COMPUTE SUPPLY CHAIN UPDATE

MEMORY INSIGHTS - MARCH 2016

Important disclosures can be found in Appendix

HIGHLIGHTS FROM MICRON'S EARNINGS CALL (CLEVELAND RESEARCH)

March 31, 2016

Key Takeaways

1. Micron forecasting industry DRAM bit supply growth to be in the low/mid 20% Y/Y this year and below 20% in CY17 based on slowing shrinks and no new wafer supply coming online. Still forecasting long-term DRAM demand growth to 20-25% Y/Y
2. Maintaining their total $5B capex spend this year (up 20%+ Y/Y) net partner contributions – mentioned Samsung's public capex comments are saying their DRAM spending will be down 50% this year and that Hynix has talked about slowing their M14 buffer capacity additions – in total Micron estimates industry DRAM capex is looking down 30% Y/Y in 2016
3. Micron reiterated they aren't going to cut wafer output unless they see negative cash margins. Maintained it would be foolish for them to take capacity offline before Samsung or Hynix saying that at their fixed cost structure it's a really bad move to cut production
4. Micron's focus isn't on market share, their focus is on deploying advanced technology at levels similar to competitors to ensure they don't incentivize others to compete on market share
5. Micron DRAM bit supply growth will be at the high-end of 25-30% range in FY17 (Aug-17) after being at the low-end in FY16 (Aug-16), it's the impact of the back-end loaded FY16 flowing through FY17
6. 1xnm for Micron won't be a meaningful part of output until mid-CY17
7. Micron hadn't intended to build inventory in the quarter, it's a delay in the qualification of the 20nm LPDDR4 into mobile that was the primary driver of the build and it was primarily in WIP. Mobile prices are subject to quarterly negotiations, so the inventory built last quarter is not at a locked in price, it will be subject to whatever the pricing does for this quarter
8. Micron highlighted how they walked away from some mobile eMCP business because it was so price aggressive at the lower-end of the market, seeing more pricing competition so shipped more discrete LPDDR3 parts in the quarter; those eMCP prices have really gotten knocked down so they aren't expecting as much of a decline in eMCP prices this quarter
9. NAND flash industry bit demand growth will be in the mid/high 30% range Y/Y this year, inline/slightly below the long term demand outlook
10. Micron is ramping gen1 3D NAND in Singapore and over 50% of their NAND output will be 3D by C2H16. Micron is expecting gen2 to ramp starting this summer. Micron expects to be below industry/market NAND bit growth this year and well above next year as 3D bit growth and better costs to ramp into C2H16

Highlights

1. **Revenues of $2.93B were at the low-end of guidance**. Revenues were $2.93B versus guidance of $2.9-3.2B. Revenues were down 12% Q/Q and 30% Y/Y.
2. **Gross margins at upper end of guidance, down 560bps Q/Q and 1400bps Y/Y.** Gross margins of 19.7% were at the high-end of the company's guided range of 17.5-20%. Margins were impacted once again by the decline in DRAM ASPs. DRAM gross margins were noted at ~20%, down from the mid 20% range in the prior quarter and from the upper 30% range reported in F3Q15 (May'15). Margins in non-volatile/NAND were noted as down a couple of percentage points from the low to mid-20% range reported in the prior quarter. Non-volatile margins had been noted as steady over the past several quarters.
3. **Guide F3Q (May) revenues to $2.8-3.1B.** At the mid-point of guidance revenues would be +1% Q/Q and down 23% Y/Y. Micron has stopped providing bit and pricing guidance per segment, but noted expecting pricing to remain challenging. Guidance is based on strong growth in DRAM bit shipments in the quarter following disappointing shipment levels of the just reported quarter.
4. **Guidance at the mid-point suggests another operating loss for the quarter.** Micron had gone 3+ years of reporting operating profits until the most recent quarter, Micron is now forecasting for a second consecutive quarter of operating losses.
5. **Gross margins guided 16.5-19% with additional inventory build projected**. Gross margins would be down 1350bps Y/Y at the mid-point and down 200bps Q/Q. Micron expects to begin to see better cost performance in the upcoming quarters as they continue to

KEVIN ROTTINGHAUS
krottinghaus@cleveland-research.com
(216) 649-7209

SEAN MUIR
smuir@cleveland-research.com
(216) 649-7256

CHANDLER CONVERSE
cconverse@cleveland-research.com
(216) 649-7280

progress on 20nm DRAM and as they ramp their 3D NAND. ***Micron DRAM costs were surprisingly up 1% Q/Q which the company attributed to higher mix of mobile; we would have thought the company would see more of a benefit from their on-going 20nm conversion.*** Micron should have a 200bps+ tailwind starting in the current quarter from changes in their Inotera agreement; this tailwind near-term appears to be more than offset by expectations for continued difficult pricing. Micron gross margins in the quarter likely saw some benefit from a 7% Q/Q increase in inventory dollars, and inventory days have grown to 100, up double-digits Q/Q and Y/Y despite the significant decline in gross margins. Micron expects to again grow inventory in the current quarter and reiterated again they have no plans to reduce production capacity to help bring market stabilization.

6. **DRAM pricing down 10% Q/Q led by PC declines; we see server and mobile as worse than normal.** PC DRAM pricing was again blamed for pricing downside. Over the past five quarters Micron DRAM pricing appears to have declined by mid-single digits to low double-digits Q/Q every quarter, leaving blended pricing down we estimate near 40% over that period. We believe F1Q16 (Nov-15) was the first quarter Micron acknowledged meaningful pricing pressure from DRAM segments other than PC; in our research server DRAM pricing has been seeing an acceleration in declines over the past several months with Micron much more active with pricing. Mobile pricing also appears weaker than expected in our research due to oversupply, and we believe Micron is pricing aggressively in mobile to try and gain share, particularly in China.
7. **Micron mobile ramps lagging, remain confident in their competitive position for C2H16.** Micron noted delays in ramping some of their mobile DRAM design wins contributing to both the revenue weakness and the growth in inventory. The company noted remaining confident in their portfolio for ramping these design wins in C2H16; our research suggests the company's portfolio in mobile is lagging both of their competitors and that Samsung has turned more active in mobile pricing in China to defend share with supply not being consumed by Samsung Mobile or Apple. Gains Micron may make in mobile we expect would likely be at margin levels similar to other DRAM markets as we believe they will be operating from a higher cost basis into what appears to be a very price aggressive market.
8. **NAND bit output growth offset by 15% Q/Q pricing declines; 3D NAND on-track for C2H16 ramp.** NAND margins held up better than DRAM margins in the quarter as costs in non-volatile memory declined 12% Q/Q against the 15% Q/Q decline in pricing. Micron noted their non-volatile gross margins declined a couple of percentage points in the quarter, better than the DRAM gross margins which likely fell 500bps+ Q/Q. Micron noted they are on track to begin shipping 3D NAND client SSDs into the channel targeting gamers and a 2TB client 3D SSD into an OEM design before year-end 2016. Our research suggests the entire NAND industry (ex-Samsung) is likely delayed in their ramp to 3D NAND with volume output more likely for late in 2016 and meaningful revenues more likely in early 2017. Micron reiterated their 3D NAND production will cross over 50% in C2H16 which we believe may prove to be faster than many of their peers.
9. **Micron appears to be lowering their forecasts for industry DRAM bit supply growth; we continue to believe Micron will likely have to be the catalyst for reduced industry output.** Micron reiterated their expectations for CY16 DRAM industry bit growth in the low/mid-20% range, and reiterated at their recent analyst day their expectations for growing DRAM output at above market rates. For CY17 Micron projected industry DRAM bit growth could dip below 20% Y/Y on slowing shrinks and limited/no incremental wafer supply. At their Feb'16 analyst day Micron had talked about 20-30% DRAM bit output growth long-term. Micron expects to ramp their 1xnm DRAM product in 2017 with a much larger cost down than their 20nm conversion, implying greater supply growth than the current on-going shrink. We expect Samsung to be in volume production on their 18nm late in 2016 with continued supply growth into 2017. Against this supply growth and in an already oversupplied market our research remains cautious on the demand opportunity in DRAM across PC, data center, and mobile. We continue to believe Samsung and Hynix will maintain at a better cost basis than Micron through 2016 and will wait for Micron to act on slowing/cutting production in DRAM before making any changes to their output.
10. **Micron generated ~$760mm in operating cash flow, or 26% of revenues, and spent ~$1.2B in capex.** Capex guidance was maintained for an increase to $5.3-5.8B with an estimated ~$300-800mm contribution from partners. Per their guidance, we estimate Micron's free cash flow to remain negative for the balance of FY16 totaling a $1.2B deficit for the year. Micron currently sits at $5.1B in cash, down $2.2B from May'15 quarter, and is carrying $6.5B in debt, up $100mm from the same May'15 quarter.

KEVIN ROTTINGHAUS
krottinghaus@cleveland-research.com
(216) 649-7209

SEAN MUIR
smuir@cleveland-research.com
(216) 649-7256

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