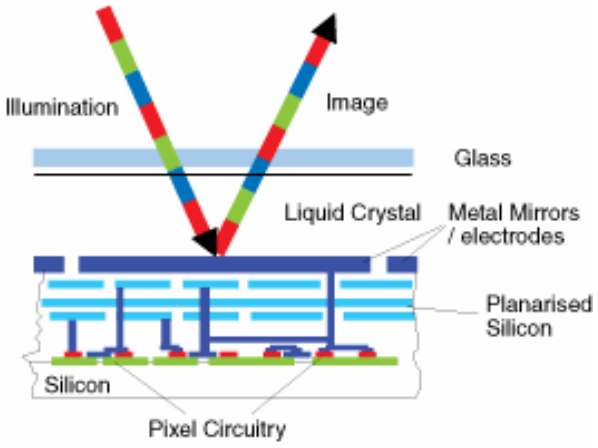
Interview with Greg Truman from ForthDD

Greg Truman is managing director of Forth Dimension Displays. He has served in that position since the formation of CRLO Displays Ltd. since its formation in September 2004, and of its predecessor, CRL Opto, he led the successful fund raising that formed Forth Dimension Displays. He has also participated in the formation of new displays companies Opsys and AccuScene. Prior roles have included Corporate Development Manager of Scipher plc, where he was part of the core team working on VC fund-raising (GBP 5 million) and, subsequently, the IPO of the Company (raising GBP 30 million) in February 2000. Earlier, Greg Truman held roles in sales, marketing, R&D project management and integrated circuit design within Thorn EMI, GEC and in a joint venture in Malaysia. Greg Truman has a BSc in Computer Science from the University of Hertfordshire.

Please give us some background information about Forth Dimension Displays. Forth Dimension Displays develops, manufactures and supplies the world's most advanced microdisplays using a proprietary, fast-switching liquid crystal technology. The company - previously named CRLO Displays Ltd - was formed in September 2004, funded by an "A" series round from Amadeus Capital Partners and Doughty Hanson Technology Ventures. The company is located in Dalgety Bay, Scotland across the River Forth from Edinburgh, with offices in California. In 2006, 82% of ForthDD's rapidly-growing revenues were from products shipped to international (non-UK) customers, mostly to the US, Germany, and Japan. ForthDD's proprietary, high-speed liquid crystal display and driver technology has major advantages in performance and cost. A portfolio of more than seventy patents protects ForthDD's Time Domain Imaging (TDI) technology.

What advantages do your ferroelectric devices have over competitive devices? The biggest advantage is that the technology is all digital. It processes images in the time domain (TDI) on a single chip, without RGB sub-pixels, separate RGB beams and optics, and without tilting mirrors. This combination allows both amplitude and phase modulated imaging. It provides high native resolution, full 24-bit colour for showing high-speed motion. The very fast switching (100 times faster than nematic LC) characteristics of the ferroelectric LCD material offers benefits in a number of applications. The most relevant of these to Forth Dimension Displays is the ability to produce high performance, colour sequential displays where it has major advantages in performance and cost. The technology is well-matched to the new LED and laser diode light sources. In addition, there are cost advantages: the single chip has no moving parts, so it is built using standard CMOS wafer processes. The absence of separate RGB light paths enables customers to use simpler, lower cost optics in their system integration.



On the left is a cross-section of a liquid crystal-based microdisplay in operation. On the right is on of ForthDD's microdisplay solutions. The company is focused on producing high-performance displays for near-to-eye applications such as head mounted displays (HMDs), which are often used to simulate scenarios that may be too dangerous or expensive to replicate in the real world. ForthDD is the world's leading supplier of microdisplays into high-end immersive training and simulation HMDs.

Reprinted with permission by UK Displays & Lighting KTN.
Not to be reproduced without authorisation.

You recently made some sizable staff reductions as a result of strategic decision to shift the focus of your business. Tell us more. We decided that the prospects of success in the rear projection TV market were being determined more by the price reductions in LCD TV than by the ability of Forth Dimension Displays to meet the product specifications. Price decreases in LCD TVs have been far greater than any analyst forecast and this made it very difficult to compete with a "high performance, value" RPTV product proposition. Forth Dimension Displays already had an established reputation as the leading supplier of premium, high native resolution microdisplays in training and simulation systems for military and aerospace customers. The company's business is expanding with products to customers in areas such as:

- Confocal microscopy and image injection for medical diagnostic and surgical systems
- Digital printing and imaging systems
- High-resolution industrial metrology and process systems
- Advanced 3D and holographic imaging systems

So the decision was made to drop the RPTV market and focus on those markets with better prospects.

Given your decision to withdraw from the rear projection TV market, can you share your thoughts about the future of RPTVs? A quick review of the news and forecasts from the RPTV market, since we withdrew, quickly shows that the pressure from LCD TV has continued to drive forecasts down and cause problems for those companies continuing to focus on that market. It is going to be very difficult for RPTVs to compete in anything other than the largest sizes (55 inch+) and emergent areas (e.g. 3D TV). Without some radical breakthrough, there seems little future for RPTV in the mainstream 36-42-inch diagonal TV market.

Please share your opinions about the new class of "pico-projector" products. The pico-projection business has the prospect of being a large market in terms of unit volumes, the challenge will be achieving profitable manufacture of microdisplays/microdisplay chipsets at the low prices they will be sold at.

So you're now focusing all of your efforts on high-resolution near-to-eye devices. How big do you see this market? It is very difficult to know, as there is little good market data and it depends largely on whether you perceive that high-resolution near-to-eye (NTE) devices will ever penetrate the consumer market in high volumes.

You are a fabless company, but still have semiconductor integration capabilities. Please tell us how your supply chain works. Actually, we are not really "fabless" but "partially fabless"; we receive silicon wafers manufactured on our behalf by a silicon foundry (the fabless bit) but do all subsequent processing (coating, laminate assembly, cell filling, mounting etc.) within our own Dalgety Bay manufacturing facility. This gives us a lot more flexibility and control versus trying to use a totally fabless approach and is one of our core strengths.

Although ForthDD does not produce its own silicon wafers, their facility in Dalgety Bay, Scotland does all the processing (coating, laminate assembly, cell filling, mounting, etc), providing advantages related to quality and scheduling.

Reprinted with permission by UK Displays & Lighting KTN.
Not to be reproduced without authorisation.

What is your current production capacity? Currently around 20,000 microdisplays per annum but we can increase capacity in Dalgety Bay to over 100,000 per annum should the market demand be there.

In terms of improving performance, is there one area in which you are focusing your development efforts? The technology already performs extremely well in our key applications, so we are focused on making small improvements across the board (while trying not to introduce negative side effects) and reducing cost of ownership to allow our customers to expend their markets.

Your current solutions are at 1280x1024 pixels. Do you see a need to move to higher resolutions? Yes, we expect to move from the current 1.3M pixel displays to 2M pixels and beyond.

What are the pitfalls in moving to higher resolutions? Is it more than just a larger die size? The key challenges include the larger die size (or reduced pixel size) and the high data rates required. A high refresh rate (120Hz), 2M pixel display requires around 10 Gbits/second to be delivered to the display.

What are the most promising applications for high-resolution near-to-eye devices? Forth Dimension Displays is the clear global market leader supplying high resolution microdisplays for near-to-eye (NTE) devices in the training and simulation market and, right now, this is the best market for us.

Do you see 3D as a big opportunity for Forth Dimension? It already is, we supply a lot of our systems for use in binocular, stereoscopic head mounted displays.

Tell us one of your favourite customer satisfaction stories. I would prefer not to put words in our customer's mouths – and suggest you contact Marc Foglia of NVis. http://www.nvisinc.com. *We contacted Mr. Foglia, who provided these insights about ForthDD:*

> "ForthDD has been our supplier for microdisplays since our company was founded in 2002, enabling NVIS to build an entire product line of high-resolution head-mounted and hand-held displays. While most microdisplay suppliers turn away low volume manufacturers, ForthDD (then CRL Opto) welcomed the opportunity to work with us. Over time, great suppliers start to feel more like partners, and ForthDD always treated NVIS as a partner. They made it clear to us that our success was an important part of their business. This was evident in their responsiveness to our requests for technical information, documentation, and at times, demanding delivery schedules. As a small manufacturer, our ability to support our customers is often tied to our suppliers' support for us, and in this capacity our relationship with ForthDD has been vital to our success. We see a bright future together with ForthDD as both our businesses grow."

The NVis nVisor ST uses ForthDD's high-resolution ferroelectric liquid crystal on silicon. The illumination scheme includes an RGB LED mounted on the top-face of a polarizing beam splitter prism. The microdisplay is illuminated by the light reflected off the polarizing beam splitter surface. Colour is generated by the LED using an advanced color sequential algorithm that rapidly switches between red, green, and blue light which is synchronized with the pixels on the LCoS device to generate a 24-bit color image.

Given your earlier financial troubles, when do you expect to reach profitability? We have not had any financial issues since the formation of CRLO Displays (later Forth Dimension Displays) in September 2004. We have always had positive cash in the bank and have very supportive investors/owners. We expect to achieve break even in late 2007 and move into sustained profitability in 2008.

Please describe what you think Forth Dimension will look like three years from now. I would expect that we have grown substantially, are consistently profitable and cash generative and have a value that justifies our investors' belief and investment in us.

Reprinted with permission by UK Displays & Lighting KTN.
Not to be reproduced without authorisation.