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#42017

**INFOCUS:**



## **More electronics in smaller spaces**

**– the advantages and challenges with flex boards**

The trend in electronics development is heading towards physically smaller and technically more advanced products. The growing need for more electronics to be fitted into smaller spaces has led to a demand for more advanced PCBs, which in turn requires even higher precision in the design of the PCB.

The boards have not only to be technologically advanced, but also physically flexible. This has made board types such as flex, semi-flex and flex-rigid interesting for new categories. Jeffery Beauchamp, Field Application Engineer for NCAB Group's Eastern Region in the United States, tells our InFocus reporter more about this:

"Today we are seeing how more and more technology - and often more advanced - being fitted into physically smaller applications. Historically, in my region, we have not had much of a demand for flex, semi-flex or flex-rigid boards, but we've seen this increasing of late, which is very exciting and challenging for us," he says.



Jeffrey Beauchamp, Field Application Engineer, NCAB Group USA

The main benefit with this type of board is that it allows the design of the PCB to be customized to the requirements of its end-use. With rigid boards, the PCB itself sets limits on the size of the product, but different flex variants open up the range of possibilities in this respect. Obviously, these more advanced boards cost more to manufacture, but at the same time they enable you to save time and costs - and even reduce some risks at the assembly stage. The great possibilities

come from being able to expand your build in three dimensions. You can do away with cables and connectors and instead get the boards already pre-connected. Flex-rigid PCBs allow you to interconnect multiple parts without adding more assembly time, as the connectors are already built in. Through eliminating cables and connectors, you are, in turn, eliminating possible sources of error.

**"You should never overly complicate things. If the application leaves room for rigid PCBs, this is the least expensive option and the one to opt for."**

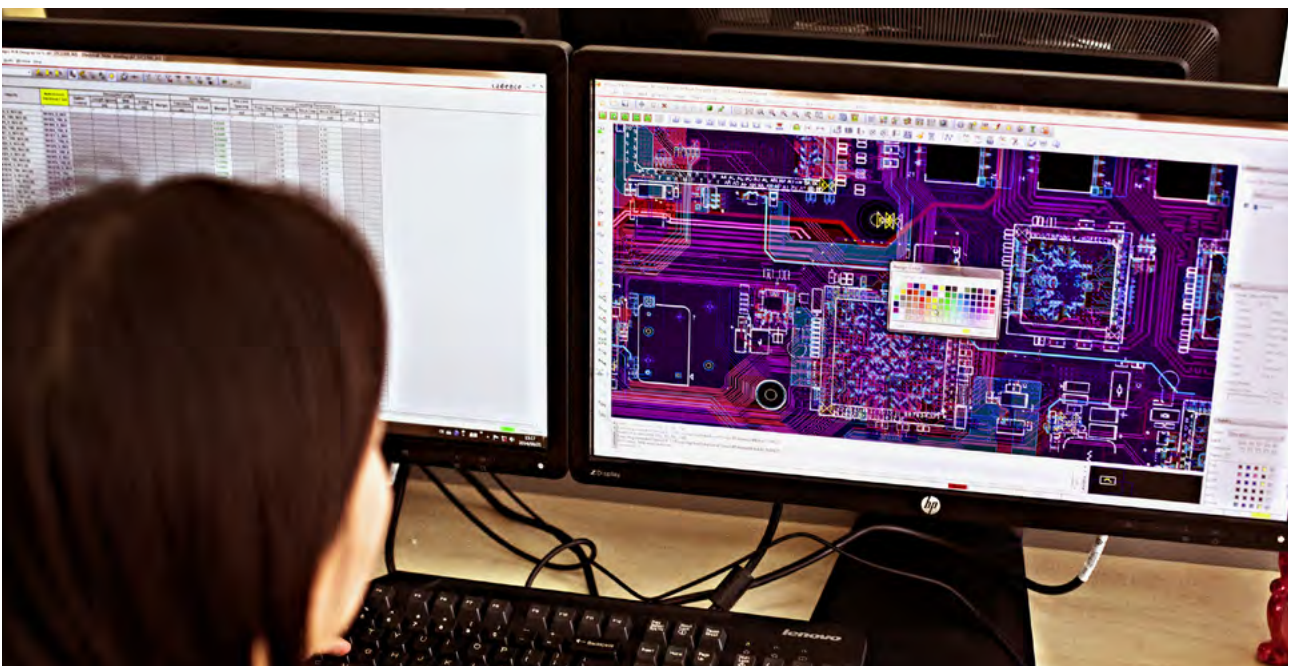
JEFFREY BEAUCHAMP, FIELD APPLICATION ENGINEER, NCAB USA

### NEW SKILLS ARE NEEDED IN THE DEVELOPMENT PHASE

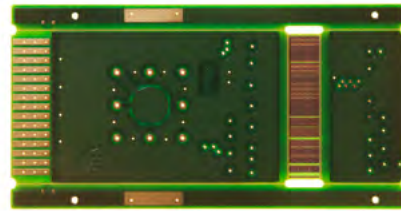
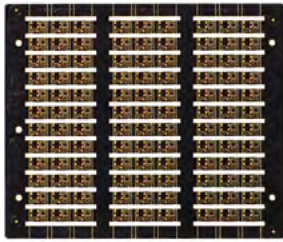
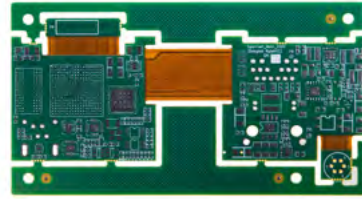
Another question that comes into play when considering higher density PCBs that permit flexibility is the complexity that you would be adding. This puts greater demands on the PCB design, with high precision being a paramount factor.

"Things can easily get overlooked and result in different design errors. When evaluating more advanced designs for our customers, we make a point of working as a team, with several of us involved with the same design. That is how vital it is that nothing is missed. It is also extremely important to work closer to customers when it comes to this type of board," explains Jeffery.

Rigid, flex, semi-flex and flex-rigid printed circuit boards represent four different levels of technology with very different production methods, and are therefore manufactured in different factories in volume. These technologies should only be used when the application requires it.



"When considering using technology at this level, it is advisable that the customer involves us as early as possible. At best, we want to be involved already in the design phase. The sooner we join, the better we can help," Jeffrey Beauchamp says.



Rigid, flex, semi-flex and rigid-flex printed circuit boards represent four different levels of technology with very different production methods, and are therefore manufactured in different factories in volume. From left to right: 2L flex board, 6L rigid-flex board, 4L HDI board and 6L semi-flex board.

“You should never overly complicate things. If the application leaves room for rigid PCBs, this is the least expensive option. Whereas with designs comprising many connections to the next layer, tight spaces, or where reliability is key, you would probably be advised to look at one of the flexible PCB alternatives. If you need to bend the board dynamically, it’s best to use flexible or flex-rigid boards.”

**“It is all about knowing what the customer needs and using our knowledge and experience to deliver a solution that best meets these needs.”**

**JEFFREY BEAUCHAMP, FIELD APPLICATION ENGINEER, NCAB USA**

### MORE ISSUES THAT ARE RELEVANT

NCAB Group can help find the right solution for a particular application and provide suggestions on how to design a PCB to achieve a good yield. Nevertheless, to be able to help customers, we need to know more about the exact application. This is in contrast to rigid boards, where you don’t need to know so much about the end-use to produce it. What is the board going to be used for? Why does it have to be flexible? What features do they need? What temperatures will the board be exposed to (this is important regarding the choice of material and surface finish)?

“Many more issues have to be considered. We need to understand exactly what customers intend to do with their boards. That would enable us to help them find the right solution that does the job, without making it all too advanced or complex. That is why the customer should involve us as early as possible when considering using technology at this level. At best, we want to be involved already in the design phase. The sooner we join, the better we can help,” Jeffrey Beauchamp says.

There is an increased interest in these technologies because the feeling is that this is the direction the world is heading. However, considering the higher complexity, it is vital you know what you are do-

ing. That is why you should take full advantage of the manufacturers’ skills. Something as simple as where you place the bend could make all the difference between success or failure.

NCAB helps customers navigate between the risks and pitfalls. Jeffery Beauchamp points out that the semi-flex PCBs often can function as a more than adequate solution for certain more advanced applications, while manufacturing is less complicated.

“Semi-flex is a technology that I have not seen much of in the US so far, and I hope American designers will use it more. Often, it’s a way that combines the best of both worlds. You can bend the board one time to fit the finished product, while not complicating things unnecessarily by laying on a higher level of technology than necessary. Semi-flex means a lower price-point which tends to make the customer happy,” he says.

In other cases, using more advanced PCBs can of course be the best alternative. NCAB has the design skills and knows which factories have the capability to manufacture the boards you need, thus ensuring a robust end result.

“It is all about knowing what the customer needs and using our knowledge and experience to deliver a solution that best meets these needs,” concludes Jeffrey Beauchamp.

### WHAT TO REMEMBER WHEN USING FLEX BOARDS

- Have a dialogue with your PCB supplier when using these technologies.
- Flexible PCBs can very easily end up being “Single source” design. Be aware, since problems may arise with volume production.
- Mind the gap, domestic prototypes and off shore serial production can differ in ways that are non transferable.



"When it comes to hand tools, it's important that they do not get too big. The ergonomics should be appropriate in terms of weight and size. Since you want to make the most of the product's size, flex-PCBs boards will be extremely useful," Roland Brändström, System Developer Atlas Copco Industrial Technique, explains.

## More electronics in your hand

Atlas Copco Industrial Technique has extensive experience of working with different kinds of flex-boards. Today's advanced industrial power tools are packed full of electronics, but they must not take up too much space.

The Industrial Technique business area, of this Swedish manufacturing group develops and manufactures Atlas Copco electrical tools for industrial use under the product names Tensor and Power Focus. They supply manufacturers with both handheld and fixed tools as well as controllers. The global automotive industry is an important customer group, although Atlas Copco is also an important supplier to other sectors of the manufacturing industry.

**"We deliver many thousands of handheld power tools each year, both cable and battery tools."**

**ERIK BAKER, GROUP MANAGER ELECTRONICS DESIGN,  
ATLAS COPCO INDUSTRIAL TECHNIQUE**

"We deliver many thousands of handheld power tools each year, both cable and battery tools. We are talking about tools that offer durability and accuracy of a totally different calibre than you get with consumer tools. For example, one and the same tool can make several thousand connections every day," says Erik Baker, Group Manager Electronics Design at Atlas Copco Industrial Technique's Research and Development Department, with a workforce of some 300 employees.

### **FLEX-BOARDS DATE BACK TO THE 90'S**

Atlas Copco Industrial Technique began using flexible PCBs in their tools in the mid 90's. At that time, the functions they offered were quite simple, and the PCBs contained few components.



Erik Baker, Group Manager Electronics Design, Atlas Copco Industrial Technique

"When it comes to hand tools, it's important that they do not get too big. The ergonomics should be appropriate in terms of weight and size. Since you want to make the most of the product's size, flex PCBs boards will be extremely useful," explains Roland Brändström, System Developer at Atlas Copco Industrial Technique.

The first decade of the millennium saw the next phase, with more complex functionality being introduced into the tools. Flex boards started to be used instead of cable circuits inside the tools, saving a lot of space. Since 2004, Atlas Copco have had products that exclusively use flex-boards. Shortly thereafter, flex-rigid HDI boards also started to make their appearance in more advanced tools.

## “In the case of flex transitions, the design phase is very important. Another difficulty is moving applications.”

**ROLAND BRÄNDSTRÖM, SYSTEM DEVELOPER,  
ATLAS COPCO INDUSTRIAL TECHNIQUE**

Nowadays, many of Atlas Copco's tools incorporate features that accurately measure and ensure that the tool performs optimally for the task at hand.

“With a tightening tool, you can now verify that the connection is properly tightened and the results are regularly sent to a database,” explains Erik Baker.

### COMPACT AND EASY TO HANDLE UNITS

Flex technology enables you to save volumes while at the same time more and more electronics are being introduced into the tools. You still want a compact and manageable device, even if it contains more functionality.

“At the same time, this technology sometimes enables processes to be streamlined. By using flex-rigid boards, you can, for example, cut down on the amount of test equipment used, as all you need is one HDI board, where you would otherwise need several rigid boards.” says Roland Brändström.

Yet another advantage of flex technology is that it dispenses with the need for connectors and cables. This enables not only the surface area of the PCBs to be reduced, but also eliminates potential sources of error. Handling connectors and cables constitutes a risk during assembly.



Roland Brändström, System Developer, Atlas Copco Industrial Technique

“At the same time, it is vital to make sure the entire service organization realizes how important it is to handle the flex-boards with extreme care. You can't treat them like you might do cables,” says Erik Baker.

However, he points out that what is driving this technology is actually not production advantages:

“Our customers are quite simply looking for smaller tools that are easier to handle and offer full functionality. When we develop our tools, ergonomics is extremely important. Our starting point is the size of the tool and the features that can add value to the customer. Then, we choose the components and design an appropriate layout that will accommodate both the hardware and allow the necessary cooling.

### DESIGN HAS A STRONG BEARING ON QUALITY

The specific challenges we need to tackle regarding the more

advanced PCBs is to reduce the price to an appropriate level without risking quality problems. An issue that flex-rigid boards are known to have is sensitive vias. To avoid problems, particular care needs to be taken when designing the Flex transitions.

“In the case of flex transitions, the design phase is very important. Another difficulty is moving applications. We do not have so many of those, but the PCBs still have to function reliably despite being subjected to many small movements. So that is also a challenge for the designers,” says Roland Brändström.

“On the other hand, flex-rigid boards can make mounting simpler and cheaper since the number of contact points are reduced. Using these boards also reduces the risk of errors, so it can improve the quality of the final product providing the PCB itself is of a high quality,” says Erik Baker.

## “Compared to other components, we find that PCBs can be more easily adapted in terms of size and design. We want to get the basic design prerequisites right to ensure optimum yield and it certainly helps to be able to discuss these matters with a knowledgeable supplier like NCAB.”

**ERIK BAKER, GROUP MANAGER ELECTRONICS DESIGN,  
ATLAS COPCO INDUSTRIAL TECHNIQUE**

Atlas Copco Industrial Technique appreciates being able to interact with the PCB suppliers at the design stage to secure a design that will work well on the production line.

“Compared with other components, we find that PCBs can be more easily adapted in terms of size and design. We want to get the basic design prerequisites right to ensure optimum yield and it certainly helps to be able to discuss these matters with a knowledgeable supplier like NCAB,” says Erik Baker.

“You often have to make difficult choices and it feels good to be able to turn to someone for help to get a grasp of the pros and cons of the available options,” Roland Brändström concludes.

#### ATLAS COPCO INDUSTRIAL TECHNIQUE – IN BRIEF

- Leading supplier of industrial power tools, assembly systems, quality assurance products, software and service to the manufacturing industry.
- Over 4,000 electrical and compressed air and battery powered tools in the company's product range. These include grinding and crushing machines, electric screwdrivers and nut-runners, pulse tools, torque wrenches, drills and chipping hammers.
- Headquarters in Nacka, Sweden with own sales companies worldwide.
- Assembly plant in Tierp, Sweden and in a number of other countries.
- The business area has close to 7,000 employees globally.

## Questions around the world – customers have less space in end products to package their electronics:

How do you see customers solve the density issues in the packaging of electronics solutions? What trends do you see in customers' strategy in choosing PCB technology for new designs?



### CHINA

#### ELLEFEN JIANG

PCB Design Manager,  
NCAB Group China

"What I see is a trend in higher component density on the PCBs. The end solution has more built in intelligence and more international in design. The end product has to work anywhere in the world. In this connection, we are seeing more and more designers now opting for flex and rigid-flex as the economically viable route to take. "

"The trend is that customer are choosing the lowest possible cost solutions, but are also factoring in an higher level of reliability than before."



### UK

#### NIC WESCOMBE

Engineering Manager,  
NCAB Group UK

"I would describe it as accepting a fact. It's just the direction the industry is moving. Often designs are constrained by the mechanics around them, before a PCB design is even finalized. As such there is a need for denser packages to provide a desirable number of features on the smallest area possible. The battle comes with working with fabrication houses to get them to push the boundaries and get these designs made to a workable yield."

"Typically, track, gap and via size are the key trends I see. In that smaller is increasingly becoming the norm. We're not there yet, most designs I've come across can easily be achieved with standard sizes. That said, with packages getting increasingly tighter in pitch, and certain designs trending towards minimum area, those standards are being tested. Where before an annular ring of 0.1mm would be considered an acceptable minimum, sizes as low as 0.075mm and perhaps smaller would greatly help to lessen the routed density of certain designs. From my sole perspective, technology in manufacturing needs to keep pace with the rate of miniaturization in electronics."



### GERMANY

#### FRANZ KANTNER

Technical Manager,  
NCAB Group Germany

"The continuous increase in packing density has been a fact of life that designers, PCB manufacturers and especially the EMS companies have always had to face. What is driving the increasing packing density of the components and assemblies are higher signal speeds, higher integration and limited space in the end application. Apart from the challenges linked to assembly, this also puts significantly tougher demands on the design and ultimately on the PCB itself."

"For PCB production, we are indeed seeing new trends and technological developments.

- Increasing use of HDI technique with more complex structures.
- Special materials for high frequency/ high temperature applications.
- IMS PCBs and thick copper superstructures for thermal management.
- Embedded Components Technology with further developments.
- 3D-MID technology gives a look in to future developments, such as wearable/ IOT applications.
- Last but not least: within flexible/rigid flexible PCBs, we are seeing a significant upswing and a broader product range.

We should also not forget that all technologies have cost aspects attached to them and can ultimately only be successful and convincing, if there is no real available alternative that can be used instead."

# A PCB comes in many shapes and sizes

HANS STÄHL  
CEO NCAB GROUP



There are many types of PCBs, but most designs today are based on flat, hard and rigid materials. Designers are often reluctant to deviate from the established way of constructing component bearers. In many cases, they might even have failed to stay ahead of developments, especially with regard to flex and flex rigid boards.

If you just take into account the cost of the board itself, a flex or flex-rigid board is more expensive than a regular FR4 board. Nonetheless, with today's tough demands for miniaturization, the final overall cost can often be lower than using regular boards, since flex boards can be customized in a different way. To achieve lower total

costs with this approach, however, calls for a knowledge of the technology, as it differs greatly from rigid boards and one can encounter many pitfalls along the way.

The manufacturing process is different and the skills available in this field may often not measure up to the requirements, since these types of boards are not so common. That is why it is extremely important to work closely with both PCB manufacturers who are well versed in the technology, as well as with established and well-known factories. Then you can ensure you get an optimum design and the desired results in terms of quality as well as total cost.



## NCAB Group in Social Media

For a few months now, customers and other interested parties have been able to follow us on Twitter and

LinkedIn. We have also started a blog where we immerse ourselves in the versatile world of circuit boards! Follow us on:

» [Twitter](#) » [LinkedIn](#) » [Blog](#) » [YouTube](#)

## Join us!

We're always looking for competent people. If you are a well skilled technician, customer service or

sales person, don't hesitate to contact us or send your resume to: [recruitment@ncabgroup.com](mailto:recruitment@ncabgroup.com)

## Subjects we have covered earlier

Do read our earlier newsletters. You will find them all on our website, [www.ncabgroup.com/newsroom/](http://www.ncabgroup.com/newsroom/)

### » Sustainable Business

2017 10 25 | NEWSLETTER 3 2017

### » The PCB Industry in Asia

2017 06 29 | NEWSLETTER 2 2017

### » Engagement and competence development in focus

2017 04 06 | NEWSLETTER 1 2017

### » Future strategy

2016 12 14 | NEWSLETTER 4 2016

### » Working closely with the factory

2016 10 12 | NEWSLETTER 3 2016

### » Responsibility as a business concept

2016 06 22 | NEWSLETTER 2 2016

## Are we taking up the wrong subjects?

We are always looking for interesting subjects that we could take a more in depth look at.

If there is something you would like to learn more about, or perhaps you would like to comment on anything we have written, do get in touch with us and tell us more.

Mail: [sanna.magnusson@ncabgroup.com](mailto:sanna.magnusson@ncabgroup.com)