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THE GLOBAL MARKET FOR POWER SUPPLY AND POWER MANAGEMENT INTEGRATED CIRCUITS, FOURTH EDITION

VOLUME 2: OEM DEMAND ANALYSIS



VENTURE DEVELOPMENT CORPORATION
TECHNOLOGY MARKET RESEARCHERS AND STRATEGISTS SINCE 1971

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THE GLOBAL MARKET FOR POWER SUPPLY AND POWER MANAGEMENT INTEGRATED CIRCUITS, FOURTH EDITION

VOLUME 2: OEM DEMAND ANALYSIS

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TABLE OF CONTENTS

**The Global Market for Power Supply and Power Management Integrated Circuits, Fourth
Edition Volume 2: OEM Demand Analysis**

I EXECUTIVE SUMMARY.....	1
INDUSTRY AND PRODUCT OVERVIEW	2
PRODUCT DEVELOPMENT AND TRENDS	2
EMERGING FEATURES.....	2
VENDOR PERCEPTION.....	3
APPLICATIONS ANALYSIS	3
II SCOPE AND METHODOLOGY	4
SCOPE	5
Product Focus	5
Industry Focus	6
Geographical Focus	6
Distribution Channel Focus	6
METHODOLOGY	7
Primary Research.....	7
Secondary Research	7
III OEM TREND & TECHNOLOGY OVERVIEW	9
INDUSTRY AND PRODUCT OVERVIEW	10
Product Development and Trends.....	12
Is Silicon Germanium a Trend in Power ICs ?.....	12
OEM EMERGING FEATURES, FUNCTIONS AND APPLICATIONS.....	13
Emerging Features and Functions	13
Emerging Applications	19
VENDOR PERCEPTIONS.....	19
OEM and Vendor Comments.....	20
IV APPLICATIONS ANALYSIS.....	22
MERCHANT POWER SUPPLIES	23
COMPUTERS AND PERIPHERALS	35
TELECOM/DATACOM.....	45
CONSUMER PRODUCTS.....	54
AUTOMOTIVE.....	59
INDUSTRIAL CONTROL AND AUTOMATION	62
INSTRUMENTATION.....	73
MEDICAL.....	82
MILITARY	86
APPENDIX: VENDOR LIST	95

LIST OF EXHIBITS

The Global Market for Power Supply and Power Management Integrated Circuits, Fourth Edition Volume 2: OEM Demand Analysis

EXECUTIVE SUMMARY

I-1	Awareness of and Preference for PSIC Vendors Among Surveyed OEMs (Ranked by # of Responses by Surveyed OEMs).....	3
-----	--	---

OEM TREND & TECHNOLOGY OVERVIEW

III-1	Survey Respondent Distribution by Principal Industry Served (Percent of Respondents).....	11
III-2	Survey Respondents Using Each Type of Power IC (Percent of Respondents).....	11
III-3	Overall Product Selection Criteria for Respondents Using PWM/PFM (Mean Rating) 1=Not Important, 5=Very Important	13
III-4	Overall Product Selection Criteria for Respondents Using DC/DC Regulators (Mean Rating) 1=Not Important, 5=Very Important	14
III-5	Overall Product Selection Criteria for Respondents Using AC/DC Off Line Regulators (Mean Rating) 1=Not Important, 5=Very Important	14
III-6	Overall Product Selection Criteria for Respondents Using Linear Regulators (Mean Rating) 1=Not Important, 5=Very Important	15
III-7	Overall Product Selection Criteria for Respondents Using PFC Controllers (Mean Rating) 1=Not Important, 5=Very Important	15
III-8	Overall Product Selection Criteria for Respondents Using Battery Charging and Management IC's (Mean Rating) 1=Not Important, 5=Very Important	16
III-9	Overall Product Selection Criteria for Respondents Using Hot Swap Controllers (Mean Rating) 1=Not Important, 5=Very Important	16
III-10	Overall Product Selection Criteria for Respondents Using MOSFETS (Mean Rating) 1=Not Important, 5=Very Important	17
III-11	Overall Non-Product Selection Criteria for All Respondents (Mean Rating) 1=Not Important, 5=Very Important	18
III-12	Awareness of and Preference for PSIC Vendors Among Surveyed OEMs (Ranked by # of Responses by Surveyed OEMs).....	19

APPLICATIONS ANALYSIS

IV-1	Merchant Power Supply Respondents Using Each Type of Power IC (Percent of Respondents).....	23
IV-2	PWM/PFM Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important	24
IV-3	DC/DC Regulator Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important	25
IV-4	AC/DC Off Line Regulators Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important	26
IV-5	Linear Regulator Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	27
IV-6	PFC Controllers Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	28

IV-7	Battery Charging and Management ICs Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important	29
IV-8	MOSFET Driver Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	30
IV-9	Use of PWMs in Merchant Power Supply Industry (Percent of Respondents).....	31
IV-10	Use of DC/DC Regulators in Merchant Power Supply Industry (Percent of Respondents).....	31
IV-11	Use of AC/DC Off Line Regulators in Merchant Power Supply Industry (Percent of Respondents).....	32
IV-12	Use of Linear Regulators in Merchant Power Supply Industry (Percent of Respondents).....	32
IV-13	Use of PFC Controllers in Merchant Power Supply Industry (Percent of Respondents).....	33
IV-14	Use of Battery Charging and Management IC's in Merchant Power Supply Industry (Percent of Respondents).....	33
IV-15	Use of MOSFETS in Merchant Power Supply Industry (Percent of Respondents).....	34
IV-16	Non-Product Selection Criteria for Merchant Power Supply Respondents (Mean Rating) 1=Not Important, 5=Very Important	35
IV-17	Computer and Peripherals Respondents Using Each Type of Power IC (Percent of Respondents).....	36
IV-18	PWM/PFM Product Selection Criteria for Computers and Peripherals Respondents (Mean Rating) 1=Not Important, 5=Very Important	37
IV-19	DC/DC Regulators Product Selection Criteria for Computers and Peripherals Respondents (Mean Rating) 1=Not Important, 5=Very Important	38
IV-20	Linear Regulators Product Selection Criteria for Computers and Peripherals Respondents (Mean Rating) 1=Not Important, 5=Very Important	39
IV-21	Battery Charging and Management IC's Product Selection Criteria for Computers and Peripherals Respondents (Mean Rating) 1=Not Important, 5=Very Important	40
IV-22	MOSFET Product Selection Criteria for Computers and Peripherals Respondents Using (Mean Rating) 1=Not Important, 5=Very Important	41
IV-23	Use of PWMs in the Computers and Peripherals Industry (Percent of Respondents).....	42
IV-24	Use of DC/DC Regulators in the Computers and Peripherals Industry (Percent of Respondents).....	42
IV-25	Use of Linear Regulators in the Computers and Peripherals Industry (Percent of Respondents)	43
IV-26	Use of Battery Charging and Management IC's in the Computers and Peripherals Industry (Percent of Respondents).....	43
IV-27	Use of MOSFETS in the Computers and Peripherals Industry (Percent of Respondents).....	44
IV-28	Non-Product Selection Criteria for Computers and Peripherals Respondents (Mean Rating) 1=Not Important, 5=Very Important	44
IV-29	Telecom/Datacom Respondents Using Each Type of Power IC (Percent of Respondents).....	45

IV-30	PWM/PFM Product Selection Criteria for Telecom and Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important	46
IV-31	DC/DC Regulators Product Selection Criteria for Telecom and Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important	47
IV-32	Linear Regulators Product Selection Criteria for Telecom and Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	48
IV-33	Battery Charging and Management ICs Product Selection Criteria for Telecom and Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important	49
IV-34	MOSFET Product Selection Criteria for Telecom and Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important	50
IV-35	Use of PWMs in the Telecom and Datacom Industry (Percent of Respondents).....	51
IV-36	Use of DC/DC Regulators in the Telecom and Datacom Industry (Percent of Respondents).....	51
IV-37	Use of Linear Regulators in the Telecom and Datacom Industry (Percent of Respondents).....	52
IV-38	Use of Battery Charging and Management IC's in the Telecom and Datacom Industry (Percent of Respondents).....	52
IV-39	Use of MOSFETS in the Telecom and Datacom Industry (Percent of Respondents).....	53
IV-40	Non-Product Selection Criteria for Telecom Datacom Respondents (Mean Rating) 1=Not Important, 5=Very Important	53
IV-41	Consumer Products Respondents Using Each Type of Power IC (Percent of Respondents).....	54
IV-42	DC/DC Regulators Product Selection Criteria for Consumer Products Respondents (Mean Rating) 1=Not Important, 5=Very Important	55
IV-43	Linear Regulators Product Selection Criteria for Consumer Products Respondents (Mean Rating) 1=Not Important, 5=Very Important	55
IV-44	Use of PWMs in the Consumer Products Industry (Percent of Respondents).....	56
IV-45	Use of DC/DC Regulators in the Consumer Products Industry (Percent of Respondents).....	57
IV-46	Use of Linear Regulators in the Consumer Products Industry (Percent of Respondents).....	57
IV-47	Use of MOSFETS in the Consumer Products Industry (Percent of Respondents).....	58
IV-48	Non-Product Selection Criteria for All Consumer Product Respondents (Mean Rating) 1=Not Important, 5=Very Important	58
IV-49	Automotive Respondents Using Each Type of Power IC (Percent of Respondents).....	59
IV-50	Linear Regulators Product Selection Criteria for Automotive Respondents (Mean Rating) 1=Not Important, 5=Very Important	60
IV-51	Use of PWMs in the Automotive Industry (Percent of Respondents).....	60
IV-52	Use of Linear Regulators in the Automotive Industry (Percent of Respondents).....	61
IV-53	Use of MOSFETS in the Automotive Industry (Percent of Respondents).....	61

IV-54	Non-Product Selection Criteria for Automotive Respondents (Mean Rating) 1=Not Important, 5=Very Important	62
IV-55	Industrial Control and Automation Respondents Using Each Type of Power IC (Percent of Respondents)	63
IV-56	PWM/PFM Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important	64
IV-57	DC/DC Regulators Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	65
IV-58	AC/DC Off Line Regulators Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	66
IV-59	Linear Regulators Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	67
IV-60	PFC Controllers Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important.....	68
IV-61	Battery Charging and Management ICs Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important	69
IV-62	MOSFET Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important	70
IV-63	Use of PWMs in the Industrial Control and Automation Industry (Percent of Respondents).....	70
IV-64	Use of DC/DC Regulators in the Industrial Control and Automation Industry (Percent of Respondents).....	71
IV-65	Use of AC/DC Off Line Regulators in the Industrial Control and Automation Industry (Percent of Respondents).....	71
IV-66	Use of Linear Regulators in the Industrial Control and Automation Industry (Percent of Respondents).....	72
IV-67	Use of Battery Charging and Management ICs in the Industrial Control and Automation Industry (Percent of Respondents).....	72
IV-68	Non-Product Selection Criteria for Industrial Control and Automation Respondents (Mean Rating) 1=Not Important, 5=Very Important	73
IV-69	Instrumentation Respondents Using Each Type of Power IC (Percent of Respondents) 1=Not Important, 5=Very Important	74
IV-70	PWM/PFM Product Selection Criteria for Instrumentation Respondents (Mean Rating) 1=Not Important, 5=Very Important	75
IV-71	DC/DC Regulators Product Selection Criteria for Instrumentation Respondents (Mean Rating) 1=Not Important, 5=Very Important	76
IV-72	AC/DC Off Line Regulators Product Selection Criteria for Instrumentation Respondents (Mean Rating) 1=Not Important, 5=Very Important	77
IV-73	Linear Regulators Product Selection Criteria for Instrumentation Respondents (Mean Rating) 1=Not Important, 5=Very Important	78
IV-74	Use of PWMs In the Instrumentation Industry (Percent of Respondents)	78

IV-75	Use of DC/DC Regulators in the Instrumentation Industry (Percent of Respondents).....	79
IV-76	Use of AC/DC Off Line Regulators In the Instrumentation Industry (Percent of Respondents).....	79
IV-77	Use of Linear Regulators In the Instrumentation Industry (Percent of Respondents).....	80
IV-78	Use of PFC Controllers in the Instrumentation Industry (Percent of Respondents).....	80
IV-79	Use of Battery Charging and Management ICs In the Instrumentation Industry (Percent of Respondents).....	81
IV-80	Non-Product Selection Criteria for Instrumentation Respondents (Mean Rating) 1=Not Important, 5=Very Important	81
IV-81	Medical Respondents Using Each Type of Power IC (Percent of Respondents) 1=Not Important, 5=Very Important	82
IV-82	DC/DC Regulators Product Selection Criteria for Medical Respondents (Mean Rating) 1=Not Important, 5=Very Important	83
IV-83	MOSFET Product Selection Criteria for Medical Respondents (Mean Rating) 1=Not Important, 5=Very Important	83
IV-84	Use of DC/DC Regulators in the Medical Industry (Percent of Respondents).....	84
IV-85	Use of Linear Regulators in the Medical Industry (Percent of Respondents).....	84
IV-86	Use of MOSFETS in the Medical Industry (Percent of Respondents).....	85
IV-87	Non-Product Selection Criteria for Medical Respondents (Mean Rating) 1=Not Important, 5=Very Important	85
IV-88	Military and Aerospace Respondents Using Each Type of Power IC (Percent of Respondents).....	86
IV-89	PWM/PFM Product Selection Criteria for Military and Aerospace Respondents (Mean Rating) 1=Not Important, 5=Very Important	87
IV-90	DC/DC Regulators Product Selection Criteria for Military and Aerospace Respondents (Mean Rating) 1=Not Important, 5=Very Important	88
IV-91	Linear Regulators Product Selection Criteria for Military and Aerospace Respondents (Mean Rating) 1=Not Important, 5=Very Important	89
IV-92	PFC Controllers Product Selection Criteria for Military and Aerospace (Mean Rating) 1=Not Important, 5=Very Important	90
IV-93	MOSFET Product Selection Criteria for Military and Aerospace Respondents (Mean Rating) 1=Not Important, 5=Very Important	91
IV-94	Use of PWMs in the Military and Aerospace Industry (Percent of Respondents).....	92
IV-95	Use of Linear Regulators in the Military and Aerospace Industry (Percent of Respondents).....	92
IV-96	Use of PFC Controllers in the Military and Aerospace Industry (Percent of Respondents).....	93
IV-97	Use of MOSFETS in the Military and Aerospace Industry (Percent of Respondents).....	93
IV-98	Non-Product Selection Criteria for Military and Aerospace Respondents (Mean Rating) 1=Not Important, 5=Very Important	94

FOREWORD

Venture Development Corporation was founded in 1971 by graduates of the Harvard Business School, and all staff members are skilled in analyzing and forecasting the impact of new technology on a client's marketing, engineering, financial, and manufacturing plans. Each member of the consulting staff has had extensive "practical" technical management experience in his or her area of specialization.

Venture Development Corporation has assisted numerous electronic companies worldwide in formulating product and business strategies. We pride ourselves in providing clients with practical, innovative, incisive, and thorough analytical research. Custom services we provide include:

Strategic Planning

- Formulating business plans at the corporate, divisional, or departmental level
- Developing strategies for internal growth or growth by acquisition
- Conducting acquisition or divestiture searches
- Performing industry analyses
- Evaluating technological trends

Marketing

- Conducting in-depth market research
- Developing marketing strategies
- Recommending product and/or pricing policy
- Evaluating channels of distribution
- Conducting competitive analyses

Financial Services

- Formulating financial policies
- Developing pro forma cash flows, income statements, balance sheets, and budgets
- Raising debt or equity capital

Venture Development Corporation's strength lies in our unique ability to bring multidisciplinary capabilities in technology, economics, marketing, finance, engineering, and manufacturing to solve our client's problems. In the changing and competitive environment of the electronics industry, management decisions cut across boundaries of all of these disciplines. VDC is well positioned to work as a "team" with all aspects of our client's organization and recommend strategies, which will benefit the entire enterprise.

Venture Development Corporation is able to augment its clients' capabilities with the resources, skills, and perspectives necessary to deal systematically with the interrelated problems of technological, market, economic, social and political change. Most important, we are staffed by professionals who are not only aware of evolving electronic technologies but have the ability to work with clients in developing imaginative and workable business policies and strategies.

Our objective is to provide our clients with superior consulting services that fill real needs and are of lasting value, thereby gaining and holding client respect and loyalty. We welcome your inquiries and would be pleased to discuss our wide range of services with you.

VDC offers the following research services:

INDUSTRY REPORTS

Funded entirely by Venture Development Corporation, industry reports present a comprehensive analysis on all phases of a particular industry, technology or product category. Based on research conducted by our own full time staff, industry reports identify key technology trends, competitive strategies, as well as areas of risk and opportunity. An analysis of the end user, including purchase decision criteria, is one highlight of every industry report, as is a market forecast for the next five years broken out by relevant categories.

MULTICLIENT STUDIES

Research efforts funded by a group(s) of clients with similar needs for information and counsel.

SUBSCRIPTION SERVICES

Annual services that track product areas continually from a variety of prospectives. Typical deliverables include market data books, quarterly research bulletins, distribution channel analysis books and end user analysis books. In addition, clients receive unlimited inquiry privileges and an executive presentation.

VENTURESEARCH

This unique information service provides clients with immediate answers to specific product or market questions at low cost. By drawing on our research skills and our comprehensive electronics industry data base, VDC can provide timely and inexpensive answers to a wide range of information requests.

How Venturesearch Works

- You may telephone or fax to describe your information needs.
- Within 24 hours VDC will send a no-cost quotation in reply to your request.
- VDC will provide a fixed price quote and inform you of the expected duration of the search.

- Most searches take between one day and two weeks to complete and typical costs range from \$500 to \$7,500.
- You approve the project and receive the data
- In writing on the agreed upon date, or
- Over the telephone or facsimile if time is critical

In most instances, VDC can provide you with data more quickly, more accurately, and more economically than you can yourself. Our data base of electronic industry information is more comprehensive than most clients could justify maintaining. Venturesearch is like having an auxiliary research department, except you pay only a tiny fraction of the cost and only when you use it.

PROPRIETARY CUSTOM RESEARCH

Venture Development Corporation specializes in analyzing the strategic aspects of building businesses, marketing new products, and financing the growth of new enterprises. We welcome difficult custom research assignments where no easily obtainable data exists and where the research and pioneering can be done jointly, in close cooperation with a client's personnel.

FOLLOW-UP SERVICES

The Need – VDC services, while comprehensive, cannot possibly answer every question or provide all of the information desired by each and every client. In order to ensure that purchasers of reports have access to VDC's database and consulting staff, we provide follow-up services at cost. The goal of this program is to provide clients with additional data and analyses which are of specific interest. It is hoped that through the use of these services our clients will have the best possible information for making decisions and developing strategies. Naturally, questions that are procedural, involve clarification of methodology or definitions, are welcome at no charge to subscribers.

How It Works – Contact VDC and explain the information you desire. We will discuss your needs, call you back, tell you how much it will cost, and how long it will take.

Applicability – Follow-up services pertain to previously purchased reports and are limited to directly related subjects covered therein.

Costs – VDC's fees for follow-up services will be at our cost for labor, plus expenses incurred. It is recommended that clients seek a quotation in advance.

Timing – VDC will provide follow-up services as soon as possible after the attached agreement is received, and will promptly inform client of the expected completion date. As soon as the project is completed, the data will be conveyed to the client by mail or fax as previously arranged.

I EXECUTIVE SUMMARY

INDUSTRY AND PRODUCT OVERVIEW

As a whole, the semiconductor industry is facing unprecedented changes. Three simultaneous factors are changing the landscape on how vendors and OEMS do business. First, the days of double-digit market growth are behind us. Single-digit long-term growth is the best that can be expected. Second, manufacturing investments have and continue to stagger for most companies. Thirdly, many technologies have matured.

The results of these factors have led many of the smaller players on the sidelines when it comes to technology investments. This has resulted in industry-wide layoffs, liquidations, consolidations and partnerships. In addition, many companies have or will be moving manufacturing to offshore locations where labor is cheaper.

PRODUCT DEVELOPMENT AND TRENDS

A few key trends and product developments have taken place as some companies focus on Research and Development during this economic downtime:

- Vendors are realizing the importance of OEMs having second source availability for identical or pin-for-pin replacements.
- OEMs in the consumer market are demanding smaller, less power-hungry MOSFETS for power management in cell phones, PDAs, portable music players, GPS receivers etc.
- Next-generation communication, automotive, 48v-distributed and battery-powered systems will benefit from cost-effective, non-isolated bias buck regulators.
- Battery charging and Battery management ICs are making technological advances at a rapid pace.

EMERGING FEATURES

- Packaging which allows for more functionality and power dissipation in smaller packages.
- Sophisticated drive schemes to power white LEDs
- Advances in trench processes have pushed $R_{DS(on)}$ to new lows
- Need for high-voltage MOSFETS aimed at automotive switching applications
- Boost in alternator output in the automotive industry from power conversion devices.
- Start-up sequencing of multiple converters to meet system requirements.
- Programmable output switching regulators
- Tighter specifications for fuel gauging and battery charging.
- Lower quiescent currents

VENDOR PERCEPTION

OEMs quite often are aware of many vendors but obviously prefer certain vendors to others, based on a variety of reasons. Exhibit I-1 is a ranking of vendor awareness and vendor preference for PSIC vendors among OEMS surveyed.

Exhibit I-1 Awareness of and Preference for PSIC Vendors Among Surveyed OEMs (Ranked by # of Responses by Surveyed OEMs)		
<u>Awareness of Vendors</u>	<u>Rank</u>	<u>Preference for Vendors</u>
Texas Instruments	1	Texas Instruments
Linear Technology	2	Linear Technology
National Semiconductor	3	National Semiconductor
On Semiconductor	4	On Semiconductor
Fairchild, ST Microelectronics	5	ST Microelectronics
Maxim, Motorola	6	Motorola
Micrel	7	Micrel
International Rectifier, Unisonic Technologies	8	Fairchild
Infineon	9	Maxim
Intersil	10	Infineon

APPLICATIONS ANALYSIS

The full applications analysis chapter provides a detailed look at the vertical markets and specific applications within the vertical markets that use power supply and power management ICs. Information for this chapter was gathered through targeted interviews with leading OEMs from each vertical market application. Some of the highlights are listed here:

- Still recovering from economic stagnation, overcapacity and heavily reduced demand, the power supply industry has turned its attention to improved product technology, architecture, delivery, price and quality. From an application perspective, the most compelling changes in the Merchant power supply industry are occurring at the distributed power level. The proliferation of different voltages at higher current levels has led to changing technologies and architectures.
- Personal and laptop computers, servers, mainframes, workstations, printers, fax machines, copiers, etc. lead the market in cutting-edge technical innovation and product specifications.
- The Telecom/Datacom market as a whole is still anemic as it tries to recover from the devastation of the bursting bubble. Nonetheless wireless technology, such as wireless LANs, is one of the market-leading technologies that will require an abundance of next-generation power IC products.
- An increasing number of power ICs are being used in motor vehicle applications including motor/body load control, ABS, power train management, injection systems, anti-theft systems, auto-lock systems and car area network systems.
- Geo-political circumstances have fueled an increased demand by OEMs in the Military and Aerospace market.

II SCOPE AND METHODOLOGY

SCOPE

This report is an applications analysis of the worldwide market for power supply and power management integrated circuits. Market analysis and detailed segmentations can be found in Volume 1 of VDC's service on the "Global Market for Power Supply and Power Management Integrated Circuits, Fourth Edition."

Product Focus

The following power supply and power management IC products are included in the scope of this volume:

Note: The difference between PWM/PFM controllers and DC/DC regulators is that controllers drive an external switch (FET), while regulators integrate the switch.

Note: These products are all integrated circuits (ICs) and NOT modular power supplies. Both ICs and modular power supplies perform the same functions using the same topologies but they are manufactured in different ways.

PWM/PFM Controllers: Pulse-frequency modulated and/or pulse-width modulated control circuits used to drive an external switch (FET). These will be segmented by isolated and non-isolated.

DC/DC Regulators: Non-isolated controllers with a switch (FET) integrated on the IC. These include boost and buck regulators, and charge pumps.

AC/DC Offline Regulators: A low-voltage control circuit integrated with a high-voltage switching transistor, so to be used in an offline AC/DC application (e.g. TopSwitch)

Linear Regulators: Positive and negative linear regulators, as well as low dropout voltage (LDO) regulators (both positive and negative).

Power Factor Correction (PFC) Preregulators: Provides power supply input circuitry that performs power factor correction.

Battery Charging/Management ICs: These include battery charging, protection, and fuel gauge ICs, as well as smart battery ICs that allow battery data communication.

Hot Swap Controller ICs: ICs enabling the removal and/or insertion of a board from a 'live' system without inrush current damaging the system.

MOSFET Drivers: Switch (FET) driver ICs used exclusively for power supply applications.

Industry Focus

- Merchant Power Supplies: Power supplies and battery chargers that switching power supplies, UPSs, battery chargers, etc.
- Computers and Peripherals: Personal and laptop computers, servers, mainframes, workstations, printers, fax machines, copiers, etc.
- Telecom/Datacom: Fixed and mobile telecommunication equipment, switches, hubs, routers, other networking and data communications equipment.
- Consumer Products: Mobile phones, personal communicators, pagers, PDAs, set-top boxes, gaming consoles, audio/video, home appliances, etc.
- Automotive: Electronics in automobiles, trucks, and commercial vehicles, etc.
- Industrial Control and Automation : Distributed control systems, motor/motion control, semiconductor fabrication equipment, etc.
- Instrumentation: Automated test equipment, scientific instrumentation, test equipment, etc.
- Medical: Medical imaging, patient monitoring, etc.
- Military/Aerospace: Radar systems, guidance and navigation equipment, avionic systems, command and control, space and military communications, etc.
- Other: Retail, Security , transportations etc.

Geographical Focus

This is a global study covering products manufactured worldwide and shipped worldwide. Geographical segmentation is defined by shipments to regional destinations. The following geographical segments are used when discussing market shares, forecasts, trends, and individual vendor coverage:

- North America - Canada, Mexico, and the United States
- Europe - Western, Central, and Eastern Europe
- Asia - Asia-Pacific excluding Japan
- Japan
- Other, or ROW - Those geographical areas not elsewhere classified

Distribution Channel Focus

The following distribution channel categories are used in this report:

- Direct - Sales made by company personnel to customers who apply the products, such as original equipment manufacturers (OEMs).
- Manufacturer Representatives (Reps) - Sales made by independent representatives to customers who apply the products, such as OEMs.
- Distributors - Sales to regional and global distributors, who may or may not also offer support or design assistance to bolster their sales participation. These distributors typically sell to lower-volume purchasers.

Sales made through e-commerce can be directed to any one of the above distribution channels. For that reason e-commerce will be noted separately and not as an independent distribution channel category.

METHODOLOGY

In order to develop market data, forecasts, and insights for this report, VDC employed the following research methodology.

Primary Research

- Original Equipment Manufacturer (OEM) Interviews - VDC conducted interviews with power supply IC specifiers, design engineers, and engineering managers at OEMs to understand the needs and preferences of this customer group. Representative industries and applications covered in the OEM interviews included: military and commercial power supplies (AC/DC, DC/DC, and UPS); portable and desktop computers; computer peripherals; data communication/networking equipment; fixed and portable telecommunication equipment; automotive electronics; medical and scientific equipment; test equipment; military/aerospace equipment; consumer electronics; industrial electronic equipment; and other portable electronics.
- Interviews with power supply and power management IC Manufacturers - VDC's research staff conducted in-depth phone interviews with employees of the world's manufacturers of power supply and power management ICs. Titles of those interviewed included Product Marketing Manager, Director of Marketing, Vice President of Product Development, Vice President of Marketing, President, and Chief Executive Officer. A detailed questionnaire, developed by VDC, served as the basis for these interviews.
- Microprocessor Manufacturer Interviews - VDC conducted interviews with Power Supply Engineers, Market Applications Specialists, and Engineering Managers at several leading microprocessor manufacturers. These interviews discussed power management strategies, standards and initiatives, and changing microprocessor power supply requirements and the effect on power supply and power management ICs.
- Battery Manufacturer Interviews - Applications Engineers, Marketing Managers, Product Managers, and Vice Presidents of rechargeable battery vendors were interviewed by VDC's research staff. Discussions included charging and protection strategies, changes in battery chemistries, strategies to support smart batteries, and the effects of standards such as SMBus.

Secondary Research

In addition to the extensive primary research, VDC also used secondary research to develop and cross-check our findings, including:

- Manufacturer Financial Information - annual reports, 10-K and 10-Q statements, and financial press releases;
- Manufacturer Product Information - catalogs, data books, application notes, sales literature, product press releases;

-
-
- Trade Press - including magazine articles on new products, applications, and trends; and
 - Publications of Standards and Initiatives - including voltage regulator module (VRM) specifications, Advanced Configuration and Power Management Interface (ACPI), Smart Battery System (SBS), and other guidelines and initiatives.

***III OEM TREND & TECHNOLOGY
OVERVIEW***

INDUSTRY AND PRODUCT OVERVIEW

As a whole, the semiconductor industry is facing unprecedented changes. Three simultaneous factors are changing the landscape on how vendors and OEMS do business. First, the days of double-digit market growth are behind us. Single-digit long-term growth is the best that can be expected. Second, manufacturing investments have and continue to stagger for most companies. Thirdly, many technologies have matured.

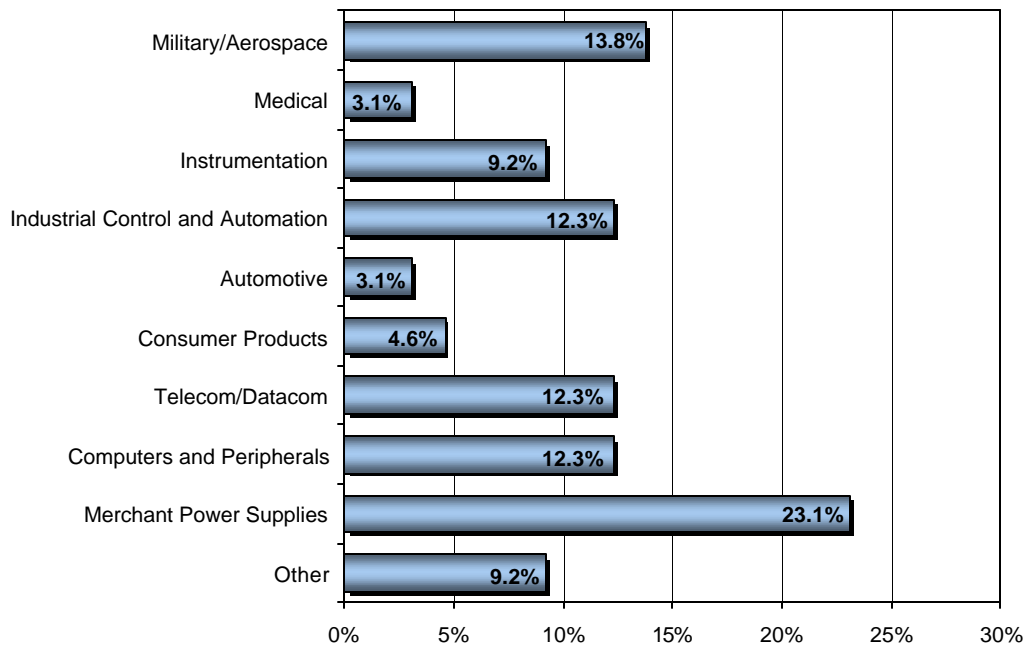
The results of these factors have led many of the smaller players on the sidelines when it comes to technology investments. This has resulted in industry-wide layoffs, liquidations, consolidations and partnerships. In addition, many companies have or will be moving manufacturing to offshore locations where labor is cheaper.

The following lists a few examples from the past two years:

- Sipex Completes Transfer of Billerica Test Operations to Malaysia
- Semtech Announces Strategic Partnership with Samsung
- On Semiconductor Opens Second Wafer Fab in Slovakia
- IBM and Intersil Announce Foundry Service Agreement
- Infineon Expands China Operations
- International Rectifier and SANYO form Joint Venture.
- Fairchild Semiconductor closes several production lines and cuts about 1,000 jobs.
- Infineon and Chartered strike power IC foundry deal.
- Toshiba and Fujitsu form alliance.
- Intersil and Elantac merge.

This section gives an overview (Chapter 4 is specific to each vertical market) from the OEM perspective on the importance of each product selection criteria for each type of power IC. Information was gathered through a comprehensive Web-based survey and through targeted interviews. Exhibit III-1 reveals the overall distribution of survey respondents by principal industry served.

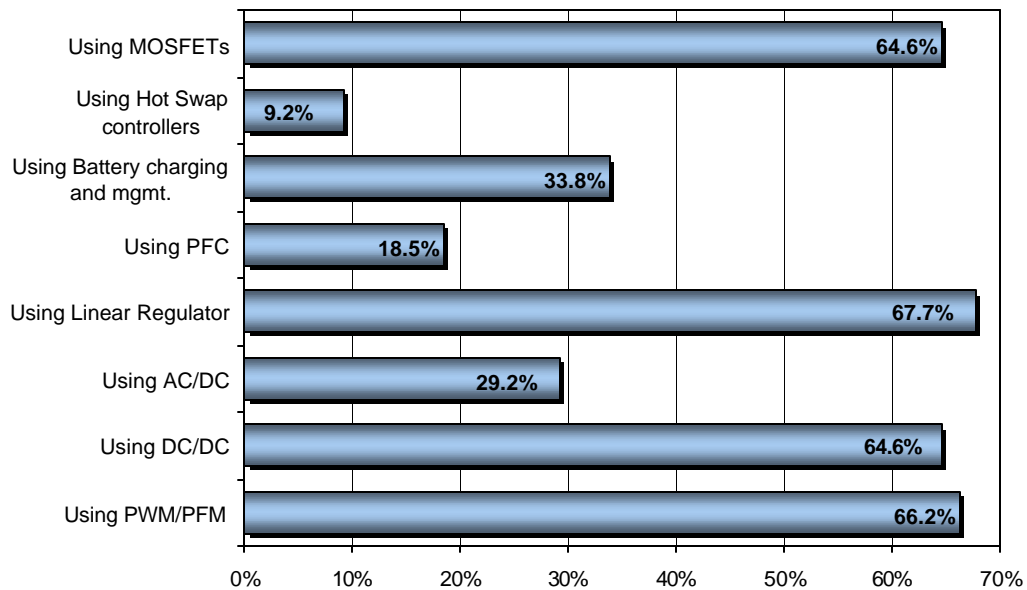
Exhibit III-1
Survey Respondent Distribution by Principal Industry Served
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

Exhibit III-2 shows the percent of respondents by each type of power IC

Exhibit III-2
Survey Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

PRODUCT DEVELOPMENT AND TRENDS

A few key trends and product developments have taken place as some companies focus on Research and Development during this economic downtime:

- Vendors are realizing the importance of OEMs having second source availability for identical or pin-for-pin replacements. Although vendors tend to develop proprietary ICs that are potentially more lucrative, much of the market demands more standard parts with multiple sources. Shared Licensing agreements facilitate second source relationships. A recent example includes Artesyn and Astec reaching a second source licensing agreement with Texas Instruments to standardize leading technology for high-performance power converters, ensuring interoperability and customer design flexibility.
- OEMs in the consumer market are demanding smaller, less power-hungry MOSFETS for power management in cell phones, PDAs, portable music players, GPS receivers etc. Companies such as Fairchild have introduced parts with a greater steady state current, reduced switching loss in packaging that uses 60% less board space.
- Next-generation communication, automotive, 48v-distributed and battery-powered systems will benefit from cost-effective, non-isolated bias buck regulators. National Semiconductor adopts a simple inductor filter and a couple of external components to deliver a smaller, more efficient way to produce bias power.
- Battery charging and Battery management ICs are making technological advances at a rapid pace. Companies such as Intersil are offering very small, advanced Li-ion/Li-polymer in a 3x3 package. Thermal efficiency with full current and voltage protection are offered. Vendors focusing on smart batteries are predicted to offer the greatest feature enhancements.

Is Silicon Germanium a Trend in Power ICs ?

Silicon Germanium technology has been used primarily in the power amplifier space. Some vendors have been asking whether a trend exists to move this to the PSIC world. The response from OEMs has been muted at best.

- The most likely power IC to utilize SiGe technology is the DC/DC converter. The DC/DC converter may realize higher efficiencies when manufactured with a modified SiGe process.
- Some OEMs have heard of SiGe but none were actively pursuing a purchasing or design path utilizing SiGe.
- The biggest concern on the part of OEMs has been availability and supply. Right now there are many players producing with the standard silicon process. Switching to SiGe is viewed as risky.
- Some OEMs may be willing to weigh the risk of a new process in exchange for cost savings, size reduction and increased efficiency.

OEM EMERGING FEATURES, FUNCTIONS AND APPLICATIONS

Emerging Features and Functions

Required features are highly specific to individual applications and end uses. This creates a marketplace that is highly segmented, making it difficult for large suppliers to broadly reach every application but make it relatively easy for small suppliers to quickly develop a market niche unto themselves.

Exhibits III-3 through III-10 shows the overall product selection criteria for respondents using each type of power IC. OEMs clearly place cost, efficiencies and voltage requirements very high on the list. As stated earlier, products have matured and vendors who differentiate themselves through creative feature enhancements stand to gain market share.

Exhibit III-3
Overall Product Selection Criteria for Respondents Using PWM/PFM
(Mean Rating)

1=Not Important, 5=Very Important

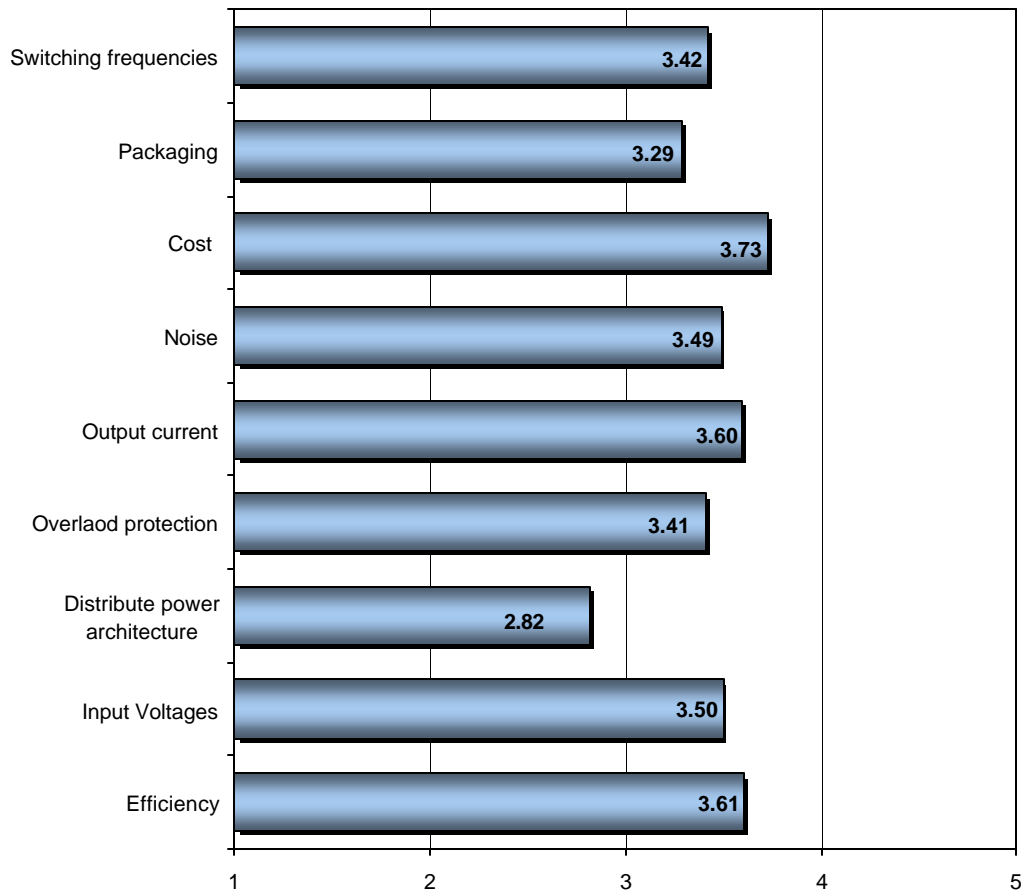


Exhibit III-4
 Overall Product Selection Criteria for Respondents Using DC/DC Regulators
 (Mean Rating)

1=Not Important, 5=Very Important

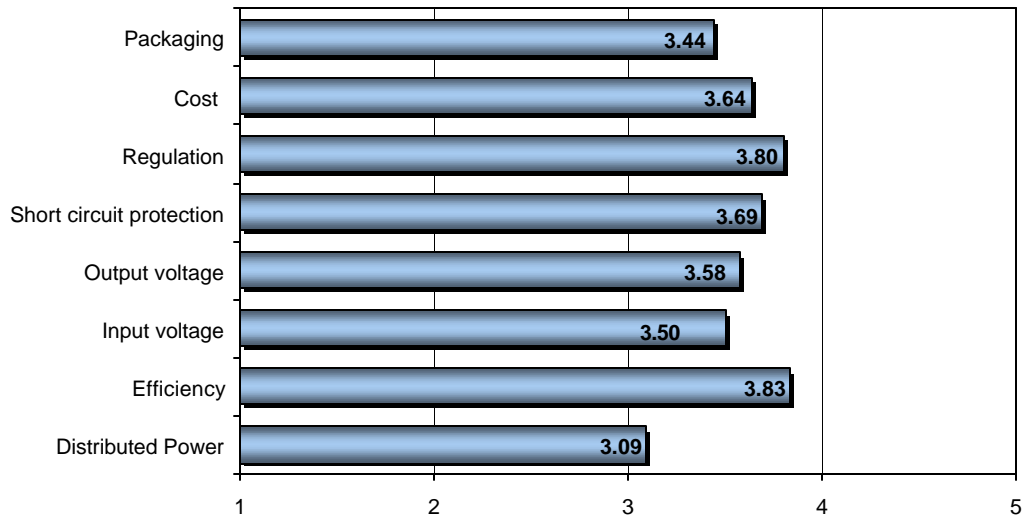


Exhibit III-5
 Overall Product Selection Criteria for Respondents Using AC/DC Off Line Regulators
 (Mean Rating)

1=Not Important, 5=Very Important

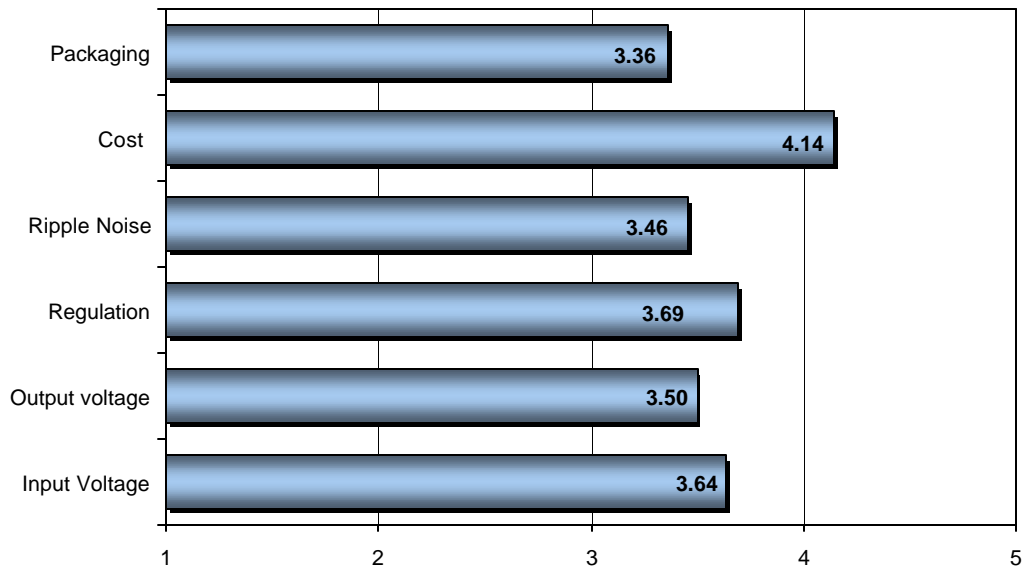


Exhibit III-6
 Overall Product Selection Criteria for Respondents Using Linear Regulators
 (Mean Rating)

1=Not Important, 5=Very Important

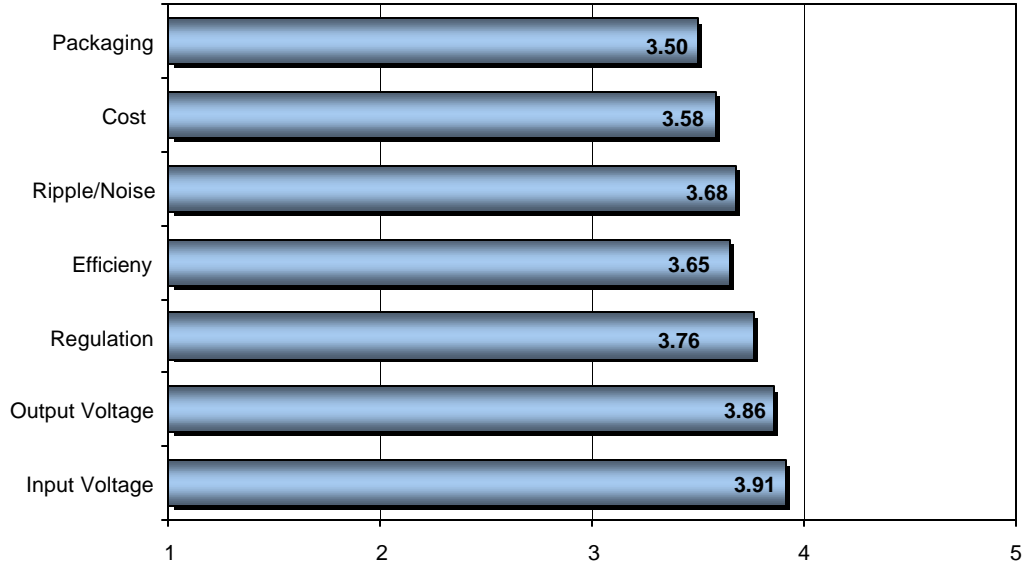


Exhibit III-7
 Overall Product Selection Criteria for Respondents Using PFC Controllers
 (Mean Rating)

1=Not Important, 5=Very Important

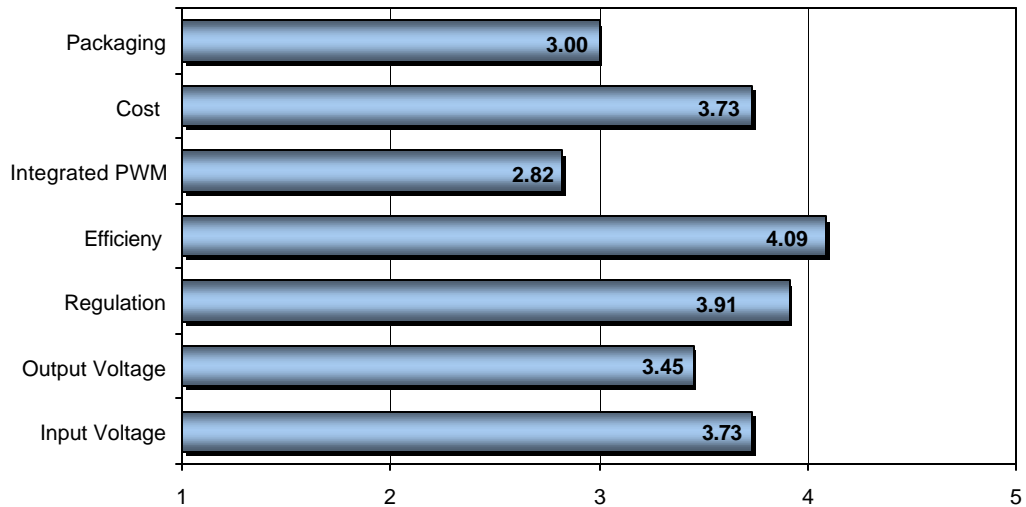


Exhibit III-8
 Overall Product Selection Criteria for Respondents Using Battery Charging and Management IC's
 (Mean Rating)

1=Not Important, 5=Very Important

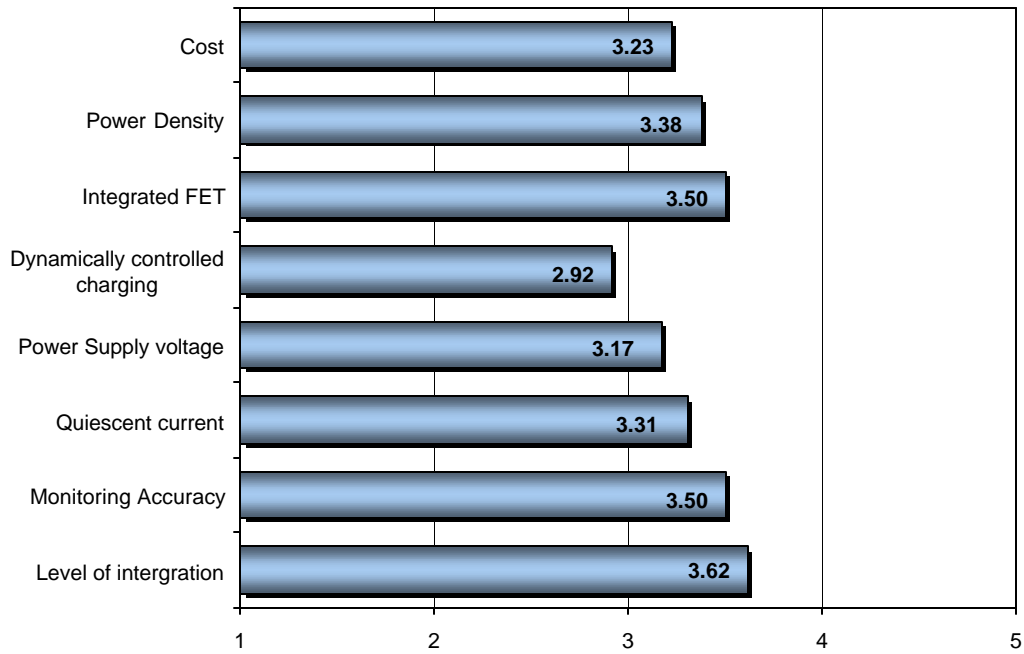


Exhibit III-9
 Overall Product Selection Criteria for Respondents Using Hot Swap Controllers
 (Mean Rating)

1=Not Important, 5=Very Important

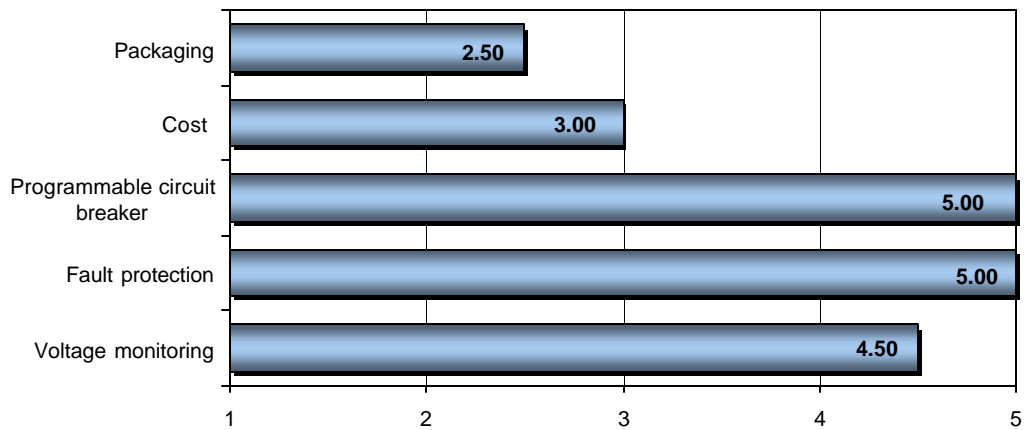
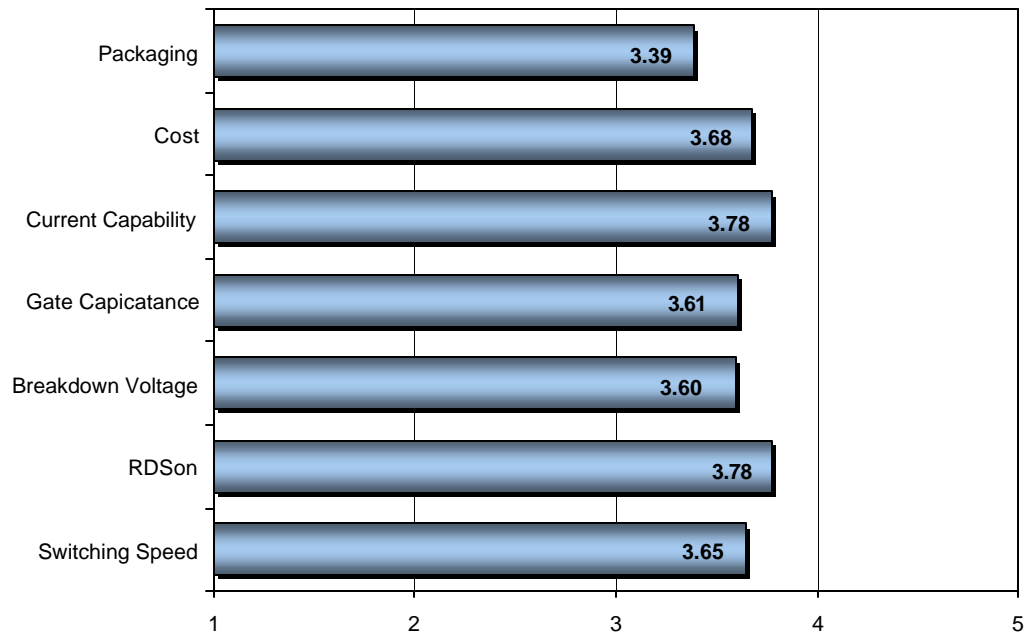


Exhibit III-10
Overall Product Selection Criteria for Respondents Using MOSFETS
(Mean Rating)

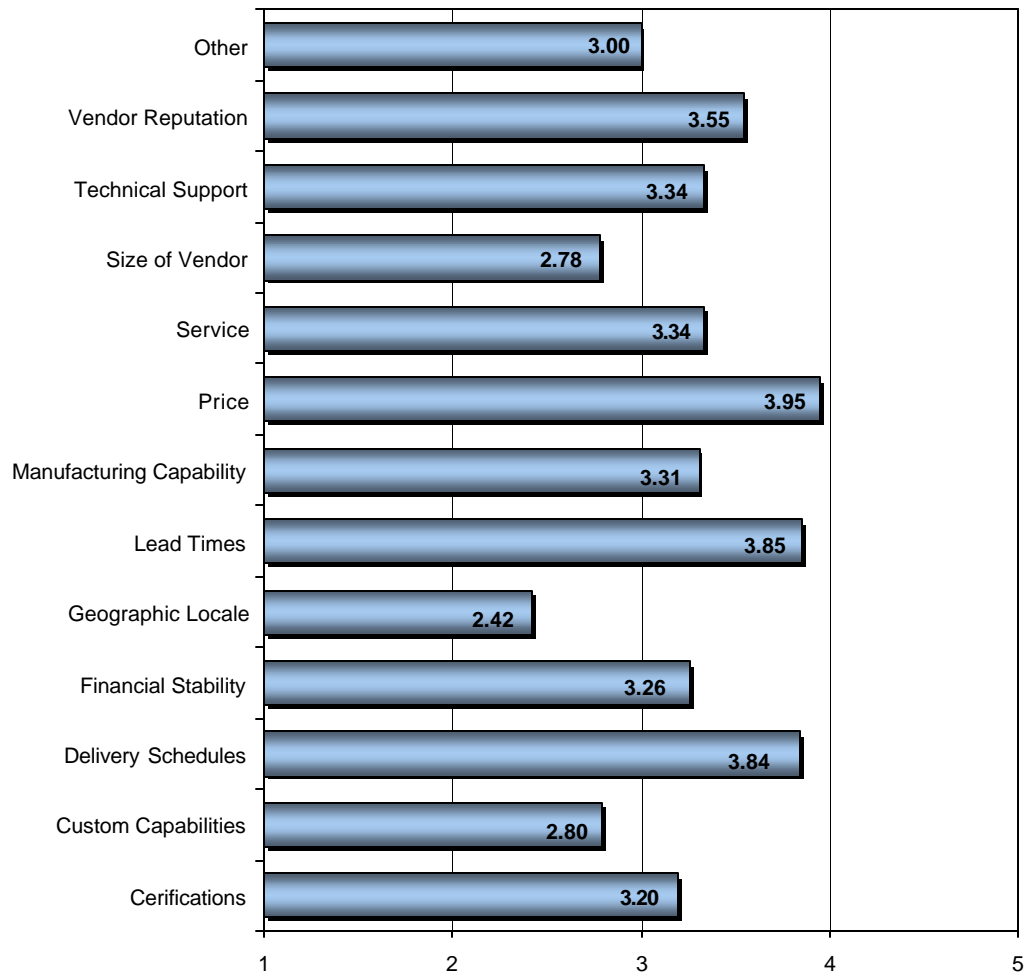
1=Not Important, 5=Very Important



In the most general sense there is strong price sensitivity on the part of OEMs. In many cases, particularly for standard applications, OEMs will choose price over all other criteria (see Exhibit III-11). Of course there are still vertical markets and applications that defy this overall trend, as discussed in Chapter 4.

Exhibit III-11
Overall Non-Product Selection Criteria for All Respondents
(Mean Rating)

1=Not Important, 5=Very Important



As a result of the OEM interviews and Web-based survey, the following list includes emerging feature demands by the OEMs:

- Packaging which allows for more functionality and power dissipation in smaller packages.
- Sophisticated drive schemes to power white LEDs
- Advances in trench processes have pushed $R_{DS(on)}$ to new lows
- Need for high-voltage MOSFETS aimed at automotive switching applications
- Boost in alternator output in the automotive industry from power conversion devices.
- Start-up sequencing of multiple converters to meet system requirements.

- Programmable output switching regulators
- Tighter specifications for fuel gauging and battery charging.
- Lower quiescent currents

Emerging Applications

Within each vertical market there are a number of individual applications with promising potential in the near future:

In the Merchant power supply market, point of load DC converters are solving the problem of voltage proliferation at higher current levels.

- In the Consumer products market, mobile handsets, digital cameras and gaming consoles are consuming large quantities of power ICs.
- In the Telecom/Datacom space, a variety of power ICs are being demanded by wireless LAN OEMs as they continue to see increased demand.
- Geo-political circumstances have fueled an increasing demand in the military/aerospace market, particularly for military communications.
- Within the Computers and Peripherals market, battery management ICs are being challenged to meet stricter power requirements. In addition, wearable computing is emerging as a growth-oriented application for the mid-term.

VENDOR PERCEPTION

OEMs quite often are aware of many vendors but obviously prefer certain vendors to others, based on a variety of reasons. Exhibit III-12 is a ranking of vendor awareness and vendor preference for PSIC vendors among OEMs surveyed.

Exhibit III-12 Awareness of and Preference for PSIC Vendors Among Surveyed OEMs (Ranked by # of Responses by Surveyed OEMs)		
<u>Awareness of Vendors</u>	<u>Rank</u>	<u>Preference for Vendors</u>
Texas Instruments	1	Texas Instruments
Linear Technology	2	Linear Technology
National Semiconductor	3	National Semiconductor
On Semiconductor	4	On Semiconductor
Fairchild, ST Microelectronics	5	ST Microelectronics
Maxim, Motorola	6	Motorola
Micrel	7	Micrel
International Rectifier, Unisonic Technologies	8	Fairchild
Infineon	9	Maxim
Intersil	10	Infineon

OEM and Vendor Comments

Perceptions of vendors in the marketplace by competitors and OEMs provide a measure of performance. These perceptions can point out strengths and weaknesses and provide indications of where performance might need to be improved. These perceptions are particularly illuminating when compared to a firm's own perception of its strengths and weaknesses.

The following are summary comments obtained about specific PSIC vendors:

NOTE: These are summaries of comments about the vendors by one or more people obtained during interviews. VDC is not claiming any statistical relevance of these opinions by printing them.

Fairchild

- Technology innovator
- Excellent Support

Intersil

- Strong PWM technology
- Meets high technology specs

Linear

- Pushes technology limits
- Does not obsolete products quickly
- Priced on the higher end

Maxim

- Good selection
- Sometimes long lead times

Micrel

- Functionality of ICs high
- Obsoletes products quickly

National

- Broad Product Selection

On Semi

- Strong Design Assistance
- Quality applications notes

ST Microelectronics

- Stability
- Priced on the high side

Texas Instruments

- Technology leader
- Meets high efficiency specs
- Good support

IV APPLICATIONS ANALYSIS

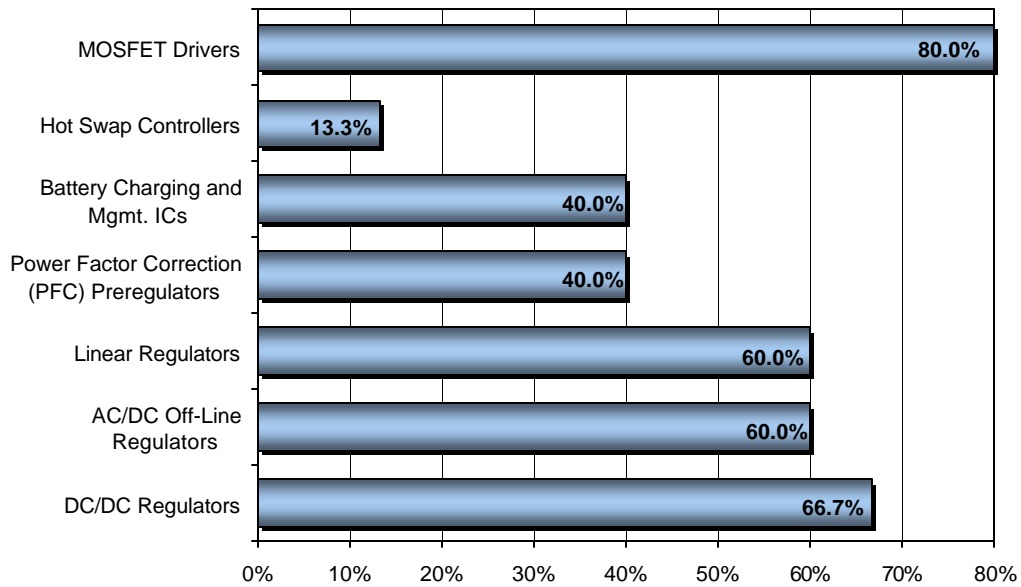
This chapter provides a detailed look at the vertical markets and specific applications within the vertical markets that use power supply and power management ICs. Information for this chapter was gathered through a comprehensive web-based survey and targeted interviews with leading OEMs from each vertical market. The vertical markets include:

- Merchant Power Supplies
- Computers and Peripherals
- Telecom/Datacom
- Consumer Products
- Automotive
- Industrial Control and Automation
- Instrumentation
- Medical
- Military/Aerospace

MERCHANT POWER SUPPLIES

Merchant power supplies use a vast majority of power ICs. Exhibit IV-1 shows the distribution of survey respondents using each type of power IC. This section will summarize the results of the survey for respondents using Merchant power supplies.

Exhibit IV -1
Merchant Power Supply Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

Still recovering from economic stagnation, overcapacity and heavily reduced demand, the merchant power supply industry has turned its attention to improved product technology, architecture, delivery, price and quality.

An increasingly competitive landscape has amplified the pressure on power IC vendors to provide lower cost, more efficient devices. Shrinking space requirements translate into cost savings, therefore higher density; smaller devices providing greater power are being required.

This is exemplified in Exhibit IV-2 through IV-8, which show cost and/or efficiency to be the most important product selection criteria by OEMs.

Exhibit IV-2
 PWM/PFM Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

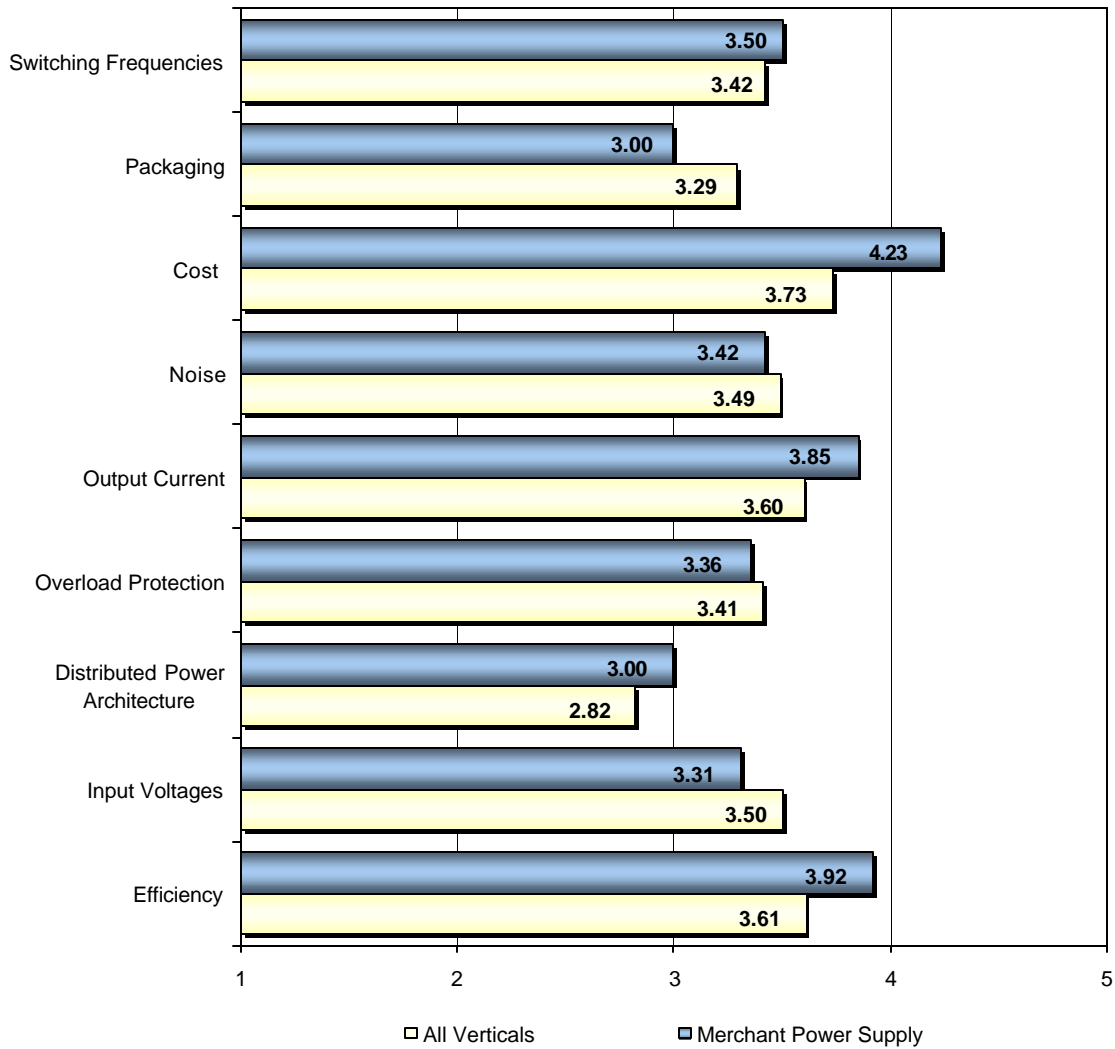


Exhibit IV -3
 DC/DC Regulator Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

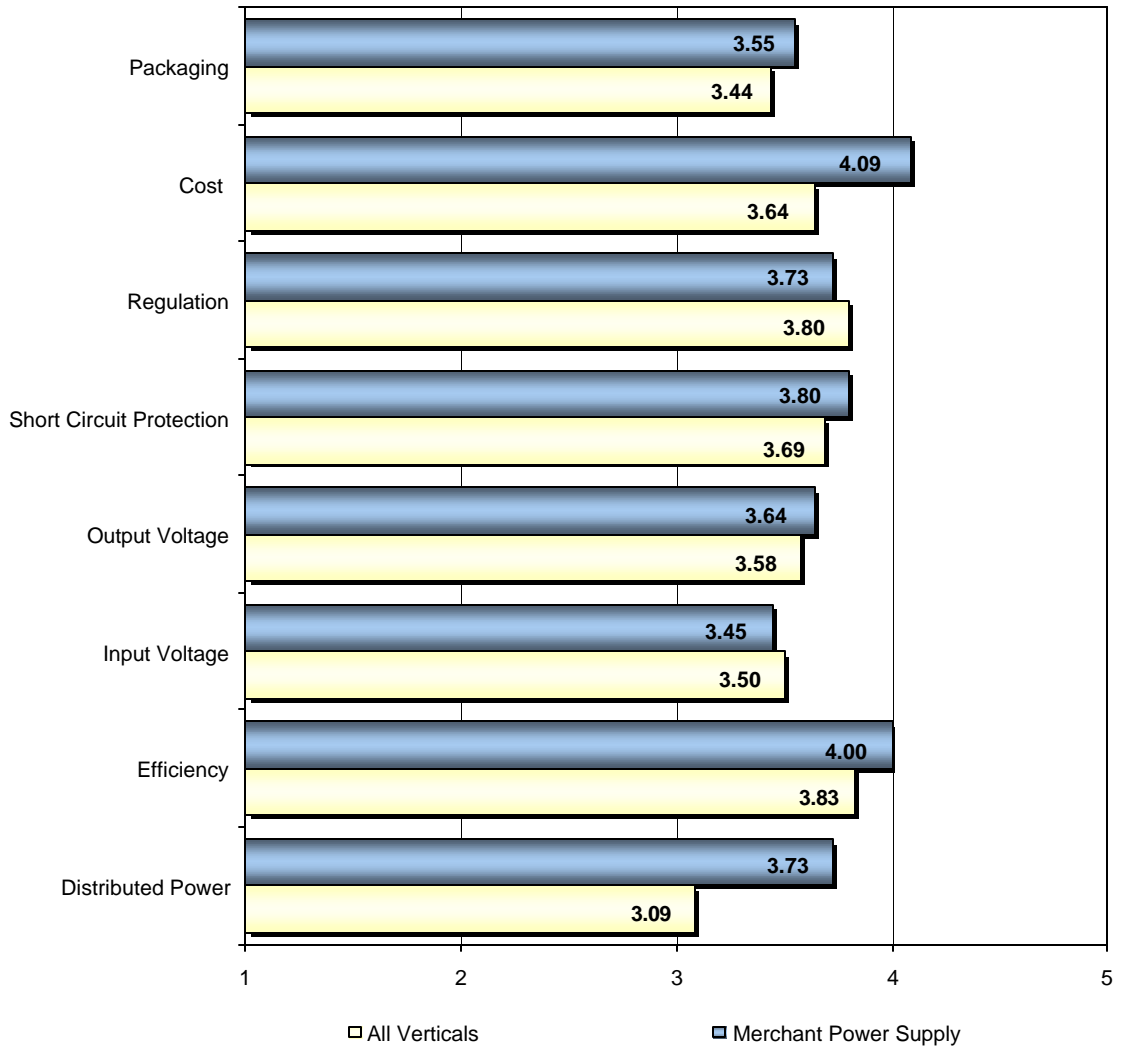


Exhibit IV -4
 AC/DC Off Line Regulators Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

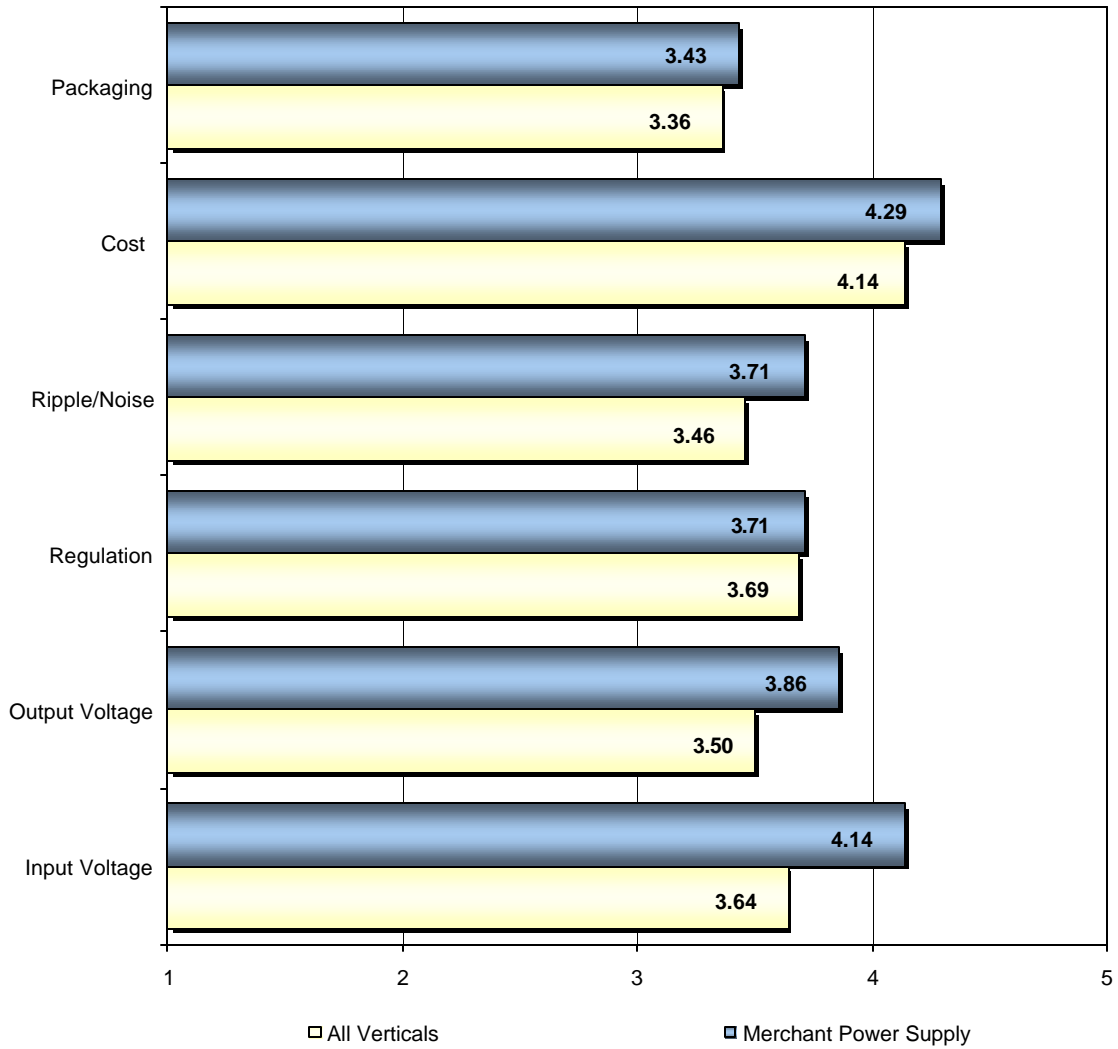


Exhibit IV -5
 Linear Regulator Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

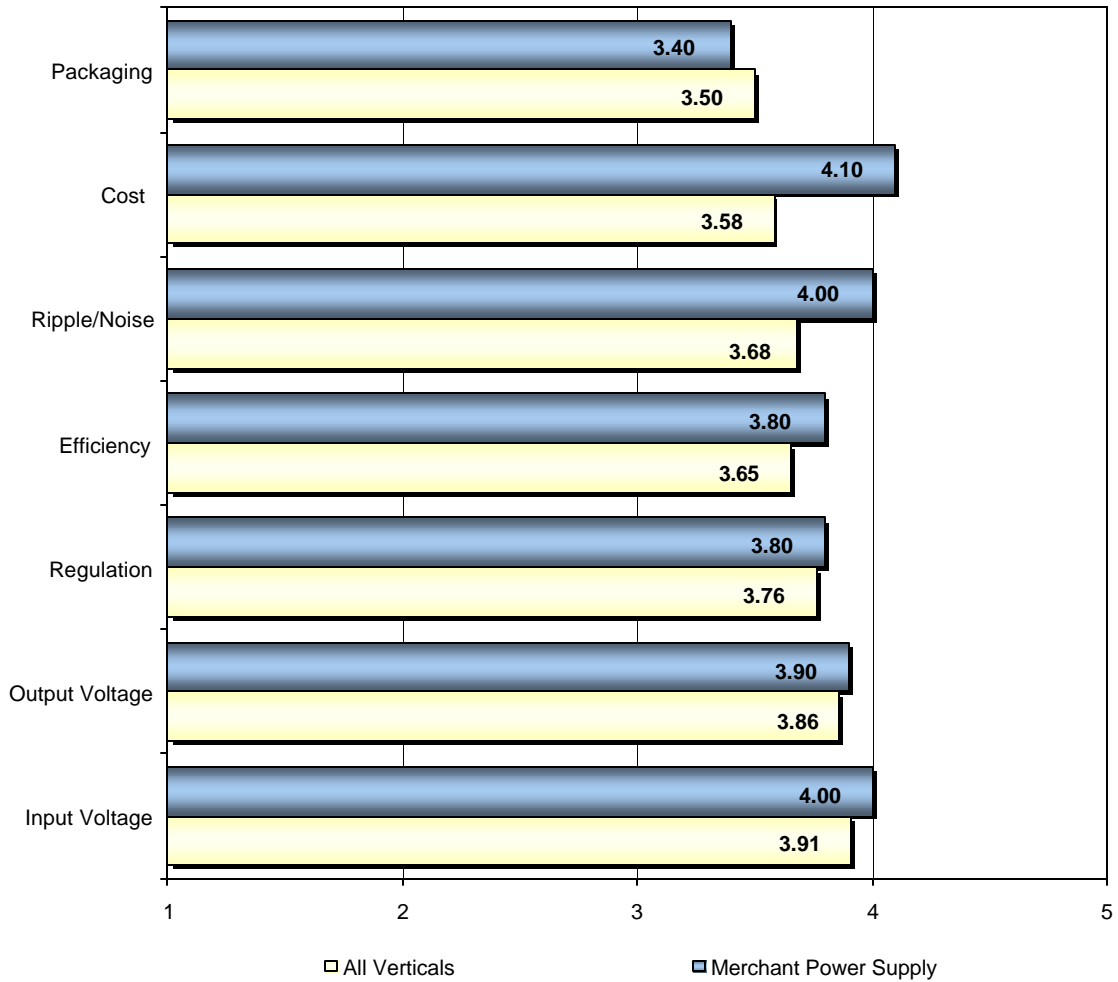


Exhibit IV-6
 PFC Controllers Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

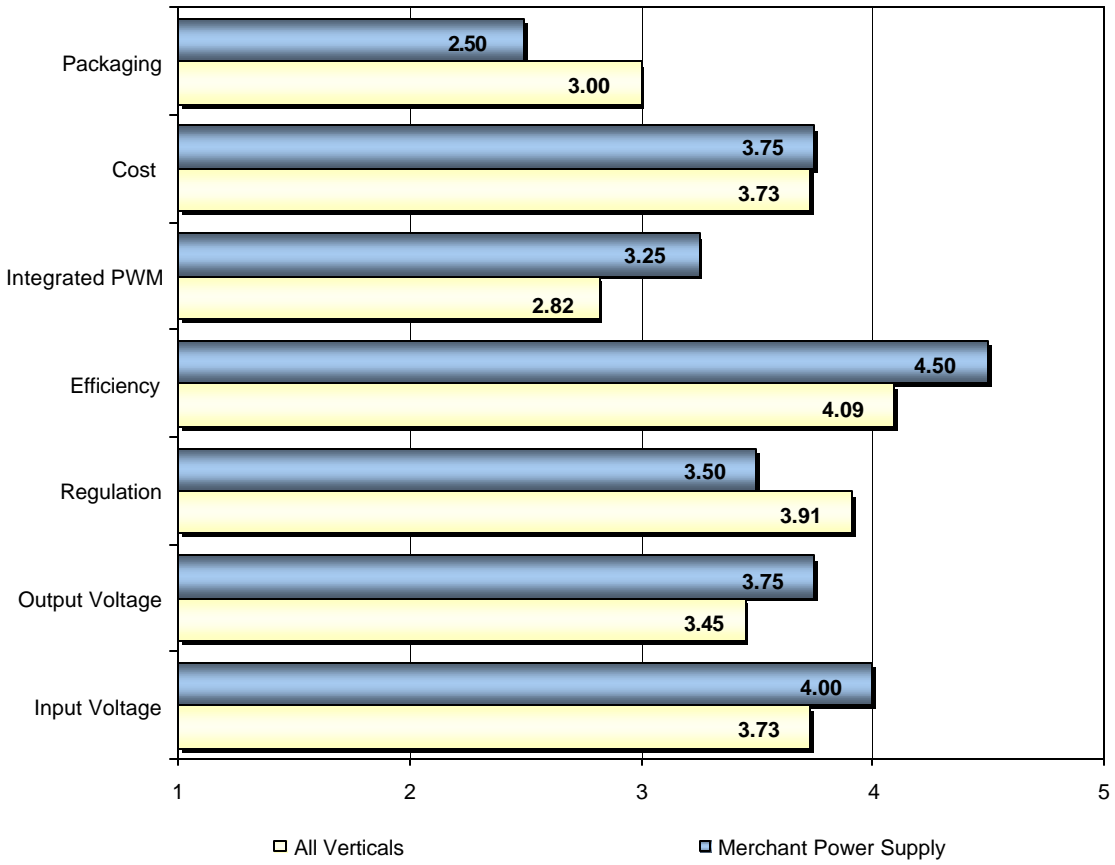


Exhibit IV -7
 Battery Charging and Management ICs Product Selection Criteria for Merchant Power Supply Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

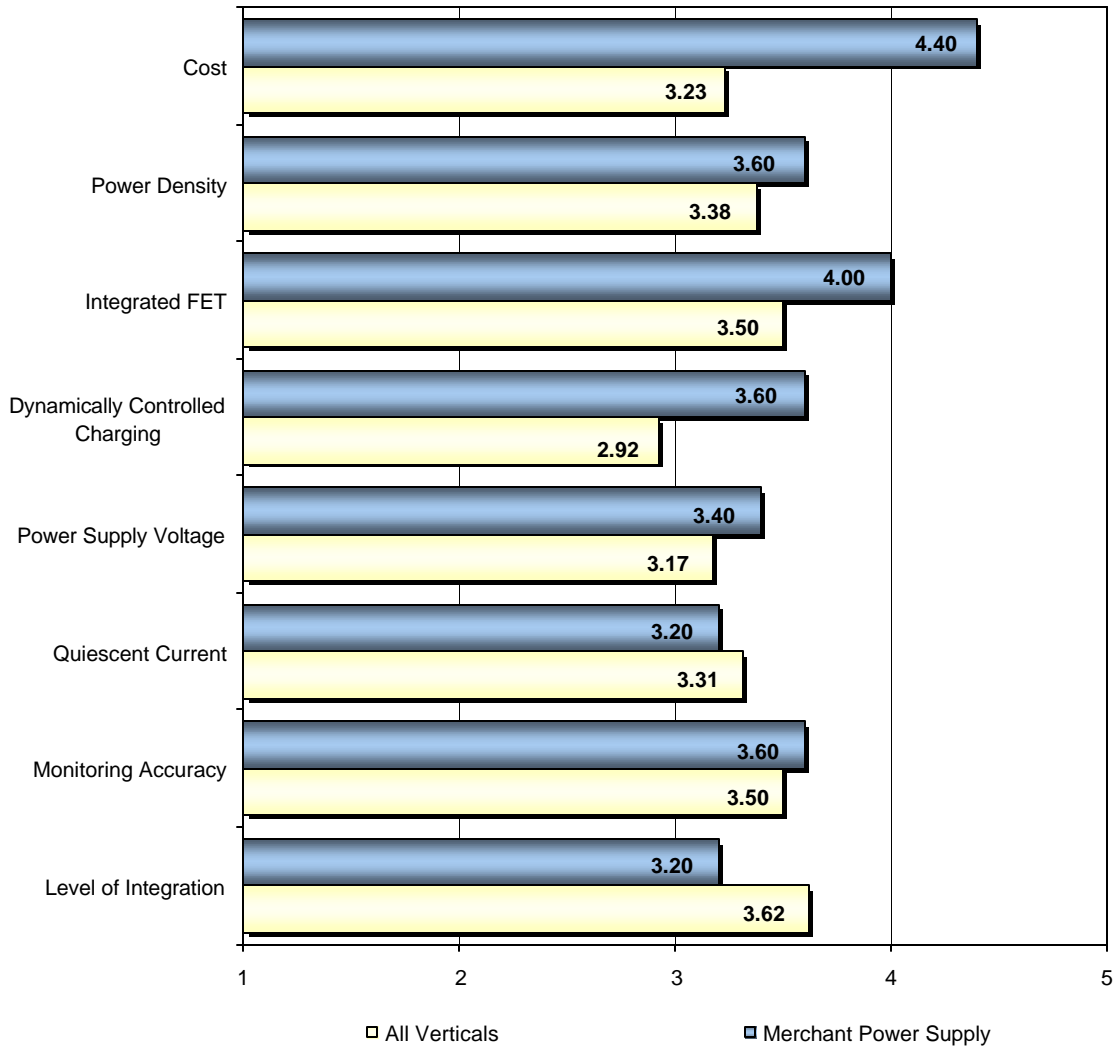
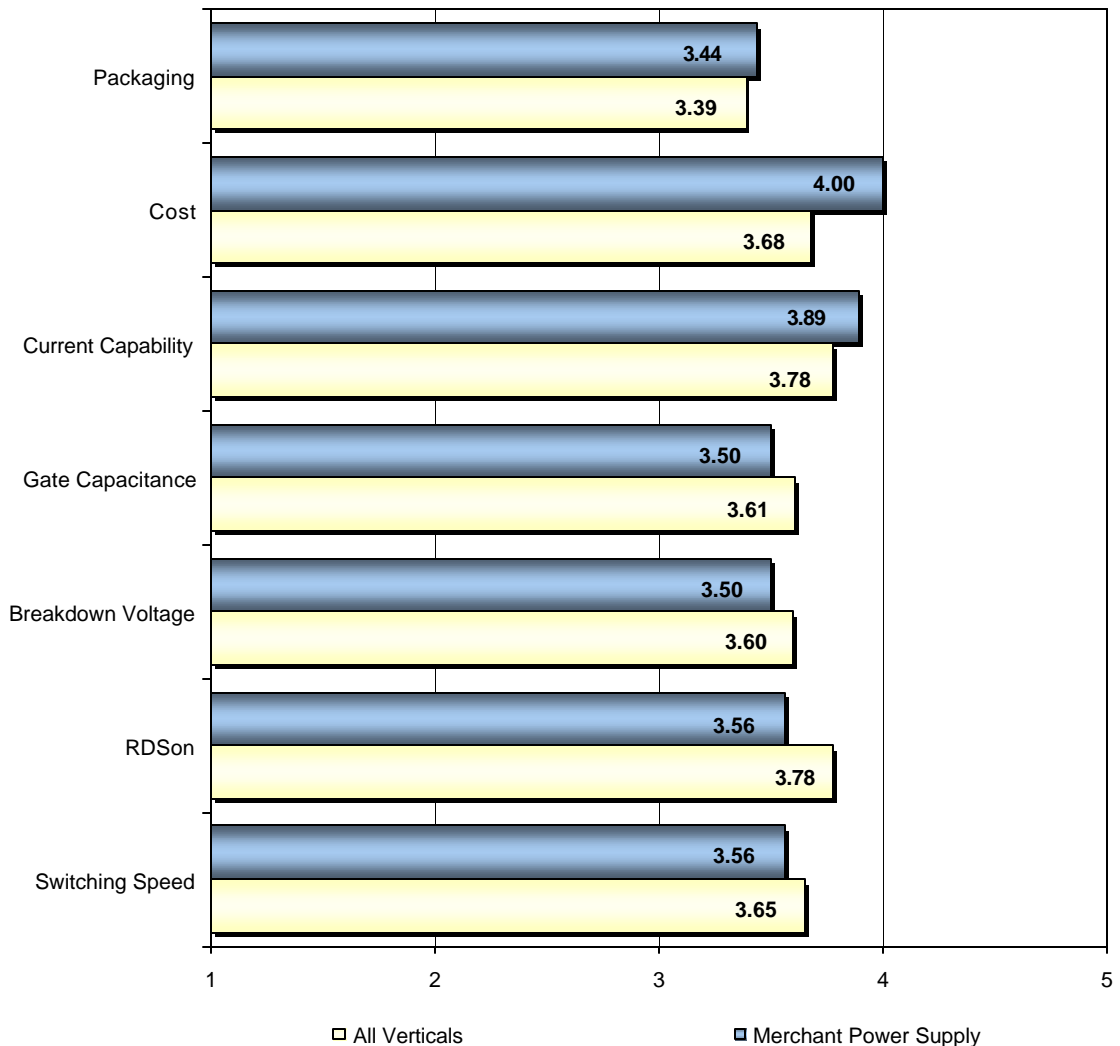


Exhibit IV -8
MOSFET Driver Product Selection Criteria for Merchant Power Supply Respondents
(Mean Rating)

1=Not Important, 5=Very Important



In general, VDC has observed the following for the overall global Merchant power supply market:

- A continuing decline in shipments through 2003, due primarily to the ongoing economic slowdown.
- Flat to slight growth expected for 2004, as excess inventory is exhausted and a slow recovery begins.
- Accelerating worldwide and North American growth in 2005 and beyond as demand from all vertical markets begins to increase.

Exhibits IV-9 through IV-15 compare the OEM future use responses between power ICs in the Merchant power supply industry to power ICs in the overall market place.

Exhibit IV-9
Use of PWMs in Merchant Power Supply Industry
(Percent of Respondents)

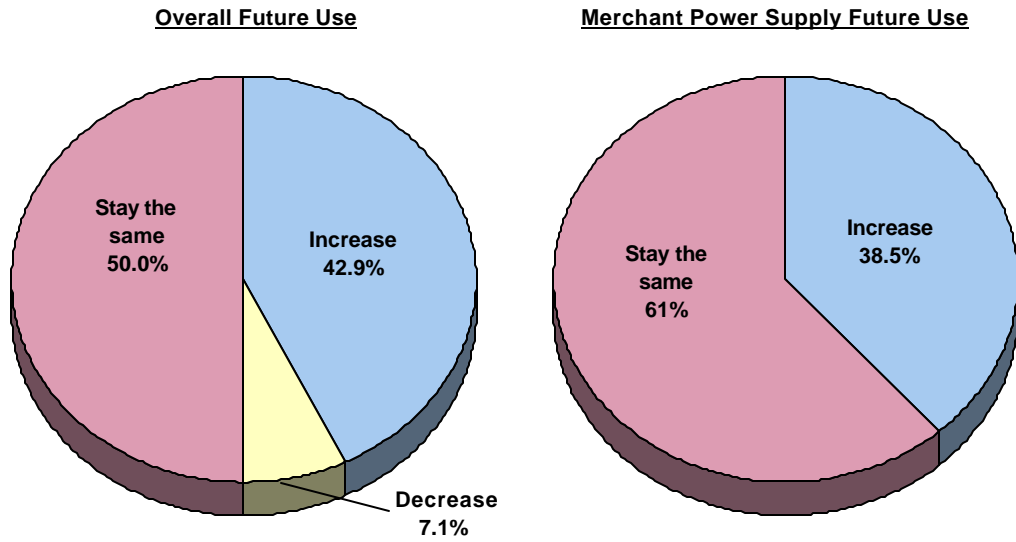


Exhibit IV -10
Use of DC/DC Regulators in Merchant Power Supply Industry
(Percent of Respondents)

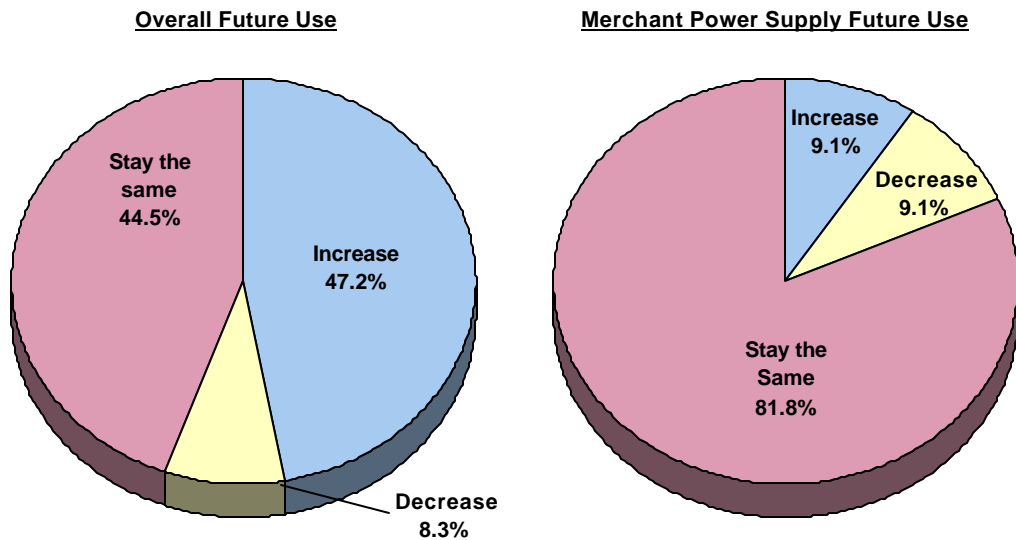
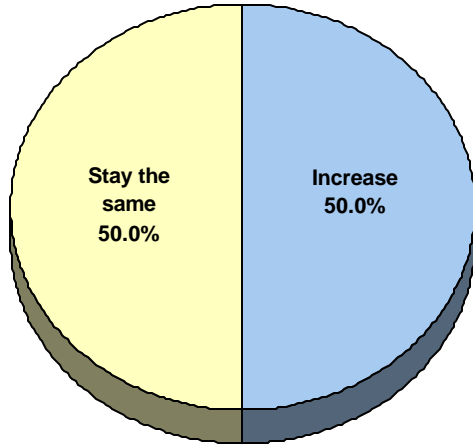


Exhibit IV - 11
Use of AC/DC Off Line Regulators in Merchant Power Supply Industry
(Percent of Respondents)

Overall Future Use



Merchant Power Supply Future Use

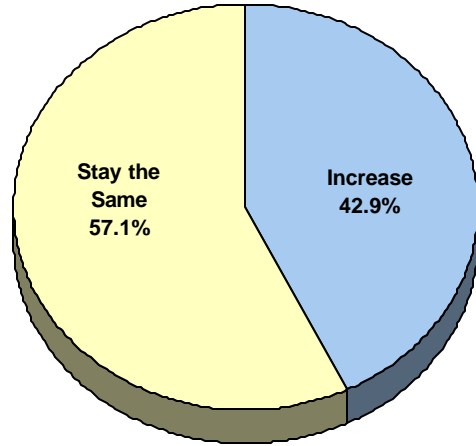
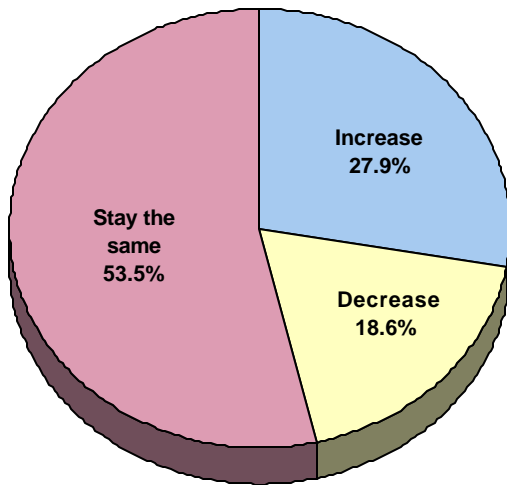


Exhibit IV - 12
Use of Linear Regulators in Merchant Power Supply Industry
(Percent of Respondents)

Overall Future Use



Merchant Power Supply Future Use

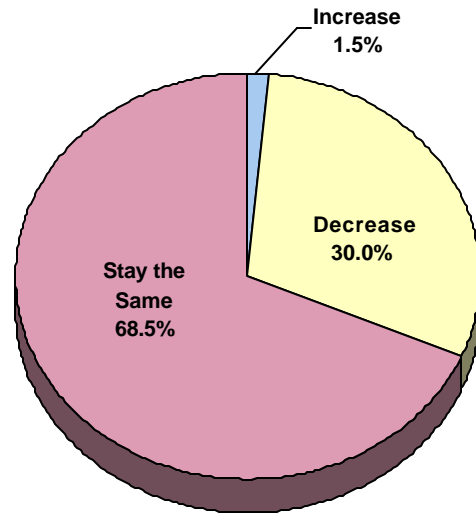


Exhibit IV -13
Use of PFC Controllers in Merchant Power Supply Industry
(Percent of Respondents)

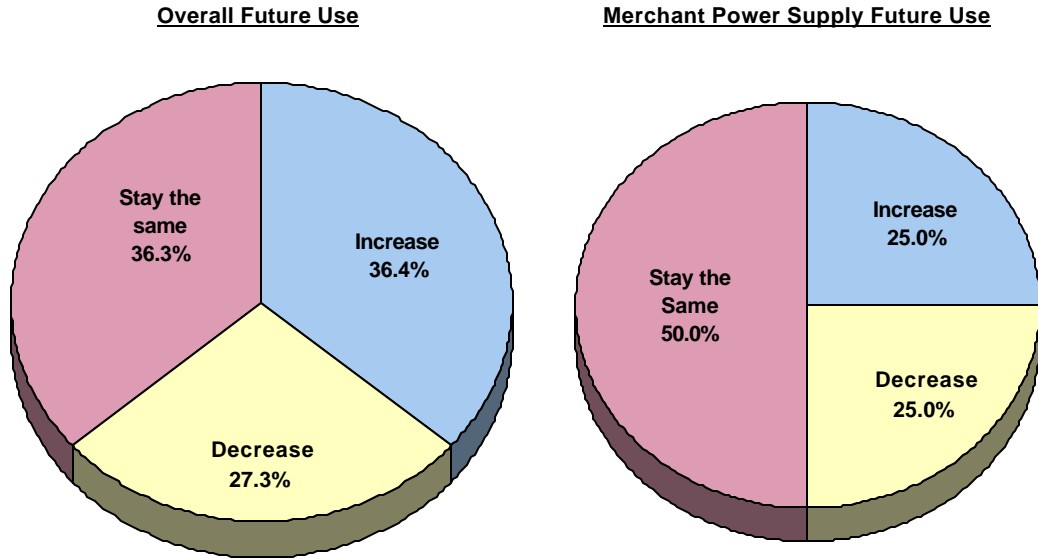


Exhibit IV -14
Use of Battery Charging and Management IC's in Merchant Power Supply Industry
(Percent of Respondents)

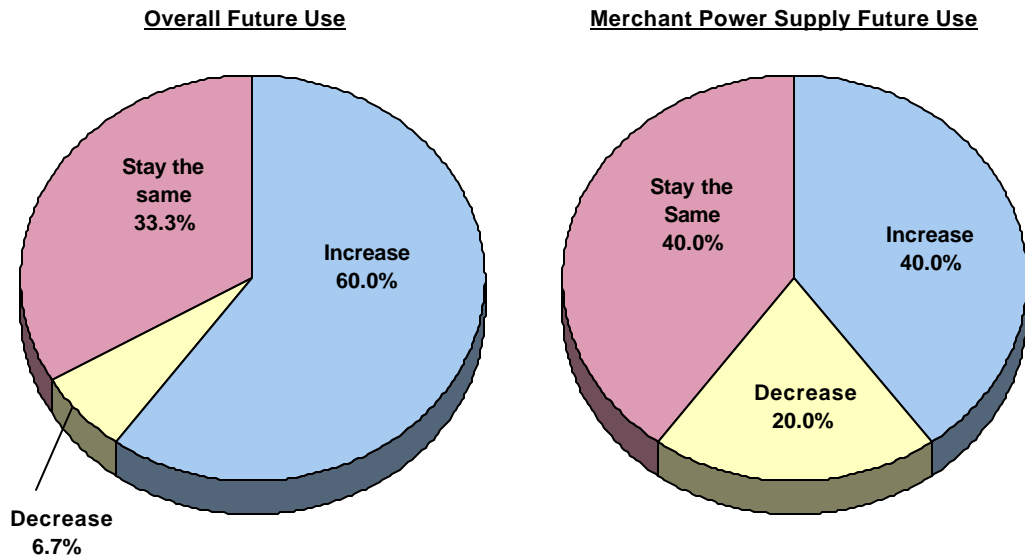
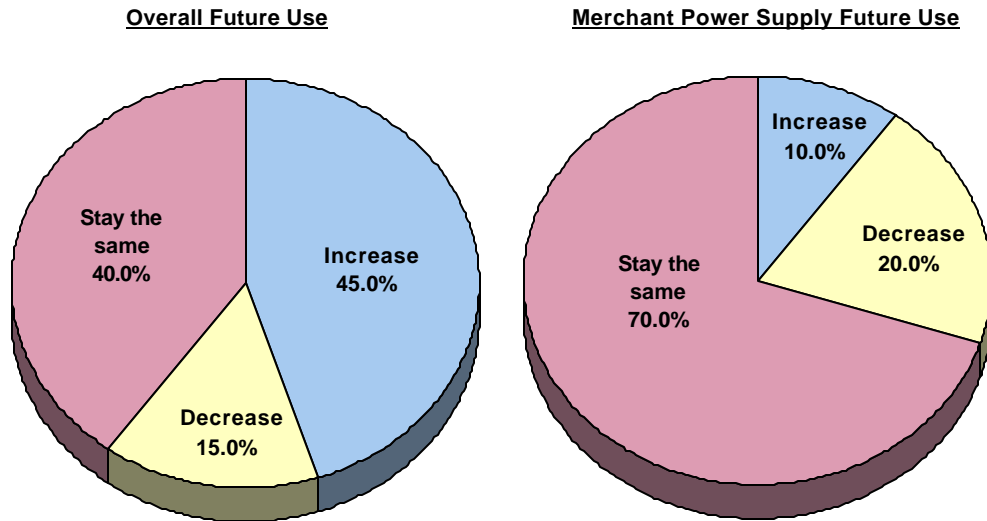


Exhibit IV -15
Use of MOSFETS in Merchant Power Supply Industry
(Percent of Respondents)

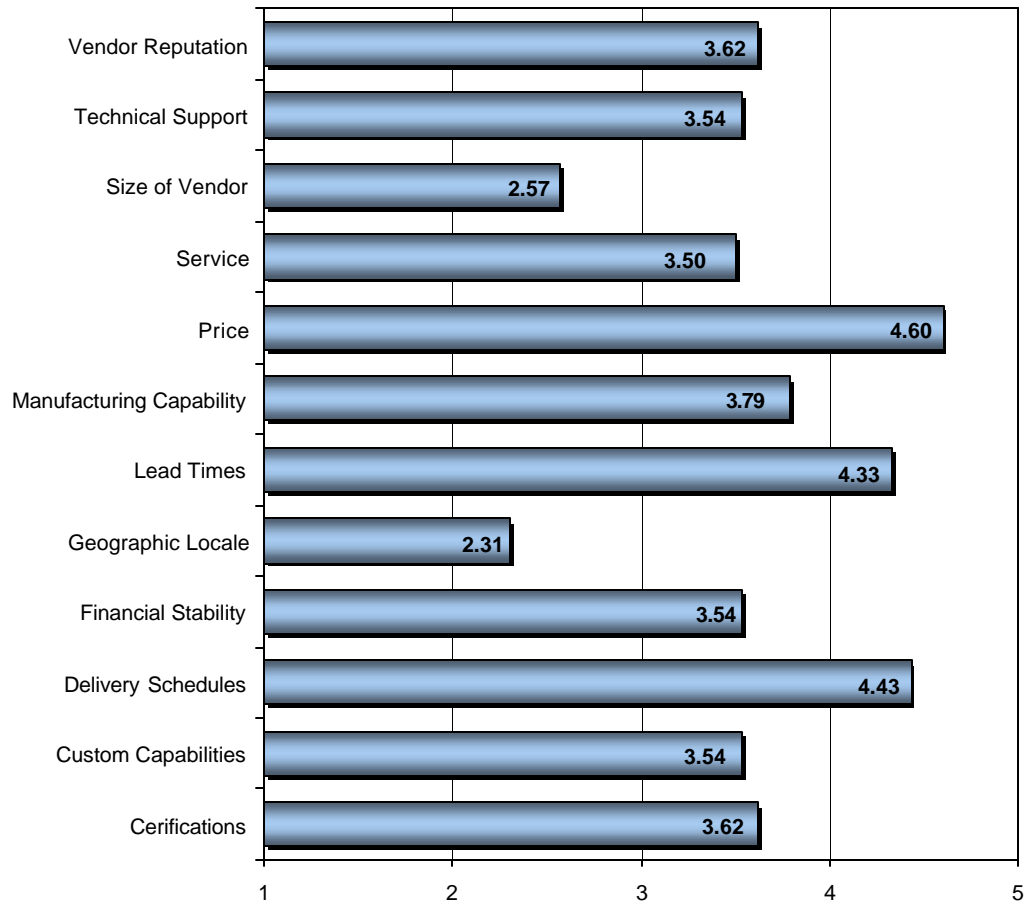


From an application perspective, the most compelling changes in the Merchant power supply industry are occurring at the distributed power level. The proliferation of different voltages at higher current levels has led to changing technologies and architectures. The distributed bus architecture is rapidly changing from the converter/brick structure to one where the voltage required for a particular load is generated from a DC bus with point of load regulation. This creates significant opportunities for the power IC vendor.

Furthermore, the vendor who can offer a lower price, combined with short lead times and prompt delivery schedules will most likely capture market share (See exhibit IV-16).

Exhibit IV -16
Non-Product Selection Criteria for Merchant Power Supply Respondents
(Mean Rating)

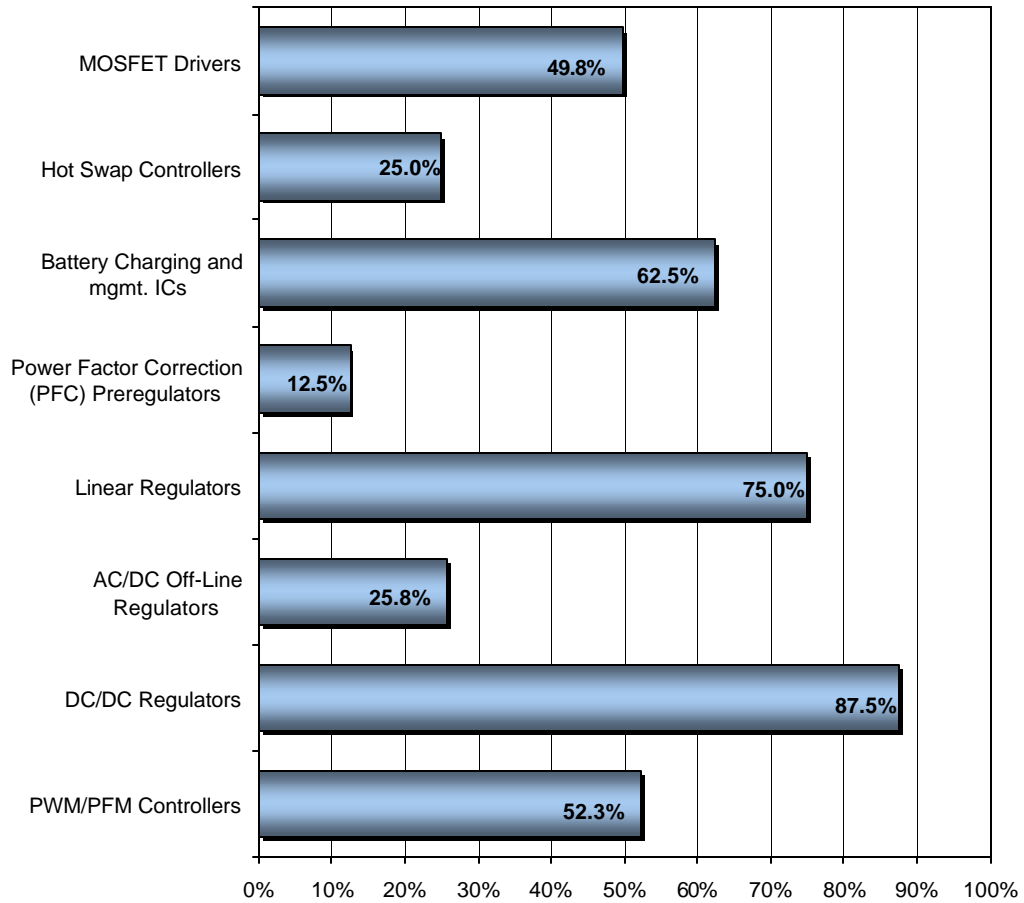
1=Not Important, 5=Very Important



COMPUTERS AND PERIPHERALS

Personal and laptop computers, servers, mainframes, workstations, printers, fax machines, copiers, etc. lead the market in cutting-edge technical innovation and product specifications. Exhibit IV-17 displays the percent of respondents using each type of power IC. Clearly this is a vertical market that touches every type of power IC.

Exhibit IV -17
Computer and Peripherals Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

With board space at a premium, the need for better performance in a smaller packaging format has led semiconductor vendors to develop a number of new solutions with reduced values of $R_{DS(on)}$, inductance, and thermal resistance. Unfortunately, each vendor has a different approach to package design, and although customers have been left with many choices, little exists in the way of standardization. Expect this situation to persist until customers and vendors get behind one or more packaging options. Exhibits IV-18 through IV-22 delineate the importance of product characteristics, such as $R_{DS(on)}$ for Mosfets, Noise for PWM/PFM controllers etc.

Exhibit IV -18
 PWM/PFM Product Selection Criteria for Computers and Peripherals Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

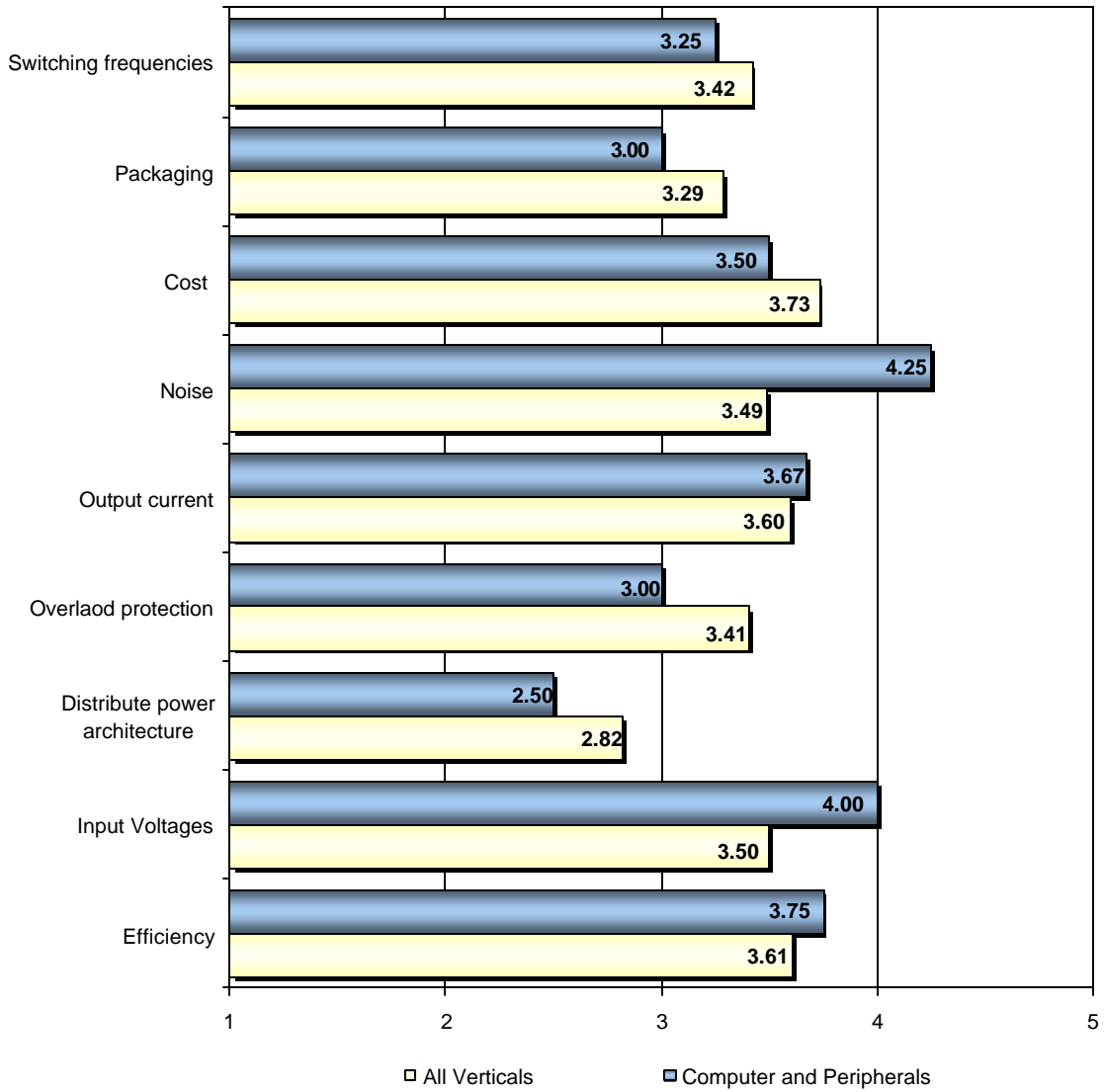


Exhibit IV -19
 DC/DC Regulators Product Selection Criteria for Computers and Peripherals Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

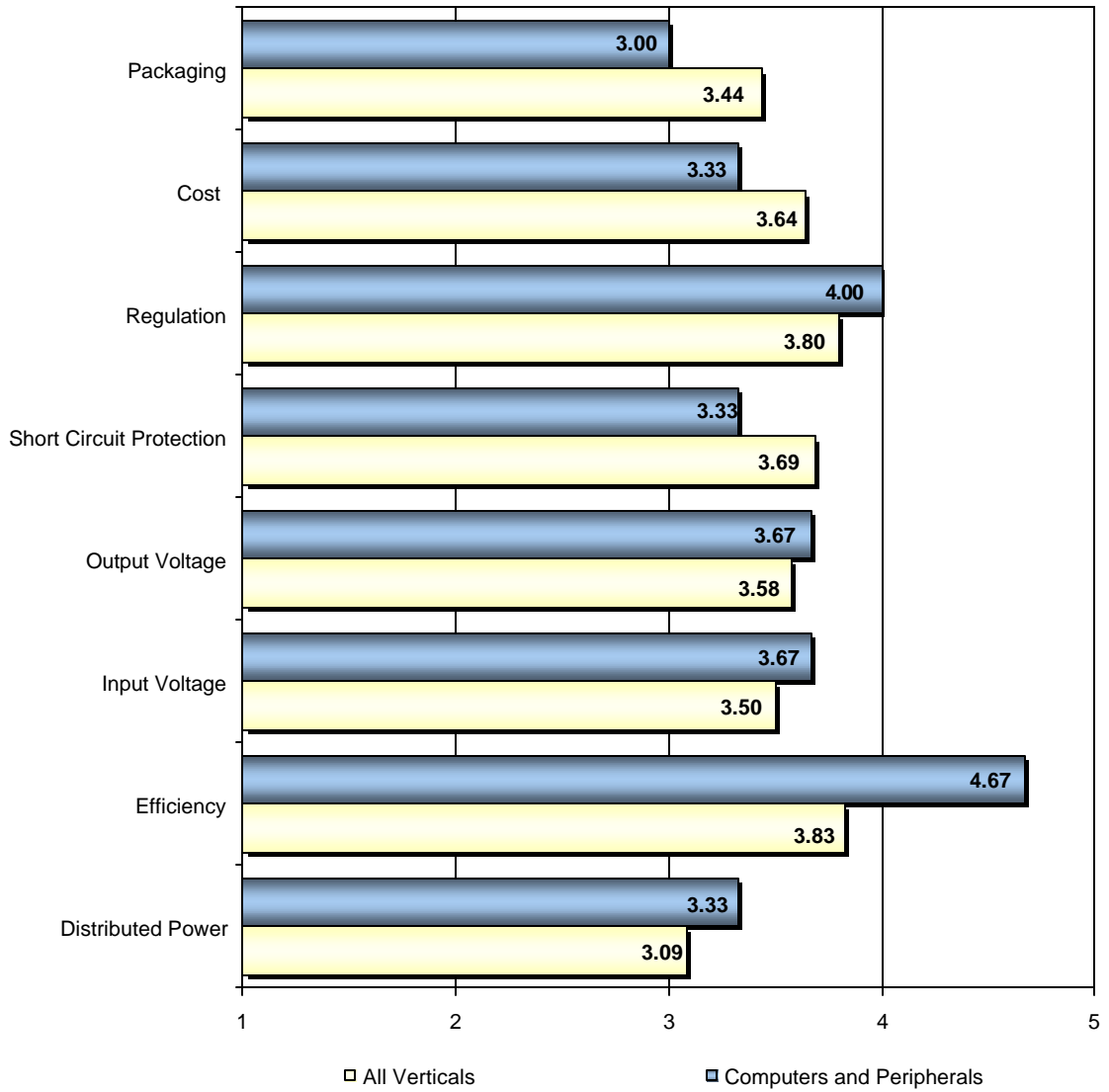


Exhibit IV -20
 Linear Regulators Product Selection Criteria for Computers and Peripherals Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

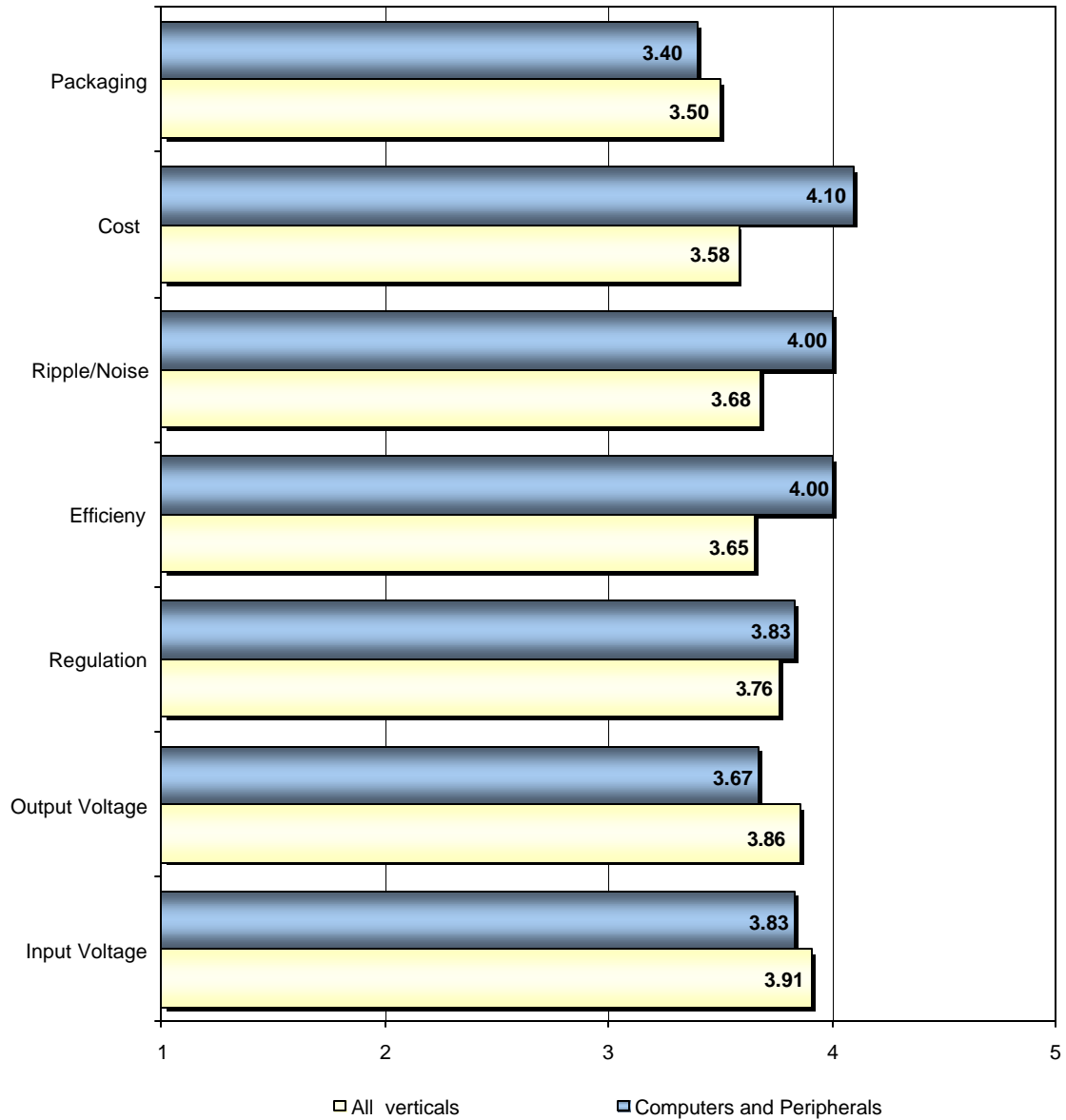


Exhibit IV -21
 Battery Charging and Management IC's Product Selection Criteria for Computers and Peripherals Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

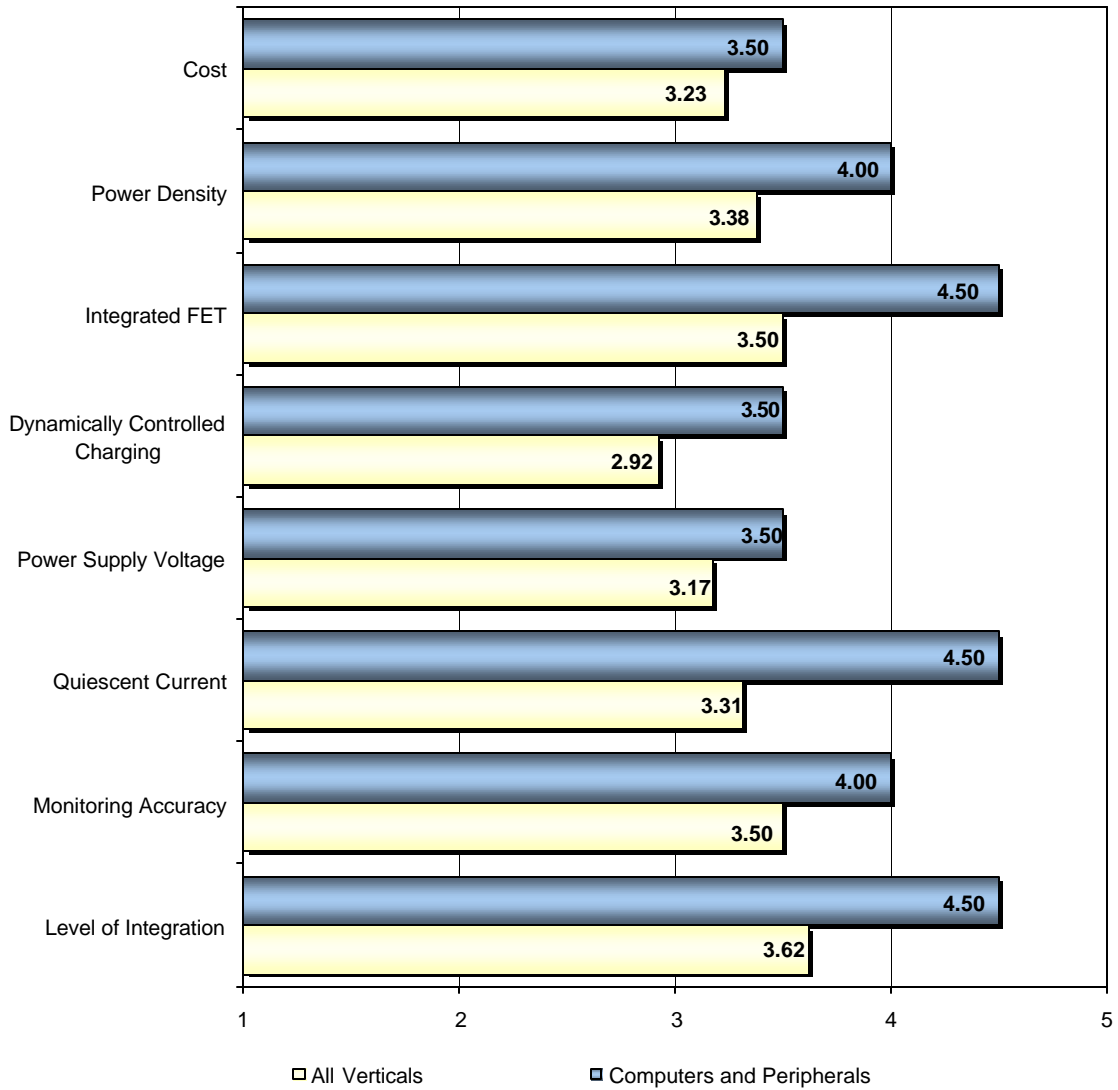
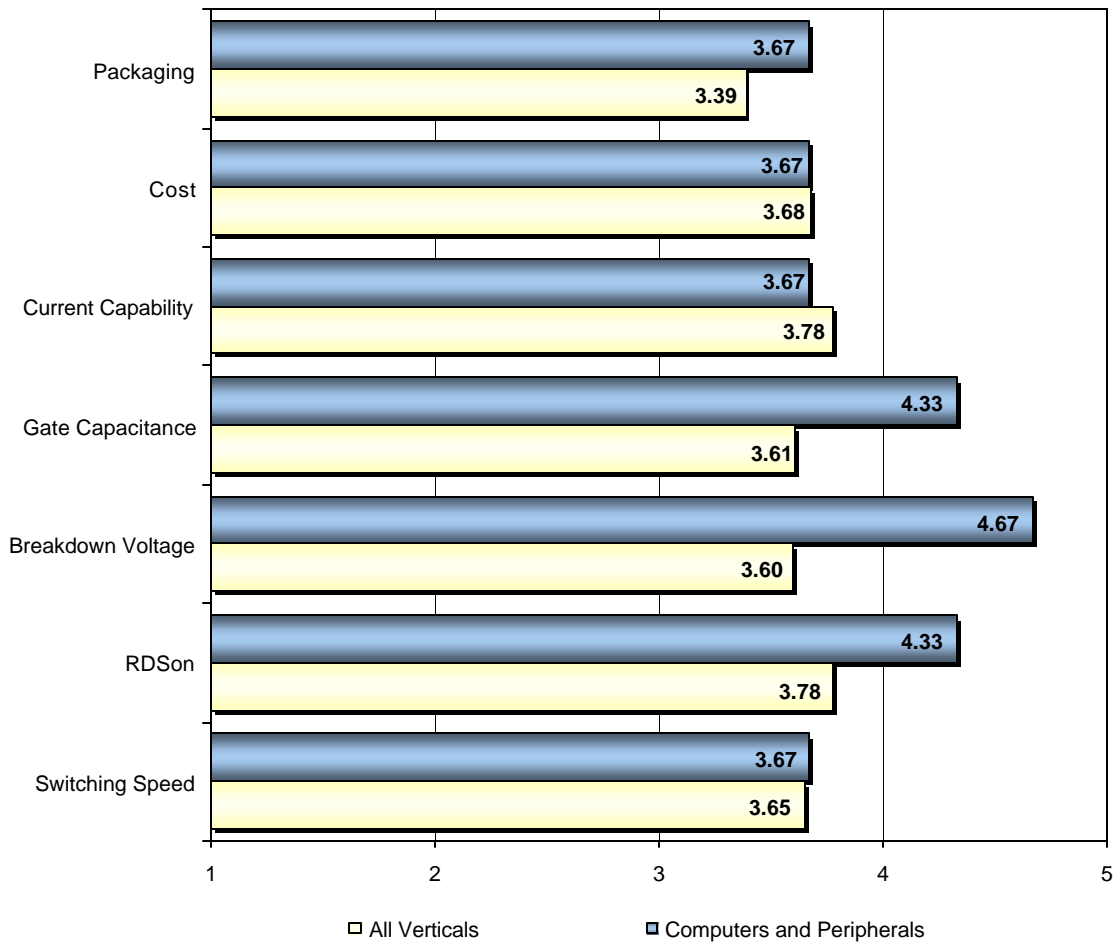


Exhibit IV -22
MOSFET Product Selection Criteria for Computers and Peripherals Respondents Using
(Mean Rating)

1=Not Important, 5=Very Important



OEM future usage response is displayed in Exhibits IV-23 to IV-27. The non-isolated DC/DC intermediate bus offers a significant opportunity for substantially higher PSIC volume requirements from the Computer and Peripheral OEMS. Exhibit IV-24 clearly shows this possible demand – the computer and peripheral future requirements are 19% higher than the overall market. Vendors seeking opportunities in the DC/DC regulator space may want to investigate the Computer and Peripheral market.

Many power IC suppliers and PC suppliers maintain close relationships. Due to the strong competitive landscape and the critical importance of next-generation time-to-market, Computer and Peripheral OEMS value lead times as their most important non-product criteria (See Exhibit IV-28).

Exhibit IV -23
Use of PWMs in the Computers and Peripherals Industry
(Percent of Respondents)

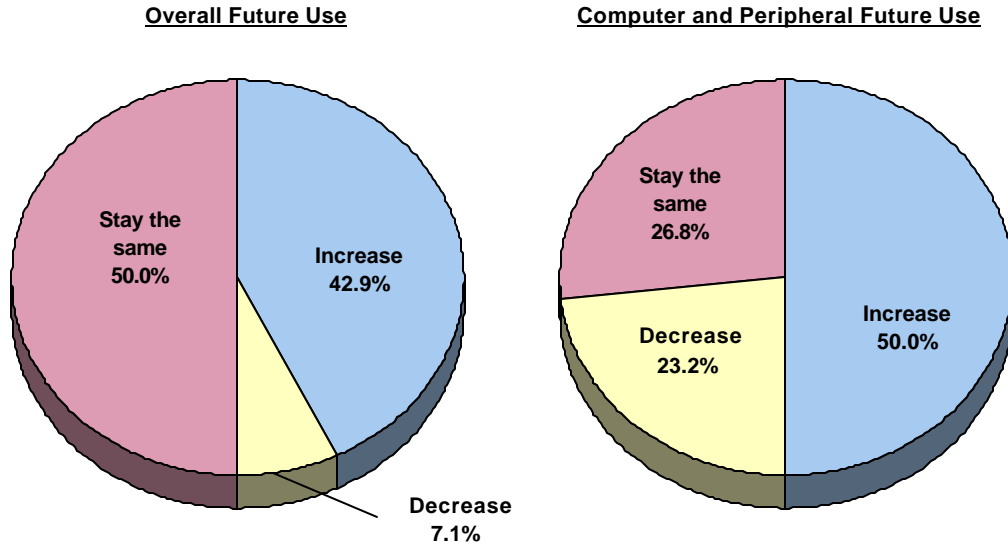


Exhibit IV -24
Use of DC/DC Regulators in the Computers and Peripherals Industry
(Percent of Respondents)

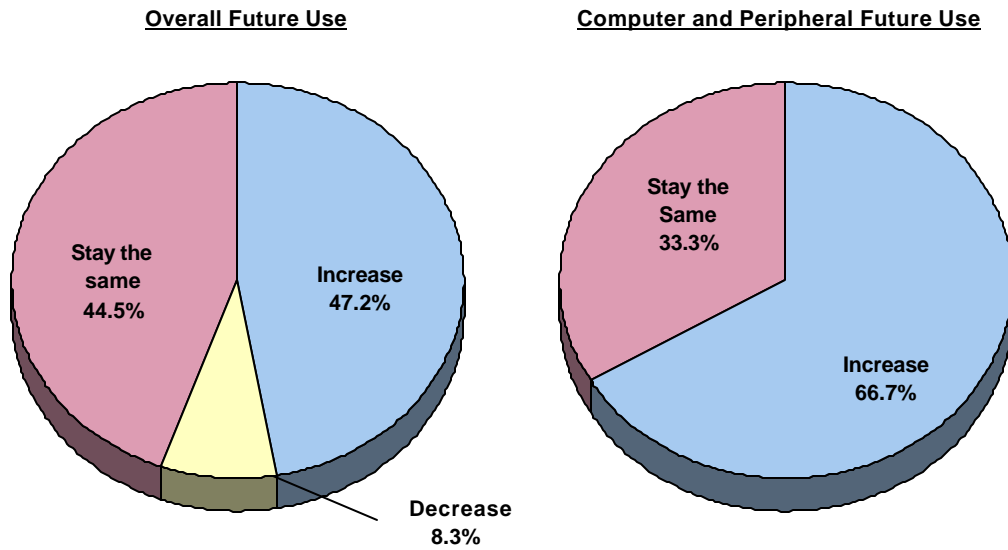


Exhibit IV -25
 Use of Linear Regulators in the Computers and Peripherals Industry
 (Percent of Respondents)

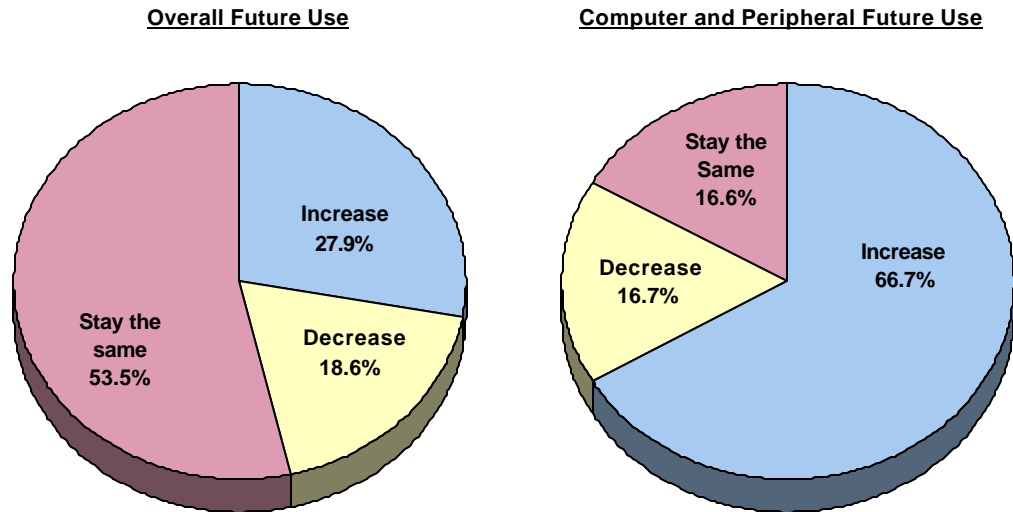


Exhibit IV -26
 Use of Battery Charging and Management IC's in the Computers and Peripherals Industry
 (Percent of Respondents)

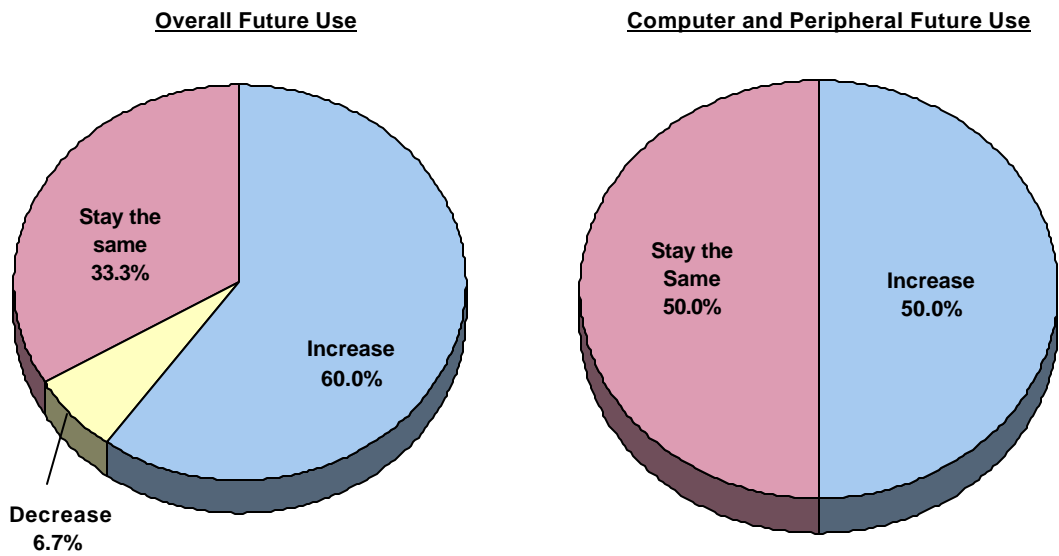


Exhibit IV -27
 Use of MOSFETS in the Computers and Peripherals Industry
 (Percent of Respondents)

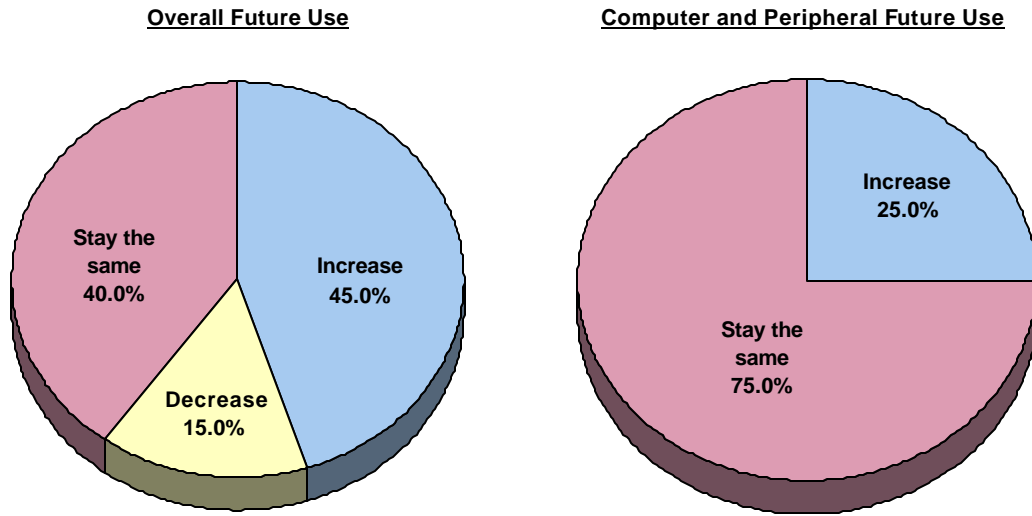
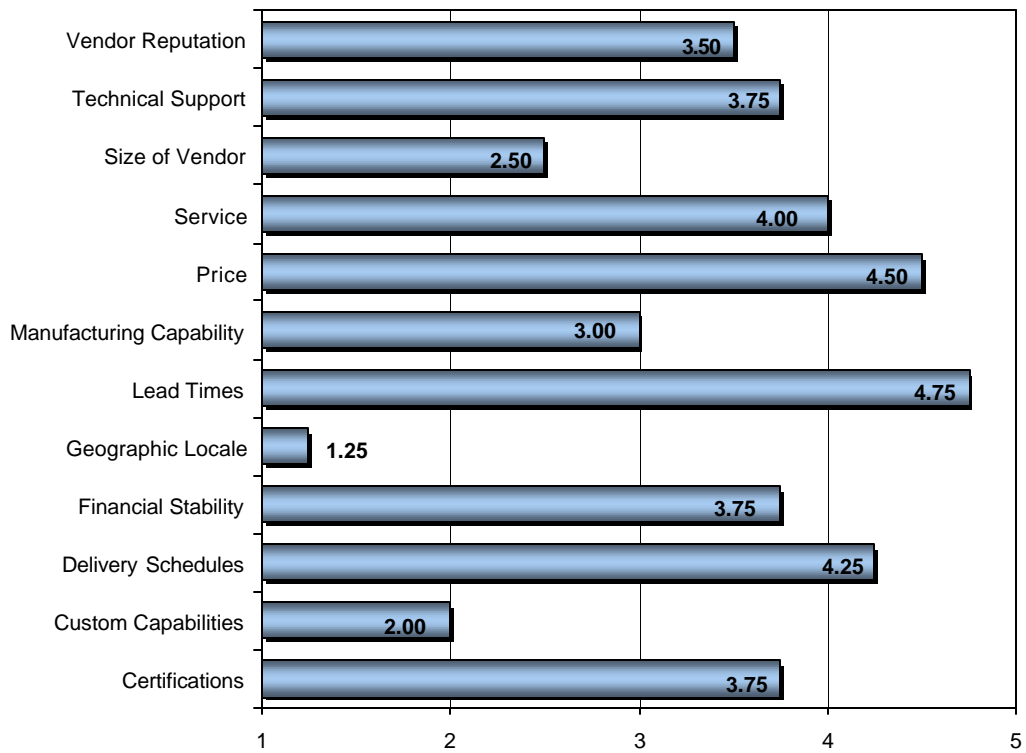


Exhibit IV -28
 Non-Product Selection Criteria for Computers and Peripherals Respondents
 (Mean Rating)

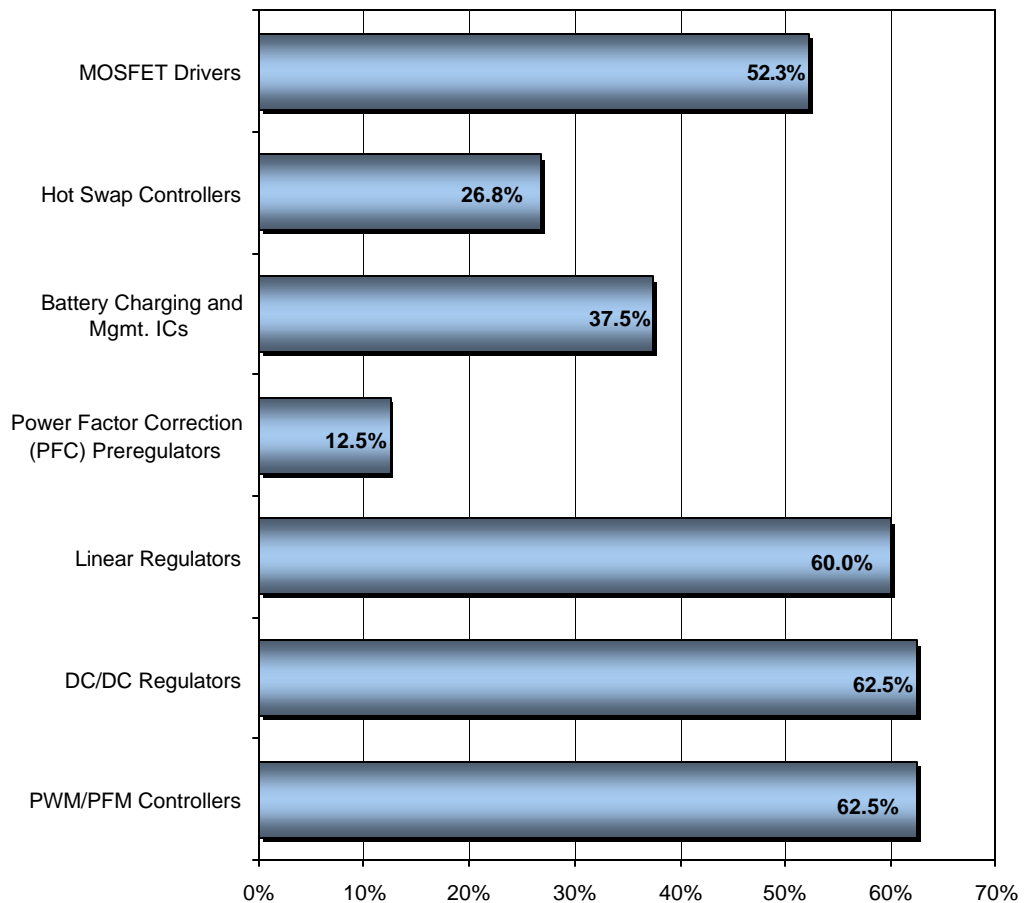
1=Not Important, 5=Very Important



TELECOM/DATACOM

The Telecom/Datacom market as a whole is still anemic as it tries to recover from the devastation of the bursting bubble. Nonetheless wireless technology, such as wireless LANs, is one of the market-leading technologies that will require an abundance of next-generation power IC products. Exhibit IV-29 displays the Telecom/Datacom respondents using each type of power IC.

Exhibit IV -29
Telecom/Datacom Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

Wireless LAN OEMs tend to lean toward multiple output linear regulators because they may offer a total WLAN solution in less space for less money.

- Offer high efficiency
- Save space and lowers BOM Cost
- Offer low-noise output

- Extensive protection and monitoring features
 - Thermal shutdown
 - Current limiting
 - Short-circuit protection
 - Reverse battery protection
- Low-profile packaging

Exhibits IV-30 through IV-34 show product selection criteria for each type of power IC used in Telecom/Datacom applications. Telecom applications such as wireless LANS require a level of sophistication that emphasizes characteristics such as RDSon and efficiency over price.

Exhibit IV -30
 PWM/PFM Product Selection Criteria for Telecom and Datacom Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

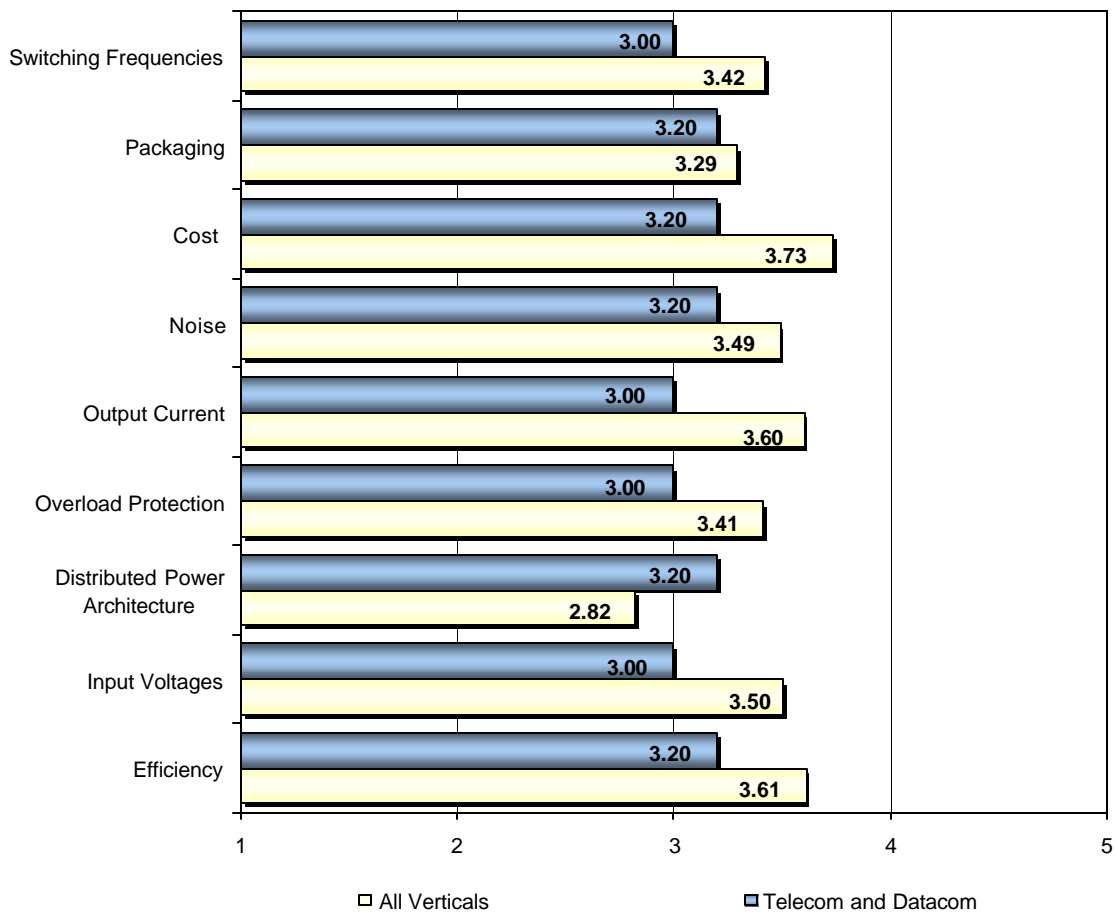


Exhibit IV -31
 DC/DC Regulators Product Selection Criteria for Telecom and Datacom Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

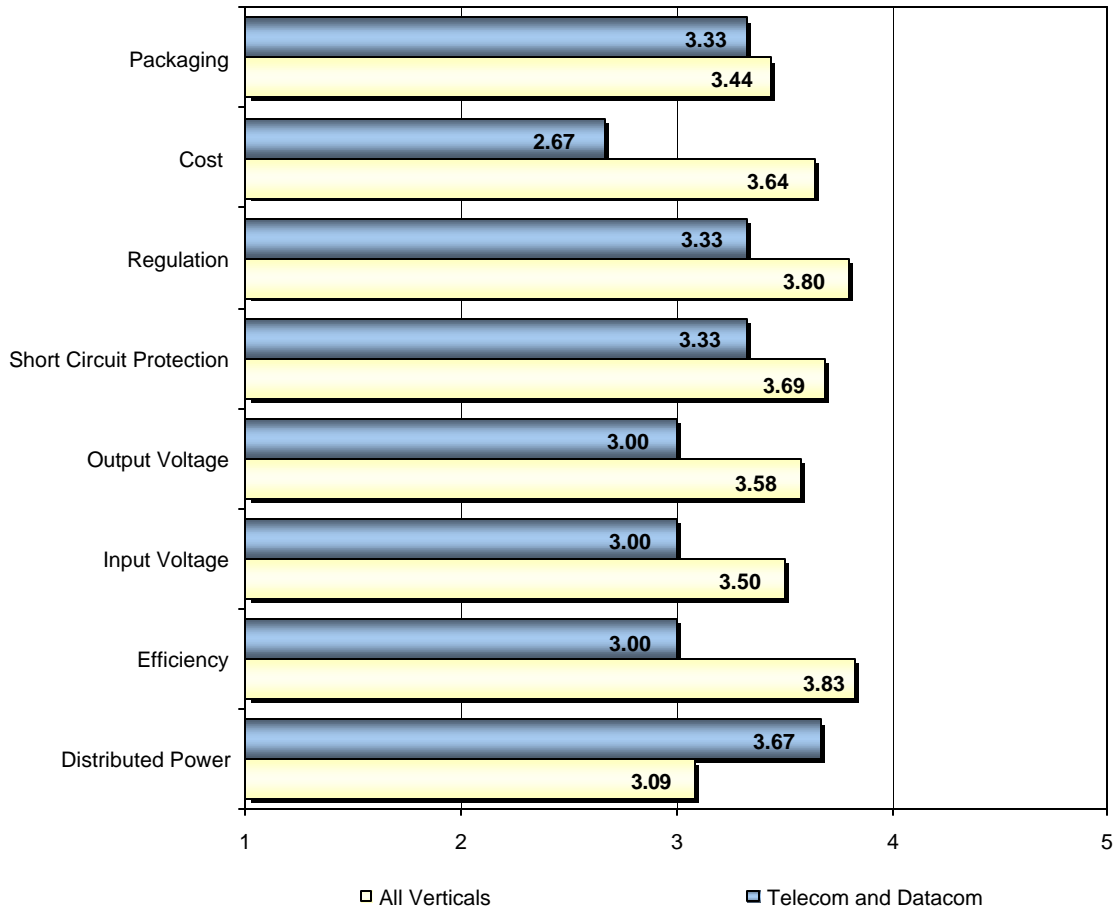


Exhibit IV -32
 Linear Regulators Product Selection Criteria for Telecom and Datacom Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

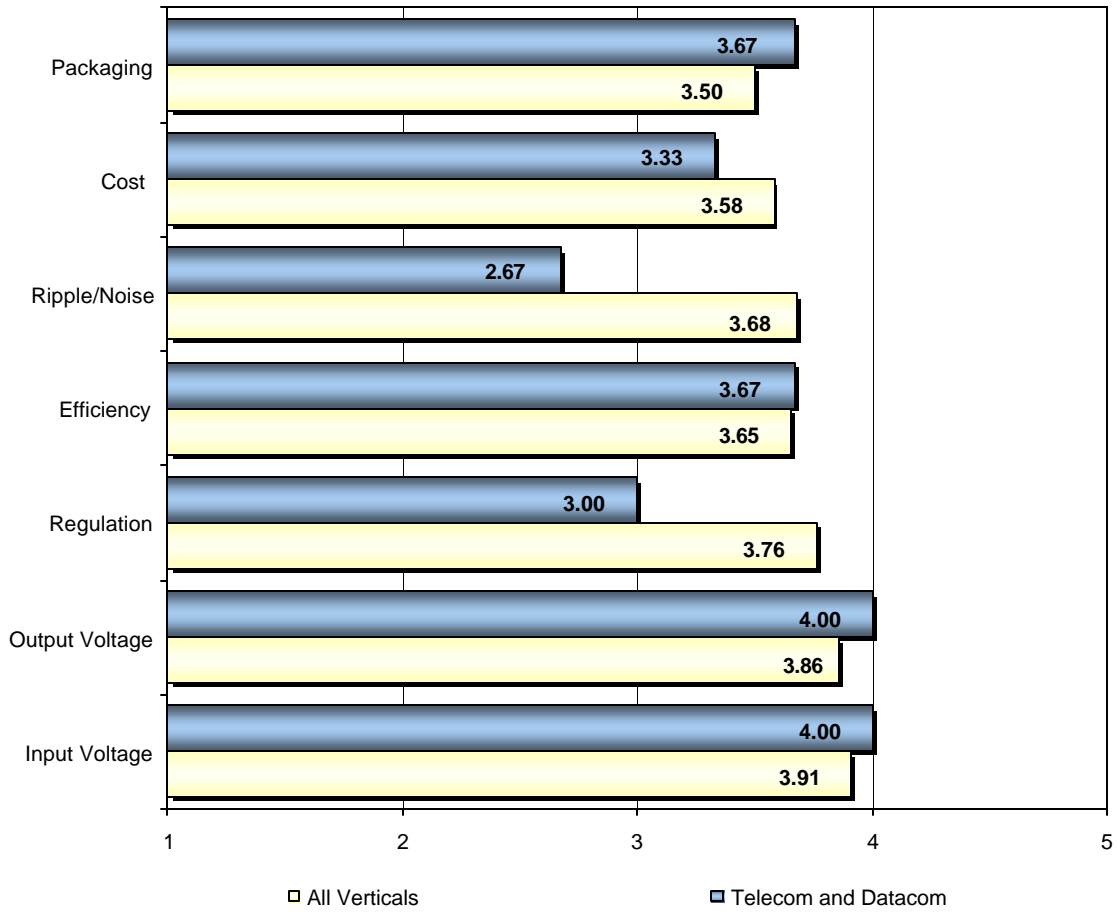


Exhibit IV -33
 Battery Charging and Management ICs Product Selection Criteria for Telecom and Datacom Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

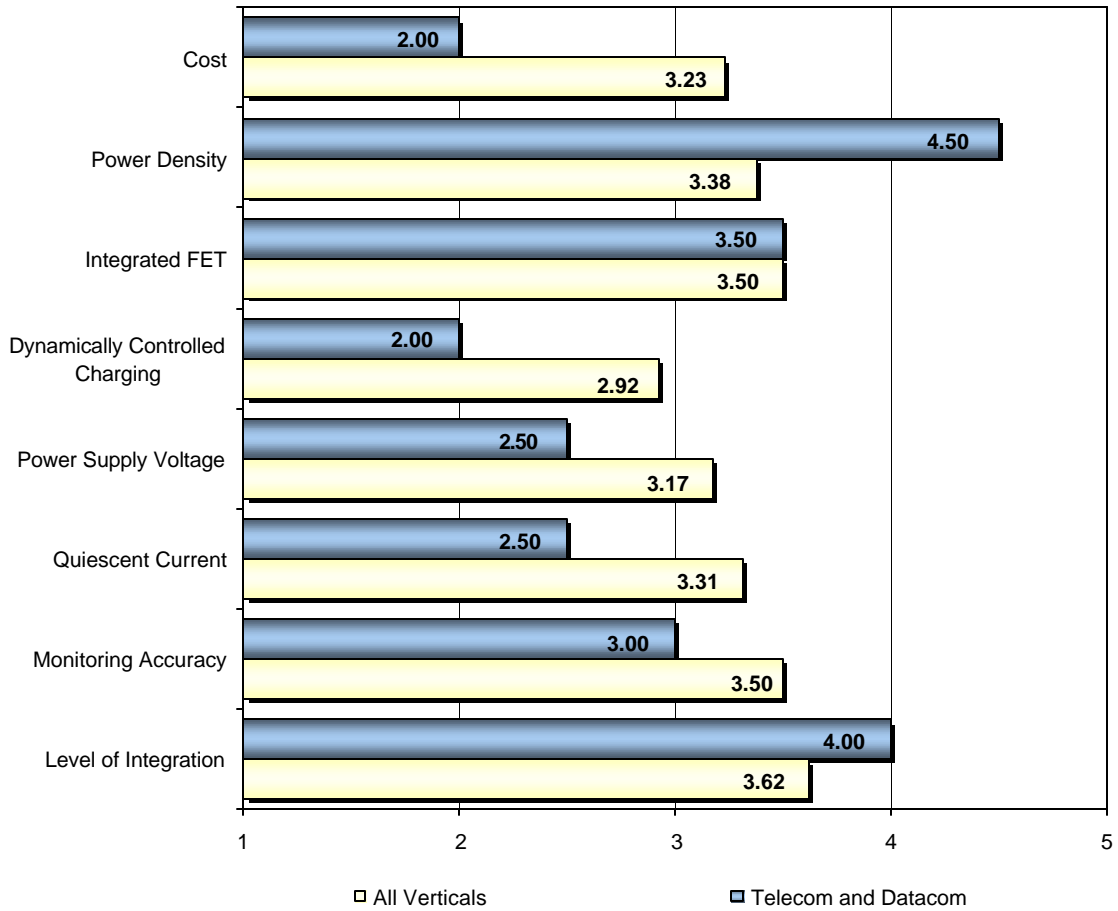
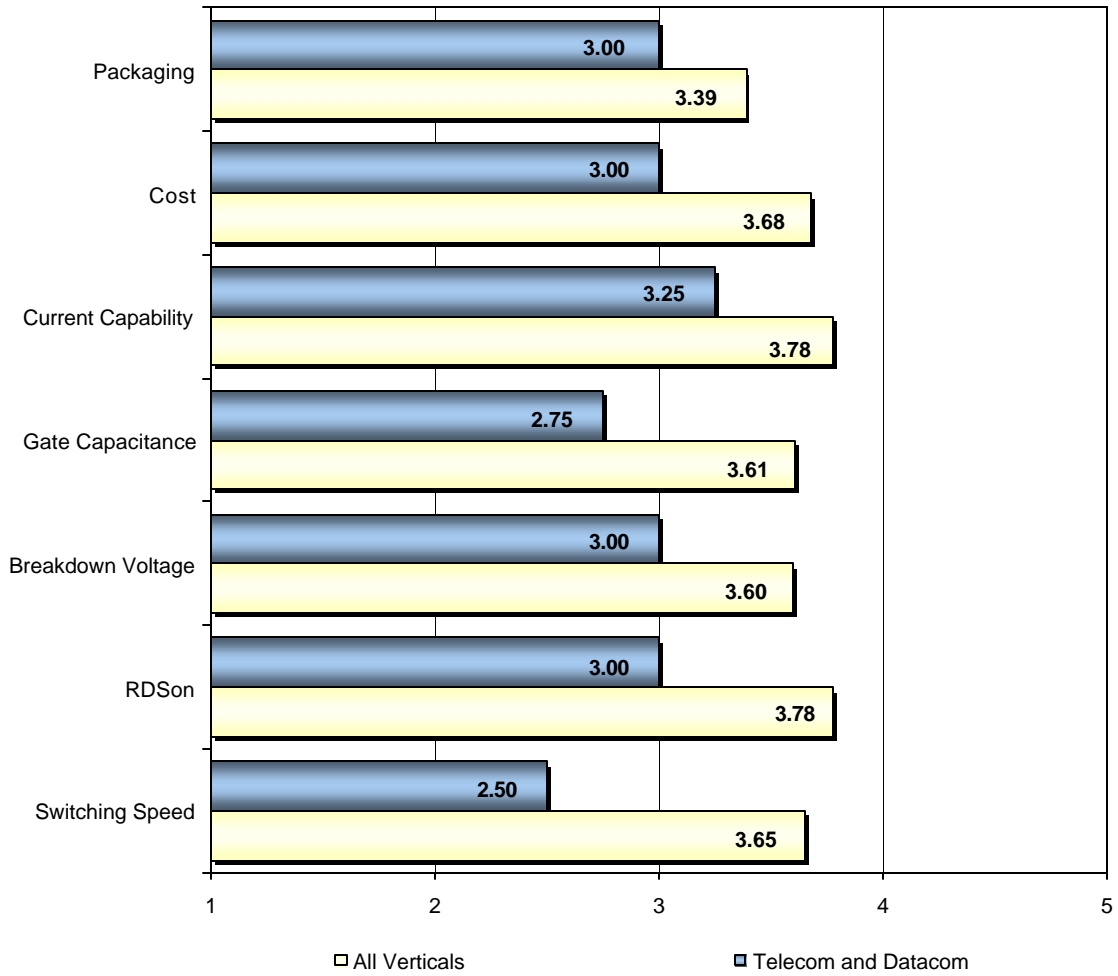


Exhibit IV -34
 MOSFET Product Selection Criteria for Telecom and Datacom Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



OEMs' optimistic responses regarding future use of power ICs (Exhibits IV-35 to IV-39) may be a sign that the worst is behind in this struggling market.

Exhibit IV -35
Use of PWMs in the Telecom and Datacom Industry
(Percent of Respondents)

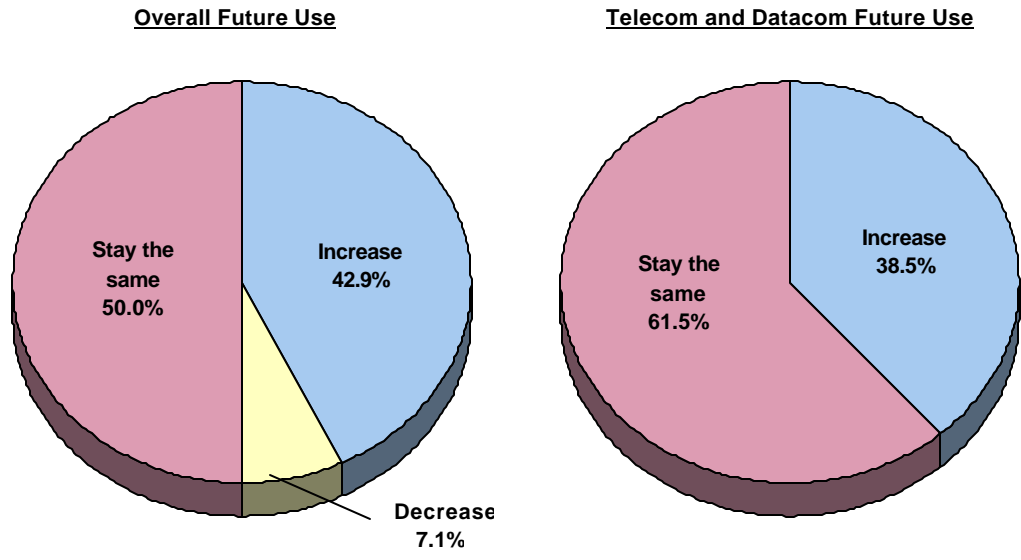


Exhibit IV -36
Use of DC/DC Regulators in the Telecom and Datacom Industry
(Percent of Respondents)

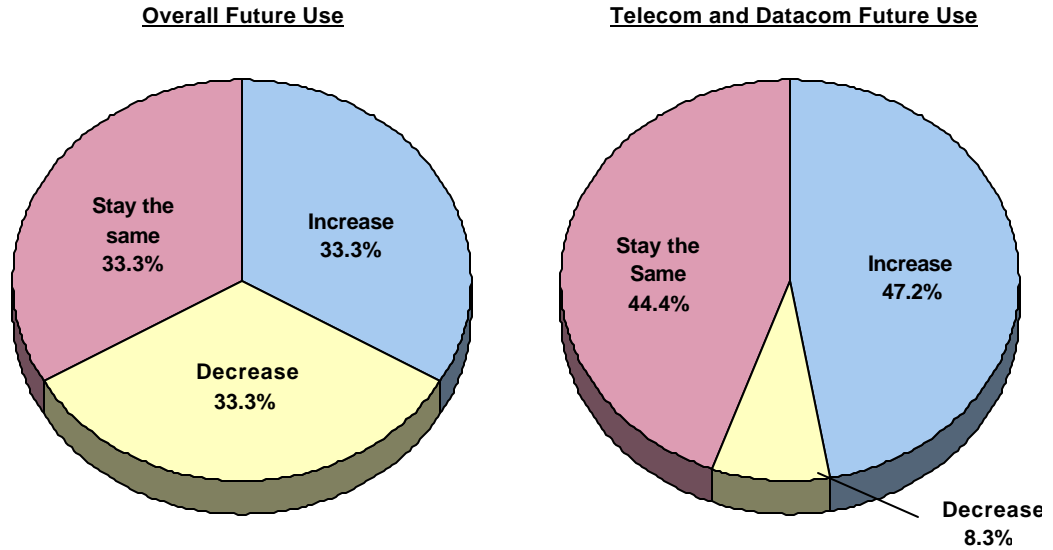


Exhibit IV -37
Use of Linear Regulators in the Telecom and Datacom Industry
(Percent of Respondents)

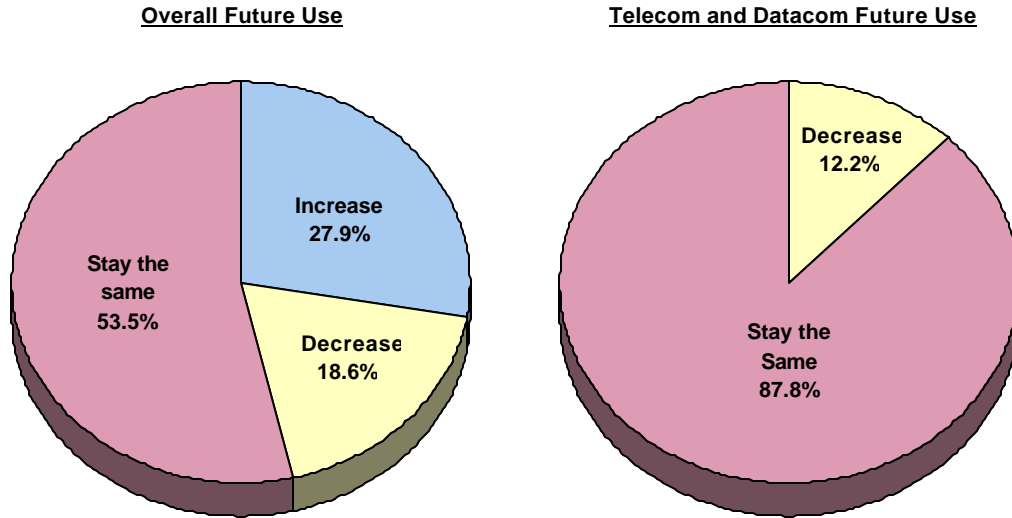


Exhibit IV -38
Use of Battery Charging and Management IC's in the Telecom and Datacom Industry
(Percent of Respondents)

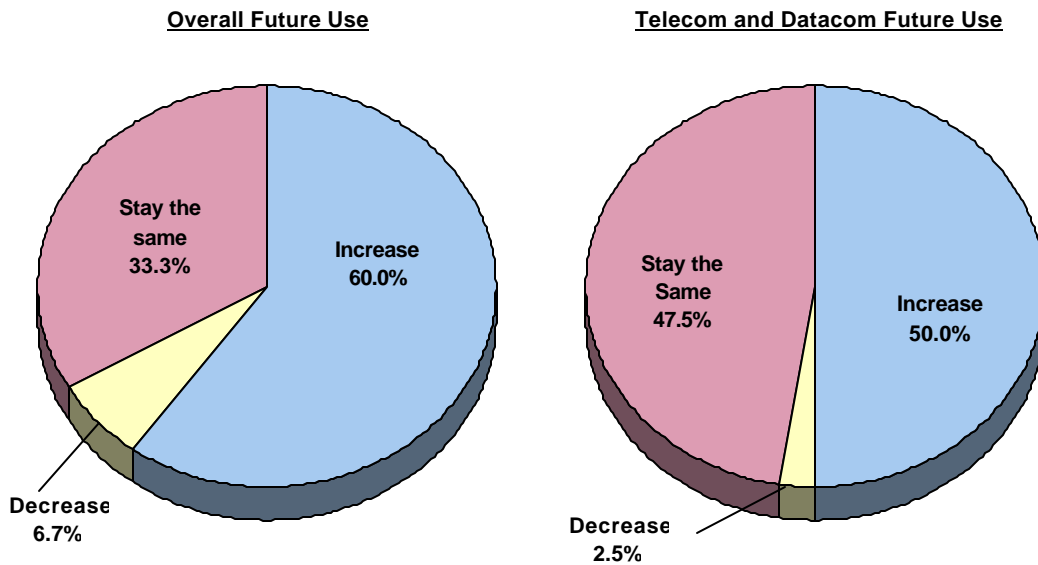


Exhibit IV -39
 Use of MOSFETS in the Telecom and Datacom Industry
 (Percent of Respondents)

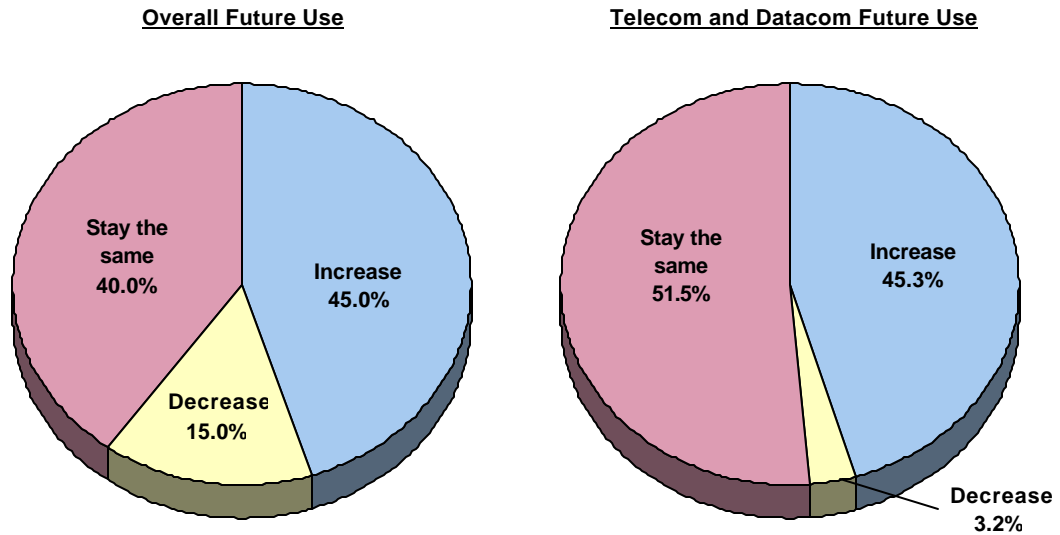
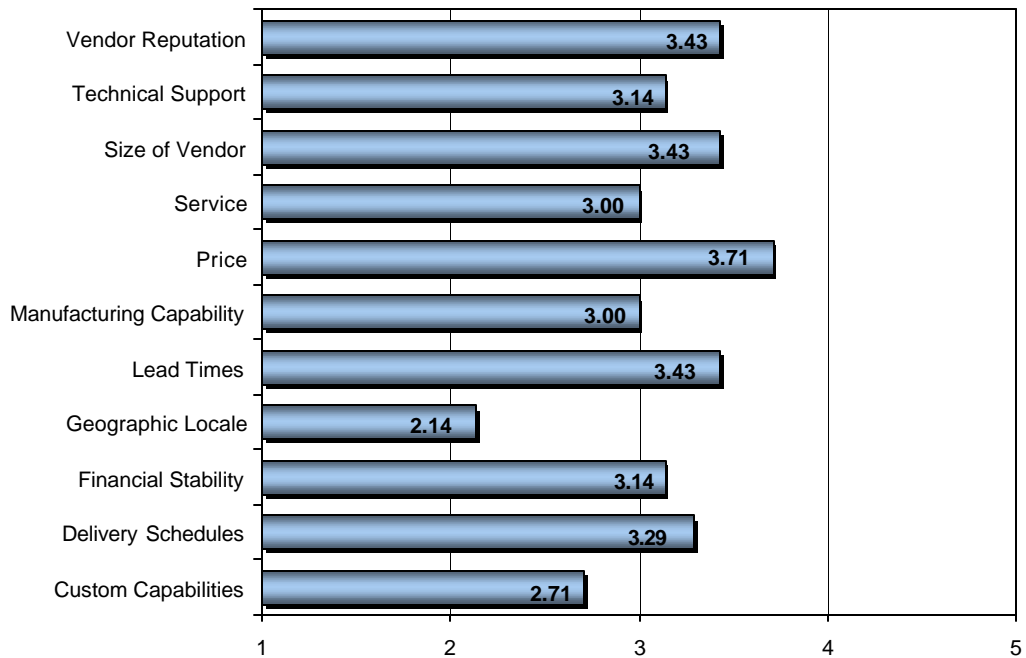


Exhibit IV-40 displays OEM importance for the non-product selection criteria. Price and vendor reputation take priority over geographic locale. Many OEMs are loyal to particular vendors.

Exhibit IV -40
 Non-Product Selection Criteria for Telecom Datacom Respondents
 (Mean Rating)

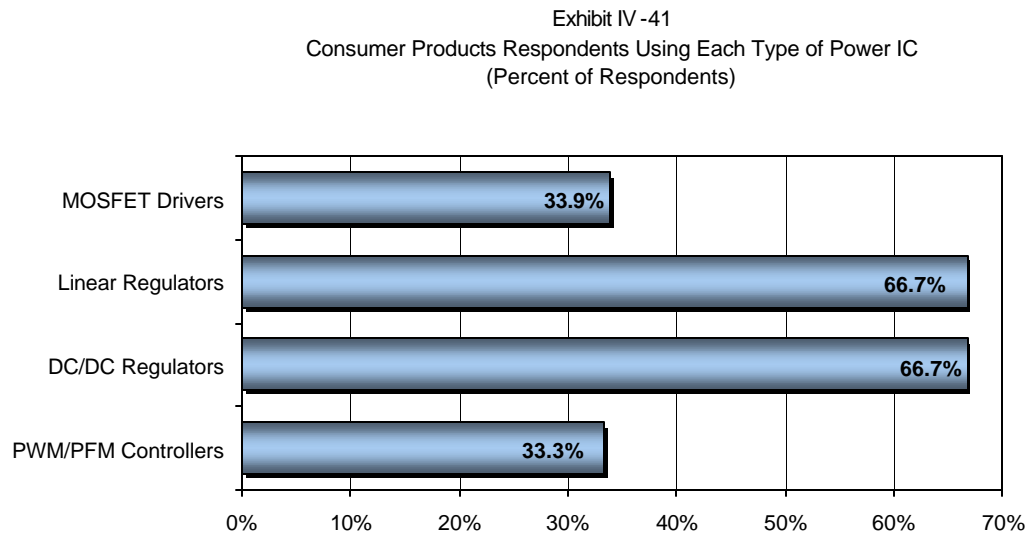
1=Not Important, 5=Very Important



CONSUMER PRODUCTS

The Consumer Product market, particularly the mobile applications, is one of the fastest-growing market segments in the industry. Mobile phones, PDAs, and digital cameras are all power-hungry devices that are pushing the industry harder than any other vertical market in terms of size, battery life, thermal packaging enhancements and technological innovations. Part of this trend is comprised of increased demand for compact LED backlighting solutions.

Exhibit IV-41 shows the percent of Consumer Product respondents using each type of power IC.



Note: Percentages sum to over 100% due to multiple responses.

These multimedia-based devices bring an entirely new set of power management requirements to handset design. Multimedia applications need higher performance to maximize the quality of the user experience. For example, handsets running multimedia applications must provide accelerated graphics for fast gameplay, support compression of JPEG images, and deliver the high video frame rates needed for video playback. Similarly, just as still images need a camera flash, today's camera chips need subject lighting during video capture. While the requirements for camera flash and movie-mode lighting are still evolving as LED technologies improve, clearly these new applications demand higher power than earlier devices and force the designer to carefully optimize voltage-supply requirements and minimize power consumption for high-frequency processors and related components.

Furthermore, today's power management ICs must not only provide high efficiency, they must be available in the smallest packages to support the highly compact footprints used in handset design. Moreover, they must use a minimal number of external components to lower cost and boost reliability. Exhibit IV-42 and IV-43 reveal a stronger requirement for efficiency, voltage, cost and packaging by OEMs in the Consumer and Portable Application market compared to all other vertical markets.

Exhibit IV -42
DC/DC Regulators Product Selection Criteria for Consumer Products Respondents
(Mean Rating)

1=Not Important, 5=Very Important

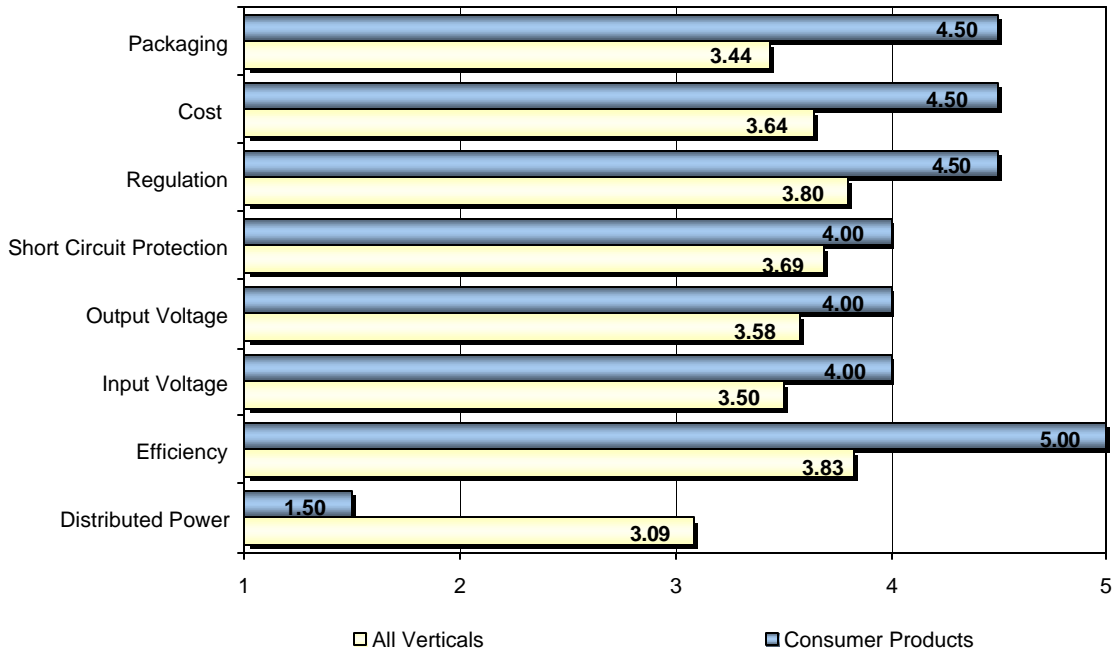
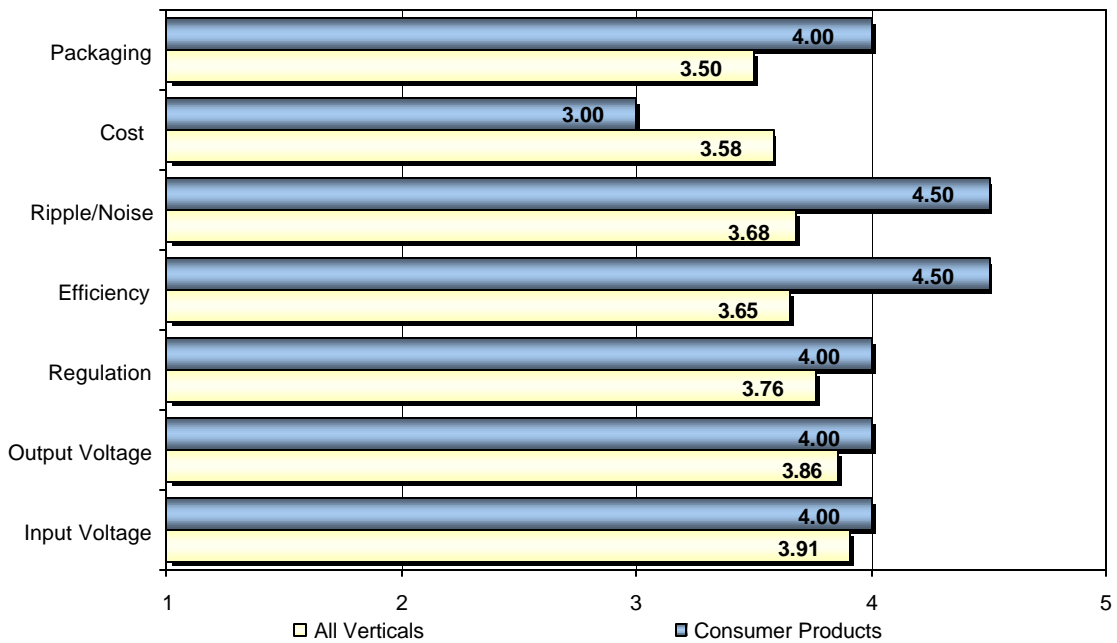


Exhibit IV -43
Linear Regulators Product Selection Criteria for Consumer Products Respondents
(Mean Rating)

1=Not Important, 5=Very Important



A general rule of thumb in the world of portable electronics is simply stated as “more functionality = more power.” Consumers are constantly demanding more functionality.

The need for more power will increasingly drive demand for advanced battery charging and management ICs. The majority of the OEMs surveyed see the continued need for chemistry-independent host-controlled charging.

As shown in Exhibits IV-44 to IV-47, most OEMS expect either a level of increased demand in their use of power ICs for consumer applications. Most notably is the substantial increase expected for MOSFETs. MOSFETS are ideal for portable and battery-powered equipment – offering high switching speeds, typically low resistance speeds, and the ability to be driven from a 2.5V supply in very small footprints.

Exhibit IV-48 reaffirms the need for custom ICs in this space.

Exhibit IV -44
Use of PWMs in the Consumer Products Industry
(Percent of Respondents)

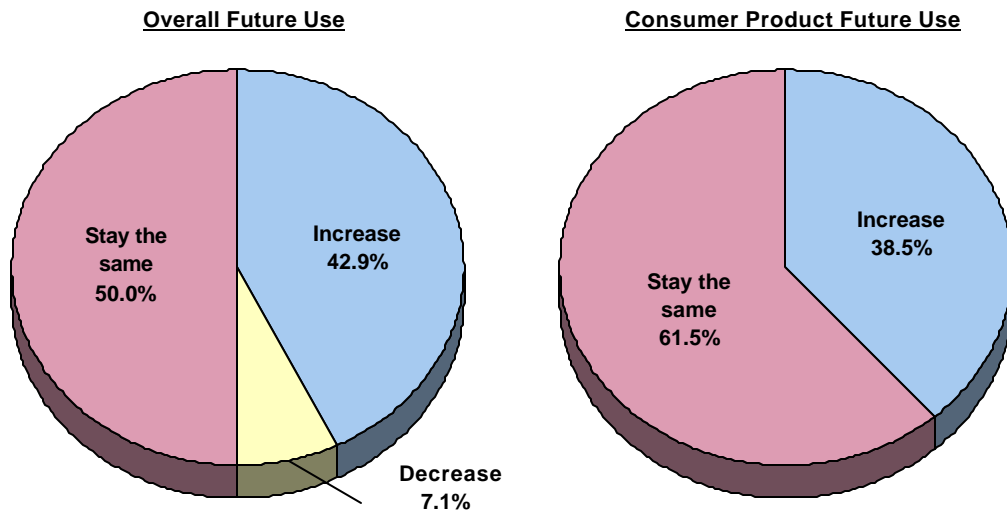


Exhibit IV -45
Use of DC/DC Regulators in the Consumer Products Industry
(Percent of Respondents)

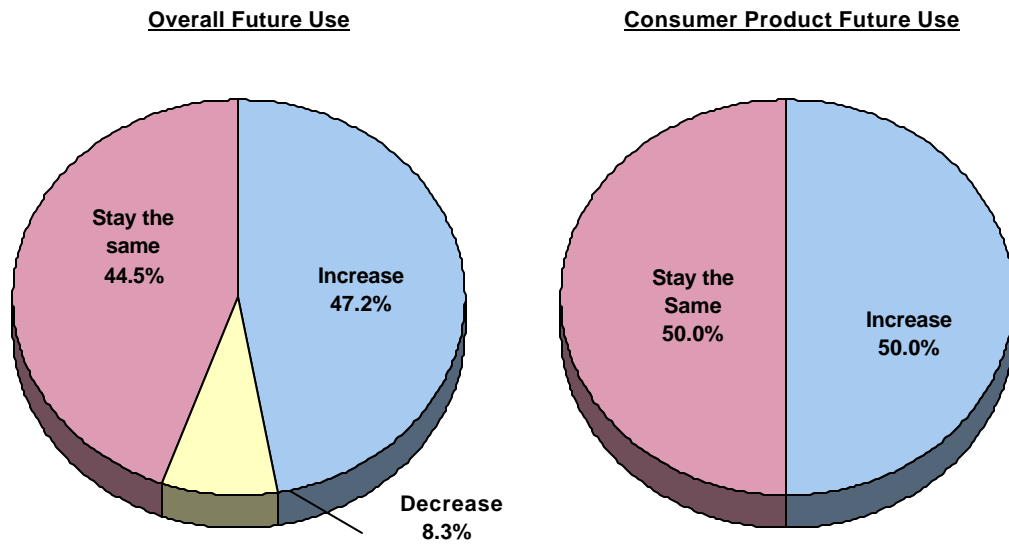


Exhibit IV -46
Use of Linear Regulators in the Consumer Products Industry
(Percent of Respondents)

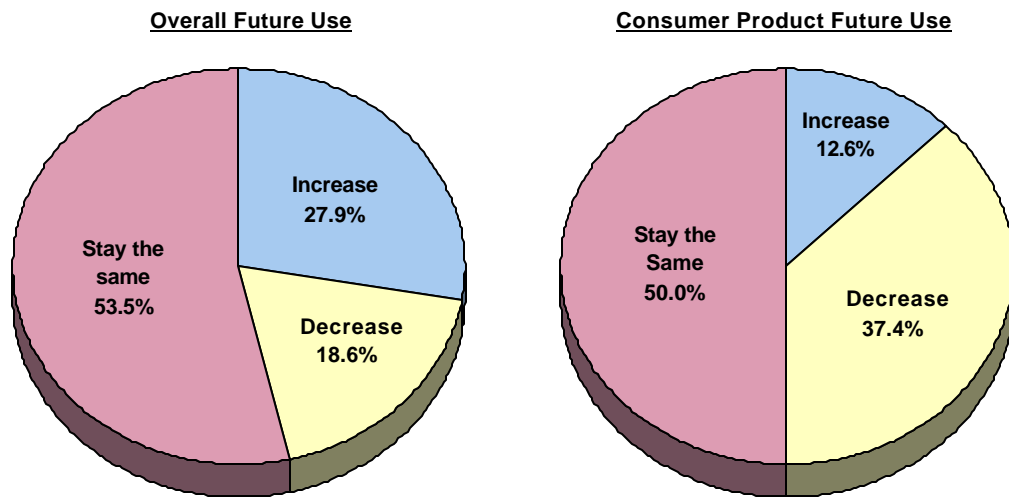


Exhibit IV -47
 Use of MOSFETS in the Consumer Products Industry
 (Percent of Respondents)

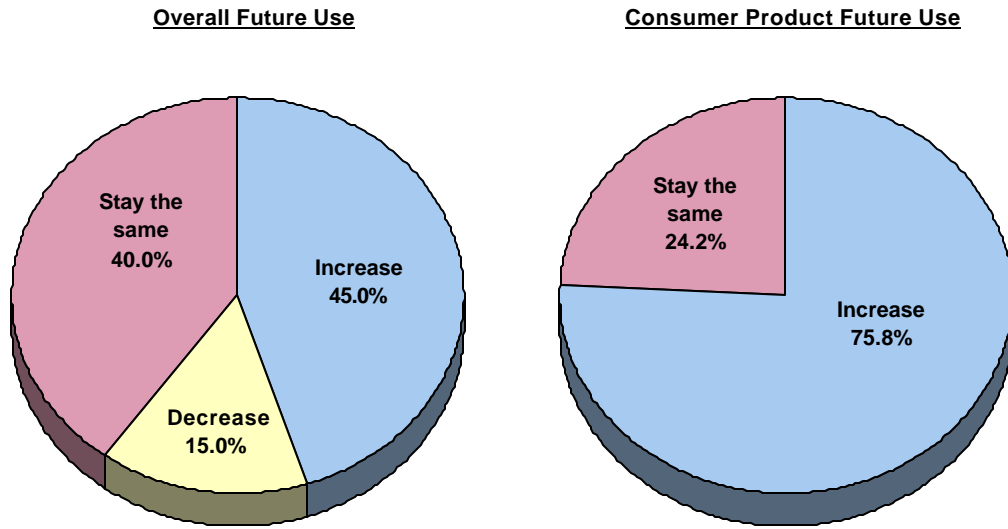
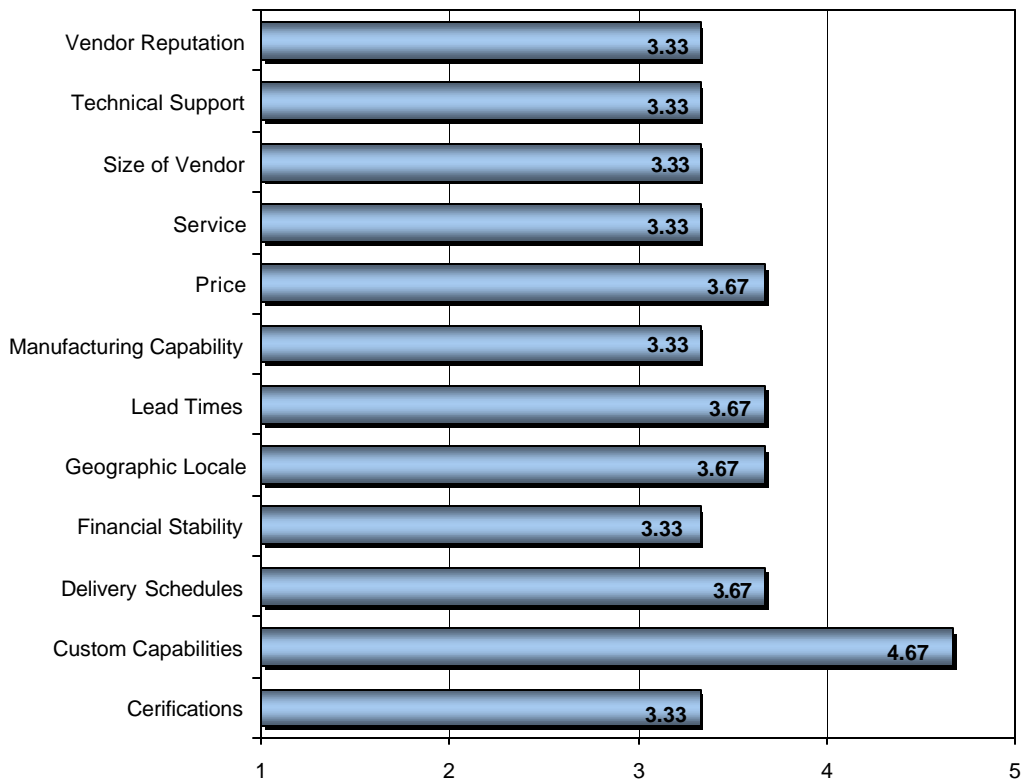


Exhibit IV -48
 Non-Product Selection Criteria for All Consumer Product Respondents
 (Mean Rating)

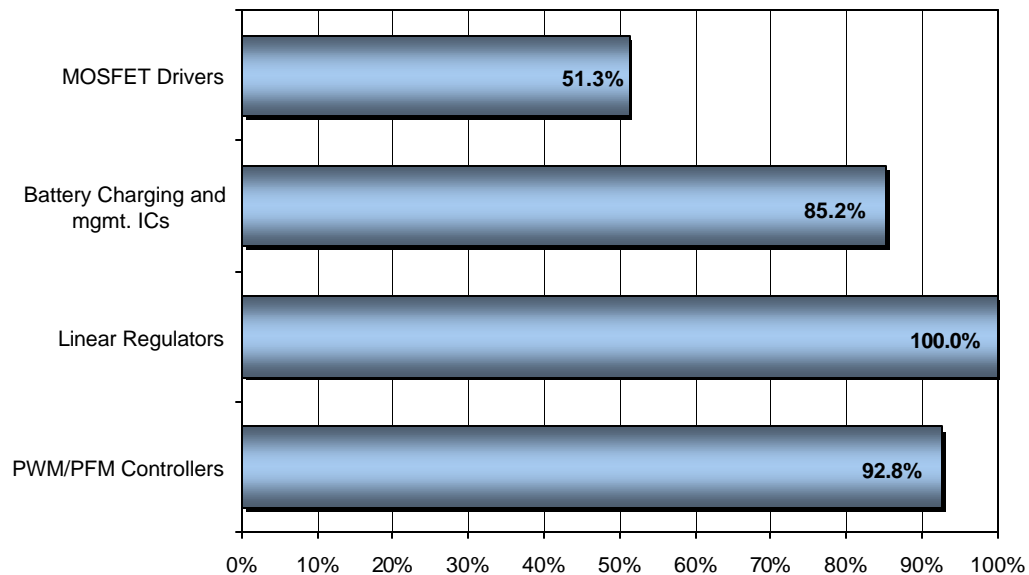
1=Not Important, 5=Very Important



AUTOMOTIVE

An increasing number of power ICs are being used in motor vehicle applications including motor/body load control, ABS, power train management, injection systems, anti-theft systems, auto-lock systems and car area network systems. Exhibit IV-49 shows the percentage of respondents using each type of power IC in the Automotive industry.

Exhibit IV -49
Automotive Respondents Using Each Type of Power IC
(Percent of Respondents)



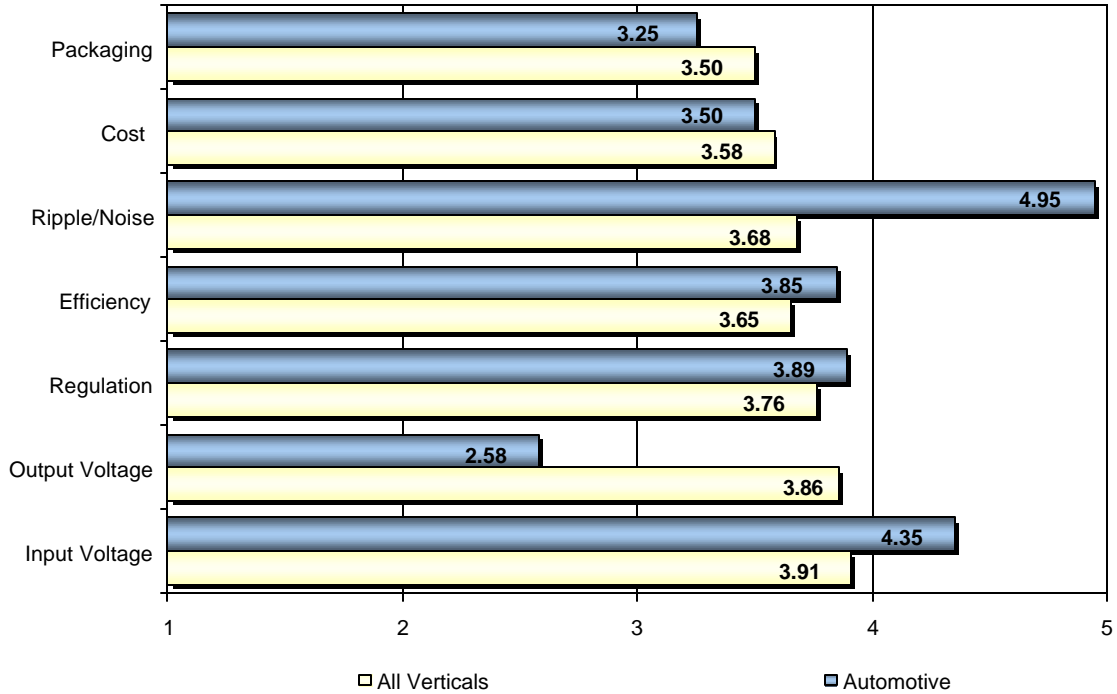
Note: Percentages sum to over 100% due to multiple responses.

The demand for increased power and the support of 42V systems is being driven by four major forces: enhanced vehicle performance; improved fuel economy; emissions reduction; and new "intelligent" electronic systems, such as electric power steering, electromechanical breaks, onboard navigation systems, entertainment systems and electrically-controlled air-conditioning and heating systems.

The general consensus is that the conversion to 42V systems will happen; it is simply a matter of when this will become mainstream. Power IC manufacturers are trending to build devices that will migrate or be compatible with new technologies. Exhibit IV-50 shows a sampling of product selection criteria for Automotive respondents.

Exhibit IV -50
 Linear Regulators Product Selection Criteria for Automotive Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



As shown in Exhibits IV-51 through IV-53, regardless of when the conversion to 42v occurs, OEMs are expressing increasing use of power ICs, particularly linear regulators and MOSFETs.

Exhibit IV -51
 Use of PWMs in the Automotive Industry
 (Percent of Respondents)

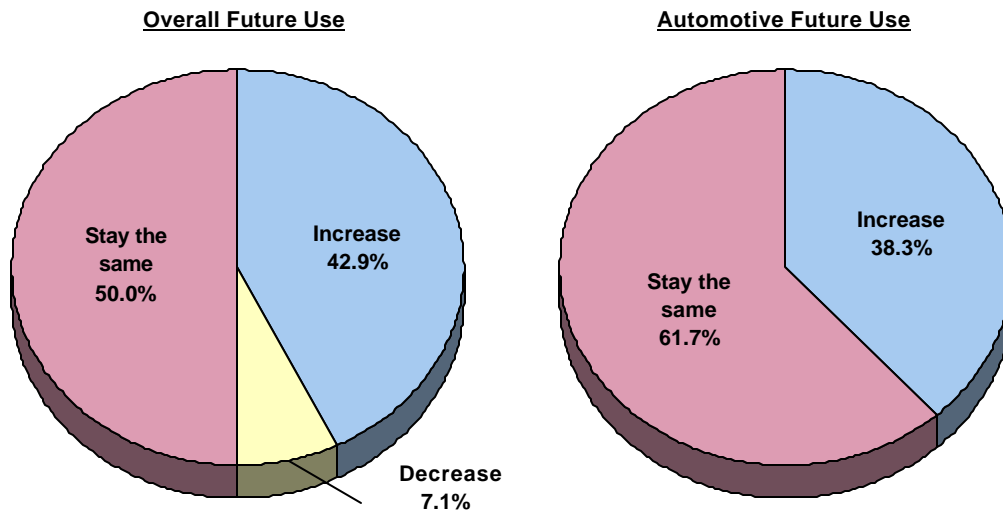


Exhibit IV -52
Use of Linear Regulators in the Automotive Industry
(Percent of Respondents)

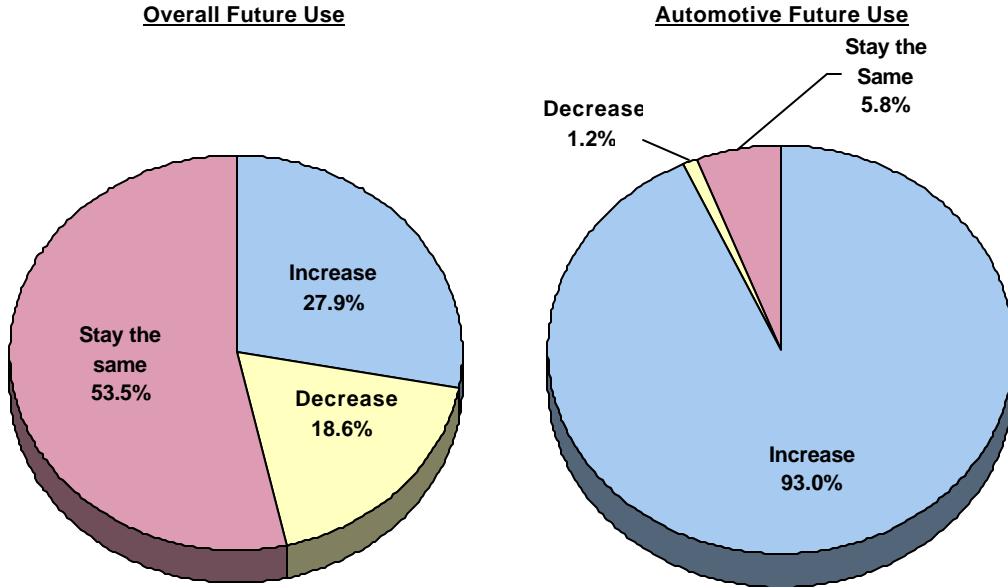
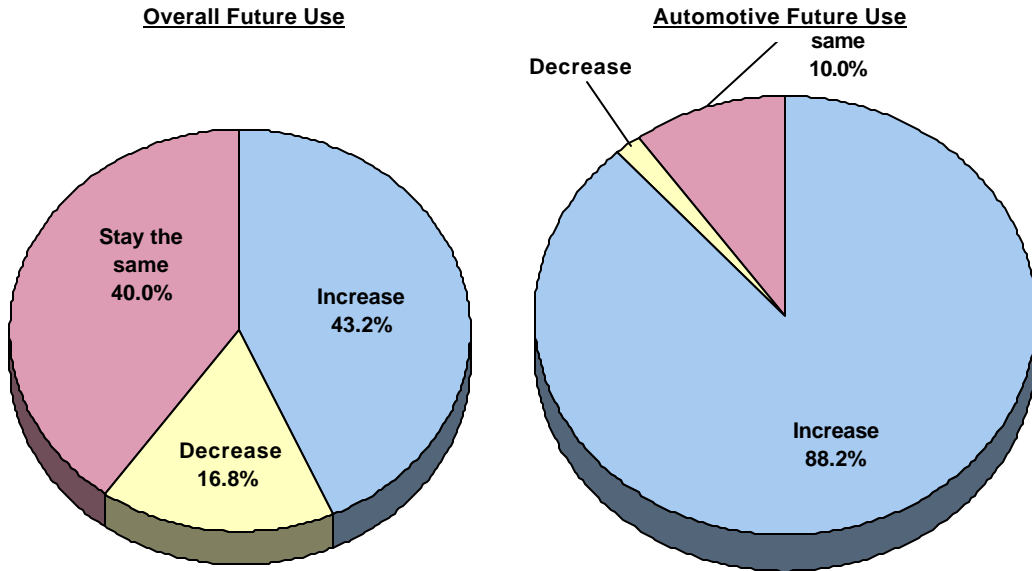


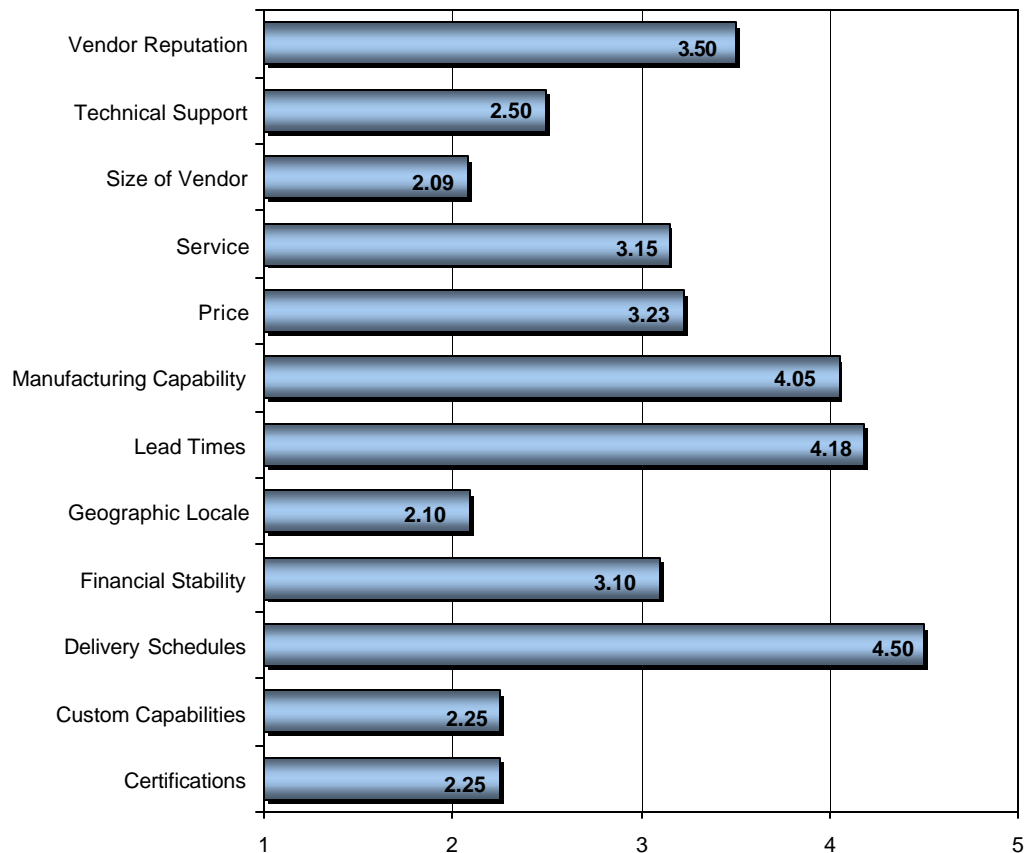
Exhibit IV -53
Use of MOSFETS in the Automotive Industry
(Percent of Respondents)



The primary driver behind the conversion to 42V automotive systems is cost: the cost of components and the cost of semiconductors. With 42V systems, more subsystems can be powered at a cheaper cost. However, unlike some other previously discussed vertical markets, cost is not the primary selection criteria with regard to OEMs' non-product selection criteria. As shown in Exhibit IV-54, lead times and delivery schedules are most important. Automotive manufacturers must meet stringent schedule platforms and therefore deem delivery to be most critical.

Exhibit IV -54
Non-Product Selection Criteria for Automotive Respondents
(Mean Rating)

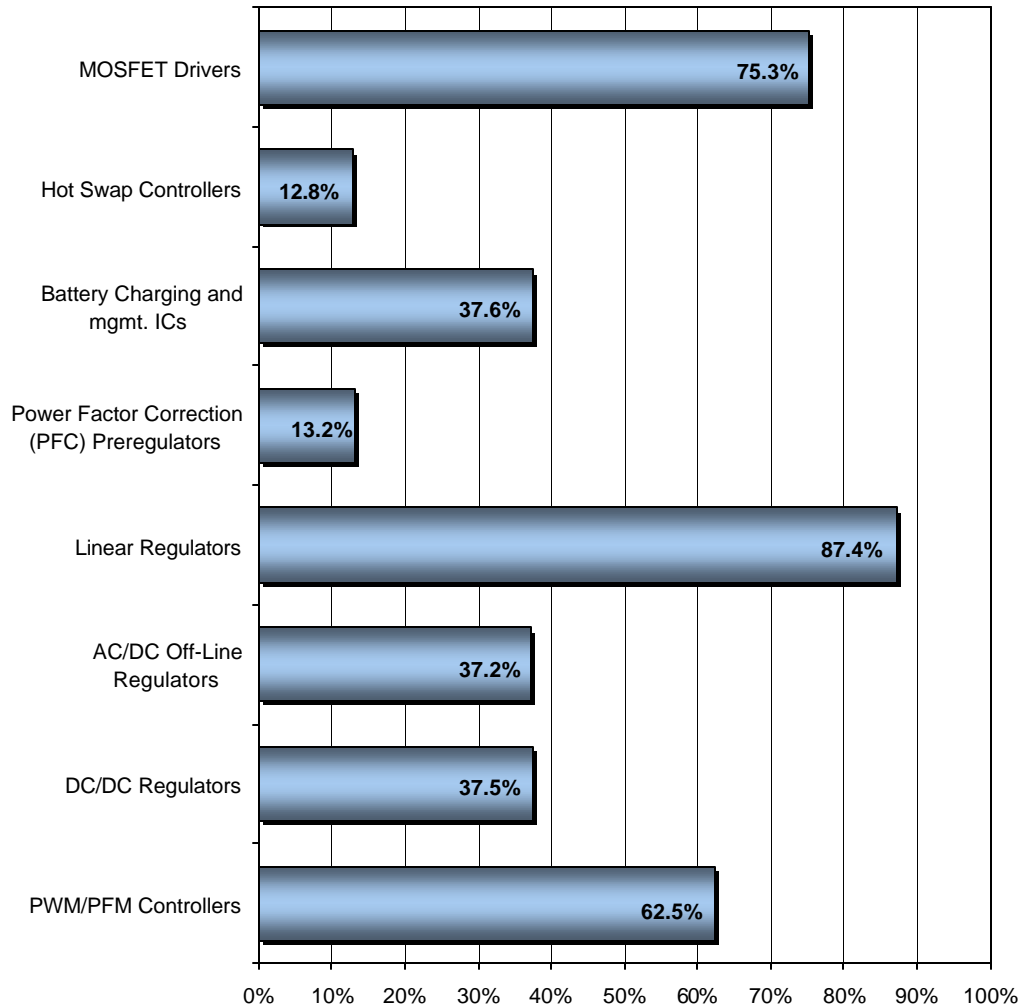
1=Not Important, 5=Very Important



INDUSTRIAL CONTROL AND AUTOMATION

Industrial Control and Automation is one of the smaller but steadier representations of power IC uses. Exhibit IV-55 shows the percentage of Industrial Control and Automation respondents using each type of power IC.

Exhibit IV -55
Industrial Control and Automation Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

The needs in the Industrial Control market tend to be diverse and standard. OEMs do not typically customize their power IC uses, nor are they pushing the envelope in design strides. Therefore price-sensitive off-the-shelf ICs that tend to get the job done in a reasonable manner represent the typical demand. Exhibit IV-56 – IV-62 show just how important the cost is in comparison to product criteria such as efficiency.

Exhibit IV -56
 PWM/PFM Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

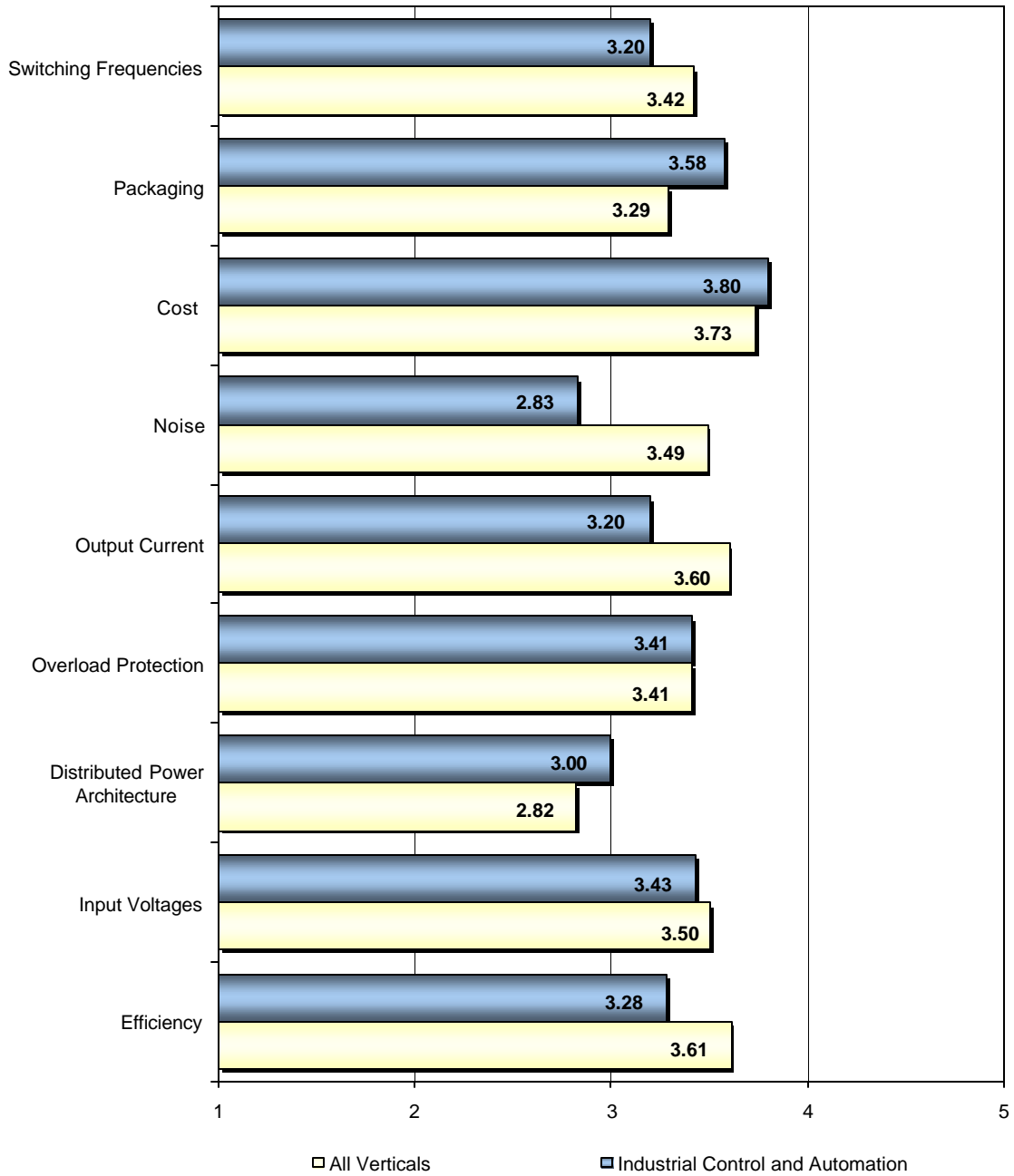


Exhibit IV -57
 DC/DC Regulators Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

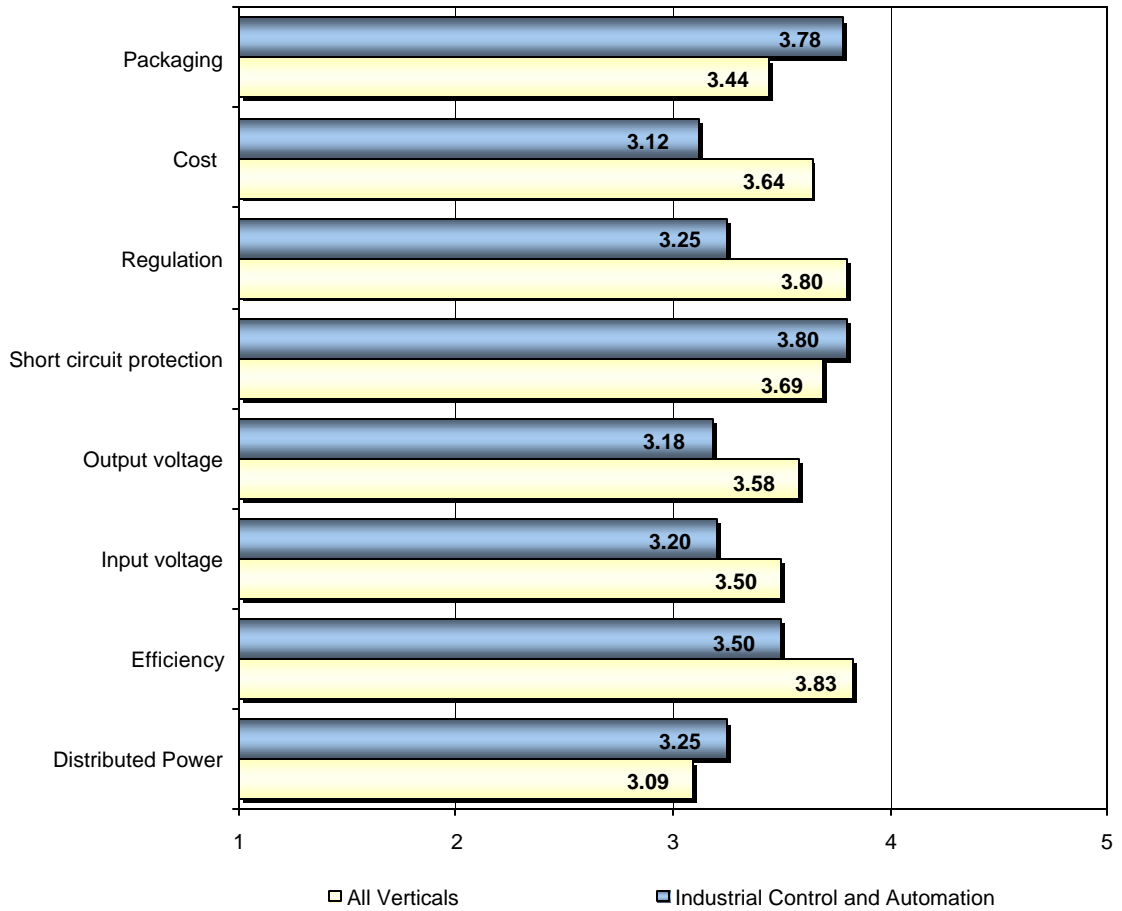


Exhibit IV -58
AC/DC Off Line Regulators Product Selection Criteria for Industrial Control and Automation Respondents
(Mean Rating)

1=Not Important, 5=Very Important

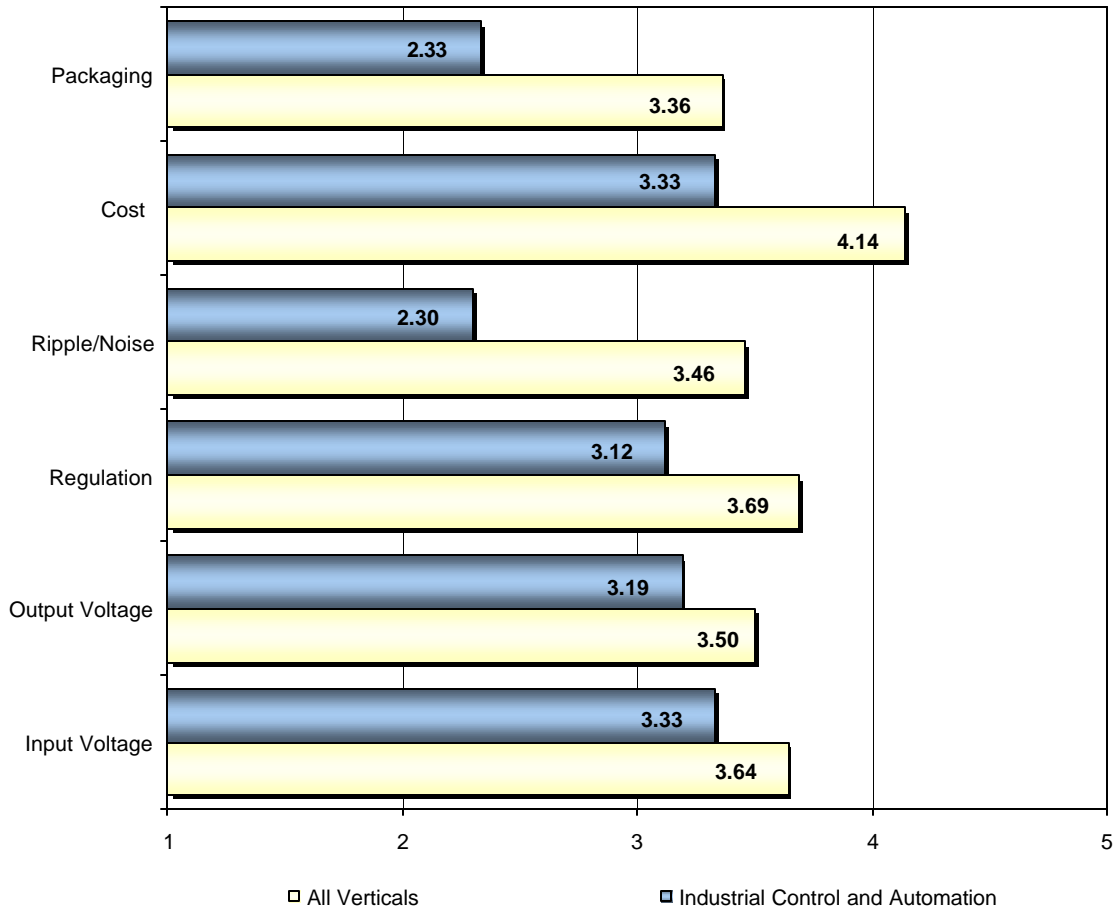


Exhibit IV -59
 Linear Regulators Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

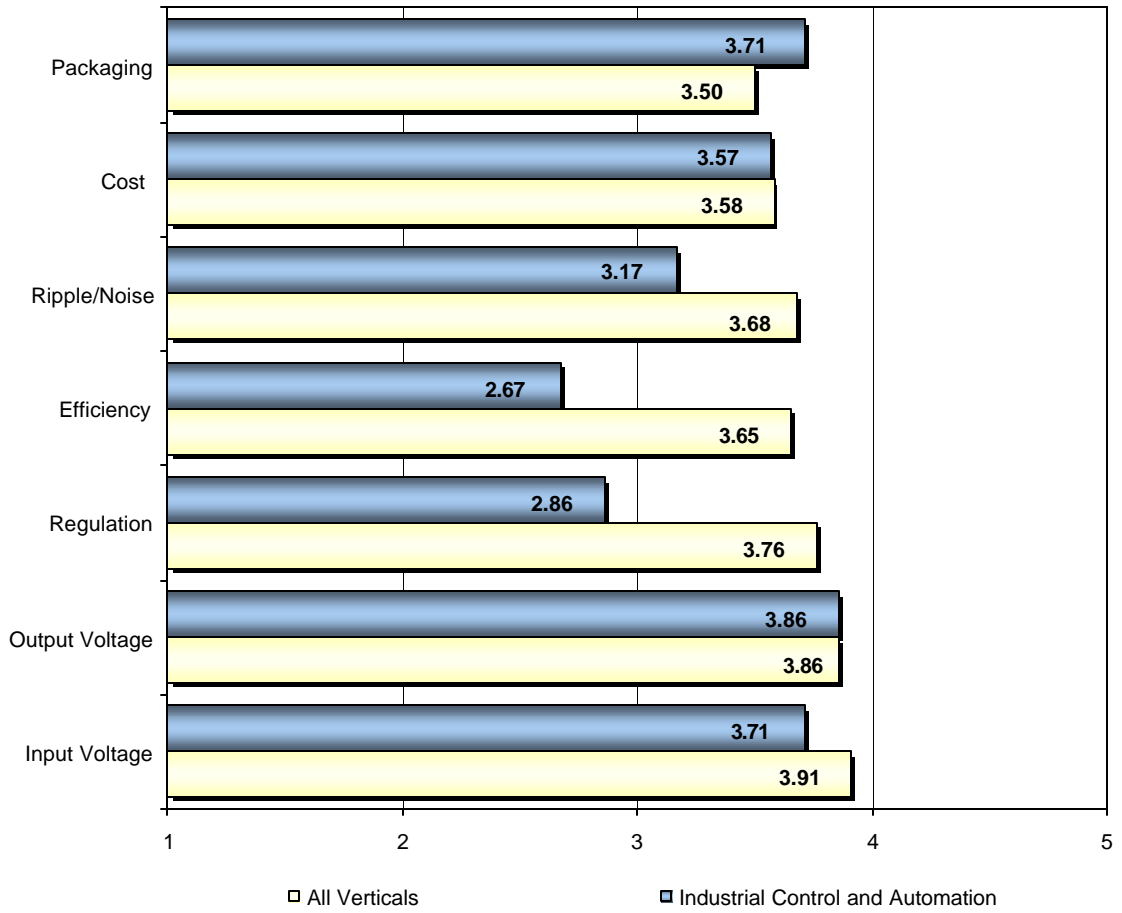


Exhibit IV -60
 PFC Controllers Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

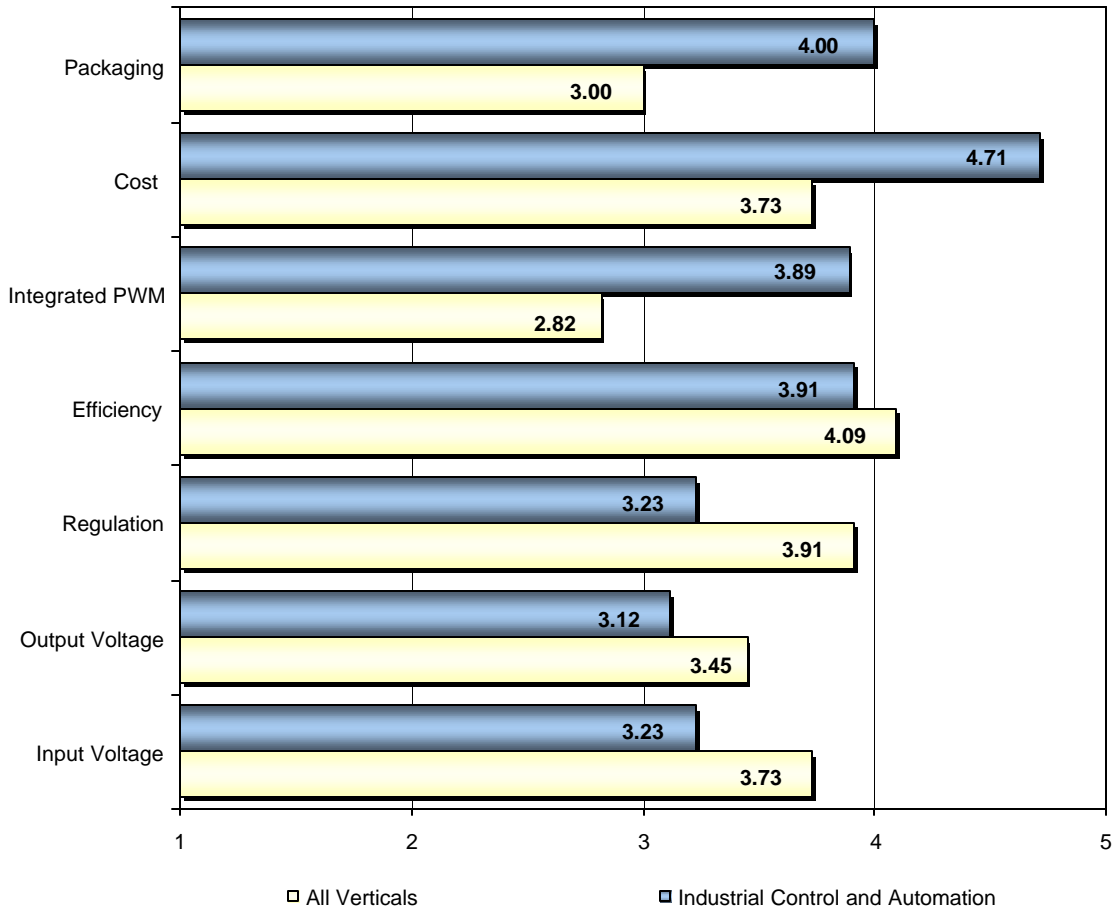


Exhibit IV -61
 Battery Charging and Management ICs Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

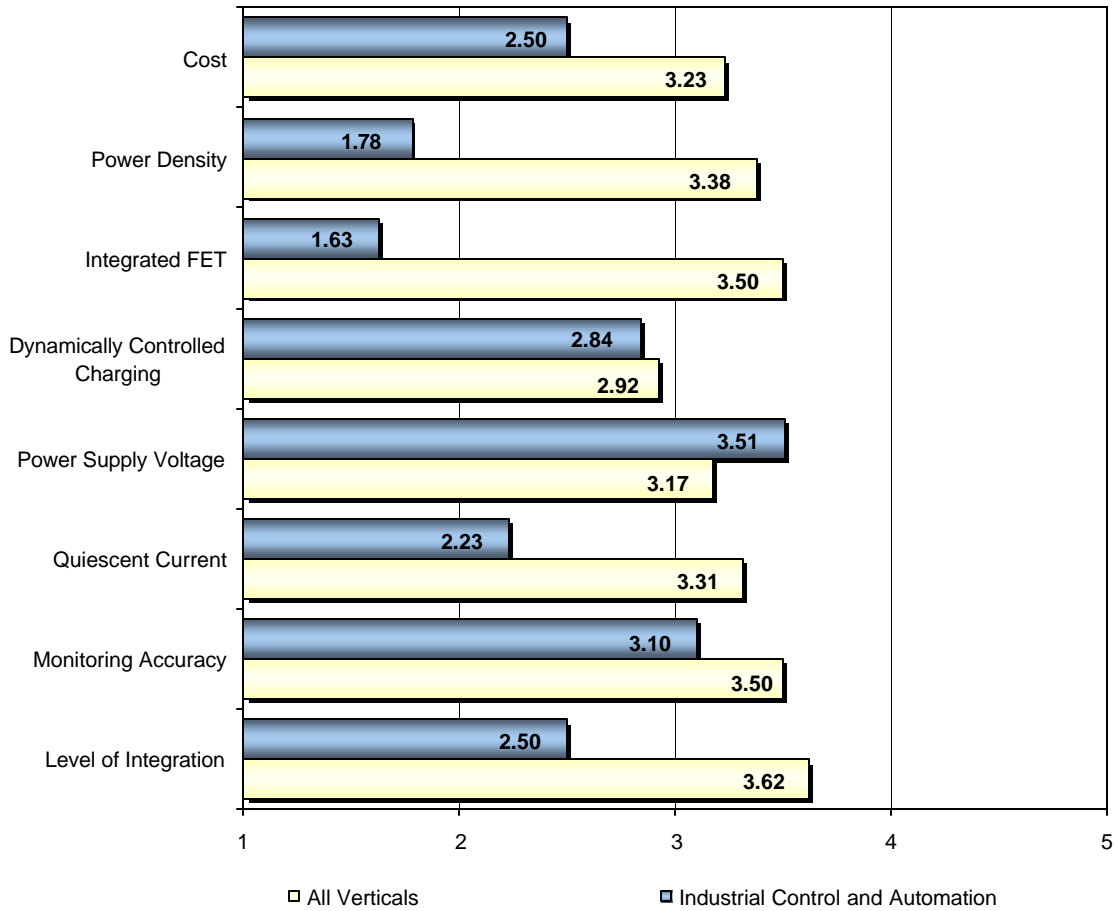
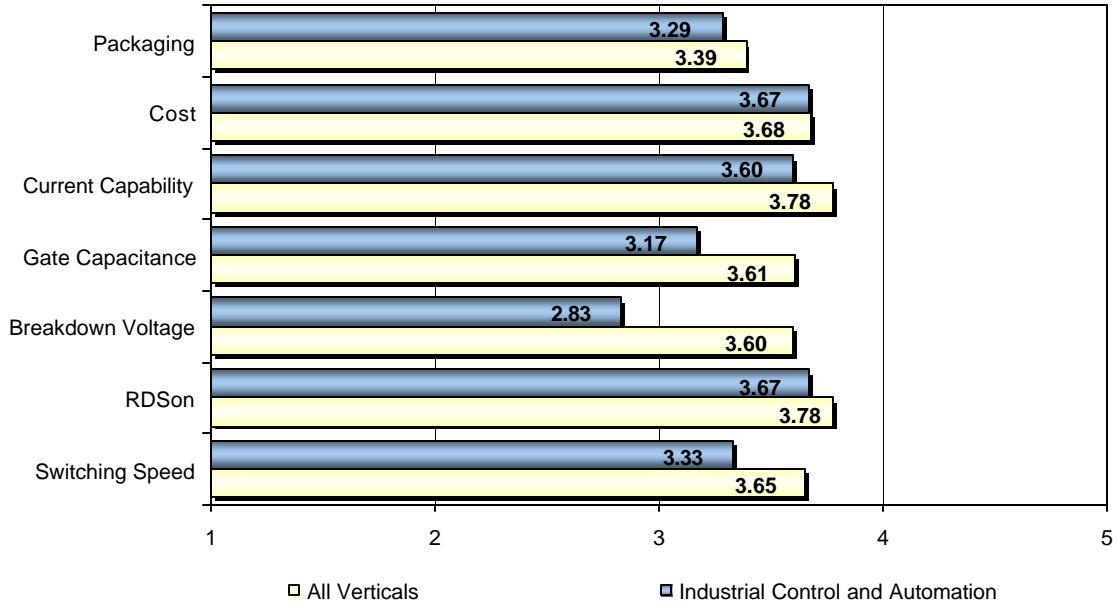


Exhibit IV -62
 MOSFET Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



Most OEMs expect a level or increase in volumes as shown in Exhibits IV-63 through IV-67. Optimism about the economy and the need for more industrial automation is a common thread among OEMs.

Exhibit IV -63
 Use of PWMs in the Industrial Control and Automation Industry
 (Percent of Respondents)

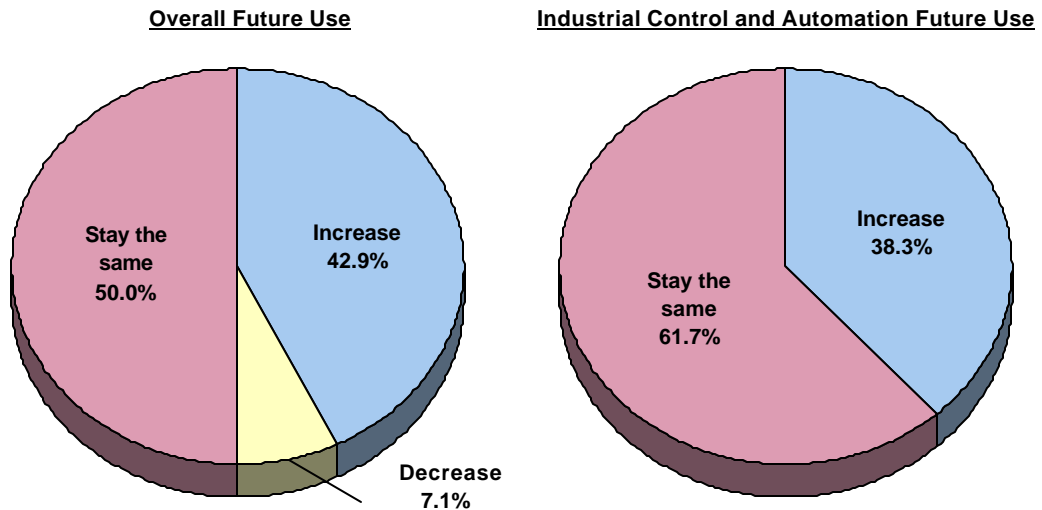


Exhibit IV -64
Use of DC/DC Regulators in the Industrial Control and Automation Industry
(Percent of Respondents)

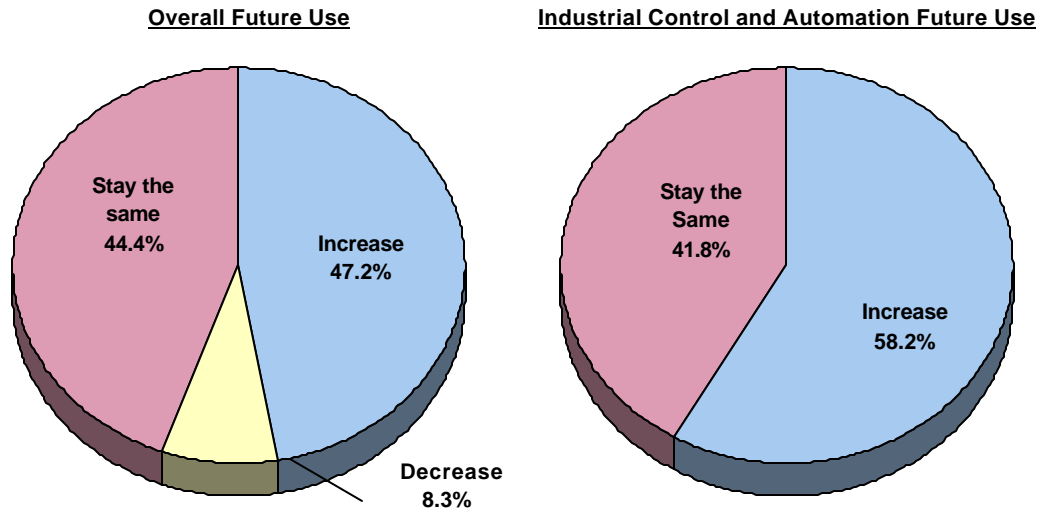


Exhibit IV -65
Use of AC/DC Off Line Regulators in the Industrial Control and Automation Industry
(Percent of Respondents)

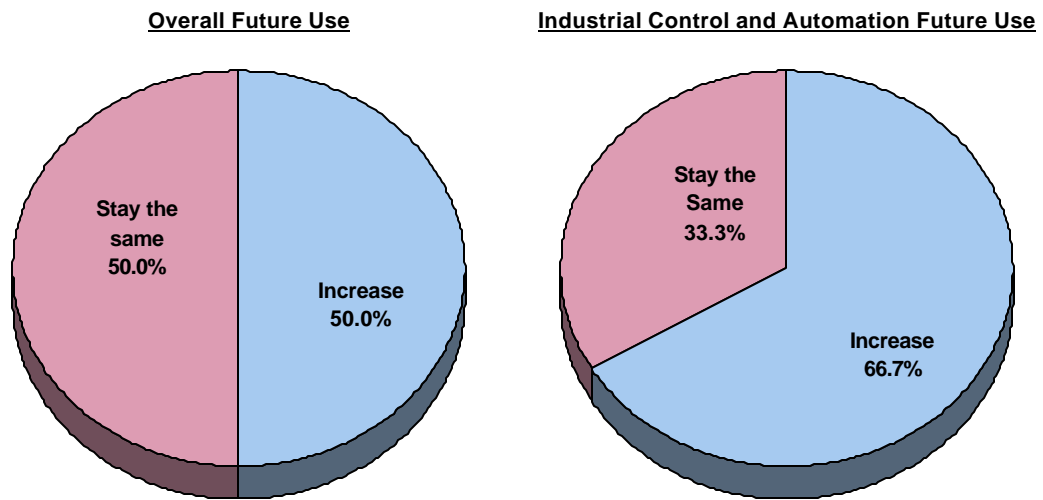


Exhibit IV -66

Use of Linear Regulators in the Industrial Control and Automation Industry
(Percent of Respondents)

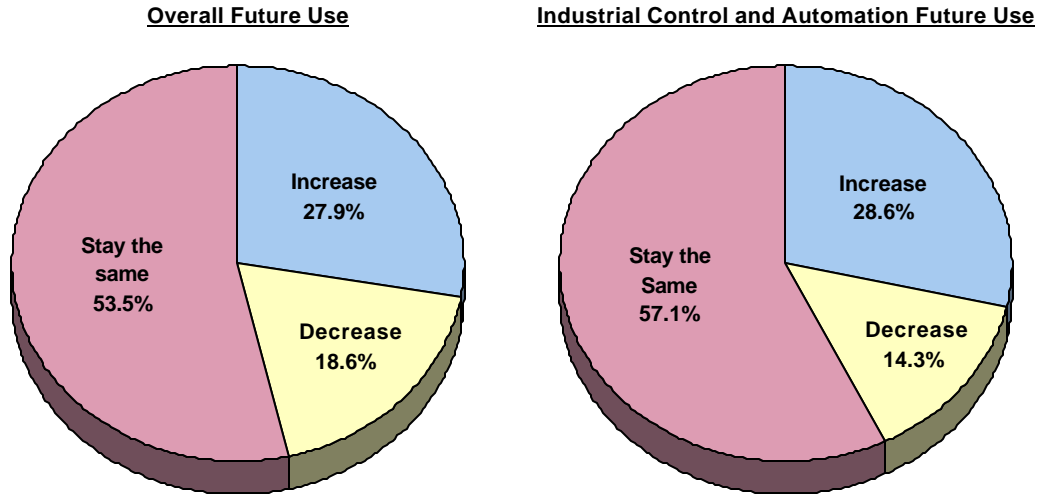


Exhibit IV -67

Use of Battery Charging and Management ICs in the Industrial Control and Automation Industry
(Percent of Respondents)

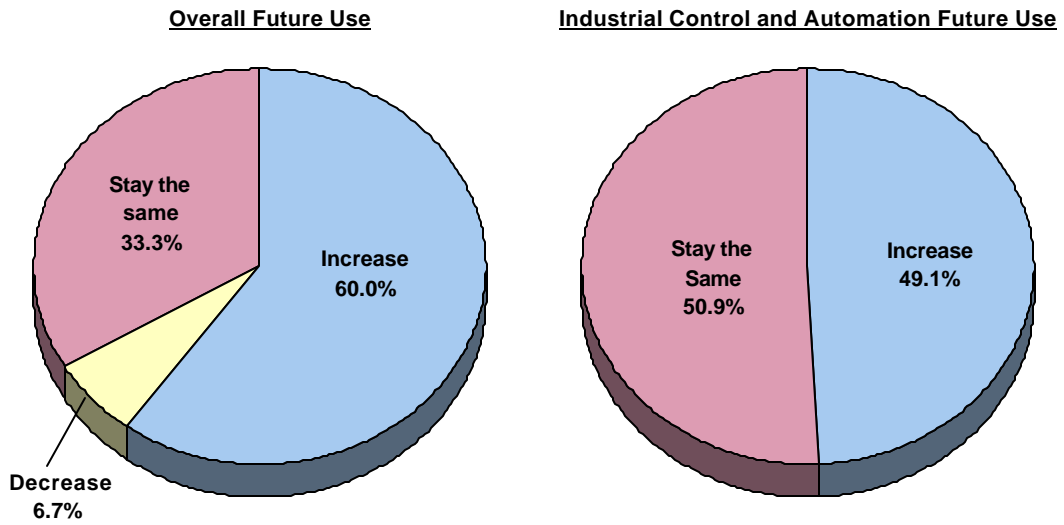
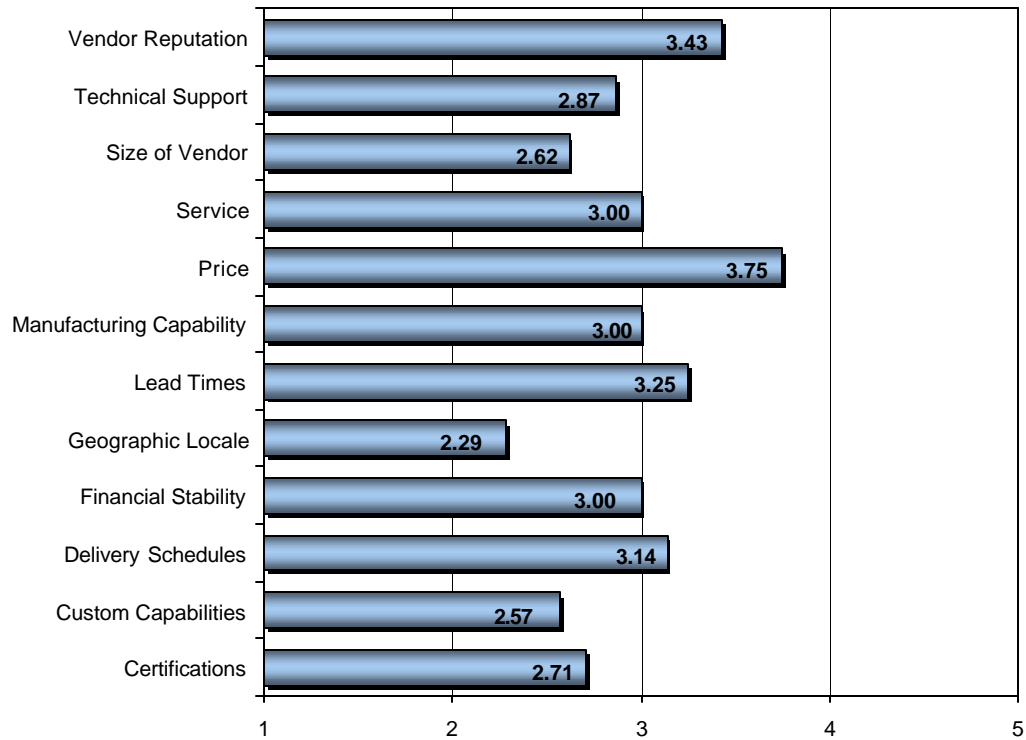


Exhibit IV -68
 Non-Product Selection Criteria for Industrial Control and Automation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



Once again, as in most standard or commodity products, price is the most important non-product criteria.

INSTRUMENTATION

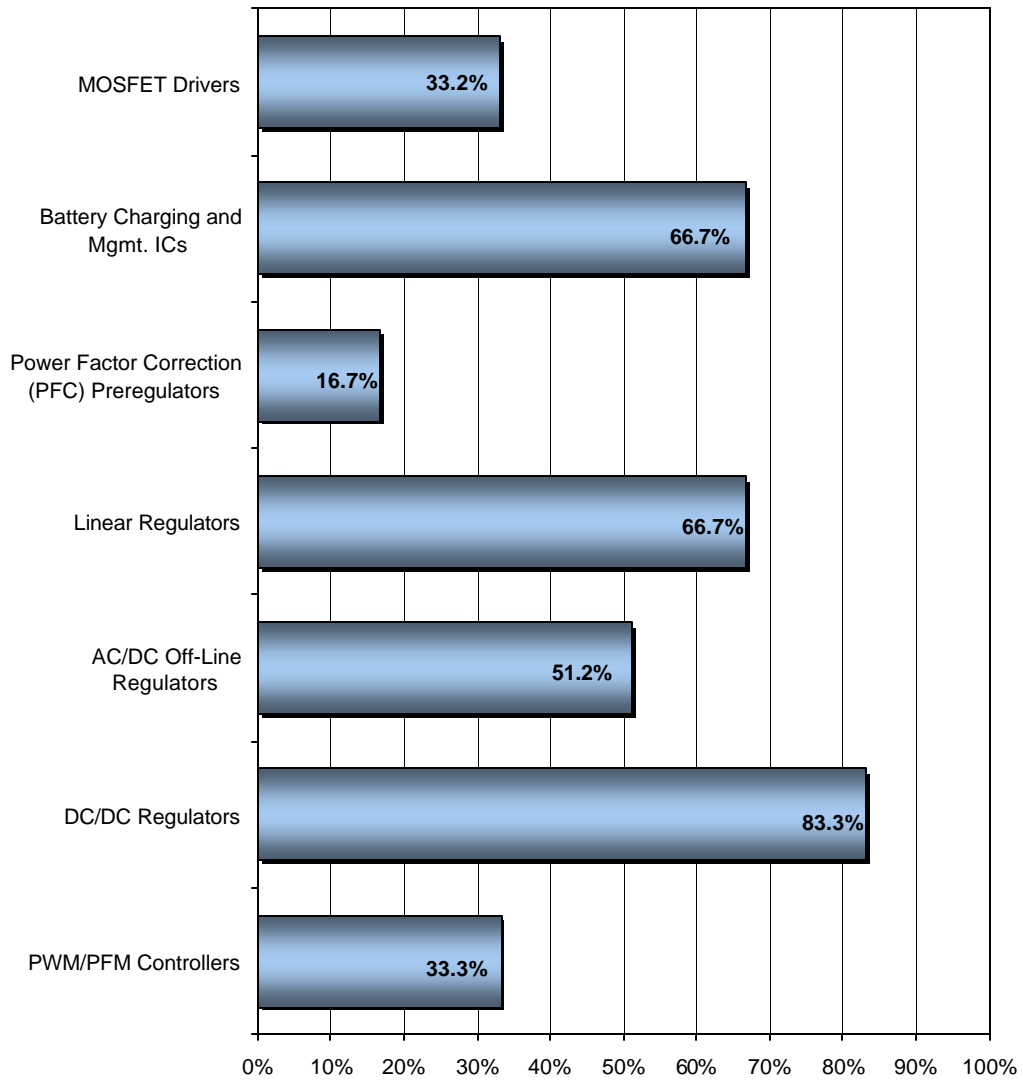
Exhibit IV-69 shows the percent of instrumentation respondents using each type of power IC.

The instrumentation industry also represents itself as one of the steadier uptick potentials. For the most part OEMS require a high accuracy, a high dynamic range, a high speed, low power consumption, an excellent reliability and low costs.

Exhibit IV-69 through IV-73 show the importance of each product criteria, while Exhibits IV-74 through IV-79 show the expected flat to increases in demand.

Exhibit IV -69
 Instrumentation Respondents Using Each Type of Power IC
 (Percent of Respondents)

1=Not Important, 5=Very Important



Note: Percentages sum to over 100% due to multiple responses.

Exhibit IV -70
 PWM/PFM Product Selection Criteria for Instrumentation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

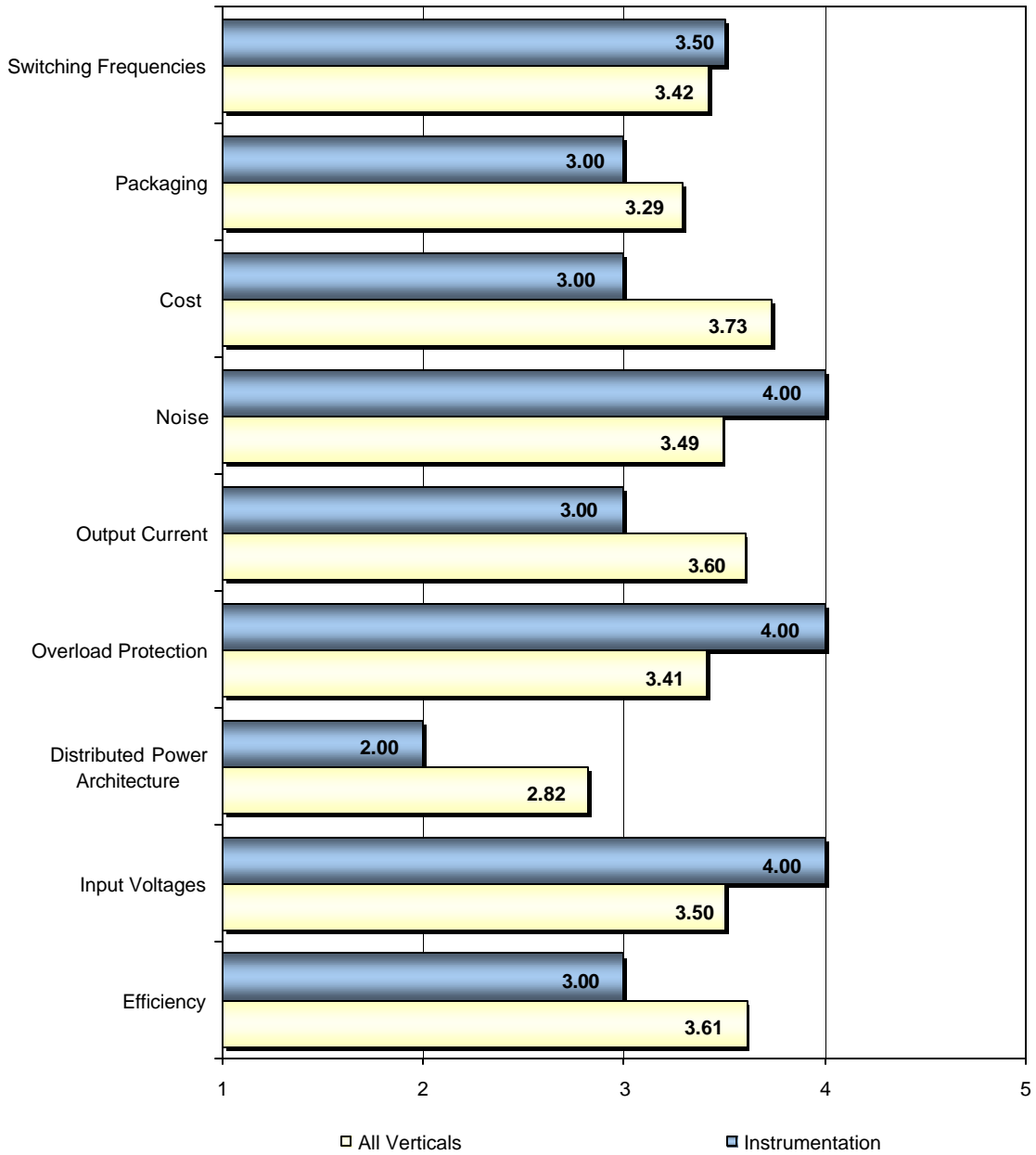


Exhibit IV -71
DC/DC Regulators Product Selection Criteria for Instrumentation Respondents
(Mean Rating)

1=Not Important, 5=Very Important

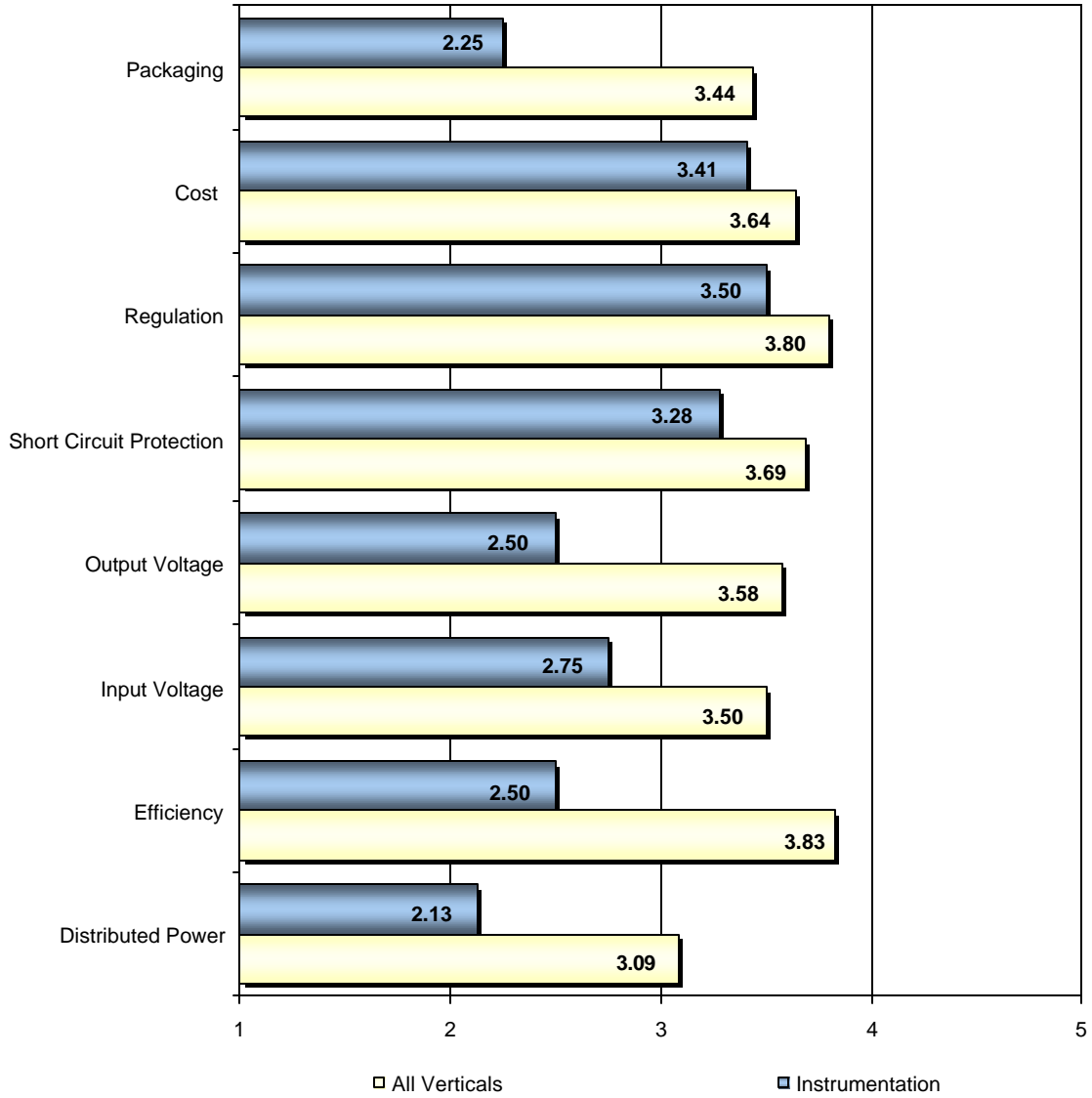


Exhibit IV-72
AC/DC Off Line Regulators Product Selection Criteria for Instrumentation Respondents
(Mean Rating)

1=Not Important, 5=Very Important

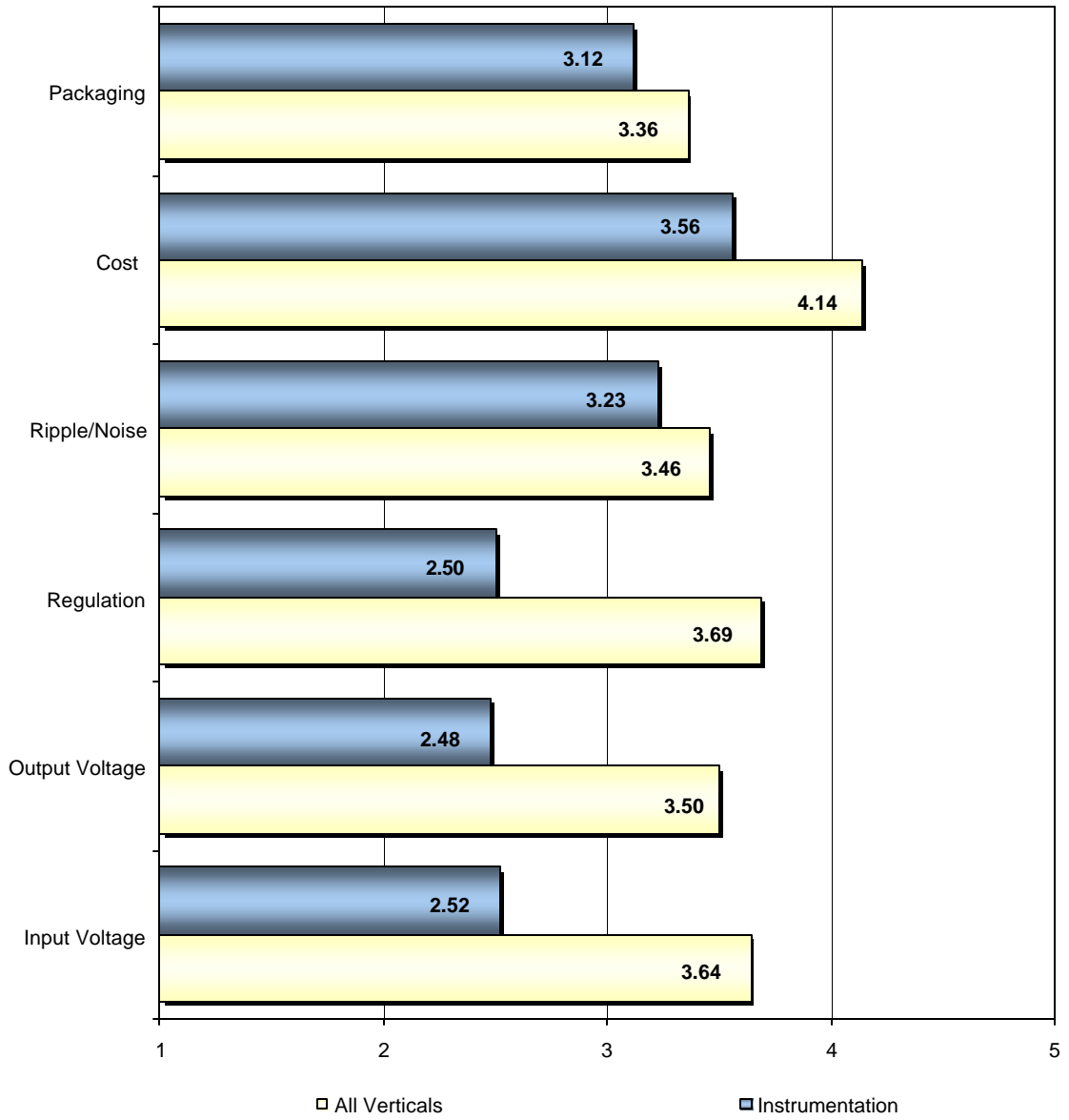


Exhibit IV -73
 Linear Regulators Product Selection Criteria for Instrumentation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

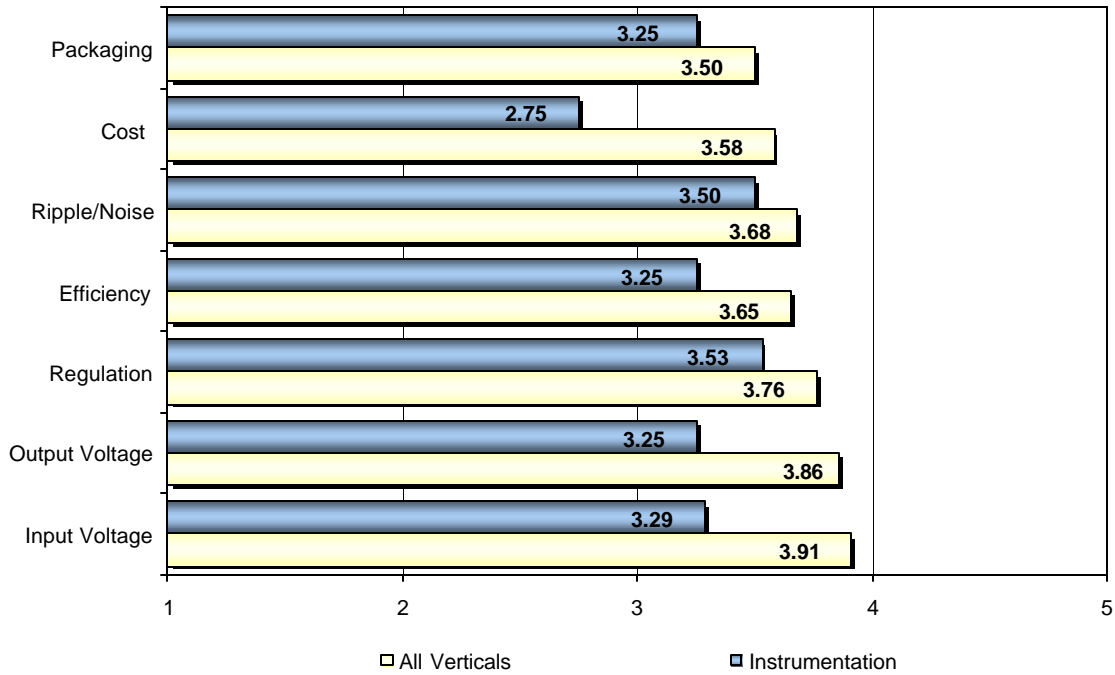


Exhibit IV -74
 Use of PWMs In the Instrumentation Industry
 (Percent of Respondents)

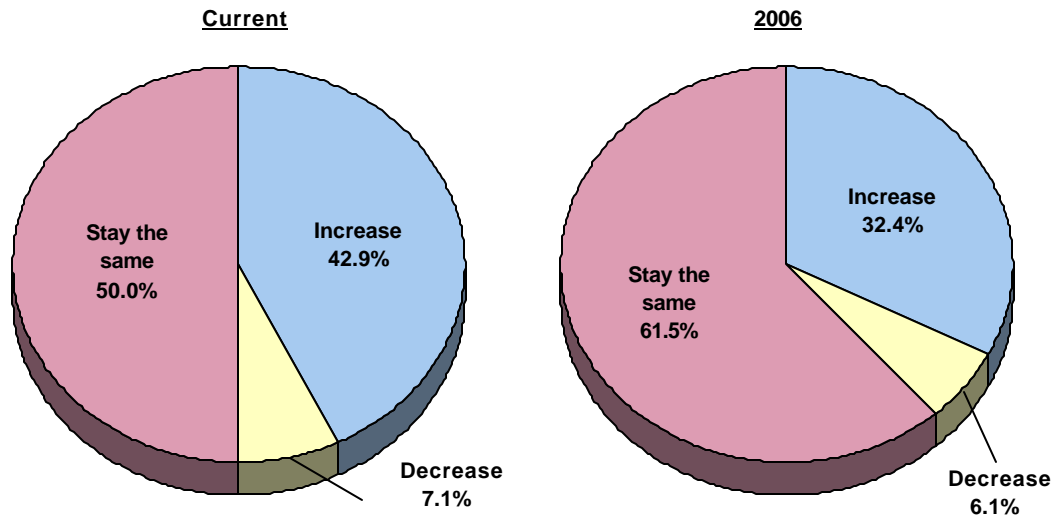


Exhibit IV -75
Use of DC/DC Regulators in the Instrumentation Industry
(Percent of Respondents)

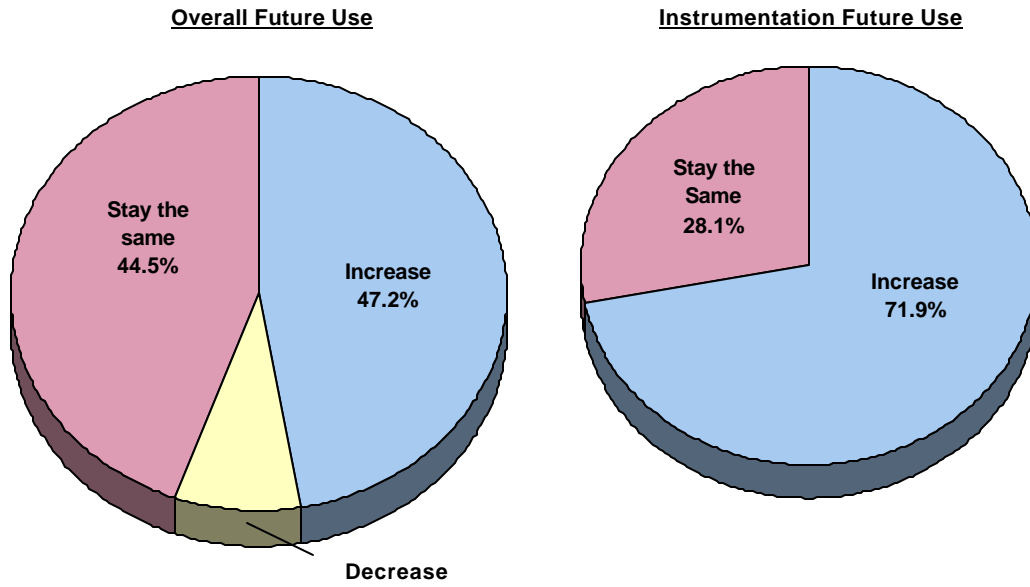


Exhibit IV -76
Use of AC/DC Off Line Regulators In the Instrumentation Industry
(Percent of Respondents)

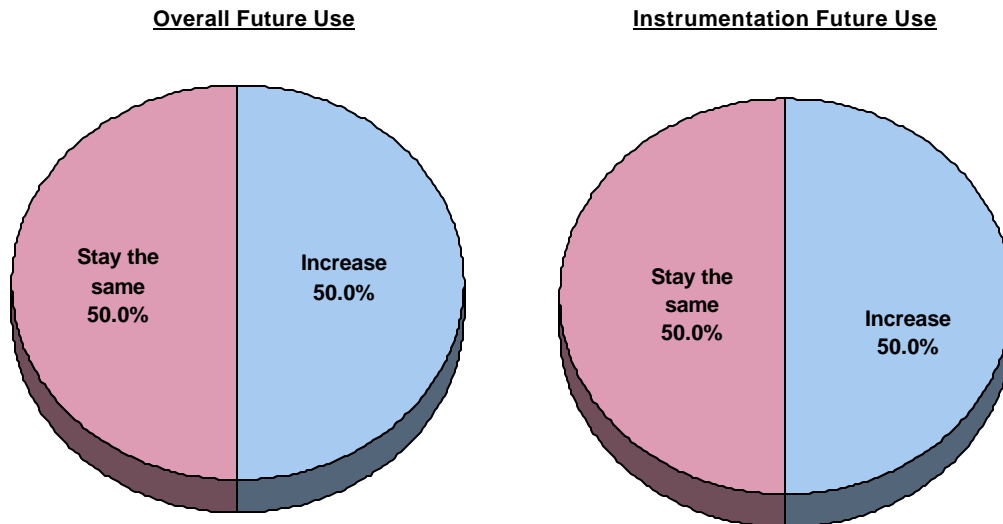


Exhibit IV -77
 Use of Linear Regulators In the Instrumentation Industry
 (Percent of Respondents)

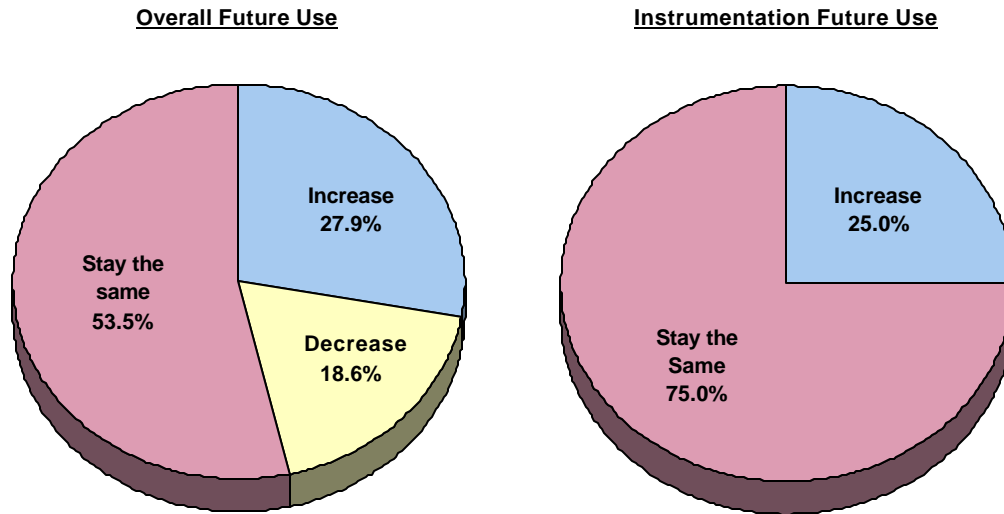


Exhibit IV -78
 Use of PFC Controllers in the Instrumentation Industry
 (Percent of Respondents)

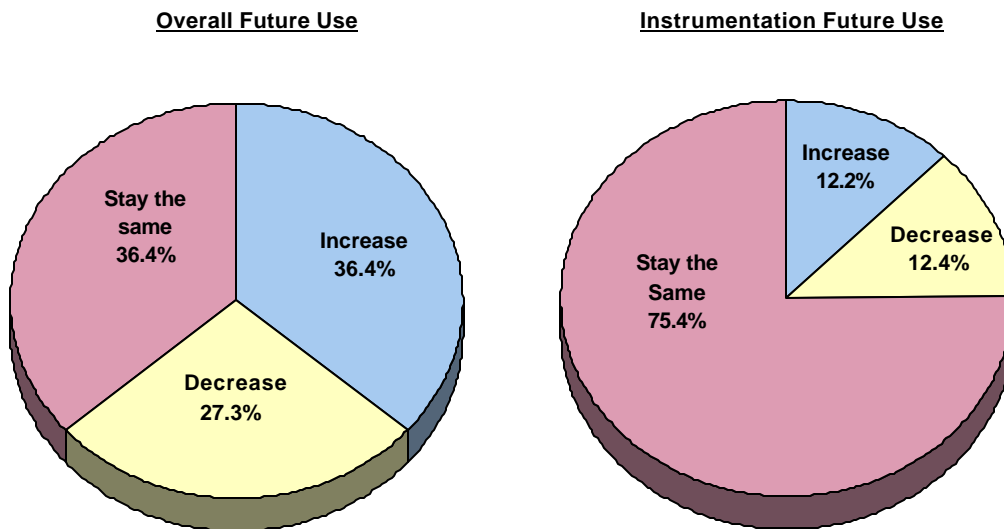
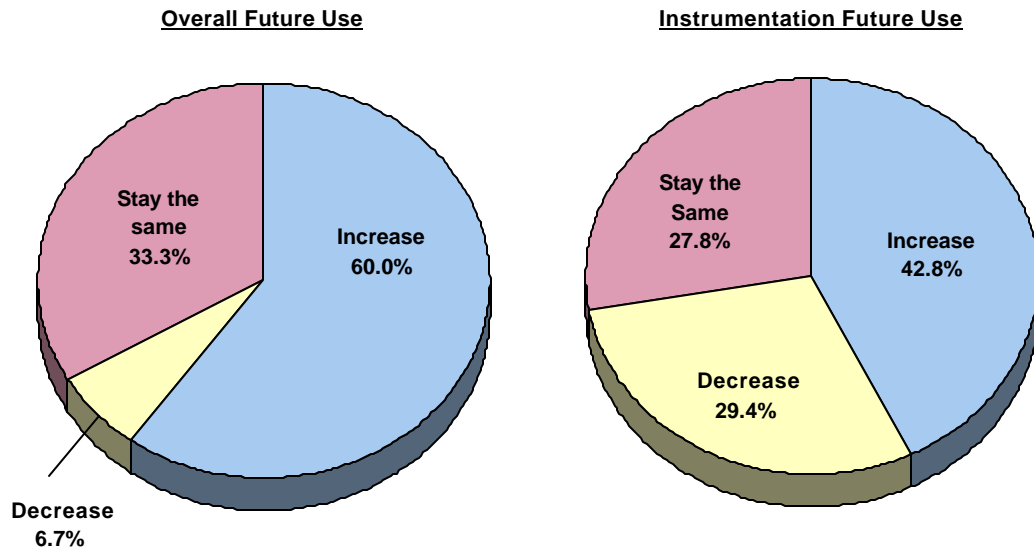


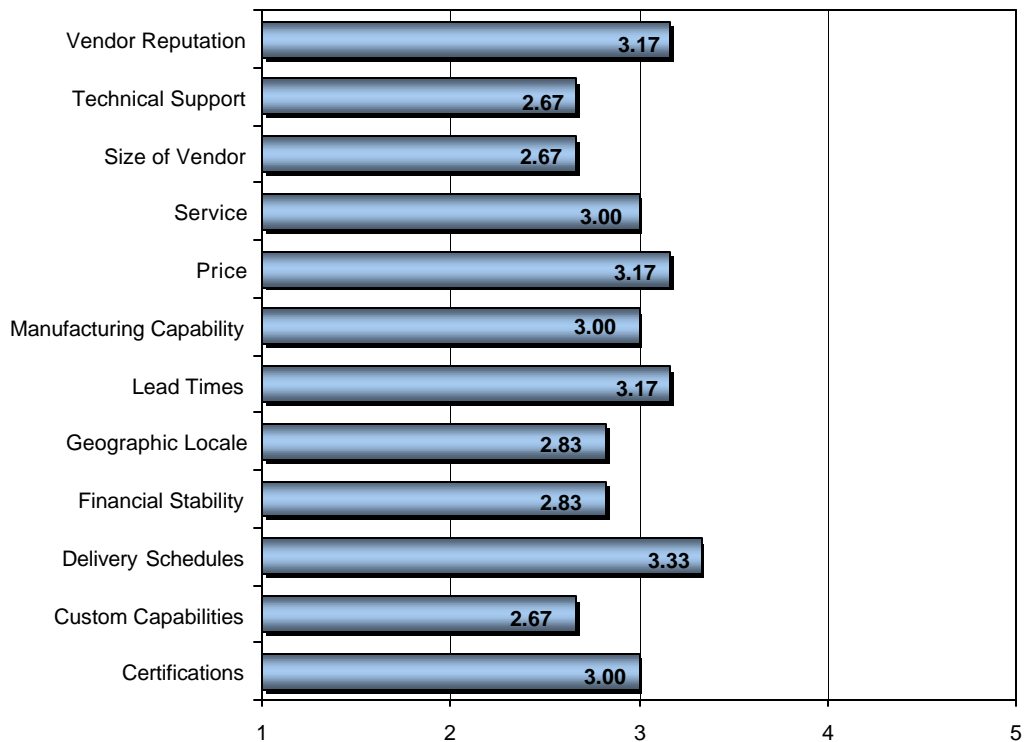
Exhibit IV -79
 Use of Battery Charging and Management ICs In the Instrumentation Industry
 (Percent of Respondents)



The Instrumentation market relies heavily on making schedules as evidenced by delivery schedules being the most important non-product selection criteria (Exhibit IV-80).

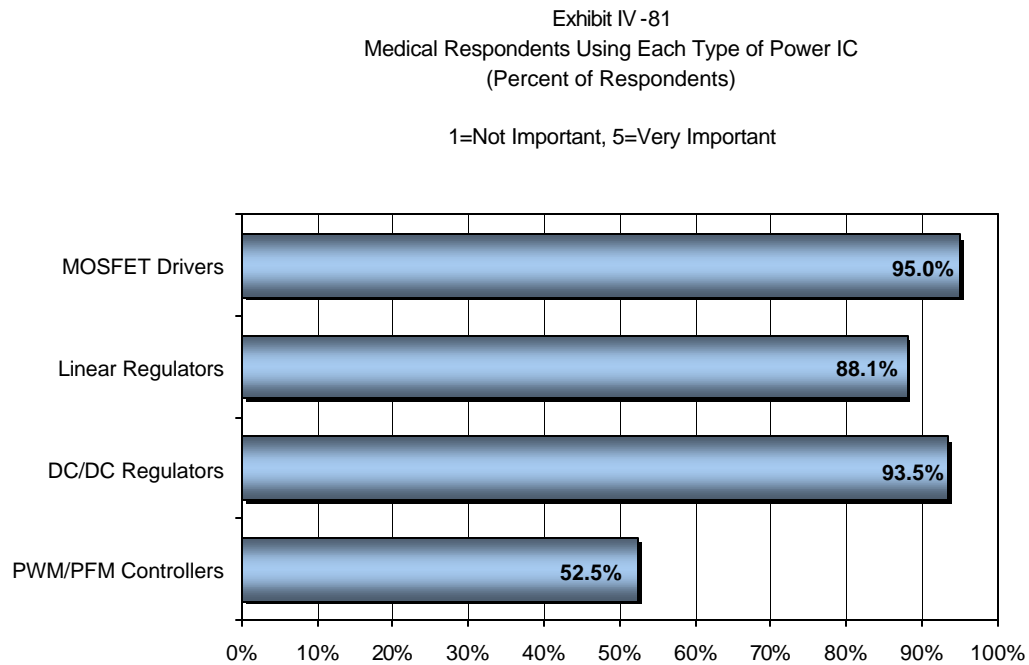
Exhibit IV -80
 Non-Product Selection Criteria for Instrumentation Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



MEDICAL

The Medical industry has always relied on a variety of power ICs for imaging and patient monitoring, and will continue to do so. Exhibit IV-81 shows the percent of medical respondents using each type of power IC.



Note: Percentages sum to over 100% due to multiple responses.

The Medical Imaging market is becoming more sophisticated with regard to graphics and speed. Both require the use of many power ICs. A higher percentage of custom ICs are seen in the medical market, particularly with thermal considerations in packaging.

Exhibits IV-82 and IV-83 highlight the important product selection criteria, while Exhibits IV-84 and IV-86 show the OEM projected usage. Price, lead times and delivery schedules are most important to OEMs in the Medical industry. (Exhibit IV-87)

Exhibit IV -82
DC/DC Regulators Product Selection Criteria for Medical Respondents
(Mean Rating)

1=Not Important, 5=Very Important

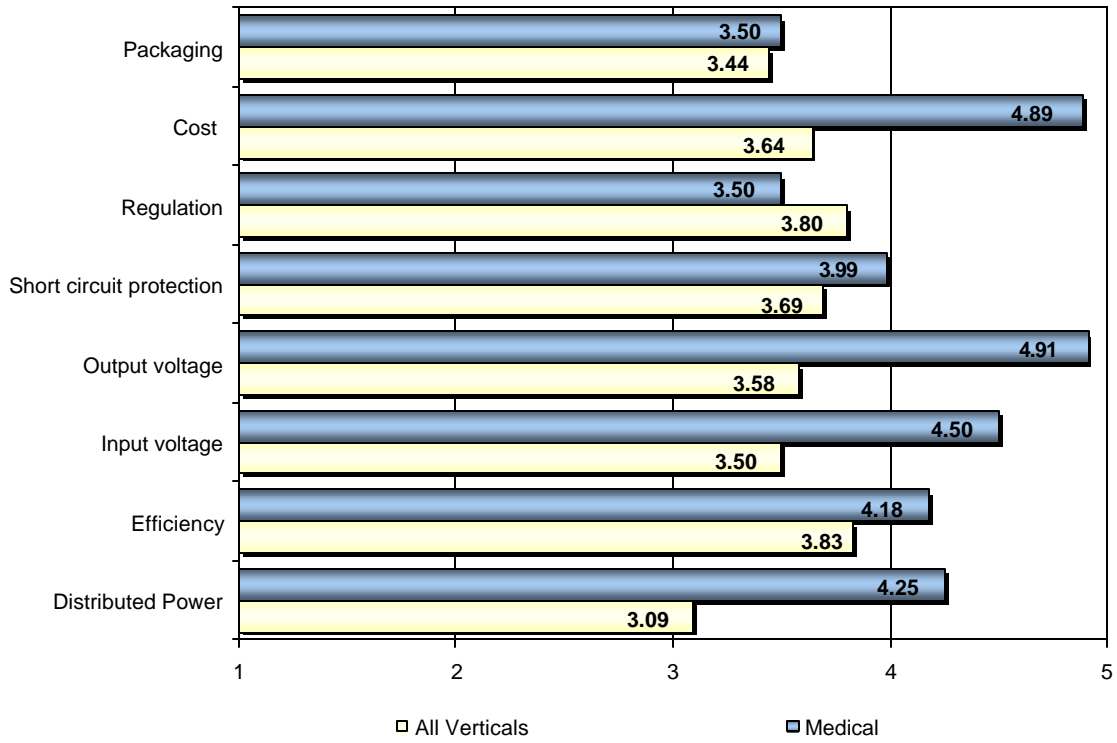


Exhibit IV -83
MOSFET Product Selection Criteria for Medical Respondents
(Mean Rating)

1=Not Important, 5=Very Important

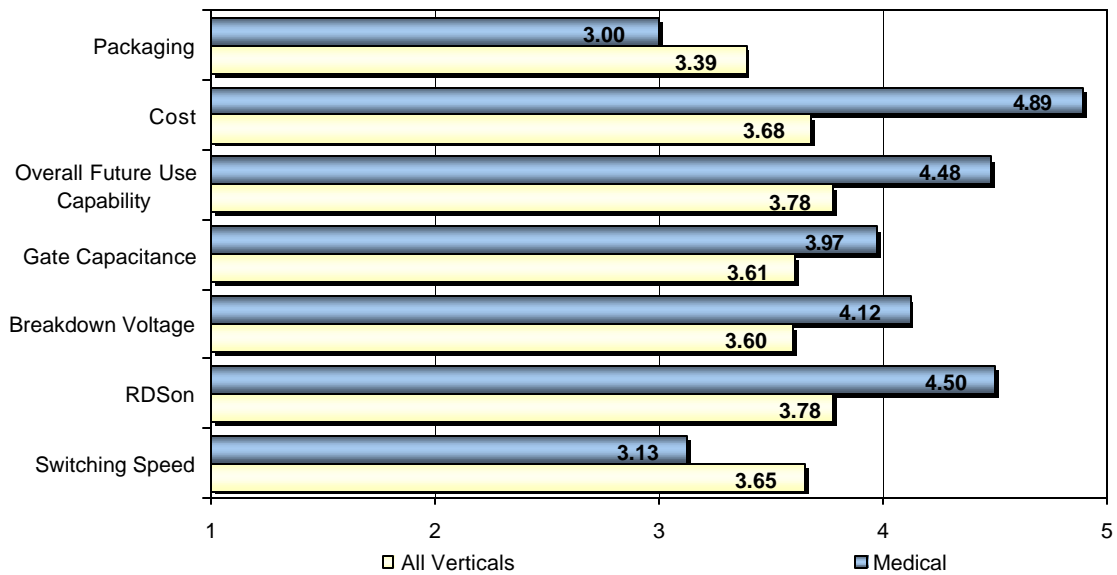


Exhibit IV -84
Use of DC/DC Regulators in the Medical Industry
(Percent of Respondents)

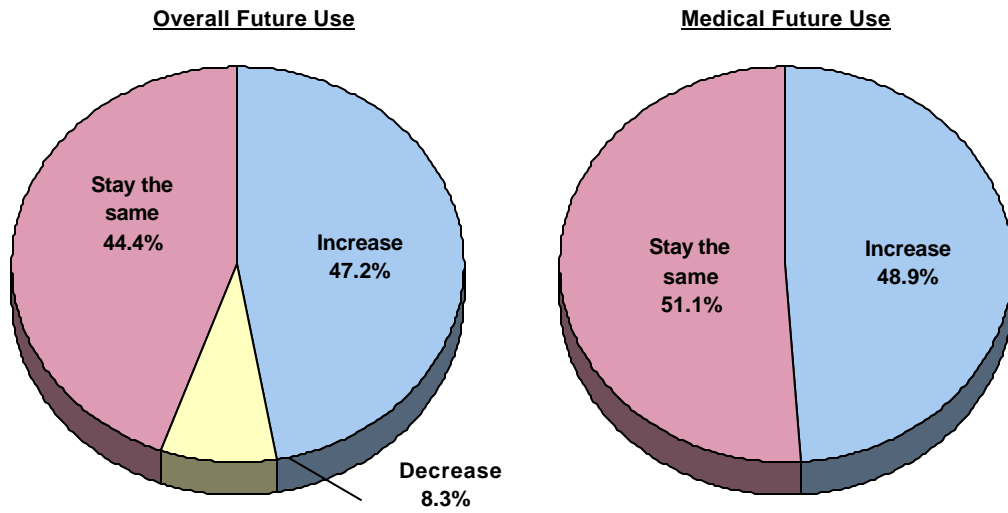


Exhibit IV -85
Use of Linear Regulators in the Medical Industry
(Percent of Respondents)

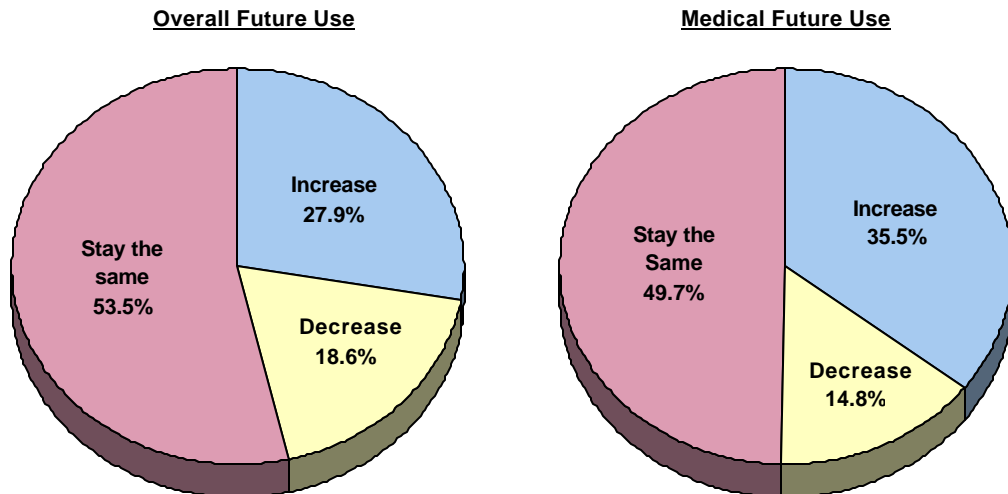


Exhibit IV -86
Use of MOSFETS in the Medical Industry
(Percent of Respondents)

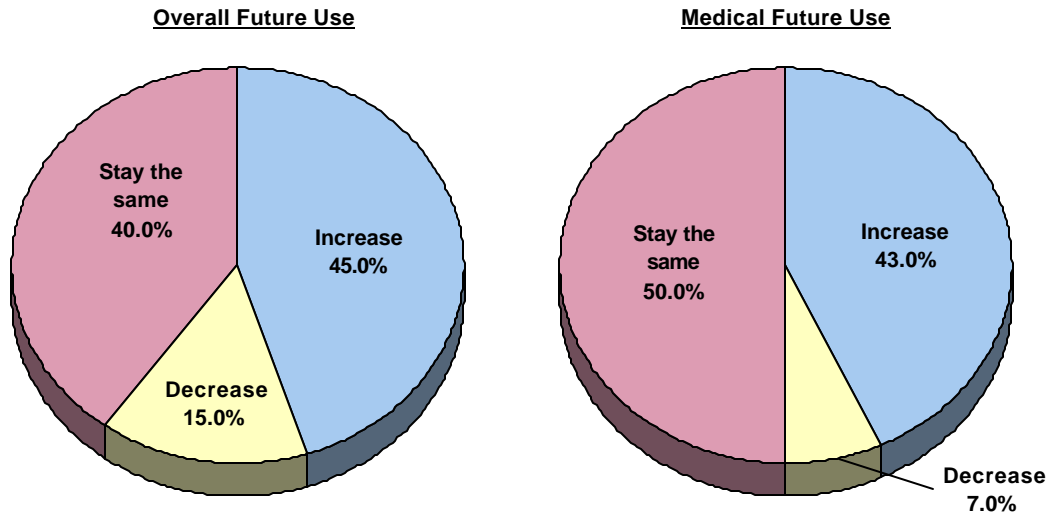
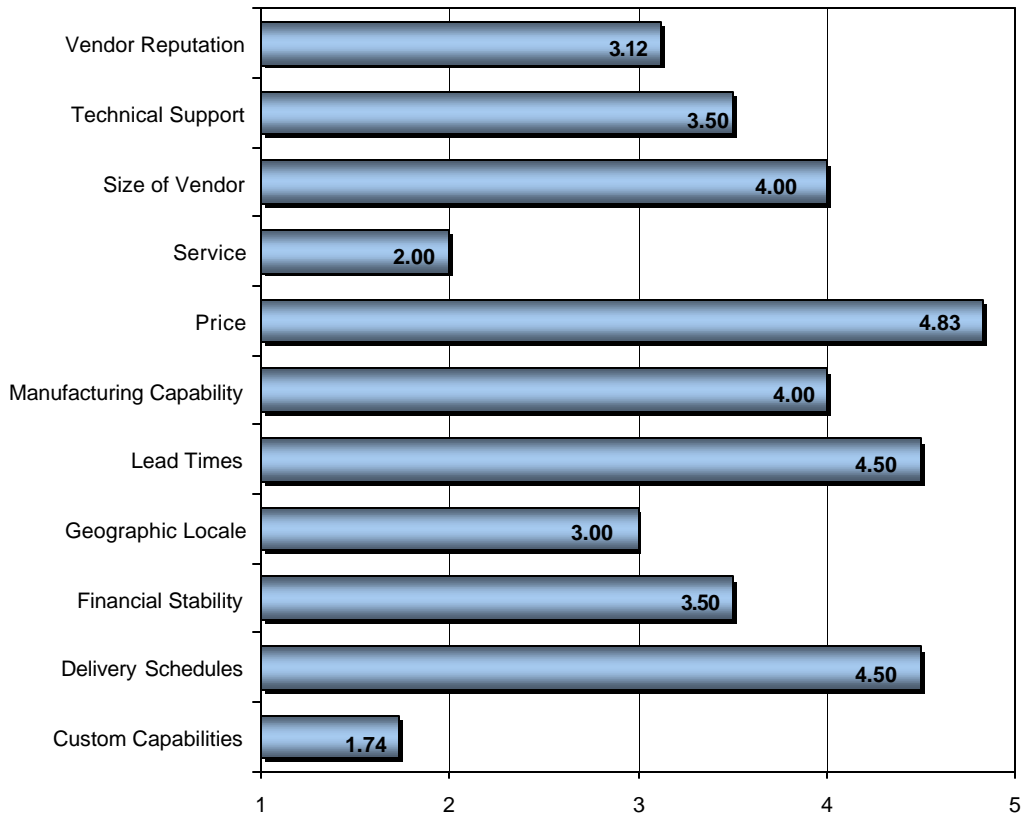


Exhibit IV -87
Non-Product Selection Criteria for Medical Respondents
(Mean Rating)

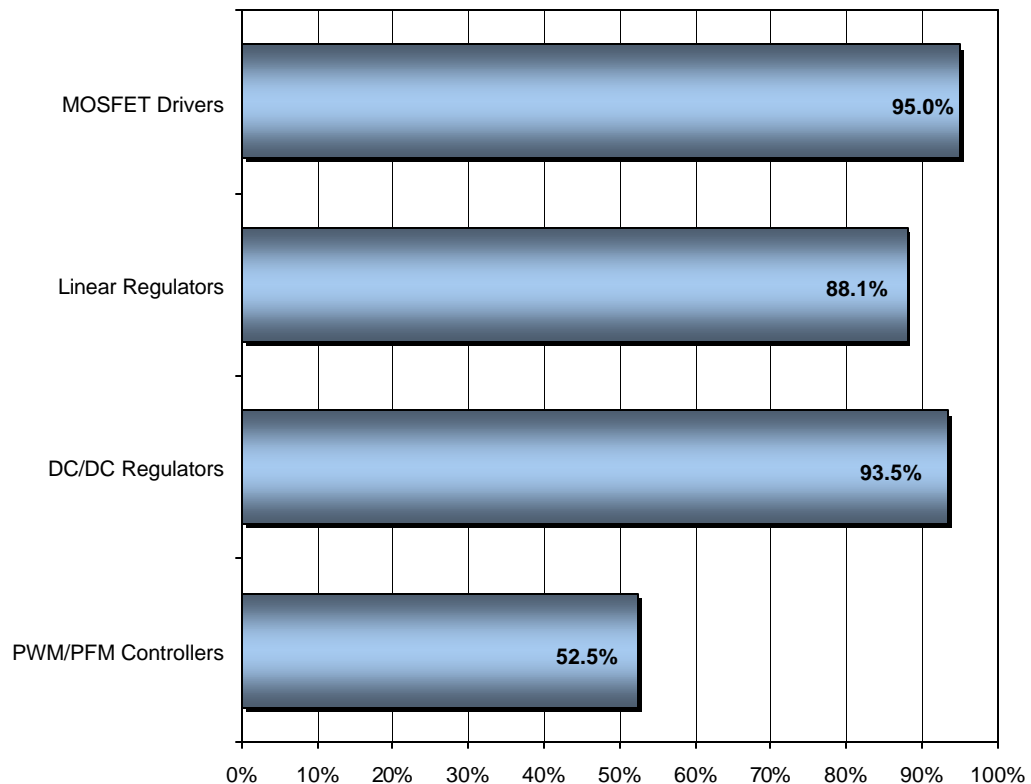
1=Not Important, 5=Very Important



MILITARY

Geo-political circumstances have fueled an increased demand by OEMs in the Military and Aerospace market. Exhibit IV-88 shows the percent of respondents in the Military/Aerospace market using each type of power IC.

Exhibit IV -88
Military and Aerospace Respondents Using Each Type of Power IC
(Percent of Respondents)



Note: Percentages sum to over 100% due to multiple responses.

ICs used in aerospace applications are highly specialized and are more frequently purchased in lower quantities. As evidenced in Exhibit IV-89 IV-93 product criteria such as switching frequencies, input voltages are of highest importance. Generally the ICs are designed to meet stringent requirements put forth by aerospace or military specs.

Exhibit IV -89
 PWM/PFM Product Selection Criteria for Military and Aerospace Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

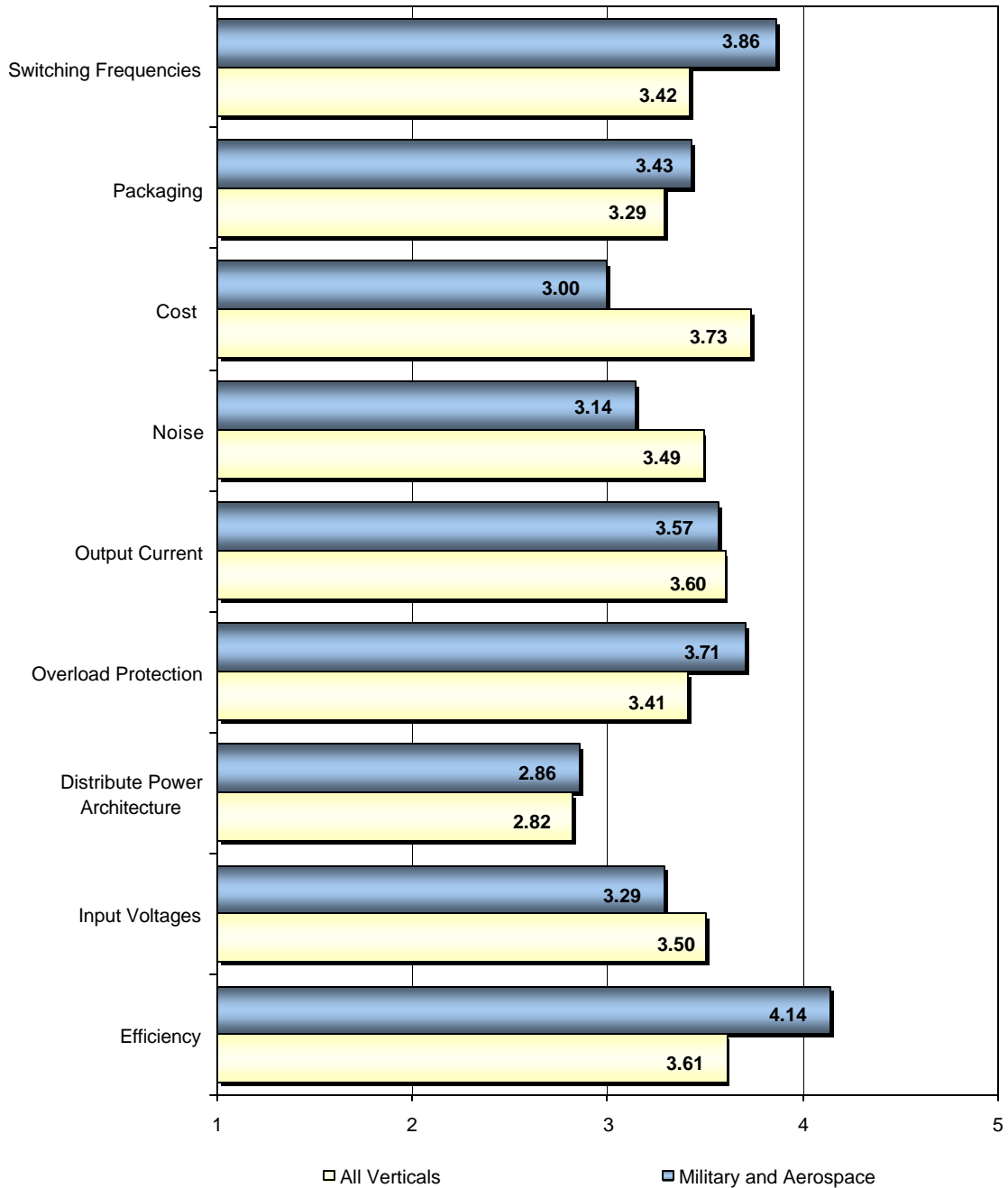


Exhibit IV -90
 DC/DC Regulators Product Selection Criteria for Military and Aerospace Respondents
 (Mean Rating)

1=Not Important, 5=Very Important

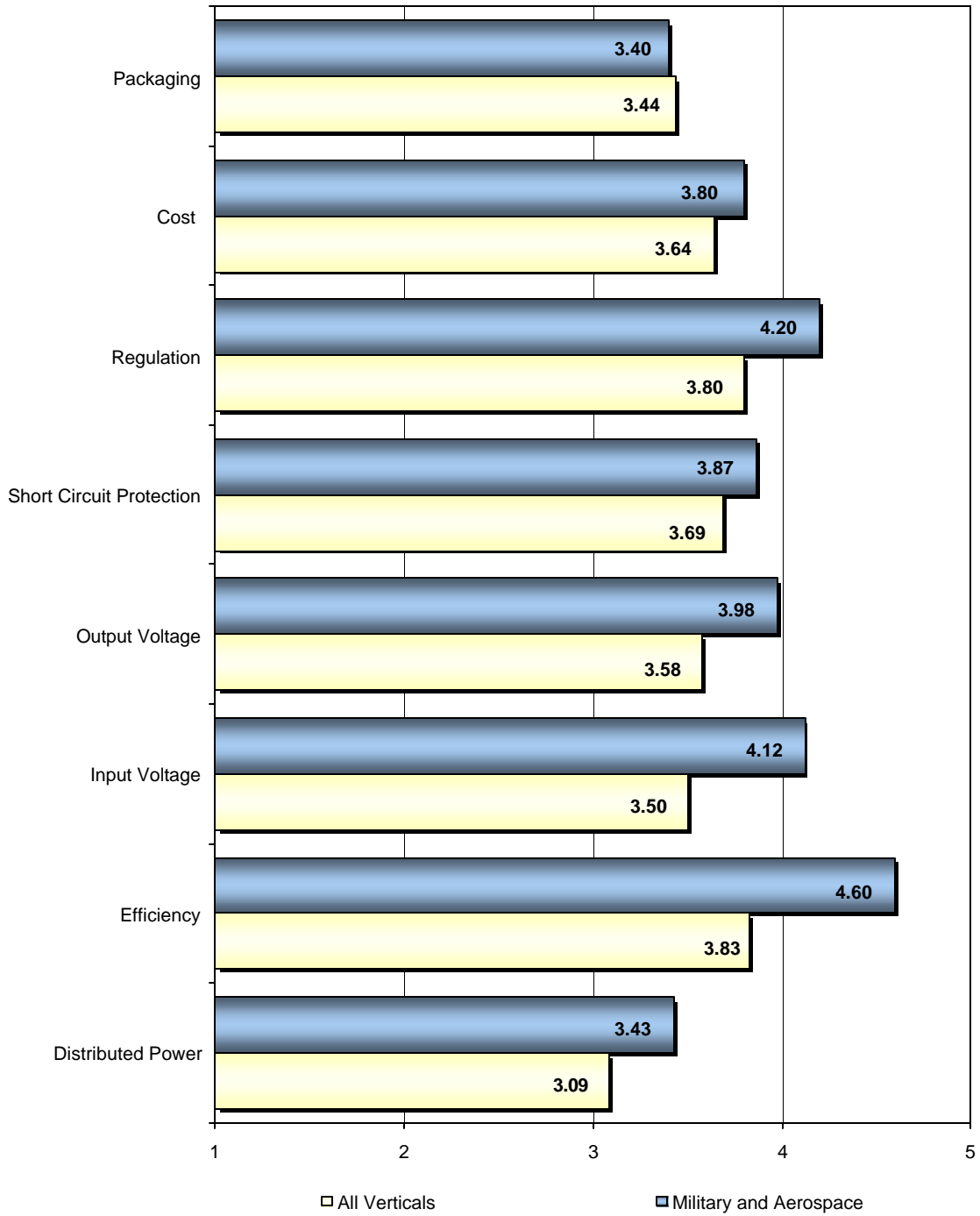


Exhibit IV -91
Linear Regulators Product Selection Criteria for Military and Aerospace Respondents
(Mean Rating)

1=Not Important, 5=Very Important

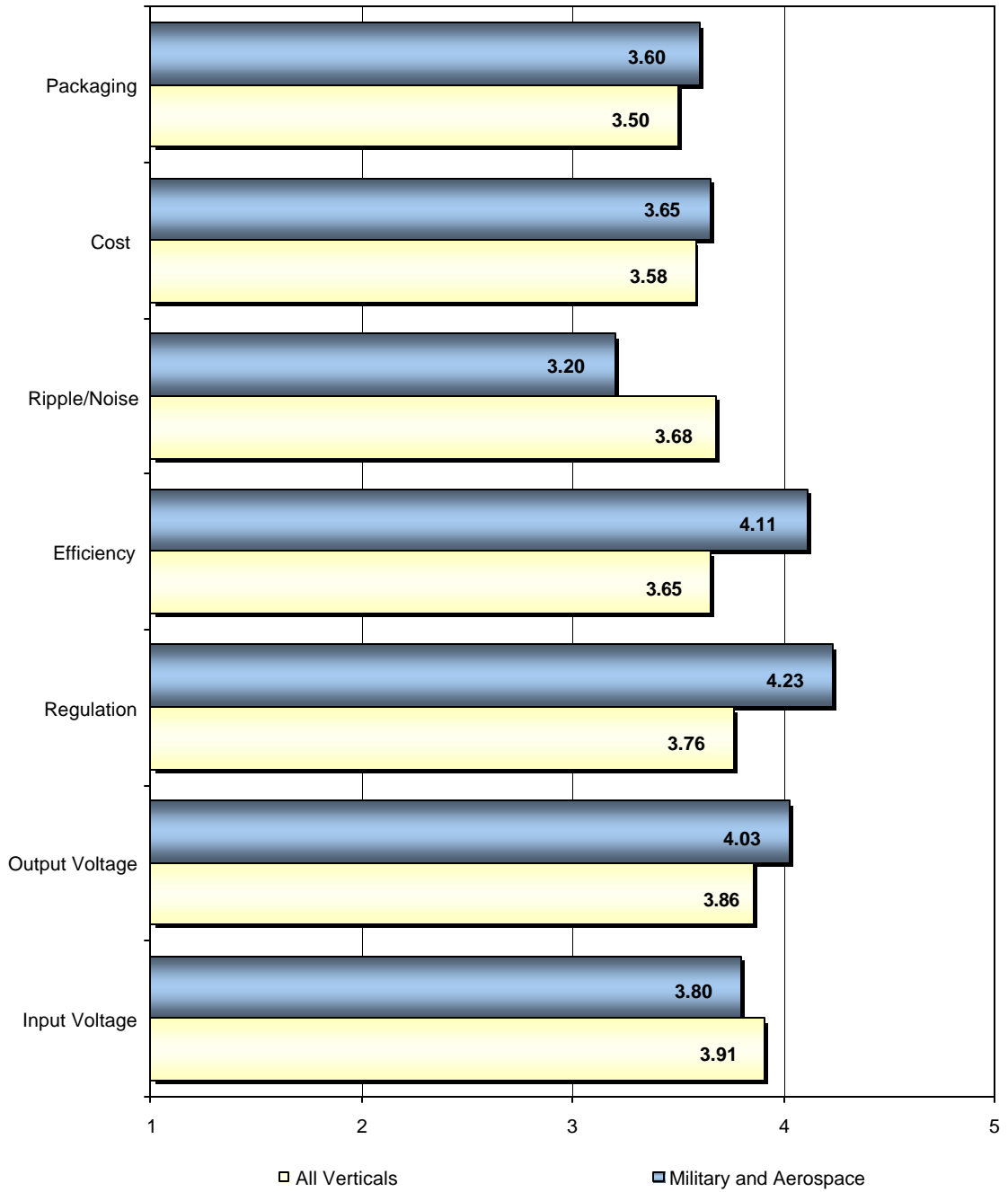


Exhibit IV -92
 PFC Controllers Product Selection Criteria for Military and Aerospace
 (Mean Rating)

1=Not Important, 5=Very Important

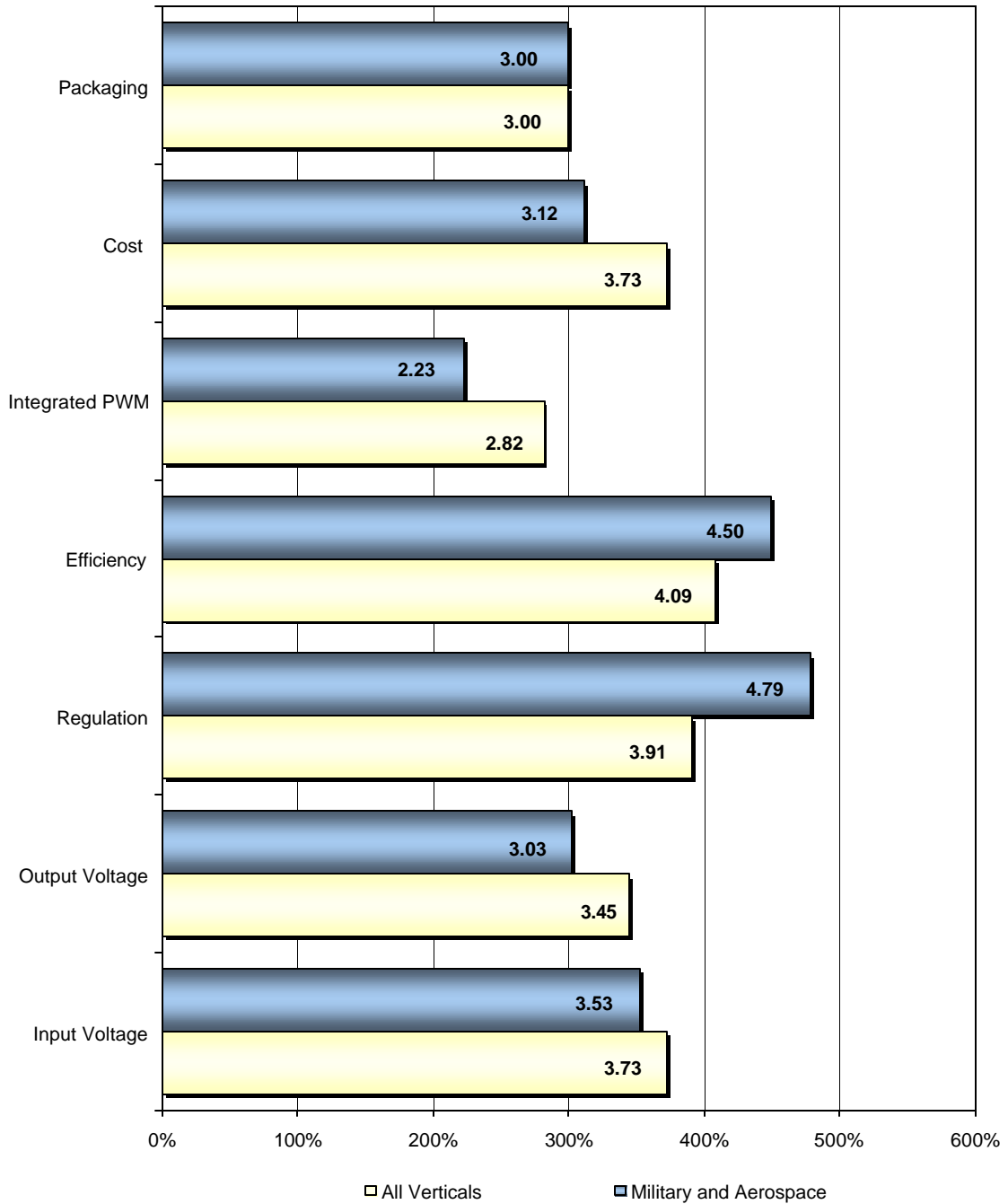
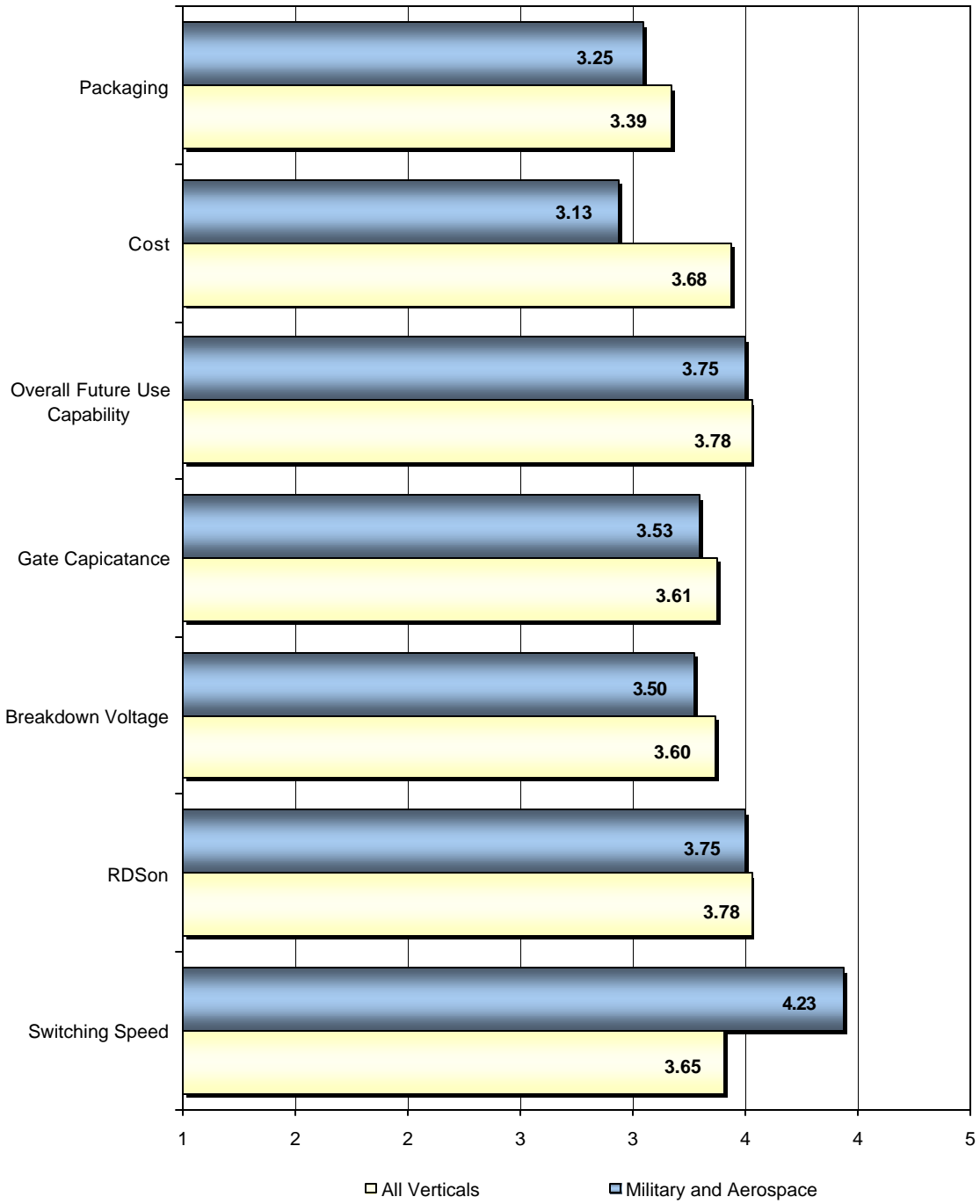


Exhibit IV -93
 MOSFET Product Selection Criteria for Military and Aerospace Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



Exhibits IV-94 through IV-97 show fluctuating demand pictures by the OEMS. However, power ICs for the Military industry tend to have high margins and offer profitability at lower volumes.

Exhibit IV -94
Use of PWMs in the Military and Aerospace Industry
(Percent of Respondents)

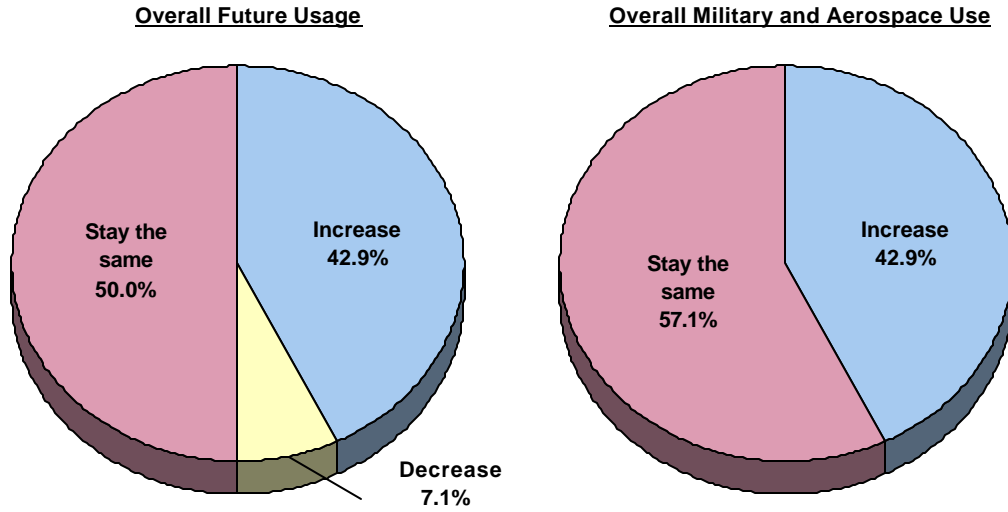


Exhibit IV -95
Use of Linear Regulators in the Military and Aerospace Industry
(Percent of Respondents)

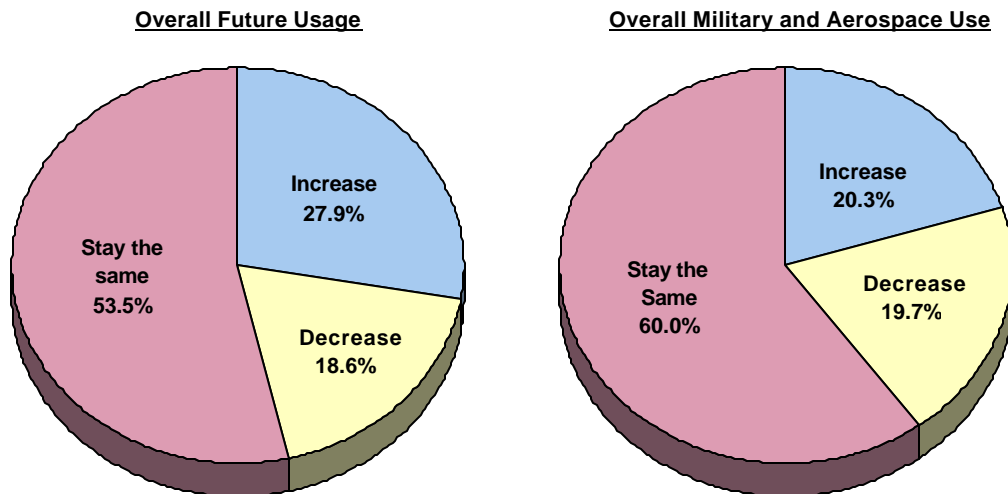


Exhibit IV -96
Use of PFC Controllers in the Military and Aerospace Industry
(Percent of Respondents)

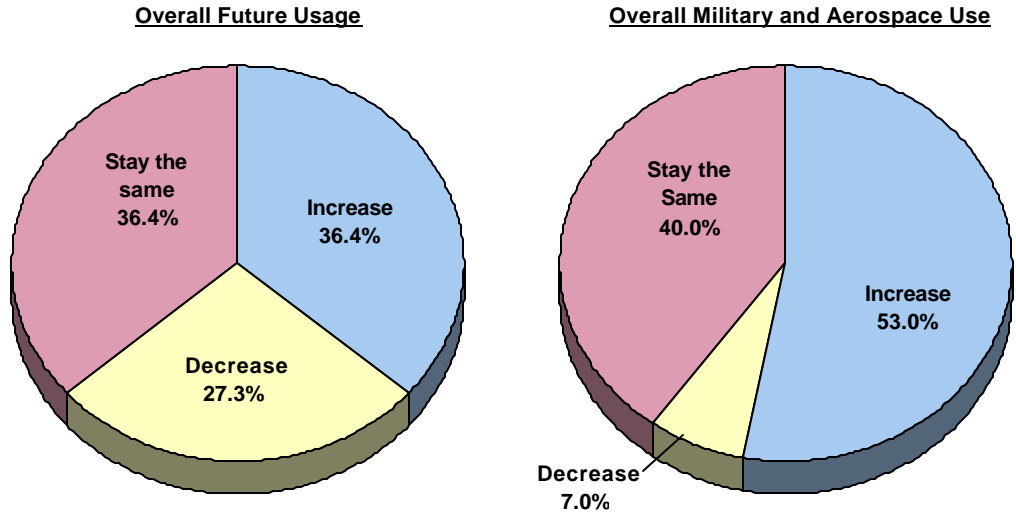
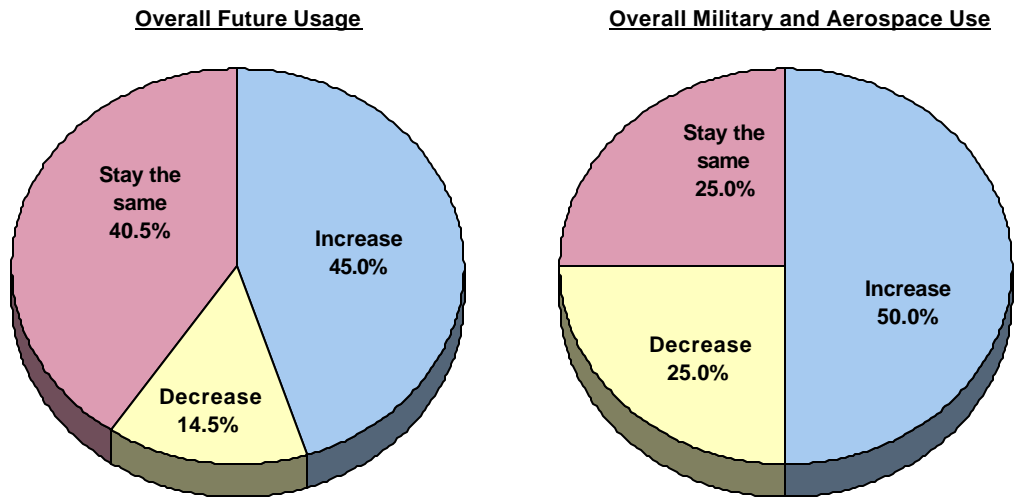


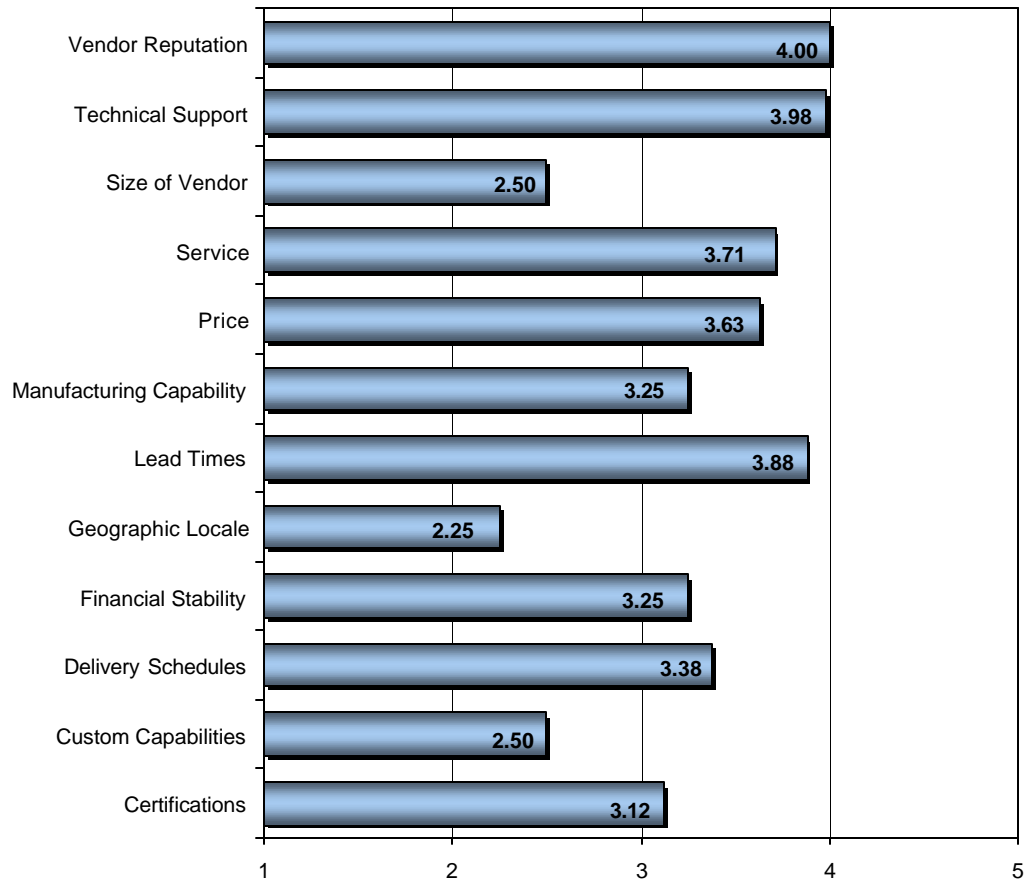
Exhibit IV -97
Use of MOSFETS in the Military and Aerospace Industry
(Percent of Respondents)



Vendor reputation and long-standing relationships characterize the most important non-product selection criteria in the Military/Aerospace market. (Exhibit IV-98)

Exhibit IV -98
 Non-Product Selection Criteria for Military and Aerospace Respondents
 (Mean Rating)

1=Not Important, 5=Very Important



APPENDIX: VENDOR LIST

ADD MICROTECH INC.

492 Altamont Drive
Milpitas, CA 95035
Tel: +1-408-941-0420
Fax :+1-408-941-0864
<http://www.addmtek.com/Index.htm>

**ADVANCED MONOLITHIC SYSTEMS
(AMS) INC.**

418 Stealth Street
Livermore, CA 94550
TEL: 925-443-0722
FAX: 925-443-0723
<http://www.advanced-monolithic.com>

AITEC

Subsidiary of BTI
Suite # 118
1000 Old County Circle
Windsor Locks, CT 06096
Tel: 860 292-1477
<http://home.sprintmail.com/~aitec/>

ALLEGRO MICROSYSTEMS INC.

Unit of Sanken Electric Co., Ltd.
115 Northeast Cutoff
P.O. Box 15036
Worcester, MA 01615
Tel: 508 853-5000
Fax: 508 853-5049
<http://www.allegromicro.com>

**ALPHA MICROELECTRONICS GROUP
GMBH**

Im Technologiepark 1
15236 Frankfurt (Oder), Germany
Tel: ++49-335-557-1750
Fax: ++49-335-557-1759
<http://www.alpha-microelectronics.de/>

ANADIGICS INC.

35 Technology Drive
Warren, New Jersey 07059
Tel: 908 668-5000
Fax: 908 668-5068
<http://www.anadigics.com>

ANALOG DEVICES INC.

3 Technology Way
P.O. Box 9106
Norwood, MA 02062
Tel: 781 329-4700
Fax: 781 326-8703
<http://www.analog.com>

ANALOG INTEGRATIONS CORP .

8F, No. 443, Rui Guang Rd.
Nei Hu Dist., Taipei, Taiwan
Tel: 886-2 8797-6777
Fax: 886-2 8797-6788
<http://www.analog.com.tw/>

ANALOG MICROELECTRONICS INC.

3100 De La Cruz Boulevard
Suite 201
Santa Clara, CA 95054-2046
Tel: 408 988-2388
Fax: 408 988-2489
<http://www.analogmicro.com>

ANALOGICTECH

830 East Arques Ave.
Sunnyvale Ca.
TEL: 408-737-4600
FAX: 408-737-4611
<http://www.analogictech.com>

ANPEC ELECTRONICS CORP.

5F, No. 2 Li-Hsin Road, SBIP
Hsin-Chu, Taiwan, R.O.C.
Tel: 886-3-5642000
Fax: 886-3-5642050
Taipei Branch
7F, No. 137, Lane 235, Pao Chiao Rd.
Hsin Tien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-89191368
Fax: 886-2-89191369

APEX MICROTECHNOLOGY

5980 North Shannon Road
Tuscon, Arizona 85741
Tel: 520.690.8600
www.apexmicrotech.com

ASTEC SEMICONDUCTOR

255 Sinclair Frontage Rd.
Milipitas, CA 95035
Tel: 408 263-8300
Fax: 408 263-8340
<http://www.astecsemi.com>

BOCA SEMICONDUCTOR CORPORATION

6660 East Rogers Circle
Boca Raton, Florida 33487
Tel: 561-226-8501
Fax: 561-226-8524
<http://www.bocasemi.com/>

CALIFORNIA MICRO DEVICES

215 Topaz Street
Milipitas, CA 95035
Tel: (408) 263-3214
Fax: (408) 263-7846
<http://www.calmicro.com/>

CALOGIC, LLC

237 Whitney Place
Fremont, CA
Tel: 510-656-2900
Fax: 510-651-1076
<http://www.calogic.net/>

CCS POWER

1000 Old County Circle
Windsor Locks, CT 06096
Tel: 860-292-1477
Fax: 860-292-1477

CERAMATE TECHNICAL CO LTD

1F-5 No. 66
Nan-Kan Road, Sec. 2
Luchu, Tao Yuan
Taiwan 338
Tel: (886 3) 3529445
Fax: (886 3) 3521052
<http://www.ceramate.com.tw>

DIALOG SEMICONDUCTOR

54 Old Highway 22
Clinton, New Jersey 08809
Tel: (+1) 908 238 0200
Fax: (+1) 908 238 0201
<http://www.dialog-semiconductor.com/index.php>

DYNEX SEMICONDUCTOR LTD.

Doddington Road, Lincoln
Lincolnshire. LN6 3LF, United Kingdom
Tel: 44 (0) 1522-500500
<http://www.dynexsemi.com>

FAIRCHILD SEMICONDUCTOR CORP.

82 Running Hill Road
South Portland, ME 04106
Tel: 207 775-8100
Fax: 207 761-6020
<http://www.fairchildsemi.com>

FUJI ELECTRIC CORP. OF AMERICA

Park 80 West Plaza II
Saddle Brook, NJ 07663
Tel: 201 712-0555
Fax: 201 368-8258
<http://www.fujielectric.co.jp>

FUJI ELECTRIC CO., LTD.

Shinjuku Koyama Bldg., 30-3, Yoyogi 4-chome
Shibuya-ku, Tokyo, 151-8520 Japan
Tel: 03-5388-7652
Fax: 03-5388-7982
<http://www.fujielectric.co.jp>

FUJI SEMICONDUCTORS

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome
Shinagawa-ku, Tokyo 141-0032, JAPAN
Tel: 3-5435-7155
Fax: 3-5435-7466
<http://www.fujielectric.co.jp/eng/denshi/scd/index.html>

FUJITSU LTD., JAPAN

4-1-1 Kamikodanaka, Nakahara-ku,
Kawasaki, Kanagawa
211-8588, Japan
Tel: 81-44 777-1111
Fax: 81-44 754-3329
<http://www.fujitsu.co.jp>

**FUJITSU MICROELECTRONICS
AMERICA, INC.**

Unit of Fujitsu Ltd, Japan
3545 North First Street
San Jose, California 95134-1804
Tel: 408 922-9000
Fax: 408 432-9044
<http://www.fujitsumicro.com>

GALAXY POWER INC.

2500 Eisenhower Avenue
PO Box 890
Valley Forge, PA 19482
Tel: 610 676-0188
Fax: 610 676-0189
<http://www.galaxypower.com>

GMT TECHNOLOGY

6F, No.11, Park Ave. 2, Science-Based
Industrial Park
HsinChu, Taiwan, R.O.C. 300
Tel: 886-3-578-8833
Fax: 886-3-578-4289
<http://www.gmt.com.tw/>

HOLTEK SEMICONDUCTOR INC.

No.3 Creation Rd. II
Science-based Industrial Park
Hsinchu, Taiwan, R.O.C
Tel: 886-3-563-1999
Fax : 886-3-563-1189
<http://www.holtek.com.tw>

HONEYWELL, INC.

101 Columbia Road
Morristown, NJ 07962
Tel: (973) 455-2000
Fax: (973) 455-4807
<http://www.honeywell.com/>

I WATT

90 Albright Way
Los Gatos, CA 95032-1827
Tel: 408.374.4200
Fax: 408.341.0455
<http://www.iwatt.com>

IMP INC.

2830 North First Street
San Jose, CA 95134-2071
Tel: 408 432-9100
Fax: 408 434-0335
<http://www.impweb.com>

INFINEON TECHNOLOGIES AG

St. Martin Str. 53
P.O. Box 80 09 49
81609 München, Germany
Tel: 49 89-23 40
<http://www.infineon.com>

**INFINEON TECHNOLOGIES
CORPORATION**

1730 North First St.
San Jose, CA 95112
Tel: 408 501-6000
Fax: 408 501-2424
<http://www.infineon.com>

INTERNATIONAL RECTIFIER CORP.

233 Kansas Street
El Segundo, CA 90245
Tel: 310 322-3331
Fax: 310 322-3332
<http://www.irf.com>

INTERSIL HOLDING CO.

7585 Irvine Center Dr.
Irvine, CA 92618
Tel: (949) 341-7000
<http://www.intersil.com>

IXYS CORPORATION

3540 Bassett St.
Santa Clara, CA 95054.
Tel.: 408-982-0700
Fax: 408-748-9788
<http://www.ixys.com/>

JINGUSA LTD

309. Donggil Bldg, 252-16 Kui-dong
Kwangjin-ku
Seoul 143-200 Korea
Tel: 82-2-456-1866
Fax : 82-2-455-3613/452-1551
<http://www.jingusa.com>

JTECH: JESS TECHNOLOGY CO., LTD.

20/F., First Pacific Bank Center,
56 Gloucester Road
Wan Chai, Hong Kong.
Tel: (852) 2123 3289
Fax: (852) 2123 3393
http://www.jesstech.com/_english/index.html

KOREA ELECTRONICS CO. LTD. (KEC)

Suite 801, Shinsong Building 25-4
Youido-dong, Yongdungpo-gu
Seoul, Korea
Tel: 82-2-785-7761
Fax : 82-2-782-4529
<http://www.keccorp.com>

KEC AMERICA CORP.

Division of Korea Electronics Co. Ltd. (KEC)
1200 Main Suite D
Irvine, CA 92614
Tel: 949 852-8807
Fax: 949 852-8809
<http://www.keccorp.com>

LINEAR TECHNOLOGY CORPORATION

1630 McCarthy Boulevard
Milipitas, CA 95035
Tel: 408 432-1900
Fax: 408 434-0507
<http://www.linear-tech.com>

LOVOLTECH, INC.

3333 Bowers Avenue, #236
Santa Clara, CA 95054
Tel: 408 654-1980
Fax: 408 654-1988

M. S. KENNEDY CORP.

4707 Dey Road
Liverpool, NY 13088
Tel: 315 701-6751
Fax: 315 701-6752
<http://www.mskennedy.com>

MACROBLOCK, INC.

F.6-4 No.18, Pu-Ting Rd.
Hsinchu, Taiwan, R.O.C.
Tel: +886-3-5790068
<http://www.mblock.com.tw/index.html>

MAXIM INTEGRATED PRODUCTS INC.

120 San Gabriel Drive
Sunnyvale, CA 94086
Tel: 408 737-7600
Fax: 408 737-7194
<http://www.maxim-ic.com>

MICREL SEMICONDUCTOR

1849 Fortune Drive
San Jose, CA 95131
Tel: 408 944-0800
Fax: 408 944-0970
<http://www.micrel.com>

MICRO ANALOG SYSTEMS

Kamreerintie 2
Espoo, Finland FIN-02770
Tel: 358 9805-2355
Fax: 358 9805-3213
<http://www.mas-oy.com>

MICRO ELECTRONICS LTD.

38 Hung To Road,
Kwun Tong, Hong Kong. (P.O. Box 69477)
Tel: (852)-2343 0181
Fax: (852)-2341 0321
<http://www.microelectr.com.hk/>

MICROCHIP TECHNOLOGY INC.

2355 West Chandler Blvd.
Chandler, Arizona 85224-6199
Tel: 480-792-7200
Fax: 480-792-9210
<http://www.microchip.com/>

MICRON TECHNOLOGY, INC.

8000 South Federal Way
P.O. Box 6
Boise, Idaho 83707-0006
Tel: 208-368-4000
Fax: 208-368-2536
<http://www.micron.com/>

MICROSEMI CORPORATION

2830 South Fairview St.
Santa Ana, CA 92704
Tel: 714 979-8220
Fax: 714 557-5989
<http://www.microsemi.com>

MITSUBISHI ELECTRIC CORPORATION

2-3 Marunouchi, Chiyoda-ku
Tokyo 100, Japan
Tel: 81 3 3218-2111
Fax: 81 3 3218-3537
<http://www.mitsubishi.com>

**MITSUBISHI ELECTRIC & ELECTRONICS
USA INC.**

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Japan
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5665 Plaza Drive
P.O. Box 6007
Cypress, CA 90630-5023
Tel: (714) 220-2500
Fax: (714) 229-3854
<http://www.mitsubishichips.com>

MITSUBISHI SEMICONDUCTOR

Mitsubishi Electric & Electronics USA
Electronic Device Group
1050 East Arques Avenue
Sunnyvale, CA 94085
Tel: 408-730-5900
Fax: 408-732-9382
<http://www.mitsubishichips.com/index.htm>

MITSUMI ELECTRIC CO. LTD.

8-8-2, Kokuryo-cho, Chofu-shi
Tokyo 182-8557, Japan
Tel: 03 3489-5333
Fax: 03 3488-3031
<http://www.mitsumi.co.jp>

MITSUMI ELECTRONICS USA

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5808 West Campus Circle Drive
Irving, TX 75063
Tel: 972 550-7300
Fax: 972 550-7424
<http://www.mitsumi.com>

**NANJING MICRO ONE ELECTRONICS
INC.**

Tel: 86-25-4705909
Fax: 86-25-4712685
<http://www.microne.com.cn/edoc/p2.php>

NATIONAL SEMICONDUCTOR CORP.

2900 Semiconductor Drive
P.O. Box 58090
Santa Clara, CA 95052-8090
Tel: 408 721-5000
Fax: 408 739-9803
<http://www.national.com>

NEC CORPORATION

7-1, Shiba 5-chome Minato-ku
Tokyo 108-8001, Japan
Tel: 03 3454-1111
Fax: 03 3798-1510
<http://www.nec-global.com>

NEC ELECTRONICS INC.

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2880 Scott Blvd.
Santa Clara, CA 95050-2554
Tel: 408 588-6000
Fax: 408 588-6130

NEOTEC SEMICONDUCTOR LTD.

1F, No.7, Lane 17, Ming Chuan Street
Chu Pei City, Hsin Chu Hsien, Taiwan
Tel: + 8863 - 3 - 5537688
Fax: + 8863 - 3 - 5537789
<http://www.neotec.com.tw>

NEW JAPAN RADIO CO.,LTD. (NJR)

3-10, Nihonbashi Yokoyama-cho,
Chuo-ku, Tokyo 103-8456, Japan
Tel: 81 3 5642-8222
Fax: 81 3 5642-8220
http://www.njr.co.jp/index_e.htm

NJR CORPORATION

Unit of New Japan Radio Co., Ltd., Japan
198 Stauffer Blvd
San Jose, CA 95125
Tel: (408) 995-6200
Fax : (408) 938-5580
<http://www.njr.com>

**NIPPON PRECISION CIRCUITS INC.
(NPC)**

4-3, Fukuzumi 2-chome
Koto-ku, Tokyo, 135-8430 Japan
Tel: 81 3 3642-6661
Fax: 81 3 3642-6698
<http://www.npc.co.jp>

**NIPPON PRECISION CIRCUITS INC.
(NPC)**

2320 Walsh Avenue, Suite 1A, Augustine, Suite
240
Santa Clara, Ca. 95054
Tel: 408-855-8589
Fax: 408-516-9916
<http://www.npcamerica.com>

O2 MICRO

3118 Patrick Henry Drive
Santa Clara, CA 95054
Tel: (408) 987-5920
Fax: (408) 987-5929
<http://www.o2micro.com>

ON SEMICONDUCTOR

Semiconductor Components Industries, LLC
5005 East McDowell
PO Box 64222
Phoenix, Arizona 85082-4222
Tel: 602 244-6600
Fax: 602 244-6071
<http://www.onsemi.com>

**PANASONIC SEMICONDUCTOR
COMPANY**

Matsushita Electronics Corporation
1 Kotari-Yakemachi
Nagaokakyo, Kyoto 617-8520 Japan
Tel: 075 951-8151
<http://www.mec.panasonic.co.jp/semicon>

PHILIPS ELECTRONICS N.V.

5600 PB, Eindhoven
The Netherlands
Tel: 31 40 278-3749
Fax: 31 40 278-8399
<http://www.philips.com>

PHILIPS SEMICONDUCTORS

Unit of Philips Electronics N.V.
811 East Arques Avenue
PO Box 3409
Sunnyvale, CA 94088
Tel: 408 991-2000
Fax: 408 991-2311
<http://www.semiconductors.philips.com>

POWEREX INC.

200 E. Hillis Street
Youngwood, PA 15697
Tel: 724-925-7272
<http://www.pwr.com>

POWER INTEGRATIONS INC.

5245 Hellyer Avenue
San Jose, CA 95138
Tel: (408) 414-9200
Fax: (408) 414-9201
<http://www.powerint.com>

POWERSMART INC.

One Research Drive
Shelton, CT 06484
Tel: 203 925-1340
Fax: 203 925-1714
<http://www.powersmart.com>

PRIMARION

2507 West Geneva Drive
Tempe, AZ 85282
Tel: (602) 454-7205
Fax: (602) 454-7220
<http://www.primarion.com>

PRINCETON TECHNOLOGY C&C CORP.

8F No. 2 Alley 6 Lane 235
Baio Chad Rd.
HSIN TIEN Taipei Hsien Taiwan Roc
Tel: 866-(2)-2915-1818
Fax: 866-(2)-2915-1616
Email: service@Ptcc.com.tw

RAYCHEM CIRCUIT PROTECTION

Division of Tyco Electronics
308 Constitution Drive
Menlo Park, CA 94025-1164
Tel: 650 361-6900
Fax: 650 361-5579
<http://www.circuitprotection.com>

RICOH ELECTRONIC DEVICES

Division of Ricoh Company Ltd.
13-1 Himemuro-cho, Ikeda City
Osaka 563-8501, Japan
Tel: 81 727 53-1111
<http://www.ricoh.co.jp/LSI/english>

RICOH CORPORATION EDD US

5 Dedrick Place
West Caldwell, NJ 07006
Tel: 973/882-2000
Fax: 973/882-5840
<http://www.ricoh-usa.com>

ROHM CO., LTD.

21, Saiin Mizosaki-cho
Ukyo-ku, Kyoto 615-8585, Japan
Tel: 075 311-2121
Fax: 075 315-0172
<http://www.rohm.com>

ROHM ELECTRONICS USA

Division of Rohm Co., Ltd., Japan
10145 Pacific Heights
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San Diego, CA 92121
Tel: 858 625-3630
Fax: 858 625-3670
<http://www.rohmelectronics.com>

SAMSUNG SEMICONDUCTOR, INC.

3655 North First St.
San Jose, CA 95134-1707
Tel: (408) 544-4000
Fax: (408) 544-4934
<http://www.usa.samsungsemi.com/>

SANKEN ELECTRIC CO., LTD.

3-6-3, Kitano, Nitza-shi
Saitama-ken 352-8666, Japan
Tel: 81 48 472-1111
Fax: 81 48 471-6249
<http://www.sanken-ele.co.jp>

SANREX CORPORATION

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Port Washington, NY 11050-4618
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Fax: (516) 625-8845
<http://www.sanrex.com>

SANYO ELECTRIC CO., LTD.

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Taito-ku, Tokyo 110-8534 Japan
Tel: 81-3-3837-6339
Fax: 81-3-3837-6377
<http://www.semic.sanyo.co.jp>

SANYO SEMICONDUCTOR CORPORATION

Division of Sanyo Electric Co., Ltd.
2010 N.1st Street, Suite 500
San Jose, CA 95131
Tel: 408 441-6567
Fax: 408 441-6672
<http://www.semic.sanyo.co.jp>

SATCON

165 Cedar Hill Street
Marlborough Ma. 01752
Tel: 508-485-6350
Fax: 508-485-5160
<http://www.satconelectronics.com>

SEIKO INSTRUMENTS INC., JAPAN

8, Nakase 1-chome,
Mihama-ku, Chiba-shi
Chiba 261-8507, Japan
<http://www.sii.co.jp>

SEIKO INSTRUMENTS USA INC.

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2990 West Lomita Boulevard
Torrance, CA 90505
Tel: 310 517-7771
Fax: 310 517-7792
<http://www.seiko-usa-eed.com>

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<http://www.semelab.co.uk/>

SEMIKRON INTERNATIONAL

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Sigmundstr. 200
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Hudson, N.H. 03051
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Fax: 603-883-8021
<http://www.semikron.com/semineu/index.html>

SEMTECH CORPORATION

652 Mitchell Road
Newbury Park, CA 91320
Tel: 805 498-2111
Fax: 805 498-3804
<http://www.semtech.com>

SENSITRON SEMICONDUCTOR, INC.

221 West Industry Ct.
Deer Park, NY 11729
Tel: 631 586-7600
Fax: 631 242-9798
<http://www.sensitron.com>

SHARP MICROELECTRONICS GROUP

Unit of Sharp Corporation, Japan
5700 Northwest Pacific Rim Boulevard #20
Camas, WA 98607
Tel: 360 834-2500
Fax: 360 834-8903
<http://www.sharpmeg.com>

SHINDENGEN AMERICA, INC.

2985 East Hillcrest Dr., Suite 140
Westlake Village, CA 91362-3170
Tel: (805) 373-1130
Fax: (805) 373-3710
<http://www.shindengen.com/>

SIPEX CORP.

22 Linnell Circle
Billerica, MA 01821
Tel: 978 667-8700
Fax: 978 670-9001
<http://www.sipex.com>

SKYWORKS SOLUTIONS

20 Sylvan Road
P.O. Box 1044
Woburn, MA 01801
Tel: 781 376-3000
Fax: 617 824-4579
<http://www.skyworksinc.com/>

STMICROELECTRONICS

1310 Electronic Drive
Carrollton, TX 75006
Tel: 972 466-6000
Fax: 972 466-7997
<http://www.st.com>

SUMMIT MICROELECTRONICS, INC.

300 Orchard City Drive, #131
Campbell, CA 95008
Tel: (408) 378-6461
Fax: (408) 378-6586
<http://www.summitmicro.com/home/>

SUPERTEX INC.

1235 Bordeaux Drive
Sunnyvale, CA 94089
Tel: 408 744-0100
Fax: 408 222-4800
<http://www.supertex.com>

TEXAS INSTRUMENTS INC.

12500 TI Boulevard
Dallas, TX 75243-4136
Tel: 972 995-3333
<http://www.ti.com>

TOKO INC. JAPAN

1-17, Higashi-yukigaya 2-chome
Ohta-ku, Tokyo, 145-8585 Japan
Tel: 03 3727-1161
Fax: 03 3727-1176
<http://www.toko.co.jp>

TOKO AMERICA INC.

Unit of Toko Inc., Japan
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Mt. Prospect, IL 60056
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Fax: 847 699-7864
<http://www.tokoam.com>

TOREX SEMICONDUCTOR

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1-2-7 Etchujima
Koto-ku, Tokyo 135-0044 Japan
Tel: 03 3630-3323
Fax: 03 3630-3343
<http://www.torex.co.jp>

TOSHIBA AMERICA ELECTRONIC COMPONENTS

9775 Toledo Way
Irvine, CA 92618
Tel: 949 455-2000
Fax: 949 859-3963
<http://www.toshiba.com/taec>

UNISONIC TECHNOLOGIES CO, LTD.

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San-Chung City, Taipei Hsien, Taiwan
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<http://www.unisonic.com.tw/about.htm>

VISHAY/SILICONIX

2201 Laurelwood Road
Santa Clara, CA 98054
Tel: 408 988-8000
Fax: 408 970-3950
<http://www.siliconix.com>

WELTREND SEMICONDUCTOR, INC.

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<http://www.xicor.com>

Y&Y UNICTRON ENTERPRISE CO.

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ZETEX PLC.

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