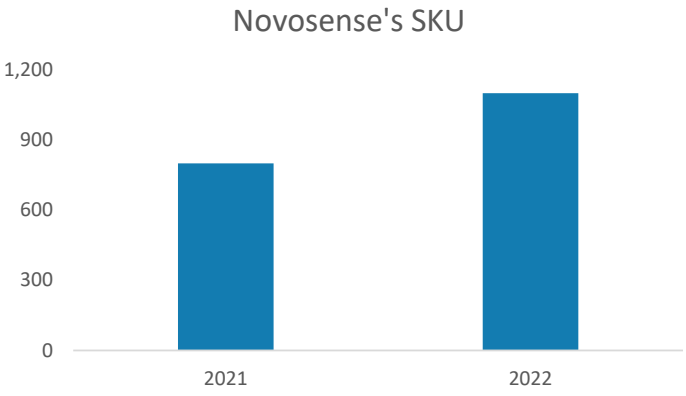
Although the company's main product is signal chain (98% revenue exposure), it is also investing in PMIC, which currently has only 1-2% revenue contribution. PMIC's revenue contribution should remain low in the next two years as Novosense is currently only targeting PMIC for the auto market. The company is planning to have an LED driver PMIC product for auto.

Exhibit 74: Key China analog company's SKU - Novosense has an SKU of 1,100



Source: Company data, Morgan Stanley Research.

Exhibit 75: Novosense has increased its SKU rapidly



Source: Company data, Morgan Stanley Research.

Novosense: Thesis #2 - Strong product portfolio helps it to gain market share

Novosense has a strong product portfolio

Novosense's product portfolio includes 1) Signal and sensor IC; 2) Isolator and interface IC ; 3) Driver and sampling IC; and 4) ASIC.

#1: Signal and sensor IC (19% revenue contribution in 1H22)

Novosense's key product line for signal and sensor IC is mainly for consumer electronic products (Exhibit 79). Signal and sensor IC is the company's core product line. Novosense provides various sensor products to measure temperature, humidity...etc. The company continues to invest in R&D to expand into more applications, and expects to introduce new signal and sensor IC products with higher GM.

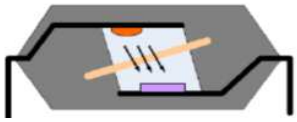
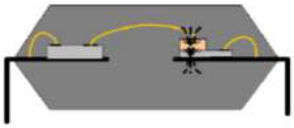
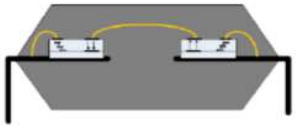
#2: Isolator and interface IC (36% revenue contribution in 1H22)

Novosense's key product line for isolator and interface IC is for the auto, industrial, and solar segments (Exhibit 80). Isolator is a highly customized product in terms of design, and the OSAT process also has a different requirement from other consumer electronic components. Novosense is developing a comprehensive product line for isolators. It also has a digital auto isolator, mainly for battery, motor and electric control system products.

An isolator protects different power components from each other. EVs and electrical devices all need isolator ICs.

Comparing the different isolators

Exhibit 76: There are three types of major coupler/isolators

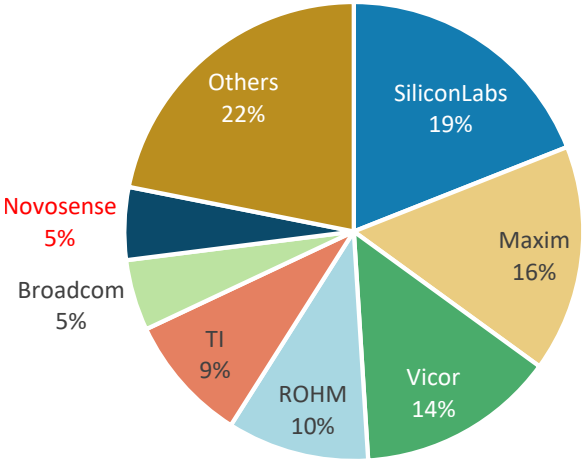
Indicator	Optical Isolator	Digital Isolator	
		Magnetic Isolator	Capacitive Isolator
			
Transit Signal	Optical signal	Magnetic field signal	Electric field signal
Material	Polyimide	Polyimide	SiO2
Withstand Voltage	High	High	High
Data transmit Abaility	Slow	Fast	Fast
Density Integration	Low	High	High
Temperature Range	Limited	Wide	Wide

Source: Company data, Morgan Stanley Research.

Novosense to continue expanding its market share in isolators

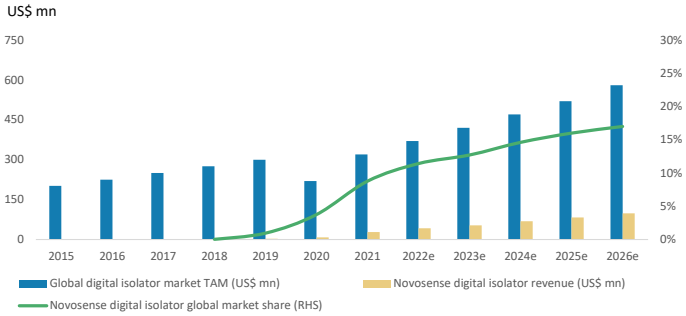
In 2020, Novosense had an isolator global market share of 5% in terms of revenue (Exhibit 77). We expect this to expand to 15% by 2024 (Exhibit 78).

Exhibit 77: Global isolator market share (2020)



Source: Company data, Morgan Stanley Research.

Exhibit 78: We expect Novosense's digital isolator global market share to grow to 15% by 2024e



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

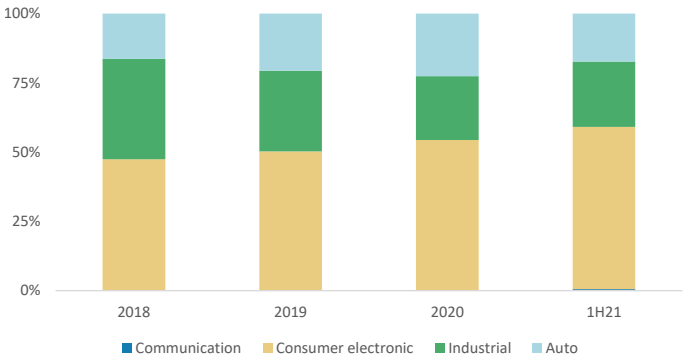
#3: Driver and sampling IC (44% revenue contribution in 1H22)

This is a fast-growing business for Novosense (Exhibit 81), especially in the past two years where revenue contribution expand from 0% to 23% in 2021. China's isolator and driver products still have a very low localization rate, but as the localization trend grows we expect Novosense to gain domestic market share, thanks to the quality of its products.

Novosense's driver and sampling IC's product ASP is higher than that of its other two product lines (signal and sensor IC, and isolator and interface IC). Growth of key customers from the energy and auto industries (mainly for battery, motor and electric control system products) has been fast in the past two years where revenue contribution expand from 0% to 23% in 2021.

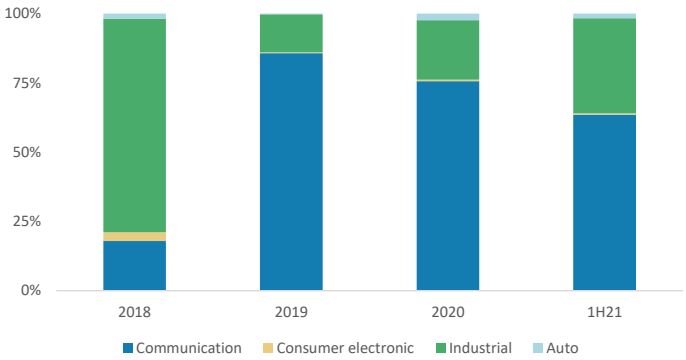
Going forward, Novosense plans to expand its business into base station, EV, industrial automation, smart power grid, solar ...etc, and to continue to develop driver products for auto motor, auto lighting, auto common application power systems.

Exhibit 79: Signal and sensor IC business is mainly for consumer electronic products



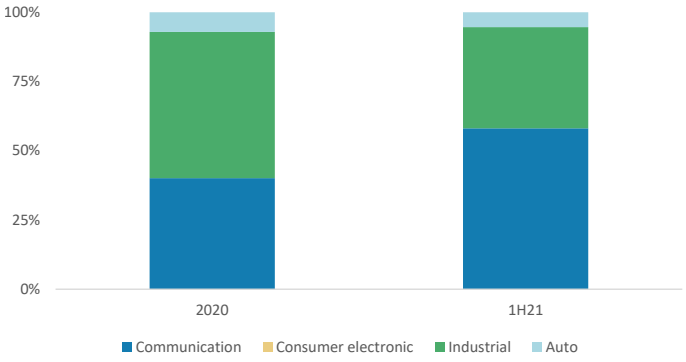
Source: Company data, Morgan Stanley Research.

Exhibit 80: Isolator and interface IC is mainly for communication and industrial products



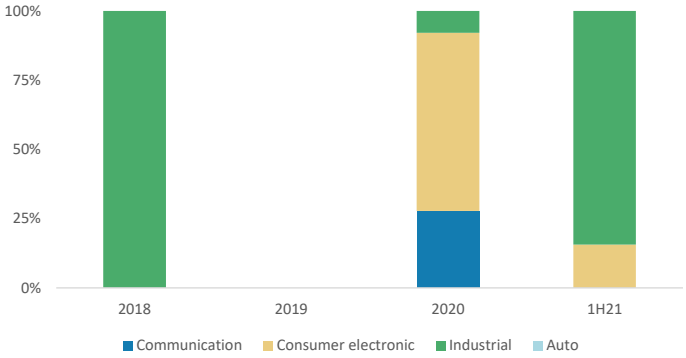
Source: Company data, Morgan Stanley Research.

Exhibit 81: Driver and sampling IC mainly for communication and industrial products



Source: Company data, Morgan Stanley Research.

Exhibit 82: Customized ASIC mainly for industrial products



Source: Company data, Morgan Stanley Research.

Novosense: Where are we versus consensus?

Our 2023/24 EPS estimates are 19%/ 28% higher than Street expectations

We believe Novosense will become a long-term winner in the China analog IC market, as it is adopting the right business model which dedicated to investing in a high entry barrier market like industrial and auto.

Our 2023/2024 EPS forecasts are 19%/28% above consensus.

Investment positives

The company has high exposure to the industrial and automotive businesses, which enjoy high margins with high entry barriers.

Investment concerns

Although Novosense has less exposure to consumer electronic applications, business might be slower if the overall analog cycle gets slower.

Where we could be wrong

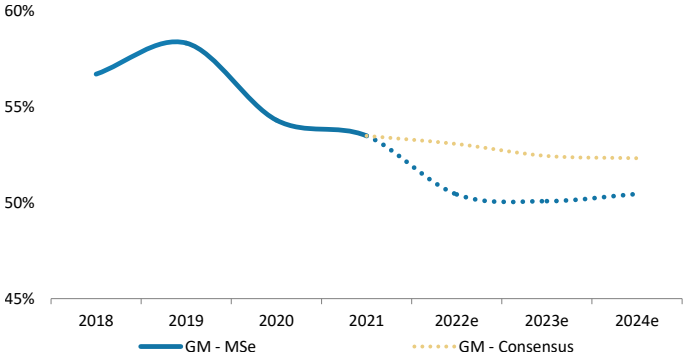
We could be wrong if: 1) Novosense's industrial business is weaker than expected; 2) Novosense's automotive business is weaker than expected; 3) China analog IC price competition is stronger than expected.

Exhibit 83: Novosense: Morgan Stanley Research vs. consensus

Rmb mn	2022e			2023e			2024e		
	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*
Sales	1,785	1,609	*11%*	2,909	2,342	*24%*	4,155	3,257	*28%*
Operating profit	460	476	*-3%*	894	737	*21%*	1,424	1,115	*28%*
Net income	412	439	*-6%*	805	677	*19%*	1,282	1,001	*28%*
EPS (Rmb)	4.34	4.63	*-6%*	7.96	6.70	*19%*	12.68	9.90	*28%*
GM	50.4%	53.1%	*-2.6ppt*	50.1%	52.5%	*-2.4ppt*	50.5%	52.3%	*-1.9ppt*
OpM	25.8%	29.6%	*-3.8ppt*	30.7%	31.5%	*-0.8ppt*	34.3%	34.2%	*0.0ppt*

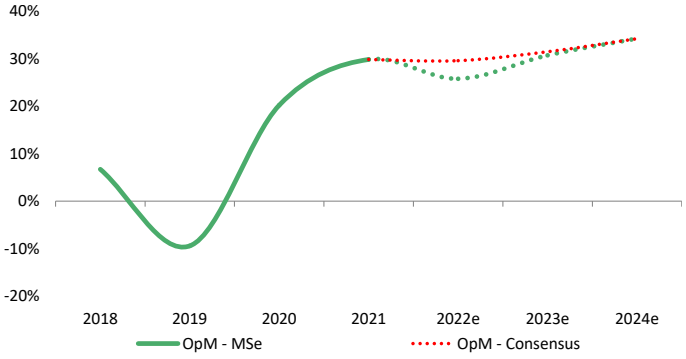
Source: Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 84: Novosense's gross margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 85: Novosense's operating margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

Novosense: Valuation methodology

Our price target is Rmb420: We derive our price target (which is also our base case value) from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.3% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 5.8%), a payout ratio of 50%, a medium-term growth rate of 19.0%, and a terminal growth rate of 5.0%, all of which are in-line with other analog IC companies in our coverage.

Our price target implies 97x 2022 earnings and 53x 2023 earnings. 53x 2023 earnings is 1SD below the historical average, as we believe the long-term opportunities justify this valuation.

Exhibit 86: Novosense: Residual income model

Rmb million	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E
Total Equity	**556**	**1,257**	**1,968**	**2,814**	**3,820**	**5,017**	**6,442**	**8,138**	**10,156**	**12,557**	**15,415**	**18,815**
Net Profit	**412**	**805**	**1,282**	**1,525**	**1,815**	**2,160**	**2,570**	**3,058**	**3,639**	**4,331**	**5,153**	**6,133**
ROAE	**74.1%**	**88.7%**	**79.5%**	**63.8%**	**54.7%**	**48.9%**	**44.9%**	**41.9%**	**39.8%**	**38.1%**	**36.8%**	**35.8%**
Residual Income	360	442	883	1,073	1,279	1,514	1,786	2,107	2,485	2,933	3,465	4,097
Spread	**64.8%**	**79.5%**	**70.2%**	**54.5%**	**45.5%**	**39.6%**	**35.6%**	**32.7%**	**30.5%**	**28.9%**	**27.6%**	**26.6%**
Ending Equity Capital	556											
PV of Forecast Period	7,247											
PV of Continuing Value	26,662											
Equity Value	**34,464**											
No. of Shares	82											
Projected Price (Rmb)	**420**											

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Bull/bear case discussion

Our bull case value is Rmb580: Stronger sales growth with faster auto and industrial expansion

In this scenario, we assume semiconductor industry growth recovers rapidly, customers deplete their inventory faster than in our base case amid stronger end-demand triggered by the automotive and industrial industries.

Our bull scenario assumptions include 1) a revenue CAGR of 53% in 2022-24, and 2) Novosense's penetration rate in auto and industrial grows faster than expected.

Our bear case value is Rmb230: Slower sales growth with slower auto and industrial expansion

In this scenario, we assume the global economy heads into a recession. As a result, the semiconductor industry has corrected severely, inventory at customers piles up rapidly given sluggish demand, and Novosense's penetration rate in auto and industrial grows slower than expected.

Peer comparison

We expect Novosense's earnings to achieve a CAGR of 76% during 2022-24e, well above that of Greater China analog IC company peers at a CAGR of 33%. We think this justifies our OW rating on Novosense as it is trading at 30x 2023 P/E (based on our EPS estimate), which is just below the Greater China analog peer average at 33x 2023 P/E.

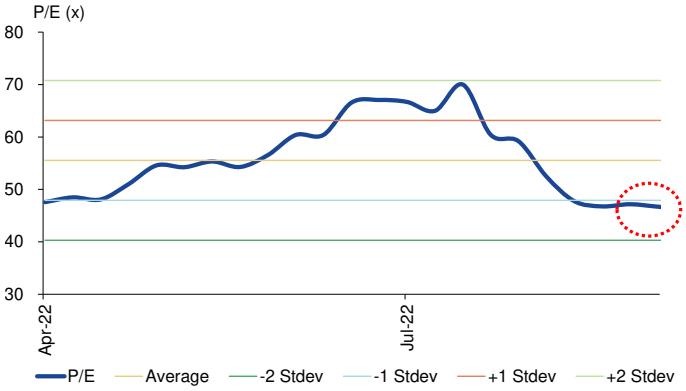
We estimate Novosense's PEG for 2023 is at 0.6, much lower than other Greater China analog peers at 1.1-1.8.

Exhibit 87: Novosense: Peer comparison

Ticker	Company	Closing Price	Rating	Price Target (LC)	Market Cap (US$mn)	EPS 2020	EPS 2021	EPS 2022e	EPS 2023e	EPS 2024e	P/E 2020	P/E 2021e	P/E 2022e	P/E 2023e	P/E 2024e	ROE 2020	ROE 2021e	ROE 2022e	ROE 2023e	ROE 2024e	Trading Volume (US$ mn)
China Companies																					
688052.SS	**Novosense**	290.50	**O**	**420.00**	4,148	0.7	2.9	4.3	8.0	12.7	427.2	98.5	66.9	36.5	22.9	23.3	50.9	74.1	88.7	71.3	47
300661.SZ	**SG Micro**	136.52	**E**	**170.00**	6,871	1.9	3.0	3.3	4.1	5.8	73.4	45.9	41.2	33.0	23.6	21.7	35.3	38.2	37.9	38.6	88
688536.SS	3Peak	253.50	E	313.00	4,282	2.8	5.5	4.4	6.0	7.0	89.6	46.0	57.5	42.5	36.1	13.2	15.4	15.4	17.8	17.8	52
688595.SS	Chipsea	37.19	U	33.00	735	1.1	0.9	0.4	0.7	1.1	33.8	39.6	85.2	53.5	35.4	15.8	10.4	5.6	9.3	12.7	24
688798.SS	**Awinic**	90.54	**U**	**75.00**	2,124	0.8	2.1	1.8	2.0	2.9	110.6	43.3	51.0	44.7	31.2	28.9	14.0	9.0	9.8	12.9	14
688508.SS	Chipown	56.00	NC	NA	895	0.9	1.6	2.2	3.2	4.3	63.5	34.6	24.7	17.2	12.8	11.3	12.5	14.6	17.2	19.1	28
Average											**133.0**	**51.3**	**54.4**	**37.9**	**27.0**	**19.0**	**23.1**	**26.1**	**30.1**	**28.7**	**42**
Taiwan Companies																					
6415.TW	Silergy	450.00	U	430.00	5,416	33.8	58.7	17.1	16.9	20.4	13.3	7.7	26.3	26.6	22.1	19.3	27.3	26.3	24.5	25.7	104
6719.TW	uPI	266.50	U	230.00	625	6.2	14.6	15.9	13.2	16.8	42.8	18.2	16.8	20.2	15.9	28.4	47.7	39.1	25.6	26.7	26
6138.TWO	Anpec	119.00	NC	NA	279	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29
8081.TW	GMT	131.50	NC	NA	359	11.4	25.5	26.9	17.1	NA	10.8	4.8	4.6	7.2	NA	20.4	42.7	NA	NA	NA	6
Average											**22.3**	**10.2**	**15.9**	**18.0**	**19.0**	**22.7**	**39.2**	**32.7**	**25.1**	**26.2**	**41**
Global Companies																					
6723.T	Renesas	1,305.00	O	2,000.00	17,703	64.9	120.4	198.1	185.8	219.6	20.1	10.8	6.6	7.0	5.9	7.4	14.3	22.4	18.2	18.8	102
NXPI.O	NXP	152.94	E	183.00	40,162	6.1	10.8	13.7	13.6	15.5	24.9	14.2	11.2	11.3	9.8	0.3	23.7	39.8	35.7	45.4	493
ADI.O	Analog Devices Inc.	154.18	E	173.00	72,995	5.0	6.5	9.5	9.4	9.7	30.6	23.9	16.3	16.5	16.0	10.3	5.6	6.9	6.7	7.0	602
ON.O	ON Semi	63.31	E	65.00	27,428	0.9	2.9	5.1	4.7	4.9	74.4	21.6	12.4	13.6	12.8	6.8	24.9	37.8	27.1	22.0	426
TXN.O	Texas Instrument	170.74	U	160.00	147,372	5.3	8.3	9.3	8.4	8.7	32.4	20.7	18.3	20.3	19.6	61.8	69.0	64.1	52.1	47.9	955
IFXGn.DE	Infineon	22.97	NC	NA	29,499	0.6	1.1	1.9	1.9	2.1	37.4	20.4	12.1	12.0	11.1	7.7	13.4	20.7	16.5	16.4	161
Average											**36.6**	**18.6**	**12.8**	**13.4**	**12.6**	**15.7**	**25.1**	**32.0**	**26.1**	**26.2**	**457**

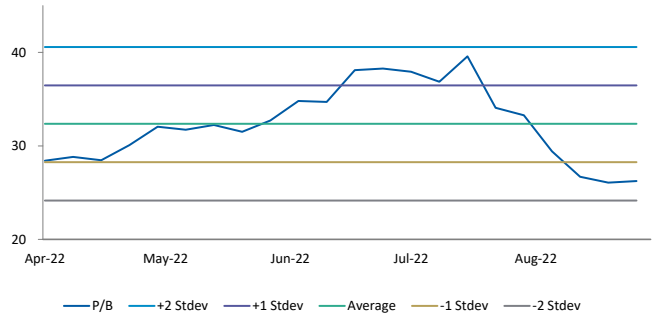
Source: Company data, Refinitiv, Morgan Stanley Research estimates. E = Morgan Stanley Research estimates for covered companies, Refinitiv consensus for noncovered ("NC") companies. Note: Share prices as of the market close on September 23, 2022.

Exhibit 88: Novosense: P/E band chart



Source: Company data, Refinitiv, Morgan Stanley Research estimates.

Exhibit 89: Novosense: P/B band chart



Source: Company data, Refinitiv, Morgan Stanley Research estimates.

Novosense: Financial summary

Exhibit 90: Novosense: Financial summary

Income Statement

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Net sales	92	242	862	1,785	2,909	4,155
COGS	(38)	(111)	(401)	(885)	(1,452)	(2,058)
Gross profit	54	131	461	901	1,457	2,097
Operating expenses	(62)	(83)	(204)	(440)	(563)	(673)
Operating income	**(9)**	**49**	**257**	**460**	**894**	**1,424**
Non-operating income	(0)	5	(9)	(1)	0	0
Pre-tax income	(9)	54	248	459	894	1,424
Income tax	0	3	25	48	89	142
Reported net Income	**(9)**	**51**	**224**	**412**	**805**	**1,282**
Adj.wtd.avg.shrs(m)	54	75	76	82	84	84
Reported EPS (Rmb)	**(0.17)**	**0.68**	**2.95**	**4.34**	**7.96**	**12.68**
Modelware EPS (Rmb)	**(0.16)**	**0.88**	**2.95**	**4.34**	**7.96**	**12.68**

Balance Sheet

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Cash	60	124	78	643	1,030	1,775
Mkt Securities	0	1	0	0	0	0
AR/NR	8	42	111	159	259	370
Inventory	18	85	224	341	559	793
Other	21	50	107	107	107	107
Current Assets	**107**	**302**	**520**	**1,250**	**1,956**	**3,045**
Long-term investments	4	0	0	0	0	0
Fixed assets	24	79	214	284	354	424
Deffered assets	0	1	3	3	3	3
Other assets	10	55	105	105	105	105
Total Assets	**145**	**437**	**841**	**1,641**	**2,417**	**3,576**
S/T borrowings	8	40	94	94	94	94
AP/NP	6	30	74	115	189	268
Other ST liabilities	19	34	98	858	858	858
LT debt	0	9	0	0	0	0
Other LT liabilities	0	1	19	19	19	19
Common shares	7	76	76	76	76	76
Total Liabilities	**32**	**114**	**285**	**1,086**	**1,159**	**1,238**
Additional capital	107	191	200	200	200	200
Retained earning	(0)	50	274	274	976	2,056
Other shareholders' equity	0	6	6	6	6	6
Total Equity	**113**	**323**	**556**	**556**	**1,257**	**2,338**
Total Liab. & Shrhldr's Equity	**145**	**437**	**841**	**1,641**	**2,417**	**3,576**

E = Morgan Stanley Research Estimates

Source: Morgan Stanley Research, Company Data

Cash Flow Statement

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Cashflow from Operations	**8**	**(41)**	**101**	**287**	**560**	**1,016**
Net profits	(9)	51	224	412	805	1,282
Depreciation	0	0	0	0	0	0
Working Capital Change	(11)	(43)	(127)	(124)	(245)	(266)
Other adjustments	28	(48)	4	0	0	0
Cashflow from Investing	**(34)**	**(87)**	**(186)**	**(70)**	**(70)**	**(70)**
Capex	0	(56)	(187)	(70)	(70)	(70)
Change of LT Investment	27	56	0	0	0	0
Change of ST Investment	0	0	0	0	0	0
Other adjustments	(60)	(87)	1	0	0	0
Cashflow from financing	**68**	**191**	**39**	**348**	**(103)**	**(201)**
Increase in L/T debt	0	0	0	0	0	0
Increase in S/T debt	0	0	0	0	0	0
Cash Dividend Paid	(0)	(2)	(2)	(56)	(103)	(201)
Dir& Emp Bonus Paid	0	0	0	0	0	0
Issuance of stock	0	0	0	0	0	0
Other adjustments	69	193	42	404	0	0
Exchange rate adjustment	0	0	0	0	0	0
Net change in cash	**43**	**64**	**-46**	**565**	**387**	**745**

Financial Ratios

	2019	2020	2021	2022E	2023E	2024E
Growth(%)						
Turnover	129.0	162.7	256.3	107.1	62.9	42.8
Operating profits	-421.3	-663.6	426.1	78.9	94.2	59.3
Pretax profits	-494.9	-698.9	357.9	84.9	94.6	59.3
Net profits	-494.6	-657.9	340.3	83.9	95.5	59.3
EPS	-494.6	-657.9	235.0	47.3	83.3	59.3
Margins (%)						
Gross Margin	58.3	54.3	53.5	50.4	50.1	50.5
Operating Margin	-9.4	20.2	29.9	25.8	30.7	34.3
Pretax Margin	-9.8	22.4	28.8	25.7	30.7	34.3
Net Profit	-9.9	21.0	26.0	23.0	27.7	30.8
Return (%)						
ROAE	(12.4)	23.3	50.9	74.1	88.7	71.3
ROAA	(9.5)	17.5	35.0	33.2	39.7	42.8
Gearing (%)						
Net Debt/Equity	(46.7)	(25.9)	2.9	(98.8)	(74.4)	(71.9)
Liabilities/Equity	28.3	35.3	51.3	195.3	92.2	53.0
Ratios (X)						
Current ratio	3.3	2.9	2.0	1.2	1.7	2.5
Quick ratio	2.1	1.6	0.7	0.8	1.1	1.8
Others						
AR/NR Turnover (days)	18	38	33	33	33	33
Inventory Turnover (days)	123	170	141	141	141	141
AP Turnover (days)	34	60	48	48	48	48
Cash Conversion (days)	107	149	126	126	126	126

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

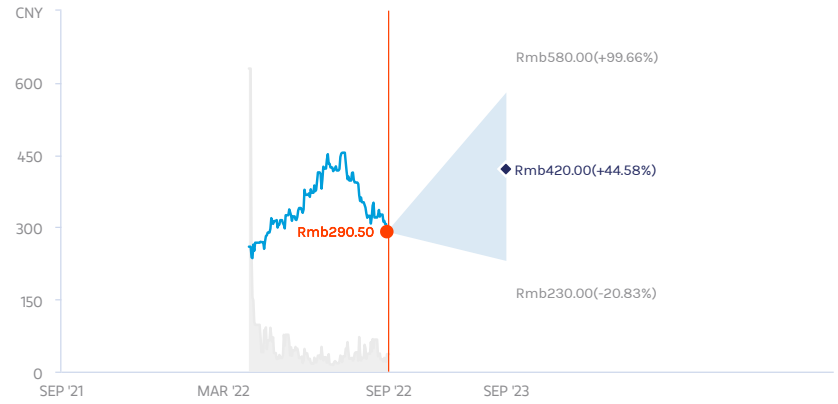
Risk Reward – Suzhou Novosense Microelectronics Co Ltd (688052.SS)

A rising star dedicated to industrial and auto applications

PRICE TARGET Rmb420.00

Base case, derived from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.3% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 5.8%), a payout ratio of 50%, a medium-term growth rate of 19.0%, and a terminal growth rate of 5.0%, all of which are in-line with the other analog IC companies in our coverage.

RISK REWARD CHART



Key: Historical Stock Performance Current Stock Price Price Target

Source: Refinitiv, Morgan Stanley Research

OVERWEIGHT THESIS

- Novosense is dedicated to investing in application-specific areas: These areas include industrial and auto, which require long-term investments as it takes years for qualification and design. These areas have provided strong business growth opportunities for Novosense.
- We believe Novosense will become a long-term winner in the China analog IC market, as it is dedicated to investing in application-specific areas like industrial and auto where there are high entry barriers. The company should also benefit from the business tailwinds in the solar, server, base station, industrial automation, and EV segments.

Consensus Rating Distribution

100%	Overweight
0%	Equal-weight
0%	Underweight

MS Rating

Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Electric Vehicles:	*Positive*
Market Share:	*Positive*
Pricing Power:	*Positive*

View descriptions of Risk Rewards Themes here

BULL CASE Rmb580.00

134x 2022e EPS

In this scenario, we assume semiconductor industry growth recovers rapidly, customers deplete their inventory faster than in our base case amid stronger end-demand triggered by the automotive and industrial industries. We assume (1) Revenue CAGR will be higher than 53% in 2022-24, and 2) Novosense's penetration rate in auto and industrial grows faster than expected.

BASE CASE Rmb420.00

97x 2022e EPS

We believe Novosense will become a long-term winner in the China analog IC market, as it is dedicated to investing in application-specific areas like industrial and auto that have high entry barriers. We forecast 2022-24 1) sales CAGR of 53%, and 2) earnings CAGR of 76%.

BEAR CASE Rmb230.00

53x 2022e EPS

In this scenario, we assume the global economy heads into a recession. As a result, the semiconductor industry has corrected severely, inventory at customers piles up rapidly given sluggish demand, and Novosense's penetration rate in auto and industrial grows slower than expected.

Risk Reward – Suzhou Novosense Microelectronics Co Ltd (688052.SS)

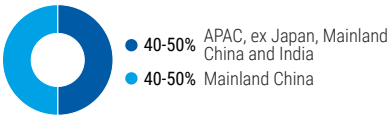
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Revenue from Signal and Sensor interface IC segment (Rmb, mn)	245	319	540	721
Revenue from Isolator and Interface IC segment (Rmb, mn)	418	673	883	1,234
Revenue from Driver and Sampling IC segment (Rmb, mn)	196	792	1,464	2,153

INVESTMENT DRIVERS

- Revenue momentum and market share gains in China
- R&D investments

GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

RISKS TO PT/RATING

RISKS TO UPSIDE

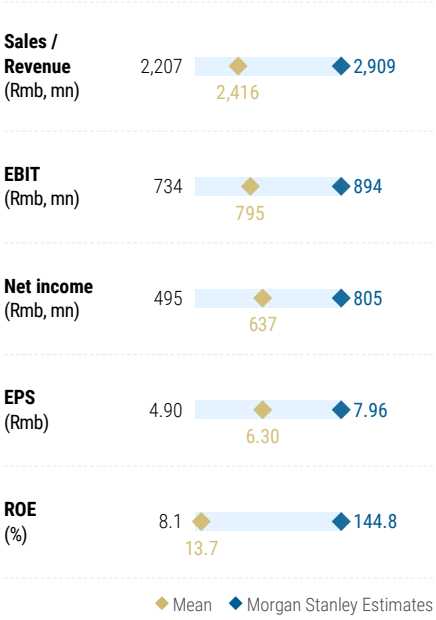
1) Novosense's market share expands faster than expected; 2) pricing of auto and industrial analog is better than expected.

RISKS TO DOWNSIDE

1) Novosense's industrial business is weaker than expected; 2) Novosense's automotive business is weaker than expected; 3) China analog IC price competition is stronger than expected.

MS ESTIMATES VS. CONSENSUS

FY 2023e



Source: Refinitiv, Morgan Stanley Research

Novosense: Quarterly earnings summary

Exhibit 91: Novosense: Quarterly earnings summary

Rmb in million	1Q22	2Q22	3Q22E	4Q22E	1Q23E	2Q23E	3Q23E	4Q23E	2020	2021	2022E	2023E	2024E
Total Revenues	339	454	485	507	501	631	792	985	242	862	1,785	2,909	4,155
Sequential Change	*0.0%*	*34.0%*	*6.8%*	*4.4%*	*-1.2%*	*26.1%*	*25.5%*	*24.4%*					
Change vs Year Ago	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*47.6%*	*38.9%*	*63.3%*	*94.5%*	*162.7%*	*256.3%*	*107.1%*	*62.9%*	*42.8%*
Cost of Sales	166	225	242	252	250	315	395	492	111	401	885	1,452	2,058
Percent of Revenues	*49%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*46%*	*46%*	*50%*	*50%*	*50%*
Gross Profit	174	229	244	254	251	316	397	494	131	461	901	1,457	2,097
Percent of Revenues	*51.2%*	*50.4%*	*50.2%*	*50.2%*	*50.1%*	*50.1%*	*50.1%*	*50.1%*	*54.3%*	*53.5%*	*50.4%*	*50.1%*	*50.5%*
Incremental Margin	*0%*	*48%*	*47%*	*50%*	*NM*	*50%*	*50%*	*50%*	*54%*	*54%*	*50%*	*50%*	*51%*
Total Opex	63	120	126	131	125	134	146	158	83	204	440	563	673
Percent of Revenues	*18.7%*	*26.4%*	*26.0%*	*25.9%*	*25.0%*	*21.3%*	*18.4%*	*16.1%*	*34.1%*	*23.6%*	*24.7%*	*19.4%*	*16.2%*
R&D	38	67	70	72	70	72	75	78	41	107	247	295	335
Percent of Revenues	*11.1%*	*14.8%*	*14.5%*	*14.2%*	*14.0%*	*11.4%*	*9.5%*	*7.9%*	*17.1%*	*12.4%*	*13.8%*	*10.1%*	*8.1%*
General & administrative	19	34	36	38	35	37	39	41	25	60	126	152	172
Percent of Revenues	*5.5%*	*7.4%*	*7.4%*	*7.4%*	*7.0%*	*5.9%*	*4.9%*	*4.2%*	*10.3%*	*7.0%*	*7.0%*	*5.2%*	*4.1%*
Selling & marketing	7	19	20	21	20	25	32	39	16	36	67	116	166
Percent of Revenues	*2.1%*	*4.2%*	*4.2%*	*4.2%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*	*6.8%*	*4.2%*	*3.8%*	*4.0%*	*4.0%*
Operating Income	110	109	118	123	126	182	251	335	49	257	460	894	1,424
Percent of Revenues	*32.5%*	*24.1%*	*24.2%*	*24.3%*	*25.1%*	*28.8%*	*31.7%*	*34.0%*	*20.2%*	*29.9%*	*25.8%*	*30.7%*	*34.3%*
Change vs Year Ago	*NM*	*NM*	*NM*	*NM*	*9.7%*	*40.9%*	*43.5%*	*44.3%*	*NM*	*426.1%*	*78.9%*	*94.2%*	*59.3%*
Total Non-operating Income(Loss)	(17)	16	0	0	0	0	0	0	5	(9)	(1)	0	0
Profit Before Taxes	94	125	118	123	126	182	251	335	54	248	459	894	1,424
Percent of Revenues	*28%*	*27%*	*24%*	*24%*	*25%*	*29%*	*32%*	*34%*	*22%*	*29%*	*26%*	*31%*	*34%*
Taxes	9	14	12	12	13	18	25	34	3	25	48	89	142
Tax Rate	*10.1%*	*11.4%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*6.2%*	*9.9%*	*10.4%*	*10.0%*	*10.0%*
Reported Income (TW GAAP)	**84**	**111**	**106**	**111**	**113**	**163**	**226**	**302**	**51**	**224**	**412**	**805**	**1,282**
Percent of Revenues	*25%*	*24%*	*22%*	*22%*	*23%*	*26%*	*29%*	*31%*	*21%*	*26%*	*23%*	*28%*	*31%*
Change vs Year Ago	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*NM*	*340%*	*84%*	*95%*	*59%*
Reported EPS (Rmb, TW GAAP)	**1.11**	**1.10**	**1.05**	**1.10**	**1.12**	**1.62**	**2.24**	**2.99**	**0.68**	**2.95**	**4.34**	**7.96**	**12.68**
Change vs Year Ago	*NM*	*NM*	*NM*	*NM*	*1%*	*48%*	*114%*	*172%*	*NM*	*334%*	*47%*	*83%*	*59%*

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Novosense: Company background

Founded in 2013, Novosense is an IC design company that focuses mainly on high-quality signal chain and analog-related segments. Its major products include signal and sensor interface IC, isolator and interface IC, and driver and sampling IC. Novosense first started with signal and sensor ASIC then later expanded into other product categories. It currently has over 1,100 types of products, with automotive, industrial, communication and consumer tech being its key target end-markets. As of 2H22, the industrial markets are the largest exposure (59.64% of revenue), with automotive (18.26%), communication (12.74%) and consumer tech (9.37%) as follow.

Exhibit 92: Novosense's sensor products

Source: Company data.

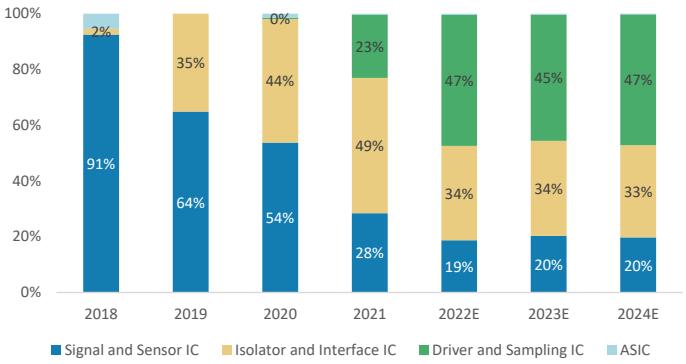
Exhibit 93: Novosense's isolator

Source: Company data.

Exhibit 94: Novosense's driver IC

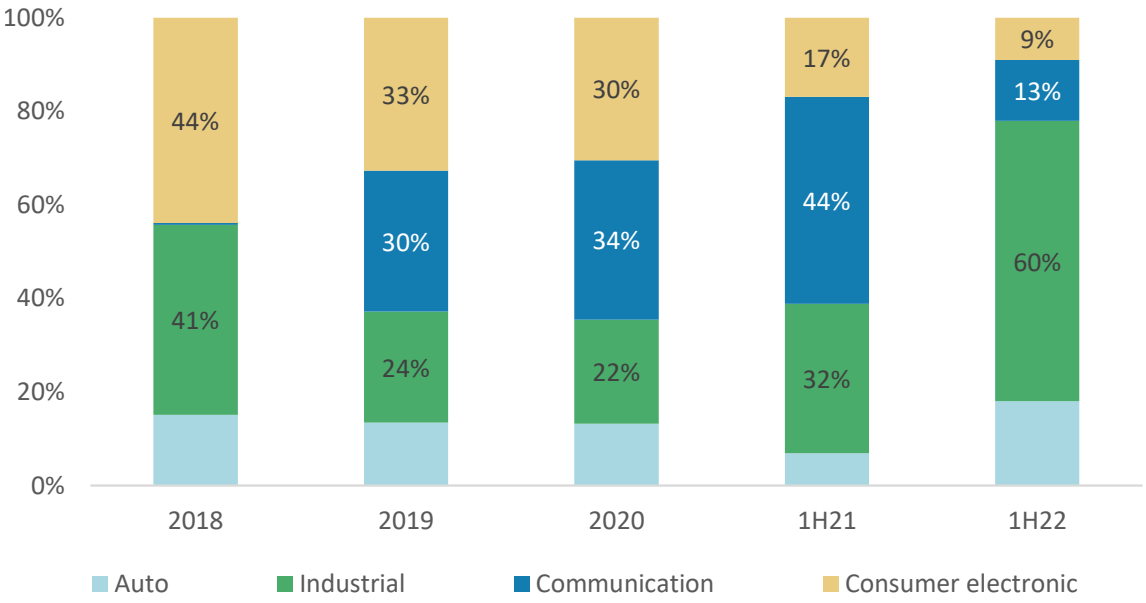
Source: Company data.

Exhibit 95: Novosense has a well-diversified product portfolio



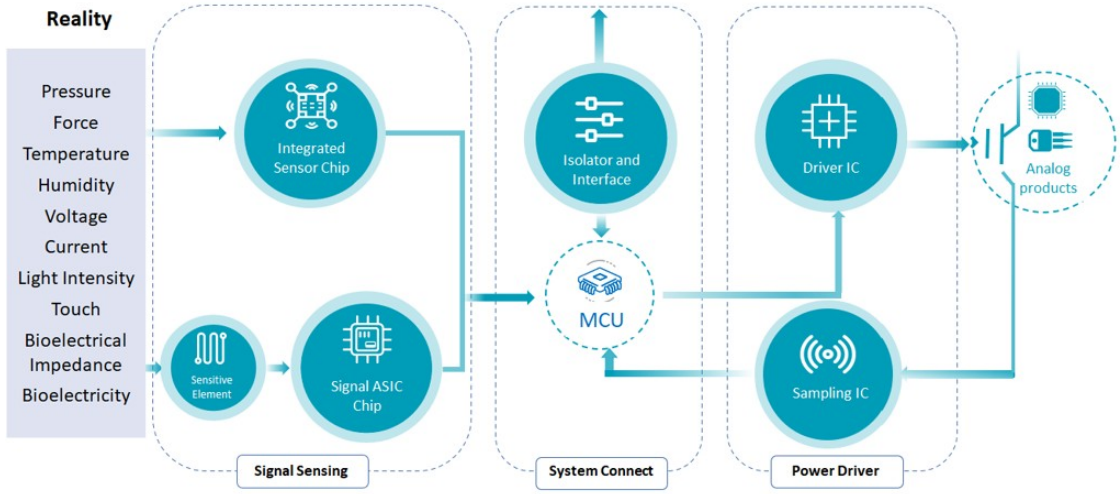
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 96: Auto and industrial are currently Novosense's major end-markets. It has successfully lowered its consumer tech exposure



Source: Company data, Morgan Stanley Research.

Exhibit 97: Novosense: Product map



Source: Company data.

Foundry costs account for 55% of COGS

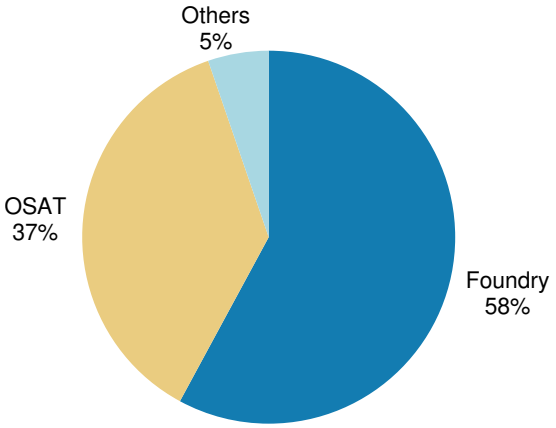
Novosense's main foundry supplier is Dongbu HiTek, although its other suppliers include SMIC and TSMC. Its suppliers for OSAT service are ASE and JCET. Novosense also produces the sensitive elements of a ceramic capacitive pressure transducer. It purchases materials to make these elements from Xiangyang Zhanxin.

Novosense announced a 100% control in its subsidiary Suzhou Naxiwei from the end of 2021, as it helps to conduct IC packaging and testing for Novosense. It expects the Naxiwei fab to enter the mass production stage by 2H22.

As Novosense runs a fabless business model without foundry businesses, production costs are largely allocated in foundry and OSAT. These account for 95% of COGS in total.

- Foundry costs make up 55% of COGS. Most foundry processes are in 0.13-0.18um, while motor driver is at 90nm (for digital process).
- Packaging and testing (OSAT) account for 35% of COGS.
- Others make up 5% of COGS.

Exhibit 98: Novosense's COGS (2021)

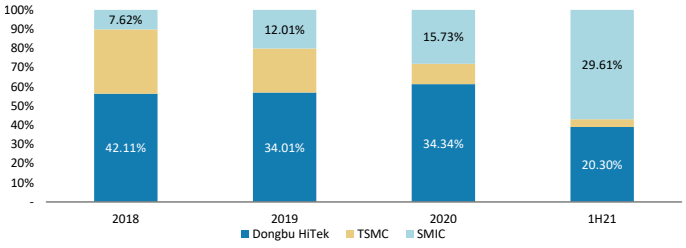


Source: Company data, Morgan Stanley Research.

Exhibit 99: Novosense key suppliers

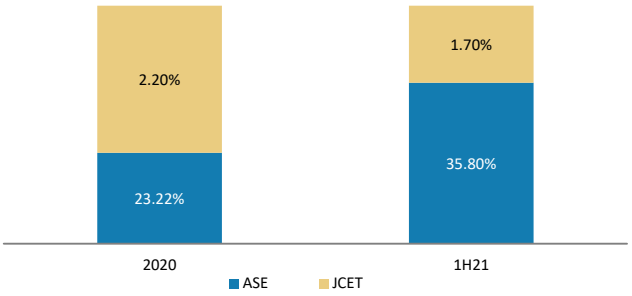
Source: Company data, Morgan Stanley Research.

Exhibit 100: Dongbu HiTek is now the largest foundry supplier of Novosense



Source: Company data, Morgan Stanley Research.

Exhibit 101: JCET is currently Novosense's major OSAT supplier



Source: Company data, Morgan Stanley Research.

Key customers

Novosense's well-known distributor partners include Ameston and Avnet etc. Suzhou MiraMEMS, Wuxi Willmems Semiconductor are also among its direct sales customers. The auto market is its target end-market. It has successfully entered several Chinese EV OEMs' supply chain, including BYD, Wuling, CATL, FAW Group and Great Wall Motor. For Industrial and consumer products, it has also entered Sungrow Power Supply, ZTE, Will Semi, Hikvision and Inovance. China is Novosense's major market.

Shareholders and management - China "ADI"

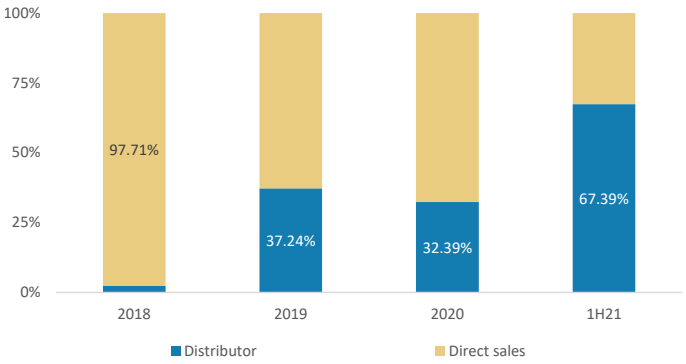
ShengYang Wang, Founder, Chairman and CEO started his career as an engineer at ADI Shanghai during 2009-12. Before founding Novosense, he was an R&D manager at Wuxi Nano MEMS Inc. and Director of Shanghai Geting Micro.

Yun Sheng, Founder, Board member, vice president and head of R&D, was previously Director of Research at Wuxi Nano MEMS Inc. before he founded Novosense. He was also the senior design engineer previously at ADI Shanghai.

Yifang Wang, Board member and vice president, was previously a Director at Jing Yun Chuang Xiang Technology in 2014-16. Prior to that he was a product manager at Wuxi Rave Optoelectronics Technology during 2009-13.

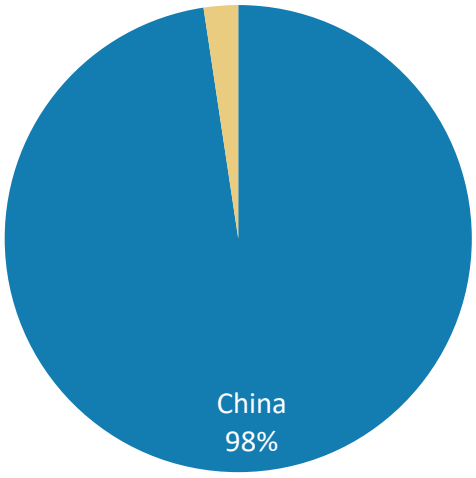
Besides ShengYang Wang and Yun Sheng, a number of Novosense R&D engineers previously worked at ADI. These include ShaoYu Ma (director of IC Design center), Chia Chao (Director of Signal IC business) and Chien Yeh (Isolator and Interface business).

Exhibit 102: Novosense sells its products via direct sales and distributors



Source: Company data, Morgan Stanley Research.

Exhibit 103: China is Novosense's major revenue exposure



Source: Company data, Morgan Stanley Research.

Exhibit 104: Novosense: Top 10 shareholders as of 2Q22

Shareholder	%	Remark
Shengyang Wang	14.6	Chairman and CEO
Yun Sheng	13.6	
Suzhou Guorun Ruiqi Venture Capital	11.38	
Suzhou Ruixi Info Consultant	6.15	Novosense's employee stock incentive platform. Also jointly funded by Shengyang Wang (45%), Yun Shen (40%) and Yifang Wang (15%)
Yifang Wang	5.1	
Senzhen Huiyue Growth Investment	5.04	
Suzhou Novosense No.1 Info Consultant	3.66	Novosense's employee stock incentive platform.
Shenzhen Shangyun Sensing Investment	3.5	
Shanghai IoT Phase2 Venture Capital Fund	2.97	
Suzhou Huayue Zhiyuab No.1 Venture Capital	2.97	

Source: Company data, Morgan Stanley Research.

Awinic: Faces greater headwinds than peers; initiate at UW

Awinic has 60-65% exposure to smartphones, mainly Chinese brands including OppO, Xiaomi, and Vivo. Although the smartphone market remains large, competition is also high – especially as we enter a weaker smartphone cycle. Historically, Awinic's revenue momentum has had a strong correlation to Chinese smartphone brands' annual shipments (correlation = 0.95). After a 15% decline in China's smartphone shipments in 2022, we forecast the smartphone market might only grow by mid-single-digits in 2023.

Awinic's key growth driver is volume: In 2018-21, the company's main source of growth was unit shipments as opposed to price hikes as it gained market share. We believe volume products may face stronger headwinds during a weaker cycle. The company is expanding into industrial and auto, but we believe the initial revenue contribution will be low in the next few years.

Awinic's GM is much lower than Greater China analog peers, as it targets a GM of only 40%. As the company thinks high GM business will attract more competition from peers, they are looking for areas with a reasonable GM. On the other hand, GM cannot be too low as they still need to support their R&D. As such, a GM of 40% seems suitable for Awinic's position in the China market.

Lack of business momentum and relatively low investment in application-specific areas; initiate at UW: We believe Awinic will face more challenges during a weaker smartphone cycle, and it might be difficult for the company to catch up in the industrial and auto segments in the near term.

Key upside risks to our view: 1) Market share expansion during a weak cycle; 2) Faster-than-expected expansion in the industrial and auto businesses; and 3) Faster-than-expected expansion in long-term GM as it wins more business from high-end market.

Reuters:688798.SS / Bloomberg: 688798:CH Greater China Technology Semiconductors	
Price target	Rmb75.00
Up/downside to price target (%)	-17%
Shr price, close(Sep 23,2022)	Rmb90.54
52-Week Range	Rmb90.35-261.99
Sh out, dil, curr (mn)	166
Mkt cap, curr (mn)	Rmb15,030
EV, curr (mn)	Rmb15,030
Avg daily trading value (mn)	NA

Fiscal Year Ending	12/21	12/22e	12/23e	12/24e
ModelWare EPS(Rmb)	2.09	1.78	2.02	2.90
Consensus EPS(Rmb)§	1.64	2.20	3.19	4.40
Revenue, net (Rmb mn)	2,327	2,861	3,099	3,598
EBITDA (Rmb mn)	266	290	342	491
ModelWare net inc (Rmb mn)	288	295	336	482
P/E	103.3	51.0	44.7	31.2
P/BV	8.0	4.6	4.2	3.8
RNOA (%)	56.5	12.1	10.0	13.8
ROE (%)	75.8	7.9	10.2	13.6
EV/EBITDA	104.9	49.4	41.3	28.2
Div yld (%)	0.2	0.5	0.6	0.0
FCF yld ratio (%)	0.5	(7.6)	1.7	2.6
Leverage (EOP) (%)	(51.9)	(21.4)	(24.9)	(30.1)

Unless otherwise noted, all metrics are based on Morgan Stanley ModelWare framework

§ = Consensus data is provided by Thomson Reuters Estimates

e = Morgan Stanley Research estimates

Company description

Founded in 2008, Aiwinic is an IC design company, mainly focusing on high quality signal chain, analog and RF related segments. Major products include Audio amplifier, Power Management IC, RF Front-end IC and Motor driver IC. Smartphone, wearables, TWS, tablets, NB, IoT module and smart speakers being its key target end markets.

Awinic: Thesis #1 - Highly exposed to the smartphone market

60-65% exposure to smartphones: In 1H22, Awinic had a 60-65% revenue contribution (Exhibit 110) from smartphones (mainly Chinese brands including OppO, Xiaomi, and Vivo). Although the smartphone revenue contribution has come down from 85%+ back in 2018-2020 (Exhibit 105, Exhibit 106), it remains the highest among all Greater China analog companies we cover.

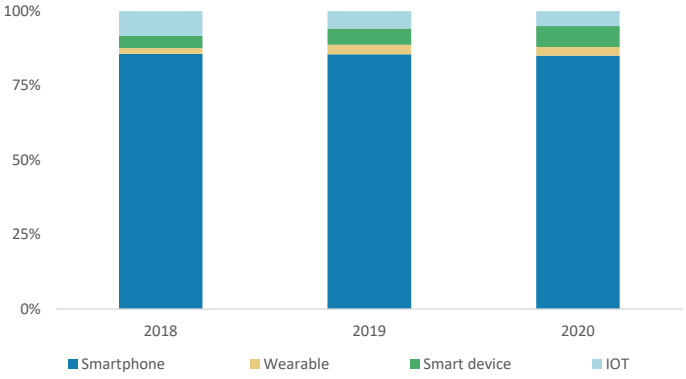
Smartphones remain a large TAM… It makes sense that smaller IC design houses target the smartphone market, as strong revenue and shipment growth can be achieved when they break into a new smartphone model. Smartphone shipments also remain much higher volume compared to NBs, auto and industrial products. China IC design houses such as Maxscend have used the same strategy and enjoyed strong growth momentum in the business expansion stage.

…but competition is also high: As there are already analog suppliers in the smartphone supply chain, newcomers might have to provide more attractive pricing to smartphone ODMs/OEMs to tap into the supply chain. Moreover, design houses usually have less bargaining power with smartphone ODM/OEM suppliers. We think this is one of the reasons Awinic is only targeting a 40% GM longer term, and its key driver of revenue growth is shipments (Exhibit 114) instead of ASP expansion (Exhibit 115).

More competition in a weak smartphone cycle: Awinic's management has indicated that customer demand is slowing down, especially for smartphone customers, and it is still unclear how long it will take for customers to adjust inventory.

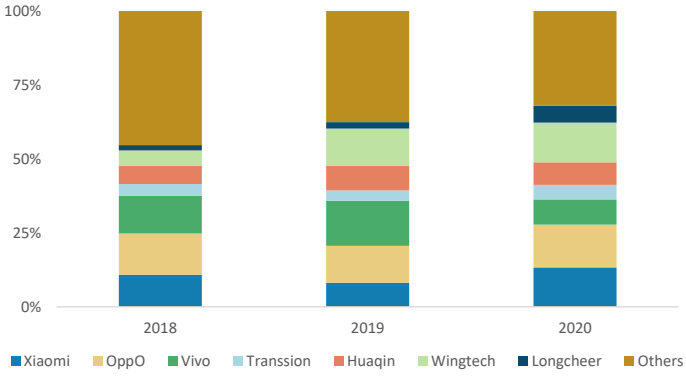
Historically, Awinic's revenue momentum has had a strong correlation to Chinese smartphone brands' annual shipments (correlation = 0.95; Exhibit 108), including Huawei, OppO, Vivo, and Xiaomi. After a 15% decline in China's smartphone shipments in 2022, we forecast, the smartphone market might only grow by mid-single-digits in 2023. That is to say, it will be challenging for Awinic to grow revenue rapidity into 2023-24.

Exhibit 105: Awinic had 85%+ revenue exposure to smartphones in 2018-20



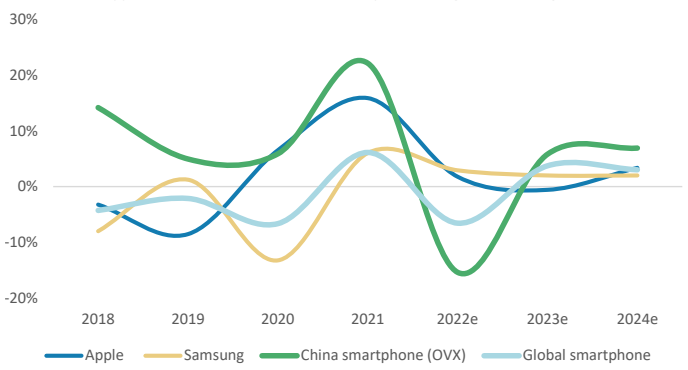
Source: Company data.

Exhibit 106: Awinic's key customers are mainly smartphone OEMs and ODMs



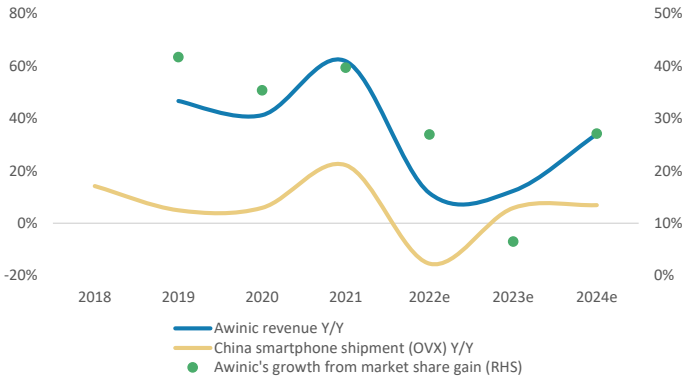
Source: Company data.

Exhibit 107: Weakening China smartphone demand



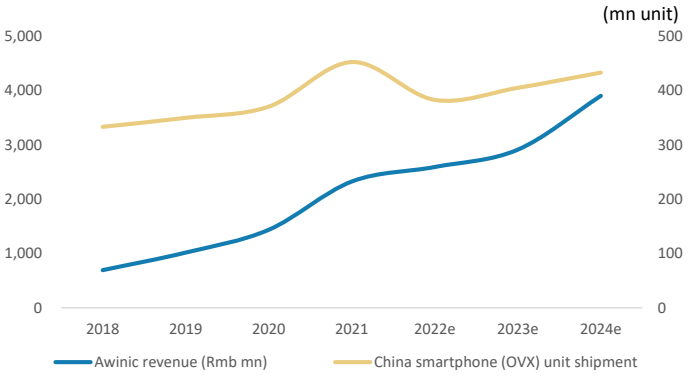
Source: Gartner, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 108: Awinic's revenue growth momentum has a strong correlation to China smartphone (OVX) unit shipments



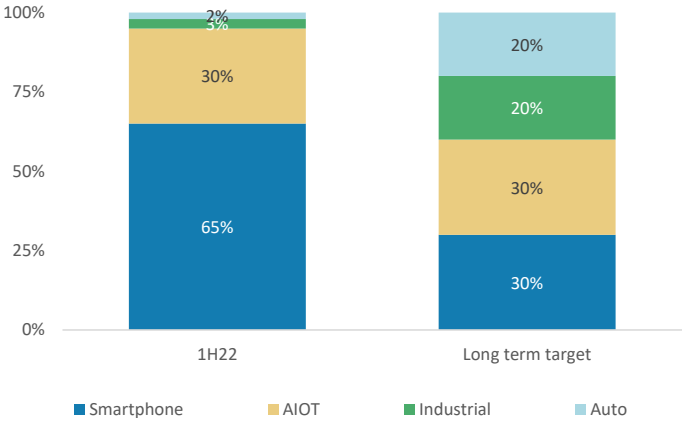
Source: Gartner, company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 109: Awinic should outgrow China's smartphone TAM, thanks to market share gains as it invests in R&D



Source: IHS, company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 110: Awinic's long-term target is to have 20% of revenue from industrial and 20% from auto



Source: IHS, company data, Morgan Stanley Research estimates.

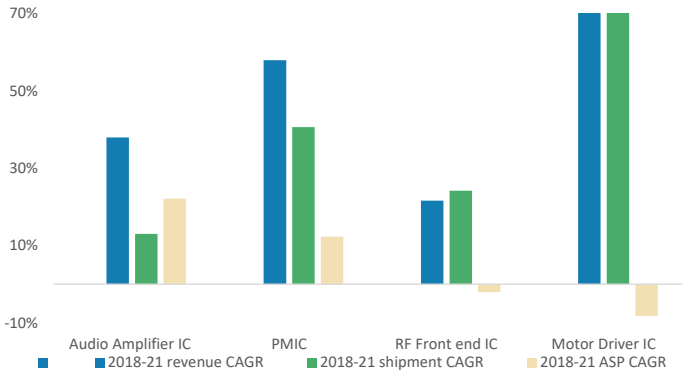
What is Awinic's strategy? Key growth driver coming from volume instead of value

Can the company provide more value to customers? In Theme #2: Focus on companies dedicated to application-specific areas, such as industrial or automotive , we shared the reason we believe companies with stronger industrial and auto businesses should win in the long term.

Awinic management has indicated that they would like to diversify away from the smartphone market, and their long-term revenue exposure targets are smartphones (30%), AIOT (30%), industrial (20%), and auto (20%) (Exhibit 110).

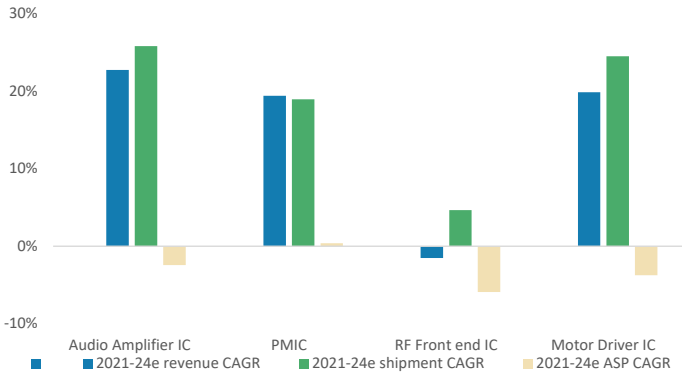
If we look back to 2018-21 (Exhibit 111), it is clear that the main source of growth was unit shipments instead of ASP hikes. This means the company gained market share (Exhibit 109) by providing attractive pricing to customers.

Exhibit 111: During 2018-21, most of Awinic's revenue expansion was from shipment growth instead of price hikes



Source: Company data.

Exhibit 112: We expect shipments will continue to be the key growth driver during 2021-24



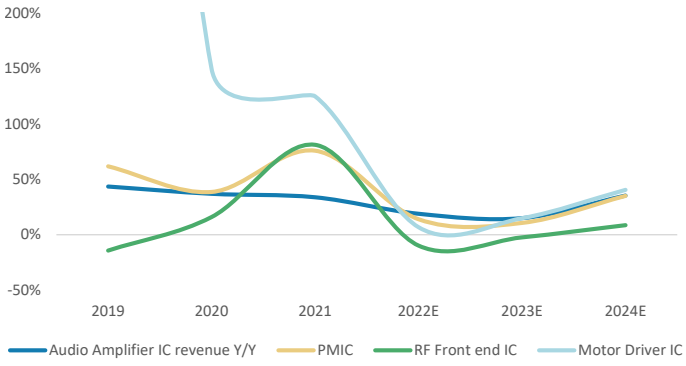
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Volume products might face stronger headwinds during a weaker cycle

We expect Awinic's 2023-24 revenue momentum to slow down due to weak China smartphone demand. It might be hard for Awinic to come up with rapid growth from value products quickly as it takes time to penetrate key auto and industrial customers.

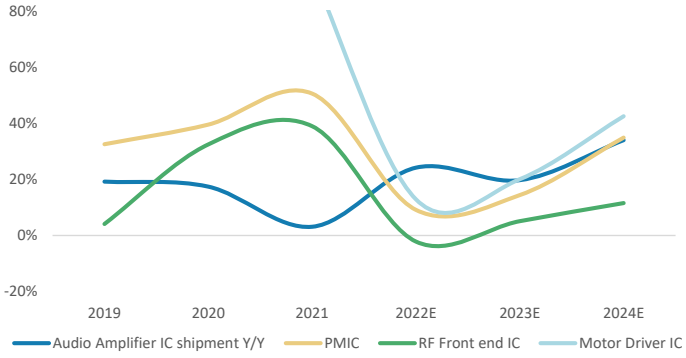
Although Awinic has some strategy partners like Samsung, Facebook, Amazon, and Google, and has started to work with auto brands like BYD, Chery, Geely, Wuling, and Hyundai Motor, it will take time for the revenue contribution to become significant.

Exhibit 113: We expect revenue growth to slow into 2023-24



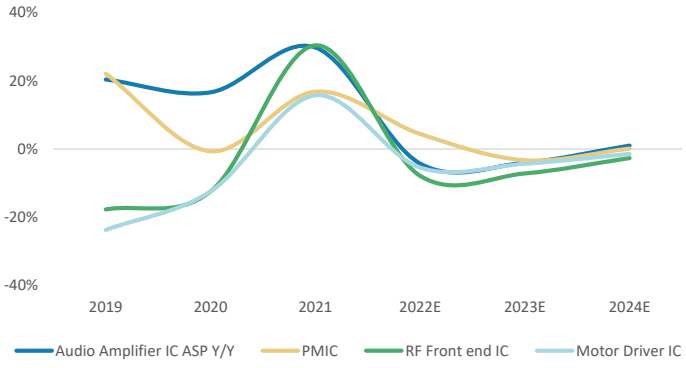
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 114: Shipments are the main source of growth



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 115: ASP trend – Awinic continues to adopt a competitive pricing strategy

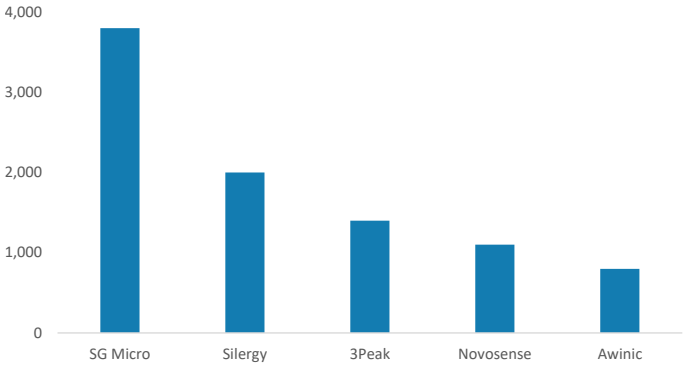


Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Still room for SKU to grow

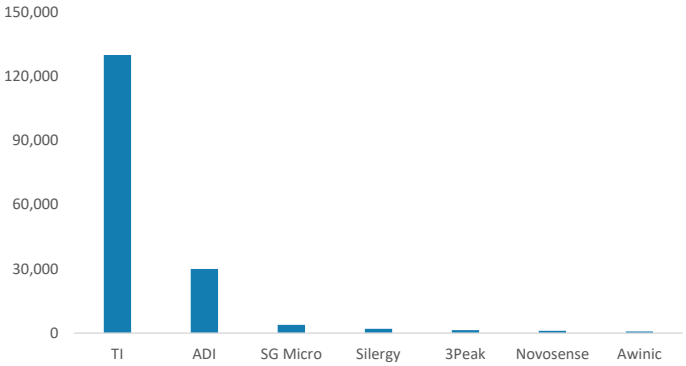
Awinic has only 800+ SKU so far, much lower than its global and China analog peers (Exhibit 116). The company has stated that it will continue to invest in R&D for more SKUs in different end-applications.

Exhibit 116: Key China analog company's SKU - Awinic's SKU (800) is less than other China PMIC peers in 1H22



Source: Gartner, Morgan Stanley Research.

Exhibit 117: Greater China analog players still have a big gap in terms of SKU compared to the global analog leaders in 1H22



Source: Gartner, Morgan Stanley Research.

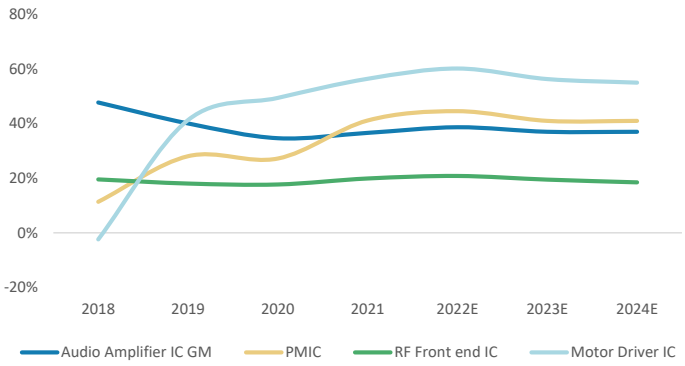
Awinic: Thesis #2 - Margin compression from macroeconomic environment, business strategy, and competition

The company is not targeting high margins

Awinic targets GM of only 40%. The company thinks a high GM business will attract more competition from peers, so it is looking for the areas with reasonable GM. On the other hand, GM cannot be too low as the company still needs to make a profit to support its R&D investment. As such, it views having a GM of 40% is a suitable range for it to become competitive in the China analog market.

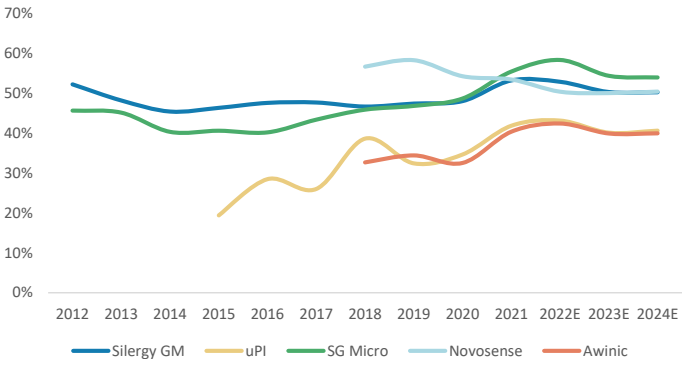
Awinic's GM is much lower than its Greater China analog peers such as Silergy, SG Micro, and Novosense (Exhibit 119). We do not expect such strategy to bring too much value to investors. Considering Awinic is not dedicated to investing in the high-end market, it might lose its competitive ability in the long term.

Exhibit 118: Awinic's GM trend by product



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 119: Awinic gross profit breakdown by product line



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

What are the key areas of R&D investment?

The company plans to continue investing in R&D: Awinic shared in its 2Q22 earnings call that R&D labor will continue to expand in 2023 vs. 2022. Although the company is facing a downcycle near term, it aims to continue investing in new product lines.

Expanding new customers: including

- Microsoft
- AR/ VR brand for strategic partners (like Tiktok, Xiaomi, Huawei) to supply audio motors and power management products
- Auto customers: Awinic's module product has already passed Tier 1 qualification and has direct support from BYD

R&D development continues for its charging product (for 10-100W) and audio product (20-75W). The company is expanding its R&D center for auto and industrial testing. This would enable Awinic to perform product quality tests for those 8-inch/12-inch products that require a high temperature working environment.

What are the key business drivers going forward?

The company will continue to expand its business in audio amplifier IC, PMIC, radio frequency (RF) front-end IC, and motor driver IC.

- Audio amplifier IC: This key product is currently mainly for smartphones, although the company plans to eventually penetrate into NB, speaker, AR/VR, and auto applications. While we learned that Awinic's audio amplifier business market share is already quite high (~30%) compared to other Greater China analog peers,

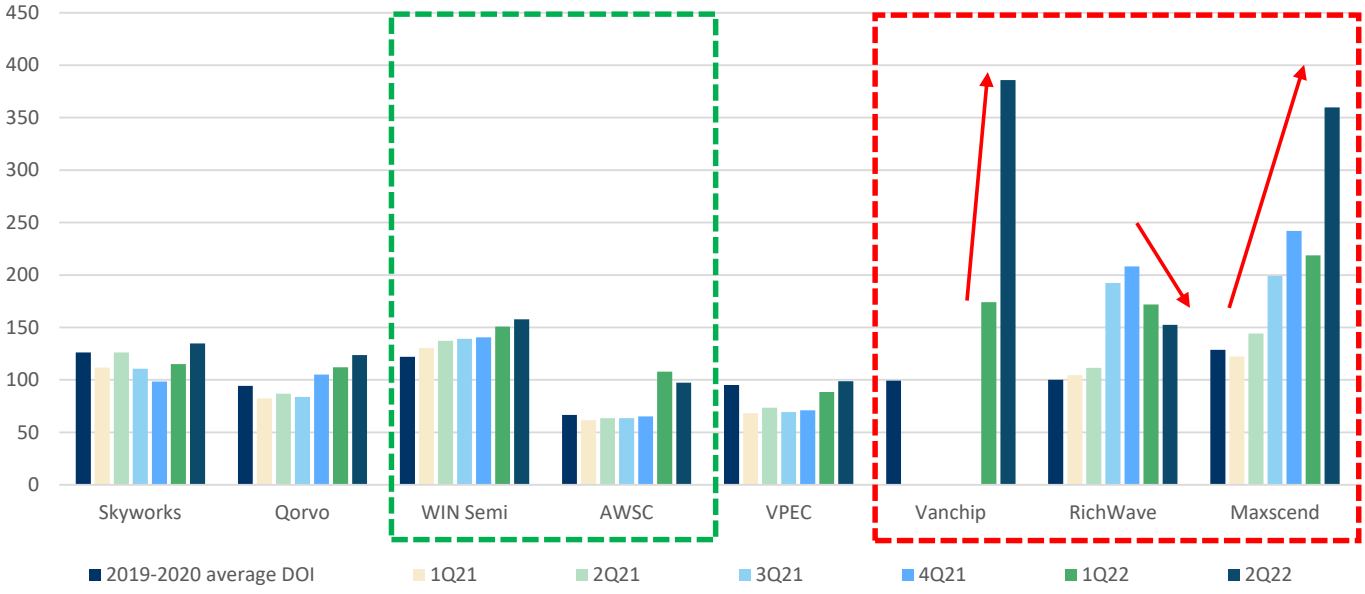
according to our supply chain check. The company has stated that it might extend this business from audio amplifier to audio codec (to upstream).

- **PMIC:** Considering PMIC is very important in the analog market, the company has stated that it will continue investing in the product. Awinic is targeting DC/DC, charger, and load switch products. Management shared that the PMIC market remains big, and that it sees opportunity to gain a broad base of clients in this market.
- **RF front-end IC:** Products for RF include switches, tuners, and modules. Aside from smartphones, Awinic plans to also supply RF front-end IC to AIOT applications, which require a more diversified product line and should come out with more SKU to support smaller customers.
- **Motor driver IC:** The company thinks the motor driver IC business might continue to contribute 12%+ in the long term.

We are concerned about the challenging China RF market

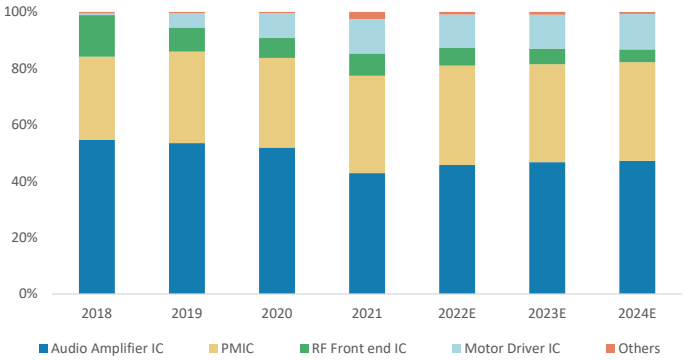
Competition in the China RF market will continue to grow. As demand will likely remain weak for the next few quarters, there may be a higher risk of price cuts. Awinic may thus find it difficult to expand its business in the RF market during a such weak business environment. Moreover, key China RF players such as Vanchip and Maxscend are suffering from high days of inventory (DOI), leaving limited room for newcomers to gain market share. For further details see Maxscend: Challenging environment without sign of improvement (29 Aug 2022).

Exhibit 120: Maxscend's high inventory level could lead to risk of inventory write-off



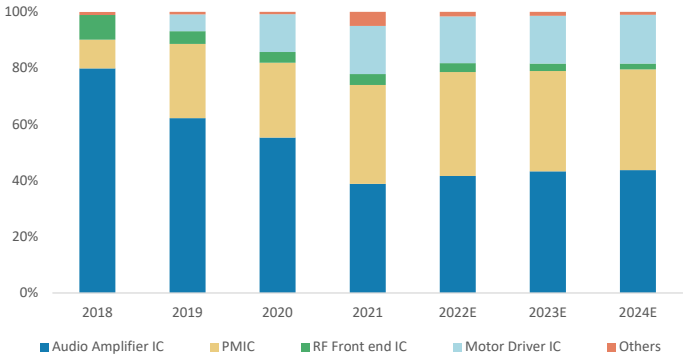
Source: Bloomberg, Morgan Stanley Research.

Exhibit 121: Awinic revenue breakdown by product line



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 122: Awinic gross profit breakdown by product line



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 123: Awinic's customers as of 2021

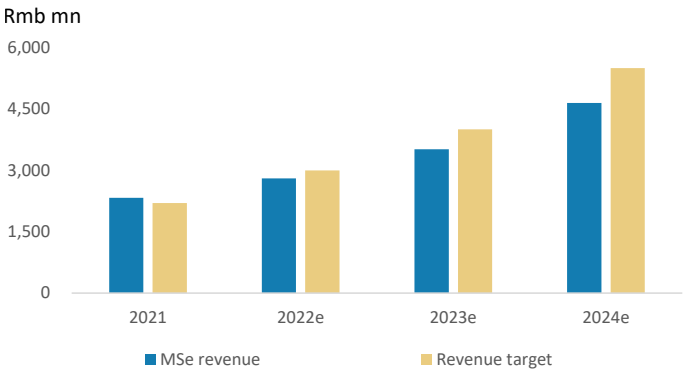
	Audio Amplifier IC	PMIC	RF Front end IC	Motor Driver IC
Samsung	V	V	V	
Xiaomi	V	V	V	V
Huawei	V	V	V	V
OppO	V	V	V	V
Vivo	V	V	V	V
Lenovo	V	V	V	V
Moto	V	V	V	V
ZTE	V	V	V	
Nubia	V	V		V
Transsion	V	V	V	V
LG	V			
Black Shark		V		
iFlytek		V		
Meizu		V		
OnePlus				V
AUSU				V

Source: Company data, Morgan Stanley Research.

Awinic's stock compensation program

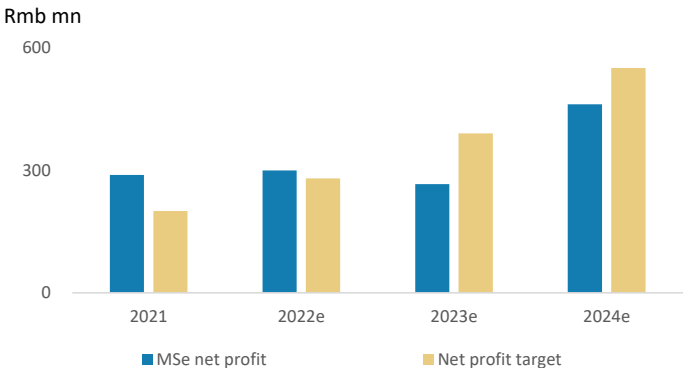
On October 2021, Awinic announced a stock compensation program targeting **1)** 2021/22/23/24 revenue to reach Rmb2.2/3.0/4.0/5.5bn, respectively, and **2)** 2021/22/23/24 net profit to reach Rmb200/280/390/550mn, respectively. We think it might be a bit challenging for the company to achieve these targets due to the weak smartphone demand cycle and compared with its peers it is less exposed to other industries with higher entry barriers. Although the company is investing more in R&D for new sectors, competition remains high so it might not easily monetize those investments in the near term.

Exhibit 124: Stock compensation program revenue target vs. MS estimates



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 125: Stock compensation program net income target vs. MS estimates



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Awinic: Where are we versus consensus?

Our 2023/24 EPS estimates are 42%/ 39% lower than Street expectations

We think the Street has overestimated Awinic's revenue growth potential, as it has a high revenue exposure to China smartphones, which is facing serious headwinds. On the other hand, the company's GM will likely be much lower than Street expectations due to the unfavorable pricing environment.

Our 2022/2023/2024 EPS forecasts are 25%/ 42%/ 39% below consensus.

Investment concerns

Awinic's business might be softer than other Greater China analog peers, as it has more exposure to consumer electronic applications, which should face more competition in the long term.

Investment positives

The company offers great solution to price sensitive customers, which is another angle for Awinic to grow it's business.

Where we could be wrong

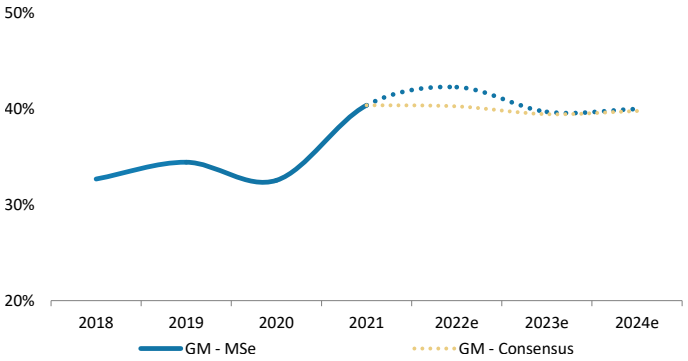
We could be wrong if 1) Awinic is able to expand market share during a weak demand cycle, 2) Awinic's industrial business expands faster than expected, 3) Awinic's auto business expands faster than expected, and 4) Awinic's long-term GM expands faster than expected as it gains more businesses from the high-end market.

Exhibit 126: Awinic: Morgan Stanley Research vs. consensus

Rmb mn	2022e			2023e			2024e		
	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*
Sales	2,861	3,376	*-15%*	3,099	4,757	*-35%*	3,598	6,282	*-43%*
Operating profit	290	446	*-35%*	342	608	*-44%*	491	840	*-42%*
Net income	295	395	*-25%*	336	576	*-42%*	482	795	*-39%*
EPS (Rmb)	1.78	2.38	*-25%*	2.02	3.47	*-42%*	2.90	4.79	*-39%*
GM	42.3%	40.3%	*2.0ppt*	39.7%	39.5%	*0.2ppt*	40.0%	39.8%	*0.2ppt*
OpM	10.1%	13.2%	*-3.1ppt*	11.1%	12.8%	*-1.7ppt*	13.6%	13.4%	*0.3ppt*

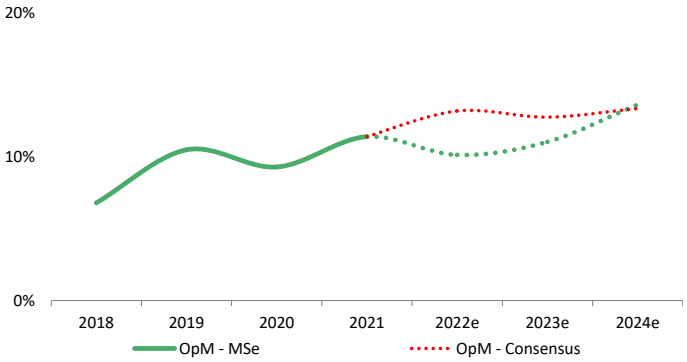
Source: Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 127: Awinic's gross margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 128: Awinic's operating margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

Awinic: Valuation methodology

Our price target is Rmb75: We derive our price target (which is also our base case value) from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.8% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 6.2%), a payout ratio of 60%, a medium-term growth rate of 16.0%, and a terminal growth rate of 5.0%, all of which are in-line with other IC design companies under our coverage. We believe our medium-term growth rate is justified, given Awinic's position as one of the leading China analog IC designers.

Our price target implies 42x 2022 earnings and 37x 2023 earnings. 37x 2023 earnings is 1SD below its average multiple since August 2021 (historical trading band of 70-200x).

Bull/bear case discussion

Our bull case value is Rmb145: Stronger sales growth with a more diversified product portfolio

In this scenario, we assume Awinic successfully ramps-up its non-consumer segment products.

Our bull scenario assumptions include: 1) a revenue CAGR of 30% in 2022-24e; 2) OPM expands to 20% in 2024 from 9% in 2020; 3) Non-consumer segment products expand to 60% of revenue from 30-35% in 2022.

Our bear case value is Rmb50: Weaker sales growth with a less diversified product portfolio

In this scenario, we assume Awinic does not successfully ramp-up its auto and industrial segment products.

Our bear scenario assumptions include: 1) a revenue CAGR of 5% in 2022-24e; 2) OPM returns to 10% vs. 9% in 2020; 3) Non-consumer segment products drop to 15% of revenue from 30-35% in 2022.

Peer comparison

We forecast Awinic's earnings to achieve a CAGR of 28% during 2022-24e, below that of our covered Greater China analog IC companies at a CAGR of 33%. We think this justifies our UW rating on Awinic as it is trading at 45x 2023 P/E (based on our EPS estimate), significantly higher than the Greater China analog IC peer average at 33x 2023 P/E.

Exhibit 129: Awinic: Residual income model

Rmb million	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E
Total Equity	**3,281**	**3,543**	**3,941**	**4,198**	**4,496**	**4,842**	**5,243**	**5,708**	**6,248**	**6,874**	**7,600**	**8,443**
Net Profit	**295**	**336**	**482**	**559**	**648**	**752**	**872**	**1,011**	**1,173**	**1,361**	**1,579**	**1,831**
ROAE	**8.4%**	**9.8%**	**12.9%**	**13.7%**	**14.9%**	**16.1%**	**17.3%**	**18.5%**	**19.6%**	**20.7%**	**21.8%**	**22.8%**
Residual Income	(50)	3	111	157	217	286	365	457	564	687	829	994
Spread	**-1.3%**	**0.1%**	**3.1%**	**4.0%**	**5.2%**	**6.4%**	**7.5%**	**8.7%**	**9.9%**	**11.0%**	**12.1%**	**13.1%**
Ending Equity Capital	3,281											
PV of Forecast Period	1,257											
PV of Continuing Value	7,898											
Equity Value	**12,437**											
No. of Shares	166											
Projected Price (Rmb)	**75**											

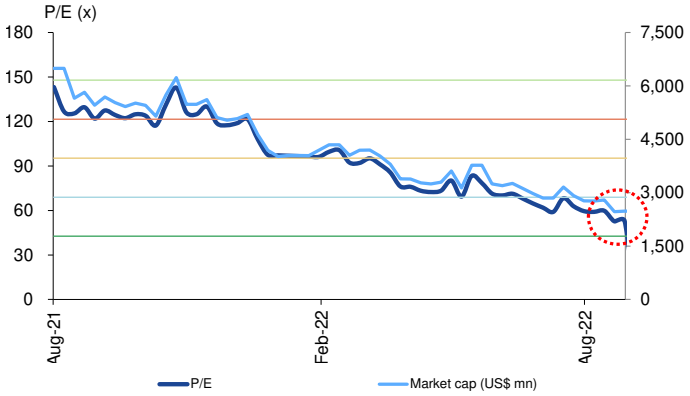
Source: Morgan Stanley Research estimates.

Exhibit 130: Awinic: Peer comparison

Ticker	Company	Closing Price	Rating	Price Target (LC)	Market Cap (US$mn)	EPS 2020	EPS 2021	EPS 2022e	EPS 2023e	EPS 2024e	P/E 2020	P/E 2021e	P/E 2022e	P/E 2023e	P/E 2024e	ROE 2020	ROE 2021e	ROE 2022e	ROE 2023e	ROE 2024e	Trading Volume (US$ mn)
China Companies																					
688052.SS	**Novosense**	290.50	**O**	**420.00**	4,148	0.7	2.9	4.3	8.0	12.7	427.2	98.5	66.9	36.5	22.9	23.3	50.9	74.1	88.7	71.3	47
300661.SZ	**SG Micro**	136.52	**E**	**170.00**	6,871	1.9	3.0	3.3	4.1	5.8	73.4	45.9	41.2	33.0	23.6	21.7	35.3	38.2	37.9	38.6	88
688536.SS	3Peak	253.50	E	313.00	4,282	2.8	5.5	4.4	6.0	7.0	89.6	46.0	57.5	42.5	36.1	13.2	15.4	15.4	17.8	17.8	52
688595.SS	Chipsea	37.19	U	33.00	735	1.1	0.9	0.4	0.7	1.1	33.8	39.6	85.2	53.5	35.4	15.8	10.4	5.6	9.3	12.7	24
688798.SS	**Awinic**	90.54	**U**	**75.00**	2,124	0.8	2.1	1.8	2.0	2.9	110.6	43.3	51.0	44.7	31.2	28.9	14.0	9.0	9.8	12.9	14
688508.SS	Chipown	56.00	NC	NA	895	0.9	1.6	2.2	3.2	4.3	63.5	34.6	24.7	17.2	12.8	11.3	12.5	14.6	17.2	19.1	28
Average											**133.0**	**51.3**	**54.4**	**37.9**	**27.0**	**19.0**	**23.1**	**26.1**	**30.1**	**28.7**	**42**
Taiwan Companies																					
6415.TW	Silergy	450.00	U	430.00	5,416	33.8	58.7	17.1	16.9	20.4	13.3	7.7	26.3	26.6	22.1	19.3	27.3	26.3	24.5	25.7	104
6719.TW	uPI	266.50	U	230.00	625	6.2	14.6	15.9	13.2	16.8	42.8	18.2	16.8	20.2	15.9	28.4	47.7	39.1	25.6	26.7	26
6138.TWO	Anpec	119.00	NC	NA	279	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29
8081.TW	GMT	131.50	NC	NA	359	11.4	25.5	26.9	17.1	NA	10.8	4.8	4.6	7.2	NA	20.4	42.7	NA	NA	NA	6
Average											**22.3**	**10.2**	**15.9**	**18.0**	**19.0**	**22.7**	**39.2**	**32.7**	**25.1**	**26.2**	**41**
Global Companies																					
6723.T	Renesas	1,305.00	O	2,000.00	17,703	64.9	120.4	198.1	185.8	219.6	20.1	10.8	6.6	7.0	5.9	7.4	14.3	22.4	18.2	18.8	102
NXPI.O	NXP	152.94	E	183.00	40,162	6.1	10.8	13.7	13.6	15.5	24.9	14.2	11.2	11.3	9.8	0.3	23.7	39.8	35.7	45.4	493
ADI.O	Analog Devices Inc.	154.18	E	173.00	72,995	5.0	6.5	9.5	9.4	9.7	30.6	23.9	16.3	16.5	16.0	10.3	5.6	6.9	6.7	7.0	602
ON.O	ON Semi	63.31	E	65.00	27,428	0.9	2.9	5.1	4.7	4.9	74.4	21.6	12.4	13.6	12.8	6.8	24.9	37.8	27.1	22.0	426
TXN.O	Texas Instrument	170.74	U	160.00	147,372	5.3	8.3	9.3	8.4	8.7	32.4	20.7	18.3	20.3	19.6	61.8	69.0	64.1	52.1	47.9	955
IFXGn.DE	Infineon	22.97	NC	NA	29,499	0.6	1.1	1.9	1.9	2.1	37.4	20.4	12.1	12.0	11.1	7.7	13.4	20.7	16.5	16.4	161
Average											**36.6**	**18.6**	**12.8**	**13.4**	**12.6**	**15.7**	**25.1**	**32.0**	**26.1**	**26.2**	**457**

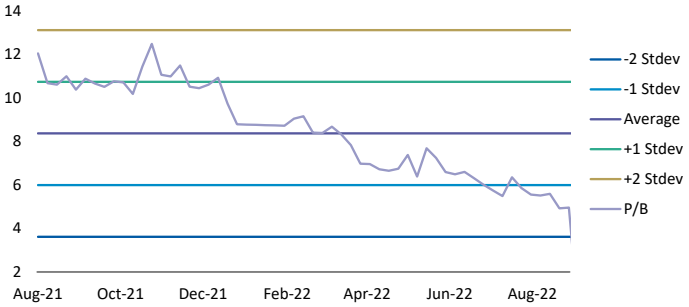
Source: Company data, Refinitiv, Morgan Stanley Research. E = Morgan Stanley Research estimates for covered companies, Refinitiv consensus estimates for non-covered ("NC") companies. Note: Share prices as of September 23, 2022.

Exhibit 131: Awinic: P/E band chart



Source: Company data, Refinitiv, Morgan Stanley Research estimates.

Exhibit 132: Awinic: P/B band chart



Source: Company data, Refinitiv, Morgan Stanley Research estimates.

Awinic: Financial summary

Exhibit 133: Awinic: Financial summary

Income Statement

Rmb mn (Years End Dec)	2018	2019	2020	2021	2022E	2023E	2024E
Net sales	694	1,018	1,438	2,327	2,861	3,099	3,598
COGS	(467)	(667)	(969)	(1,387)	(1,650)	(1,868)	(2,158)
Gross profit	227	351	468	940	1,210	1,231	1,440
Operating expenses	(180)	(244)	(334)	(675)	(920)	(888)	(949)
Operating income	**47**	**107**	**134**	**266**	**290**	**342**	**491**
Non-operating income	(8)	(14)	(35)	30	9	0	0
Pre-tax income	39	93	99	295	299	342	491
Income tax	1	3	(3)	7	4	7	9
Reported net Income	**38**	**90**	**102**	**288**	**295**	**336**	**482**
Adj.wtd.avg.shrs(m)	83	83	124	138	166	166	166
Reported EPS (Rmb)	**0.46**	**1.09**	**0.82**	**2.09**	**1.78**	**2.02**	**2.90**
Modelware EPS (Rmb)	**0.46**	**1.09**	**0.82**	**2.09**	**1.78**	**2.02**	**2.90**

Balance Sheet

Rmb mn (Years End Dec)	2018	2019	2020	2021	2022E	2023E	2024E
Cash	74	164	218	1,976	746	924	1,231
Mkt Securities	0	0	0	0	0	0	0
AR/NR	2	26	17	34	32	34	40
Inventory	189	300	379	482	512	579	669
Other	65	28	41	1,174	1,174	1,174	1,174
Current Assets	**329**	**518**	**656**	**3,666**	**2,463**	**2,712**	**3,114**
Long-term investments	0	0	0	80	80	80	80
Fixed assets	160	191	275	441	511	581	651
Deffered assets	5	10	34	60	60	60	60
Other assets	4	19	88	206	733	733	733
Total Assets	**497**	**739**	**1,053**	**4,452**	**3,847**	**4,165**	**4,637**
S/T borrowings	70	145	190	65	65	65	65
AP/NP	78	186	362	349	423	479	553
Other ST liabilities	77	82	116	232	0	0	0
LT debt	1	1	1	57	57	57	57
Other LT liabilities	0	2	4	21	21	21	21
Common shares	83	83	124	166	166	166	166
Total Liabilities	**227**	**416**	**673**	**725**	**566**	**622**	**697**
Additional capital	90	90	57	3,084	2,637	2,637	2,637
Retained earning	91	115	167	455	455	717	1,115
Other shareholders' equity	7	35	33	23	23	23	23
Total Equity	**271**	**322**	**381**	**3,728**	**3,281**	**3,543**	**3,941**
Total Liab. & Shrhldr's Equity	**497**	**739**	**1,053**	**4,452**	**3,847**	**4,165**	**4,637**

E = Morgan Stanley Research Estimates

Source: Morgan Stanley Research, Company Data

Cash Flow Statement

Rmb mn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Cashflow from Operations	**89**	**200**	**286**	**341**	**322**	**460**
Net profits	90	102	288	295	336	482
Depreciation	0	0	0	0	0	0
Working Capital Change	(126)	159	(24)	46	(14)	(21)
Other adjustments	125	(61)	22	0	0	0
Cashflow from Investing	**(13)**	**(130)**	**(1,476)**	**(597)**	**(70)**	**(70)**
Capex	0	0	0	(70)	(70)	(70)
Change of LT Investment	31	4	(1,136)	0	0	0
Change of ST Investment	0	0	3,201	0	0	0
Other adjustments	(44)	(134)	(3,541)	(527)	0	0
Cashflow from financing	**1**	**(7)**	**2,949**	**(974)**	**(74)**	**(84)**
Increase in L/T debt	(173)	(417)	(463)	0	0	0
Increase in S/T debt	0	0	0	0	0	0
Cash Dividend Paid	(72)	(53)	(7)	(72)	(74)	(84)
Dir& Emp Bonus Paid	0	0	0	0	0	0
Issuance of stock	0	0	0	0	0	0
Other adjustments	245	463	3,419	(902)	0	0
Exchange rate adjustment	13	(9)	(1)	18	0	0
Net change in cash	**91**	**54**	**1,758**	**-1,212**	**178**	**306**

Financial Ratios

	2019	2020	2021	2022E	2023E	2024E
Growth(%)						
Turnover	46.7	41.3	61.9	22.9	8.3	16.1
Operating profits	126.4	25.2	98.6	9.2	18.0	43.4
Pretax profits	134.9	6.7	198.3	1.3	14.5	43.4
Net profits	135.2	12.9	183.6	2.3	13.9	43.3
EPS	135.2	-24.7	155.3	-15.0	13.9	43.3
Margins (%)						
Gross Margin	34.5	32.6	40.4	42.3	39.7	40.0
Operating Margin	10.5	9.3	11.4	10.1	11.1	13.6
Pretax Margin	9.1	6.9	12.7	10.5	11.1	13.6
Net Profit	8.9	7.1	12.4	10.3	10.8	13.4
Return (%)						
ROAE	30.4	28.9	14.0	8.4	9.8	12.9
ROAA	14.6	11.3	10.5	7.1	8.4	10.9
Gearing (%)						
Net Debt/Equity	(5.9)	(7.5)	(51.3)	(20.8)	(24.2)	(29.6)
Liabilities/Equity	129.1	176.8	19.4	17.3	17.6	17.7
Ratios (X)						
Current ratio	1.3	1.0	5.7	5.0	5.0	5.0
Quick ratio	0.5	0.4	3.1	1.6	1.8	2.1
Others						
AR/NR Turnover (days)	5	5	4	4	4	4
Inventory Turnover (days)	134	128	113	113	113	113
AP Turnover (days)	72	103	94	94	94	94
Cash Conversion (days)	67	30	24	24	24	24

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

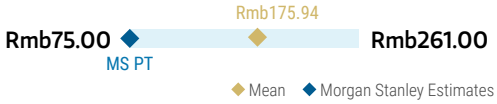
Risk Reward – Shanghai Awinic Technology (688798.SS)

Faces greater headwinds than peers

PRICE TARGET Rmb75.00

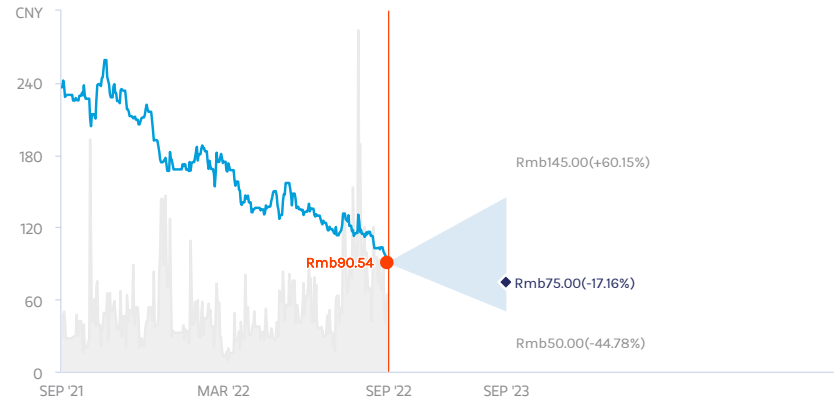
Base case, derived from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.8% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 6.2%), a payout ratio of 60%, a medium-term growth rate of 16.0%, and a terminal growth rate of 5.0%, all of which are in-line with the other analog IC companies in our coverage.

Consensus Price Target Distribution



Source: Refinitiv, Morgan Stanley Research

RISK REWARD CHART



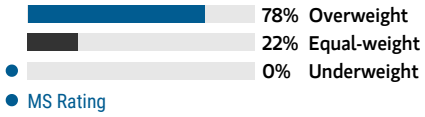
Key: Historical Stock Performance Current Stock Price Price Target

Source: Refinitiv, Morgan Stanley Research

UNDERWEIGHT THESIS

- Awinic has 60-65% revenue exposure to smartphones: These are mainly China smartphone brands including OppO, Xiaomi, Vivo. Although the smartphone market remains large, competition is also high especially as we enter a weaker smartphone cycle.
- Its key growth driver is from volume instead of value: In 2018-21, its main source of growth was unit shipments instead of ASP hikes. It gained market share by providing customers attractive prices.
- it lacks business momentum, and to date it has made relatively low investment in application-specific areas.
- Our UW rating on Awinic relative to our coverage reflects our forecast earnings CAGR of 28% in 2022-24e, vs. peers' 33%.

Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Electric Vehicles:	*Positive*
Market Share:	*Positive*
Secular Growth:	*Positive*

View descriptions of Risk Rewards Themes here

BULL CASE Rmb145.00

82x 2022e EPS

Stronger sales growth with a more diversified product portfolio.

Our assumptions include: 1) a revenue CAGR of 30% in 2022-24e; 2) OPM expands to 20% in 2024 from 9% in 2020; 3) Non-consumer segment products expand to 60% of revenue from 30-35% in 2022.

BASE CASE Rmb75.00

42x 2022e EPS

Our assumptions include: 1) a revenue CAGR of 12% in 2022-24e; 2) OPM expands to 14% in 2024 from 9% in 2020; 3) Non-consumer segment products account for 30-35% of revenue in 2022.

BEAR CASE Rmb50.00

28x 2022e EPS

Weaker sales growth with a less diversified product portfolio.

Our assumptions include: 1) a revenue CAGR of 5% in 2022-24e; 2) OPM returns to 10% in 2024 vs. 9% in 2020; 3) Non-consumer segment products drop to 15% of revenue from 30-35% in 2022.

Risk Reward – Shanghai Awinic Technology (688798.SS)

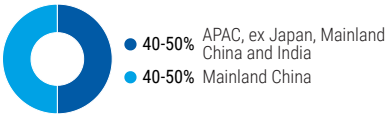
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Revenue from Audio Amplifier IC segment (Rmb, mn)	997	1,311	1,460	1,665
Revenue from PMIC segment (Rmb, mn)	803	1,009	1,075	1,273
Revenue from RF Front end IC segment (Rmb, mn)	184	181	187	171
Motor Driver IC segment (Rmb, mn)	285	336	350	460

INVESTMENT DRIVERS

- Revenue momentum
- R&D investments

GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

RISKS TO PT/RATING

RISKS TO UPSIDE

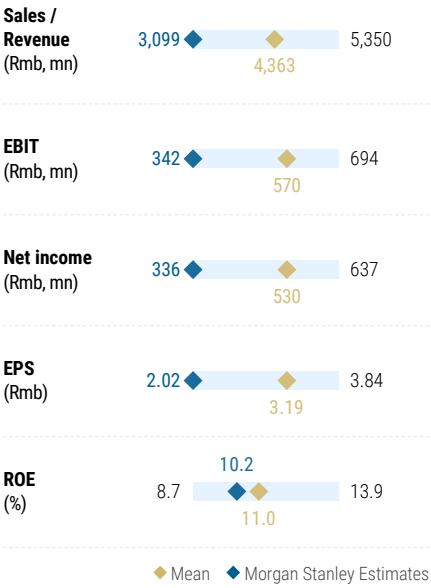
1) Awinic is able to expand market share during a weak cycle; 2) Awinic's industrial business expands faster than expected; 3) Awinic's auto business expands faster than expected; 4) Awinic's long-term GM expands faster than expected as it wins more business from high-end market.

RISKS TO DOWNSIDE

1) Awinic's pricing power is weaker than expected; 2) Awinic's new business development is slower than expected.

MS ESTIMATES VS. CONSENSUS

FY 2023e



Source: Refinitiv, Morgan Stanley Research

Awinic: Quarterly earnings summary

Exhibit 134: Awinic: Quarterly earnings summary

Rmb in million	1Q22	2Q22	3Q22E	4Q22E	1Q23E	2Q23E	3Q23E	4Q23E	2020	2021	2022E	2023E	2024E
Total Revenues	595	704	758	804	662	717	803	918	1,438	2,327	2,861	3,099	3,598
Sequential Change	*-10.6%*	*18.2%*	*7.7%*	*6.0%*	*-17.6%*	*8.3%*	*12.1%*	*14.3%*					
Change vs Year Ago	*0.0%*	*0.0%*	*0.0%*	*20.7%*	*11.2%*	*1.8%*	*5.9%*	*14.2%*	*41.3%*	*61.9%*	*22.9%*	*8.3%*	*16.1%*
Cost of Sales	318	411	448	481	402	435	489	559	969	1,387	1,650	1,868	2,158
Percent of Revenues	*53%*	*58%*	*59%*	*60%*	*61%*	*61%*	*61%*	*61%*	*67%*	*60%*	*58%*	*60%*	*60%*
Gross Profit	277	293	310	322	260	282	313	359	468	940	1,210	1,231	1,440
Percent of Revenues	*46.5%*	*41.6%*	*40.9%*	*40.1%*	*39.2%*	*39.3%*	*39.0%*	*39.2%*	*32.6%*	*40.4%*	*42.3%*	*39.7%*	*40.0%*
Incremental Margin	*NM*	*14%*	*31%*	*28%*	*NM*	*41%*	*37%*	*40%*	*33%*	*40%*	*45%*	*9%*	*42%*
Total Opex	214	234	236	237	215	217	224	232	334	675	920	888	949
Percent of Revenues	*35.9%*	*33.2%*	*31.1%*	*29.5%*	*32.4%*	*30.3%*	*27.9%*	*25.3%*	*23.3%*	*29.0%*	*32.2%*	*28.7%*	*26.4%*
R&D	148	156	157	158	150	152	154	156	205	417	620	612	628
Percent of Revenues	*24.9%*	*22.2%*	*20.8%*	*19.7%*	*22.7%*	*21.2%*	*19.2%*	*17.0%*	*14.3%*	*17.9%*	*21.7%*	*19.7%*	*17.5%*
General & administrative	38	39	37	35	35	33	34	35	67	131	150	137	159
Percent of Revenues	*6.4%*	*5.6%*	*4.9%*	*4.4%*	*5.3%*	*4.6%*	*4.2%*	*3.8%*	*4.6%*	*5.6%*	*5.2%*	*4.4%*	*4.4%*
Selling & marketing	28	38	41	43	30	32	36	41	62	127	150	139	162
Percent of Revenues	*4.7%*	*5.4%*	*5.4%*	*5.4%*	*4.5%*	*4.5%*	*4.5%*	*4.5%*	*4.3%*	*5.5%*	*5.3%*	*4.5%*	*4.5%*
Operating Income	63	59	74	85	45	65	89	127	134	266	290	342	491
Percent of Revenues	*10.6%*	*8.4%*	*9.8%*	*10.6%*	*6.8%*	*9.0%*	*11.1%*	*13.8%*	*9.3%*	*11.4%*	*10.1%*	*11.1%*	*13.6%*
Change vs Year Ago	*0.0%*	*0.0%*	*0.0%*	*28.2%*	*-27.7%*	*42.6%*	*33.8%*	*36.5%*	*25.2%*	*98.6%*	*9.2%*	*18.0%*	*43.4%*
Total Non-operating Income(Loss)	(5)	14	0	0	0	0	0	0	(35)	30	9	0	0
Profit Before Taxes	58	73	74	85	45	65	89	127	99	295	299	342	491
Percent of Revenues	*10%*	*10%*	*10%*	*11%*	*7%*	*9%*	*11%*	*14%*	*7%*	*13%*	*10%*	*11%*	*14%*
Taxes	1	0	1	2	1	1	2	3	(3)	7	4	7	9
Tax Rate	*1.6%*	*0.2%*	*2.0%*	*2.0%*	*2.0%*	*2.0%*	*2.0%*	*2.0%*	*-2.7%*	*2.4%*	*1.4%*	*1.9%*	*1.9%*
Reported Income (TW GAAP)	**58**	**73**	**73**	**84**	**44**	**63**	**88**	**125**	**102**	**288**	**295**	**336**	**482**
Percent of Revenues	*10%*	*10%*	*10%*	*10%*	*7%*	*9%*	*11%*	*14%*	*7%*	*12%*	*10%*	*11%*	*13%*
Change vs Year Ago	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*13%*	*184%*	*2%*	*14%*	*43%*
Reported EPS (Rmb , TW GAAP)	**0.35**	**0.44**	**0.44**	**0.50**	**0.26**	**0.38**	**0.53**	**0.75**	**0.82**	**2.09**	**1.78**	**2.02**	**2.90**
Change vs Year Ago	*0%*	*0%*	*0%*	*-25%*	*-24%*	*-13%*	*20%*	*49%*	*-25%*	*155%*	*-15%*	*14%*	*43%*

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Awinic: Company background

Founded in 2008, Awinic is an IC design company that focuses mainly on high-quality signal chain, analog- and RF-related segments. Its major products include audio amplifiers, power management IC, RF font-end IC and motor driver IC. It currently has over 800 types of products. Its key target end-markets include martphones, wearables, TWS (True Wireless Stereo), tablets, NB, IoT modules and smart speakers.

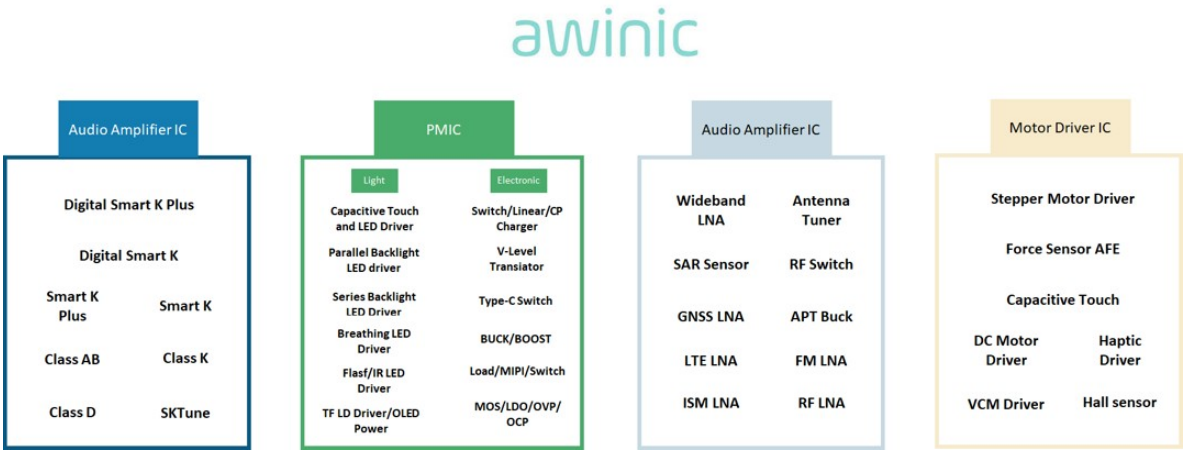
Key products include:

- Audio amplifier IC: Mainly for mobile phones, smart speakers, wearable devices, portable audio devices, shared bicycles, smart toys, smart homes
- **PMIC:** Mobile phones, tablets, smart speakers, mice, keyboards, wearable devices, smart toys, Internet of Things, etc.
- **RF front-end IC:** Mobile phones, tablets, wearable devices, smart speakers, communication devices
- **Motor driver IC:** Mobile phones, laptops, wearable devices, gaming devices, IP cameras, POS machines, smart locks, printers, robots, etc.

Customer

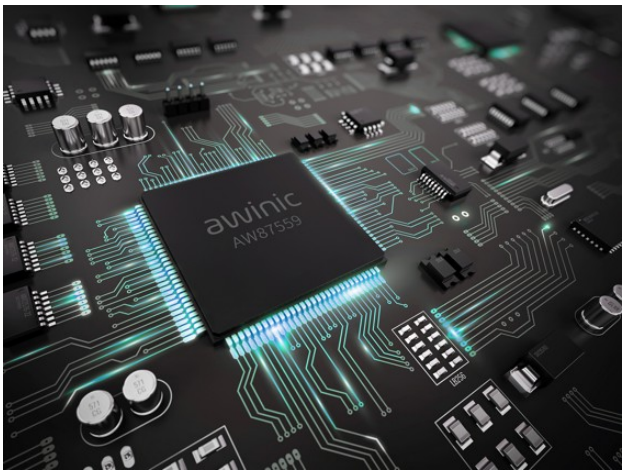
- Smartphones: Honor (used to be mainly Huawei), Xiaomi, Oppo, Vivo, Samsung, LG, Lenovo, Moto, TCL, Transsion, ZTE, etc.
- **Smartphone ODMs:** Huaqin, Wingtech, Longcheer
- **Wearables and AIoTs:** iFlytek, DJI, Baidu, Haier, Google, Amazon, JBL, Meituan, 360, etc.

Exhibit 135: Awinic's products and end-markets



Source: Company data, Morgan Stanley Research.

Exhibit 136: Awinic's audio amplifier

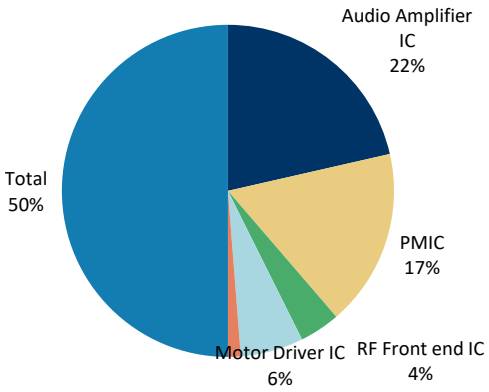


Source: Company data, Morgan Stanley Research.

Exhibit 137: Awinic's PMIC

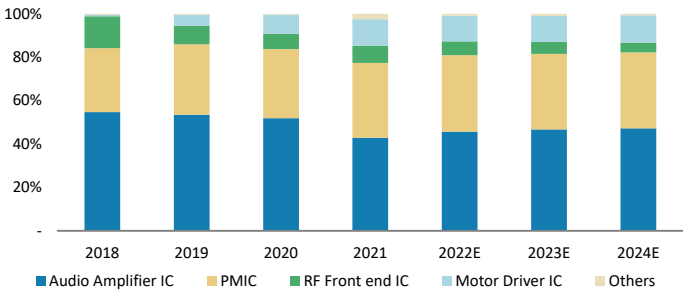
Source: Company data, Morgan Stanley Research.

Exhibit 138: Awinic's revenue breakdown, by application (2021)



Source: Company data, Morgan Stanley Research.

Exhibit 139: Awinic: Audio Amplifier IC is its main growth driver, followed by PMIC and motor driver ICs



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 140: Audio Amplifier, PMIC, RF front-end and motor driver IC are Awinic's major products

Source: Awinic.

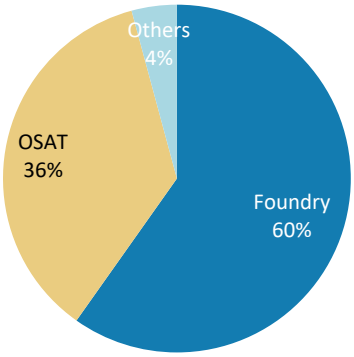
Foundry accounts for 60% of COGS

Awinic operates in a fabless business model, wherein foundry and OSAT costs are its major COGS exposure.

Awinic's foundry process is mainly (>94%) the 8-inch process, adopting 90nm-0.5um node CMOS, BCD, eflash, and SOI technology. TSMC is its main foundry supplier, from 48% of Awinic's total foundry costs in 2018 to 75% in 2020. CSMC, CR Micro's foundry service subsidiary, is Awinic's second-largest foundry source, although its portion of Awinic's total foundry costs has decreased from 40% in 2018 to 13% in 2020%. Besides TSMC and CR Micro, Awinic's other foundry sources include Hua Hong, Tower Semi and Global Foundry. We note that Awinic has increased its BCD (Bipolar-CMOS-DMOS) process (from 19% in 2018 to 52% in 2020) and decreased its process from CMOS (from 74% in 2018 to 45% in 2020).

For the OSAT (Outsourced Semiconductor Assembly and Testing) side, Tong Fu Micro is Awinic's major supplier, rose from 30% in 2018 to 48% in 2020. JCET also declined from 58% in 2018 to 37% in 2020.

Exhibit 141: COGS breakdown (2021)

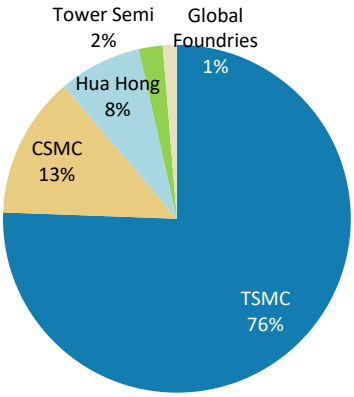


Source: Company data, Morgan Stanley Research.

Exhibit 142: Key suppliers of Awinic

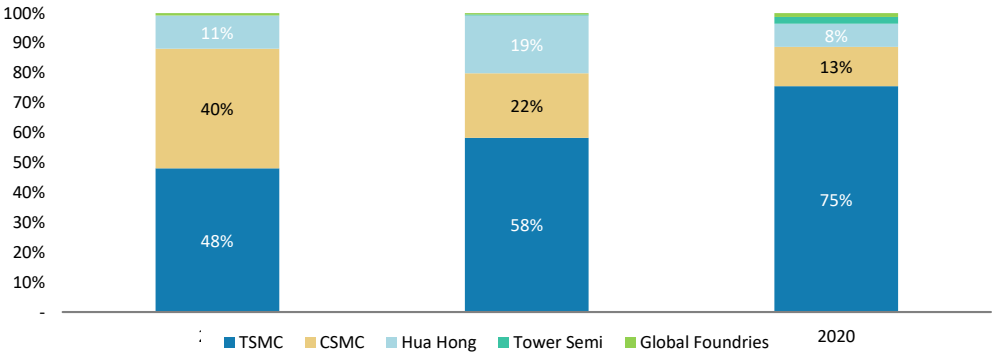
Source: Company data, Morgan Stanley Research.

Exhibit 143: Awinic: TSMC and CSMC are its major foundry suppliers (2020)



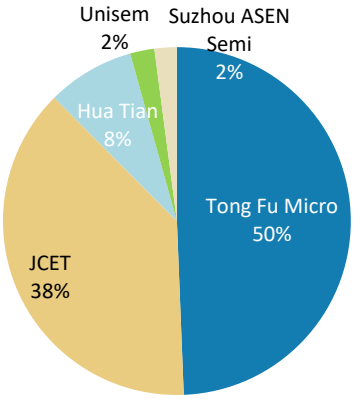
Source: Company data, Morgan Stanley Research.

Exhibit 144: TSMC has surpassed CSMC as Awinic's major supplier



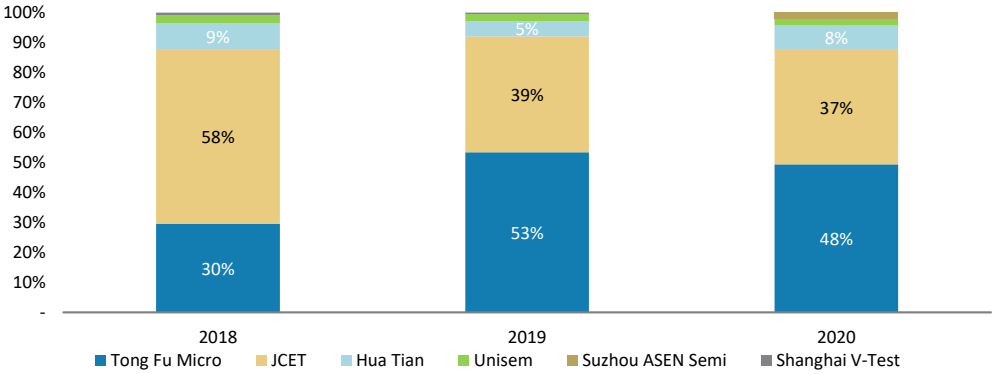
Source: Company data, Morgan Stanley Research.

Exhibit 145: Tong Fu Micro and JCET are Awinic's major OSAT service providers (as of 2020)



Source: Company data, Morgan Stanley Research.

Exhibit 146: Awinic: Tong Fu Micro has also surpassed JCET on OSAT services



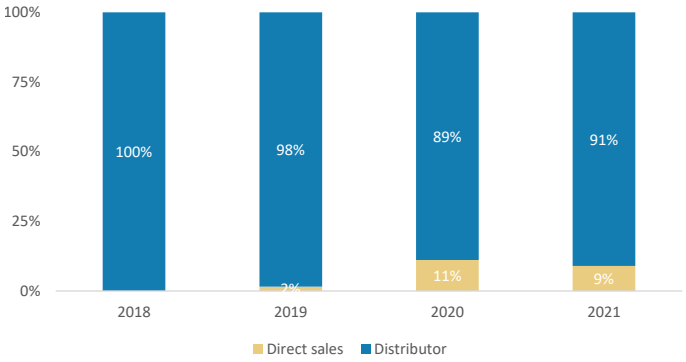
Source: Company data, Morgan Stanley Research.

Sales channel mainly from distributors

Over 90% of the company's revenue comes from distributors (Exhibit 141), as they help Awinic to promote and interact with a larger customer base. As a result, Awinic has to share the profits with its distributors (Exhibit 142).

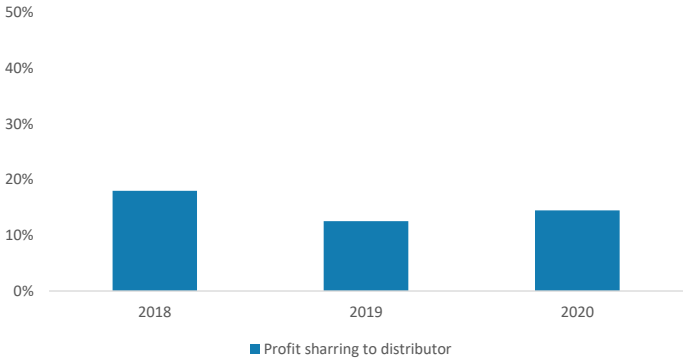
Awinic's major business model is to sell its products mainly through distributors and partially via direct sales, which is quite different from other analog IC designers. Awinic has a diversified client base. Smartphone brand customers include Samsung, Xiaomi, Oppo, Vivo, Transsion. Its major ODM clients include Huaqin, Wingtech and Longcheer. Awinic's exposure to the smartphone market is high at around 60-70% of total exposure. Awinic's long-term goal is to diversify its end-market exposure to "3/3/2/2", meaning 30% in smartphone, 30% in AIoT, 20% in industrial and 20% in auto.

Exhibit 147: Awinic: Sales channel mainly from distributors



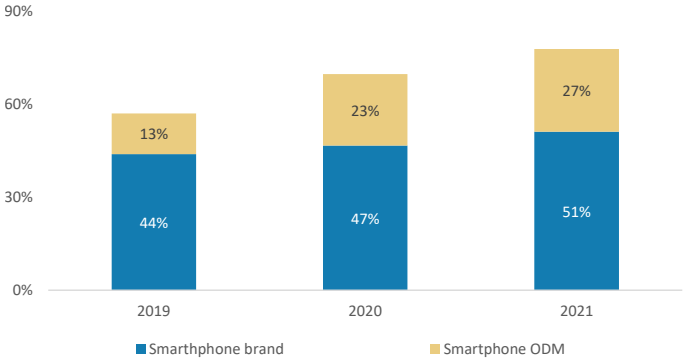
Source: Company data, Morgan Stanley Research.

Exhibit 148: Awinic: Profit sharing to distributors



Source: Company data, Morgan Stanley Research.

Exhibit 149: Awinic: Smartphone brands are the major smartphone customers



Source: Company data, Morgan Stanley Research.

Exhibit 150 Awinic: Smartphone and tablet clients

Source: Company data, Morgan Stanley Research.

Exhibit 151 Awinic: IoT, industrial and auto clients

Source: Company data, Morgan Stanley Research.

Key shareholders and management

The Chairman and CEO of Awinic, Hongjun Sun, founded the company in 2008. He was previously the Product Director of Shanghai Qipanwei Electron in 2002-08. He was also previously the engineer and Technical specialist at Huawei. He holds a master's degree in Semiconductor Devices and Microelectronics from China Southeast University.

The vice president and member of the Board, Hui Guo, has a master's degree in Physics of Semiconductor and Semiconductor Devices from Fudan University. Mr. Guo was previously a vice president at Shanghai Qipanwei Electron. Prior to that he was a manager and IC design engineer at Huawei.

Board member and founder of Awinic, Jiantao Cheng is an experienced analog IC design engineer. He previously worked at Huawei, Shanghai Qipanwei Electron, Zhuhai Yali Electron. Mr Cheng holds a B.A degree in Microelectronics from China Harbin Institute of Technology.

The Head of R&D and Vice President, Liming Du was previously an engineer at Shanghai Qizin Technology and Shanghai Qipanwei Electron. He holds a B.A in Microelectionics from China Xidian University.

Exhibit 152: Awinic: Top 10 shareholding structure in 2Q22

Shareholder	%	Remark
Hongjun Sun	41.9	Founder, Chairman and CEO of Awinic
Hui Guo	9.76	Founder, Board member
SHanghai Aizhun ENT Management Center	6.18	Awinic's employee shareholding platform
Jiantao Cheng	3.94	Founder, Board member
Zhong Zhang	3.25	Research director of Awinic
Shengbo Luo	3.06	Founder, Board member
Liming Du	2.08	Head of R&D
Invesco Ltd.	2.00	
Shanghai Awinic Employee AMP	1.93	Awinic's employee shareholding platform
HSBC Jintrust Fund Management	1.89	

Source: Company data, Bloomberg, Morgan Stanley Research.

SG Micro: iPhone business creates upside potential, but the analog cycle is our primary concern; initiate at EW

SG Micro has a strong R&D effort, and the most comprehensive SKU portfolio among the Greater China analog companies: SG Micro has ~4,000 SKUs – much higher than levels at other China analog IC companies, such as Silergy (2,000-3,000), 3Peak (1,400), Novosense (1,100), and Awinic (800). The company targets to add an additional 400-500 SKU per year.

iPhone business fosters business upside potential: Apple has been adding more China suppliers to its list of suppliers, and the new iPhone 14 product line in 2022 is the first time that Apple has adopted SG Micro's analog product. SG Micro has been working on pin-to-pin product with Apple's existing analog IC supplier. We expect this effort will contribute 2-4% of SG Micro's total revenue in 2022. Going forward, Apple revenue contribution might grow to 10%+ of SG's annual revenue if Apple increases analog content value to SG Micro from US$0.5-0.6 to US$2-3, based on our estimate.

Initiate at EW: Although SG Micro is a fast-growing analog IC player, we are concerned about weakening end-demand for analog ICs. Thus, we initiate at EW.

Key risks to our view: Upside: 1) Faster-than-expected China market share gains; 2) iPhone business content value increases rapidly; 3) Better analog price in 2023/24. **Downside:** 1) Intensifying analog price competition; 2) Lower iPhone business market share; 3) Slower R&D for new products.

Reuters:300661.SZ / Bloomberg: 300661:CH Greater China Technology Semiconductors	
Price target	Rmb170.00
Up/downside to price target (%)	24%
Shr price, close(Sep 23,2022)	Rmb136.52
52-Week Range	Rmb134.22-252.00
Sh out, dil, curr (mn)	356
Mkt cap, curr (mn)	Rmb48,621
EV, curr (mn)	Rmb48,621
Avg daily trading value (mn)	NA

Fiscal Year Ending	12/21	12/22e	12/23e	12/24e
ModelWare EPS(Rmb)	2.98	3.31	4.13	5.78
Consensus EPS(Rmb)§	1.83	3.06	4.19	5.72
Revenue, net (Rmb mn)	2,238	3,449	4,597	6,161
EBITDA (Rmb mn)	676	1,207	1,601	2,237
ModelWare net inc (Rmb mn)	679	1,080	1,472	2,057
P/E	71.3	41.4	33.2	23.7
P/BV	18.5	13.5	10.8	7.9
RNOA (%)	88.6	96.0	112.1	132.5
ROE (%)	45.3	44.9	44.5	45.6
EV/EBITDA	63.6	38.6	28.5	19.7
Div yld (%)	0.4	0.6	0.8	1.1
FCF yld ratio (%)	1.0	2.2	2.7	3.8
Leverage (EOP) (%)	(60.8)	(67.6)	(71.9)	(76.1)

Unless otherwise noted, all metrics are based on Morgan Stanley ModelWare framework

§ = Consensus data is provided by Thomson Reuters Estimates

e = Morgan Stanley Research estimates

Company description

Founded in 2007, SG Micro specializes in high performance, high quality analog IC design, marketing and sales, and offers innovative solutions for a broad range of applications in wireless communication, consumer, medical, automotive and industrial markets.

SG Micro: Thesis #1 – Strong R&D investment with the most comprehensive SKU portfolio

SG Micro has the most comprehensive product portfolio among all China analog IC companies

SG Micro has ~4,000 SKUs: This is a much higher level than at other China analog IC companies, such as Silergy (2,000-3,000), 3Peak (1,400), Novosense (1,100), and Awinic (800) (Exhibit 72). SG Micro currently has 25 product lines, much higher than its 16 in 2019, and the company targets to introduce 200-300 new products per year (with additional 400-500 SKU introduction; Exhibit 73).

Per our assessment, adding more product lines in different end-applications, with more SKU introduction, is a key to success for analog companies, as the required R&D development boosts the future growth opportunity. Historically, SG Micro's revenue has a strong correlation to its SKU numbers (Exhibit 155 ; correlation = 0.99).

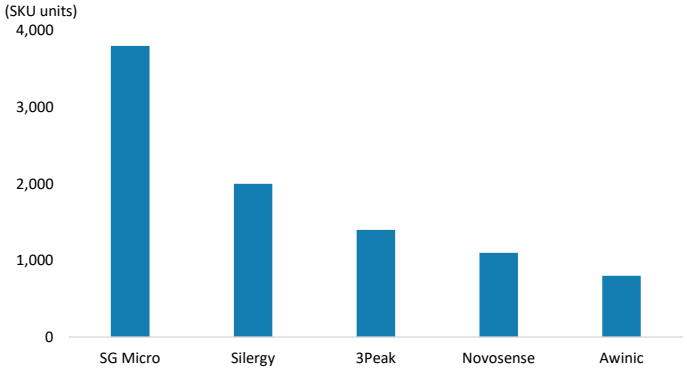
Future business driver

SG Micro plans to invest more in power chargers and DC/DC products in the upcoming years, and to introduce an AMOLED display power supply chip product; such development should help SG Micro grow its analog IC chip volume in various sectors.

What is SG Micro's niche?

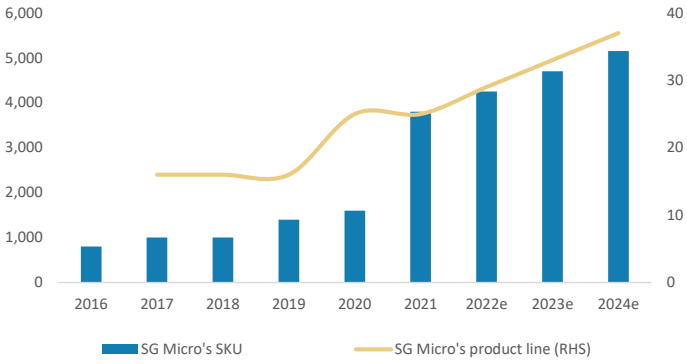
Compared with its overseas analog IC peers, SG Micro has many local customers to service and provide competitive time-to-market design. Analog is a fragmented market in which smaller players can take share and remain profitable; other Asia analog companies, such as Richtek, uPI, Silergy, GMT, are such examples. SG Micro offers a relatively more differentiated technology and product portfolio than its Chinese peers. It leads in low power, high current, and high precision analog design.

Exhibit 153: SG Micro has the largest SKU portfolio among Greater China analog companies in our coverage



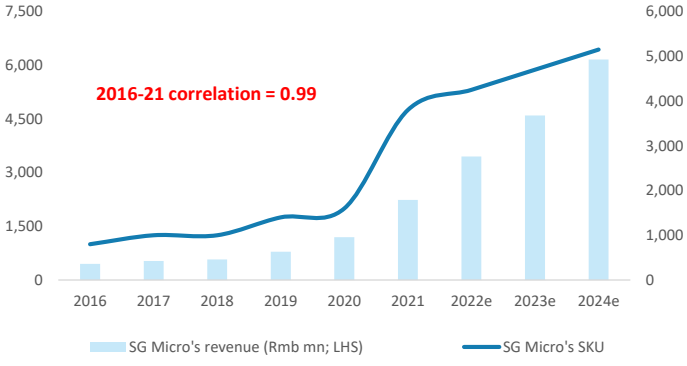
Source: Company data, Morgan Stanley Research estimates.

Exhibit 154: SG Micro continues to expand its product line and SKUs



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 155: SG Micro continues to expand its SKUs, which provides future revenue growth momentum



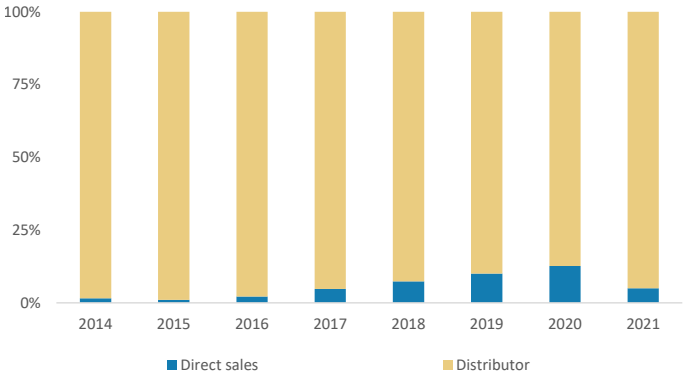
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Business model is very reliant on distributors

SG Micro is a fast-growing design house, starting from a relatively small scale (2021 revenue of US$320mn vs. TI at US$18.3bn, or 2% of TI's business size). An effective approach for smaller design houses to expand business is to work closely with distributors, as distributors can help manage smaller clients, provide more comprehensive components to clients, and help manage accounts receivable and inventory – which is also a costly process.

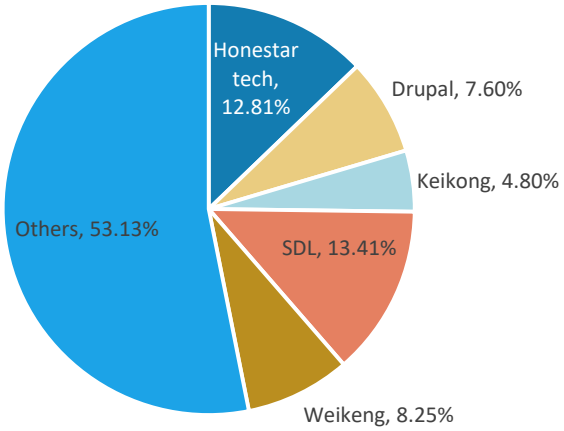
As such, SG Micro has 95%+ (Exhibit 156) revenue from distributors – SG Micro's key distributors include Honestar Tech, Drupal, Keikong, SDL, and Weikeng (Exhibit 157). In our view, the company might be able to develop more direct sales business if it can attract larger ODM/ OEM companies.

Exhibit 156: SG Micro has 95%+ revenue from distributors



Source: Company data.

Exhibit 157: SG Micro's revenue breakdown - mainly to distributors (2021)



Source: Company data.

SG Micro: Thesis #2 – iPhone business fosters business upside potential

SG Micro starts to supply PMIC and level shifter for iPhone 14

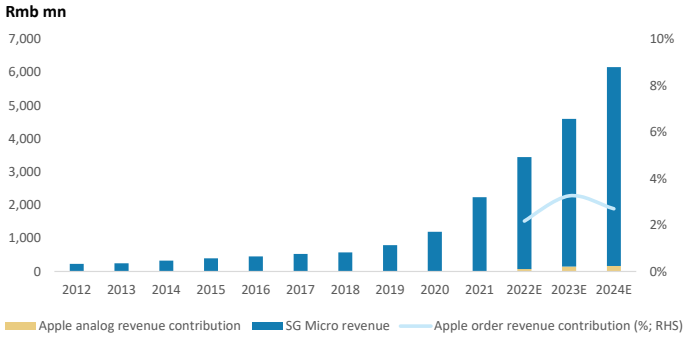
Apple has been adding more China suppliers to its list of suppliers: The iPhone 14 represents the first time that Apple has adopted SG Micro's analog product. SG Micro has been working on pin-to-pin product with Apple's existing analog IC supplier. Apple's business strategy incorporates supply chain risk management and supply chain diversification. We expect its selection of SG Micro to contribute 2-4% (Exhibit 158) of SG Micro's total revenue in 2022, assuming:

- iPhone new models (iPhone 14 and after) ship 90/ 180/ 200mn in 2022/23/24, respectively
- iPhone PMIC + level shifter (analog shifting the voltage) content value is US$0.5-0.6
- SG Micro has ~20% supply share for iPhone PMIC + level shifter

What is the potential? Apple revenue contribution might grow to 10%+ revenue contribution, assuming SG Micro gains more analog content in iPhone model as Apple would like to diversify its material supply to lower the supply chain risk: As there is a total of US$40 analog content value (including PMIC and signal chain) per smartphone, if we assume SG Micro maintains 20% supply share, while increasing content value from US$0.5-0.6 to US$2-3, this would bring much more upside potential to SG Micro's business. We believe this could serve as another growth driver for SG Micro in the coming few years.

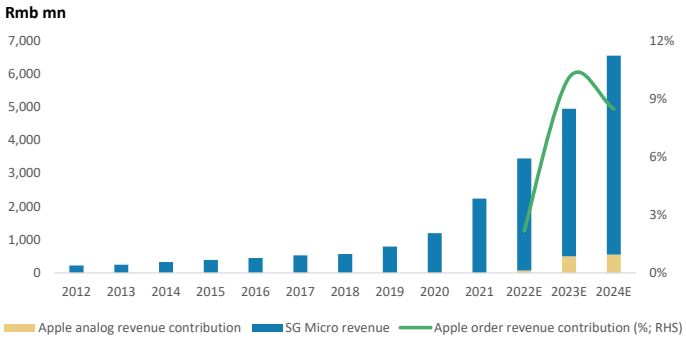
We also acknowledge that that this would lead to higher cost to support any such business ramp-up.

Exhibit 158: Apple's PMIC + level shifter revenue contribution (base case)



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 159: iPhone business may have potential to contribute more than 10% of SG Micro's revenue, if Apple were to release more analog orders to SG Micro



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

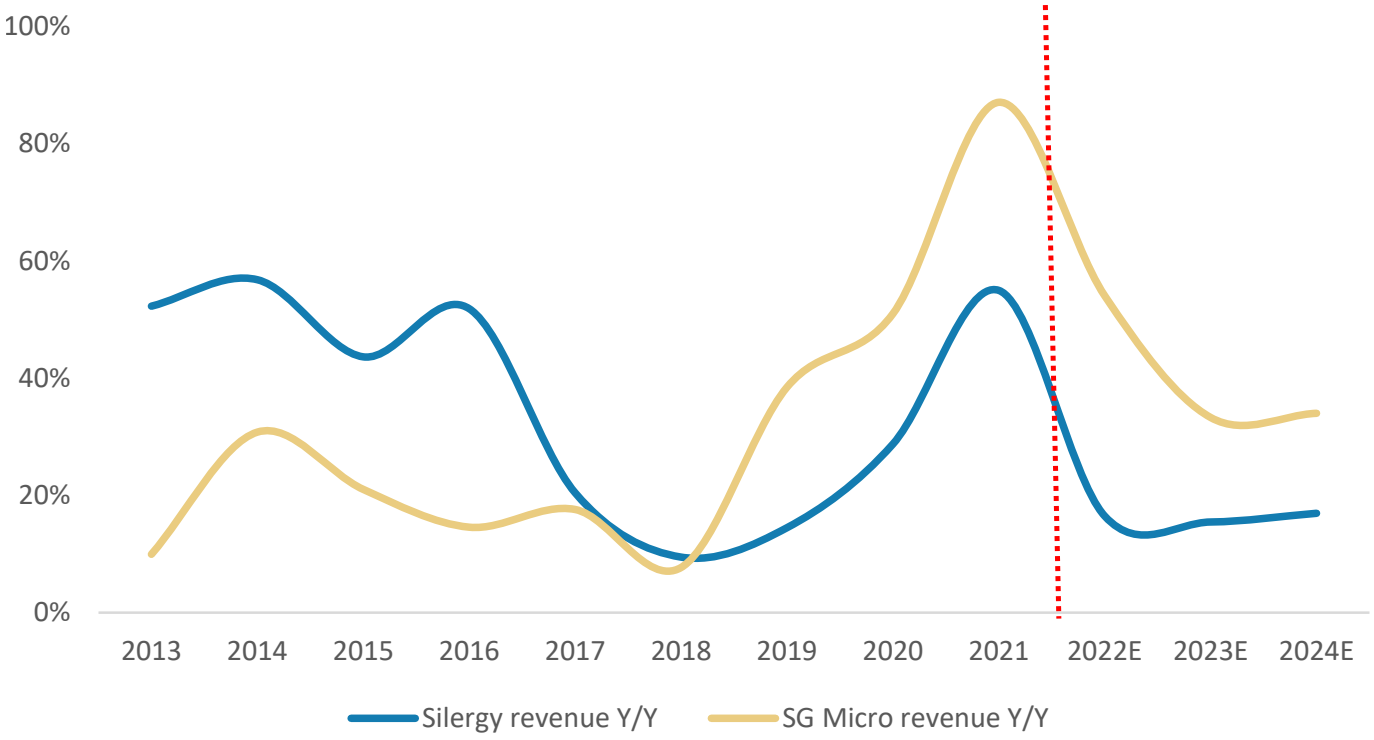
SG Micro: Thesis #3 – SG Micro has been growing faster than Silergy since 2019

SG Micro has been growing faster than Silergy since 2019 (Exhibit 160). Silergy's revenue was 3.7x larger than was SG Micro's in 2018, while it might only become 1.6x larger than SG Micro in 2022, per our estimate.

SG Micro enjoyed strong growth momentum over the past three years, thanks to the market share gain from global IDM players thanks to supply chain disruption and China analog IC localization demand. SG Micro has been gaining orders from consumer electronics (including smartphones, smart speakers, TWS), along with its PMIC business line expansion (more SKU introduction).

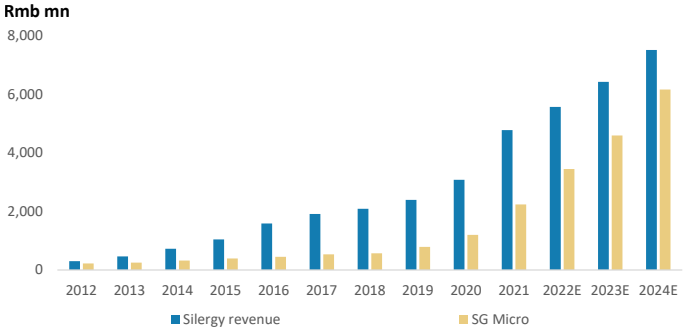
SG Micro's signal chain product was mainly focusing on amplifier-related applications.

Exhibit 160: SG Micro revenue has outgrown Silergy since 2019



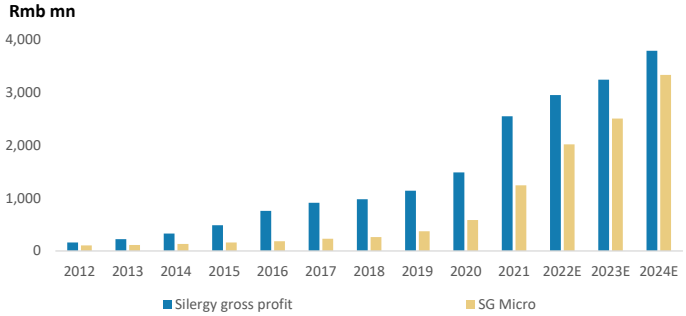
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 161: SG Micro's vs. Silergy's revenue



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 162: SG Micro's vs. Silergy's gross profit



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

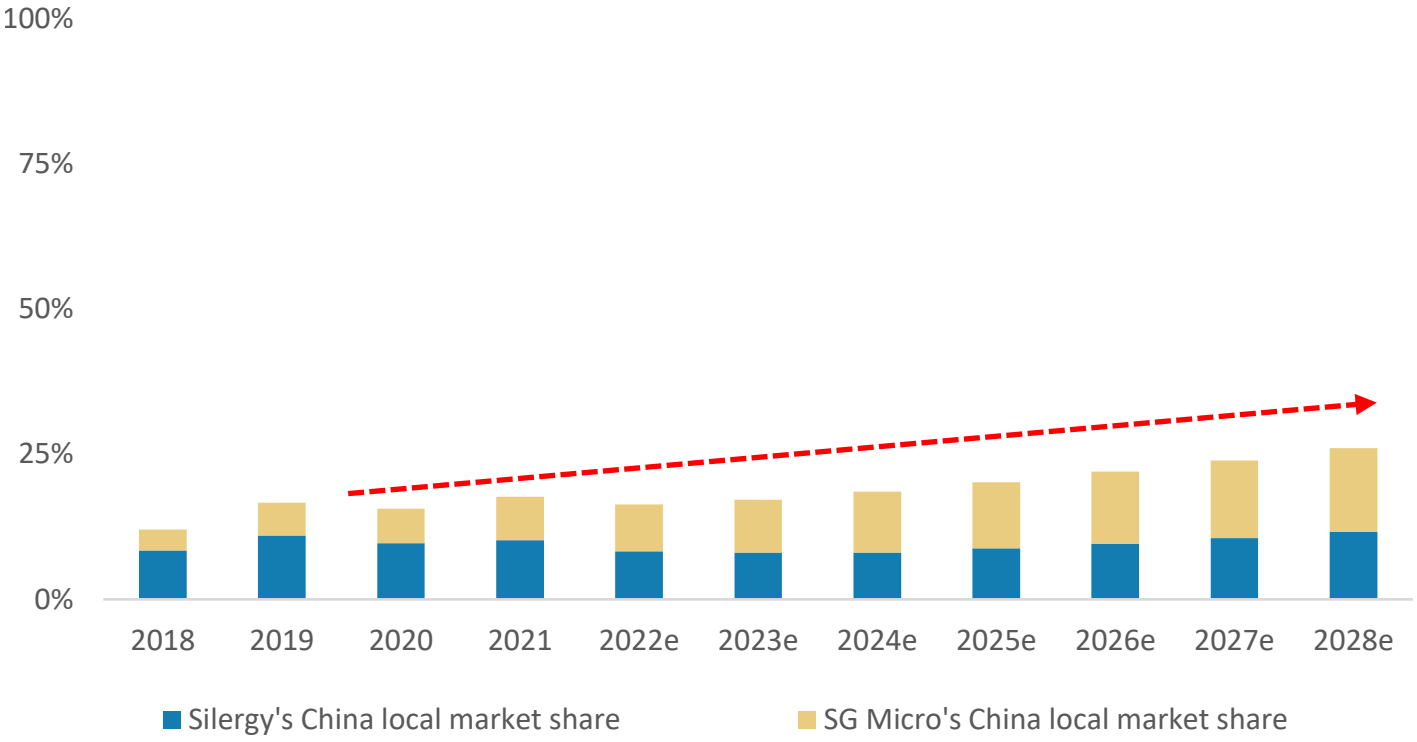
SG Micro and Silergy should continue to be the two key analog IC companies in China

Both SG Micro and Silergy should gain share in the long run: We expect key China local analog players to continue to gain market share in China. It is common in the analog industry that the leading company dominates the market (ex: TI), as only the leading company is able to provide comprehensive solutions and SKUs to meet customer demands. The larger company also has more recourse to invest in new product lines. We expect key China analog players, such as Silergy, SG Micro, and Novosense, to outgrow the China market TAM (Exhibit 163).

Silergy still has better product quality: Silergy is more focused in PMIC product, and it still has a better product quality and brand name. Silergy also started to expand its business into more signal chain product.

SG Micro continues to expand product SKU: A strong portfolio of PMIC and signal chain products should enable SG Micro to gain share from global leading IDM players.

Exhibit 163: We believe both Silergy and SG Micro will gain market share in China for the long term



Source: Omdia, Morgan Stanley Research. E = Morgan Stanley Research estimates.

SG Micro: Where are we versus consensus?

Our 2023/24 revenue and EPS estimates are largely in-line with Street expectations

We are more bearish on the analog IC cycle into 2023 and 2024. Still, iPhone business growth potential at SG Micro is still at the early stage. PMIC price erosion is another concern.

Investment positives

SG Micro has the largest product portfolio within those China analog IC players – we believe this will lead to higher user stickiness to its end customers.

Investment concerns

There might be downside risk to our estimates if: 1) analog price competition becomes more severe; 2) SG Micro's iPhone market share lower than expected; 3) R&D for new product is slower than expected.

Where we could be wrong

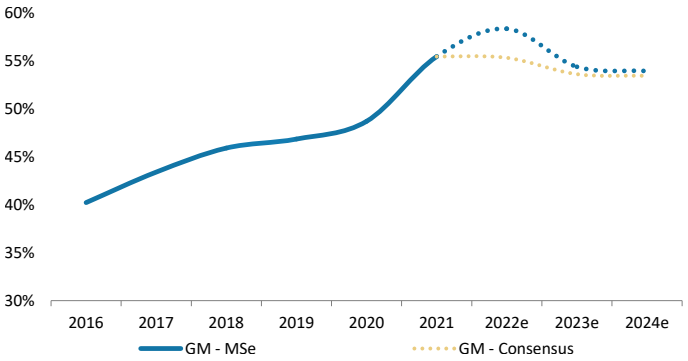
We could be wrong if: 1) SG Micro's China market share grows faster than expected; 2) iPhone business content value increases rapidly; 3) analog price in 2023/24 is better than expected.

Exhibit 164: SG Micro: Morgan Stanley Research vs. consensus

Rmb mn	2022e			2023e			2024e		
	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*	MSe.	Con.	*Diff.*
Sales	3,449	3,439	*0%*	4,597	4,818	*-5%*	6,161	6,456	*-5%*
Operating profit	1,207	1,149	*5%*	1,601	1,543	*4%*	2,237	2,077	*8%*
Net income	1,080	1,074	*1%*	1,472	1,476	*0%*	2,057	2,007	*2%*
EPS (Rmb)	3.31	3.29	*1%*	4.13	4.15	*0%*	5.78	5.64	*2%*
GM	58.4%	55.4%	*3.0ppt*	54.4%	53.7%	*0.8ppt*	54.0%	53.5%	*0.5ppt*
OpM	35.0%	33.4%	*1.6ppt*	34.8%	32.0%	*2.8ppt*	36.3%	32.2%	*4.1ppt*

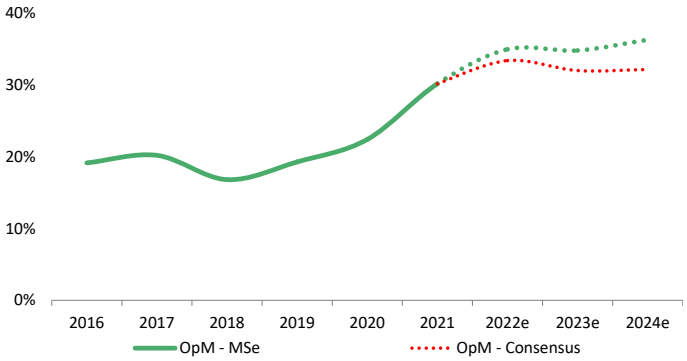
Source: Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 165: SG Micro's gross margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

Exhibit 166: SG Micro's operating margin: MSe vs. consensus



Source: Company data, Refinitiv consensus estimates, Morgan Stanley Research estimates.

SG Micro: Valuation methodology

Our price target is Rmb170: We derive our price target (which is also our base case value) from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.4% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 5.9%), a payout ratio of 55%, a medium-term growth rate of 17.0%, and a terminal growth rate of 5.0%, all of which are in-line with other IC design companies in our coverage. We believe our medium-term growth rate is justified, given SG Micro's position as one of the leading analog IC designers in China. We expect that both the ongoing opportunities from analog IC content growth and China's semi localization trend will fuel the company's growth.

Our price target implies 51x 2022 earnings and 41x 2023 earnings. 41x 2023 earnings is slightly above its historical average multiple since 2017 (historical trading band of 10-60x).

Bull/bear case discussion

Our bull case value is Rmb300: Stronger sales growth with faster OPM improvement

In this scenario, we assume SG Micro successfully ramps up its analog products and gains further market share in China.

Our bull scenario assumptions include: 1) a revenue CAGR of 50% in 2021-24; 2) OPM expands to 45% in 2023, from 19% in 2019.

Our bear case value is Rmb100: Slower sales growth with flat OPM

In this scenario, we assume the global economy heads into recession, resulting in decelerated analog product rollouts and weakened end-demand. This would result in slower product upgrades, and, hence, intensified competition from vendors. We also assume major customers find alternative partners with similar technologies, while new customer demand misses our base case assumptions significantly.

Our bear scenario assumptions include: 1) a revenue CAGR of 20% in 2021-24; 2) OPM declines to 25% in 2023, from 19% in 2019 and 30% in 2021.

Peer comparison

We expect SG Micro's earnings to rise at a 32% CAGR, 2022-24e, largely in-line with the Greater China analog IC company segment, at 33%. We think this justifies our EW rating on SG Micro as it is trading at 33x 2023 P/E (based on our EPS estimate), similar to the Greater China analog IC peer average at 33x 2023 P/E.

Exhibit 167: SG Micro: Residual income model

NT$million	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E
Total Equity	**3,310**	**4,512**	**6,201**	**7,937**	**9,968**	**12,344**	**15,124**	**18,376**	**22,181**	**26,633**	**31,842**	**37,937**
Net Profit	**1,080**	**1,472**	**2,057**	**2,407**	**2,816**	**3,295**	**3,855**	**4,511**	**5,278**	**6,175**	**7,225**	**8,453**
ROAE	**37.8%**	**37.6%**	**38.4%**	**34.1%**	**31.5%**	**29.5%**	**28.1%**	**26.9%**	**26.0%**	**25.3%**	**24.7%**	**24.2%**
Residual Income	684	936	1,310	1,530	1,753	2,010	2,308	2,655	3,060	3,532	4,084	4,729
Spread	**28.4%**	**28.3%**	**29.0%**	**24.7%**	**22.1%**	**20.2%**	**18.7%**	**17.6%**	**16.7%**	**15.9%**	**15.3%**	**14.9%**
Ending Equity Capital	3,310											
PV of Forecast Period	9,889											
PV of Continuing Value	42,357											
Equity Value	**55,556**											
No. of Shares	326											
Projected Price (Rmb)	**170**											

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 168: SG Micro: Peer comparison

Ticker	Company	Closing Price	Rating	Price Target (LC)	Market Cap (US$mn)	EPS 2020	EPS 2021	EPS 2022e	EPS 2023e	EPS 2024e	P/E 2020	P/E 2021e	P/E 2022e	P/E 2023e	P/E 2024e	ROE 2020	ROE 2021e	ROE 2022e	ROE 2023e	ROE 2024e	Trading Volume (US$ mn)
China Companies																					
688052.SS	**Novosense**	290.50	**O**	**420.00**	4,148	0.7	2.9	4.3	8.0	12.7	427.2	98.5	66.9	36.5	22.9	23.3	50.9	74.1	88.7	71.3	47
300661.SZ	**SG Micro**	136.52	**E**	**170.00**	6,871	1.9	3.0	3.3	4.1	5.8	73.4	45.9	41.2	33.0	23.6	21.7	35.3	38.2	37.9	38.6	88
688536.SS	3Peak	253.50	E	313.00	4,282	2.8	5.5	4.4	6.0	7.0	89.6	46.0	57.5	42.5	36.1	13.2	15.4	15.4	17.8	17.8	52
688595.SS	Chipsea	37.19	U	33.00	735	1.1	0.9	0.4	0.7	1.1	33.8	39.6	85.2	53.5	35.4	15.8	10.4	5.6	9.3	12.7	24
688798.SS	**Awinic**	90.54	**U**	**75.00**	2,124	0.8	2.1	1.8	2.0	2.9	110.6	43.3	51.0	44.7	31.2	28.9	14.0	9.0	9.8	12.9	14
688508.SS	Chipown	56.00	NC	NA	895	0.9	1.6	2.2	3.2	4.3	63.5	34.6	24.7	17.2	12.8	11.3	12.5	14.6	17.2	19.1	28
Average											**133.0**	**51.3**	**54.4**	**37.9**	**27.0**	**19.0**	**23.1**	**26.1**	**30.1**	**28.7**	**42**
Taiwan Companies																					
6415.TW	Silergy	450.00	U	430.00	5,416	33.8	58.7	17.1	16.9	20.4	13.3	7.7	26.3	26.6	22.1	19.3	27.3	26.3	24.5	25.7	104
6719.TW	uPI	266.50	U	230.00	625	6.2	14.6	15.9	13.2	16.8	42.8	18.2	16.8	20.2	15.9	28.4	47.7	39.1	25.6	26.7	26
6138.TWO	Anpec	119.00	NC	NA	279	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29
8081.TW	GMT	131.50	NC	NA	359	11.4	25.5	26.9	17.1	NA	10.8	4.8	4.6	7.2	NA	20.4	42.7	NA	NA	NA	6
Average											**22.3**	**10.2**	**15.9**	**18.0**	**19.0**	**22.7**	**39.2**	**32.7**	**25.1**	**26.2**	**41**
Global Companies																					
6723.T	Renesas	1,305.00	O	2,000.00	17,703	64.9	120.4	198.1	185.8	219.6	20.1	10.8	6.6	7.0	5.9	7.4	14.3	22.4	18.2	18.8	102
NXPI.O	NXP	152.94	E	183.00	40,162	6.1	10.8	13.7	13.6	15.5	24.9	14.2	11.2	11.3	9.8	0.3	23.7	39.8	35.7	45.4	493
ADI.O	Analog Devices Inc.	154.18	E	173.00	72,995	5.0	6.5	9.5	9.4	9.7	30.6	23.9	16.3	16.5	16.0	10.3	5.6	6.9	6.7	7.0	602
ON.O	ON Semi	63.31	E	65.00	27,428	0.9	2.9	5.1	4.7	4.9	74.4	21.6	12.4	13.6	12.8	6.8	24.9	37.8	27.1	22.0	426
TXN.O	Texas Instrument	170.74	U	160.00	147,372	5.3	8.3	9.3	8.4	8.7	32.4	20.7	18.3	20.3	19.6	61.8	69.0	64.1	52.1	47.9	955
IFXGn.DE	Infineon	22.97	NC	NA	29,499	0.6	1.1	1.9	1.9	2.1	37.4	20.4	12.1	12.0	11.1	7.7	13.4	20.7	16.5	16.4	161
Average											**36.6**	**18.6**	**12.8**	**13.4**	**12.6**	**15.7**	**25.1**	**32.0**	**26.1**	**26.2**	**457**

Source: Company data, Refinitiv, Morgan Stanley Research. E = Morgan Stanley Research estimates for covered companies, Refinitiv consensus for noncovered ("NC") companies. Note: Share prices as of September 23, 2022.

Exhibit 169: SG Micro: P/E band chart

Source: Company data, Refinitiv, Morgan Stanley Research estimates.

Exhibit 170: SG Micro: P/B band chart

Source: Company data, Refinitiv, Morgan Stanley Research estimates.

SG Micro: Financial summary

Exhibit 171: SG Micro: Financial summary

Income Statement

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Net sales	792	1,197	2,238	3,449	4,597	6,161
COGS	(421)	(613)	(996)	(1,435)	(2,095)	(2,835)
Gross profit	372	583	1,242	2,014	2,502	3,326
Operating expenses	(219)	(315)	(567)	(807)	(901)	(1,088)
Operating income	**153**	**268**	**676**	**1,207**	**1,601**	**2,237**
Non-operating income	36	32	64	6	10	10
Pre-tax income	189	300	739	1,213	1,611	2,247
Income tax	14	17	50	122	129	180
Reported net Income	**176**	**289**	**699**	**1,080**	**1,472**	**2,057**
Adj.wtd.avg.shrs(m)	104	155	235	326	356	356
Reported EPS (Rmb)	**1.70**	**1.86**	**2.98**	**3.31**	**4.13**	**5.78**
Modelware EPS (Rmb)	**1.70**	**1.86**	**2.98**	**3.31**	**4.13**	**5.78**

Balance Sheet

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Cash	255	773	1,186	1,963	2,971	4,441
Mkt Securities	0	0	0	0	0	0
AR/NR	84	61	93	119	158	212
Inventory	174	260	399	475	694	939
Other	616	320	430	430	430	430
Current Assets	**1,129**	**1,414**	**2,108**	**2,987**	**4,253**	**6,022**
Long-term investments	131	154	275	275	275	275
Fixed assets	38	59	114	184	254	324
Deffered assets	68	138	250	250	250	250
Other assets	28	102	302	302	302	302
Total Assets	**1,393**	**1,867**	**3,049**	**3,998**	**5,334**	**7,173**
S/T borrowings	0	0	0	0	0	0
AP/NP	132	156	247	290	424	574
Other ST liabilities	95	120	240	240	240	240
LT debt	0	0	0	0	0	0
Other LT liabilities	45	92	157	157	157	157
Common shares	104	156	236	236	236	236
Total Liabilities	**273**	**368**	**645**	**688**	**821**	**971**
Additional capital	548	630	833	833	833	833
Retained earning	424	635	1,216	2,122	3,324	5,013
Other shareholders' equity	45	77	120	120	120	120
Total Equity	**1,121**	**1,498**	**2,404**	**3,310**	**4,512**	**6,201**
Total Liab. & Shrhldr's Equity	**1,393**	**1,867**	**3,049**	**3,998**	**5,334**	**7,173**

E = Morgan Stanley Research Estimates

Source: Morgan Stanley Research, Company Data

Cash Flow Statement

Rmbmn (Years End Dec)	2019	2020	2021	2022E	2023E	2024E
Cashflow from Operations	**145**	**324**	**763**	**1,022**	**1,348**	**1,908**
Net profits	176	289	699	1,080	1,472	2,057
Depreciation	0	0	0	0	0	0
Working Capital Change	(29)	29	105	(58)	(124)	(149)
Other adjustments	(3)	6	(42)	0	0	0
Cashflow from Investing	**(99)**	**229**	**(320)**	**(70)**	**(70)**	**(70)**
Capex	0	0	0	(70)	(70)	(70)
Change of LT Investment	0	(5)	(2)	0	0	0
Change of ST Investment	11	34	46	0	0	0
Other adjustments	(110)	200	(364)	0	0	0
Cashflow from financing	**(17)**	**(18)**	**(46)**	**(175)**	**(270)**	**(368)**
Increase in L/T debt	0	0	0	0	0	0
Increase in S/T debt	0	0	0	0	0	0
Cash Dividend Paid	(28)	(52)	(78)	(175)	(270)	(368)
Issuance of stock	0	0	0	0	0	0
Other adjustments	11	34	32	0	0	0
Exchange rate adjustment	1	(18)	16	0	0	0
Net change in cash	**30**	**517**	**414**	**777**	**1,008**	**1,470**

Financial Ratios

	2019	2020	2021	2022E	2023E	2024E
Growth(%)						
Turnover	38.5	51.0	87.1	54.1	33.3	34.0
Operating profits	58.8	75.5	151.8	78.6	32.7	39.7
Pretax profits	69.7	58.9	146.3	64.0	32.8	39.5
Net profits	69.8	64.0	142.2	54.5	36.3	39.8
EPS	29.7	9.5	60.0	11.3	24.8	39.8
Margins (%)						
Gross Margin	46.9	48.7	55.5	58.4	54.4	54.0
Operating Margin	19.3	22.4	30.2	35.0	34.8	36.3
Pretax Margin	23.8	25.1	33.0	35.2	35.0	36.5
Net Profit	22.2	24.1	31.2	31.3	32.0	33.4
Return (%)						
ROAE	17.6	22.0	35.8	37.8	37.6	38.4
ROAA	14.3	17.7	28.5	30.7	31.6	32.9
Gearing (%)						
Net Debt/Equity	(22.8)	(51.6)	(49.3)	(59.3)	(65.8)	(71.6)
Liabilities/Equity	24.3	24.6	26.8	20.8	18.2	15.7
Ratios (X)						
Current ratio	5.0	5.1	4.3	5.6	6.4	7.4
Quick ratio	1.5	3.0	2.6	3.9	4.7	5.7
Others						
AR/NR Turnover (days)	26	22	13	13	13	13
Inventory Turnover (days)	121	129	121	121	121	121
AP Turnover (days)	79	86	74	74	74	74
Cash Conversion (days)	68	66	60	60	60	60

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

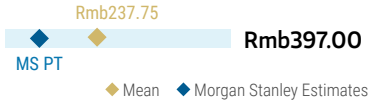
Risk Reward – SG Micro Corp. (300661.SZ)

iPhone business fosters upside potential, but analog cycle is a concern

PRICE TARGET Rmb170.00

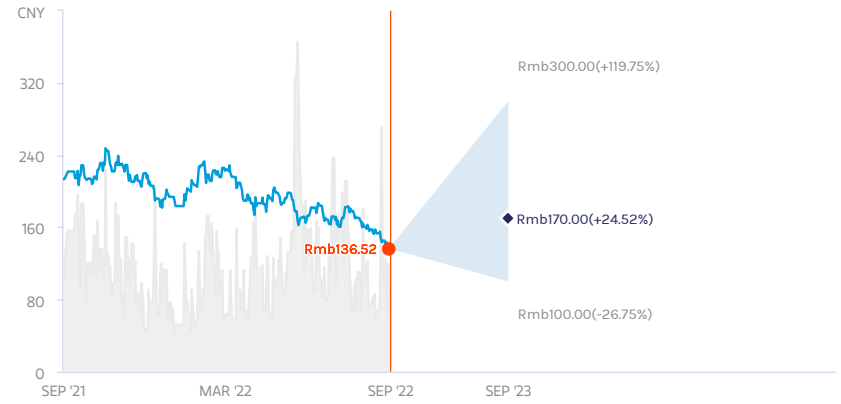
Base case, derived from a residual income model, as we believe this methodology best captures the stock's long-term value. We assume a 9.4% cost of equity (beta 1.25, risk-free rate 2.0% and risk premium 5.9%), a payout ratio of 55%, a medium-term growth rate of 17.0%, and a terminal growth rate of 5.0%. Our medium-term growth rate reflects SG Micro's position as one of the leading analog IC designers in China.

Consensus Price Target Distribution



Source: Refinitiv, Morgan Stanley Research

RISK REWARD CHART



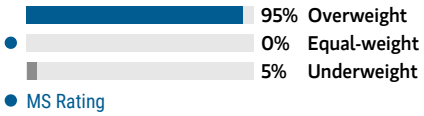
Key: Historical Stock Performance Current Stock Price Price Target

Source: Refinitiv, Morgan Stanley Research

EQUAL-WEIGHT THESIS

- SG Micro has strong R&D, with the most comprehensive SKU portfolio among Greater China analog companies
- Apple has been adding more China suppliers to its list of suppliers, and iPhone 14 represents the first time that Apple has adopted SG Micro's analog product
- Although SG Micro is growing fast, we are concerned about weakening end-demand for analog ICs, hence our EW rating.

Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Market Share:	*Positive*
Secular Growth:	*Positive*

View descriptions of Risk Rewards Themes here

BULL CASE Rmb300.00

91x 2022e EPS

SG Micro successfully ramps up its analog products and gains further market share in China.

Our assumptions include: 1) a revenue CAGR of 50% in 2021-24; 2) OPM expands to 45% in 2023, from 19% in 2019.

BASE CASE Rmb170.00

51x 2022e EPS

SG Micro successfully ramps up its analog products and gains further market share in China.

Our assumptions include: 1) a revenue CAGR of 36% in 2021-24; 2) OPM expands to 34% in 2023, from 19%/30% in 2019/2021.

BEAR CASE Rmb100.00

30x 2022e EPS

The global economy heads into recession, resulting in decelerated analog product rollouts and weakened end-demand. This results in slower product upgrades, and, hence, intensified competition from vendors. We also assume major customers find alternative partners with similar technologies, while new customer demand misses our base case assumptions significantly.

Our assumptions include: 1) a revenue CAGR of 20% in 2021-24; 2) OPM declines to 25% in 2023, from 19%/30% in 2019/2021.

Risk Reward – SG Micro Corp. (300661.SZ)

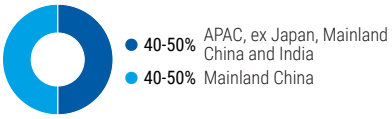
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Revenue from Signal Chain segment (Rmb, mn)	709	1,133	1,549	2,252
Revenue from PMIC segment (Rmb, mn)	1,529	2,288	3,008	3,869
Revenue from Maintenance & others segment (Rmb, mn)	1	27	40	40

INVESTMENT DRIVERS

- Better revenue momentum thanks to market share gain in China
- Steady R&D investment, resulting in more SKU to support larger client base

GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

RISKS TO PT/RATING

RISKS TO UPSIDE

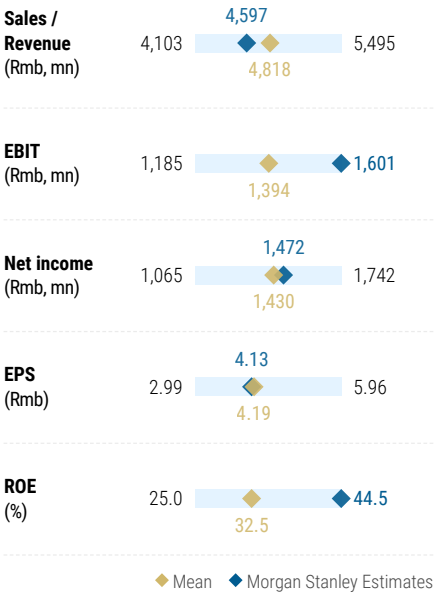
1) SG Micro's China market share grows faster than expected; 2) iPhone business content value increases rapidly; 3) analog price in 2023/24 is better than expected.

RISKS TO DOWNSIDE

1) analog price competition becomes more severe; 2) SG Micro's iPhone market share is lower than expected; 3) R&D for new product is slower than expected.

MS ESTIMATES VS. CONSENSUS

FY 2023e



Source: Refinitiv, Morgan Stanley Research

SG Micro: Quarterly earnings summary

Exhibit 172: SG Micro: Quarterly earnings summary

Rmb in million	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22E	4Q22E	2020	2021	2022E	2023E	2024E
Total Revenues	394	522	620	703	775	876	899	899	1,197	2,238	3,449	4,597	6,161
Sequential Change	*18.0%*	*32.4%*	*18.9%*	*13.4%*	*10.3%*	*13.0%*	*2.6%*	*0.0%*					
Change vs Year Ago	*104.3%*	*91.3%*	*56.0%*	*110.6%*	*96.8%*	*68.0%*	*45.0%*	*27.8%*	*51.0%*	*87.1%*	*54.1%*	*33.3%*	*34.0%*
Cost of Sales	205	241	248	301	305	359	387	387	613	996	1,435	2,095	2,835
Percent of Revenues	*52%*	*46%*	*40%*	*43%*	*39%*	*41%*	*43%*	*43%*	*51%*	*45%*	*42%*	*46%*	*46%*
Gross Profit	189	280	371	402	470	517	512	512	583	1,242	2,014	2,502	3,326
Percent of Revenues	*47.9%*	*53.8%*	*59.9%*	*57.2%*	*60.6%*	*59.0%*	*57.0%*	*57.0%*	*48.7%*	*55.5%*	*58.4%*	*54.4%*	*54.0%*
Incremental Margin	*74%*	*72%*	*93%*	*37%*	*94%*	*47%*	*-22%*	*NM*	*52%*	*63%*	*64%*	*42%*	*53%*
Total Opex	107	133	156	170	180	201	210	217	315	567	807	901	1,088
Percent of Revenues	*27.2%*	*25.6%*	*25.2%*	*24.2%*	*23.2%*	*22.9%*	*23.4%*	*24.1%*	*26.3%*	*25.3%*	*23.4%*	*19.6%*	*17.7%*
R&D	69	86	109	114	121	139	144	149	207	378	553	590	670
Percent of Revenues	*17.6%*	*16.6%*	*17.6%*	*16.2%*	*15.6%*	*15.8%*	*16.0%*	*16.6%*	*17.3%*	*16.9%*	*16.0%*	*12.8%*	*10.9%*
General & administrative	12	17	16	26	21	20	20	22	40	70	82	126	154
Percent of Revenues	*3.1%*	*3.3%*	*2.5%*	*3.6%*	*2.6%*	*2.3%*	*2.2%*	*2.4%*	*3.3%*	*3.1%*	*2.4%*	*2.7%*	*2.5%*
Selling & marketing	26	30	32	31	38	42	46	46	68	118	173	185	264
Percent of Revenues	*6.5%*	*5.7%*	*5.1%*	*4.4%*	*4.9%*	*4.8%*	*4.8%*	*4.8%*	*5.7%*	*5.3%*	*5.0%*	*4.0%*	*4.3%*
Operating Income	81	147	215	232	290	316	302	295	268	676	1,207	1,601	2,237
Percent of Revenues	*20.6%*	*28.2%*	*34.8%*	*33.0%*	*37.4%*	*36.1%*	*33.6%*	*32.8%*	*22.4%*	*30.2%*	*35.0%*	*34.8%*	*36.3%*
Change vs Year Ago	*31.4%*	*51.6%*	*69.6%*	*19.7%*	*80.8%*	*26.0%*	*-63.1%*	*NM*	*75.5%*	*151.8%*	*78.6%*	*32.7%*	*39.7%*
Total Non-operating Income(Loss)	3	56	(4)	9	2	(1)	2	2	32	64	6	10	10
Profit Before Taxes	84	203	212	240	292	315	305	298	300	739	1,213	1,611	2,247
Percent of Revenues	*21%*	*39%*	*34%*	*34%*	*38%*	*36%*	*34%*	*33%*	*25%*	*33%*	*35%*	*35%*	*36%*
Taxes	10	20	23	(3)	35	39	24	24	17	50	122	129	180
Tax Rate	*11.8%*	*9.9%*	*11.0%*	*-1.2%*	*11.9%*	*12.3%*	*8.0%*	*8.0%*	*5.5%*	*6.8%*	*10.0%*	*8.0%*	*8.0%*
Reported Income (TW GAAP)	**75**	**185**	**191**	**248**	**260**	**280**	**278**	**271**	**289**	**699**	**1,080**	**1,472**	**2,057**
Percent of Revenues	*19%*	*35%*	*31%*	*35%*	*34%*	*32%*	*31%*	*30%*	*24%*	*31%*	*31%*	*32%*	*33%*
Change vs Year Ago	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*64%*	*142%*	*54%*	*36%*	*40%*
Reported EPS (Rmb, TW GAAP)	**0.48**	**0.80**	**0.82**	**1.06**	**1.10**	**0.79**	**0.78**	**0.76**	**1.86**	**2.98**	**3.31**	**4.13**	**5.78**
Change vs Year Ago	*65%*	*65%*	*23%*	*101%*	*128%*	*-1%*	*-4%*	*-28%*	*9%*	*60%*	*11%*	*25%*	*40%*

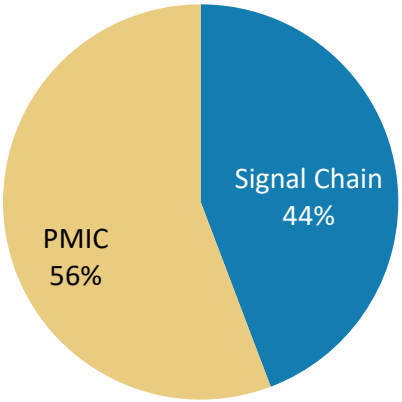
Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

SG Micro: Company background

Founded in 2007, SG Micro specializes in high-performance, high-quality analog IC design, marketing and sales, and offers innovative solutions for a broad range of applications in wireless communication, consumer, medical, automotive and industrial markets. SG Micro operates based on a fabless business model.

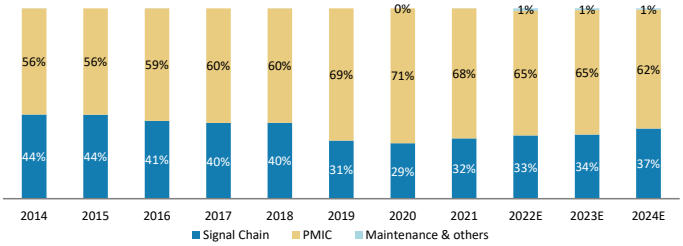
SG Micro is China's second-largest analog IC producer (behind Silergy) – it has introduced 25 categories and more than 3,500 analog IC products with solid reliability and consistency, including precision signal conditioning products such as amplifiers, buffers, comparators, switches and interface products, as well as the energy efficient power management ICs.

Exhibit 173: SG Micro's business (revenue as of 2021)



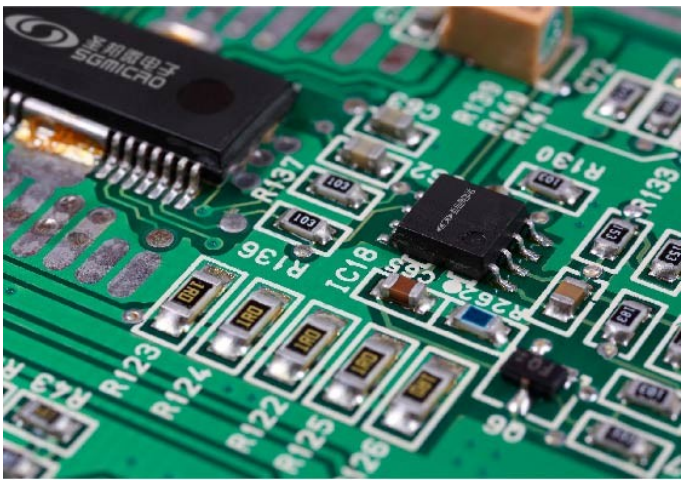
Source: Company data, Morgan Stanley Research.

Exhibit 174: Signal Chain products has gained share from PMIC in SG Micro's product mix



Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 175: SG Micro's signal chain product

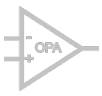


Source: Company data, Morgan Stanley Research.

Exhibit 176: SG Micro's PMIC

Source: Company data, Morgan Stanley Research.

Exhibit 177: SG Micro product portfolio

Product type	Analog IC										Logic IC
	Signal Chain					Power management IC					Logic IC
											
Product name	OpAmps (Operational Amplifiers)	Comparator	Audio/Video Driver (Amplifier)	ADC/DAC	Analog Switch	DC/DC Converter	LDO (low-dropout linear regulators)	MOSFET Driver	LED Driver	Li-Ion Battery charger	Small Logic Series
Function	With an external power source, it can magnify the voltage and current of an input signal, and further transfer as a high-power output.	It would first compare two currents or voltages, and further outputs a digital signal, showing which is greater.	A interface driver IC to enhance vido brightness and chroma, or provide high-quality audio out put for various interface/applications (e.g. speakers, headphones, MCU, ASIC) based on different designs	It will help convert analog signals to digital signals/ vice versa	When switching ON, could switch the direction between digital and analog signal. When in isolation mode, the switch terminals goes off.	It will convert direct current (DC) to another. The operating voltage can vary over a wide rang, based on different devices.	LDO helps to drop a higher input to a lower output voltage at relatively moderate power levels. It's suitable in applications which require low noise/current or small voltage difference between input and output.	It helps drive external MOSFETs, and is suitable for high-speed swithcing applications.	LED driver is a voltage converter, which can help balance power and provide constant current.	An IC which provides Li-ion battery charge management function.	Basic components of logic products
Major end application	Consumer Tech (STB, portable charger) & Industrial (Security, smart manfacturing)					Communication & Consumer Tech (smartphone, PC)					Communication & Consumer Tech

Source: Company data, Morgan Stanley Research.

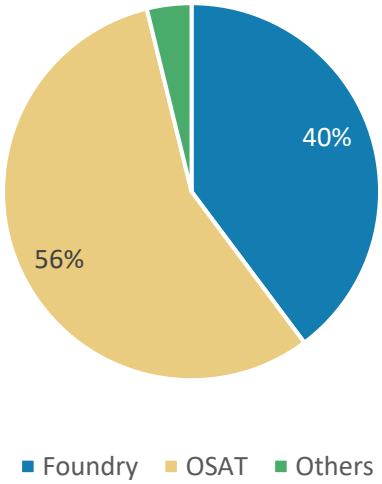
Packaging and testing cost accounts for 56% of COGS

SG Micro's foundry supplier is mainly TSMC, while also expanding into UMC, SMIC and Dongbu HiTek. OSAT supply is mainly from JCET, TongFu Micro, and Unisem.

As SG Micro runs a fabless business model without foundry and OSAT businesses, production costs are largely allocated in Foundry and OSAT. These account for 97% of COGS in total.

- Foundry costs contribute 40% of COGS
- Packaging and Testing (OSAT) contributes 56%
- Others contribute 4%

Exhibit 178: SG Micro's COGS (2021)



Source: Company data, Morgan Stanley Research.

Exhibit 179: SG Micro key suppliers

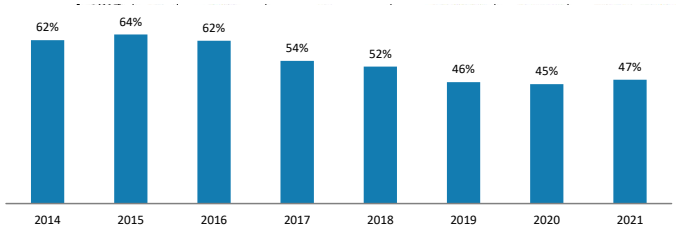
Source: Company data, Morgan Stanley Research.

Key customers

SG Micro's top 5 customer revenue contribution continues to decline – as diversification rises

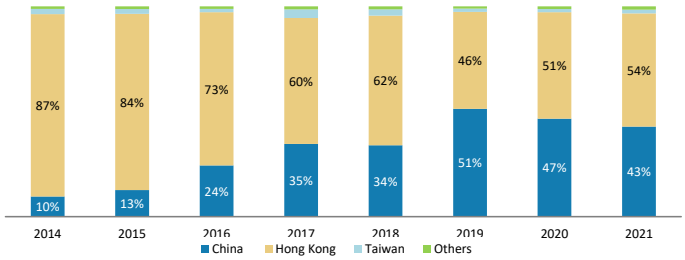
SG Micro has accumulated over 2,000 customers, and its major business model is mainly selling through distributors, and partially via direct sales. SG Micro's well-known distributor partners include Beigaozhi, Colorbeam, Linpo, Kei Kong, etc. ZTE is also one of its direct sales customers. SG Micro has also lowered its top 5 customer concentration from 64% in 2015 to 47% in 2022, which shows it has successfully diversified its client portfolio. China and Hong Kong are SG Micro's major market.

Exhibit 180: SG Micro has lowered the top 5 customer concentration from 62% to 47% in the past 7 years



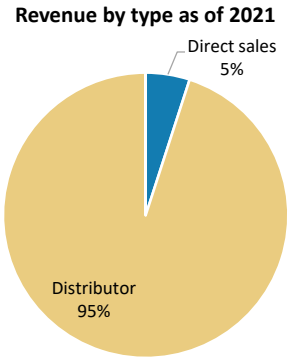
Source: Company data, Morgan Stanley Research.

Exhibit 181: China and Hong Kong are SG Micro's major exposure



Source: Company data, Morgan Stanley Research.

Exhibit 182: SG Micro conducts a "Distributor as the major, Direct sales as the second" selling policy



Source: Company data, Morgan Stanley Research.

Key shareholder and management

The Chairman and CEO of SG Micro, Dr. Zhang Shilong, has a track record in analog R&D over the past 20 years. He has previously worked as an engineer in top analog firms in the US, including Burr-Brown and TI, and was also recruited by the Chinese government through "the Thousand Talents Plan" (the Recruitment Program of Global Experts by China).

The vice Chairman/CEO and secretary of the Board, Ms. Qin Zhang, holds a BA degree. Qin had previously been vice CEO of Harbin SG Micro. She now serves as a board member of SG Micro's fully controlled Hong Kong subsidiary and an executive director of Baoli Hong Ya, a shareholder of SG Micro.

CFO of SG Micro, Ms. Xuan Zhang, holds a BA in Accounting from Central University of Finance and Economics in China. Xuan used to work in Kyoto Tien Hua accounting firm and was also a senior consultant of Beijing Hony Capital. Besides being the CFO of SG Micro, she now serves as the CFO of Shanghai Junying, Dalian SG Micro and Suzhou SG Micro. Xuan holds a CPA certificate as well.

Continues to expand R&D strength

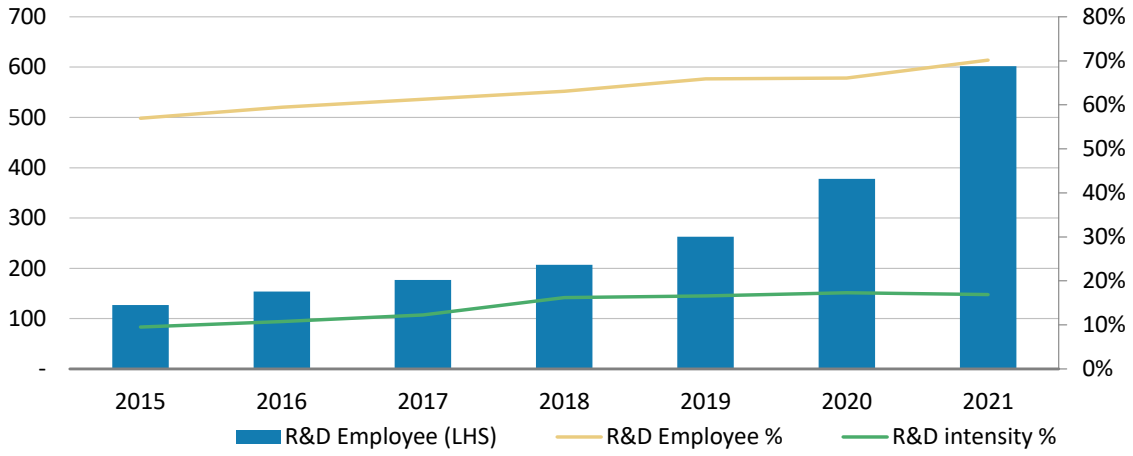
SG Micro continues to enhance its R&D strength, as its number of R&D employees has expanded from 127 in 2015 to 602 in 2021, driving R&D employees to account for 70.16% of its total number of employees. We expect SG Micro to extend its R&D ability by applying both organic and inorganic opportunities in the future.

Exhibit 183: SG Micro: Top 10 shareholding structure in 2Q22

Shareholder	%	Remark
XZ HS Yong Tai Management	19.51	100% Controlled by CEO Shilong Zhang
XZ BaoLi HonYa Management	8.42	100% Controlled by CEO's cousin Qin Zhang
Hong Kong Securities Clearing Co Ltd	7.36	
Lin Lin	6.95	SG Micro management team
GF Fund Management	5.9	
Power Trend	4.78	
Harvest Fund Management	2.69	
Lion Fund Management	2.45	
China Asset Managemet	1.63	
Allianz SE	1.45	

Source: Bloomberg, company data.

Exhibit 184: SG Micro continued to expand its R&D team, from 127 to 602 employees during 2015-21



Source: Company data, Morgan Stanley Research.

Silergy: Estimate revision summary and quarterly financials

We cut our earnings forecasts by 2% for 2022, 9% for 2023, and 10% for 2024: Our lower earnings estimates are mainly to reflect the volume weakness due to prolonged weak consumer demand. We also are concerned on the competition from Texas Instruments in the long run, as TI will start to have new capacity released starting 2022.

Exhibit 185: Silergy: Earnings estimate revision summary

NT$ mn	New '22E	Old '22E	Diff.	New '23E	Old '23E	Diff.	New '24E	Old '24E	Diff.
Net sales	24,845	25,050	-1%	27,264	28,924	-6%	31,828	33,827	-6%
Gross profit	13,129	13,259	-1%	13,745	14,566	-6%	15,966	17,014	-6%
Operating profit	6,878	6,998	-2%	7,195	7,943	-9%	8,698	9,650	-10%
Pretax Income	7,441	7,561	-2%	7,375	8,123	-9%	8,878	9,830	-10%
Net income	6,782	6,892	-2%	6,711	7,392	-9%	8,079	8,945	-10%
Reported EPS (NT$)	**17.13**	**17.40**	**-2%**	**16.95**	**18.67**	**-9%**	**20.40**	**22.59**	**-10%**
Margins									
Gross margin	52.8%	52.9%		50.4%	50.4%		50.2%	50.3%	
Operating margin	27.7%	27.9%		26.4%	27.5%		27.3%	28.5%	
Pretax margin	29.9%	30.2%		27.0%	28.1%		27.9%	29.1%	
Net margin	27.3%	27.5%		24.6%	25.6%		25.4%	26.4%	

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 186: Silergy: Quarterly financials

NT$ in million	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22E	4Q22E	2019	2020	2021	2022E	2023E	2024E
Total Revenues	4,180	5,258	5,914	6,154	6,021	6,801	5,975	6,049	10,778	13,876	21,506	24,845	27,264	31,828
Sequential Change	*2.5%*	*25.8%*	*12.5%*	*4.1%*	*-2.2%*	*13.0%*	*-12.2%*	*1.2%*						
Change vs Year Ago	*46.5%*	*59.3%*	*62.3%*	*50.9%*	*44.0%*	*29.3%*	*1.0%*	*-1.7%*	*14.5%*	*28.8%*	*55.0%*	*15.5%*	*9.7%*	*16.7%*
Cost of Sales	2,185	2,450	2,587	2,828	2,796	3,160	2,832	2,928	5,662	7,204	10,050	11,716	13,519	15,862
Percent of Revenues	*52%*	*47%*	*44%*	*46%*	*46%*	*46%*	*47%*	*48%*	*53%*	*52%*	*47%*	*47%*	*50%*	*50%*
Gross Profit	1,995	2,808	3,327	3,326	3,225	3,641	3,142	3,121	5,115	6,672	11,456	13,129	13,745	15,966
Percent of Revenues	*47.7%*	*53.4%*	*56.3%*	*54.0%*	*53.6%*	*53.5%*	*52.6%*	*51.6%*	*47.5%*	*48.1%*	*53.3%*	*52.8%*	*50.4%*	*50.2%*
Incremental Margin	*187%*	*75%*	*79%*	*0%*	*NM*	*53%*	*NM*	*-28%*	*53%*	*50%*	*63%*	*50%*	*25%*	*49%*
Total Opex	997	1,161	1,302	1,377	1,451	1,601	1,573	1,626	2,782	3,614	4,837	6,251	6,550	7,268
Percent of Revenues	*23.8%*	*22.1%*	*22.0%*	*22.4%*	*24.1%*	*23.5%*	*26.3%*	*26.9%*	*25.8%*	*26.0%*	*22.5%*	*25.2%*	*24.0%*	*22.8%*
R&D	628	736	838	1,000	992	1,080	1,080	1,120	1,610	2,161	3,203	4,273	4,290	4,440
Percent of Revenues	*15.0%*	*14.0%*	*14.2%*	*16.3%*	*16.5%*	*15.9%*	*18.1%*	*18.5%*	*14.9%*	*15.6%*	*14.9%*	*17.2%*	*15.7%*	*14.0%*
General & administrative	164	177	213	111	192	211	221	231	538	714	666	855	1,060	1,300
Percent of Revenues	*3.9%*	*3.4%*	*3.6%*	*1.8%*	*3.2%*	*3.1%*	*3.7%*	*3.8%*	*5.0%*	*5.1%*	*3.1%*	*3.4%*	*3.9%*	*4.1%*
Selling & marketing	204	248	252	265	267	309	272	275	634	739	968	1,123	1,200	1,528
Percent of Revenues	*4.9%*	*4.7%*	*4.3%*	*4.3%*	*4.4%*	*4.5%*	*4.5%*	*4.5%*	*5.9%*	*5.3%*	*4.5%*	*4.5%*	*4.4%*	*4.8%*
Operating Income	999	1,647	2,024	1,949	1,774	2,040	1,569	1,495	2,333	3,058	6,619	6,878	7,195	8,698
Percent of Revenues	*23.9%*	*31.3%*	*34.2%*	*31.7%*	*29.5%*	*30.0%*	*26.3%*	*24.7%*	*21.6%*	*22.0%*	*30.8%*	*27.7%*	*26.4%*	*27.3%*
Change vs Year Ago	*52.6%*	*117.6%*	*147.2%*	*135.3%*	*77.6%*	*23.9%*	*-22.5%*	*-23.3%*	*21.9%*	*31.1%*	*116.4%*	*3.9%*	*4.6%*	*20.9%*
Total Non-operating Income(Loss)	48	97	46	(399)	44	327	95	98	78	266	(207)	563	180	180
Profit Before Taxes	1,047	1,745	2,071	1,550	1,817	2,367	1,664	1,593	2,412	3,325	6,413	7,441	7,375	8,878
Percent of Revenues	*25%*	*33%*	*35%*	*25%*	*30%*	*35%*	*28%*	*26%*	*22%*	*24%*	*30%*	*30%*	*27%*	*28%*
Taxes	72	190	171	182	173	204	144	137	86	83	615	658	664	799
Tax Rate	*6.9%*	*10.9%*	*8.3%*	*11.8%*	*9.5%*	*8.6%*	*8.6%*	*8.6%*	*3.6%*	*2.5%*	*9.6%*	*8.8%*	*9.0%*	*9.0%*
Reported Income (TW GAAP)	**975**	**1,555**	**1,900**	**1,368**	**1,644**	**2,163**	**1,521**	**1,455**	**2,326**	**3,242**	**5,797**	**6,782**	**6,711**	**8,079**
Percent of Revenues	*23%*	*30%*	*32%*	*22%*	*27%*	*32%*	*25%*	*24%*	*22%*	*23%*	*27%*	*27%*	*25%*	*25%*
Change vs Year Ago	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*27%*	*39%*	*79%*	*17%*	*-1%*	*20%*
Reported EPS (NT$, TW GAAP)	**9.91**	**15.71**	**19.19**	**13.82**	**4.15**	**5.46**	**3.84**	**3.67**	**25.34**	**33.80**	**58.66**	**17.13**	**16.95**	**20.40**
Change vs Year Ago	*35%*	*110%*	*141%*	*25%*	*-58%*	*-65%*	*-80%*	*-73%*	*27%*	*33%*	*74%*	*-71%*	*-1%*	*20%*

Source: Refinitiv, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Valuation methodology

We cut our price target to NT$430 from NT$508: It reflects our reduced earnings estimates and lowered payout ratio, down to 35% from 48% previously.

Our price target is based on a residual income model using our base case forecasts. We keep other assumptions unchanged – a cost of equity of 9.5% (2.0% risk-free rate, 6% risk premium, 1.25 beta), an intermediate growth rate of 14.0% and a long-term growth rate of 5.0%.

Our bull case and bear case values are changed accordingly. Our bull case is cut to NT$700 from NT$808, and bear case is cut to NT$240 from NT$300.

Exhibit 187: Silergy: Residual income model

NT$million	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E	2034E
Total Equity	**28,062**	**31,382**	**36,105**	**42,397**	**49,570**	**57,747**	**67,070**	**77,697**	**89,812**	**103,623**	**119,368**	**137,317**	**157,779**
Net Profit	**6,782**	**6,711**	**8,079**	**9,210**	**10,499**	**11,969**	**13,645**	**15,555**	**17,733**	**20,215**	**23,046**	**26,272**	**29,950**
ROAE	**26.0%**	**22.6%**	**23.9%**	**23.5%**	**22.8%**	**22.3%**	**21.9%**	**21.5%**	**21.2%**	**20.9%**	**20.7%**	**20.5%**	**20.3%**
Residual Income	3,981	3,670	4,532	5,042	5,653	6,348	7,140	8,042	9,069	10,240	11,574	13,095	14,828
Spread	**16.5%**	**13.1%**	**14.4%**	**14.0%**	**13.3%**	**12.8%**	**12.4%**	**12.0%**	**11.7%**	**11.4%**	**11.2%**	**11.0%**	**10.8%**
Ending Equity Capital	28,062	31,382											
PV of Forecast Period	40,921	41,138											
PV of Continuing Value	112,596	86,447											
Equity Value	**181,579**	**158,967**											
No. of Shares	396	396											
Projected Price	**459**	**401**											
Projected Price (2H22-1H23)	**430**												

Source: Refinitiv, Morgan Stanley Research. E = Morgan Stanley Research estimates.

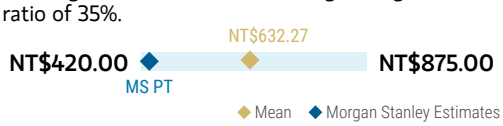
Risk Reward – Silergy Corp. (6415.TW)

Higher uncertainty with weakening demand

PRICE TARGET NT$430.00

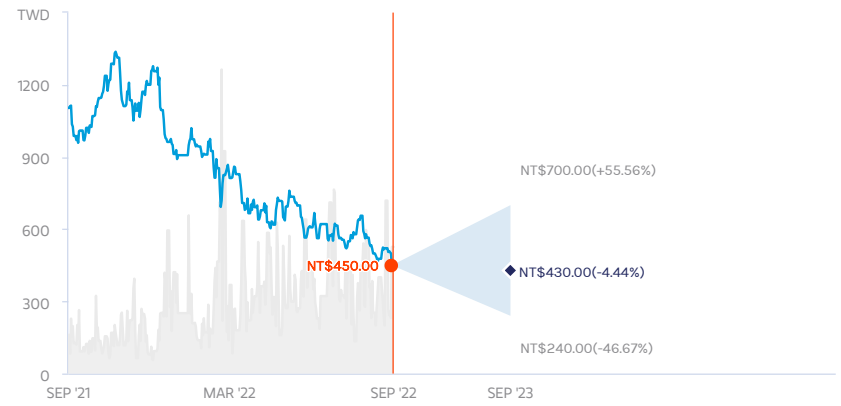
Base case, residual income model. We assume a cost of equity of 9.5% (2.0% risk-free rate, 6% risk premium, beta of 1.25), an intermediate growth rate of 14.0%, a long-term growth rate of 5.0% and a cash dividend payout ratio of 35%.

Consensus Price Target Distribution



Source: Refinitiv, Morgan Stanley Research

RISK REWARD CHART



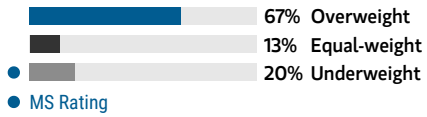
Key: Historical Stock Performance Current Stock Price Price Target

Source: Refinitiv, Morgan Stanley Research

UNDERWEIGHT THESIS

- We are UW on cyclical semi plays with softening end demand, elevated supply chain inventories, and diminishing pricing power. Silergy is part of this group.
- We expect higher foundry costs and competition from global peers to erode gross margin.
- Our estimates reflect weaker momentum from competition and the cycle.
- We think it's just a matter of time for soft demand to spread from consumer electronics to other applications.
- We view TI's comeback in the server and PC PMIC market as a double whammy for Silergy into 2023.
- After tempering our price target again, we still find valuation full.
- Cyclical indicators - rapid inventory buildup, Y/Y revenue slowdown, and GM erosion - signal de-rating.

Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Secular Growth:	*Positive*
Market Share:	*Negative*

View descriptions of Risk Rewards Themes here

BULL CASE NT$700.00

41x 2022e EPS

Substantial market share gains with further margin improvement: Silergy adds high-margin industrial product lines, such as automotive ICs, faster than expected. Meanwhile, legacy product lines show better growth, given faster market share gains and improved local semiconductor demand from China. Revenue CAGR for 2020-23 accelerates to over 45%.

BASE CASE NT$430.00

25x 2022e EPS

Weaker momentum in 2H22 with margin pressure: Revenue growth momentum is turning weaker into 2H22. New product segments (e.g., automotive, base stations) and technology transition gradually kick in, improving the company's product mix and margin profile. Pricing pressure from competition in the low-end segment remains intense.

BEAR CASE NT$240.00

14x 2022e EPS

Rising competition with serious margin erosion: Revenue growth decelerates because of macro conditions and severe market share loss. Contribution of new products stays sluggish, while gross margin declines to <45% amid weakened product mix and intense price competition in China's LED driver IC market. Revenue CAGR for 2020-23 falls to around 15%.

Risk Reward – Silergy Corp. (6415.TW)

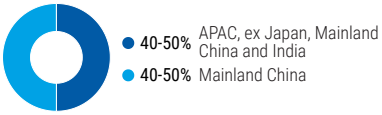
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Revenue from Consumer Segment (NT$, mn)	8,479	9,868	9,815	10,865
Revenue from IT Segment (NT$, mn)	3,689	3,373	3,762	3,649
Revenue from Communication Segment (NT$, mn)	1,929	2,882	3,079	3,485
Revenue from Industrial Segment (NT$, mn)	7,288	7,499	8,194	9,787

INVESTMENT DRIVERS

- LED driver IC market share gain/loss
- New products, e.g., automotive, industrials
- Gross margin improvement/erosion
- China's semiconductor localization demand

GLOBAL REVENUE EXPOSURE



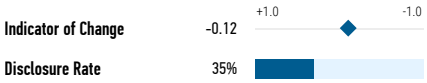
Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

MS ALPHA MODELS

3/5 MOST — 3 Month Horizon

Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

SUSTAINABILITY & ESG



RISKS TO PT/RATING

RISKS TO UPSIDE

- Gross margin expansion amid stabilized competition
- A surge in LED demand as pricing drops to the sweet spot
- Greater-than-expected benefits from China's support in local semiconductors
- Higher-than-expected dividend payout ratio

RISKS TO DOWNSIDE

- Lower gross margin amid intensified competition
- Weaker-than-expected benefits from China's support in local semiconductors
- Lower-than-expected dividend payout ratio

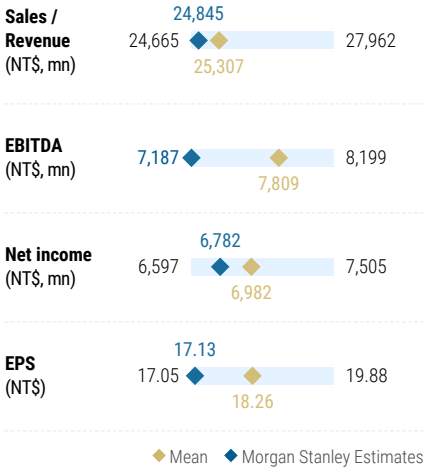
OWNERSHIP POSITIONING

Inst. Owners, % Active 88.6%

Source: Refinitiv, Morgan Stanley Research

MS ESTIMATES VS. CONSENSUS

FY Dec 2022e



Source: Refinitiv, Morgan Stanley Research

Silergy: Financial summary

Exhibit 188: Silergy: Financial summary

Income Statement

NT$mn (Years End Dec)	2020	2021	2022E	2023E	2024E
Net sales	13,876	21,506	24,845	27,264	31,828
COGS	(7,204)	(10,050)	(11,716)	(13,519)	(15,862)
Gross profit	6,672	11,456	13,129	13,745	15,966
Operating expenses	(3,614)	(4,837)	(6,251)	(6,550)	(7,268)
Operating income	**3,058**	**6,619**	**6,878**	**7,195**	**8,698**
Non-operating income	266	(207)	563	180	180
Pre-tax income	3,325	6,413	7,441	7,375	8,878
Income tax	83	615	658	664	799
Reported net Income	**3,242**	**5,797**	**6,782**	**6,711**	**8,079**
Adj.wtd.avg.shrs(m)	92	93	378	378	378
Reported EPS (NT$)	**33.80**	**58.66**	**17.13**	**16.95**	**20.40**
Modelware EPS (NT$)	**33.80**	**58.66**	**17.13**	**16.95**	**20.40**

Balance Sheet

NT$mn (Years End Dec)	2020	2021	2022E	2023E	2024E
Cash	9,248	11,614	15,515	18,264	22,170
Mkt Securities	230	1,247	1,247	1,247	1,247
AR/NR	1,017	1,920	1,696	1,861	2,173
Inventory	2,314	2,784	2,972	3,429	4,023
Other	227	501	501	501	501
Current Assets	**13,036**	**18,066**	**21,931**	**25,303**	**30,115**
Long-term investments	1,639	3,004	3,004	3,004	3,004
Fixed assets	1,191	1,471	1,541	1,611	1,681
Deffered assets	38	54	54	54	54
Other assets	3,964	4,047	4,047	4,047	4,047
Total Assets	**19,867**	**26,643**	**30,578**	**34,020**	**38,901**
S/T borrowings	0	0	0	0	0
AP/NP	618	741	792	914	1,073
Other ST liabilities	803	1,601	1,601	1,601	1,601
LT debt	95	122	122	122	122
Other LT liabilities	0	0	0	0	0
Common shares	929	944	944	944	944
Total Liabilities	**1,517**	**2,465**	**2,516**	**2,638**	**2,797**
Additional capital	7,799	9,256	9,256	9,256	9,256
Retained earning	10,613	15,310	19,194	22,514	27,237
Other shareholders' equity	(990)	(1,333)	(1,333)	(1,333)	(1,333)
Total Equity	**18,351**	**24,178**	**28,062**	**31,382**	**36,105**
Total Liab. & Shrhldr's Equity	**19,867**	**26,643**	**30,578**	**34,020**	**38,901**

E = Morgan Stanley Research Estimates

Source: Morgan Stanley Research, Company Data

Cash Flow Statement

NT$mn (Years End Dec)	2020	2021	2022E	2023E	2024E
Cashflow from Operations	**3,984**	**6,431**	**7,179**	**6,550**	**7,706**
Net profits	3,242	5,797	6,782	6,711	8,079
Depreciation	181	281	309	340	374
Working Capital Change	(376)	(617)	87	(501)	(747)
Other adjustments	937	970	0	0	0
Cashflow from Investing	**1,357**	**(3,344)**	**(379)**	**(410)**	**(444)**
Capex	(333)	(547)	(379)	(410)	(444)
Change of LT Investment	1,581	(1,017)	0	0	0
Change of ST Investment	140	(1,309)	0	0	0
Other adjustments	(32)	(470)	0	0	0
Cashflow from financing	**(358)**	**(464)**	**(2,899)**	**(3,391)**	**(3,356)**
Increase in L/T debt	(38)	27	0	0	0
Increase in S/T debt	(100)	0	0	0	0
Cash Dividend Paid	(683)	(971)	(2,899)	(3,391)	(3,356)
Dir& Emp Bonus Paid	0	0	0	0	0
Issuance of stock	0	0	0	0	0
Other adjustments	464	480	0	0	0
Exchange rate adjustment	(243)	(256)	0	0	0
Net change in cash	**4,740**	**2,366**	**3,901**	**2,749**	**3,906**

Financial Ratios

	2020	2021	2022E	2023E	2024E
Growth(%)					
Turnover	28.8	55.0	15.5	9.7	16.7
Operating profits	31.1	116.4	3.9	4.6	20.9
Pretax profits	37.9	92.9	16.0	-0.9	20.4
Net profits	39.4	78.8	17.0	-1.0	20.4
EPS	33.4	73.6	-70.8	-1.0	20.4
Margins (%)					
Gross Margin	48.1	53.3	52.8	50.4	50.2
Operating Margin	22.0	30.8	27.7	26.4	27.3
Pretax Margin	24.0	29.8	29.9	27.0	27.9
Net Profit	23.4	27.0	27.3	24.6	25.4
Return (%)					
ROAE	19.3	27.3	26.0	22.6	23.9
ROAA	17.7	24.9	23.7	20.8	22.2
Gearing (%)					
Net Debt/Equity	(50.4)	(48.0)	(55.3)	(58.2)	(61.4)
Liabilities/Equity	8.3	10.2	9.0	8.4	7.7
Ratios (X)					
Current ratio	9.2	7.7	9.2	10.1	11.3
Quick ratio	7.2	5.8	7.2	8.0	9.1
Others					
AR/NR Turnover (days)	26	25	25	25	25
Inventory Turnover (days)	107	93	93	93	93
AP Turnover (days)	33	25	25	25	25
Cash Conversion (days)	100	93	93	93	93

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Chipsea: Estimate revision summary and quarterly financials

We cut our earnings forecasts by 3% for 2022, 4% for 2023, and 3% for 2024: Our lowered earnings estimates are mainly to reflect the volume weakness due to prolonged weak consumer demand.

Exhibit 189: Chipsea: Earnings estimate revision summary

Rmb mn	Current 2022E	Previous 2022E	Diff.	New 2023E	Previous 2023E	Diff.	New 2024E	Previous 2024E	Diff.
Net sales	835	847	-1%	1,057	1,081	-2%	1,310	1,339	-2%
COGS	483	490		624	638		761	779	
Gross profit	352	357	-1%	433	443	-2%	549	561	-2%
Operating expenses	344	347		375	381		436	443	
Operating profit	8	10	-18%	58	62	-6%	112	118	-4%
Non-op. income (exp.)	42	42		48	48		48	48	
Pretax Income	50	52	-3%	106	110	-4%	160	165	-3%
Taxes	(5)	(5)		9	9		13	13	
Net income	55	56	-3%	97	101	-4%	147	152	-3%
Reported EPS (Rmb)	0.44	0.45	**-3%**	0.69	0.72	**-4%**	1.05	1.08	**-3%**
Margins									
Gross margin	42.2%	42.1%	0 ppt	41.0%	41.0%	0 ppt	41.9%	41.9%	0 ppt
Operating margin	1.0%	1.1%	0 ppt	5.5%	5.8%	0 ppt	8.6%	8.8%	0 ppt
Pretax margin	6.0%	6.1%	0 ppt	10.1%	10.2%	0 ppt	12.2%	12.4%	0 ppt
Net margin	6.5%	6.6%	0 ppt	9.2%	9.3%	0 ppt	11.2%	11.3%	0 ppt

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 190: Chipsea: Quarterly financials

Rmb mn (YE DEC 31)	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22E	4Q22E	2021	2022E	2023E	2024E
Total Revenues	**104**	**171**	**188**	**196**	**149**	**189**	**242**	**256**	**659**	**835**	**1,057**	**1,310**
Sequential Change	*-5.0%*	*65.0%*	*10.0%*	*4.4%*	*-24.2%*	*26.8%*	*27.9%*	*6.0%*				
Change vs Year Ago	*84.0%*	*65.8%*	*99.5%*	*80.0%*	*43.8%*	*10.4%*	*28.4%*	*30.3%*	*81.7%*	*26.7%*	*26.6%*	*23.9%*
Cost of Sales	57	82	84	93	84	108	140	151	315	483	624	761
Percent of Revenues	*55%*	*48%*	*44%*	*47%*	*56%*	*57%*	*58%*	*59%*	*48%*	*58%*	*59%*	*58%*
Gross Profit	**47**	**89**	**105**	**103**	**65**	**81**	**101**	**105**	**344**	**352**	**433**	**549**
Percent of Revenues	*45.0%*	*52.3%*	*55.6%*	*52.6%*	*43.6%*	*42.9%*	*41.9%*	*41.0%*	*52.2%*	*42.2%*	*41.0%*	*41.9%*
Incremental Margin	*NM*	*64%*	*88%*	*-16%*	*NM*	*40%*	*38%*	*25%*	*58%*	*5%*	*36%*	*46%*
Total Opex	40	58	64	108	77	85	91	91	270	344	375	436
Percent of Revenues	*38.6%*	*33.7%*	*34.0%*	*54.9%*	*51.7%*	*44.9%*	*37.8%*	*35.6%*	*40.9%*	*41.2%*	*35.4%*	*33.3%*
R&D	19	45	40	65	45	48	53	51	169	197	214	262
Percent of Revenues	*18.1%*	*26.5%*	*21.1%*	*33.3%*	*30.1%*	*25.3%*	*22.0%*	*20.0%*	*25.7%*	*23.6%*	*20.2%*	*20.0%*
General & administrative	18	7	18	31	20	25	26	27	73	99	119	135
Percent of Revenues	*17.5%*	*3.9%*	*9.5%*	*15.6%*	*13.8%*	*13.3%*	*10.8%*	*10.6%*	*11.1%*	*11.8%*	*11.2%*	*10.3%*
Selling & marketing	3	6	6	12	12	12	12	13	27	48	42	39
Percent of Revenues	*3.0%*	*3.4%*	*3.4%*	*6.0%*	*7.8%*	*6.2%*	*5.0%*	*5.0%*	*4.1%*	*5.8%*	*4.0%*	*3.0%*
Operating Income	**7**	**32**	**41**	**(5)**	**(12)**	**(4)**	**10**	**14**	**74**	**8**	**58**	**112**
Percent of Revenues	*6.4%*	*18.6%*	*21.6%*	*-2.3%*	*-8.1%*	*-1.9%*	*4.1%*	*5.4%*	*11.3%*	*1.0%*	*5.5%*	*8.6%*
Change vs Year Ago	*-65.3%*	*24.7%*	*353.7%*	*-4182.0%*	*-283.6%*	*-111.5%*	*-75.4%*	*-399.4%*	*46%*	*-89%*	*635%*	*93%*
Total Non-operating Income(Loss)	(11)	20	(2)	9	8	14	12	12	16	42	48	48
Interest income	0	0	0	0	0	0	0	0	0	0	0	0
Interest expense	0	0	0	0	0	0	0	0	0	0	0	0
Investment Income(loss)	0	1	0	0	0	0	0	0	1	0	0	0
Tax Rate	*29.9%*	*3.6%*	*7.0%*	*-212.2%*	*124.9%*	*-40.8%*	*8.0%*	*8.0%*	*-5.8%*	*-10.1%*	*8.0%*	*8.0%*
Net Income, Cont Ops	(3)	50	36	13	1	15	21	24	96	55	98	148
Percent of Revenues	*-3%*	*29%*	*19%*	*6%*	*1%*	*8%*	*9%*	*9%*	*15%*	*7%*	*9%*	*11%*
Minority interest	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0	(0)	(1)	(1)
Reported Income	**(3)**	**50**	**36**	**13**	**1**	**15**	**20**	**24**	**96**	**55**	**97**	**147**
Percent of Revenues	*-3%*	*29%*	*19%*	*6%*	*1%*	*8%*	*8%*	*9%*	*15%*	*7%*	*9%*	*11%*
Reported EPS (Rmb)	**(0.03)**	**0.50**	**0.36**	**0.12**	**0.01**	**0.13**	**0.15**	**0.17**	**0.94**	**0.44**	**0.69**	**1.05**
Change vs Year Ago	*-113%*	*31%*	*72%*	*-65%*	*-135%*	*-75%*	*-59%*	*37%*	*-15%*	*-54%*	*59%*	*51%*

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Valuation methodology

We cut our price target to Rmb33 from Rmb38, reflecting our reduced earnings estimates and lowered medium-term growth rate, down to 16% from 17.2% previously. The lowered medium-term growth rate is because of more competition after foundry supply easing.

Our price target is our base case scenario value, derived from a residual income model. Except for medium-term growth rate, we keep our other model assumptions unchanged - an 8.6% cost of equity (beta 1.2, risk-free rate 2.0% and risk premium 5.5%), a payout ratio of 12%, and a terminal growth rate of 5.0%.

Our bull case and bear case values are changed accordingly.

Exhibit 191: Chipsea: Residual income model

Rmb mn	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E
Total Equity	**1,031**	**1,121**	**1,257**	**1,409**	**1,587**	**1,792**	**2,031**	**2,308**	**2,629**	**3,001**	**3,433**	**3,934**
Net Profit	**55**	**97**	**147**	**171**	**198**	**229**	**266**	**309**	**358**	**415**	**482**	**559**
ROAE	**5.4%**	**9.0%**	**12.4%**	**12.8%**	**13.2%**	**13.6%**	**13.9%**	**14.2%**	**14.5%**	**14.8%**	**15.0%**	**15.2%**
Residual Income	(32)	5	42	53	65	79	95	114	136	162	191	226
Spread	**-3.2%**	**0.4%**	**3.8%**	**4.2%**	**4.6%**	**5.0%**	**5.3%**	**5.6%**	**5.9%**	**6.2%**	**6.4%**	**6.6%**
Ending Equity Capital	1,031											
PV of Forecast Period	450											
PV of Continuing Value	2,656											
Equity Value	**4,137**											
No. of Shares	125											
Projected Price (Rmb)	**33**											

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Chipsea: Financial summary

Exhibit 192: Chipsea: Financial summary

Income Statement Rmb mn (Years End Dec)	2021	2022E	2023E	2024E
Net sales	659	835	1,057	1,310
COGS	(315)	(483)	(624)	(761)
Gross profit	344	352	433	549
Operating expenses	(270)	(344)	(375)	(436)
Operating income	**74**	**8**	**58**	**112**
Non-operating income	16	42	48	48
Pre-tax income	90	50	106	160
Income tax	(5)	(5)	9	13
Minority interests	0	(0)	(1)	(1)
Reported net Income	**96**	**55**	**97**	**147**
Adj.wtd.avg.shrs(m)	102	125	140	140
MW EPS (Rmb)	0.94	0.44	0.69	1.05
Reported EPS (Rmb)	**0.94**	**0.44**	**0.69**	**1.05**

Balance Sheet Rmb mn (Years End Dec)	2021	2022E	2023E	2024E
Cash	382	368	385	444
Mkt Securities	52	52	52	52
AR/NR	138	137	173	215
Inventory	127	191	247	301
Other	78	78	78	78
Current Assets	**776**	**826**	**935**	**1,090**
Long-term investments	18	18	18	18
Fixed assets	130	130	130	130
Deferred assets	43	43	43	43
Other assets	151	151	151	151
Total Assets	**1,118**	**1,167**	**1,277**	**1,432**
S/T borrowings	0	0	0	0
AP/NP	62	68	88	107
Other ST liabilities	45	45	45	45
LT debt	0	0	0	0
Other LT liabilities	23	23	23	23
Total Liabilities	**130**	**136**	**156**	**175**
Common shares	100	100	100	100
Additional capital	672	672	672	672
Retained earning	216	259	349	485
Other shareholders' equity	(0)	(0)	(0)	(0)
Total Equity	**988**	**1,031**	**1,121**	**1,257**
Total Liab. & Shrhldr's Equity	**1,118**	**1,167**	**1,277**	**1,432**

Cash Flow Statement Rmb mn (Years End Dec)	2021	2022E	2023E	2024E
Cashflow from Operations	**122**	**5**	**32**	**78**
Net profits	96	55	97	147
Depreciation	7	7	7	7
Working Capital Change	20	(57)	(72)	(76)
Other adjustments	(1)	0	0	0
Cashflow from Investing	**(176)**	**(7)**	**(7)**	**(7)**
Capex	(131)	(7)	(7)	(7)
Change of LT Investment	(26)	0	0	0
Change of ST Investment	0	0	0	0
Other adjustments	(19)	0	0	0
Cashflow from financing	**(141)**	**(12)**	**(7)**	**(11)**
Increase in L/T debt	(19)	0	0	0
Increase in S/T debt	(80)	0	0	0
Cash Dividend Paid	(32)	(12)	(7)	(11)
Dir& Emp Bonus Paid	0	0	0	0
Issuance of stock	0	0	0	0
Other adjustments	(9)	0	0	0
Exchange rate adjustment	19	0	0	0
Net change in cash	**-176**	**-14**	**17**	**59**

Financial Ratios	2021	2022E	2023E	2024E
Growth(%)				
Turnover	81.7	26.7	26.6	23.9
Operating profits	45.8	-89.3	634.8	92.5
EPS	-14.5	-53.6	59.1	51.1
Margins (%)				
Gross Margin	52.2	42.2	41.0	41.9
Operating Margin	11.3	1.0	5.5	8.6
Pretax Margin	13.7	6.0	10.1	12.2
Net Margin	14.5	6.5	9.2	11.2
Return (%)				
ROAE	10.4	5.4	9.0	12.4
ROAA	8.9	4.8	8.0	10.9
Gearing (%)				
Net Debt/Equity	(38.6)	(35.7)	(34.4)	(35.4)
Liabilities/Equity	13.1	13.2	13.9	13.9
Ratios (X)				
Current ratio	7.3	7.3	7.0	7.2
Quick ratio	4.9	4.5	4.2	4.3
Others				
AR/NR Turnover (days)	60	60	60	60
Inventory Turnover (days)	145	145	145	145
AP Turnover (days)	51	51	51	51
Cash Conversion (days)	153	153	153	153

E = Morgan Stanley Research Estimates
Source: Morgan Stanley Research, Company Data

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

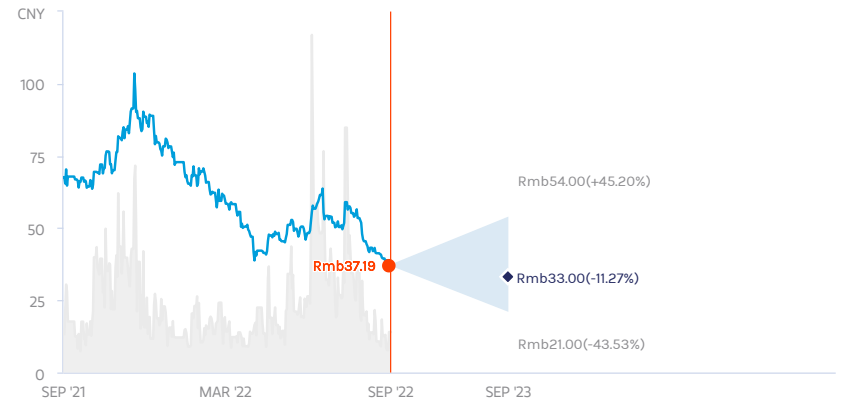
Risk Reward – Chipsea Technologies Shenzhen Corp (688595.SS)

Stock price is ahead of fundamentals, in our view

PRICE TARGET Rmb33.00

Base case, residual income model. We assume an 8.6% cost of equity (beta 1.2, risk-free rate 2.0% and risk premium 5.5%), a payout ratio of 12%, a medium-term growth rate of 16.0%, and a terminal growth rate of 5.0%.

RISK REWARD CHART



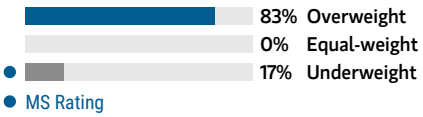
Key: Historical Stock Performance Current Stock Price Price Target

Source: Refinitiv, Morgan Stanley Research

UNDERWEIGHT THESIS

- Chipsea is a niche MCU player in China focusing on the healthcare market.
- It has strong ADC technology in China and can compete with global peers.
- We believe it plays an important role in China's MCU localization in healthcare devices.
- We believe the company's general purpose MCU faces headwinds given consumer electronics weakness.
- We expect Chipsea to launch BMIC products in 2022 thanks to its strong design capabilities in ADC technology
- However, it has not commercialized BMIC yet, and valuation is expensive, so we rate the stock UW.

Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Contrarian:	*Negative*
Market Share:	*Positive*
Pricing Power:	*Negative*

View descriptions of Risk Rewards Themes here

BULL CASE Rmb54.00

78x 2023e EPS

We assume a 10% CAGR for healthcare AIoT chips, ADC to grow 50%+, and MCU to show a 40%+ CAGR in 2021-24e.

BASE CASE Rmb33.00

48x 2023e EPS

We assume a -9% CAGR for healthcare AIoT chips, ADC to grow 40%+, and MCU to show a 30-40% CAGR in 2021-24e.

BEAR CASE Rmb21.00

30x 2023e EPS

We expect a -20% CAGR for healthcare AIoT, ADC to grow below 20%, and MCU to post a below 25% CAGR in 2021-24e.

Risk Reward – Chipsea Technologies Shenzhen Corp (688595.SS)

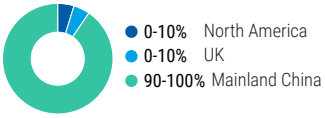
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Healthcare AIoT chips unit growth (%)	30.6	(44.0)	26.7	25.1
Analog signal chain chips unit growth (%)	12.5	104.1	33.0	31.5
MCU unit growth (%)	58.4	0.0	35.2	23.9

INVESTMENT DRIVERS

- SOC and ADC unit shipments
- Pricing trends
- Household medical device growth in China
- TWS shipments in China
- E-cigarette shipments in China
- USB PD shipments in China

GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

RISKS TO PT/RATING

RISKS TO UPSIDE

- MCU up-cycle is more sustained than expected into 2023.
- China's MCU localization pace is faster than expected.
- More traction is gained from healthcare and consumer business.
- Margin expansion is more significant.

RISKS TO DOWNSIDE

- MCU up-cycle ends earlier with sharp pricing erosion.
- China's MCU localization pace is slower than expected.
- Traction from healthcare and consumer device business is less.
- Margins contract.

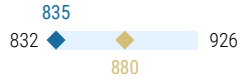
OWNERSHIP POSITIONING

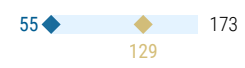
Inst. Owners, % Active 100%

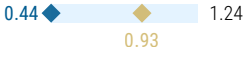
Source: Refinitiv, Morgan Stanley Research

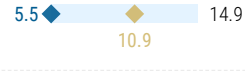
MS ESTIMATES VS. CONSENSUS

FY Dec 2022e









Mean Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

3Peak: Estimate revision summary and quarterly financials

We cut our EPS forecasts by 33% for 2022-24 to reflect scrip issue: 3Peak's scrip issue took place on September 20, 2022, at a ratio of 10:14.9. We adjust our EPS estimates to reflect the higher number of shares. Our other assumptions remain unchanged.

Exhibit 193: 3Peak: Earnings estimate revision summary

	Current	Previous		New	Previous		New	Previous	
Rmb mn	**2022E**	**2022E**	**Diff.**	**2023E**	**2023E**	**Diff.**	**2024E**	**2024E**	**Diff.**
Net sales	2,300	2300	0%	3,113	3,113	0%	3,728	3,728	0%
COGS	943	943		1,302	1,302		1,596	1,596	
Gross profit	1,357	1357	0%	1,811	1,811	0%	2,132	2,132	0%
Operating expenses	814	814		974	974		1,147	1,147	
Operating profit	544	544	0%	837	837	0%	984	984	0%
Non-op. income (exp.)	35	35		0	0		0	0	
Pretax Income	579	579	0%	837	837	0%	984	984	0%
Taxes	53	53		126	126		148	148	
Net income	526	526	0%	712	712	0%	837	837	0%
Reported EPS (Rmb)	**4.41**	**6.56**	**-33%**	**5.97**	**8.89**	**-33%**	**7.02**	**10.46**	**-33%**
Margins									
Gross margin	59.0%	59.0%	0 ppt	58.2%	58.2%	0 ppt	57.2%	57.2%	0 ppt
Operating margin	23.6%	23.6%	0 ppt	26.9%	26.9%	0 ppt	26.4%	26.4%	0 ppt
Pretax margin	25.2%	25.2%	0 ppt	26.9%	26.9%	0 ppt	26.4%	26.4%	0 ppt
Net margin	22.9%	22.9%	0 ppt	22.9%	22.9%	0 ppt	22.4%	22.4%	0 ppt

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 194: 3Peak: Quarterly financial statement

(RMB$ mn) YE Dec31	1Q21	2Q21	3Q21	4Q21	1Q22	2Q22	3Q22E	4Q22E	2021	2022E	2023E	2024E
Total revenues	**167**	**318**	**406**	**435**	**442**	**556**	**620**	**683**	**1,326**	**2,300**	**3,113**	**3,728**
Q/Q Change	*49.9%*	*90.0%*	*27.9%*	*7.1%*	*1.7%*	*25.6%*	*11.5%*	*10.2%*				
Y/Y Change	*30.9%*	*82.3%*	*165.4%*	*290.2%*	*164.7%*	*74.9%*	*52.5%*	*57.0%*	*134.1%*	*73.5%*	*35.3%*	*19.7%*
Cost of Sales	**70**	**124**	**153**	**176**	**190**	**226**	**250**	**277**	**523**	**943**	**1,302**	**1,596**
Percent of Revenues	*41.9%*	*39.2%*	*37.7%*	*40.4%*	*43.0%*	*40.6%*	*40.4%*	*40.5%*	*39.5%*	*41.0%*	*41.8%*	*42.8%*
Gross Profit	**97**	**193**	**253**	**259**	**252**	**330**	**369**	**406**	**803**	**1,357**	**1,811**	**2,132**
Gross Margin	***58.1%***	***60.8%***	***62.3%***	***59.6%***	***57.0%***	***59.4%***	***59.6%***	***59.5%***	***60.5%***	***59.0%***	***58.2%***	***57.2%***
Incremental Margin	*71%*	*64%*	*68%*	*21%*	*-97%*	*69%*	*61%*	*58%*	*60%*	*57%*	*56%*	*52%*
Total Opex	**76**	**90**	**113**	**143**	**175**	**205**	**206**	**227**	**423**	**814**	**974**	**1,147**
Percent of Revenues	*45.4%*	*28.2%*	*27.9%*	*33.0%*	*39.6%*	*36.9%*	*33.3%*	*33.3%*	*31.9%*	*35.4%*	*31.3%*	*30.8%*
R&D	56.0	60.2	80.7	104.1	138.3	159.2	154.9	170.7	301.0	623.1	716.0	838.8
Percent of Revenues	*33.5%*	*18.9%*	*19.9%*	*23.9%*	*31.3%*	*28.7%*	*25.0%*	*25.0%*	*22.7%*	*27.1%*	*23.0%*	*22.5%*
General & Adm Exp.	9.7	15.8	15.6	15.4	14.9	15.3	17.1	18.8	56.5	66.2	85.9	102.9
Percent of Revenues	*5.8%*	*5.0%*	*3.8%*	*3.5%*	*3.4%*	*2.8%*	*2.8%*	*2.8%*	*4.3%*	*2.9%*	*2.8%*	*2.8%*
Selling Expenses	10.2	13.6	17.2	24.0	22.0	30.7	34.2	37.7	65.0	124.5	171.8	205.7
Percent of Revenues	6.1%	4.3%	4.2%	5.5%	5.0%	5.5%	5.5%	5.5%	4.9%	5.4%	5.5%	5.5%
Operating Income	**21**	**104**	**140**	**116**	**77**	**125**	**163**	**179**	**380**	**544**	**837**	**984**
Operating Margin	*12.7%*	*32.6%*	*34.4%*	*26.6%*	*17.4%*	*22.5%*	*26.3%*	*26.2%*	*28.7%*	*23.6%*	*26.9%*	*26.4%*
Total Non-operating Income (loss)	**14**	**18**	**15**	**17**	**15**	**20**	**0**	**0**	**65**	**35**	**0**	**0**
Profit Before Taxes	**36**	**122**	**155**	**133**	**92**	**145**	**163**	**179**	**445**	**579**	**837**	**984**
Percent of Revenues	*21.4%*	*38.3%*	*38.1%*	*30.6%*	*20.7%*	*26.1%*	*26.3%*	*26.2%*	*33.6%*	*25.2%*	*26.9%*	*26.4%*
Taxes	**5**	**(2)**	**(2)**	**1**	**0**	**2**	**24**	**27**	**2**	**53**	**126**	**148**
Tax Rate	12.8%	-1.6%	-1.5%	1.0%	0.1%	1.1%	15.0%	15.0%	0.3%	9.1%	15.0%	15.0%
Minor interest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Net Income to Parent	**31**	**124**	**157**	**132**	**91**	**144**	**139**	**152**	**444**	**526**	**712**	**837**
Percent of Revenues	*18.6%*	*38.9%*	*38.6%*	*30.3%*	*20.7%*	*25.8%*	*22.4%*	*22.3%*	*33.5%*	*22.9%*	*22.9%*	*22.4%*
Modelware EPS (Rmb)	**0.39**	**1.55**	**1.96**	**1.64**	**0.77**	**1.20**	**1.16**	**1.28**	**5.53**	**4.41**	**5.97**	**7.02**

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Valuation methodology

We cut our price target to Rmb313 from Rmb382.55 (which is adjusted for the scrip issue), reflecting our lower medium-term growth rate, down to 16.0%, from 18.3%, reflecting eased foundry supply, which may lead to more competition from other IC design houses.

Our price target is our base case scenario value, derived from a residual income model. Except for medium-term growth rate, we keep our other key assumptions unchanged – we assume an 8.0% cost of equity (beta 1.1, risk-free rate 3.0%, and risk premium 4.5%), a payout ratio of 20%, and a terminal growth rate of 5.5%.

Our bull and bear case values are also adjusted to Rmb417 and Rmb208, respectively, given the base case adjustment.

Exhibit 195: 3Peak: Residual income model

(Rmb mn)	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E	2033E
Total Equity	**3,657**	**4,316**	**5,082**	**5,878**	**6,801**	**7,872**	**9,114**	**10,555**	**12,227**	**14,166**	**16,415**	**19,024**
Net Profit	**526**	**712**	**837**	**971**	**1,126**	**1,306**	**1,515**	**1,757**	**2,039**	**2,365**	**2,743**	**3,182**
ROAE	**15.4%**	**17.8%**	**17.8%**	**17.7%**	**17.8%**	**17.8%**	**17.8%**	**17.9%**	**17.9%**	**17.9%**	**17.9%**	**18.0%**
Residual Income	233	359	422	492	571	664	771	896	1,040	1,208	1,402	1,628
Spread	**7.4%**	**9.8%**	**9.8%**	**9.7%**	**9.7%**	**9.8%**	**9.8%**	**9.8%**	**9.9%**	**9.9%**	**9.9%**	**9.9%**
Ending Equity Capital	3,657											
PV of Forecast Period	4,769											
PV of Continuing Value	28,881											
Equity Value	**37,308**											
No. of Shares	119											
Price Target	**313**											

Source: Morgan Stanley Research. E = Morgan Stanley Research estimates.

3Peak: Financial summary

Exhibit 196: 3Peak: Financial summary

Income Statement

RMB$ mn (Years End Dec)	2021	2022E	2023E	2024E
Net sales	1,326	2,300	3,113	3,728
COGS	(523)	(943)	(1,302)	(1,596)
Gross profit	803	1,357	1,811	2,132
Operating expenses	(423)	(814)	(974)	(1,147)
Operating income	**380**	**544**	**837**	**984**
Non-operating income	65	35	0	0
Pre-tax income	445	579	837	984
Income tax	2	53	126	148
Minority Interest	0	0	0	0
Reported net Income	**444**	**526**	**712**	**837**
Adj.wtd.avg.shrs(m)	80.0	119.2	119.2	119.2
Reported EPS (Rmb)	**5.53**	**4.41**	**5.97**	**7.02**
Modelware EPS (Rmb)	**5.53**	**4.41**	**5.97**	**7.02**

Balance Sheet

RMB$mn (Years End Dec)	2021	2022E	2023E	2024E
Cash	297	679	1,166	1,791
Mkt Securities	2,366	2,366	2,366	2,366
AR/NR	264	295	399	478
Inventory	146	196	271	332
Other	147	147	147	147
Current Assets	**3,222**	**3,684**	**4,350**	**5,115**
Long-term investments	39	39	39	39
Fixed assets	57	93	128	163
Deffered assets	2	2	2	2
Other assets	122	122	122	122
Total Assets	**3,442**	**3,940**	**4,641**	**5,441**
S/T borrowings	0	0	0	0
AP/NP	95	111	153	187
Other ST liabilities	157	157	157	157
LT debt	0	0	0	0
Other LT liabilities	15	15	15	15
Common shares	80	80	80	80
Total Liabilities	**266**	**282**	**325**	**359**
Additional capital	2,405	2,405	2,405	2,405
Retained earning	648	1,130	1,789	2,555
Other shareholders' equity	42	42	42	42
Total Equity	**3,176**	**3,657**	**4,316**	**5,082**
Total Liab. & Shrhldr's Equity	**3,442**	**3,940**	**4,641**	**5,441**

E = Morgan Stanley Research Estimates

Source: Morgan Stanley Research, Company Data

Cash Flow Statement

RMB$mn (Years End Dec)	2021	2022E	2023E	2024E
Cashflow from Operations	**242**	**479**	**593**	**749**
Net profits	444	526	712	837
Depreciation	13	13	13	13
Working Capital Change	(443)	(64)	(137)	(105)
Other adjustments	228	4	4	4
Cashflow from Investing	**(1,447)**	**(53)**	**(53)**	**(53)**
Capex	(53)	(53)	(53)	(53)
Change of LT Investment	(9,533)	0	0	0
Change of ST Investment	8,116	0	0	0
Other adjustments	24	0	0	0
Cashflow from financing	**4**	**(44)**	**(53)**	**(71)**
Increase in L/T debt	0	0	0	0
Increase in S/T debt	0	0	0	0
Cash Dividend Paid	0	(44)	(53)	(71)
Issuance of stock	30	0	0	0
Other adjustments	(27)	0	0	0
Exchange rate adjustment	(1)	0	0	0
Net change in cash	**(1,202)**	**382**	**487**	**625**

Financial Ratios

	2021	2022E	2023E	2024E
Growth(%)				
Turnover	134.1	73.5	35.3	19.7
Operating profits	127.4	43.1	54.0	17.6
Pretax profits	145.9	30.0	44.7	17.6
Net profits	141.3	18.5	35.3	17.6
EPS	95.4	-20.2	35.3	17.6
Margins (%)				
Gross Margin	60.5	59.0	58.2	57.2
Operating Margin	28.7	23.6	26.9	26.4
Pretax Margin	33.6	25.2	26.9	26.4
Net Profit	33.5	22.9	22.9	22.4
Return (%)				
ROAE	15.4	15.4	17.8	17.8
ROAA	14.5	14.2	16.6	16.6
Gearing (%)				
Net Debt/Equity	(9.4)	(18.6)	(27.0)	(35.2)
Liabilities/Equity	8.4	7.7	7.5	7.1
Ratios (X)				
Current ratio	12.8	13.8	14.1	14.9
Quick ratio	2.2	3.6	5.1	6.6
Others				
AR/NR Turnover (days)	47	47	47	47
Inventory Turnover (days)	76	76	76	76
AP Turnover (days)	43	43	43	43
Cash Conversion (days)	80	80	80	80

Source: Company data, Morgan Stanley Research. E = Morgan Stanley Research estimates.

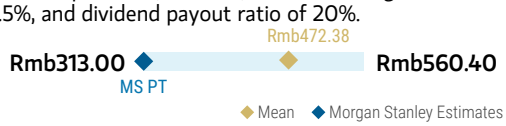
Risk Reward – 3Peak (688536.SS)

Rising analog IC design house in China, but rich valuation

PRICE TARGET Rmb313.00

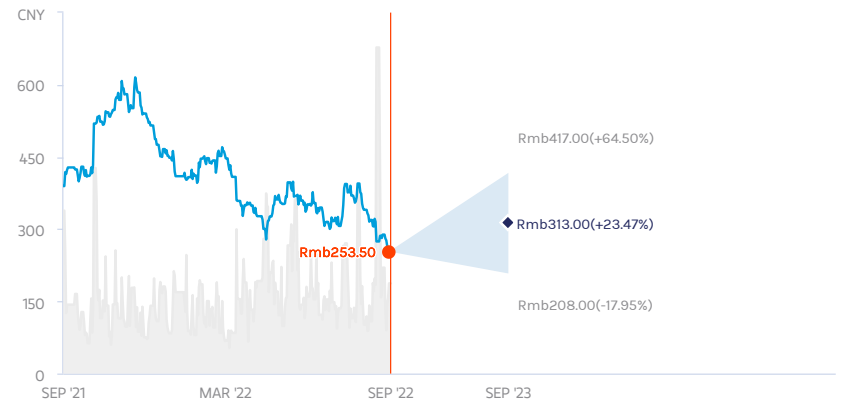
Rmb313: Base case, derived from a residual income model. Key assumptions: cost of equity constant at 8.0% (3.0% risk-free rate, 4.5% risk premium, 1.1 beta), medium-term growth rate of 16.0%, terminal growth rate of 5.5%, and dividend payout ratio of 20%.

Consensus Price Target Distribution



Source: Refinitiv, Morgan Stanley Research

RISK REWARD CHART

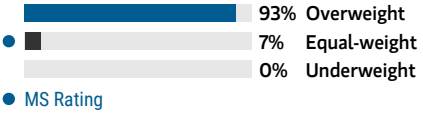


Source: Refinitiv, Morgan Stanley Research

EQUAL-WEIGHT THESIS

- 3Peak is a leading analog company in China with both mixed-signal IC and PMIC product offerings.
- Unlike other Chinese IC design houses, 3Peak has minimal exposure to the consumer market but high exposure to the communications and industrial markets, reflecting its superior design capabilities.
- 3Peak will have DC-DC products in 2022. We also expect a more meaningful contribution from BMIC in 2023.
- Our Equal-weight rating largely reflects our view that 2023e P/E valuation is full.

Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

Risk Reward Themes

Market Share:	*Positive*
Secular Growth:	*Positive*

View descriptions of Risk Rewards Themes here

BULL CASE Rmb417.00

70x 2023e EPS

Overall revenue increases at a 60% CAGR in 2021-24, gross margin above 60% in 2022, teens (%) revenue contribution from BMIC in 2023.

BASE CASE Rmb313.00

52x 2023e EPS

Revenue increases at a 40% CAGR in 2021-24, gross margin is 59% in 2022, BMIC starts to contribute in 2023.

BEAR CASE Rmb208.00

35x 2023e EPS

Overall revenue increases at a 30% CAGR in 2021-24, gross margin below 55% in 2022, minimal contribution from BMIC in 2023.

Risk Reward – 3Peak (688536.SS)

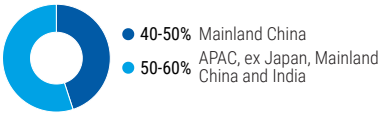
KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Mixed-Signal IC revenue growth (%)	88.6	60.7	34.0	15.3
Mixed-Signal IC ASP growth (%)	(0.9)	0.1	(3.1)	(3.9)
Overall gross margin (%)	60.5	59.0	58.2	57.2

INVESTMENT DRIVERS

- Mixed-signal IC revenue growth
- Mixed-signal IC ASP growth
- BMIC revenue contribution

GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate
View explanation of regional hierarchies here

RISKS TO PT/RATING

RISKS TO UPSIDE

- More foundry support from Tower Jazz and other foundry vendors
- Gain of more new big customers
- More market share gain over foreign peers in analog market
- Faster-than-expected development of BMIC

RISKS TO DOWNSIDE

- Insufficient foundry support from Tower Jazz or other foundry vendors
- Inability to diversify the customer base
- Inability to increase market share in analog market
- Failure to develop BMIC

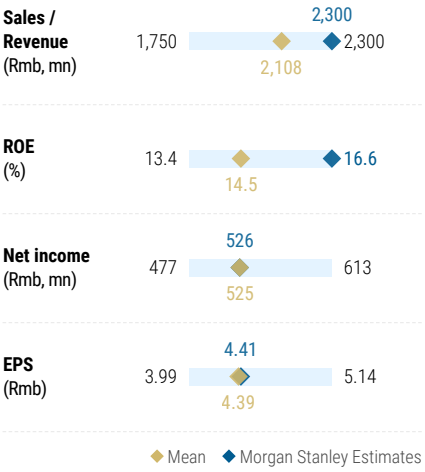
OWNERSHIP POSITIONING

Inst. Owners, % Active 99.6%

Source: Refinitiv, Morgan Stanley Research

MS ESTIMATES VS. CONSENSUS

FY Dec 2022e



Source: Refinitiv, Morgan Stanley Research

Appendix (I): Global analog market

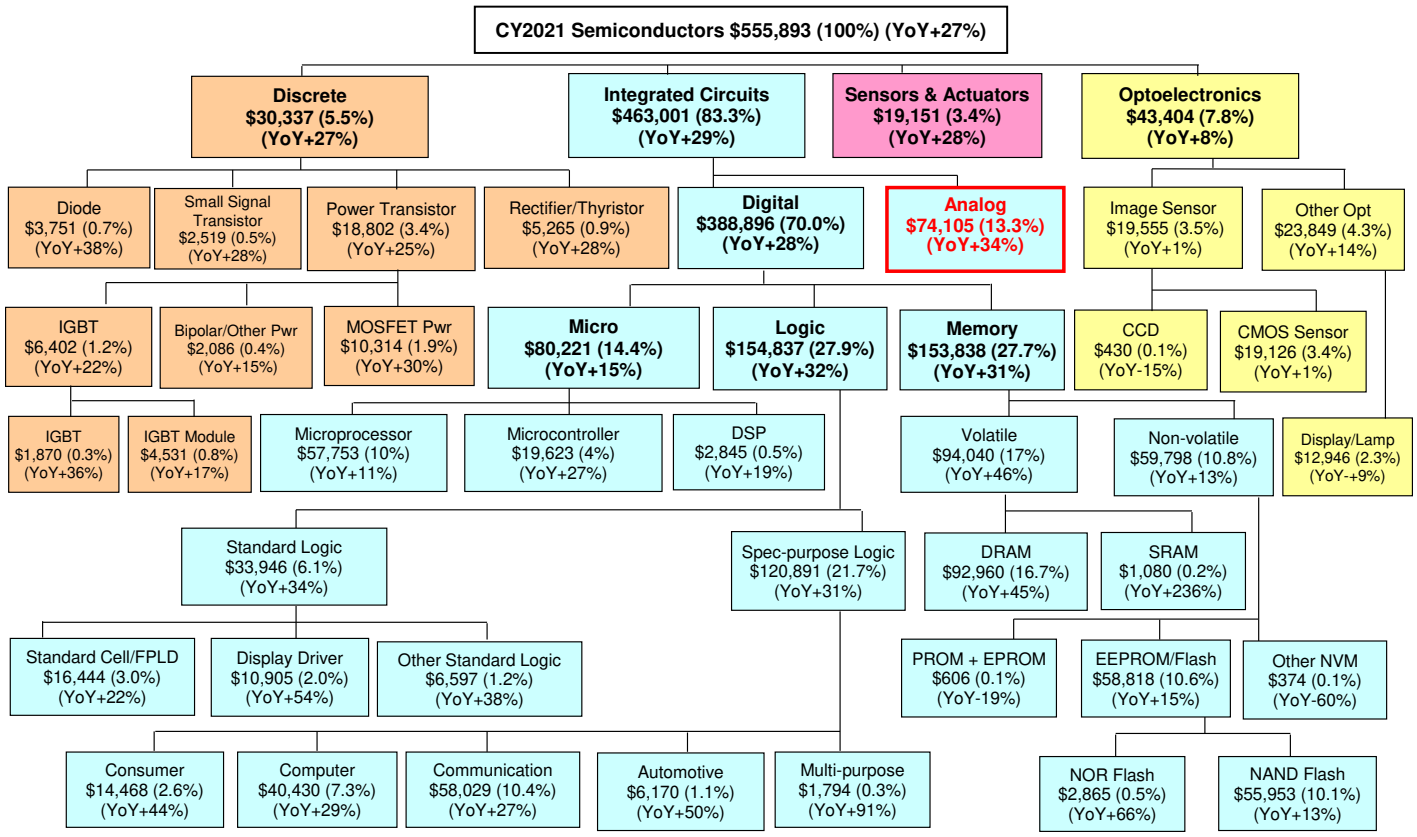
Global analog market - TAM of US$94bn into 2023

According to WSTS, the global analog market accounted for 13.3% of the global semiconductor TAM in 2021 (Exhibit 197). We expect the market to grow to US$94bn into 2023 (Exhibit 198), thanks to the semiconductor upcycle and strong demand from the industrial and automotive industries.

Going forward, we expect the global analog TAM to achieve a CAGR of 5% during 2022-28, and the China analog TAM to outgrow the global TAM with a CAGR of 8% during 2022-28.

We can further separate the analog market into signal chain (Appendix (II): Signal chain market) and PMIC (Appendix (III): PMIC market). We will discuss in the below two paragraphs.

Exhibit 197: Analog TAM



Source: SIA, Morgan Stanley Research.

Exhibit 198: Global analog TAM

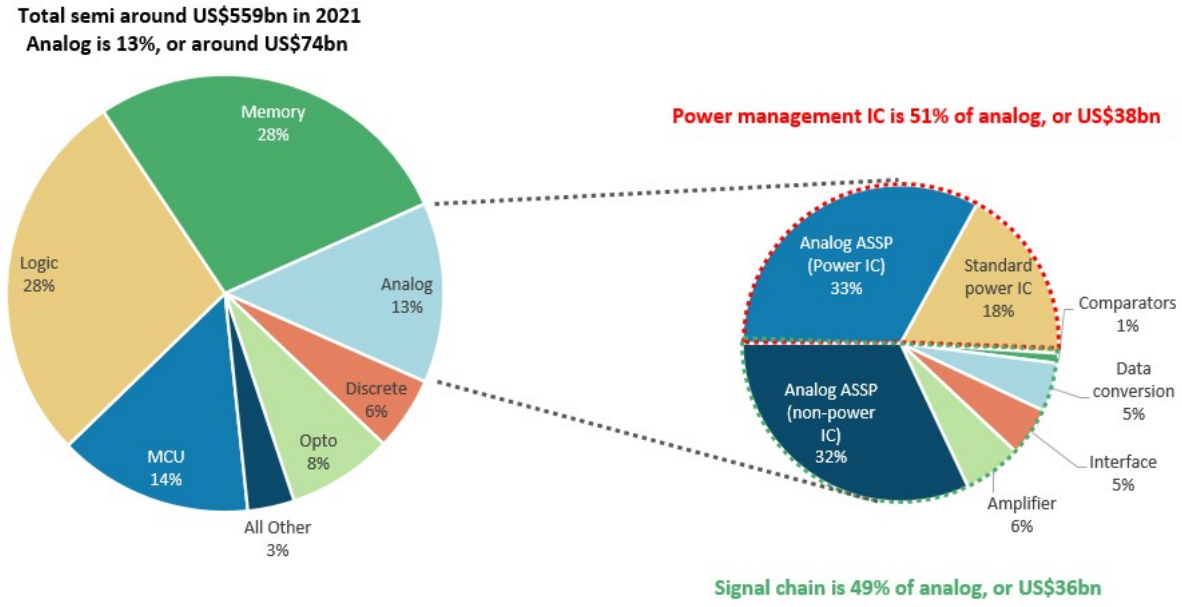
Global analog TAM (US$ bn)	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e
Total analog	**44.4**	**45.2**	**47.8**	**53.1**	**58.8**	**53.9**	**55.7**	**74.1**	**89.9**	**94.4**	**99.1**	**104.1**	**109.3**	**114.7**	**120.5**
Global general purpose analog	**18.2**	**18.6**	**19.5**	**21.8**	**23.6**	**22.5**	**23.2**	**30.1**	**36.9**	**38.7**	**40.6**	**42.7**	**44.8**	**47.0**	**49.4**
Amplifiers/ comparators (signal conditioning)	2.9	2.8	2.9	3.2	3.5	3.3	3.3	4.3							
Interface	2.0	2.0	2.1	2.1	2.2	1.9	2.1	2.8							
Power management	10.8	11.0	11.2	12.7	14.3	13.8	14.4	19.0							
Signal conversion	2.5	2.9	3.3	3.8	3.6	3.4	3.4	3.9							
Global application specific analog	**26.2**	**26.6**	**28.3**	**31.3**	**35.2**	**31.5**	**32.5**	**44.0**	**53.0**	**55.7**	**58.5**	**61.4**	**64.5**	**67.7**	**71.1**
Consumer	1.9	1.8	2.2	2.3	2.4	2.0	2.1	2.9							
Computer	2.4	2.1	1.9	2.2	2.5	2.0	2.1	2.8							
Communication	12.8	13.9	14.1	15.5	17.6	15.3	16.5	22.9							
Automotive	6.6	6.6	7.7	8.6	9.6	9.5	8.9	11.7							
Industrial & others	2.5	2.1	2.5	2.6	3.1	2.8	2.8	3.7							
								51%	51%						

China analog TAM (US$ bn)	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e
Total analog	13.3	13.8	16.2	18.5	21.8	21.3	23.3	29.5	36.9	40.2	43.4	46.9	50.6	54.7	59.0
China general purpose analog	6.3	6.8	8.0	8.6	9.7	10.4	11.4	14.4	18.1	19.7	21.3	23.0	24.8	26.8	28.9
Amplifiers/ comparators (signal conditioning)	.9	.9	12.3	1.0	1.2	1.3	1.4	1.7							
Interface	.6	.6	.8	.8	.9	.9	1.0	1.3							
Power management	4.1	4.6	5.2	5.8	6.6	7.1	7.7	10.2							
Signal conversion	.7	.7	.9	1.0	1.1	1.1	1.3	1.3							
China application specific analog	6.9	7.0	8.2	10.0	12.1	10.9	11.9	15.1	18.8	20.5	22.1	23.9	25.8	27.9	30.1
Consumer	.7	.7	1.0	1.1	1.4	1.3	1.3	1.8							
Computer	.7	.6	.7	.8	.8	.7	.8	1.1							
Communication	3.9	3.9	4.4	5.8	7.4	6.5	7.0	7.9							
Automotive	1.1	1.2	1.5	1.6	1.9	1.8	2.0	3.1							
Industrial & others	.6	.5	.6	.6	.6	.6	.7	1.0							

China market share	2014	2015	2016	2017	2018	2019	2020	2021	2022e	2023	2024e	2025e	2026e	2027e	2028e
China total analog global market share	**30%**	**30%**	**34%**	**35%**	**37%**	**40%**	**42%**	**40%**	**41%**	**43%**	**44%**	**45%**	**46%**	**48%**	**49%**
China general purpose analog market share	**35%**	**37%**	**41%**	**39%**	**41%**	**46%**	**49%**	**48%**	**49%**	**51%**	**52%**	**54%**	**55%**	**57%**	**59%**
Amplifiers/ comparators (signal conditioning)	31%	33%	426%	32%	33%	40%	41%	40%							
Interface	31%	32%	36%	36%	40%	46%	48%	46%							
Power management	38%	42%	47%	46%	46%	51%	54%	53%							
Signal conversion	27%	24%	28%	26%	30%	32%	38%	32%							
China application specific analog market share	**26%**	**26%**	**29%**	**32%**	**34%**	**35%**	**37%**	**34%**	**35%**	**37%**	**38%**	**39%**	**40%**	**41%**	**42%**
Consumer	36%	40%	45%	50%	57%	65%	63%	64%							
Computer	30%	30%	37%	35%	33%	35%	38%	40%							
Communication	30%	28%	31%	37%	42%	43%	42%	35%							
Automotive	16%	18%	19%	19%	19%	19%	23%	27%							
Industrial & others	24%	23%	23%	23%	21%	23%	25%	27%							

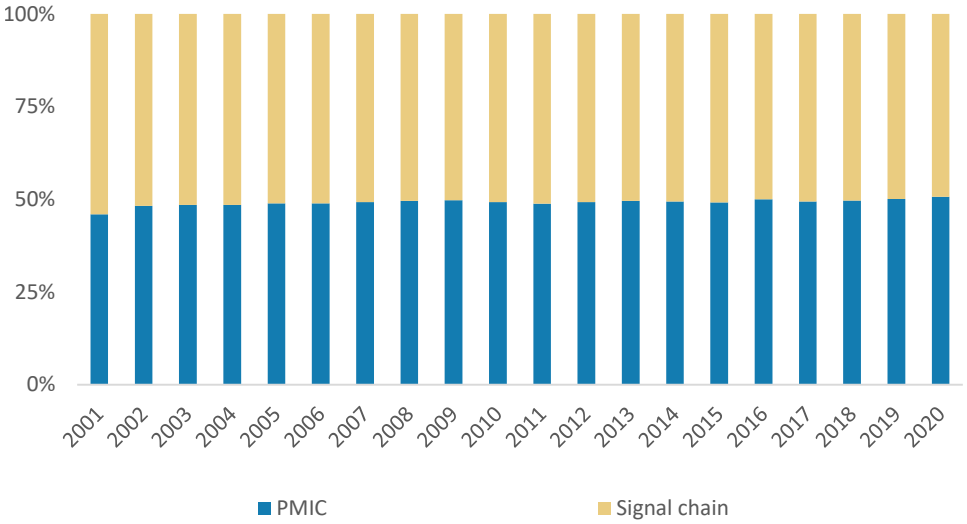
Source: WSTS, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 199: PMIC TAM was US$38bn in 2021, and signal chain TAM was US$36bn



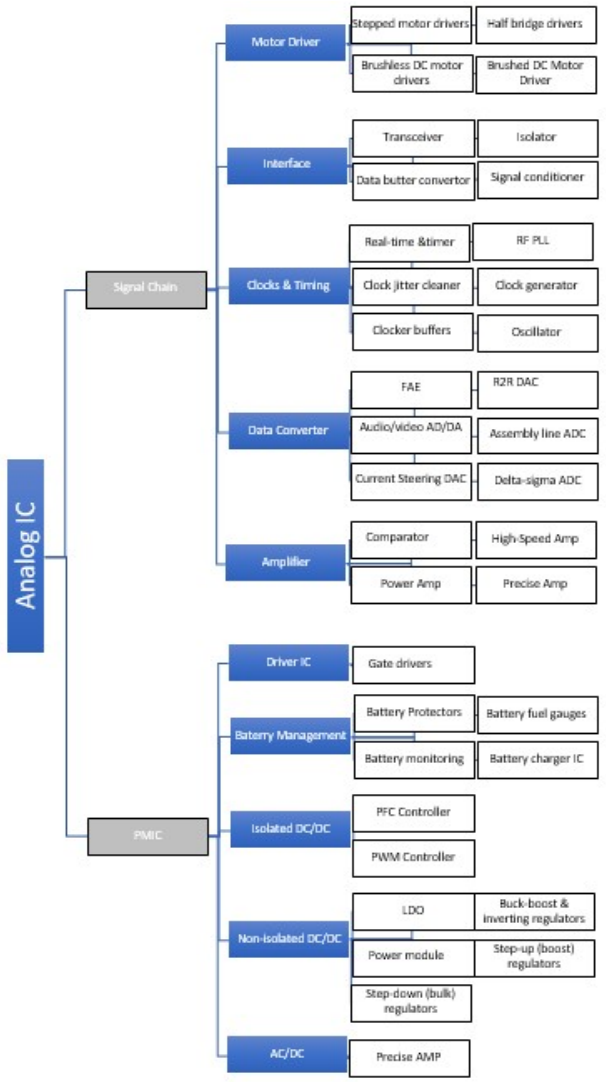
Source: WSTS, Morgan Stanley Research.

Exhibit 200: PMIC contributed 51% of global analog demand in 2020, while signal chain contributed another 49%



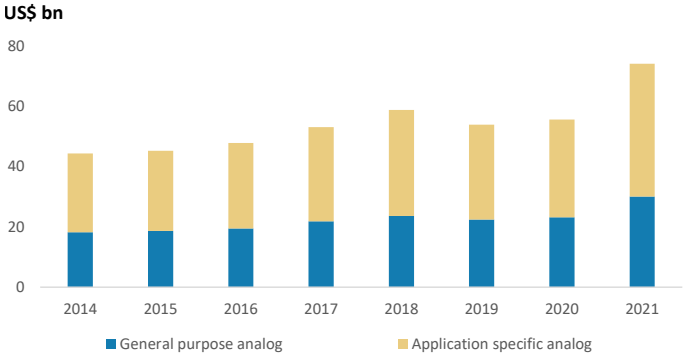
Source: Omdia, Morgan Stanley Research.

Exhibit 201: Analog IC market and major products



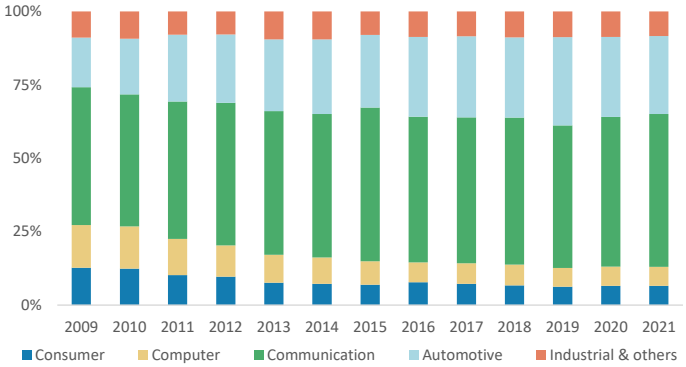
Source: Morgan Stanley Research.

Exhibit 202: General analog vs. application-specific analog



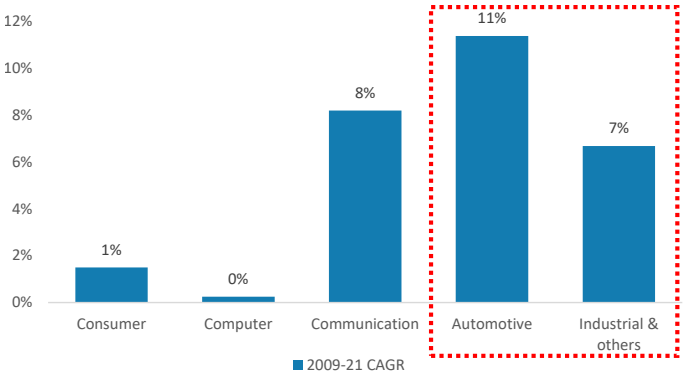
Source: Omdia, Morgan Stanley Research. Note: Underlying metric: revenue.

Exhibit 203: Application-specific analog breakdown by application



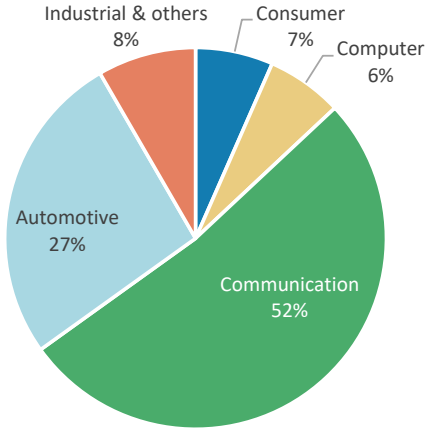
Source: Omdia, Morgan Stanley Research. Note: Underlying metric: revenue.

Exhibit 204: Global application-specific analog 2009-21 CAGRs by application



Source: Omdia, Morgan Stanley Research. Underlying metric: revenue.

Exhibit 205: Global application-specific analog breakdown by application

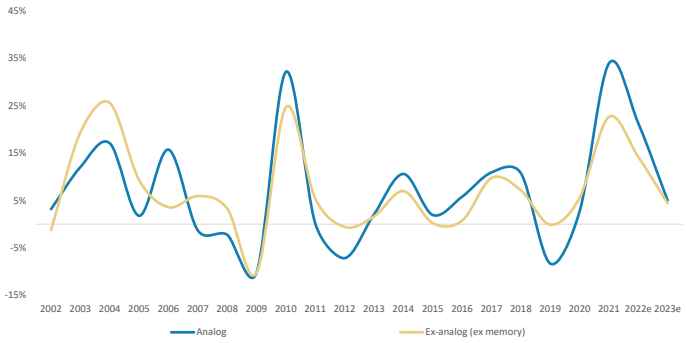


Source: Omdia, Morgan Stanley Research. Note: Data as of 2021.
Underlying metric: revenue.

Where are we in the analog cycle?

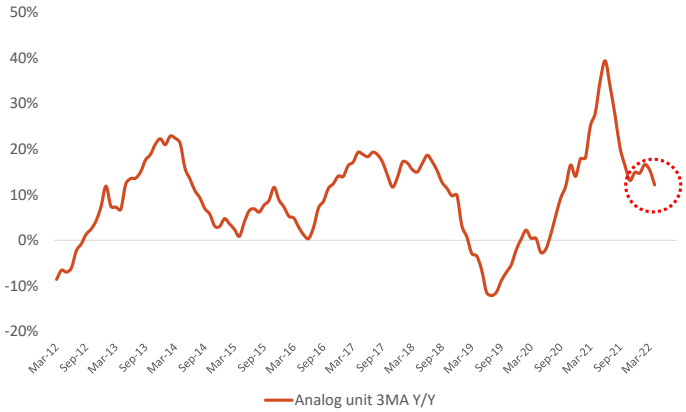
The analog market is more cyclical when compared with other semiconductor markets (excluding memory). This is especially true in the past two years due to the supply shortage and higher consumption from the high-ASP applications like industrial and automotive.

Exhibit 206: Analog market exhibited strong cyclicality in the past two years



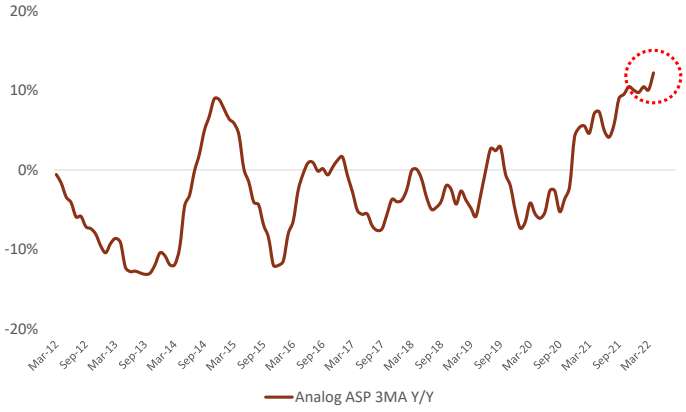
Source: WSTS, Morgan Stanley Research. E = Morgan Stanley Research estimates.

Exhibit 207: Global analog IC unit shipment 3MA Y/Y



Source: WSTS, Morgan Stanley Research.

Exhibit 208: Global analog IC ASP 3MA Y/Y

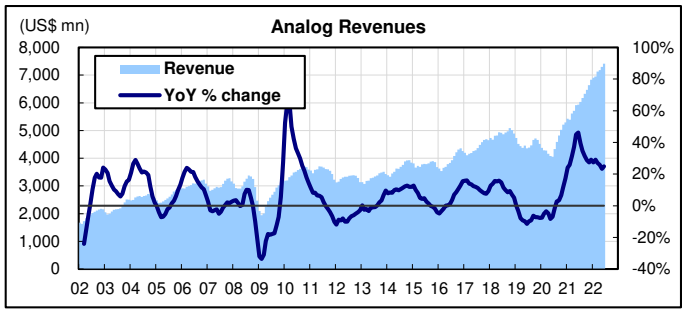


Source: WSTS, Morgan Stanley Research.

Strong automotive semi demand in the past two years

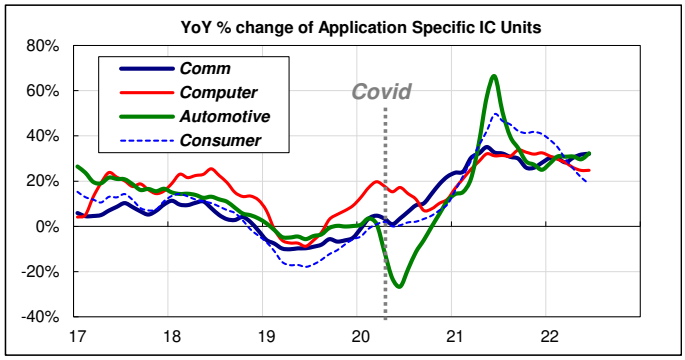
There has been strong demand for automotive-related semiconductors since 2020, due to the supply chain disruption. The COVID-19 impact also forced the automotive industry to changed their procurement strategy from just in time to a higher level of inventory on hand. Until now, there continues to be a shortage of automotive-related semiconductor components.

Exhibit 209: Global analog IC TAM - US$8bn per month (or ~US$100bn annual TAM)



Source: WSTS, Morgan Stanley Research.

Exhibit 210: Automotive demand has been the most volatile since the COVID-19 pandemic started

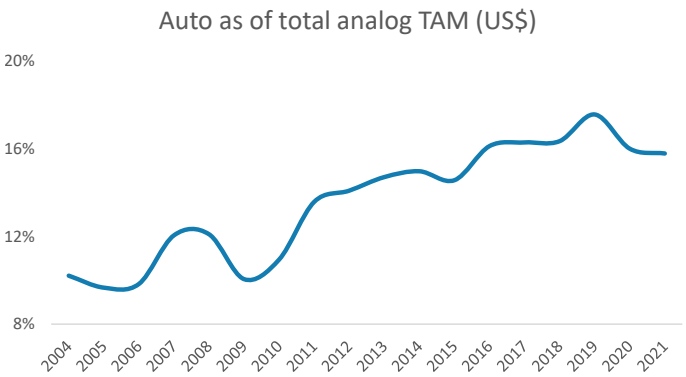


Source: WSTS, Morgan Stanley Research.

Auto industry has been increasingly important to the global analog market

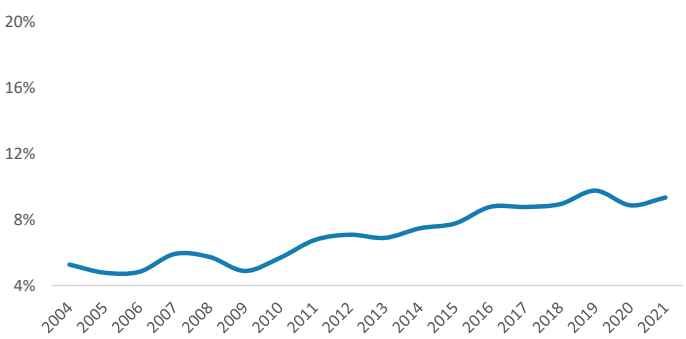
According to WSTS, the auto industry currently contributes 16% of global total analog TAM, vs. 10% in 2004-06 (Exhibit 211). Analog also currently contributes 9-10% of global total analog unit shipments, vs. 5% in 2004-06 (Exhibit 212). As auto applications rely on high-quality products and qualification due to safety concerns, the average price of auto analog is 2x higher than analog products for other applications (Exhibit 213).

Exhibit 211: Global analog IC TAM - US$8bn per month (or ~US$100bn annual TAM)



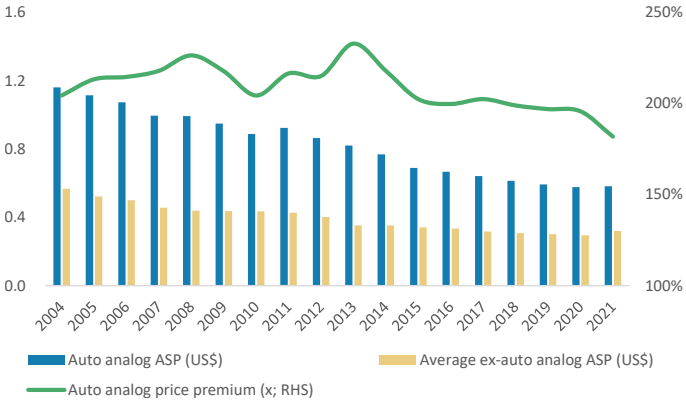
Source: WSTS, Morgan Stanley Research.

Exhibit 212: As such, analog demand has stronger cyclicality



Source: WSTS, Morgan Stanley Research.

Exhibit 213: Global analog IC TAM - US$8bn per month (or ~US$100bn annual TAM)



Source: WSTS, Morgan Stanley Research.

Appendix (II): Signal chain market

Signal chain introduction

As we discussed in the previous analog section (Appendix (I): Global analog market), signal chain contributes 49% of the total analog market.

What is signal chain? Signal chain ICs are integrated circuits that can receive, transmit, amplify, and filter analog signals. They are mainly used for complex applications with products that need a longer life cycle.

Signal chain is used in signal processing and mixed-signal system designs to describe a series of signal-conditioning electronic components that receive input (data acquired from sampling either real-time phenomena or from stored data) sequentially, with the output of one portion of the chain supplying input to the next. Signal chains are often used in signal processing applications to gather and process data or to apply system controls based on analysis of real-time phenomena (Exhibit 215).

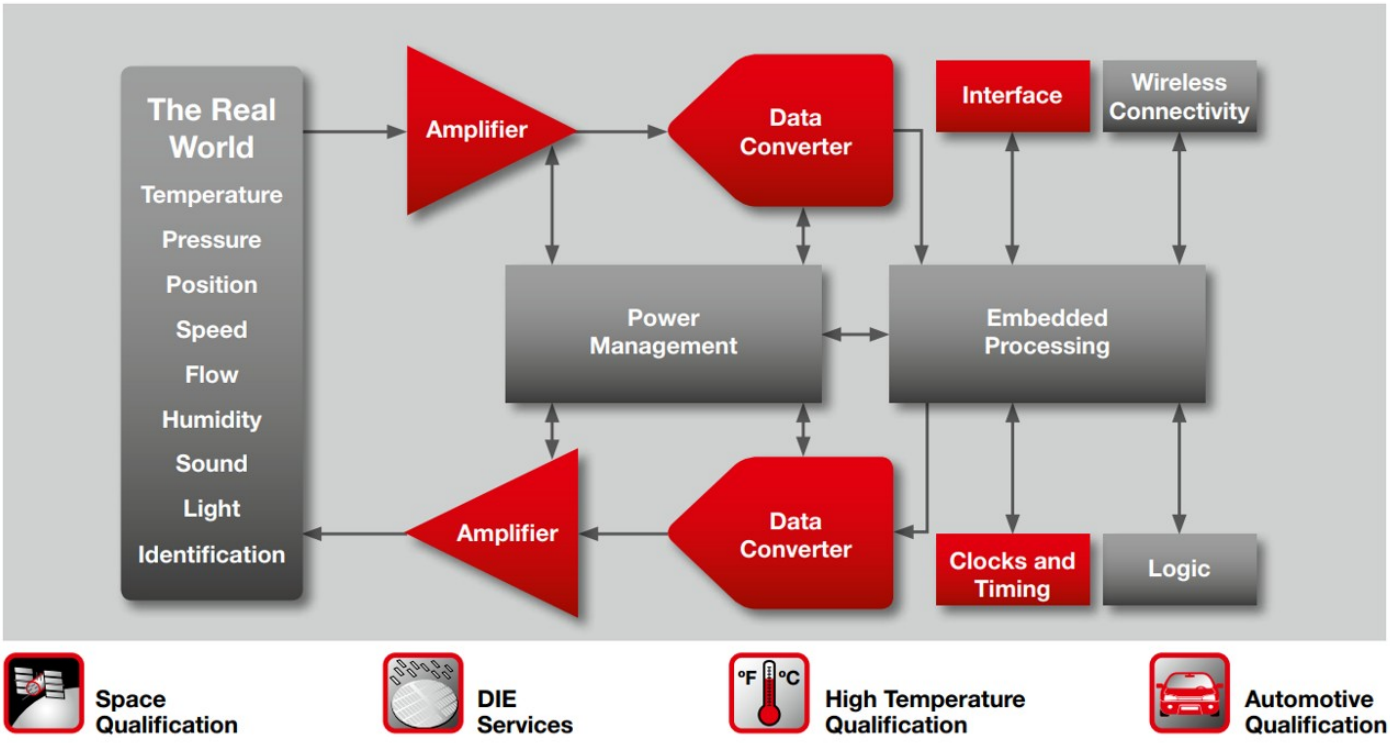
As it requires a longer life cycle and the price is more stable and lower vs. CPU, GPU, memory, etc, it needs more experienced engineers to design and develop a signal chain.

Exhibit 214: Analog semiconductor: Signal chain vs. PMIC

	Signal	Voltage	Function
Signal chain	Weaker signal	<6V	Information saving and Signal receive and transact
PMIC	Higher voltage signal	220V	Power control and management

Source: Morgan Stanley Research.

Exhibit 215: Analog signal chain product



Source: TI.

Signal Chain Products - Product types and Descriptions

Key signal chain products include high-level signal connectivity from analog switches, to bridges, to real-time clocks.

- **Clock:** It helps deliver higher accuracy and lower power consumption to a variety of end-applications if it is installed.
- **Audio and imaging:** An IC that provides an interface function between a microprocessor, micro controller, ASIC or general-purpose peripheral interface and a particular type of audio or video device.
- **Analog switch:** Supports both analog and digital I/O expansion applications, such as speaker selection in cell phones or sensor selection in industrial process monitoring applications.
- **Bridges:** Bridge ICs offer compact, low-power protocol converters to create simpler, more flexible designs while reducing software overhead and time-to-market.
- **Operational amplifiers:** A DC-coupled high-gain electronic voltage amplifier that can magnify the voltage and/or the current of an input signal to a high-power output. It needs an external power source. A good-quality operational amplifier should have high efficiency of converting external power to output gain to use less power and enable appliances to run cooler.
- **Comparator:** A device that compares two voltages or currents and outputs a digital signal indicating which is greater or lesser. A high-quality comparator product trade-off between high speed and low power depending on the needs or application.
- **Audio/ video driver:** High-speed, high-current drive and low noise, in order to output a high-quality analog signal that carries the data with high fidelity and power. A well-designed, high performance interface IC can enable higher data rates and/or longer cable lengths.
- **Analog switch:** A device that can conduct analog or digital signals in either direction when turned on and isolates the switched terminals when turned off. A high-quality switch should have high speed and low power consumption.

Appendix (III): PMIC market

PMIC (power management IC) introduction

As we discussed in the previous analog section (Appendix (I): Global analog market), PMIC contributes 51% of the total analog market.

What is PMIC? Power management integrated circuits ICs manage the power requirements of the host system, which refers to a wide range of chips. At the most basic level, PMICs take an input current/ voltage and transform it to a required output to deliver the necessary power (no more and no less) for running a semiconductor.

PMIC - Product types and descriptions

The most often seen PMIC product include LDOs (low drop out regulators), traditional linear regulators, AC-DC switching regulators, DC-DC switching regulators, isolated/ non-isolated switching controllers, gate driver ICs, hot swap controllers, monolithic power stages, multi-chip power stages, BMICs (battery management ICs), voltage reference ICs, supply voltage supervisors, and other power management interface ICs...etc.

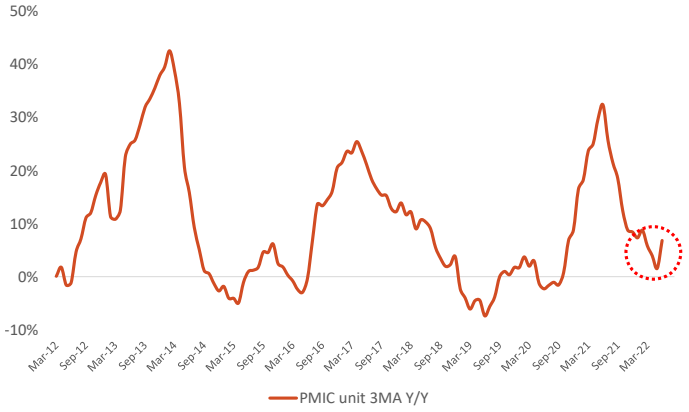
A high-quality PMIC possesses

1. High performance to meet the high frequency requirements of advanced chips such as microprocessors and graphics.
2. High efficiency to minimize the dissipation of heat.
3. High precision to deliver the necessary very low voltages required by advanced nodes transistors.

PMIC content value

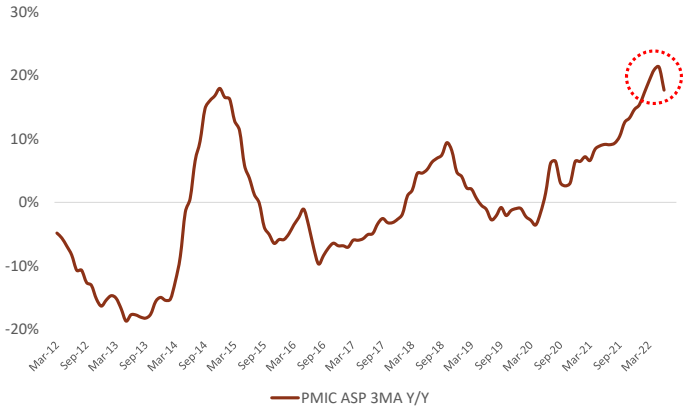
Our channel checks with industry players and end users suggest that server PMIC content value is US$40-50 per server, base station is US$40-50, and auto is US$200-300.

Exhibit 216: Global PMIC unit shipment 3MA Y/Y



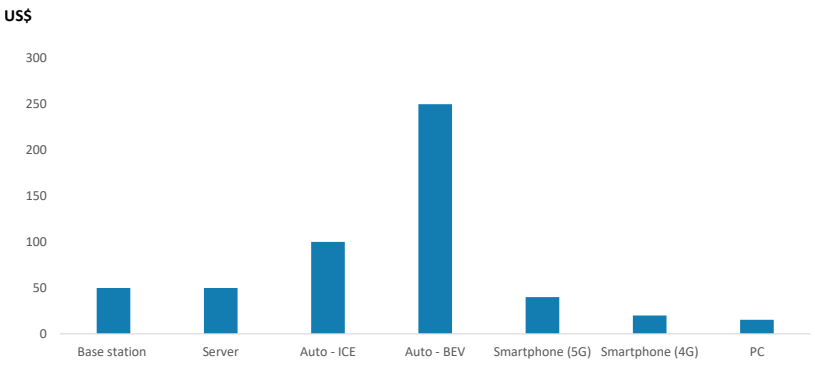
Source: WSTS, Morgan Stanley Research.

Exhibit 217: Global PMIC ASP 3MA Y/Y



Source: WSTS, Morgan Stanley Research.

Exhibit 218: Content value by product



Source: CSIA, Morgan Stanley Research.

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Equal-weight/Hold	1589	45%	349	47%	22%	716	47%
Not-Rated/Hold	0	0%	0	0%	0%	0	0%
Underweight/Sell	610	17%	90	12%	15%	225	15%
Total	3,555		743			1537	

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.

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INDUSTRY COVERAGE: Greater China Technology Semiconductors

COMPANY (TICKER)	RATING (AS OF)	PRICE* (09/26/2022)
Charlie Chan		
ACM Research Inc (ACMR.O)	O (01/22/2020)	US$13.79
Advanced Micro-Fabrication Equipment Inc (688012.SS)	O (01/25/2022)	Rmb113.60
Alchip Technologies Ltd (3661.TW)	O (05/14/2021)	NT$866.00
Andes Technology Corp (6533.TW)	O (08/04/2022)	NT$392.50
ASE Technology Holding Co. Ltd. (3711.TW)	E (10/12/2021)	NT$81.30
ASM Pacific (0522.HK)	E (10/12/2021)	HK$51.95
Global Unichip Corp (3443.TW)	U (02/12/2020)	NT$576.00
GlobalWafers Co Ltd (6488.TWO)	O (12/02/2020)	NT$382.00
Jiangsu Changjiang Electronics Tech (600584.SS)	U (10/12/2021)	Rmb21.96
Maxscend Microelectronics Co Ltd (300782.SZ)	U (01/11/2021)	Rmb92.12
MediaTek (2454.TW)	O (01/04/2021)	NT$569.00
Nanya Technology Corp. (2408.TW)	U (12/03/2021)	NT$45.65
Phison Electronics Corp (8299.TWO)	E (08/16/2022)	NT$256.00
Silergy Corp. (6415.TW)	U (05/20/2021)	NT$428.00
SMIC (0981.HK)	E (08/10/2021)	HK$16.42
TSMC (2330.TW)	O (02/07/2022)	NT$446.50
UMC (2303.TW)	O (09/14/2020)	NT$36.85
Universal Scientific Ind. (Shanghai) (601231.SS)	O (08/04/2015)	Rmb15.30
Vanguard International Semiconductor (5347.TWO)	U (09/21/2022)	NT$64.40
Will Semiconductor Co Ltd Shanghai (603501.SS)	O (02/22/2022)	Rmb83.55
WIN Semiconductors Corp (3105.TWO)	U (02/04/2021)	NT$135.50
Daisy Dai, CFA		
Hangzhou Silan Microelectronics Co. Ltd. (600460.SS)	E (06/10/2022)	Rmb33.51
Shanghai Anlogic Infotech Co Ltd (688107.SS)	U (07/25/2022)	Rmb52.50
Shanghai Fudan Microelectronics (1385.HK)	O (07/25/2022)	HK$35.50
Unigroup Guoxin Microelectronics Co Ltd (002049.SZ)	O (07/25/2022)	Rmb146.52
Yangjie Technology (300373.SZ)	O (06/10/2022)	Rmb50.92
Daniel Yen, CFA		
3Peak (688536.SS)	E (01/17/2022)	Rmb255.70
ASMedia Technology Inc (5269.TW)	O (05/14/2021)	NT$670.00
Aspeed Technology (5274.TWO)	E (05/20/2022)	NT$1,680.00
Bestechnic Shanghai Co Ltd (688608.SS)	O (04/23/2021)	Rmb100.45

Chipsea Technologies Shenzhen Corp (688595.SS)	U (07/12/2022)	Rmb36.26
Egis Technology Inc (6462.TWO)	U (04/23/2020)	NT$68.50
Espressif Systems (688018.SS)	U (07/19/2021)	Rmb79.84
GigaDevice Semiconductor Beijing Inc (603986.SS)	E (07/13/2022)	Rmb98.35
Macronix International Co Ltd (2337.TW)	U (10/19/2021)	NT$29.65
Montage Technology Co Ltd (688008.SS)	U (05/20/2022)	Rmb52.02
Novatek (3034.TW)	U (05/20/2021)	NT$222.50
Nuvoton Technology Corporation (4919.TW)	O (07/19/2021)	NT$108.50
Parade Technologies Ltd (4966.TWO)	E (07/12/2022)	NT$623.00
Realtek Semiconductor (2379.TW)	E (02/24/2022)	NT$294.50
Shenzhen Goodix Technology Co Ltd (603160.SS)	U (06/16/2020)	Rmb47.93
Sino Wealth Electronic (300327.SZ)	O (07/19/2021)	Rmb33.96
Winbond Electronics Corp (2344.TW)	U (10/19/2021)	NT$19.10
WPG Holdings (3702.TW)	U (04/09/2021)	NT$46.85
Dylan Liu		
Chipbond Technology Corp (6147.TWO)	E (05/20/2021)	NT$51.30
King Yuan Electronics Co Ltd (2449.TW)	E (10/12/2021)	NT$31.80
Ray Wu, CFA		
Advanced Wireless Semiconductor Co (8086.TWO)	U (02/11/2022)	NT$66.10
China Resources Microelectronics Limited (688396.SS)	U (07/08/2022)	Rmb46.60
Hua Hong Semiconductor Ltd (1347.HK)	O (02/04/2022)	HK$19.44
Powerchip Semiconductor Manufacturing Co (6770.TW)	U (07/12/2021)	NT$29.30
RichWave Technology Corp. (4968.TW)	E (07/12/2022)	NT$100.50
SG Micro Corp. (300661.SZ)	E (09/26/2022)	Rmb137.20
Shanghai Awinic Technology (688798.SS)	U (09/26/2022)	Rmb94.91
Silicon Motion (SIMO.O)	E (08/12/2021)	US$68.84
StarPower Semiconductor Ltd (603290.SS)	O (03/01/2022)	Rmb348.30
Suzhou Novosense Microelectronics Co Ltd (688052.SS)	O (09/26/2022)	Rmb300.39
UPI Semiconductor Corp. (6719.TW)	U (05/02/2022)	NT$231.50
Wafer Works Corp (6182.TWO)	O (04/20/2021)	NT$40.15

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* Historical prices are not split adjusted.

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