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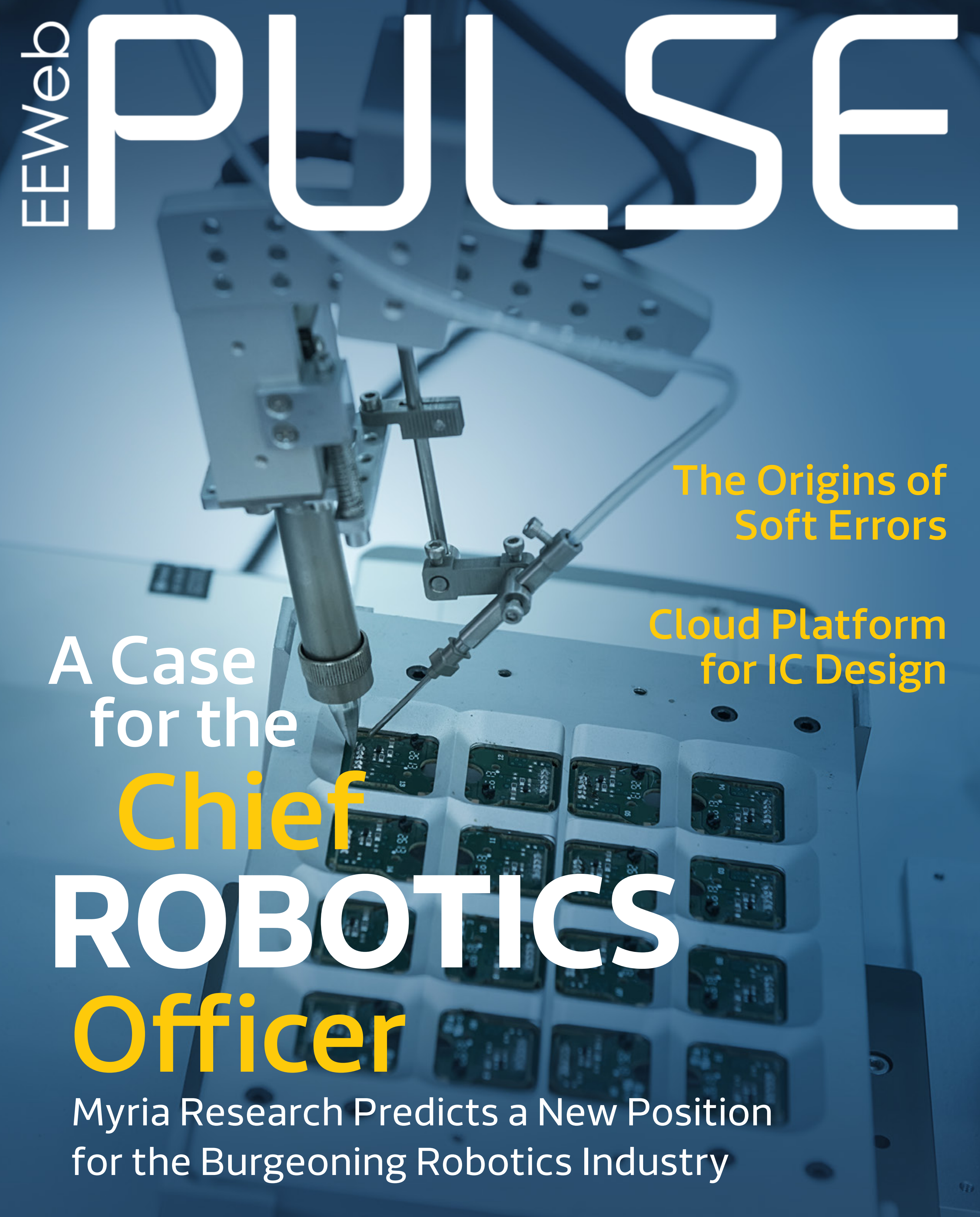

The Origins of Soft Errors

Cloud Platform for IC Design

A Case for the Chief ROBOTICS Officer

Myria Research Predicts a New Position for the Burgeoning Robotics Industry

March 17, 2015 | Issue 130

CONTENTS

Silicon Cloud Ushers in New Era of COLLABORATION

New chip design platform makes the move from localized computers to global Cloud centers

All eyes are on the Internet of Things. Semiconductor companies across the board are developing interconnected devices and wireless protocols that will enable the largest network of electronic devices known to man. The concept of the IoT is clear, however the scale of interconnectivity between devices is yet to be determined—from a smartphone controlling a kitchen appliance to a local computer sending large amounts of data to another computer through the Cloud. These modern developments have exciting ramifications for IoT product development, but they are also being used to revamp old and outdated workflows. Silicon Cloud International (SCI), a cloud solutions developer, has been developing a Cloud-based platform that will completely revolutionize an area of product development process that has yet to be reformed: chip design. EEWeb spoke to Mojy Chian, CEO at SCI, about why their Cloud-based design platform will change the way semiconductor devices are created.

The focus of the pilot program was the turnkey IC design infrastructure, where designers were able to collaborate on designs no matter where they were in the world.

"TODAY IS THE ERA OF COLLABORATION," Chian began. "Silicon Cloud realizes this, and we are building an IC design platform that everyone can use." To achieve this, SCI developed a chip design infrastructure so that other entities can use the same one through the Cloud—no matter what country they are in. SCI implemented pilot program in September 2014 to help engineers ease into the new work environment. The focus of the program was the turnkey IC design infrastructure, where designers were able to collaborate on designs no matter where they were in the world.

The company also has plans to introduce a non-chip design tool for their system, which will offer a complete solution for IoT node design. The users will then be able to do chip and sensor design with an integrated workflow. "In the future, integration will be a major component of IoT business," Chian explained. "A lot of IoT design companies right now are actually system designers—they are not even chip designers." This prompts companies to buy discrete components from providers to build their IoT designs. While it is an apt way to start a design and get software and radio development underway, Chian posited that this way is not sustainable. "Later on," he said, "when these companies want to deploy their solutions, it becomes important to reduce the footprint and reduce the cost."

As these companies go through the migration towards high-volume production, integrated solutions become increasingly vital. "As companies go on the path to maturity, we believe it is going to create significant opportunities for IC design," Chian explained. "We want to be in the position to provide the design enablement for these companies." SCI's solution comes in the form of their Cloud-based design infrastructure, which was released as a pilot program in Singapore, Malaysia, and the United Arab Emirates. While the system is still in production (hence, "pilot"), eleven universities took part in the first round of testing, which Chian believes is good for tweaking the workflow. "Universities are good pilot users for us," he explained. "They are willing to not only be the users, but they will also contribute to the system by giving us feedback." SCI is planning on launching its second iteration of the pilot program in this month, as well as a set of non-IC design tools in April of 2015.

SCI's Cloud-based design platform will be extremely helpful for IC design companies, but it will take some time for them to get accustomed to. In the current, non-Cloud-based process, users download tools and manufacturing data on their local computers—meaning all of the data resides in that single machine. These computers are typically Linux or Windows, meaning they issue commands to run tools, which is done through ownership of Linux directories.

SCI's solution offers an entirely different approach than the traditional design environment. For one thing, nothing takes place on the local machine—it is all done in the Cloud. IC design starts with opening the browser instead of a Linux program. Once the browser is open, the user logs in to the system and they are presented with the dashboard with menus and buttons. "The whole methodology is entirely different," Chian explained. "We had to go through user training to re-teach them how to set up a machine and invoke a simulator to access design IP." Chian believes it's a revolutionary new design environment, but concedes it will take awhile to get used to.

Many steps must be taken to make the Cloud-based platform a viable solution. For one, remote IC design requires a tremendous amount of data to be sent over networks—some data communications will even take place from opposite sides of the planet. This leads to the common issues of delay and latency in data transfer; if your machine is in the US and you're logging in from Singapore, it will take some time for the data to ravel from Singapore to the US and back. However, SCI already has plans to deal with the latency issues by building many Cloud centers around the world. The company's first Cloud center was built in Cary, North Carolina, and they are in the middle of setting up the second Cloud center in Singapore right now. "Over the next couple of years, we will hopefully have several more all over the world," Chian explained. "They will all be interconnected, which will allow you to connect to the machines closest to you."

Chian noted that while the semiconductor has seen dramatic changes over the past few decades, semiconductor design has been the same as it always has been. SCI is taking modern concepts like Cloud computing to bring semiconductor design out of the dark ages, so to speak. The result will usher in a new age of global collaboration that will produce devices that will power the demanding industry trends of the future. EE

As these companies go through the migration towards high-volume production, integrated solutions become increasingly vital.

MIXING SIGNALS: An Introduction to PID CONTROLLERS

{Part 5}

By Sree Harsha Angara
Cypress Semiconductor

To read the previous article in this series, click the image above.

The Agony of Choice

Analog or Digital Compensation

In the last few columns, I went through some of the math to explain exactly what compensation entails, as well as how PID compensation works. In this column, I will cover working with analog compensators and brush lightly on digital compensation (which will be covered in more detail in the next installment).

Typically, when building a closed-loop system, an engineer is faced with the choice of picking an analog or digital compensator. In the past, analog compensation was the de facto selection for making fast closed loops. However, in recent years, the use of digital compensators has grown rapidly due to the availability of fast microcontrollers with integrated ADCs. In addition, many applications require compensation for a wide variety of peripheral functions like monitoring, communication protocols, and so forth. Integrating all of these into a single microcontroller saves board space and cost when compared to using dedicated analog ICs as controllers.

For example, Cypress Semiconductor's PSoC products offer a unique mix of analog and digital resources, eliminating the need to make the hard choice between domains. This flexibility also opens up some very interesting mixed-signal approaches to solving problems, which we will see further down in the column. For user's new to the PSoC 5LP, I would recommend reading AN77759 – Getting Started with PSoC® 5LP to get an overview of the chip I'll be using to implement the controllers.

A Simple Example: The R-C Circuit

To start off, let's try controlling the output voltage of a very simple R-C circuit.

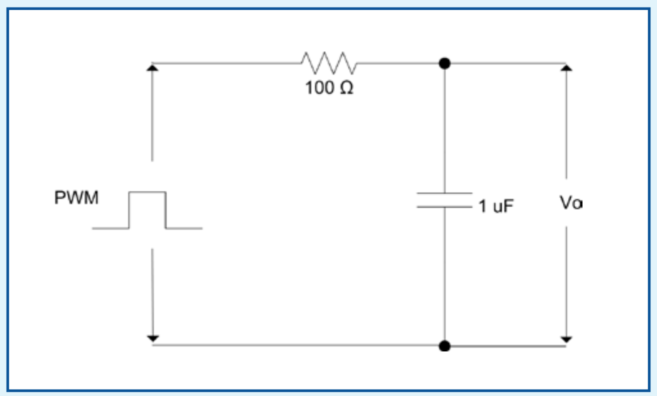

Figure 1. R-C Circuit

The input to the circuit is a PWM and the output voltage is just the filtered equivalent of the input. Changing the duty cycle of the PWM changes the output voltage. Now, say we need a crossover frequency of 1200Hz with a phase margin of 50 degrees or higher. Following the empirical rules defined in Part 3, we end up with a proportional gain (Kp) of 0.1 and an integral gain (Ki) of 10,000.

To make things interesting, we will implement this entirely in the analog domain.

Typically when you want to generate a PWM from a standard microcontroller, it serves as a simple counter with a compare register. The counter runs off the bus clock, typically between 8MHz to 80MHz. This works well for low frequency PWM's, but at higher frequencies (100KHz and above), we will find that the granularity of the step size becomes too coarse. For example, if we need to run a 250KHz PWM off a microcontroller that runs off a 48MHz bus clock, the PWM period is 192 (48MHz/250KHz), giving us a duty cycle step of 0.5%, which may be too large

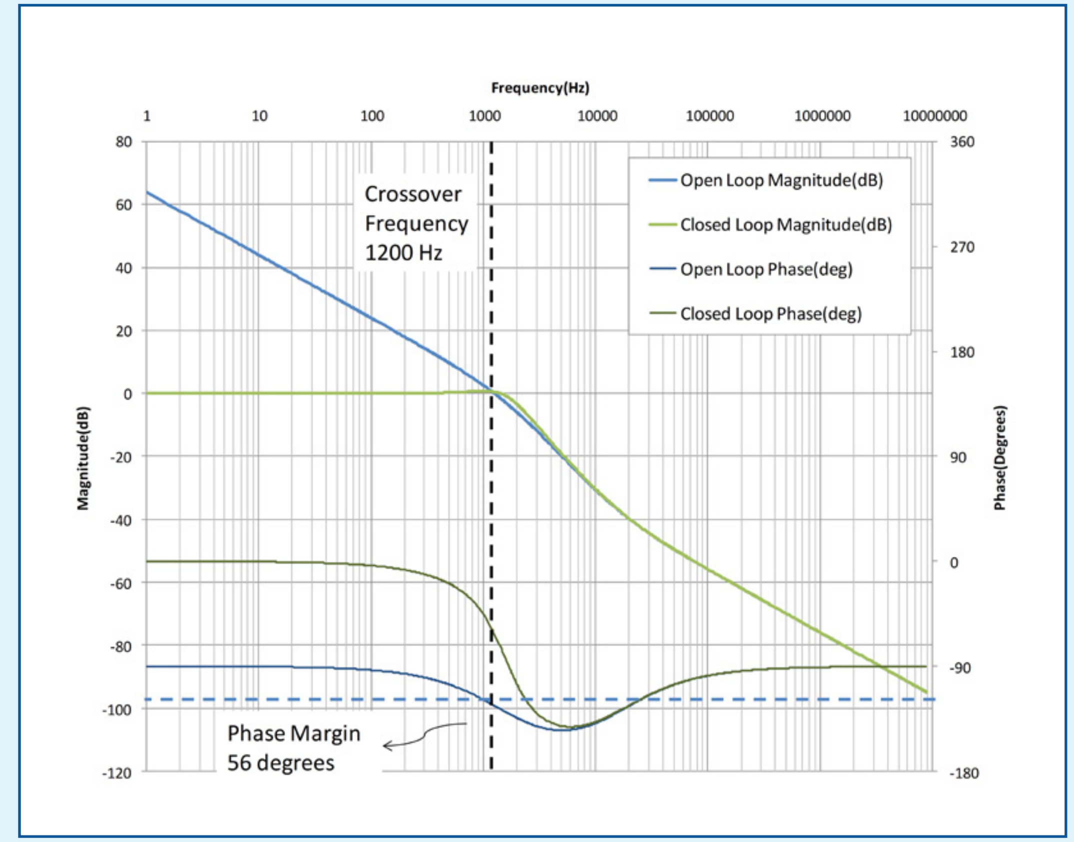

Figure 2. Compensated system

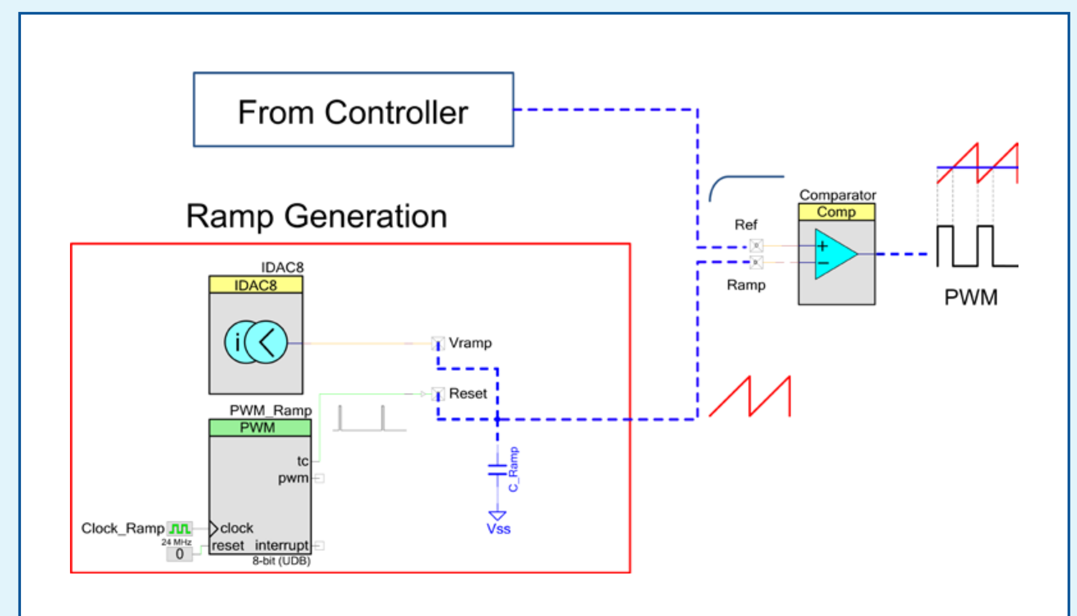

Figure 3. Analog PWM generation

for our application. Bumping up the clock is an option but this means increasing the overall power consumption and, as always, there is an upper limit to how much you can increase the clock, depending upon the microcontroller you're using.

Using the PSoC's analog resources, it is possible to generate the PWM entirely in the analog domain. The PWM is generated from a comparator that compares a sawtooth waveform with a DC voltage. Since this is closed loop control, the reference voltage is just the output of the compensator.

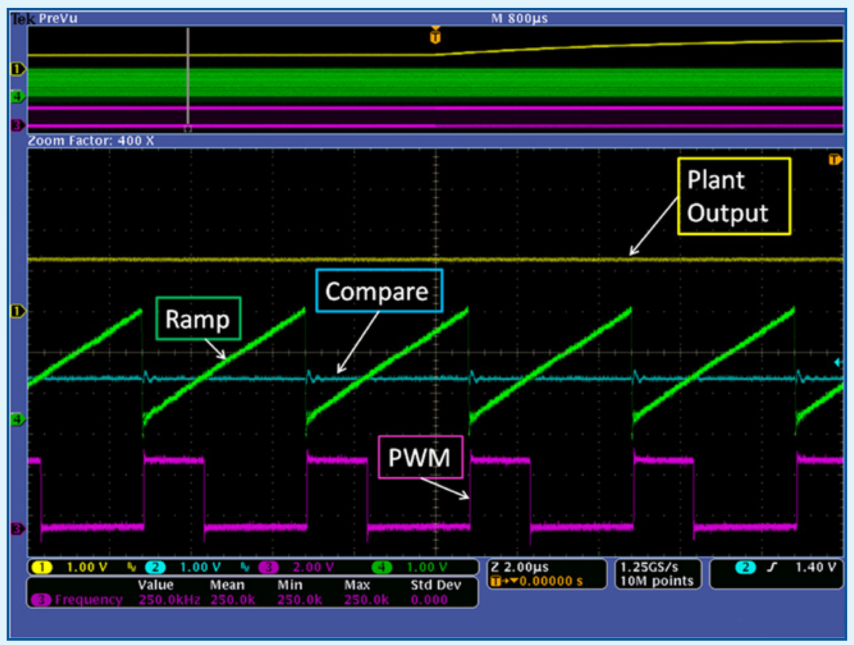

Figure 4. Scope Shot: Generating Analog PWM

To generate a ramp, we use the internal current DAC (IDAC for short) and PWM of the PSoC, which hooks up to pin with an external capacitance. The IDAC essentially charges the capacitor at a constant rate (voltage ramps up) and the PWM discharges it with every cycle. In our example, we generate a 250KHz PWM by pushing 200uA into a 250pF capacitor such that the peak voltage of the ramp is 3.3Volts.

The actual compensator can be implementing as a simple PI compensator (remember it's a first-order system) using the PSoC's internal op amps and a few external resistors and capacitors.

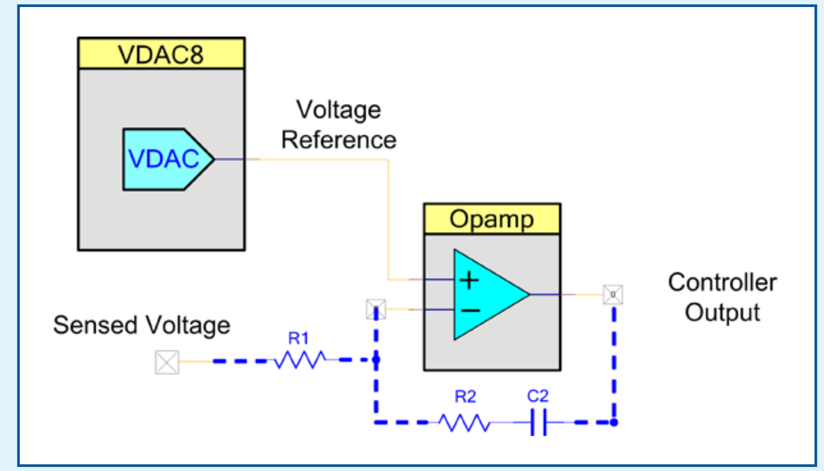

Figure 5. Analog compensator in PSoC

The combination of R1, R2, and C2 form a PI network that follows the voltage reference given by the Voltage DAC (VDAC for short). Note that the voltage DAC can also be replaced with a simple resistor divider to free up another DAC on the PSoC.

The design equations for the op amp-based controller is

$$Compensator(s) = \frac{R_2}{R_1} + \frac{\left(1/_{R_1C}\right)}{s}$$

Comparing this with the standard form we used in previous columns,

$$Compensator(s) = Kp + \frac{Ki}{s}$$

$$Kp = \frac{R_2}{R_1} \qquad Ki = \frac{1}{R_1C}$$

From our previous requirements, we assume a capacitance of 0.1uF and

$$R_1 = \frac{1}{Ki * C} = \frac{1}{10000 * 0.1 * 10^{-6}} = 10K\Omega$$

$$R_2 = R_1 * Kp = 0.1 * 10 * 10^3 = 100\ \Omega$$

The entire system is represented in Figure 6.

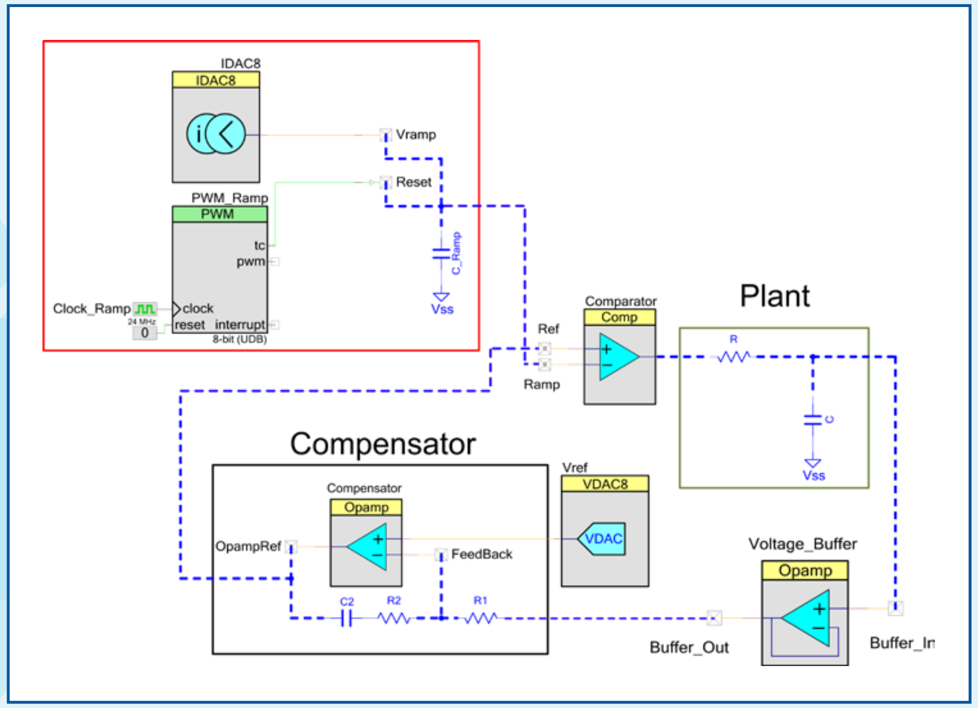

Figure 6. Analog Compensation with PSoC 5LP

And there you have it—a completely analog controller (with a mixed-signal PWM generator) that runs completely parallel to the main controller.

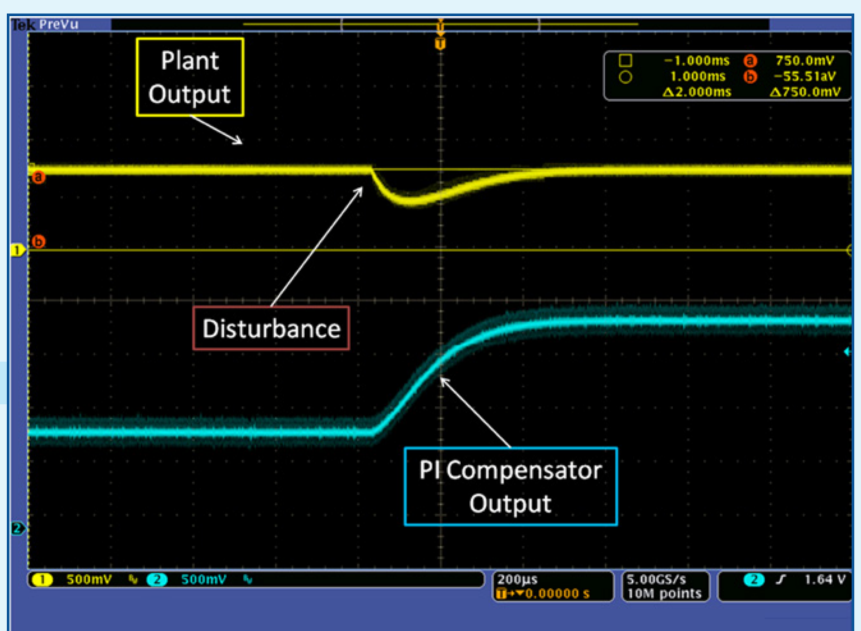

Figure 7. Analog R-C response - Disturbance rejection

A Higher Order Example: The Synchronous Buck Converter

In this example, we will be controlling a synchronous buck converter in the digital domain. The synchronous buck converter is a commonly used, high-efficiency converter for stepping down DC voltages. This time we will be using digital PID compensation.

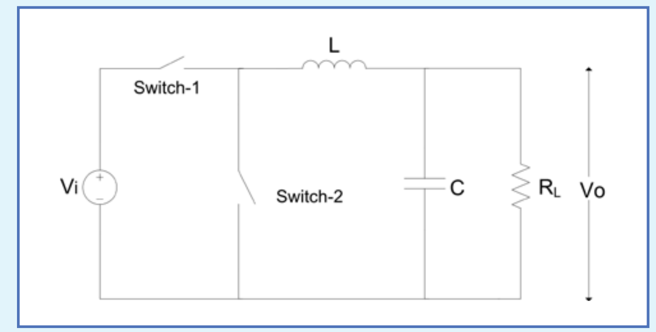

Figure 8: Synchronous Buck Converter

As always, we start with the transfer function,

$$\frac{\hat{V}_o(s)}{\hat{d}(s)} = \frac{\left(R_L // \left(\frac{1}{sC}\right)\right) V_i * D}{sL + R_L // \left(\frac{1}{sC}\right)} = \frac{V_i * D}{s^2(LC) + s\left({}^{L}/_{R_L}\right) + 1}$$

Where,

$\hat{V}_o$ is the AC component of the output voltage

$\hat{d}$ is the AC component of the duty cycle

D is the steady state duty cycle

Now, there might be some confusion among readers on the difference between $\hat{d}$ and D. Similar to what I mentioned for the boost converter in Part 4, the transfer function depends on the quiescent operating point (D in this case) of the converter. This implies that when designing loops for converters, you need to make sure you know what the operating point is. For our setup, we will be running a buck converter with the parameters:

Input voltage = 10V
Output voltage = 3.3V
Output Current = 300mA
Voltage Ripple = 1% = 3.3mV
Inductor Current Ripple = 100mA
Switching Frequency = 200 KHz

Using a couple of standard design equations, the value of the filter inductor and capacitor will come to,

$$L = \frac{V_o}{I_{ripple} * f_{sw}}(1 - D) = 110uH$$

$$C = \frac{(1 - D) * V_o}{8 * V_{ripple} * f_{sw}{}^2 * L} = 2.1uF$$

Close values of 100uH and 2.2uF are chosen.

For the digital control portion, we will be using the Digital Filter Block (DFB) of the PSoC5LP to realize the PID controller. The DFB is essentially a mini-DSP core that supports 24-bit wide Multiply and Accumulate (MAC) operations with a few additional operations thrown in. The basic block diagram of the system is,

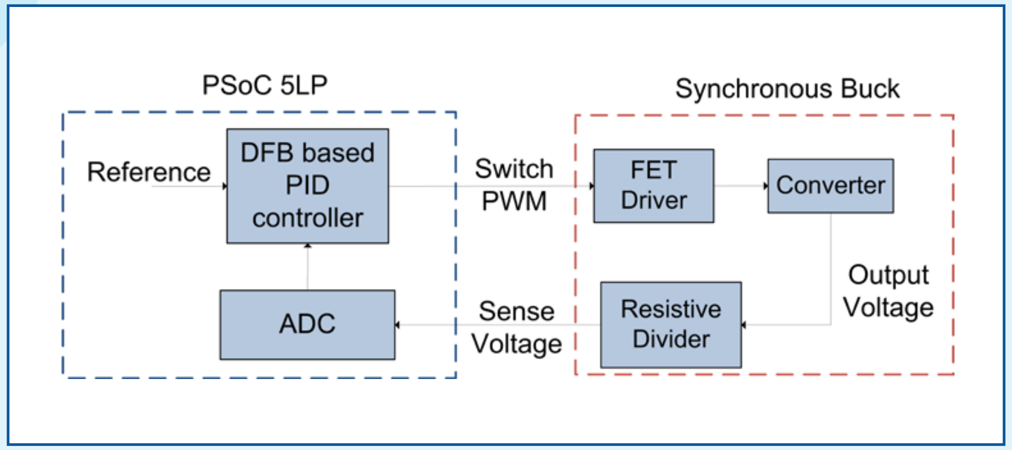

Figure 9. Synchronous Buck Block Diagram

However, there is one critical difference between our previous R-C example and this one. In the first example, I consciously chose the values of the system such that all the feedback components put together give unity gain. To illustrate, if the output of the PI compensator op amp is 1V, the duty cycle of the PWM is 1/3.3, which comes to 30.3%. Since the comparator bias value is also 3.3V, this translates to 0.303*3.3, which is 1V. If we chose a different value for the sawtooth peak, the designed controller would have shown a different characteristic.

This is even more obvious when dealing with digital controllers as the sensor gain, ADC conversion to counts, and PWM gain will significantly change the gain of the transfer function. For the buck converter, the true transfer function of the system is based on Figure 10.

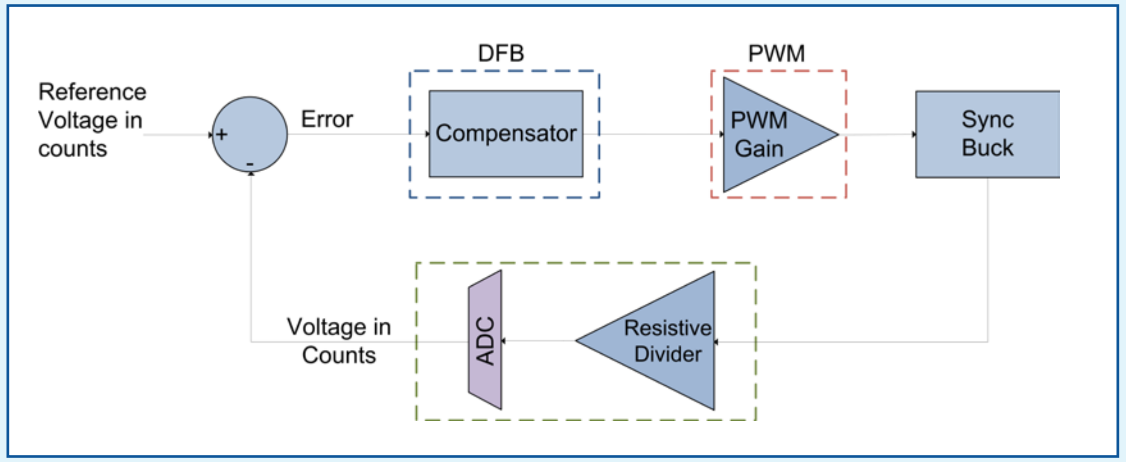

Figure 10: Synchronous Buck converter - Gains

When designing a digital controller, on top of the plant transfer function we derived previously, we should be adding in a system gain which is,

$$System\ Gain = Resistive\ Divider\ Gain * ADC\ Gain * PWM\ Gain$$

So that the 'true' transfer function is,

$$\frac{Output\ Voltage(counts)}{PWM\ compare\ value(counts)} = System\ Gain * \frac{V_i * D}{s^2(LC) + s\left({}^{L}/{}_{R_L}\right) + 1}$$

In the next part, we will look into compensating the buck converter and things to watch out for when designing digital control loops.


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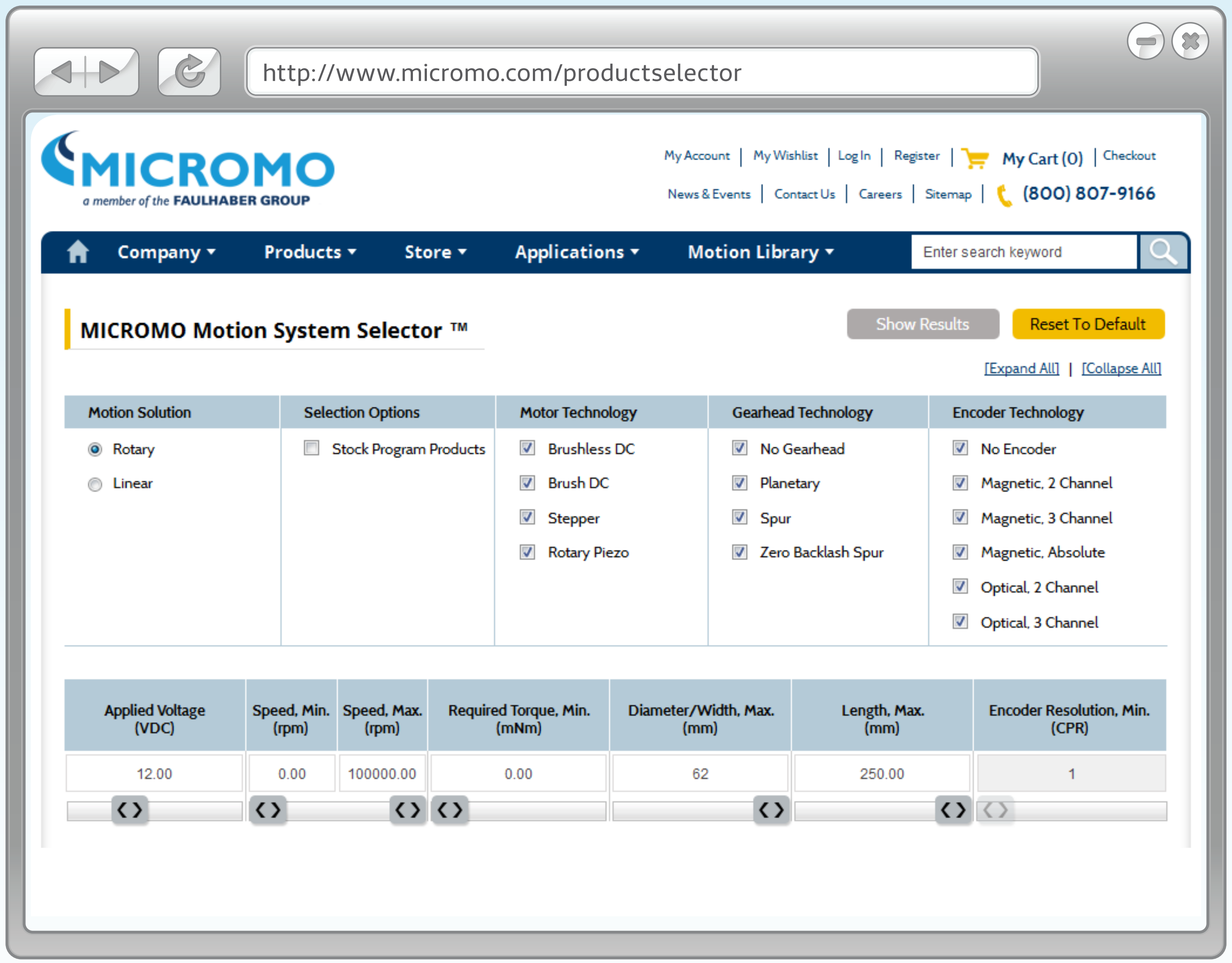
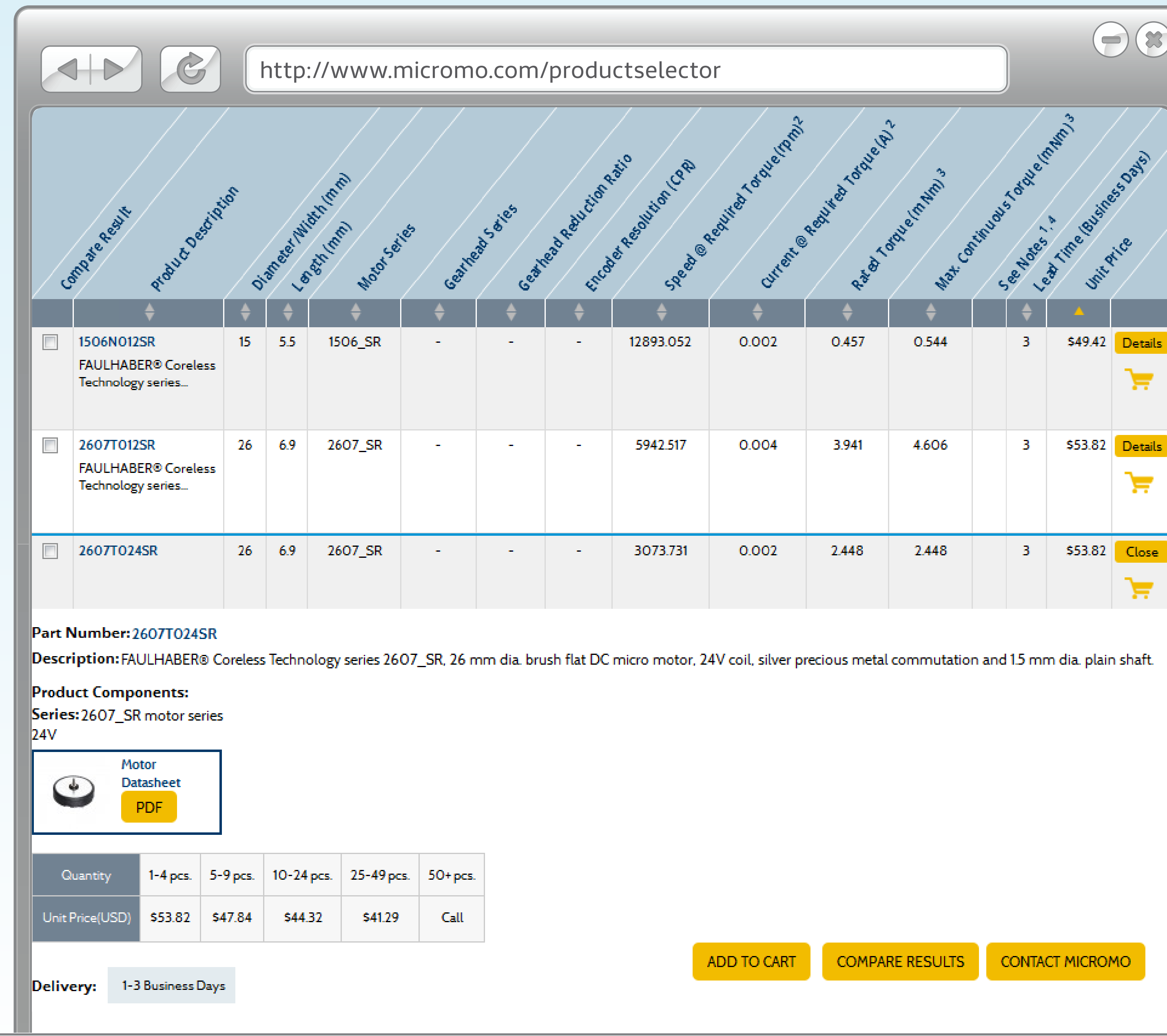
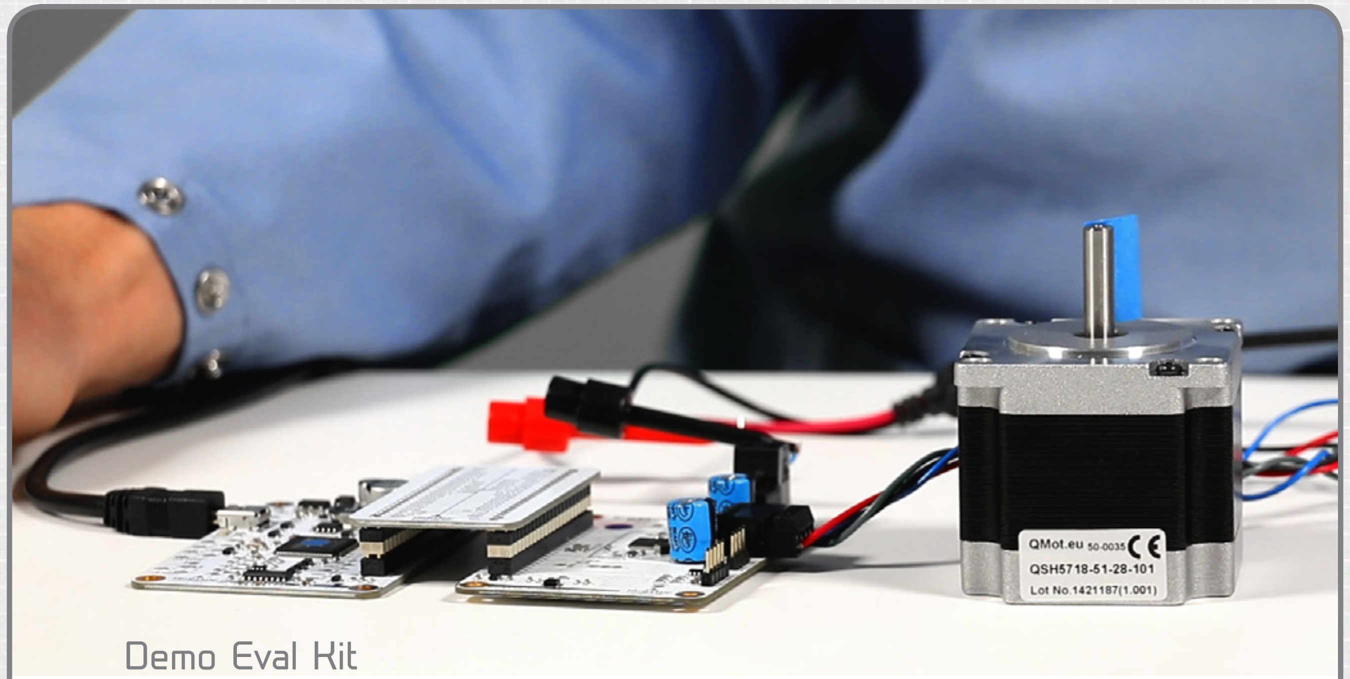




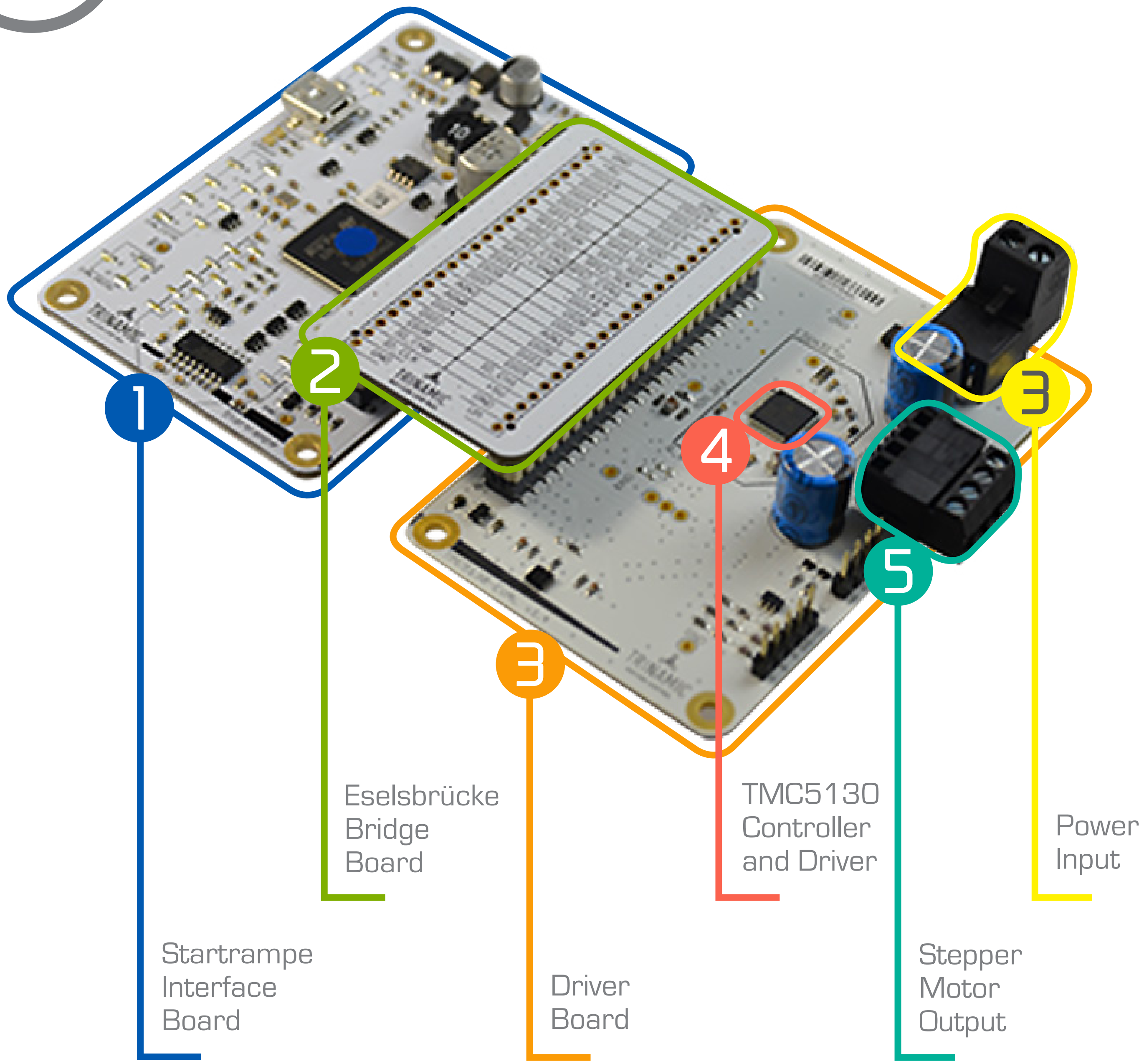
Trinamic
Motor Control and Driver



Demo Eval Kit

The TMC5130 from Trinamic is a stepper motor controller and driver IC with serial communication interfaces. This driver utilizes Trinamic's stealthChop driver technology, which provides a unique waveform shape that ensures noiseless motor operation. The TMC5130 comes with an impressive evaluation kit that helps reduce the learning curve for engineers eager to implement this technology.

Hardware

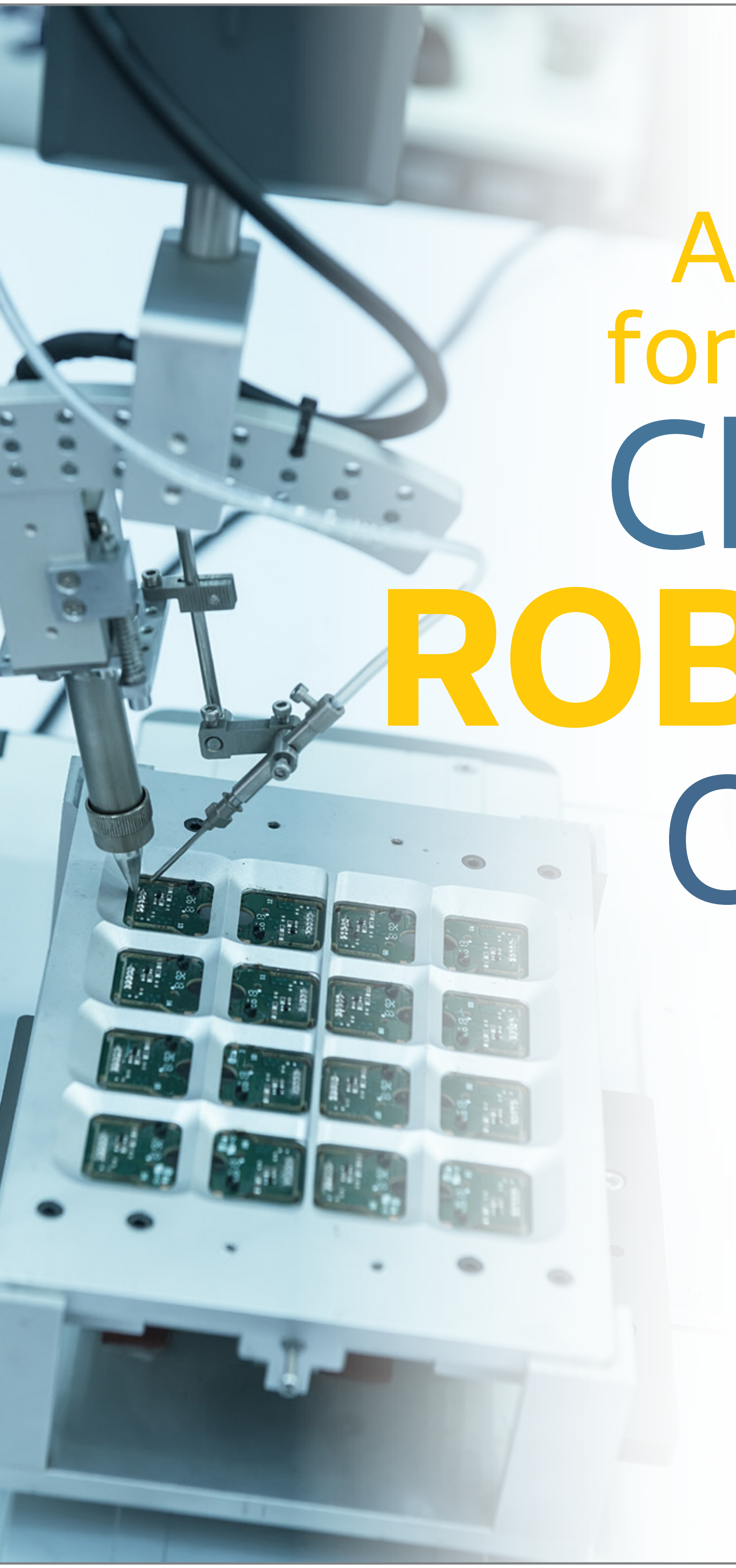


Specs

The TMC5130 eval kit comes with a very powerful and easy-to-use computer interface. This interface allows users to directly control the motor by programming the microsteps per second the direction the motor should go. Due to its high precision microstepping and quiet operation, the TMC5130 has a wide variety of possible applications, such as factory automation, CCTV, pumps, point-of-sale or ATMs, and any medical or lab applications requiring accurate motor control. The Trinamic eval kit for the TMC5130 is an impressive kit that shows how this controller and driver can make your motors quieter, more efficient, yet just as powerful.

Watch Video

To watch an overview of the TMC5130, click the image below:



A Case for the Chief ROBOTICS Officer

Why Myria Research, a robotics consultancy company, believes the rise of the robots will call for a new addition to corporate executive structures.

Remy Glaisner
Myria Research

The concept of a robot has existed for over a century. From the Jetson's robot maid to HAL9000 in 2001: A Space Odyssey, robotic systems have always been a staple of futuristic depictions. However, the state of technology has finally caught up with our collective imagination; fully functioning robots are no longer an image of the future. Industries across the board are beginning to implement robots to take care of tedious, monotonous, and potentially risky processes. While this may seem like a boon to strenuous workplace environments, the prevalence of a robotic workforce comes with its own set of complex problems. EEWeb spoke with Remy Glaisner, CEO of Myria Research, about the need for a new corporate position to take on this new set of challenges: the Chief Robotics Officer.

THE RISE OF THE ROBOT

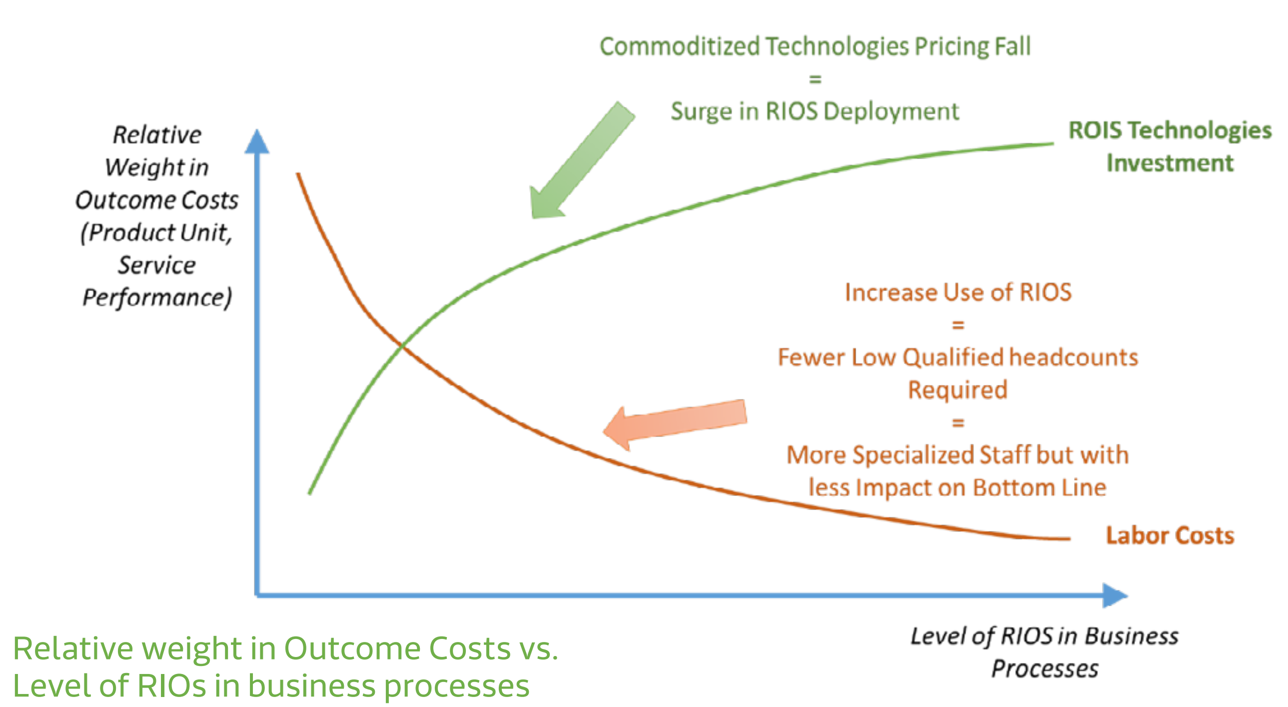
The tipping point in the robotics industry comes down to the fact that hardware is more commonly available and easier to integrate, meaning the prices are expected to continuously going down. "This is a good thing for robotics," Glaisner stated. Traditionally, Robotics & Intelligent Operational Systems (RIOS) technologies cost tens of thousands of dollars. Nowadays, popular robotics systems are able to achieve greater levels of scalability and automation. "The entry barriers in the robotics field are much lower than they used to be," Glaisner explained, meaning more and more companies will be responsible for managing robotics operations.

For Glaisner, the next few years will see a software-driven growth within the market. The Myria Research team has studied these trends for years and developed an actionable roadmap for clients looking to delve into the robotics world. The research paints an exciting vision for the robotics industry; according to Glaisner, "in three to six years, the industry will accelerate way past the annual growth we are currently seeing."

Furthermore, Myria concluded that the RIOS market and ecosystem will include full hardware, software, and services segmentation, and will reach over $320 billion in revenue by 2020. This massive market potential will be sparked by the healthcare, agri-farming, industrial, and transportation industries moving towards unmanned robotics to help with the production processes. The cost of labor in these industries has continuously risen over the years and will encourage employers to implement advanced machineries to replace basic, tedious jobs. While this might worry some workers who may be susceptible to labor displacement, it ensures businesses have able workers despite labor shortages and safety concerns. "Within three to six years," Glaisner postulated, "it will not be uncommon for robots to be integrated in many BPM [business process management] activities, just as much as computers and other IT systems are doing today."

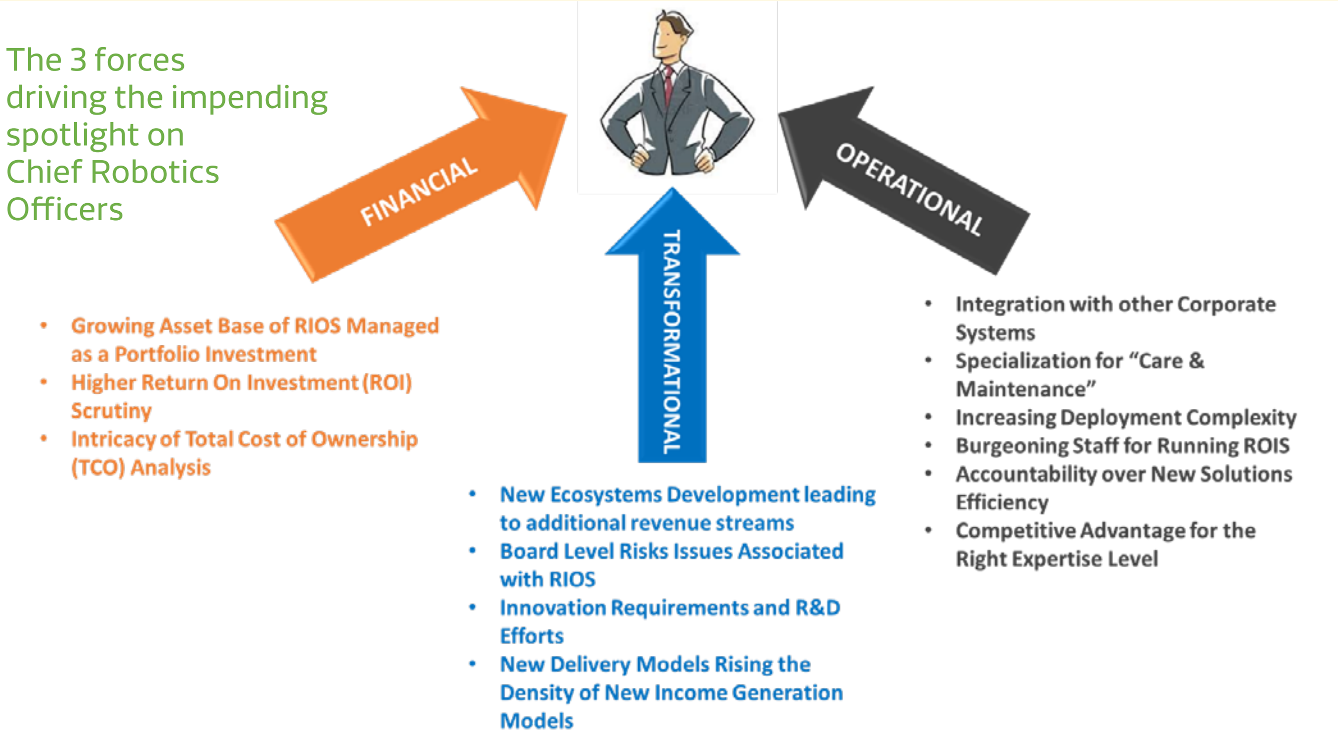
"Robotics creates new business and new business models," Glaisner explained. He gave the example of Robotics as a Service (RaaS), where solutions must be flexible (service delivered adapts to client's changing situation), elastic (the quantity of service delivered can evolve over time to match client's real-time demand), and effective (the level of usage has no—or very few—influence on the quality of service). "New robotics solutions either have to do something new, or something old better," Glaisner said. "Whenever a new product does not meet those criteria, we simply cannot get behind the solution the client is offering."

The Myria Research team has studied robotics trends for years and developed an actionable roadmap for clients looking to delve into the robotics world.



Relative weight in Outcome Costs vs. Level of RIOs in business processes

The 3 forces driving the impending spotlight on Chief Robotics Officers



"Within three to six years, it will not be uncommon for robots to be integrated in many BPM [business process management] activities, just as much as computers and other IT systems are doing today."

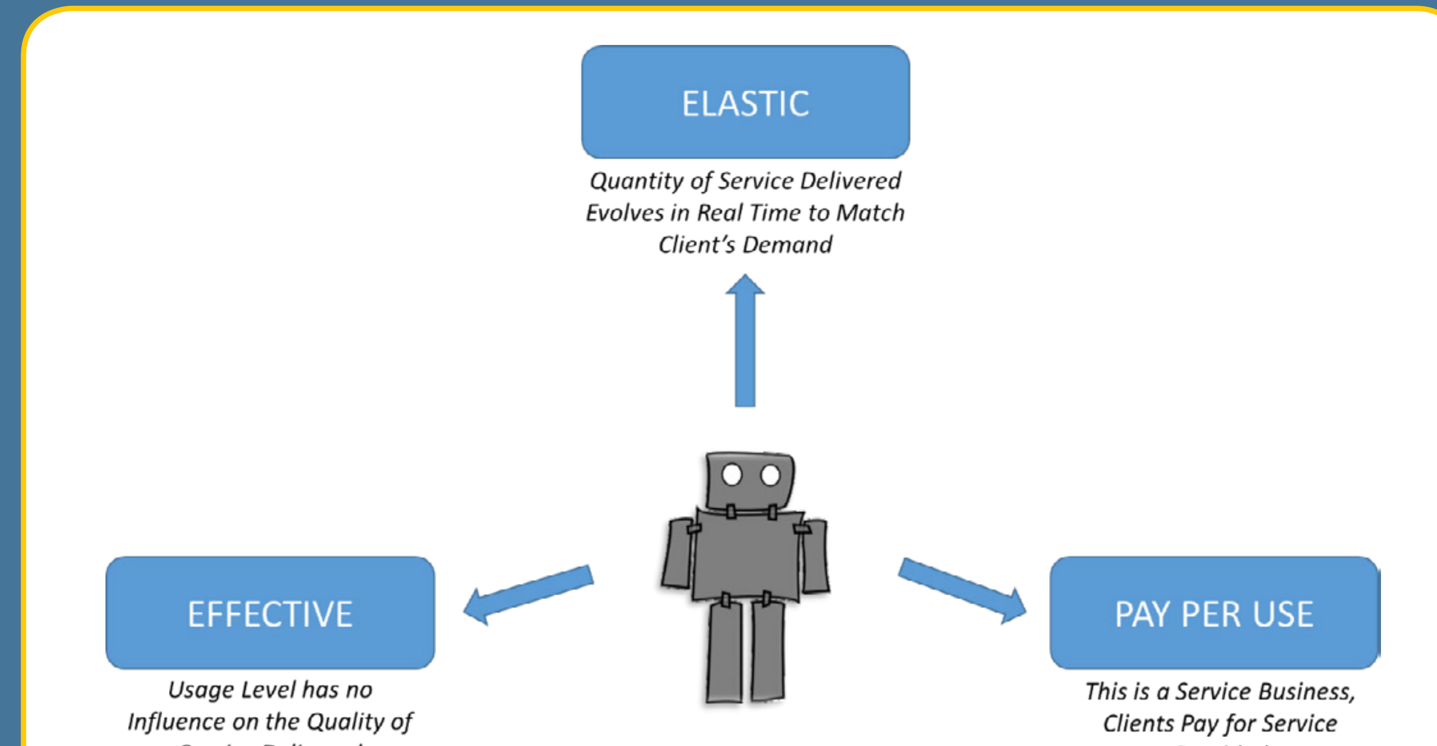
CEO, CTO, COO...CRO?

Myria projects that the predominance of robotics systems across many industries will require a new position to oversee its operation: the Chief Robotics Officer (CRO). With each vertical industry sector that employs RIOS technologies in their processes, companies will gradually embrace CROs as a part of their senior executive staff. The CRO will take charge of the business development and cost reduction potential that robotics systems will enact in their processes, and how their customers can speed up product development. Myria's recently published robotics scenario paints a clearer picture of the CROs main function:

"The CROs (and their teams) will be at the forefront of technology, to translate technology fluency into clear business advantages, and to maintain RIOS capabilities that are intimately linked to customer-facing activities, and, ultimately, to company performance."

While there are already numerous robotics vendors in the industry today, the surge of new vertical markets that will implement RIOS technologies will require a CRO to oversee robotics-related operations. Myria projects that the CRO will work across the board to manage the fast growing "Hardware-Software-Service" ecosystem. Since hardware, in more and more cases,

Emergence of Leaders and Ecosystem Complexity

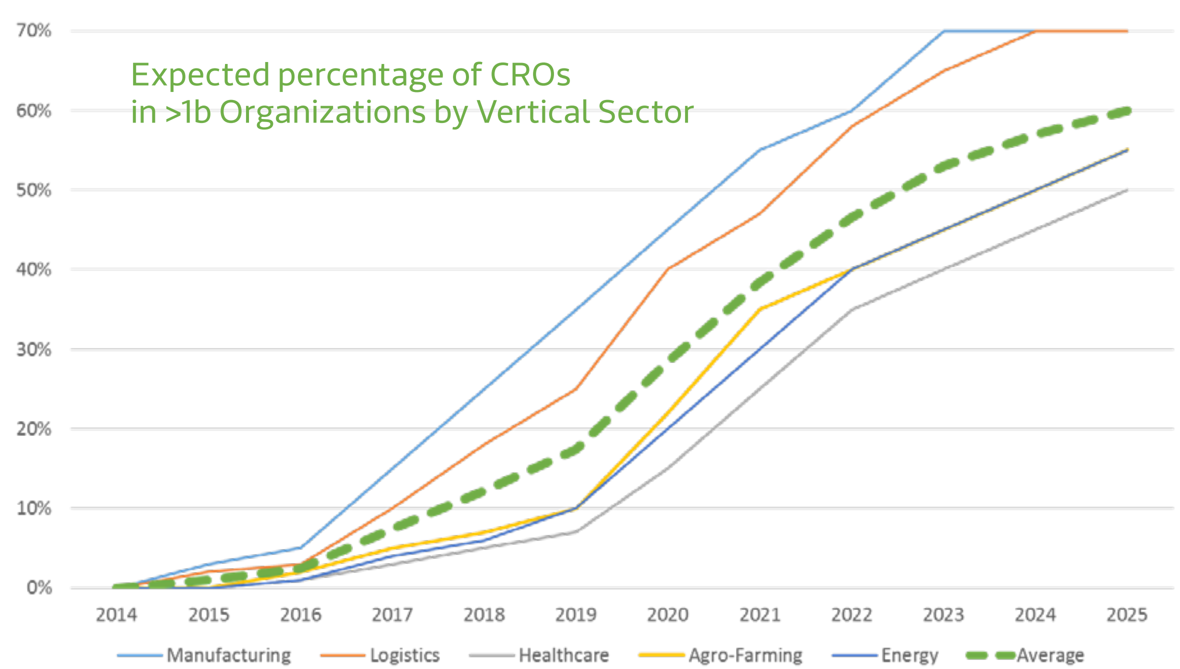


The "Robotics as a Service" Model

RIOS Adoption vs. RIOS Industry Development has reached standardization level, and ubiquitous software development has enabled interoperability across machines, RIOS technologies are now being deployed as a “service.” The shift towards robotics-as-service will push for faster adoption and will help the CRO work with clients on integration of these robotic services.

Even before mass adoption of RIOS technologies occurs, the CRO will be necessary to manage the proliferation of machines, especially the integration with other operational technologies, human operators, and strategic business processes. As such, Myria predicts that by 2025, over 60% of Global 1,000 firms in vertical markets that will implement robotic systems will include a CRO as part of their corporate organization.

The landscape of the labor workforce will dramatically shift over the next decade. While robots will replace (and displace) able workers in some cases, Myria predicts that the management of the robotics systems will require new corporate positions to manage those systems. As Glaisner concluded, “Ironically, for robotics to really take off, it needs people to help make it happen.” EE



Job Description: **Chief Robotics Officer**

POSITION SUMMARY

The Chief Robotics Officer plans, directs, organizes, and manages all activities of the RIOS (Robotics & Intelligent Operational Systems) department to ensure the effective, secure, and efficient use of all RIOS solutions and applications. These efforts must be accomplished in partnership with other business units (IT, Finance, Engineering, R&D, Operations, HR, Business Development, et al) and increasingly with senior management and the Board of Directors. CROs must have significant vertical industry knowledge so that they can better consider the evolution of RIOS solutions in existing and future functions and processes.

Primary Functions

1. Procuring, deploying, and maintaining all RIOS hardware and software and all other services and supplies necessary to keep RIOS applications operable.
2. Creating a 5-10+ year RIOS “aspirational vision” for the enterprise, as well as scenarios, strategic plans, investment and integration requirements, plus business imperatives, competitive threats, et al.
3. Developing a 3-5 year RIOS strategy and execution plan, then positioning and “selling” it to the CEO and business leaders, as well as to the Board of Directors.
4. Managing any current RIOS installations and their costs.
5. Fulfilling business and operation management requests for RIOS support by acting as liaison between RIOS suppliers and company management for informational updates and problem resolution.
6. Creating, maintaining, and enforcing company policies and procedures regarding all RIOS operations in the RIOS department and throughout the business.
7. Evaluating new RIOS equipment and processes continuously, and recommends changes as appropriate.
8. Providing company business units and employees (where applicable), with the highest quality, consistently available RIOS services, support training and maintenance throughout the company.
9. Compiling and reviewing records to determine RIOS department productivity, quality output, and cost of service. Develop methods to continually improve results.
10. Performing all functions of personnel management of department employees.
11. Building RIOS department annual budgets and administer funds according to budget approval.
12. Maintaining complete backup/recovery plans for all RIOS applications in case of system failure or disaster.

MAKERS REJOICE

2nd Annual Hackaday Prize Urges Contestants to Fix the World

Hackaday, a tech blog that posts daily hack projects from around the Internet, has launched its second Hackaday prize contest. Last year marked the first-ever Hackaday prize, which prompted contestants to develop any sort of connected device. The contest was a huge success thanks to the ever-expanding Hackaday community, and the Hackaday team wanted to continue to inspire their readers to build more projects. The second-annual Hackaday prize sets the bar even higher than the year before. The goal: build something that matters.

"This year, the focus is more on large-scale problems that affect bigger groups of people," said Sophi Kravitz, Program Manager at Hackaday. This prompts contestants not only to think outside the box, but to think outside of their immediate circles towards the world at large. Some immediate ways to do this would be to produce a product with minimal power consumption, or to create a product that provides a helpful service.

The submissions will be judged by a panel of twelve experts whose credentials range from inventing DNA scanners to working at the advanced prototypes department at Google[x]—a qualified panel by anyone's standards. The panel will judge submissions using a few criteria like originality, innovation, and its potential impact on the world. Contestants can also submit their initial project to the Product Round—a new addition this year—which will have its own juried selection process shortly after the August 17th cut-off date. The judges will select 100 entries to advance to the next round, and eventually 10 semifinalists will be selected for the final round.

One of the caveats for this year's contest is that each contestant will need to develop three working versions of their projects. "This is a way for us to verify the difference between project and product," Kravitz stated. The emphasis on developing products is reflected in the contest's "Best Product" option, which contestants can choose to enter in the first round. Winners of the "Best Product" award will win a hefty $100,000 cash prize along with a six-month stay at the HackASpace studio in Pasadena, California. In addition, Hackaday's parent company, Supplyframe, will provide the winner with introductions to venture capitalists, mentors, and other people that will help them get their product into development.

The second-annual Hackaday contest is underway, and is sure to be bigger in scale than ever before. Visit the Hackaday.io site to enter the contest and keep track of all the submissions along the way. The site offers the complete list of rules and regulations so you can start developing clever solutions for the world's most important problems. EE

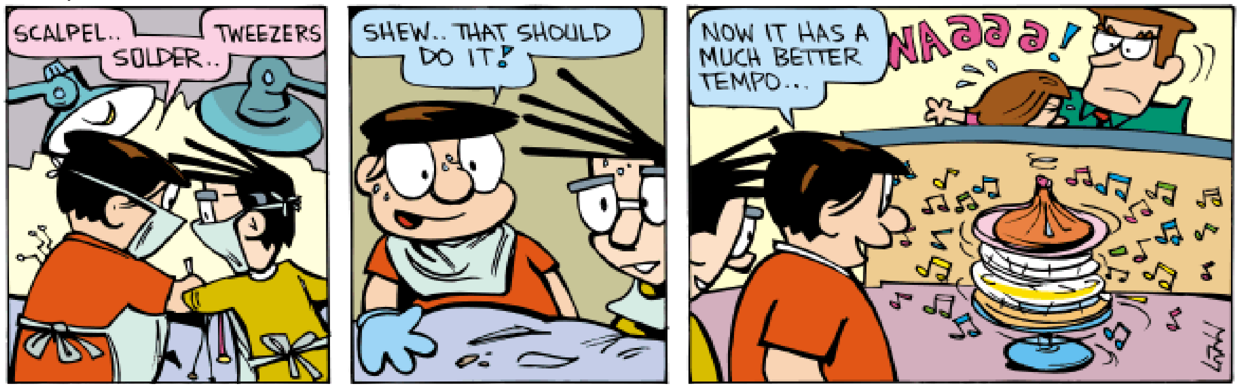
www.hackaday.io

"The panel will judge submissions using a few criteria like originality, innovation and its potential impact on the world."

Return-to-ZERO

Curious Bert - Pt. 1

Toy Modification - Pt. 2



Game Show