BERNSTEIN
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U.S. IT Hardware

Memory: New Memory LTAs part 2 - Case studies from Microchip and other Semiconductor LTAs - What's different this time?



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*Last week we published an analysis on **New Memory LTAs** (Long-term agreements), why they are different and what this means for sustainability of earnings. Today's part 2 dives deeper into **Case Studies from the Semiconductor industry** to compare and address questions and feedback from investors.*

Historically, long-term agreements in semiconductors and memory functioned primarily as a buyer's tool: Customers used LTAs to secure guaranteed volume, while sellers had little structural leverage of their own. Even when suppliers held some negotiating power, contracts were largely limited to two structures: take-or-pay, where a buyer promises to either accept a minimum volume at a pre-agreed price or pay a penalty for any shortfall; and so-called "non-cancelable" orders, a buyer's promise not to cancel delivery that, as later cycles would prove, buyers could and did cancel in practice. **Both structures offered sellers little real downside protection, since neither carried an upfront financial commitment** to compensate the supplier if a buyer walked away; the only remedy was to sue for damages, a process that was slow, expensive, and often hollow if the buyer was no longer solvent by the time judgment was reached.

Two case studies illustrate exactly how previous LTA structures failed in practice: 1. Microchip / Analog Semiconductors; and 2. Hemlock / Polysilicon. Out of the two case studies, the Hemlock case bears more resemblance to what we see in the New Memory LTAs as there were some legal teeth to the agreement but very much relied on suing its customers to get the money owed to it. The Microchip case study, which is often referenced by Semiconductor investors, was a much looser agreement without any notable legal teeth that customers had little disincentive to walk away from.

We identify three structural differences between legacy semiconductor LTAs and the New Memory LTAs, each addressing a distinct weakness that undermined prior contract structures: **1. Upfront financial commitment:** cash deposits, letters of credit, or third-party guarantees, specifically***back-end weighted*** (where the coverage ratio of remaining financial commitment as a portion of remaining purchase obligations increases substantially over time, hence increasing downside protection in the latter part of the contract when it is more needed); **2. Better counterparty quality**: financially sound, diversified buyers replace the thinly capitalized or diffuse customer bases that undermined Hemlock and Microchip; **3. Structural demand:** sustained AI-driven buildout replaces the temporary pull-in and double-ordering that ultimately undermined Microchip.

The New Memory LTAs provide meaningful but not infinite downside protection. We find that these new memory LTAs are structured in a way which provides significantly higher disincentives to customers to walk away - particularly in the latter part of the contract term. In our previous note (***New Memory LTAs***), we showed a range of scenarios of future price collapse and how those would impact earnings with and without LTAs. In conclusion, there is ***significantly more downside protection*** in these agreements than the previous cases we analyzed, but not infinite downside protection.

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BERNSTEIN TICKER TABLE

			8 Jul 2026		TTM	Adjusted EPS				Adjusted P/E (x)	
			Closing	Price	Rel.						
Ticker	Rating	Cur	Price	Target	Perf.	Cur	2025A	2026E	2027E	2025A	2026E	2027E
SNDK (SanDisk)	O	USD	1,727.18	3,000.00	3618.3%	USD	2.99	65.43	243.73	577.7	26.4	7.1
SPX			7,482.71									

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

Source: Bloomberg, Bernstein estimates and analysis.

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DETAILS

PART I: BLAST FROM THE PAST - CASE STUDIES IN EARLIER SEMICONDUCTOR LTAS

Historically, long-term agreements in semiconductors and memory functioned primarily as a buyer's tool: customers used LTAs to secure guaranteed volume, while sellers had little structural leverage of their own. Even when suppliers held some negotiating power, contracts were largely limited to two structures: take-or-pay, where a buyer promises to either accept a minimum volume at a pre-agreed price or pay a penalty for any shortfall; and so-called "non-cancelable" orders, a buyer's promise not to cancel delivery that, as later cycles would prove, buyers could and did cancel in practice. **Both structures offered sellers little real downside protection, since neither carried significant upfront financial commitment** to compensate the supplier if a buyer walked away; the only remedy was to sue for damages, a process that was slow, expensive, and often hollow if the buyer was no longer solvent by the time judgment was reached.

Two case studies illustrate exactly how previous LTA structures failed in practice: 1. Microchip / Analog Semiconductors; and 2. Hemlock / Polysilicon. Out of the two case studies, the Hemlock case bears more resemblance to what we see in the New Memory LTAs as there were some legal teeth to the agreement but very much relied on suing its customers to get the money owed to it (spoiler alert, Hemlock won the cases after years of litigation but failed to receive all it was due because of customer insolvency). The Microchip case study, which is often referenced by Semiconductor investors, was a much looser agreement without any notable legal teeth that customers had little disincentive to walk away from.

CASE STUDY 1: MICROCHIP / ANALOG - NON-CANCELABLE/NON-RESCHEDULABLE SUPPLY PROGRAM LED TO INVENTORY GLUT

During the peak of the 2020-2022 (COVID era) semiconductor shortage, automotive and industrial manufacturers scrambled to secure analog, mixed-signal, and basic MCU supply amid widespread component shortages. As a result, the industry experienced significant demand pull-forward and widespread double ordering, creating an artificially inflated backlog. To safeguard production schedules amid severe component shortages, many customers purchased well beyond their immediate requirements, effectively bringing forward several years of anticipated demand to secure limited manufacturing capacity. At the same time, double and even triple ordering became common, with customers placing overlapping orders across multiple semiconductor suppliers and distribution channels to improve their chances of obtaining product. Collectively, these behaviors distorted order patterns, inflated reported backlog levels, and significantly overstated underlying end-market demand.

Interpreting the surge in orders as evidence of sustained, secular growth, chipmakers expanded capacity plans and increasingly pushed customers to sign long-term agreements (LTAs) to secure future production commitments. Microchip launched its Preferred Supply Program (PSP). This program offered prioritized manufacturing slots in exchange for 12 months of continuous, completely non-cancellable, and non-reschedulable order backlogs.

However, demand for analog chips and microcontrollers is fundamentally tied to end-unit production and does not scale exponentially. Customers need sufficient components to manufacture vehicles, industrial equipment, appliances, and consumer electronics, but once supply constraints ease, there is little need to accumulate significant incremental inventory.

Unlike today's AI-driven memory demand, which is a huge incremental growth driver, much of the analog and MCU demand surge during the COVID-era shortage was driven by supply insecurity. In many cases, customers were stockpiling inventory and placing duplicate orders to secure supply rather than purchasing components to meet a corresponding increase in underlying end-market demand.

Therefore, when consumer demand normalized and the macroeconomic environment cooled, the LTAs collapsed under a massive inventory glut. Customers quickly found themselves with hugely bloated inventories. They did not have the physical space or the balance sheet capacity to take on more delivery. Customers were forced to freeze new orders entirely to burn through existing stockpiles. Instead of forcing customers to take chips they didn't need, giants like Analog Devices (ADI) and Microchip Technology intentionally "undershipped". They allowed buyers to pause or delay their LTA orders so distributors and factories could burn through their massive, hoarded stockpiles. This however, came at a massive short-term cost to the chipmakers:

- Microchip Technology saw its net sales plummet by over 42% (Q3 FY25 over Q3 FY24) during the height of the inventory correction.
- Analog Devices experienced a multi-quarter revenue contraction as they deliberately kept sales channels lean to prevent a market collapse.

Lessons learned: Weak contract terms, without any legal teeth to disincentivize customers from walking away, and artificial transient shortages which quickly abated.

CASE STUDY 2: HEMLOCK / POLYSILICON - TAKE-OR-PAY CONTRACT FAILURE

In the mid-2000s, a severe global shortage of polysilicon sent spot prices soaring to over $400/kg. To secure production lines, major solar companies like SolarWorld, Kyocera, JA Solar, and Yingli signed 10 to 14-year Long-Term Agreements (LTAs) with the Michigan-based Hemlock Semiconductor, then the world's leading producer of hyper-pure polysilicon. These contracts locked in "predictable" fixed prices (often around $40–$60/kg) backed by rigid "take-or-pay" provisions.

Shortly after however, the market fundamentally crashed, due to:

- **Huge Chinese supply expansion:** The Chinese government heavily subsidized domestic polysilicon production. Massive factories flooded the market, causing global spot prices to plummet from hundreds of dollars down to below $15/kg.
- **The trade war:** In retaliation for U.S. solar tariffs, China imposed steep anti-dumping duties on American-made polysilicon. This meant some of Hemlock's buyers could not even cost-effectively import the material they were legally required to buy into China for processing.

When the global polysilicon market experienced its catastrophic price collapse, long-term supply agreements completely broke down. Buyers rapidly chose to default rather than honor their contracts, driven by a compounding chain of operational and legal failures:

- **Polysilicon is an overwhelming % of solar module BOM and buyers bear razor-thin margins to begin with.** Polysilicon originally comprised up to approximately 75% of a solar module's total BOM. When market prices crashed from $400/kg to under $15/kg, buyers were still contractually locked into paying Hemlock roughly $40 to $60/kg. Manufacturing panels with raw materials priced at triple the market rate meant selling every finished product at a massive loss, making intentional contract default the only way for these module makers to survive. These contracts were a threat to these customers' survival.
- **Buyers themselves lacked the financial soundness to buffer the price collapse.** Major buyers like Yingli Solar and SolarWorld aggressively expanded using immense short-term bank debt to chase market share. These companies operated on highly leveraged, razor-thin profit margins and suffered consecutive quarters of massive losses.
- **Legal rigidity forced the break.** Hemlock's contracts featured rigid liquidated damages clauses, meaning a single missed payment instantly triggered a demand for the entire value of the remaining years. By escalating routine pricing disputes into

massive, existential legal battles, Hemlock eliminated any middle ground, leaving fragile buyers with no choice but to trigger a formal default and enter bankruptcy court.

Because the contracts were legally bulletproof but commercially impossible to satisfy, they triggered massive collapses and structural shakeups across the industry:

- **SolarWorld (Sachsen):** Even though after years of legal battles Hemlock won a massive U.S. court judgment of roughly $800 million against them, Sachsen had already declared insolvent and hence the funds were likely unable to be fully collected.
- **Kyocera:** Opted for a massive out-of-court settlement in 2018, paying Hemlock a staggering $450 million (51.1 billion yen) just to tear up the remaining LTA commitments.
- **JA Solar & Yingli:** Reached restructured settlements or faced crippling arbitration. JA Solar settled by signing new supply deals.

The legal victory, however, proved commercially hollow. While Hemlock won billions in legal settlements on paper, the actual cash recovery was highly fractured and diluted because many of the target companies simply did not have the money to pay.

Lessons learned: More significant legal teeth, but required the supplier to take its customers to court which took years of litigation and by which time one of its customers was insolvent.

EXHIBIT 1: **Old LTAs vs New Memory LTAs: this time it is really different**

Dimension	Microchip PSP	Hemlock polysilicon	SNDK / MU new memory LTAs
Industry structure	Fragmented; dozens of substitutable analog/MCU suppliers with no individual pricing power	Moderately concentrated among a few global producers	Consolidated oligopoly (roughly 3 DRAM producers / 6 NAND makers)
Demand growth profile	Shortage-driven spike plus double-ordering that reversed into a glut once customers over-inventoried	Policy/subsidy-driven solar boom-bust; genuine shortage flipped into classic commodity oversupply after 2008	Structural AI/data-center buildout; high-end memory sold out through 2026 into 2027, with both sides planning into 2027-30
Customer concentration	Extremely diffuse; PSP backlog spread across a huge base	Small solar module makers, several of which later failed or entered insolvency	Concentrated among a few high-quality hyperscalers/AI buyers
Customer type / balance sheet	Mixed industrial/auto OEMs and distributors; varied, often mid-size credit quality	Thin-margin, subsidy-dependent solar developers with weak balance sheets; SolarWorld AG filed for insolvency	Fortress-balance-sheet mega-caps able to post $10-20B+ of cash and letters of credit
Customer unit economics / incentive to honor	End-demand softened; carrying excess inventory cost more than walking away, weak incentive to honor NCNR terms	Honoring meant paying above-market feedstock prices while competitors bought cheaper spot material, strong incentive to breach and litigate	AI infrastructure is business-critical and memory gates a trillion-dollar opportunity; the deposit is trivial vs. the cost of being short, strong incentive to honor
Contract terms / enforceability	12-month rolling NCNR backlog, no cash; relaxed to 6 months in Aug 2023, then discontinued for new orders in Feb 2024, reputational, not enforced	Fixed-price take-or-pay; enforceable only via years of litigation, and even a ~$793M win proved largely uncollectible against an insolvent counterparty	Multi-year volume and price commitments backed by upfront cash deposits, letters of credit, or third-party guarantees held by (or accessible to) the supplier, with guarantee's coverage ratio rising toward 75-100% of remaining obligations in the outer years, offering real downside protection

PSP = Preferred Supplier Program; NCNR = Non Cancelable, Non Reschedulable
Source: Company reports, Bernstein analysis

PART II: KEY DIFFERENCES: OLD SEMICONDUCTOR LTAS VS. THE NEW MEMORY LTAS

We identify three structural differences between legacy semiconductor LTAs and the new memory LTAs, each addressing a distinct weakness that undermined prior contract structures:

- **Upfront financial commitment:** cash deposits, letters of credit, or third-party guarantees, specifically***back-end weighted*** (where the coverage ratio of remaining financial commitment as a portion of remaining purchase obligations increases substantially over time, hence increasing downside protection in the latter part of the contract).
- **Better counterparty quality**: financially sound, diversified buyers replace the thinly capitalized or diffuse customer bases that undermined Hemlock and Microchip.
- **Structural demand:** sustained AI-driven buildout replaces the temporary pull-in and double-ordering that ultimately undermined Microchip.

UPFRONT FINANCIAL COMMITMENT: REAL TEETH, NOT JUST A PROMISE

The most fundamental difference is the upfront financial commitment present in the New Memory LTAs. Legacy agreements required no backend weighted financial guarantee, so remedy for non-performance depended on winning in court and then collecting from the counterparty. However, under the new structures, cash deposits, letters of credit, and third-party

guarantees are posted at inception, converting a legal claim into real, standing collateral. Most importantly, these financial collateral are backend weighted, which means they offer real downside protection especially in outer years, differentiating them from typical prepayments. Sandisk backs an estimated $69 billion of remaining performance obligations with over $11 billion of guarantees, most sitting on (escrow-like) third-party balance sheets, while Micron backs its obligations with $18 billion of cash deposits on its own balance sheet plus $4 billion in letters of credit.

Because this collateral is held upfront rather than pursued entirely after a breach, the supplier is never left empty-handed while waiting on a lawsuit: if a customer walks away, the supplier can immediately draw on the cash or letter of credit already posted. Moreover, it meaningfully changes the buyer's incentives: a customer tempted to exit if spot pricing drops would forfeit real capital already posted and would also jeopardize a reliable long-term supplier relationship. As a result, continued performance becomes the more sensible choice in most circumstances.

The structure also concentrates protection where it matters most. In both cases, guarantees are weighted toward the back end of the contract, so as remaining obligations shrink over time, the fixed collateral covers a rising share of what's left, making protection strongest in the outer years, exactly when downturn risk is highest.

For additional details on the robust downside protection, please see our recent note: Memory: What do New Memory LTAs mean for sustainability of earnings and multiples? Raising SNDK TP to $3000.

EXHIBIT 2: **Paper claim vs Real Protection**

	Hemlock Take-or-Pay	New Memory LTAs (SNDK/MU)
Financial Guarantee at signing	No significant long-term upfront financial guarantee that is backend-weighted like SNDK/MU, only prepayments in installments credited towards future purchase	Cash deposits / letters of credit / third-party guarantees posted upfront, returned towards the back of the contract
Nature of protection	Legal claim; supplier must sue to collect	Financial guarantee already held by (or accessible to) the supplier
Remedy if buyer walks	File suit, litigate for years, then attempt to collect	Draw on financial guarantee directly
Timing of protection	Static; contract terms don't strengthen over time	Dynamic; guarantee covers a shrinking remaining obligation as revenue is recognized, so the guarantee's coverage ratio is higher over time
Strength in outer years	Weak - Hemlock only had some prepayments, no financial guarantee that is weighted towards the backend of the contracts	Strongest - back-loaded return schedule means coverage ratio rises toward 75-100% of remaining RPO in the outer years
Outcome when buyer distressed	Judgment often uncollectible (SolarWorld AG insolvency left Hemlock exposed even after winning)	Financial Guarantee already sits with the supplier or a trusted third party, so buyer insolvency doesn't erase the protection
Result	A won lawsuit that provided little real economic recovery	A structurally strengthening cushion that protects margins and earnings precisely when a downcycle bites

Source: Company reports, Bernstein analysis



FUNDAMENTALLY BETTER COUNTERPARTY QUALITY

The counterparty profile is categorically stronger this time, for two distinct reasons: diversification means a hyperscaler's core business cannot be destroyed by honoring higher memory LTA pricing, and concentration among a few solvent buyers makes any shortfall realistically collectible.

First, memory LTA volumes are likely predominantly with hyperscalers, which are diversified across many unrelated revenue streams, not narrowly dependent on a single commodity input. Sachsen had economics that depended almost entirely on the solar value chain; once the take-or-pay polysilicon price diverged sharply from a collapsing spot market, that single point of exposure was large enough to destroy margins and the business itself. Hyperscalers face no equivalent concentration: their revenue spans cloud infrastructure, advertising, software, and enterprise services, so memory is a meaningful input but only one of many, and its cost is a small fraction of overall earnings rather than an existential threat. Hyperscalers' scale and margin base let them absorb the cost without it threatening the core business' survival, unlike Sachsen.

Second, hyperscalers are few in number and financially sound, which matters for collectability. Hemlock's buyers were solar manufacturers - numerous, dispersed, and in several cases thinly capitalized - which meant that even after winning in court, collection depended on the solvency of a customer base that was frequently under financial distress. Microchip's non-cancelable orders, meanwhile, were spread across tens of thousands of small and mid-sized industrial and automotive customers, leaving the company with no realistic recourse when they simply stopped placing orders. However, for New Memory LTAs, the counterparty is a handful of hyperscalers and other large OEMs with investment grade balance sheets and transparent capital plans, making them more accountable and reliable, so even if there is any shortfall beyond posted collateral, it is realistically collectible rather than hollow.

EXHIBIT 3: **New Memory LTAs: Better Counterparty Risk Profile**

	Hemlock (e.g. Sachsen)	New memory LTAs (e.g. hyperscalers)
Type of customer	Solar wafer and module manufacturers	Hyperscalers, Large OEMs, and AI Infrastructure providers
Customer revenue structure	Economics depended almost entirely on the solar value chain; polysilicon was a single, dominant point of exposure	Diversified across cloud infrastructure, advertising, software, and enterprise services; memory is one input among many
Impact of honoring the contract for customer	Take-or-pay price diverging from a collapsed spot market was large enough to destroy margins and the business itself	Memory cost is a small fraction of overall earnings, absorbed without threatening core business survival
Number of customers	Numerous, dispersed solar manufacturers	A handful of hyperscalers
Financial strength of customers	Several thinly capitalized, frequently under financial distress	Investment-grade balance sheets, transparent capital plans
Collectability if shortfall occurs	Collection depended on solvency of a distressed customer base, even after winning in court	Accountable and reliable; shortfalls beyond posted collateral are realistically collectible

Source: Company reports, Bernstein analysis

LIMITED DEMAND VS. STRUCTURAL SCALING

The demand environment is a critical factor behind why the prior LTA structures failed. Microchip's PSP sat on a shortage-driven spike and double-ordering that reversed into a glut once customers realized they had bought far more analog

inventory than they would ever consume. The underlying need was inherently mean-reverting: once inventories normalized, the economic rationale for honoring long-term purchase obligations evaporated.

Memory demand today is fundamentally different because it is being fueled by a structural AI and data-center buildout, not a transient pull-forward, or double-ordering. Hyperscalers are not stockpiling memory out of panick; they are buying it because AI itself runs on data and context, and more memory directly translates into smarter, more capable systems. That is why vendors are effectively sold out on high-end memory through 2026, while hyperscalers and AI platforms are locking in volume and planning memory needs years out, treating HBM/DRAM/NAND as mission-critical inputs for AI capex.

Memory demand also has a fundamentally higher ceiling than analog ever did. Analog and microcontroller demand behaves like oxygen: once a customer has enough to build a car or an appliance, another unit adds no value, so demand hit a ceiling quickly - exactly why Microchip's backlog collapsed once the market rebalanced. However, memory demand scales much better than analogs. Every additional gigabyte of memory expands how much context a model can hold, letting it train and run with larger parameter counts and wider context windows, while in inference specifically, greater memory capacity drives smarter, more personalized, and more accurate outputs, and memory bandwidth determines how many concurrent users a system can serve. Because more memory almost always makes an AI system more capable, demand keeps compounding rather than plateauing the way analog inventory did.

Since memory is so important, the economics discourage walking away. The AI opportunity being gated is measured in trillions of dollars of future revenue and market capitalization, while the cost of honoring an LTA is small by comparison, so hyperscalers have every incentive to accept the supply they can secure rather than risk falling behind a competitor with superior memory capacity. For a hyperscaler, honoring a multi-year memory commitment is simply the rational way to keep pace in the race for smarter AI, and that structural, compounding demand is why the new memory LTAs are sustainable in a way that “non-cancelable” analog orders ultimately were not.

EXHIBIT 4: **Analog vs Memory demand: Physical Limits vs. Exponential AI Scaling**

	Analog / Microcontroller Chips	Memory Chips (DRAM/NAND/HBM)
Nature of demand	Essential but finite - like oxygen, once you have enough, you don't need a molecule more	Foundational to AI capability - more memory directly makes AI models smarter and more capable
Scaling behavior	Does not scale indefinitely; demand is a fixed allocation tied to unit production (cars, appliances, industrial equipment)	Scales continuously with AI workload growth - larger models, more inference, more data centers all require more memory
Driver of demand during shortage	Mostly a pull-forward: customers over-ordered during Covid shortage to build safety stock, not because true consumption increased	Structural buildout: driven by genuine, compounding growth in AI training and inference workloads
Underlying economic logic	Fixed ration to be filled once, then forgotten	Continuously expanding resource requirement tied to AI capability growth
Result for LTA credibility	"Non-cancellable" orders proved unenforceable in practice once the pull-forward reversed	Long-term commitments backed by real collateral are credible because underlying consumption is durable and strategically irreplaceable

Source: Company reports, Bernstein analysis

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VALUATION METHODOLOGY

SanDisk Corp

We value SNDK at $3000 on 11x FY28 EPS, or 14x through cycle EPS (FY26-30 avg EPS).

RISKS

SanDisk Corp

The biggest risks to the downside on Sandisk and to our price target are that: 1) Near-term numbers look high and face cyclical downside from NAND; 2) SNDK’s disclosures and broader investor communications have been confusing, potentially dissuading more quality-focused investors; and 3) NAND weakness could extend beyond the current cycle and be more structural, in which case Sandisk’s DCF value could be structurally lower and the impaired value of its assets may be materially below replacement cost.

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