

LINEAR TECHNOLOGY CORPORATION

Why Linear is the Most Profitable IC Vendor

PREFACE

One single example, thoroughly analyzed, is far more instructive than ten that are superficially treated

Carl von Clausewitz, On War

This detailed report on the strategy of Linear Technology Corporation provides you with a foundation for strategy assessment and formulation across the entire analog/mixed-signal space, which is projected by Petrov Group to exceed \$150B by 2007. The report complements our previous work at the analog end of the Analog-Digital Signal Spectrum, including our published work:

- The seminal report titled *Analog/Mixed-Signal Integration Trends and Opportunities: How STM, TI, ADI, National, Maxim, and Linear Leverage AMS Technologies* analyzes AMS technology and the business models of six leading vendors
- The report titled *Automotive, Medical, and Automation Mixed-Signal SoC Market and Technology* analyzes the market terrain at the end-manufacturer, equipment supplier and semiconductor component levels

Our work, including the above reports, provides a broad and fact-based knowledge base. Together with our presentations and discussions they deliver a fully completed **first phase** of any strategy formulation and competitive intelligence effort in the analog/mixed-signal domain. Our reports also illustrate the quality and integrity of our work.

Hence the second phase of a specific competitive intelligence and/or strategy examination effort can be accelerated. It can be defined and launched much earlier and more decisively, since the comprehensive knowledge and understanding we have already delivered helps determine which specific additional information should be obtained to meet your specific objectives.

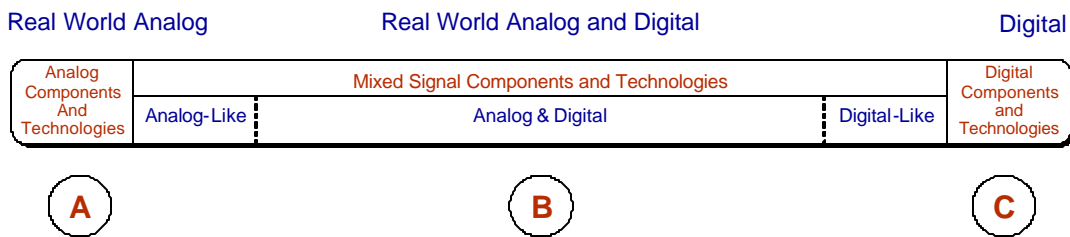
Our report on Linear Technology delivers a fully completed first phase analysis of a leading player. It provides the basis for benchmarking and/or “deep dive” specific competitive, market, application, value chain, and other analyses required for strategy formulation and implementation. Our reports and cumulative knowledge of the

electronics industry, together with our consulting and due diligence expertise, **make us eminently qualified** to assist you cost-effectively and from a running start in your strategy formulation efforts.

In the semiconductor industry we have analyzed leading vendors, markets, and technologies across the entire Analog-Digital Signal Spectrum. Among many companies analyzed over an extended period are Linear and IBM, two companies that epitomize the extreme end of the Analog-Digital Signal Spectrum and that have implemented unique and powerful business models.

For your convenience we have listed below some of our visible (published) reports, which illustrate our extensive work and intellectual property in the semiconductor industry. We will provide a list of our qualifications on request.

Examples of PG Work across Analog-Digital Signal Spectrum



Area A

- *Linear Technology Corporation—Why Linear Is the Most Profitable IC Vendor*
- *Analog/Mixed-Signal Integration Trends and Opportunities: How STM, TI, ADI, National, Maxim, and Linear Leverage AMS Technologies*
- *Analog/Mixed-Signal IC Competitive Analysis: Hard Disk Drive Case Study*

Area B

- *Automotive, Medical, and Automation Mixed-Signal SoC Market and Technology*
- *Melexis NV—Automotive Mixed-Signal and Sensor Vendor Case Study*

Area C

- *Microelectronics Business and Strategy of IBM*
- *Chip Design Strategy: IC Design Technology of IBM*
- *IBM Cellular Computing: 2004 Emergence and Impact*
- *IBM SoC/ASIC Capabilities and Technology*

Custom Engagements with Petrov Group

The minimum size of custom engagements in competitive intelligence and strategy formulation is \$40K. Our preference is to have four to six weeks to complete even such small engagements, since time cannot be compressed and there are natural timelines for research, interviews, networking, synthesis, etc.

We are confident that our report on Linear Technology demonstrates the quality, scope, and the highest standards of independence and integrity of our work. Please contact us for more information on our consulting and due diligence consulting.

We look forward to discussing your areas of interest and needs and will promptly respond to your request for proposal.

SECTION 1 (OF 21) INTRODUCTION

1.1 THE ULTIMATE MONEY MACHINE

Linear Technology stands out as the ultimate Money Machine—the most profitable IC vendor in the semiconductor business

Linear Technology Corporation (LLTC) is the most famous alumnus of National Semiconductor's Analog University® and a truly unique high technology company. It has turned the medieval science of alchemy into reality by making gold out of sand. Among the leading analog companies, also known as the "money machines," Linear Technology stands out as the ultimate Money Machine—the most profitable vendor in the semiconductor business.

Figure 1-1 Revenue Versus Market Value

	2004 Revenue (\$B)	January 2005 Market Capitalization (\$B)	Ratio (Market Cap/ Revenue)
Linear	\$0.8	\$11.1	13.9
Maxim	1.4	12.5	8.9
Analog	2.6	13.2	5.1
Intel	33.0	144.0	4.3
Intersil	0.5	2.1	4.0
TI	12.7	38.4	3.0
National	2.0	5.8	2.9
Cypress	1.0	1.3	1.3
LSI Logic	1.7	2.1	1.2
Freescale	5.8	6.7	1.2
AMD	5.0	5.6	1.1
Atmel	1.6	1.5	0.9

Leading analog companies can boast among the best operating models in the semiconductor industry and typically self-finance their own growth by using cash that they generate from operations. Linear leads them all in the money-making business; it has been far ahead the entire industry in net profit margin generation for decades. In this report we explore the

nature of Linear's exceptional performance and the competitive strategies it deploys to sustain it over a time period measured in decades.

Linear has demonstrably built and perfected a unique corporate strategy and modus operandi to optimally satisfy its specific business objectives. In our report we analyze how this corporate mechanism is constructed and how it operates—what exactly are its parts and interactions, to produce such sustainable and superior financial results.

By now it must be obvious to most observers that such exceptional performance for decades has little to do with analog design being a “black art,” a frequent journalistic explanation. Instead, Linear's fine tuned corporate mechanism achieves this by combining the advantages of the unique features of the analog IC market landscape with the guiding principles of its business mission. This is also the reason why we have analyzed in great detail the automotive, medical, and automation market terrains in our recent report on analog and mixed-signal IC consumption in these sectors.

Using a military analogy, Linear maximally exploits the features of the terrain according to the company's mission.

“Understanding the six kinds of terrain is the highest responsibility of the general, and it is imperative to examine them”

Sun Tzu, *The Art of War*

Linear's corporate mechanism is self-sustaining to enable decades-long unparalleled performance and, as we will illustrate, it also contradicts many of the generally accepted business rules and success parameters.

Our analysis of Linear has two important findings:

1. We will demonstrate that Linear's mechanism is more broadly applicable to other IC vendors than commonly perceived
2. Equivalent operational mechanisms can be developed for companies or business units with different business objectives and in entirely different product and market environments

1.2 FORWARD TO BASICS

Linear defies the conventional wisdom of today's mainstream semiconductor business by retaining a hold on technological **substance** and uncompromisingly resisting the call of the hype-based digital **form**. In fact, the Linear spin-off from National Semiconductor in 1981 was driven by National's expansion into the digital business arena. It prompted the departure of National's core analog experts led by Robert Swanson and the formation of the most profitable "National analog business—Outside," which by now represents about \$1B in annualized revenues National would otherwise have had, in addition to about \$1.7B in cash.

The actual size of revenue streams derived from high performance analog IC market opportunities remains a speculative issue:

- *It is a "stealth market" eluding the radar screens of the industry's statisticians*
- *High performance analog IC market opportunities are stratified along the value axis*

Viewed from the perspective of the mainstream digital IC business, Linear appears to be a remnant of an extinct species of semiconductor technology companies of the original Fairchild era. Linear's founding CEO, Bob Swanson, captured this view in a January 1998 interview: "I am known as the Neanderthal Man of Silicon Valley ... There is this perception that analog is low-tech. It's not glamorous. The only thing glamorous is the money we make."

The sources of Linear's superior financial performance and competitive advantage are not the proverbial silver bullets and "killer applications" of the digital hype-world but rather a mixture of basic common sense principles put into disciplined action and guided by resolute leadership. The common denominator of these principles is simplicity,

described by Mr. Swanson: “When we started this company, we bucked conventional wisdom and beat the pants off everybody else.” While digital IC companies tend to go “back to basics,” typically in troubled times, Linear progresses “forward to basics.” Here are some brief illustrations of the Linear’s “Forward to Basics” principle:

- Seventeen years after its founding the company has had only a handful of high-level organizational functions, while it took three more years to establish a business unit structure.
- At the height of the Internet bubble era the company still lacked e-mail and voice mail, enabling the company to preserve its historic close direct and personal relationships with customers.
- Only a handful of non-product related press releases are issued annually. PR and advertising focus is on products—the ammunition Linear uses against competitors. The entire company business description fits on a single page, while the product line structure and content seem to be frozen in time. Historically it has been structured by device function type, that is, by the raw power of high-performance analog technology. Supporting process technologies have also not changed significantly in the past several years.
- Financial reports are brief, while CEO Swanson rarely speaks at industry conferences—“Our attitude is to let the numbers do the talking for us” (Swanson). The 2004 Annual Report has nine content pages (out of twelve total).
- The company still has a literature department and in 2004 printed a comprehensive set of “old fashioned” data books, which total about 17,400 pages. In contrast Linear’s alma mater, National Semiconductor, prides itself on being a

“paperless company” and offers practically no printed literature.

- The focus and mission of the company, since its inception twenty-three years ago, has not changed; its business is ultra-high performance analog ICs. Consequently, the function-oriented product focus fits this mission because it is the closest to device performance.
- A notion of system-level integration (SoC) is absent. To the “call of the SoC” Mr. Swanson replies: “I believe in sticking to my knitting. I think for every application where the single-chip (SoC) approach can work, there are dozens more where it won’t work, where they can’t get the performance they need ... some of these people bragging about doing system-on-chip, they don’t even know how to do these things as a discrete.”

As a result, everything seems and looks trivially simple, the way it was done over thirty years ago; one can even meet the same people. Yet the company’s market valuation has been among the highest in the semiconductor industry. Linear’s market capitalization (cap) to revenue ratio was historically bigger than any semiconductor company in Silicon Valley except Intel, including the company’s alma mater, National Semiconductor, and the “SoC Company” LSI Logic. Linear’s cap/revenue ratio, the highest in the semiconductor industry, is increasing; it has increased from 11.3 times in 1998 to 13.9 times in 2005.

- Linear’s consistent profitability (since its 1986 IPO) is a monument to Swanson’s refusal to deviate from the original strategy of attacking the high-end of the analog market where the margins are the highest. Linear drops the product line when competitors squeeze margins and turn a product line into a commodity.

Linear's market retreats and expansions are an outstanding indication of analog versus mixed-signal market and application dynamics.

The company walks away from business when it no longer can achieve the target net income margin. Commoditization of a product line is typically driven by high unit volume demand, which is in turn typically met using lower analog performance technologies, which are dominated by the mainstream CMOS processes and mixed signal integration. Therefore, Linear could be used as a gauge of analog IC value in the marketplace. Linear addresses each and every high performance analog market segment; its participation is an excellent indication of the boundary dynamics between high performance and commodity analog ICs. Moreover, Linear's market retreats and expansions could be an outstanding indication of analog versus mixed-signal market and application dynamics.

Linear sells knowledge transformed into shippable products

Linear's engineering staff designs its expertise into Linear's ICs so that the user of Linear's circuit gets an **expert linear system in silicon**. Hence, Linear sells knowledge, not products per se, that is, knowledge transformed into shippable products.

This analog expert system solves problems that can often remain invisible to users unless the user uses inferior competitor products. The "linear system" solution or "application-specific standard product" (ASSP) direction has been a key element of Linear's original 1981 business plan, and it can be seen in Linear's approach to all its key product groups, including interface products, monolithic switched capacitor filters, integrated data acquisition systems, and switching power supply ICs.

The knowledge base ingredients of Linear's product portfolio could also be viewed as its intangible service component. Consequently, Linear's business is highly valued and represents a high competitive barrier. CEO Swanson has stated this as follows: "If you would have a billion dollars, you could compete with Intel, but if you had \$10 billion, you still couldn't compete with me, unless you hired my people."

In a knowledge-based high-tech business, human engineering assets are the key competitive weapon. Therefore, acquiring and retaining valued human engineering capital becomes a key requirement for sustainable longer-term competitive advantage. Over time Linear has developed a high share of analog engineering know-how, enabling it to build up a significant barrier to a competitive entry. At the same time, Linear has been able to retain its highly valued engineering know-how by spending lavishly on profit-sharing plans and providing lucrative stock option incentives. The net result is a profit-driven and profit-generating corporate mechanism.

Linear's competitive advantage is not in analog IC knowledge itself but in how it is harnessed and managed

Linear is a benchmark case in how to be successful in the high-tech business, because the determinant of Linear's competitive advantage is not in analog IC knowledge itself but in how it is harnessed and managed. This report analyzes how Linear's corporate mechanism is constructed, how it operates, and what exactly are its parts and interactions. The report analyzes six to eight individual strategy concepts and approaches used by Linear, and about twenty critical parts and interaction of Linear's corporate mechanism. Each of them provides a foundation for a client-confidential strategy consulting engagement—Petrov Group's business.