

## Avago Analyst Day *FBAR, VCSEL and SerDes—Oh My!*

**Avago Technologies** (AVGO, \$31.14 -2.56, Rated Hold)

**Analyst Day:** Avago hosted an Analyst Day at the NASDAQ Marketsite Friday to review its October-end FY12. I found it difficult not to be attracted to the combination of CEO Hock Tan's frankness combined with the legacy of HP/Agilent's former III-V semiconductor technology operations financially turbo-charged by customer Apple. In fact, the only thing I'm not attracted to is the fundamental share price valuation. But even then it isn't too bad if I sharpen my pencil, squint real hard, focus on price-earnings, and then argue GARP. I anxiously await share price weakness in this stock.

**Summary:** The CEO kicked off the event with a quip about hoping to show us the company was about more than just Cupertino (i.e. Apple, in my opinion), and later commented that the FBAR Wireless business would continue to expand this fiscal year along with its customer base to a major tier-one in Korea (i.e. Samsung, in my opinion). Wireless business (primarily FBAR filters to 3G and 4G/LTE smart phones) was strong enough last year to offset stagnation in its Wired business (mostly parallel optics and SerDes ASICs to data centers), weakness from Industrial markets (optocouplers, controllers and optical sensing to inverter, servo driver and factory automation applications, among others), and its de-emphasis of Consumer markets (\$100M-worth of optical mouse sensors, optical disk drives and printers). I also found the long-term pro forma financial model pretty compelling and convincing: revenue growth of +10+12% driven by +30% CAGR in the admittedly-squishy metric of design win revenue potential; gross margin of 50-53% driven by market and technology leadership in FBAR filters, VCSEL optics, high-speed SerDes, and optical sensing; R&D at 14% of sales and cap ex in the high-single-digit percentage to fuel this technology; and a tax rate of 4-5% by locating its headquarters in Singapore, among other strategies.

### **Core Technologies: FBAR, SerDes, VCSEL Embedded Parallel Optics, and Optical Sensing**

**FBAR:** FBAR filters used in smartphones is currently the company's primary growth driver. FBAR (film bulk acoustic resonator) is a high-performance filter that uses piezoelectrics to differentiate it from BAW and SAW filters. AVGO has decades of experience and owns the vast majority of the world's manufacturing capacity. FBAR has always been a high-performance filter, but the market is now coming to FBAR with crowding of the frequency spectrum due to the proliferation of radio technologies (cell, WiFi, BlueTooth, GPS, ect.) as well as 4G/LTE cell phone technology deployment. For example: LTE Bands 7, 40 and 41 are beginning to crowd around the WiFi frequency band; poor filtering could trigger interference and signal and power degradation of and between bands; and FBAR filters (used in both WiFi and LTE bands) do a better job of keeping the channels clear and separate. AVGO calls this 'co-existence.' Apple has been an early adopter, and many others are following. AVGO builds its FBAR filters on a 6-inch fab in Fort Collins, CO; is well into plans to quadruple capacity from 2011-2013; and is already planning for a doubling of current manufacturing floor space in an adjacent building. This proprietary technology is now on its 7<sup>th</sup>-generation (FBAR-VII) with a roadmap to FBAR-IX and currently supports 15 different frequency bands up from five only three years ago. AVGO leads the CDMA market with its FBAR filters.

AVGO also offers duplexers, HBT power amplifiers (PAs), pHEMPT switches and LNAs, and front-end modules (FEMs) combining all these elements. The bill-of-materials for combined filters, switches and PAs is growing from \$1.00 for the old voice-only cell phones up to \$8.50 for high-end smartphones—on top of smartphone unit growth.

**SerDes:** AVGO also specializes in very high-speed, SerDes (serializer-deserializer) ASICs and ASSPs used in switching and routing applications. These are manufactured in CMOS, but we're talking really big and really fast—like up to 400 SerDes per chip (yes, the chip is about 4-inches square) and 10-,15- and 25-Giga bits per second, including a 100-Gig ASSP standard device.

**Embedded Parallel Optics:** AVGO pioneered VCSEL fiber optic products used in the same markets noted above for SerDes devices, as well as certain industrial applications (high-speed trains, power generation/distribution). Speed scales up to 100Gb/s and supports interfaces that include Ethernet, Infiniband, Fiber Channel and proprietary.

**Optical Sensing:** AVGO is exiting low-end optical sensors, but continues to offer LEDs and is the market leader for precision sensing in factory automation and robotic applications. It serves many industrial OEMs directly.

**Avago Technologies**

Company Summary

Core Technology	Product Lines	TAM CAGR Rank			Competitors	MARKET		Applications			Customers		
		TAM	CAGR	Rank		Reported							
FBAR (III-V)	FBAR Filters			#1	Anadigics	<b>Wireless</b> 51% Sales F4Q	4G/LTE Deployment			Foxconn (Apple)			
	Power Amplifiers				Hittite		Smartphones			Samsung			
High-Speed SerDes (CMOS)	RF Front-End Modules				RF Micro Devices	<b>Wired</b> 26%	Core/Edge Routing Server/HPC Storage/Networking	1/10/40/100G Ethernet	SFP+	Cisco	Juniper	adding FY13	
	RF Multimarket				Skyworks			1/10/40G Enet, Infiniband	QSFP+	IBM	Nokia-Siemens	Alcatel-Lucent	
	Parallel Optics	\$3B	7%	18%	Finisar			1/10/40/100G Ethernet	CXP	ZTE	HP	Huawei	
Embedded Parallel Optics (VCSEL)	ASIC SerDes				LSI Logic	<b>Industrial</b> 21%	4/8/16X Fiber Channel proprietary	XFP	Ericsson	Oracle	Brocade		
	Storage Networking				STMicroelectronics			proprietary	Intel	Emulex			
Optical Sensing	Standard Networking				Toshiba, Renesas, Fairchild	Inverters (AC-DC), 20% power distribution/generation, transportation Servo Drivers, 20% motors, elevators, robotics, CNC Factory Automation, 60% optical data lines, high galvanic isolation			Siemens	Rockwell			
	Optocoupling	\$400M	9%	#1	Heidenhain, Sick Stegman, Danaher				Bosch	Schneider			
	Motion Encoder	\$850M	5%	#2	Hamamatsu, Firecomms				Tyco	Yaskawa			
	Industrial Fiber	\$230M	7%	#1	Nichia, Rohm			GE	Sanyo Denki				
	LEDs	\$600M	2%	#3				ABB					

Ticker: **AVGO**

Financials as of: 3Q  
FYE: Oct

Price/sh 12/14/12  
\$31.14 -2.56 -7.6%

**Price Changes**

	AVGO	SOX	NASDAQ	S&P500
Day:	-7.6%	-0.7%	-0.7%	-0.4%
Week:	-9.1%	0.4%	-0.2%	-0.3%
MTD:	-11.3%	1.8%	-1.3%	-0.2%
QTD:	-10.7%	-0.3%	-4.6%	-1.9%
YTD:	7.9%	4.6%	14.1%	12.4%

52wk Lo-Hi: 27.39 39.22  
percent lo: 13.7%  
percent hi: -20.6%

**MACD**

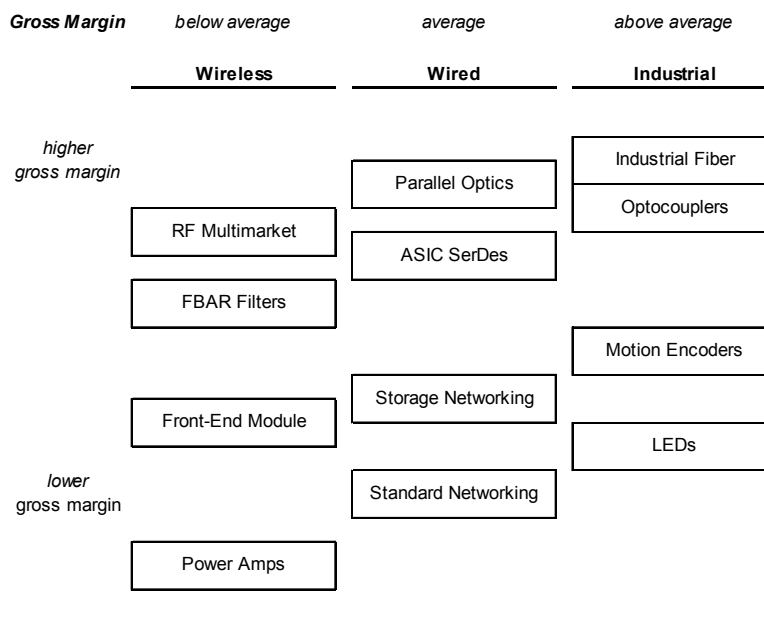
50-day: -8.2%  
200-day: -9.9%

Shares(mil): 253.0  
Mkt Cap(\$mil): 7,878  
Avg Volume: 2,268,780  
QTR Div/share: \$0.1700  
Annual Yield: 2.2%  
Cash/share: \$4.28  
Net Cash/share: \$4.28

Revenue(\$mil): \$2,364.0  
pro forma EPS: \$2.77

Valuation Metric			since: 2009		
			Average	High	Low
Price/Sales	TTM	3.3	2.7	4.1	2.0
	Cur FY	3.1			
	Next FY	no est			
Price/Earnings	TTM	11.2	12.1	17.2	8.2
	Cur FY	15.0			
	Next FY	11.16			
Price/Book	Pr/Bk	3.3			
	Tangible Pr/Bk	4.3			

**Avago Relative Gross Margin Mix**



**Long-Term Financial Model**

*pro forma*

Metric	Range
Revenue Growth	+10+12%
Gross Margin	50-53%
R&D	14%
SG&A	7%
Operating Margin	29-32%
Tax Rate	4-5%
Net Margin	28-31%
Capital Expenditures	high 1-digit%

**—Dan K. Scovel**  
Semiconductor Analyst

**Tokeneke Research LLC**  
Rowayton, CT 06853  
dscovel@tokenekeresearch.com  
www.tokenekeresearch.com  
203-554-4621

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