

Elektor Helps

Electronics in
challenging
times

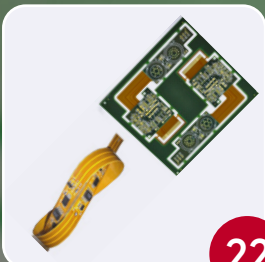
EMBEDDED TECHNOLOGY & TOOLS

USING THE IMPACT OF COVID-19 FOR PROFESSIONAL DEVELOPMENT

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By Stuart Cording

Editorial Team, Elektor Industry

While 2020 seemingly started like any other decade, by March it was clear it was to be like no other in living memory. Efforts to contain the spread of the coronavirus resulted in massive changes to work and home life. Places of work closed, the kitchen table became the new office, and parents assumed the additional role of teacher. But some have been able to take the words of John D. Rockefeller to heart: "Try to turn every disaster into an opportunity."

Some of us were unable to undertake our work from home because we work in manufacturing, or we use specialist equipment that must be operated in a laboratory. In such cases, we've been able to use the time to upskill using a range of resources, from magazines and books to online training courses. In "Using the Impact of Covid-19 for Professional Development" we look at some of the online learning material offered by the semiconductor manufacturers and talk to providers of professional training courses. It seems clear that remote and blended learning has attained a higher level of importance as a result of this crisis.



And, in our interview with Andrew Spitz, cofounder of FROLIC, the changes resulting from the Covid-19 response have also led to opportunities. New projects and time to refine processes offer a ray of sunshine amongst the gloom.

Another opportunity is our „Elektor Helps - Clients“ program, which has enabled some advertisers impacted by Covid-19 to place adverts for free in this issue - so hang in there, collaborate, continue learning, and we'll get through this together.

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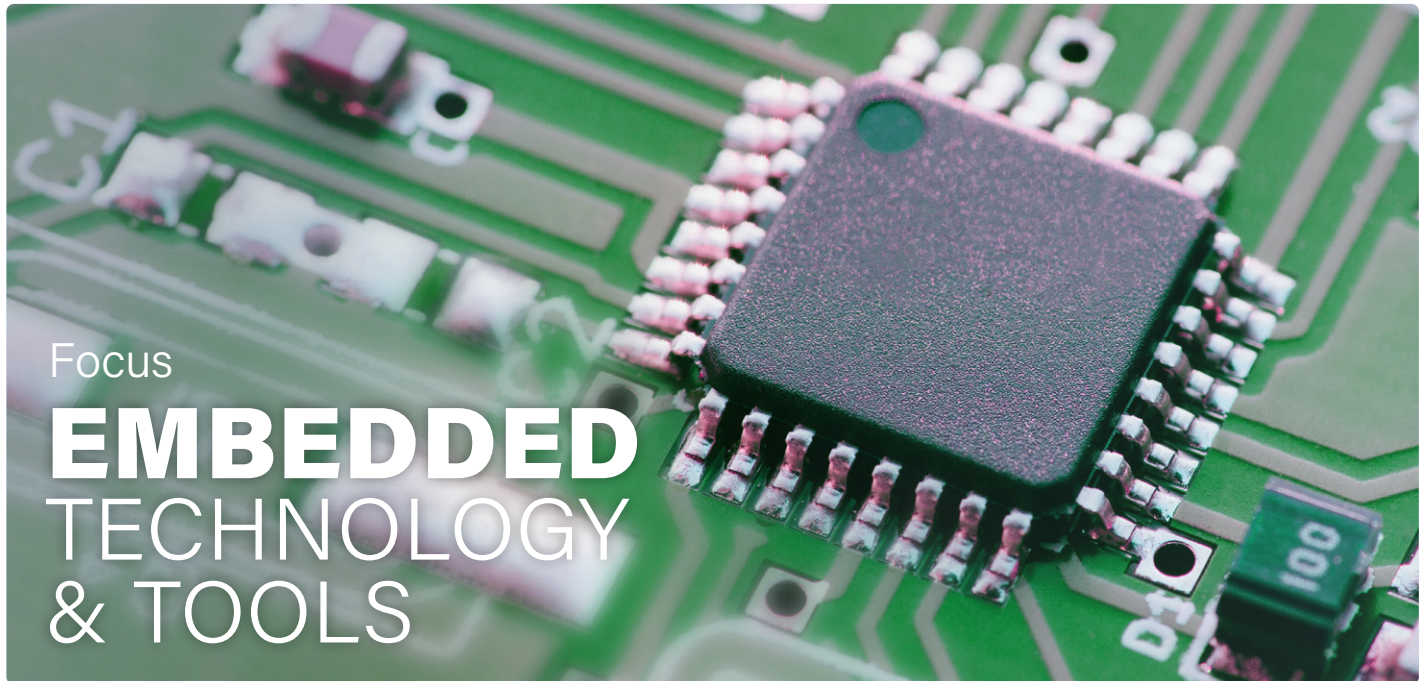
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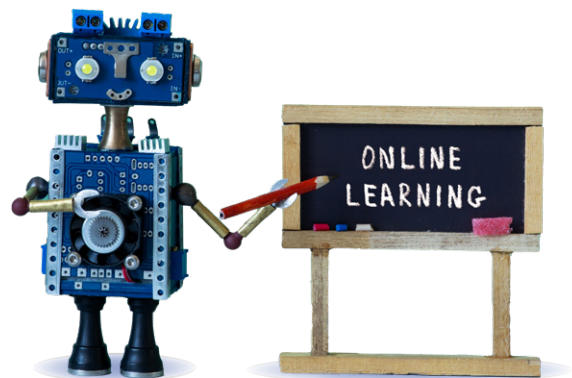


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Start-Up Update

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Elektor International Media
PO Box 11
NL-6114-ZG Susteren
The Netherlands
Tel. +31 46 43894444
Fax +31 46 4370161

Editor-in-Chief

Jens Nickel
Email: redaktion@elektor.de

Deputy Editor

Jan Buiting MA

Regular Contributors

CJ Abate, Stuart Cording,
Robert van der Zwan

Advertising

Margriet Debeij
Tel. +49 241 955 09-174
Email:
margriet.debeij@elektor.com

Layout

Harmen Heida, Patrick Wielders

Publisher

Don Akkermans

Printers

Pijper Media, Stettinweg 15,
NL-9723-HD Groningen, The
Netherlands

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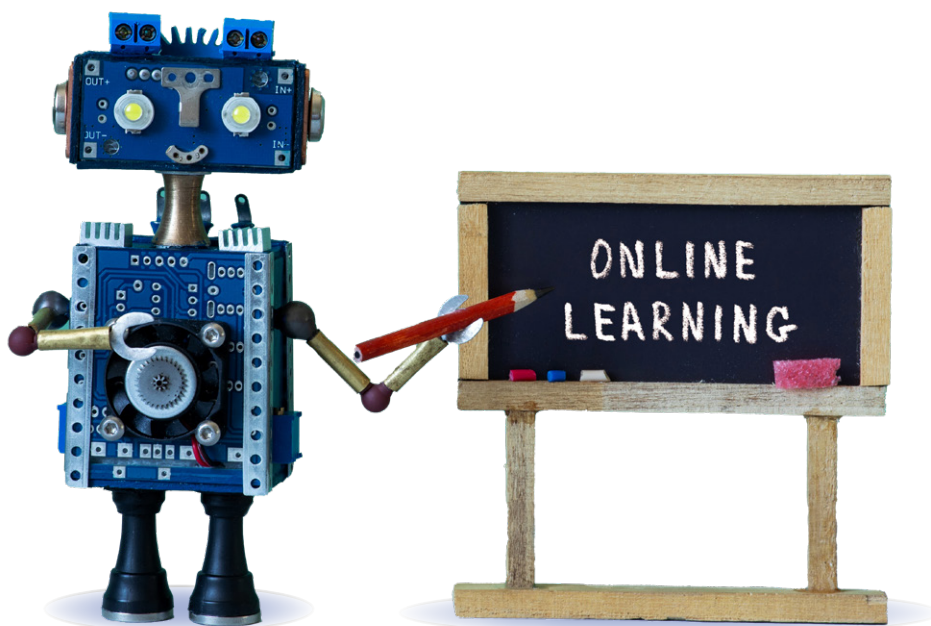
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Using the Impact of Covid-19 for Professional Development

Learning during a crisis

By Stuart Cording (Elektor Industry)

Scrolling through reams of social media posts can leave you feeling inferior on a normal day. But, with Covid-19 disrupting normal patterns of working for many, photos and discussions of everyone's lockdown achievements have been even more difficult to bear. Whether it is banana bread, Zoom yoga, or building a Raspberry Pi cluster (**Figure 1**), you are left feeling as though you wasted the opportunity Covid-19 disruption presented as world governments restricted movement. So, did being furloughed or working from home give us time to improve our skills? If it did, what did we all do and what resources did we find? And what was the impact for those currently studying to enter the field of engineering?



Covid-19 appeared like a gathering storm. We knew it was coming but were unsure what its impact would be. Very few of us have ever experienced this level of restriction in free movement in our lifetimes. For some, the move from office to kitchen table was relatively smooth. Many jobs don't require an office environment as several businesses publicly recognized. Twitter, Google, and Facebook have all announced that working from home will be extended after lockdown to those who wish to continue to do so [1]. The advantages experienced for employees are many-fold but include time saved on commuting and a higher level of focus thanks to the reduction in distractions office environments foster. On the downside, those with children still at home have had to stretch themselves between the demands of work and the new role of teacher. There may be no commute, but the time saved was more than absorbed by trying to handle the curricula being tackled by children in differing year groups. Unfortunately, a substantial number of people have been furloughed, meaning that they are staying at home on reduced salaries. If you build cars or develop electronics in laboratories, work cannot be taken home. A not insignificant number of people have also sadly lost their jobs. Such changes in daily working patterns have caused some to reflect on their situation and consider developing new skills, or extending existing ones, by participating in some sort of technical learning. A limited poll by the Elektor team on Twitter showed that around 27% of us have used changes in working patterns to participate in technical training. Furthermore, our most recent survey shows that 71% of our readers are looking for that technical know-how in magazines and books, while 21% are turning to online courses. So what resources are out there, and what does well-structured training look like?

What makes for good training?

What passes for training in many corpo-

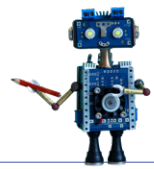


Figure 1: What, you didn't build a supercomputer during the Corona crisis? (Source: Twitter)

Where do we look for technical training?

One of the easiest places for engineers to look for support nowadays is YouTube. Another limited poll on the professional networking platform LinkedIn indicated it as one of the resources some of us turn to first. The combination of audio and video allows the complex topics we tackle to be both explained and shown visually, something that can aid comparison with the equipment, software, or circuitry we have in front of us. However, the experience can vary widely. Knowledge transfer can be hindered by the content creators being more focused on enhancing their profile than the learning they are trying to impart. In other videos, the viewer is forced to view several minutes of basics before getting to the section that interests them.

The survey also highlighted supplier websites, such as those of semiconductor vendors, as a primary source to search out training. With single-chip devices becoming increasingly complex, such as those used in signal converters and switched power supplies, it makes sense that those designing the chips also provide the training. One excellent resource is a collection of modules and courseware covering analog topics from Analog Devices [4]. Low-cost tools for both analog and RF measurements used in the modules are also available. These are used to great effect in well-structured learning modules that range from the basics, such as Kirchhoff's voltage and current laws, through to practical skills, such as determining the impedance of a loudspeaker.

The next most popular option is to access training offered by someone specializing in delivering technical training. Ideally, this should be off-site, away from office distractions, or even offered online. Worryingly, the Elektor Reader Survey indicated that more than 61% of respondents have not participated in a technical training course in five or more years.

This is not a surprise for Annette Kempf,

rations is little more than an application expert with a collection of slides. Inevitably these end with the presenter asking if the assembled participants would mind staying for another 30 minutes as 'some essential details' still haven't been covered. The presenter is not really to blame in such situations. Most have never been trained on how to impart knowledge and teach others. It is also unlikely that such trainers find themselves part of a structured training environment, making it difficult to know where they should position their material within a curriculum.

An excellent book on this topic is 'Developing Technical Training' by Ruth Colvin Clark [2]. In it, she defines technical training as:

"... a structured learning environment engineered to improve workplace performance in ways that are aligned with bottom-line business goals."

The topic of the training could be the use of a word processing application or a software version control system such as git, or even how to program microcontrollers. Its creation should follow the concepts of Instructional Systems Design (ISD) [3]. By focusing on the on-the-job needs of employees and planning appropriately, such training can help avoid expensive and time-consuming mistakes in daily processes and operations.

Many training programs start with the delivery medium first and, because it is installed on almost every computer, it typically results in a set of slides based upon a standard corporate template. To avoid this, ISD takes a five-stage approach that helps to clarify learner needs, both in terms of content and delivery method, long before any training material is created.

Process for creating technical training

The process starts with an analysis of the learner's needs. This may be undertaken by a survey, on-site observation, or analysis of existing data, such as common mistakes seen in software repository commits. It also looks at how best to train the skills needed and the optimal delivery mechanism. Three days of off-site training for the entire technical call-center team may be fun, but it would be too disruptive for the business.

Next comes the design of the training, starting by working out what the majority of learners already know. This ensures that participants don't have to sit through lots of basics or fundamentals. Some will, of course, lack some background, so fundamentals courses, perhaps as online packages, may be required. Once complete, the training is then developed for the chosen delivery media.

There follows an implementation phase. Here the training is tested with a limited number of participants. Feedback is collected using the evaluation methods defined as most appropriate during the design phase. Failings are assessed and result in changes being made to the training. The evaluation element lives on with the training package, allowing continuous improvements to be made for as long the training package is in use.

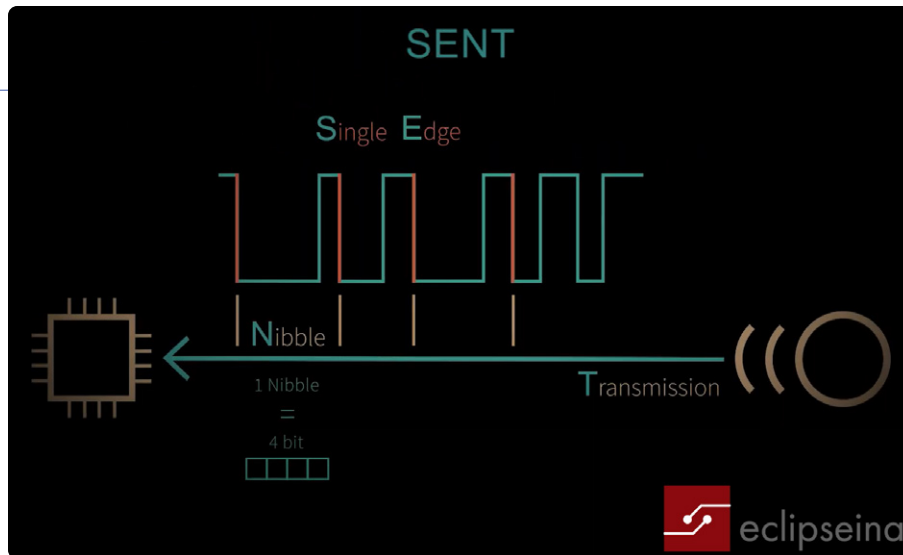
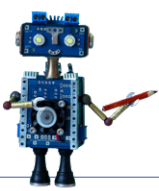


Figure 2: Video is the delivery mechanism best suited to introduce the concepts of the SENT automotive bus [8]. (Source: Eclipseina GmbH)

CEO of Eclipseina GmbH in Regensburg, Germany. Her Embedded Academy offers a broad range of well-structured training courses, covering software concepts and real-time architectures, embedded Linux, and internationally recognized software testing qualifications. “In the automotive industry, I regularly meet people who have not participated in any formal training in more than 10 years,” she explains. “While this previously mechanical world has increasingly turned electronic, the processes and vocabulary have often diverged from other industries, making training essential for those moving into the industry, as well as those just moving within the industry from, say, drivetrain to body applications.”

From in-person to online

Until recently, the impact of Covid-19 has meant that in-person seminars and courses were put on hold. Luckily, Annette’s team had already put an e-learning portal in place as part of their Embedded Academy training offering [5]. Using the ISD process, these self-paced online training packages currently focus on essential basics that support those who want to quickly get up-to-speed on specific topics. Charging of electric vehicles, automotive SPICE®, and the basics of encryption could be all that a learner is looking for. However, it may also be recommended that participants of in-person training access concept material in advance of a course so that the trainer can

be sure that all learners start with the same level of knowledge (Figure 2).

The Embedded World regular Colin O’Flynn from NewAE Technology Inc. of Halifax, Canada, has also had to rethink how he offers training too. Creator of the ChipWhisperer open-source toolchain for side-channel power analysis, he is well known for his in-person training sessions at conferences. He focuses on the security of embedded systems and the tools and methods bad actors use to circumvent it. Many of the events he planned to attend were canceled due to Covid-19. Requests for virtual training have still been coming in, with some organizations seemingly using changed working patterns to upskill. However, financial uncertainty has definitely held back some from committing to participation. So, can his training be moved online?

“The pandemic has undeniably pushed ideas that had been on the edge of being possible into the spotlight,” Colin says. “In-person training has always been perceived as being more valuable, so our online offering had been a lower priority until now (Figure 3).” He offers a lot of tutorials on the ChipWhisperer website but also has a dedicated online training portal in development, something that formalizes the self-learning embedded security material built-up over the past five years [6][7]. Something upon which both Colin and Eclipseina’s Annette agree and concerns them regarding e-learning is the resulting lack of hallway chat. “A lot

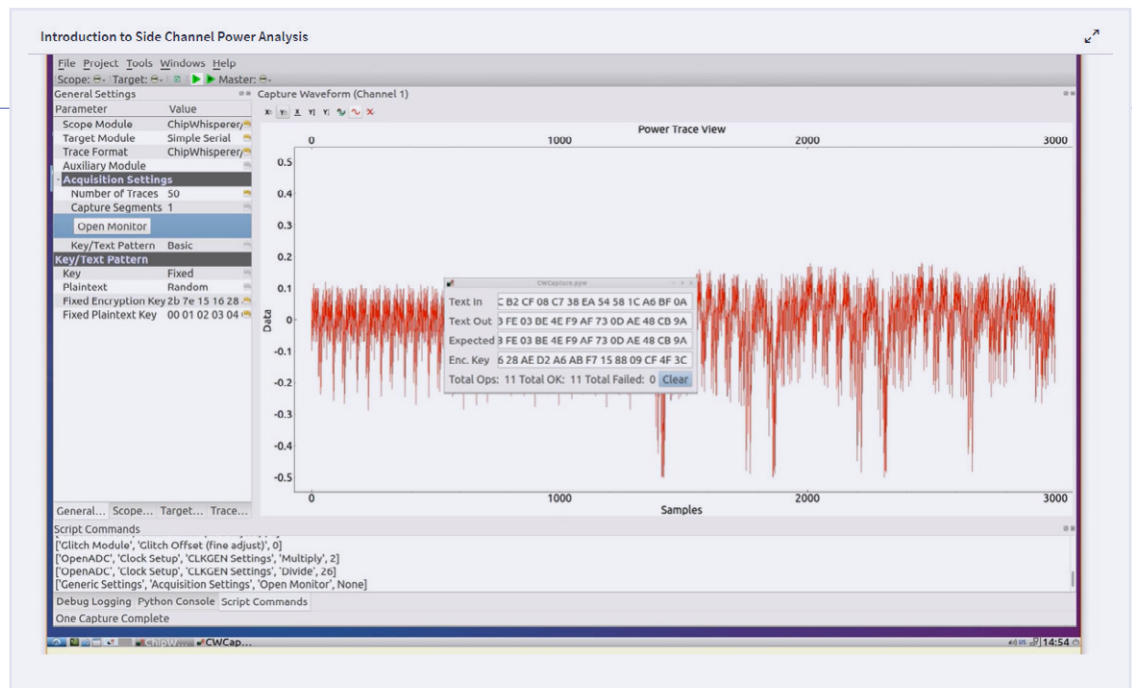
of value-add at in-person training comes from the interaction between the participants sharing their knowledge and experiences,” explains Annette.

What about next-generation engineers?

With extensive and regular interaction with students and young engineers, Annette hopes that her e-learning can help close the gap between education and the realities of the workplace. “In Germany, the move from Dipl.-Ing. to B.Eng has seen students receive a broader but shallower education. This requires employers to fill the knowledge gap to help improve their effectiveness in the workplace,” she says.

Of course, Covid-19 has had serious implications for all students this semester, stopping them from attending courses in person. Learning institutions have had to quickly modify course delivery under lockdown. The Department of Computer Science and Mathematics at the University of Applied Sciences in Munich responded quickly to the ramifications of the lockdown. “After ensuring the safety of staff and students, the highest priority was given to enabling students to continue studying,” said Prof. Dr Martin Hobelsberger. Focusing on real-time and safety-critical embedded systems, he explained “Within days we had the necessary infrastructure for streaming, online learning, group chat, as well as the legal and organizational framework, in place.”

Figure 3: A screencast allows side-channel power analysis to be demonstrated in an online training course [9]. (Source: NewAE Technology Inc.)



Around 95% of all the department's lectures could be offered online, comprising of live-stream lectures and Zoom sessions that offered practical sessions using simulation tools. Other topics were shared as recorded video, with students subsequently joining virtual meetings to discuss the content and fill learning gaps. Naturally, topics that make use of specialist laboratory equipment, such as measurement tools or the faculty's computer graphics hardware, cannot be easily replicated through distance learning. The biggest concern regarding the move to online is the loss of personal contact offered by interaction in study groups and during project work. The teaching staff are also less able to evaluate student progress and determine individual support needs.

However, the experience has shown that more learning can be offered online to complement the in-person experience such institutions provide, something known as blended learning. Martin notes that "the quantity of online learning we offer will definitely increase in the future. Overall this has been a positive experience that will be built upon."

Technical training post Covid-19

While not all of us have been able to utilize the changes Covid-19 forced upon us to participate in professional development, it has thrown the range, availability, and quality of online resources into sharper focus. For those looking for self-paced resources, supplier websites can be a source of well-constructed material.

However, should you get into difficulties with the concepts or practical activities, immediate in-person support is lacking. Those offering professional training services ensure that material is created following established processes that are matched to the needs of their learners. Blended learning, using a range of online and in-person delivery methods, ensures that fundamental concepts can be acquired efficiently, while individual questions can be responded to by an experienced trainer and discussed within the group. The move to online training also saves on travel costs. "This alone could pay for a few subscriptions to your favourite electronics magazines or a few extra textbooks," suggests NewAE's Colin O'Flynn, something we at Elektor wholeheartedly agree with.

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WEB LINKS

- [1] Coronavirus: Twitter allows staff to work from home 'forever': <https://www.bbc.com/news/technology-52628119>
- [2] Developing Technical Training (3rd Edition), Ruth Colvin Clark, ISBN 978-0787988463: <https://www.amazon.com/Developing-Technical-Training-Computer-based-Instructional-ebook/dp/B004J4VVWO>
- [3] 5 Basic Principles Of Instructional Systems Design: <https://elearningindustry.com/instructional-systems-design-5-basic-principles>
- [4] ADI Modules and Courseware: <https://www.analog.com/en/education/courses-and-tutorials.html>
- [5] Eclipseina Embedded Academy E-Learning: <https://embedded-academy.com/e-learning-en>
- [6] ChipWhisperer® Wiki: https://wiki.newae.com/Main_Page
- [7] ChipWhisperer® E-Learning: <https://learn.chipwhisperer.io/>
- [8] SENT Protocol Data Transmission Part 1 - Concept, from Eclipseina: <https://www.youtube.com/watch?v=VF1uUKLReFQ>
- [9] Introduction to side-channel power analysis training from NewAE: <https://learn.chipwhisperer.io/courses/introduction-to-side-channel-analysis>

Converters for Photovoltaic Panels

Contributed by TME (Transfer Multisort Elektronik Sp. z o.o.,

In recent years we have witnessed a growing interest in “green energy”. Numerous applications are offered that enable energy to be obtained from freely available sources, among which photovoltaic panel installations are the most popular ones. Their prices have dropped to levels permitting installation even in small summer houses. When building such systems, it is important to understand the specific nature of the energy source – a photovoltaic panel or a turbine – as well as to consider the challenges faced by the manufacturers of devices powered from such sources.



A photovoltaic panel used as an energy source is capricious because the power obtained from the panel will depend on the intensity of the incident light. Additionally, the load current also remains an important factor. Users of this energy source aren't able in most cases to obtain constant illumination or a constant load. Usually, the panels are fixed in one spot and they are rarely placed on revolving supports that track the sun. As a result, sunlight reaches the panel surface at different angles. In addition, the sun can be obscured by clouds. The load is not constant either and usually fluctuates depending on the needs of the consumers. Under such conditions, the voltage on the panel terminals will also exhibit significant variations.

Usually, users on the power network expect a stable voltage and they do not want to worry about any fluctuations. If, for example, it is 12 V_{DC}, then changes are expected to be rather small, say 2-3% of the nominal value at the most. As mentioned before, freely available energy sources are rarely capable of providing such power supply conditions. Therefore, properly constructed voltage converters are used as the intermediary between these sources and the user.

Unlike “standard” DC/DC converters for power supply — and depending on the target application — converters working with renewable energy sources must offer the right parameters to match the “caprices” of the source. The most important of these are a wide range of input voltages, suitable input resistance and high breakthrough voltage between input and output, usually at least several hundred volts.

The demand for “green energy” has resulted in devices and products designed for its acquisition being produced by many competing companies. An average user of a PV panel will be interested mainly in ready-made plug&play modules attached to the panels, but, on the other hand, electronic engineers may be searching for converter modules designed to be integrated into the user's own devices. The target applications may include illuminated traffic signs, monitoring devices or systems operating within IoT networks. Among the products for such applications, those manufactured by Canadian company Aimtec are worthy of mentioning since they are appreciated by engineers all over the world.



Series	Output Power [W]	Nominal Input Voltage [V _{DC}]	Output Voltage [V _{DC}]	Protection Options
AM5W-NZ	5	100 ...1000	5	CSP ¹⁾ , OCP ²⁾ , OVP ³⁾ , RPP ⁴⁾
AM10W-NZ	10	100 ...1000 200 ...1500	5, 9, 24	
AM10WM-NZ	10	200 ...1500	5	
AM15W-NZ	15	100 ...1000 200 ...1500	12, 15, 24	
AM15WM-NZ	15	200 ...1500	12, 15, 24	
AM40W-NZ	40	100 ...1000 200 ...1500	12, 15, 24	
AM45W-NST	45	150 ...1500	2×15	
AM200W-NZ	200	300 ...1500	24, 48	

Table 1: Basic parameters of Aimtec converters for photovoltaic panels and turbines.

Notes
1) CSP – Continuous Short-circuit Protection
2) OCP – Over Current Protection
3) OVP – Over Voltage Protection
4) RPP – Reverse Polarity Protection

Aimtec is a global company that develops and manufactures modular AC/DC and DC/DC power systems, including LED power supplies. The company is headquartered in Montreal, Canada, but also has numerous offices in Europe and Asia. Products from Aimtec are valued mainly for their unique features and the quality/price ratio.

Converters for photovoltaic panels

Converters for photovoltaic panels manufactured by Aimtec will be of particular interest to constructors of DC devices powered by 5 V to 48 V_{DC}. Of course, a battery can also be charged with this voltage, from which another converter will obtain 230 V_{AC}, but this would be at the expense of a significant loss of efficiency of the power supply. As the voltage at the terminals of photovoltaic panels and wind power generators has similar parameters, the company recommends its series of products to be used with both types of energy sources. This is the AM5W through AM200W family, where the number following the “AM” prefix indicates the maximum continuous output power available. Next, the nominal input voltage, output voltage and housing type are specified according to the manufacturer’s nomenclature. For example, the type code **AM15W-60015S-NZ** stands for a converter with these ratings:

- 15 W output power;
- 15 V_{DC} output voltage;
- up to 600 V_{DC} nominal input voltage;
- contained in a housing designed to be soldered into a PCB.

In addition to the above type of housing, there are also modules with screw terminals, an external fuse and an EMC filter (-ST), for mounting on a TH/TS35 bus with a fuse and an EMC filter (-STD, -STS) or without a fuse (-STF). For more details, please refer to the datasheets available on the website of the manufacturer or distributor, TME at www.tme.eu.

The most popular among OEM users are the 5-watt to 40-watt converters housed in a 70 mm × 48 mm × 23.5 mm case and designed to be soldered into a PCB. Importantly, the converters offered within

this family of products are enclosed in housings of the same dimensions and are compatible in terms of the layout of outputs, which allows for easy extension of the power source functionality without changing the printed circuit board. The higher power converters, i.e. 45 W and 200 W, have an open frame casing and are connected to the associated circuits using screw terminals, which will surely be appreciated by installers and service technicians. It is worth mentioning that lower power converters (as mentioned earlier) are also offered in a variant for mounting off the PCB, with a fuse, with an EMC filter, or with screw terminals.

The nominal input voltage depends on the type of the device, spans from 200 V to 1500 V_{DC}, and its range is very wide amounting to 10:1. The output voltage is constant, set by the manufacturer at the production stage. The largest selection of variants is available within the series of converters with powers of up to 40 W. These include converters with an output voltage of 5, 9, 12, 15 or 24 V_{DC}. The 45-watt converter has two 15-volt outputs, while the 200-watt converter provides 24 V_{DC} or 48 V_{DC}. All of them can be used at ambient temperatures between –40 °C and +70 °C without any deterioration in performance. The highest energy efficiency is about 80%, which translates into low power losses and no need for forced cooling.

All products meet the strict requirements of the safety standards for devices working with photovoltaic panels. They have CSA (CSA-C22.2 No.1071-01), UL (1741), and CE marking granted in accordance with European standards (a detailed list is available in the datasheet for each converter). Standard protection options include protection against overvoltage and short-circuit at the output, overheating, reverse polarity of the supply voltage.

The converter does not require a minimum load to start up, and its start-up time under no-load condition is less than one second. Typical breakthrough voltage between input and output for most converters is 4 kV.

The basic parameters of the converters in this series are listed in **Table 1**. For detailed parameter descriptions, please refer to the catalogue datasheets. ◀

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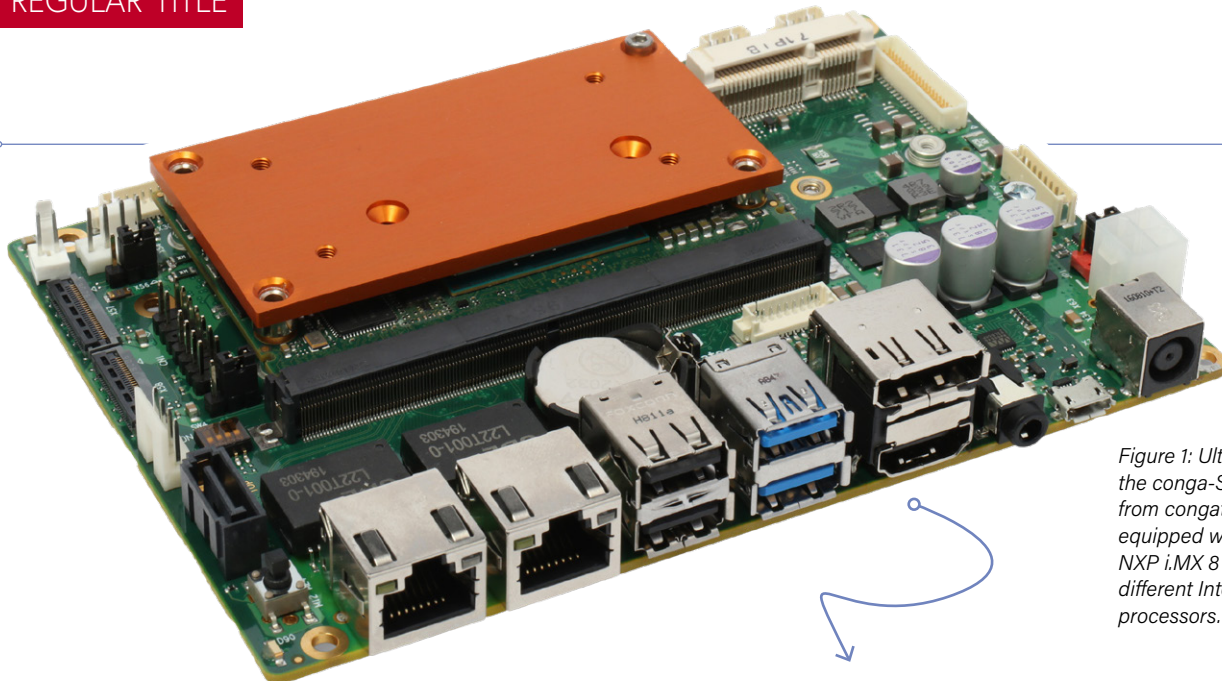


Figure 1: Ultra-scalable: the conga-SMC1 carrier from congatec can be equipped with six different NXP i.MX 8 modules or five different Intel Apollo Lake processors.

A 3.5-inch Carrier Board for i.MX 8 SMARC Modules

So much more than an evaluation board

By Martin Danzer, Director Product Management at congatec

In the past, there were hardly any application-ready standard boards for the ARM world. With the availability of application-ready SMARC modules and 3.5-inch carrier boards such as those offered by congatec, this situation has changed. Today, it's just as easy to use virtually the entire NXP i.MX 8 family as any x86 board that can be bought from the IT dealer around the corner.

In the ARM world, buying an evaluation board for the latest processor and then developing a customer-specific board used to be the only option for small series. This was because ARM was made for larger production runs. So from a cost-perspective, full-custom designs were more suitable. With the feature sets in the ARM application processor segment becoming increasingly homogenized — with fully open source operating systems such as Linux or Android and widely standardized I/O interfaces for communication, data storage and human-machine interfaces — ARM can now serve as a standard platform for any IT task. Quite often, the cost of using ARM is lower than x86. All good reasons to start the next IT project with ARM instead of x86. What this requires, however, is an application-ready hardware platform that is just as easily available from the IT dealer around the corner as the x86 boards.

Application-ready i.MX 8 platform

The embedded computing manufacturer congatec has embraced this challenge and developed an industrial-grade solution platform that meets the low-power and small form factor needs of the ARM application processor segment and is now



Martin Danzer,
Director Product
Management at
congatec



	conga-SMX8	conga-SMX8-Mini	conga-SMX8X
CPU Cores			
Cortex-A72	Up to 2	-	-
Cortex-A53	4x	up to 4	-
Cortex-A35	-	-	up to 2
Cortex-M4F	2	1	1
Graphics			
Graphics unit	dual GT7000 multimedia GPU	GC NanoUltra 3D GPU	GT7000Lite multimedia GPU
Display support	Up to 2x	1x	up to 2x
Max. resolution	4k	Full HD	4k
Video interfaces	HDMI, dual channel LVDS 24 bit, eDP, MIPI DSI	dual channel LVDS 24 bit, MIPI DSI	HDMI, dual channel LVDS 24 bit, MIPI DSI
I/Os			
PCIe	Up to 3x PCIe 3.0	1x PCIe 2.0	1x PCIe 3.0
USB	5x USB 2.0 & 1x USB 3.0	5x USB 2.0	5x USB 2.0 & 1x USB 3.0
Ethernet	2x GbE	1x GbE	2x GbE
Camera	2x MIPI CSI	1x MIPI CSI	1x MIPI CSI

Table 1: The feature set of the six NXP i.MX 8 based SMARC modules.

available in nearly all NXP i.MX 8 processor configurations. The choice fell on the compact 3.5-inch form factor, which measures 146 mm x 102 mm and is also used in standard hard drives, so there is a rich ecosystem of embedded mounting options – right up to standard box PC housings that are specifically tailored to this format. This makes it easy to assemble a suitable system on the basis of the 3.5-inch carrier, for which congatec offers a total of six NXP i.MX 8 modules (**Figure 1**). The performance range stretches from the i.MX 8QuadMax and the i.MX 8M mini processors in 14-nm technology to the low-power i.MX 8X for 2-watt applications. **Table 1** shows the main features of the six modules. With minor restrictions, it can even be scaled 1:1 towards x86 processors. This is because the conga-SMC1 carrier is also available in an x86 version, where the only main difference is the handling of the audio codes. The conga-SMC1 carrier is therefore also an excellent basis for evaluating a processor change from x86 to ARM or *vice versa* on almost 100% identical hardware. congatec offers x86 modules for the entire range of Intel Apollo Lake processors – from Intel Atom (E3950, E3940 and E3930) to Intel Celeron (N3350) and Intel Pentium (N4200) processors.

One carrier board for 11 processor variants

The conga-SMC1 carrier board offers dual GbE, 5x USB and USB hub support as well as SATA 3 for external hard drives or SSDs for all these very different processors. Specific expansion options include a miniPCIe slot as well as an M.2 Type E E2230 slot with I²S, PCIe and USB, and an M.2 Type B B2242/2280 slot with 2x PCIe and 1x USB. For IoT connection, there is a MicroSim slot, and specific embedded interfaces include 4x UART, 2x CAN, 8x GPIO, I²C and SPI. Displays can be connected via HDMI, LVDS/eDP/DP and MIPI DSI. The board further offers two MIPI CSI camera inputs, and an audio jack socket to implement I²S sound. The software offering includes fully compiled binaries with a suitably configured bootloader, appropriately compiled Linux, Yocto and Android images, as well as all necessary drivers, which are available to congatec customers on GitHub.

Comes with comprehensive software support

As congatec is putting specific emphasis on software support for this carrier, there is documentation for each SMARC module on the company website. Software developers

Development Concepts in Comparison

 COM & Carrier Designs	 Full Custom Designs
 One supercomponent	 Complex BOM
 Open standard	 Proprietary processor implementation
 Application ready BSPs	 Complex implementation of hardware-related software
 Comprehensive design-in support	 Limited support options
 Large ecosystem	 No community
 Efficient re-use of existing building blocks	 Wheel reinvented every time
 Long term availability	 Complex lifecycle management
 High design security	 Greater risk of design errors
 Low development costs	 High NRE costs
 Short time-to-market	 Long development cycles
 High scalability	 Each variant a new product
 Easy upgrades	 Always a new design
 Ideal for small to medium series	 More complex than COM & carrier fusion
 COM & carrier fusion for large series	

Figure 2: The advantages of modular designs.

can also find comprehensive guidelines there – or at <https://wiki.congatec.com/> – on how to set up the development system, the complete BSPs for Yocto 2.5 and Android 9, as well as instructions on how to set up the bootloader or configure the WLAN interface that is available in some variants of the SMARC modules. The onboard Wi-Fi module is in this case connected via the second PCIe interface (pcieb) of the i.MX 8 SoC. Since this interface is by default deactivated, it must be activated during kernel startup using the corresponding DTB file. To do this, it is necessary to enter either `imx8qm-cgtsmx8-pcieb.dtb` or `imx8qm-cgtsmx8-hdmi-pcieb.dtb` for the bootloader environment variable “fdt_file”.

For the development system, congatec recommends using an x86-based Linux system with a cross-compile toolchain to develop Yocto-based software for i.MX 8-based designs. While it is in principle possible to use a virtual machine running Linux, a dedicated system with 64 bit Ubuntu (16.04) is preferred. The host should also have a serial port for accessing the debug console, and an SD card reader. The entire Git repository can be found at <https://git.congatec.com/arm-nxp/imx8-family>.



Figure 3: congatec's MIPI/Skit-ARM starter kit.

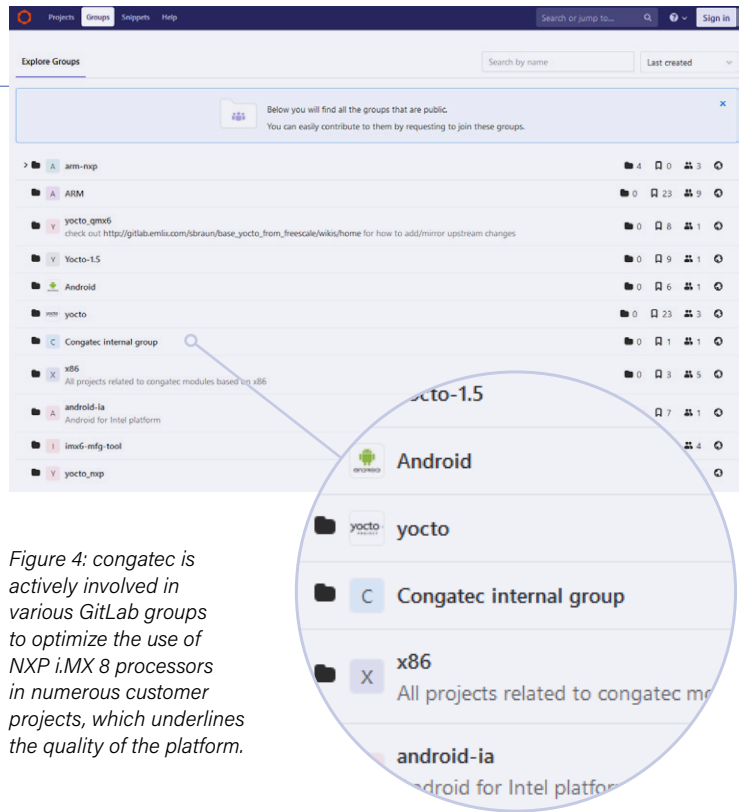


Figure 4: congatec is actively involved in various GitLab groups to optimize the use of NXP i.MX 8 processors in numerous customer projects, which underlines the quality of the platform.

Making modular benefits accessible from batch size 1

Primary targets for this carrier board with its many module variants are professional applications requiring a rugged design for 24/7 operation (**Figure 2**). All components are therefore designed for high quality and durability. And the availability of such application-ready module and carrier board combinations means that even 'batch size 1' series can now enjoy the benefits of Computer-on-Module based system design. However, when questioned, congatec claimed to have no plans to set up a web shop for such carrier/module combos. The company will continue to focus primarily on OEM customers, who tend not to purchase their embedded logic from online sources.

Easy camera integration

congatec also offers a vision kit with an integrated 13-megapixel Basler camera for the new 3.5-inch carrier board (**Figure 3**). Providing two MIPI-CSI inputs with flat-foil connectors, the board allows the direct integration of any MIPI camera without additional hardware. The full capability of ARM-based vision platforms is demonstrated by an application-ready retail kit from congatec, Basler and NXP that uses artificial intelligence to

recognize merchandise without a barcode or QR code. Recognition happens in real time, based on the video stream supplied by the camera that is integrated in the i.MX 8-based Computer-on-Module installed at

the checkout. This high-performance system does not even require a cloud connection. More customer-oriented projects are shown in **Figure 4** — all are being worked on using Gitlab.

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Vlakkbodem 10
+31 187 602 744

3247 CP Dirksland
www.tbp.nl

the Netherlands
info@tbp.nl

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Start-Up Update:

Qoitech Looks to Solve Battery Power-Related Problems for Developers

What's draining my battery?

By CJ Abate & Arthur Lampe

Vanja Samuelsson runs Qoitech, a Sweden-based start-up focused on solving battery power-related problems for hardware and software developers working on IoT devices. The Elektor team interviewed her in late February at Embedded World 2020 in Nuremberg, Germany, about her company and its technology.

Developers seeking tools to measure and analyze battery power typically must choose from expensive traditional options. Qoitech is working to change that by delivering a more affordable and accessible solution. Otii is a hardware and software tool that visualizes what drains battery power, and it helps developers choose the proper battery for their applications.

Qoitech's compact Otii Arc is a power supply, a current and voltage measurement unit, and a data acquisition module all wrapped up in one portable device. And it comes with handy desktop application for Windows, macOS, and Ubuntu. "It's all about: How do you battery-optimize? How do you make sure your device is really low power? And how do you pick the right battery for your devices?" Samuelsson said of the company's solution, which is an all-in-one tool. "You don't have to have a huge lab. You don't have to have five different tools. You can have a power supply, you can have a monitoring device, you can have a battery emulator all in one."

Interested in learning more about Qoitech? Watch the entire interview, here: <https://youtu.be/6Ms0cW8AIAw>.

Coverage by Elektor, and availability

Qoitech's Otii Arc was reviewed in 2018 by Jan Buiting, here: www.elektormagazine.com/news/review-otii-arc-demo-kit-what-s-draining-my-battery

and in May 2020 by Clemens Valens for Elektor labs, complete with a video and software examples, here:

www.elektormagazine.com/labs/otii-power-consumption-optimizer-for-wearables-and-iot-devices

The product is currently available from the Elektor Store.

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Vanja Samuelsson (CEO, Qoitech) interviewed by Elektor Industry correspondent Arthur Lampe at Embedded World 2020.

Qoitech Otii Arc – Power Supply, Power Meter and Data Acquisition

Otii Arc is the ultimate developer tool for designing highly energy efficient devices. It is easy-to-use, all-in-one tool for every developer's table. It records currents and voltages, and displays them in real time as charts and interactive measurements for analysis and comparisons. Recordings can be synchronized with UART debug logs, giving insights in what drains the energy.



4 Sale @ www.elektor.com

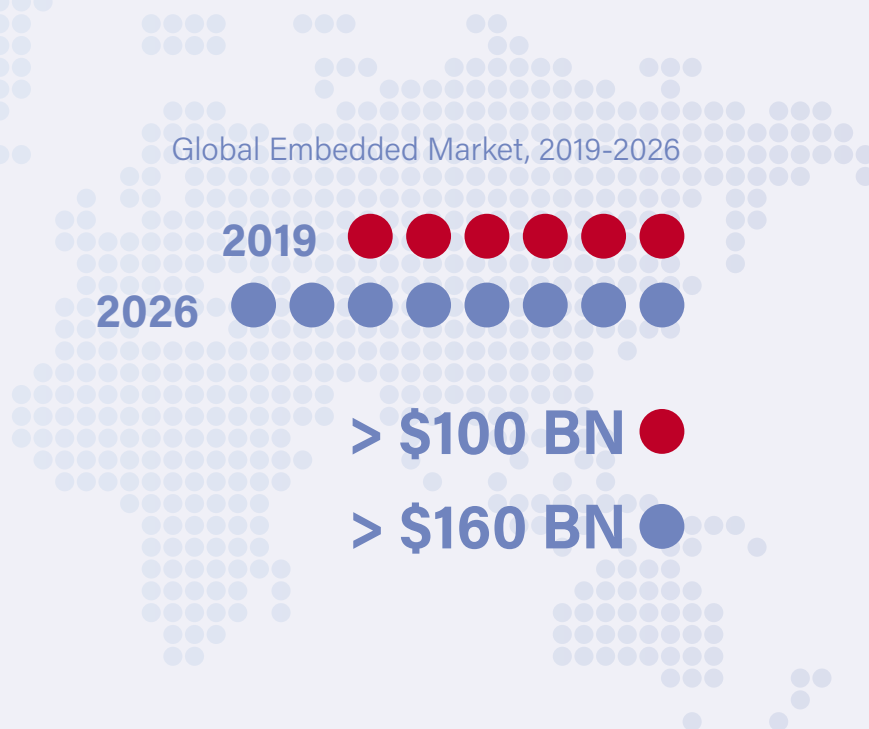
> www.elektor.com/qoitech-otii-arc-power-supply-power-meter-and-data-acquisition



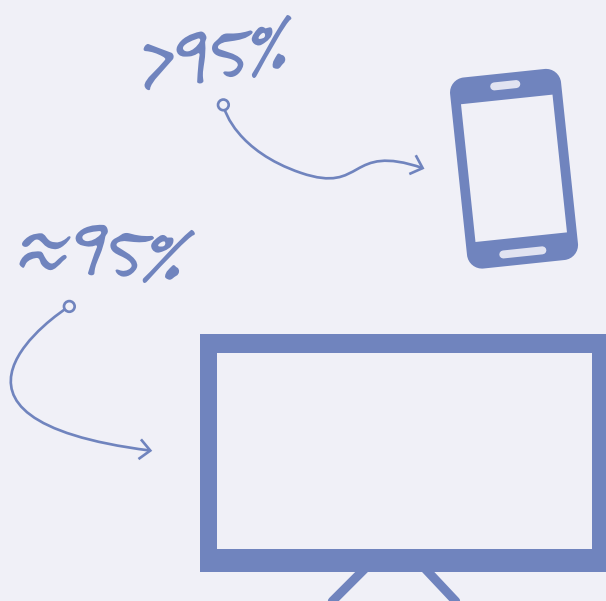
Covid-19 and MCUs: Much Remains to be Seen

What will the effect of Covid-19 be on the MCU market during the first years to come? Some research companies have updated their forecasts to include the impact of Covid-19 on the global MCU market. Based on the embedded systems using microcontrollers they paint a picture that's in line with what the IMF projects: this year a drop of about 8 to 10 percent in market value, next year a rebound of 4 to 5 percent. Looking ahead is really difficult, market research shows. For example, a second wave of outbreaks could halt the rebound completely.

(Sources: Allied Market Research, Global Market Insights [source graphics], Grand View Research, among others)



A Strong Arm Leading to Almost Every Smartphone



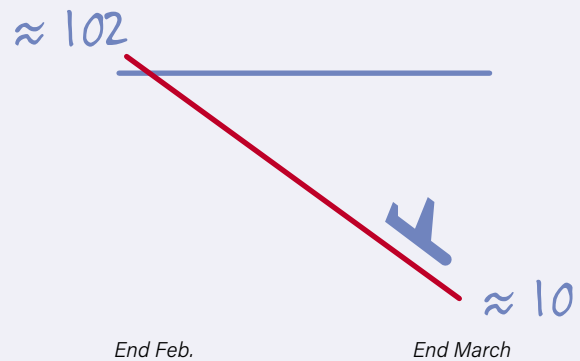
It may not come as a surprise, but it's extraordinary nevertheless. In 2010 roughly 95% of the smartphones had a processor with ARM technology inside. The latest figures show this still is the case, even after a full decade. What would be the reason for this dominance? As expected, there are multiple reasons, including its low power consumption, its rather simple RISC architecture, and a SoC philosophy with all kinds of embedded technologies on a single chip: graphics, connectivity, navigation, camera and so on. Some would also argue that Intel didn't make a real choice to challenge the ARM dominance, sticking too much to its x86 philosophy.

(Sources: ARM, Stack Overflow, among others)

Airports Hit Hard: Embedded Tech Strikes Back

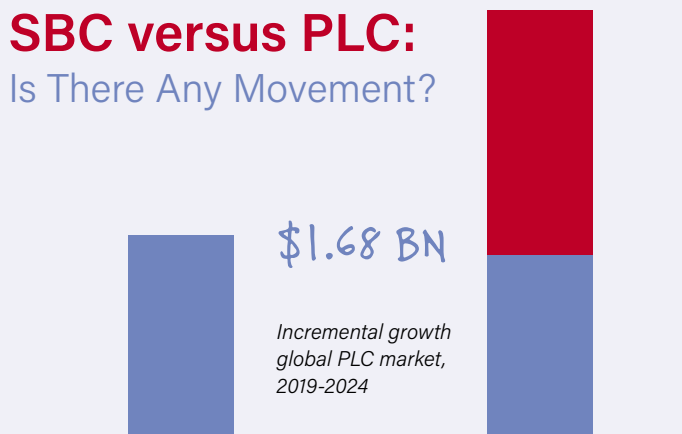
Airports have been hit hard during the Covid 19 crisis. The expectation is that it will take some four to five years before pre-Covid 19 numbers of airline passengers will pass the gates. In the meantime, what can airports do? International rescue might come from embedded technology, according to Aertec Solutions, a Spanish consultancy and engineering firm in aeronautics. This company explores an almost unlimited amount of possibilities, among which are remote control towers, tools that display the most efficient and safe taxiing routes for aircraft and of course wayfinding apps for passengers. This embedded technology cannot only save costs, but can also generate more revenue for airports.

(Sources: Aertec Solutions, Statista, among others)



Airport passenger traffic Europe (2019 = 100, 2020 depicted)

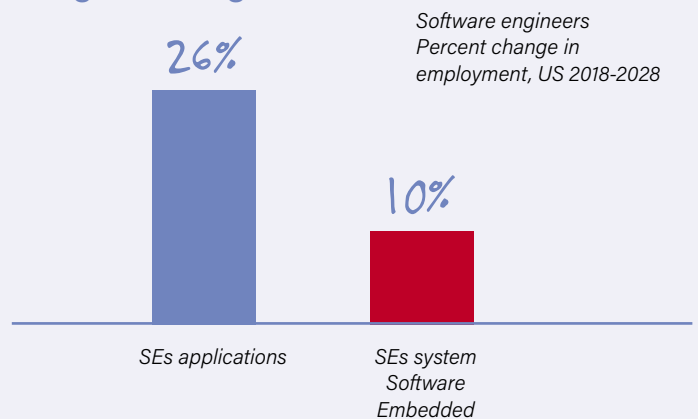
SBC versus PLC: Is There Any Movement?



They could be described as two camps when it comes to industrial automation: the camp of the single board computers and the 'good old camp' of programmable logic controllers. SBCs like Arduino and Raspberry Pi are way cheaper than the respectable PLCs from, say, Mitsubishi and Siemens. So, are SBCs the likes of Arduino and Raspberry Pi making inroads? Yes, they are. But the PLC still remains king. Whereas SBCs will reach the \$1 billion mark in 2025, PLCs were already there in 2019. The market for SBCs will probably grow twice as fast as the market for PLCs during the coming years (12% vs. 6%). Yet, in 2025 the PLC market will still be three times larger than the SBC market. Plant managers especially like the low cost of the SBC, but also the maintainability and easy programming of the PLC.

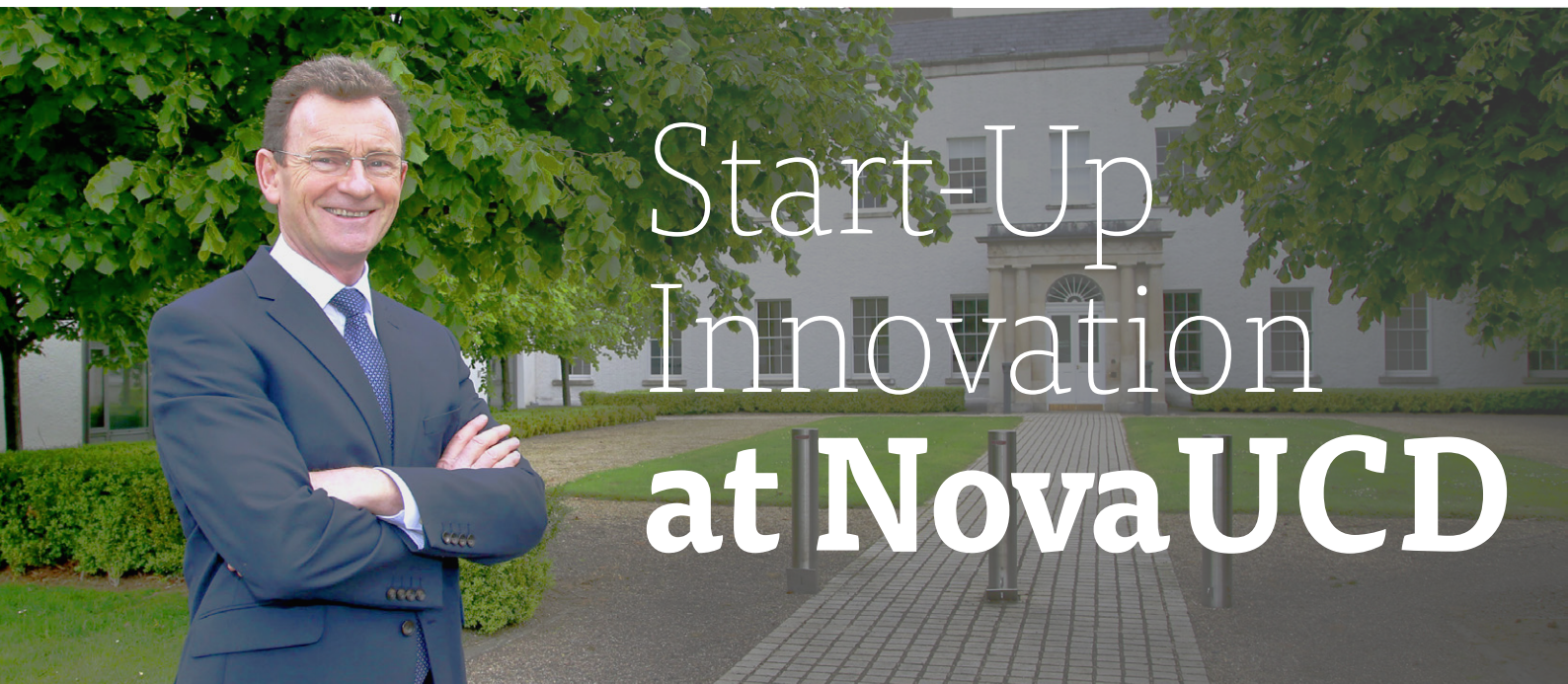
(Sources: Global Market Insights, Technavio [source graphics])

Job Outlook? Programming Tools!



The job outlook for software engineers is extremely bright, judging from research carried out by the US Bureau of Labor Statistics. Employment for software engineers in the USA is expected to grow 21% between 2018 and 2028 ("much faster than the average for all occupations"). Covid-19 can have a negative impact, but this can in no way take away the fact that people with a bachelor's degree in computer science do not have to worry one bit. What if they want to stand a better chance than their colleagues (in pay, for example)? Then they should know how to work with up-to-date programming tools, such as code generating tools and tools to create teams across engineering domains.

(Sources: US Bureau of Labor Statistics [source graphics], VDC Research)



Tom Flanagan at NovaUCD (Picture Credit: Nick Bradshaw, Fotonic)

By Rachit Syag (Elektor)

A graduate of the University College Dublin (UCD) and now the Director of Enterprise and Commercialization at NovaUCD, Tom Flanagan shares his experience and talks about innovation and entrepreneurship in an interview with Elektor.

During the past decade, several European universities have created programs to help start-ups launch and grow. NovaUCD at University College Dublin is a stand-out program. The organization supports entrepreneurs and start-ups through the various phases of business development. Tom Flanagan, Director of Enterprise and Commercialization at NovaUCD, tells us about his background as an engineer and business leader. He then covers start-up innovation at NovaUCD and offers advice for engineers interested in launching a business.

Syag: You graduated with an engineering degree from UCD, and today you are the Director of Enterprise and Commercialization at UCD. Can you tell us about this interesting journey?

Flanagan: I started out designing fibre optic circuits in the UK. I moved to Canada and then to the US, where I invented SON-ET Fibre Optic Rings and championed them to worldwide deployment. I was promoted several times and transitioned from design to product line management,





Competitions including Elektor's Fast Forward offer excellent prizes for winners so they represent opportunities to receive an investment, associated media publicity, and an opportunity to join a valuable network of former winners.

Tom Flanagan

to marketing, to sales, and then consulting. I led a \$100-million-per-year business as Vice President for Canada and Central US at Nortel before returning to Dublin to be involved in the start-up community. I enjoy working with inventors and entrepreneurs, and on returning to Dublin, I established Hothouse Innovation & Tech Transfer at Technology University Dublin. Three years ago, I moved to NovaUCD, the Centre for New Ventures and Entrepreneurs at University College Dublin, Ireland's premier innovation and start-up hub. I've been on several boards, including being a founding board member of Decawave, which was recently acquired for around \$400 million.

Syag: You have seen innovation in both the corporate world — as you were involved in creating new business units, new products, and services in telecommunications at Nortel — and in a university setting at NovaUCD. How is the innovation process different in each setting?

Flanagan: At one level, it is exactly the same. It is about inventing, creating something new, being first to see things that others don't, identifying real problems, and inventing new solutions and then convincing people that it's a good idea and worth investing funds and resources in to make it happen. Innovation in a University setting is different from the corporate world in that there is strong interest to research and discover new things that may or may not be commercial. In a corporate environment, there is always a focus on commercial outcomes.

Syag: Compared to, say, a decade ago, are universities and industry are working together more or less effectively?

Flanagan: Yes, a lot has been done around the world to establish Knowledge Transfer Professionals that can bridge the gap between industry and academia. They develop the partnerships necessary for research collaboration. They also identify the best inventions and think through how the inventions can be used. They look for potential partner companies to develop the inventions further, and take them to market or they bring together the right funds and people to launch new start-ups to take the inventions to market.

Syag: Can you briefly explain what you do at NovaUCD and how your knowledge and experience help the start-ups?

Flanagan: I lead a team of 24 people at NovaUCD that support our research and start-up community at the university. We do everything to support start-ups from ideation, market research, customer validation, building the team, business planning, preparing for investors, delivering on a plan to growing and scaling. There is a lot in this, and I have a really great professional team. We enjoy challenging inventors and entrepreneurs to reach for the stars, and we enjoy mentoring and coaching them to achieve their global ambitions. I suppose what I bring to the table is great admiration and enthusiasm for the new ventures and the scars and war stories of having tried lots of similar things myself over the years.

Syag: The NovaUCD website mentions that the organization serves “entrepreneurs, investors, industry & business, researchers, and students.” Can you briefly tell us what they can gain from your institution and its programs?

Flanagan: At NovaUCD, we offer a wide range of flexible occupancy options to our clients including; co-working space and offices, to enable them to move as their businesses grow and develop. A limited number of the offices can also be configured to laboratory space.

At NovaUCD, which has 24/7 access, additional facilities and services provided include: reception services, a permanent boardroom, seminar and meeting rooms, a dedicated video conferencing room, wireless network, a dedicated server room, and a café with an external deck.

A comprehensive business support programme is also offered to client companies. This comprises of advice, clinics, seminars, and workshops as well as facilitated access to UCD's world-class researcher community, business leaders, the NovaUCD sponsors, alumni, and investors. A specialist NovaUCD Founder's Club also convenes monthly, which generates interaction and group discussion around key issues and assists client companies in establishing new networks as part of the NovaUCD community.

NovaUCD also offers a range of tailored internships and programmes to UCD researchers and students in the areas of entrepreneurship, innovation, creativity and technology commercialization. For example, NovaUCD has an ongoing range of internship opportunities, some of which





University College Dublin, Belfield campus (Credit: UCD)

are in collaboration with the UCD Quinn School of Business and the UCD Michael Smurfit Graduate Business School, in areas such as business development and marketing, available to students to work with start-up companies. Such internships enable students, who have an interest in entrepreneurship or an ambition to start their own business, a real experience of working in the start-up sector.

In addition, we run regular one-day hackathon programmes for researchers to encourage the development of commercial outputs arising from research taking place at UCD by engaging with them at an early stage in the commercialization process. We also run three-week UCD Commercialisation Bootcamps to help equip UCD researchers, staff, and postgraduate research students with the knowledge, skills, and understanding of the commercialization process.

The university's Knowledge Transfer unit is part of the NovaUCD team and through its extensive commercial experience and drawing on a network of industry experts, patent agents, and legal experts, supports UCD researchers to commercially exploit research outputs for the benefit of the university and the wider community. NovaUCD has a growing portfolio of licensing deals which will benefit the companies to whom the technology is licensed by making them more competitive, create new products, scale, generate employment and hopefully, with time, provide financial returns to the university and the inventors. ConsultUCD, the university's managed

consultancy service, is also part of NovaUCD, and facilitates access and supports engagement between business, industry, and the university.

Syag: How do you help your start-ups in terms of funding?

Flanagan: At NovaUCD, we help our start-ups in a number of different ways to raise funding and one of my team is a dedicated Senior Manager for New Ventures. A key element of his role is to assist our start-ups to secure funding. He is very well connected to the local investor community here in Ireland, and internationally, and regularly briefs these communities on investment opportunities stemming out of NovaUCD and UCD.

Members of the local VC community regularly visit NovaUCD to meet with our clients and to build relationships with them. They attend our events, including our regular pitching events. Also, members of the VC community are represented on the judging panels for our competitions, which gives them an opportunity to see early-stage opportunities first-hand.

In addition, UCD was instrumental, along with Trinity College Dublin, in establishing a dedicated University Bridge Fund to invest in early-stage companies emerging from the research outputs generated by both universities and all Irish third-level institutions and universities. This €60 million fund, managed by Atlantic Bridge, brings together significant institutional investment from the European Invest-

ment Fund, its first cornerstone commitment in an Irish fund of this type, Enterprise Ireland, AIB and Bank of Ireland, and by both universities.

Syag: Can you share a few examples of electronics-related start-ups that have developed out of your program?

Flanagan: Over 55 companies, ranging from early-stage high-tech start-ups to established innovation-led companies, are now located on the UCD campus and are supported by NovaUCD. Over 40 of these companies are currently based at NovaUCD (the others are located at NexusUCD, our Industry Partnership Centre, managed by NovaUCD, or elsewhere on the campus), and they cover a vast array of sectors, including ICT, biotech, medical devices, wireless, and renewable energy. NovaUCD has supported well over 360 companies and early-stage ventures since it was established in 2003. NovaUCD is currently supporting a number of electronics-related start-ups, such as:

- Equal1 Labs is developing a new type of quantum computer based on the latest advances in semiconductor CMOS technology.
- iBrux is developing a smart mouth-guard and mobile app to help dentists and patients to manage Bruxism more effectively.
- Manna is a drone delivery as a service company, which is using custom-developed aerospace-grade drones.
- Naiad is developing a novel liquid-based



The 2019 UCD VentureLaunch Accelerator Programme Showcase and Awards. (Credit: Nick Bradshaw, Fotonic).



3D bioprinter that helps researchers fabricate highly-reproducible and realistic 3D tissue models.

- Output Sports has developed an end-to-end solution to test and track athletic performance with a single wearable sensor.
- PearLabs has developed a photonic chip that serves as a nanoscale optical imaging device, which are becoming the imaging stage of next-generation super-resolution microscopes.

Syag: Competitions can be an exciting way for young companies to prove their value, not only to the investors, but also to the potential customers. Do you recommend any competitions to your start-ups and your thoughts on our start-ups competitions, such as Elektor's Fast Forward competitions?

Flanagan: Yes, I agree that competitions, such as Elektor's Fast Forward competition, represent an exciting opportunity for early-stage companies. Not only do they afford start-ups an opportunity to hone their elevator pitch and introduce their prototypes to investors and potential customers, but they also represent opportunities to receive feedback on their start-up ideas and plans, which can help them to refine their business models and plans. Many such competitions, including Elektor's Fast Forward, also offer excellent prizes for competition winners so they represent opportunities to receive an investment, associated media publicity, and an opportunity to join a valuable network of former competition winners. We recognise the value of such competitions. And we regularly promote competitions — local (e.g., Irish Times Innovation Awards, InterTradeIreland Seedcorn Competition,

US-Ireland Research Innovation Awards) and international (e.g., Cartier Women's Initiative, Nature Research/Merck Spin-Off Competition) — to our clients, many of whom have reached competition finals and successfully won awards over the years.

At NovaUCD, we also run a number of our own competitions, such as the NovaUCD Student Enterprise Programme and the UCD VentureLaunch Accelerator Programme. NovaUCD Student Enterprise Programme, now in its sixth year, is run by NovaUCD as a framework to support undergraduate and postgraduate students who want to work together to develop and grow start-up companies. Its overall aim is to assist students in refining their start-up ideas through a series of structured workshops, including taught content from industry experts, interactive workshops, regular pitching sessions, and mentoring, over a four-week period. This year, as a result of COVID-19, the programme is being run virtually, including a virtual demo day, and a final pitching event and involves 11 early stage student start-ups and 30 participants.

VentureLaunch is UCD's annual 10-week accelerator programme, held at NovaUCD, to support the creation and launch of sustainable and profitable new ventures based on UCD intellectual property. The objective of the programme is to equip UCD researchers with the knowledge, skills, and understanding that will be required to work as part of a team leading a new commercial venture. On completion of the programme, the expectation is that participating new venture projects will have developed a commercially viable business plan.

The overall winner of the annual programme is announced at an Annual

Showcase and Awards. This high-profile event is attended by members of the business, investment, and university communities, and last year was attended by some 250 people. At the event, participating ventures deliver a short pitch, and an overall winner, as assessed by the independent judging panel, is announced. The winner receives €10,000 of seed money as well as professional services and supports worth an additional €20,000.

Syag: As an engineer, do you have any words of motivation to the engineers around the world who want to become entrepreneurs?

Flanagan: Yes, you are off to a great start. You know how to identify problems and break them down so that they can be solved. You can think up lots of solutions. You are inventive. Look around: the whole world needs to be reimaged and reinvented — pandemics, climate change, growing and ageing populations, limited arable land and water, food shortages, cybercrime on the rise, the race for space, etc. It's all there waiting for you.

If you want to be a billionaire entrepreneur, solve a billion dollar problem. Get advice and attract in the right partners with financial and commercial expertise and go for it. The world needs you!!

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Start-Up Innovation at NovaUCD

Check out the following resources and channels:

- Website: www.novaucd.ie
- Twitter: @NovaUCD
- LinkedIn: NovaUCD
- YouTube: NovaUCD video

🛒 How to Order a Flex PCB from PCBWay

with the Flex Quotation Calculator

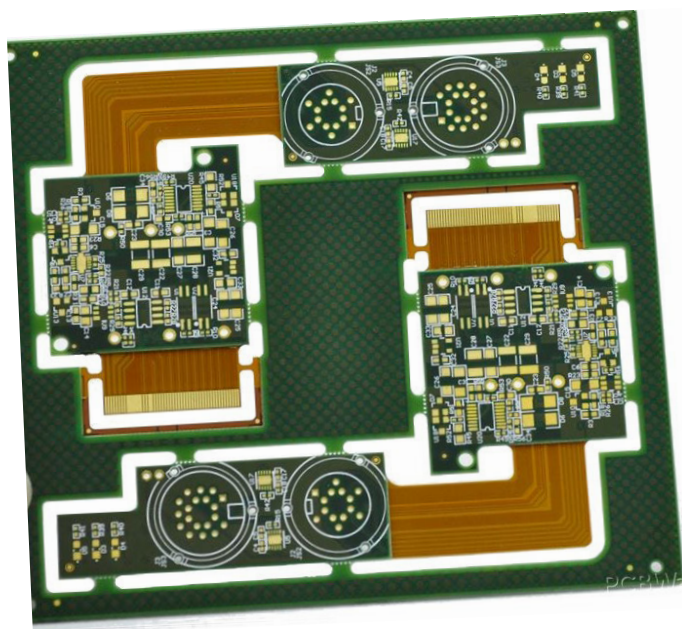


Figure 1: On the right, an assembled flex board. On the left, a panel made of rigid-flex material. Image: PCBWay.

By Yahya from atadiat.com

The most commonly seen type of printed circuit board (PCB) is the rigid type but the flex type is another that you may consider using after some getting used to. Flex PCBs are increasingly available as more manufacturers are providing them. In this article we will see what a flex PCB is, and finally how to order one from a manufacturer like PCBWay.

At first blush you'd think that PCBs come in two flavours only — rigid or flexible. Actually, there is third hybrid type called rigid-flex PCB, i.e. a circuit board that has both rigid and flexible circuit sections laminated together. Flex PCBs are also known as Flex Circuit Board or FCB. **Figure 1** shows examples of flex and rigid-flex PCBs. Flex(ible) boards can be used both as connectors and as complete circuits assembled with components. Generally, they can withstand more soldering heat than rigid ones based on the same film material. From a systematic point of view, a rigid-flex PCB may not have the flexible part laminated throughout — it could be soldered or connected to using a connector like the three different types of rigid-flex PCB shown in **Figure 2**.

However, if you choose the rigid-flex option, then it is up to you to

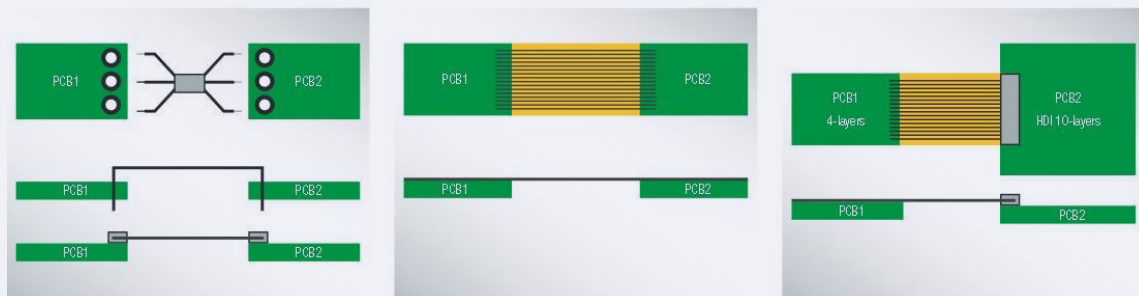


Figure 2: In the left figure, the flex section is soldered in or plugged into the rigid section. In the middle figure, the two boards have the flex part as part of their design stack-up. In the right figure, one board has the flex part in its stack-up and connected to a rigid PCB through a connector. Image courtesy of Würth Elektronik (Flex-Rigid Design Guide).

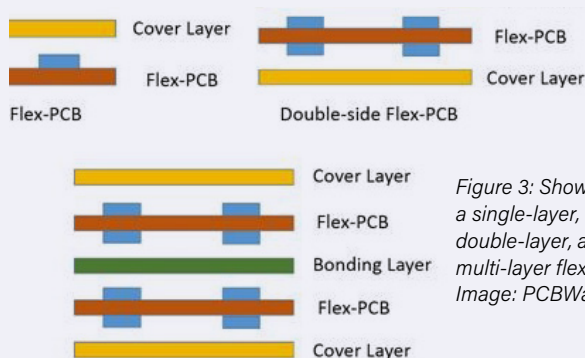


Figure 3: Showing a single-layer, a double-layer, and a multi-layer flex PCB. Image: PCBWay.



Figure 4: Making initial selections in the Flex PCBWay Quotation Calculator.

select which layer to be the flex one in your design layer stack-up. **Figure 3** shows a flex-rigid board with flexible material for the bottom layer.

It is generally advised to have the flex layer in the middle when applicable. The reason behind the freedom of choosing the flex layer position is that the manufacturing process will be similar. The multi-layer structure will be built layer by layer. Another initial impression of flex PCBs is that they are single- or double-sided only, when in fact a flex PCB can be 'multi-layer' just like the common rigid PCB.

Walkthrough: the Flex PCBWay Quotation Calculator

At www.pcbway.com/flexible.aspx, PCBWay offers a detailed calculator to find out how much your design will cost you. As flexible PCB material is more costly than rigid, it is important to employ your manufacturer's calculator to make sure that your design complies to your manufacturer rules — and more importantly, to check how you can decrease or optimize the manufacturing cost. **Figure 4** shows an example.

The first piece of information to define is the PCB type: flex or rigid-flex. Next comes the number of layers and whether you need your quantity to be within a panel or cut into single pieces. The panel option is important if you want to assemble your board using a PnP (Pick and Place) machine.

An important note about size and quantity should grab your atten-

tion, as changing the quantity may not increase/decrease the price for you. Here are two examples:

- > Dimension: L=10mm; W=10mm; 1 Layer; single pieces; flex-pcb and all other options are default. Result: lowest manufacturing cost is \$111 and the same up to 1000 pieces. So you either pay \$111 for one or two samples or manufacture 1000, and the cost for each will be around \$0.1.
- > Dimension: L=100mm; W=100mm; 1 Layer, single pieces, flex-pcb and all other options are default. Result: lowest manufacturing cost is \$111 and remains the same up to 4, then \$133 for quantity 5-8. So, you either pay \$111 for one or two samples or manufacture 4, and the cost will be \$27 apiece.

The next part of the calculator covers the selection of the flex substrate/film material type — currently only Polyimide Flex is provided. Knowing that Polyamide is the most common material, we quote from Wikipedia: "There are a number of different materials used as base films including: polyester (PET), polyimide (PI), polyethylene naphthalate (PEN), polyetherimide (PEI), along with various fluoro-polymers (FEP) and copolymers. **Polyimide** films are most prevalent owing to their blend of advantageous electrical, mechanical, chemical, and thermal properties."

The other thing to select is the film thickness of FPC. This is similar to an FR4 thickness selection in rigid PCB. Some thickness options are related to the number of layers. For example, **Figure 5** shows the

Polyimide base material: ☒ Polyimide Flex

FPC Thickness: ☒ 0.08 ☒ 0.1 ☐ 0.13 ☐ 0.15 ☐ 0.18 ☐ 0.2 ☐ 0.23 ☐ 0.26 ☐ 0.3± ☐ 0.35 ☐ 0.4

* Unit: mm
* The FPC thickness does not include the thickness of stiffener and 3M tape.

Min Track/Spacing: ☒ > 0.06mm ☐ No Drill

Min hole size/Pad size(diameter): ☒ > 0.15/0.35mm ☐ No Drill

Figure 5: Board material and thickness selection.

Solder Mask (Coverlay): ☒ Yellow Coverlay ☐ White Coverlay ☐ Black Coverlay ☐ None

Silkscreen: ☒ White ☐ Black ☐ None

Gold fingers: ☒ Yes ☐ No

Figure 6: Colour and plating options.

Stiffener: ☐ without ☐ TOP ☐ BOT ☒ Both sides

TOP Pt: Fr4: Metal:

BOT Pt: Fr4: Metal:

Please make sure to note the area which need to stiffen in your file. [#9](#)
*Unusual parameters will result in a small price increase and longer lead time.

Figure 7: 'Stiffener' selection.

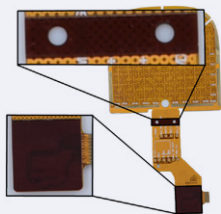


Figure 8: Example of using stiffened areas for PCB sections serving as a connector or for mounting holes. Image: PCBWay.

Surface Finish: ☒ Immersion gold (ENIG) ☐ OSP ☐ Immersion silver (Ag) ☐ Immersion tin

Thickness of Immersion Gold: ☒ 1U ☐ 2U ☐ 3U

Figure 9: Surface-finish options to choose from.

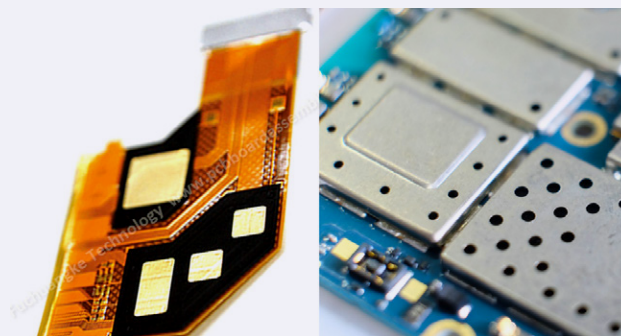


Figure 10: The shield is the black area in the left image. The right image shows the 'equivalent' for rigid PCBs: a metal shield.

options for single layer, up to 0.15 mm, while 2-layer is up to 0.26 mm. Increasing the thickness may raise the total cost. If thickness is a key thing for your design, then you should check the thickness tables for flex PCB stack-up.

Next, select some colours of flex PCB: solder mask/coverlay, silkscreen and, if necessary, plating some edge terminals with gold. These options seem to have no effect on cost. **Figure 6** shows an example. Another important part a flex PCB design may need is 'stiffeners' i.e. selected areas in the PCB made of a rigid material in order to give the board additional mechanical stability. **Figure 7** again shows an example of how to go about selecting his option.

The rigid part will be laminated to the flex part. The material type provided in PCBWay production runs is **FR4 and Metal**. For the metal component, stainless steel or aluminum is commonly used. **Figure 8** shows an example of using stiffeners for an edge connector or an areas with mounting holes. This option affects the manufacturing cost.

Customers also need to choose the type of surface finish, which is a process to add extra surface (coating) on top of copper layer to help solderability. The surface finish has four common types:

- Immersion Gold (ENIG);
- Organic Solderability Preservatives (OSP);
- Immersion Silver (Ag);
- Immersion Tin.

All of these preserve copper from oxidation and achieve better properties for component assembly. However, each type has its advantages/disadvantages. **Figure 9** shows the selection process. It seems only increasing the thickness of immersion gold will increase the cost.

The options are not exhausted yet as you still need to choose the desired copper layer thickness. Some of that thickness is related to the number of layers and base thickness.

PCBWay may perform some electrical test for your PCB to make sure nothing went wrong during manufacturing, e.g. short circuits, cut traces ... etc. This will increase the cost.

The next option is to add adhesive tape to selected areas of your flex PCB, this could be needed to mount the PCB to a surface or stick it to something. This option identified as 'may' will increase the cost a little.

Finally, if you are concerned about electromagnetic interference (EMI) then you can add a shielding film. This acts not unlike the metal house placed over a section of a rigid PCB as shown in **Figure 10**.

Conclusion

It's time to upload your design files and submit your order. For all your PCB needs, just visit www.pcbway.com.

200331-01

FROLIC Studio's Cofounder on Product Design in Challenging Times



By C. J. Abate (Elektor)

Small design and engineering firms like Amsterdam-based FROLIC studio have found ways to continue innovating during the Coronavirus crisis. Cofounder Andrew Spitz talks about how he has navigated the situation and shares details about an exciting social impact project, the COVID-19 Decontamination Toolkit, and more.

I first reached out to FROLIC studio cofounder Andrew Spitz seven years ago when I came across his Skube music player design. A few weeks ago, he popped up on my radar again. While browsing LinkedIn, one of his newest projects, the COVID-19 Decontamination Toolkit [1], grabbed my attention, and so I reached out to him. After catching up, he shared some details about FROLIC studio's work, social impact projects, and the products he is working on during these turbulent times.

Innovating in Amsterdam

Abate: Your work first caught my attention several years ago when I learned about your Skube music player. How are things? How are you holding up during the Covid-19 crisis?

Spitz: Wow, that was quite a while ago. Actually, that was the first project my business partner and I did together, and it's then that we decided to officially start the studio (www.frolicstudio.com) together. We really enjoyed working together, saw product design in a similar way, but had very complementary skills.

FROLIC
studio





Figure 1: Andrew chats in FROLIC studio's Amsterdam office.

Abate: I was working in Maastricht in February, but I have not been to Amsterdam since last fall. What's it like in Amsterdam these days?

Spitz: Maastricht is a lovely city. And so is Amsterdam. The weather has been gorgeous for Dutch standards, and with the current lockdown climate, the city is relatively peaceful — having more of a town than a city feel.

Abate: Are you working from home or at the FROLIC Studio office?

Spitz: I have been working from the studio (Figure 1). I'm fortunate enough to be able to cycle to the studio. The rest of the team has mainly been working from home and coming in when is needed — for example, to use the workshop. Lately, as things are loosening up, people have been coming in a little more. We have quite a big space (compared to our team size), so we split the space and the times people come to the studio.

Abate: Has it been difficult to navigate the COVID-19 situation as a small business owner? Any special challenges?

Spitz: Honestly, yes. All the projects we were busy with or had lined up stopped from one day to the next. Worrying about that, as well as the well-being of the team and generally needing to figure out how to conduct our work remotely, has been needing a lot of quick adapting. But there's been good in this, and we've matured a lot of our processes, and it gave us an opportunity to look at what's working, what's not, and what we want the studio to be in these times and coming out of it. That said, things are slowly starting to go



It's really important for us to be able to contribute positively where we can. It's important, as product designers, to put into consideration our planet and the people living on it.

Andrew Spitz

back towards the “new” normal. We're actually starting a new project with a dream client — can't say who yet — so we're very excited about that.

Decontamination Toolkit

Abate: We spoke recently about FROLIC studio's Decontamination Toolkit, which is an open-source kit that uses UV-C light to extend the life of face masks. When did you start calling for volunteers? And how did it all come together?

Spitz: When we entered unprecedented times we are in now, it became harder for us to sit back and watch things unfold without

trying to help. We have an extensive network, skillset, and a workshop, but there was also a limit to what we could do from our studio, especially when it came to understanding the context where support was genuinely needed. So, we also interviewed many people at the ground level of the COVID-19 challenges to better understand how we could help.

The entire process from the initial call-out to the final toolkit took only 14 days, as the studio worked round the clock to prototype very quickly. The response from the community was very quick and our call was answered by more than 130 volunteers from Brazil to Costa Rica, Sweden to Hong Kong. We got the insights from healthcare workers and then engaged industrial designers, UX/UI designers, project managers, software developers, and a number of other experts from all over the world to help us develop this solution (Figure 2).

Abate: So, to be clear, do you sell the Decontamination Toolkit, or do you just offer the instructions?

Spitz: What we want, ultimately, is that the affordability and efficacy of this toolkit gives those in the shortest supply of protective gear the chance to stay safe for longer, and ultimately to help save more lives. Especially for those outside the public eye: supermarkets, care homes, public services, and all those who show up to work, exposed, every day, and to whom protective equipment supply is not guaranteed in time of scarcity. The simplicity, and decentralization from the supply chain, of this setup means it can be used globally and immediately — and,



Figure 2: FROLIC studio's open-source Decontamination Toolkit uses UV-C light to decontaminate face masks or other equipment.



Figure 3: Smartians enables users to build smart applications.

crucially, also in developing countries. We're already seeing people from South America to Africa to Asia adopting the COVID-19 Decontamination Toolkit. With this approach, we can give a fair chance to those at the front-line of this crisis.

Abate: Do you have any feedback on the Decontamination Toolkit's use?

Spitz: One of the main issues we found was that, in spite of our efforts to make the instructions very approachable, there's still a gap between those that can or want to build it and those that really need it. Therefore, since launching, we also provided a way to match-make those that can build and those that need it.

Abate: The last time we talked, you mentioned that the Decontamination Toolkit was going to be tested by an outside lab. Any news on that?

Spitz: Yes! Great news actually. We have sent our prototype to the HygGen Lab in Germany, who has performed a screening test on some exemplary masks using the Bovine Coronavirus BCoV. The results of the disinfection process showed that the required reduction of the test virus Bovine Coronavirus by $\geq 4\lg$ steps could be achieved in eight minutes within the specific test procedures performed.

Social impact projects

Abate: You dedicate a portion of your website to "social impact" projects. First, congrats on that. I can speak for our entire team: it is inspiring to see entrepreneurs like you directing your talent toward

positive projects. Besides the Decontamination Toolkit, which social impact project was the most rewarding?

Spitz: It's really important for us to be able to contribute positively where we can. It's important, as product designers, to put into consideration our planet and the people living on it. One very rewarding project has been the Modular Covert Camera [2], which we did with a human rights NGO (undisclosed). The miniature, concealed, and connected camera we have been developing, for the purpose of documenting human rights abuses, gathers video footage. It is a valuable way to expose human rights violations at a grassroots level, and it has proven its impact on the way that activists can support communities at risk.

Another project, from the perspective of our planet, has been the Fossil Free Crib — a child's crib designed and produced without the use of any fossil fuels. A huge challenge, but a very rewarding one that got us deep into the research of materials and supply chain.

Product design journey

Abate: Your clients range from Intel to Unilever to Nike. Those companies develop quite different products. What sort of projects did you work on for them?

Spitz: Actually, you picked three vastly different clients we've done projects for. Just to use Intel as an example, one of the projects done many years ago could not be more fitting to today's climate. We explored a tabletop device to collaboratively work remotely and minimize the effects of isolation — gearing for a future where virtual presence will become the norm — yup...

Another project for them was to showcase the Intel Edison through gesture-controlled music and lighting tables [3]. These interactive 0.5-ton tables travelled around the world to Maker Faires.

Abate: FROLIC has developed more than 100 products. Tell us about your favorite.

Spitz: I would have to say Smartians [4], which was a self-initiated studio product (Figure 3). We get great satisfaction in searching for meaningful solutions to everyday problems, and we wanted to find an innovative way to address the issue of people discarding perfectly functional products, in favor of the new. We figured, why not try and encourage consumers to keep their "old" but cherished appliances by giving them the freedom to make them smart? And so, we developed Smartians, a product allowing you full flexibility to build your own smart home in a fun, efficient, and inventive way.

Abate: Which electronics-related products are you working on now?

Spitz: We're currently working a project through our IoT for Business side of the studio. We're working with Upperbloom, which has a subscription model for providing planters to people's balconies all year round. We're connecting their planters to optimize their offer by keeping track of the conditions on the balcony as well as the planters themselves. So, it's focused on operations and building data-driven insights so they can provide the best possible service and types of plants for the particular conditions for the consumer's balcony. ◀

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Wall of Fame

August 2020

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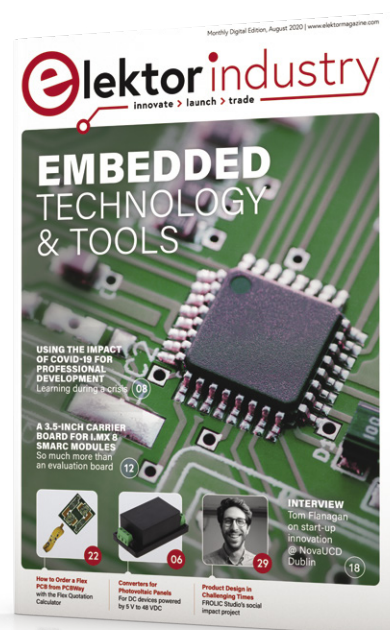
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Next edition

Edition 5/2020 of Elektor Industry magazine deals with components, modules and production of electronics. Background reports and news on the topic come from companies, industry specialists, Elektor editors and freelance authors.

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