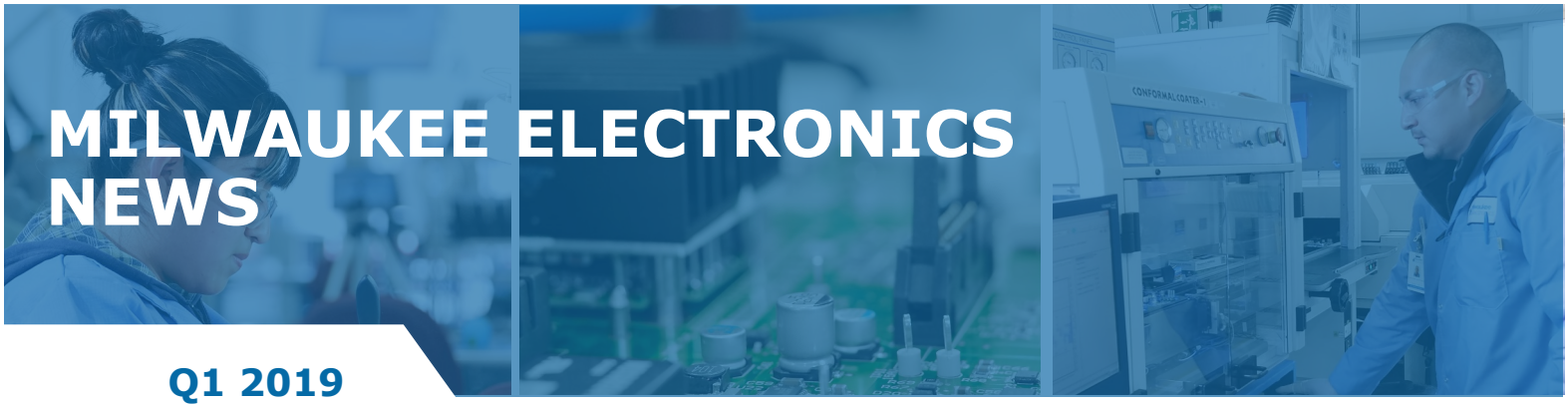

MILWAUKEE ELECTRONICS NEWS

Q1 2019

About Milwaukee Electronics

Milwaukee Electronics designs and manufactures custom circuit board assemblies for the medical, transportation, military, HVAC and a variety of other industries. The Company operates over 135,000 square feet of manufacturing in Portland, Oregon; Milwaukee, Wisconsin; and Tecate, Mexico. In addition to EMS and product design and engineering services, it offers PCB layout services through its San Diego PCB business unit and quick-turn prototyping through its Screaming Circuits business unit.

From 0-20k/Day in 6 Months: Supporting a Hot B2C Startup

One of the challenges with innovative products is that it can be difficult to predict demand and find a contract manufacturer with the right mix of services to support both the product's early stage requirements and the high volume production requirements. Milwaukee Electronics' model of strong front end product development support options combined with the high volume, lower cost manufacturing capabilities of its facility in Tecate, Mexico address that concern well.

The redesigned production line now runs at a 6 million units per year rate.

A good example is the evolution of one of the Tecate facilities' highest volume industrial product customers. The customer started as a prototype customer at Screaming Circuits and also needed contract manufacturing support. The product

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Message from Mike: Solutions Focus Is Driving Growth

I always enjoy the first quarter of each new year. It brings closure to the previous year, early signs of the potential for the coming year, and an opportunity to implement changes affecting the enterprise.

The previous 24 months have seen income growth just short of +30 percent, and the 2019 year has continued the strong double-digit growth trend. Yes, the US economy is robust, but not at the levels our company is experiencing. So other factors must be responsible.

The key driver of that growth is customers capitalizing on the benefits of our engineering-centric business model and strong North American manufacturing footprint. We find our customers utilizing the comprehensive progression of product development our company now offers. From the high tech PCB layout services available at our San Diego PCB division, progressing directly to quick turn proto delivery at Screaming Circuits, and eventually to production requirements at one of our three North American locations, the process is smooth and fast. Quite the contrast to most Asian sourcing. And the development of test fixtures for these more advanced products is proving to be a feature that is of significant value to our customers, and in high demand.

This model is consistent with the speed needed in today's product development cycle. To emphasize that, this column in future newsletters will be shared by Rick McClain, our President and COO. He and I will alternate issues to ensure that you are being kept informed about the most current and critical business issues that can affect your needs. Your successes inspire us to even greater aspirations.

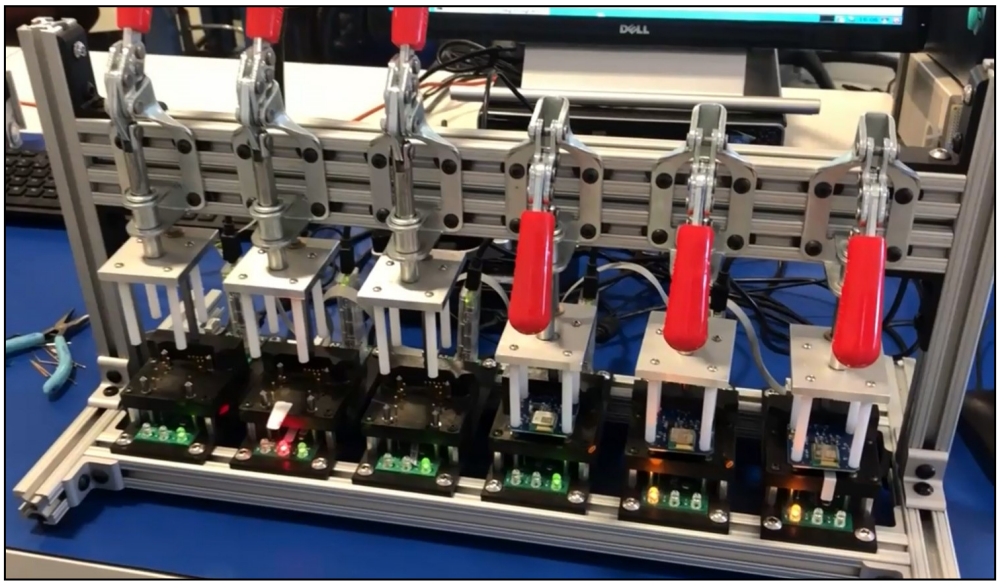
P. Michael Stoehr

CEO

Engineering in Action

Creating a Robust Test Fixture for High Volume Production

One unintended consequence of an increase in production volumes can be challenges with tooling originally designed for lower production volumes. Nowhere is that more evident than in test. As volumes grow, the stress on test fixture components during the load and unload process can cause more frequent test equipment failures.



The redesigned test fixture is better able to handle the rigors of high volume production.

In this example, customer-supplied test equipment for a new product had not been designed to support production volumes growing far faster than originally envisioned. As volumes grew to nearly 100,000 per week, the test stations became bottlenecks due to an inefficient load and unload mechanism and intermittent stress-induced failures of the test board.

The test fixture included a customer-provided test board in its base and communicated to servers at the customer. The fixture used a press-in and clamp design with retaining tips that would hold the printed circuit board assembly (PCBA) under test against a set of POGO pins soldered to the test board. The spring loaded locking ramps were scraping FR4 substrate off the sides of the PCBA and leaving significant debris in and around the test fixture. The design of the fixture allowed side loads which bent and broke POGO pins because the operators were applying 3-4 lbs. of force during the press-in and clamp process. The end result was intermittent test failures and unanticipated downtime. Milwaukee Electronics' facility in Tecate, Mexico was retesting 13 percent of production due to test failures and experiencing four hours a day of test equipment downtime.

Milwaukee Electronics' test engineering group in Oregon analyzed the issues and redesigned the fixture to better support this level of volume production. The new test fixture design addressed all the previously identified issues. The POGO pins were designed to be easily replaceable and located in a POGO block separate from the test board to eliminate strain on the test board. The spring-loaded locking ramps were replaced with spring guidepins that eliminated the scraping action on the sides of the PCBAs under test and the associated debris. The new design created a clamshell fixture where boards were quickly inserted and removed in a perfect linear motion, which addressed both throughput and stress concerns.

The net result is that tester downtime has dropped to 30 minutes per day and is entirely related to software issues associated with test information being communicated to the customer's remote server. Now only .26 percent of the PCBAs require retest.

"When a customer's engineering team designs a test fixture, they are often simply thinking about the test to be performed and not about loading inefficiencies or unacceptable stress in the load and unload process. Because our team interacts with production on a regular basis we are cognizant of those issues. While we can fix problems as they arise, it works better if we are involved in the design as early as possible," said Brandon Loo, Milwaukee Electronic's West Coast Engineering Manager.

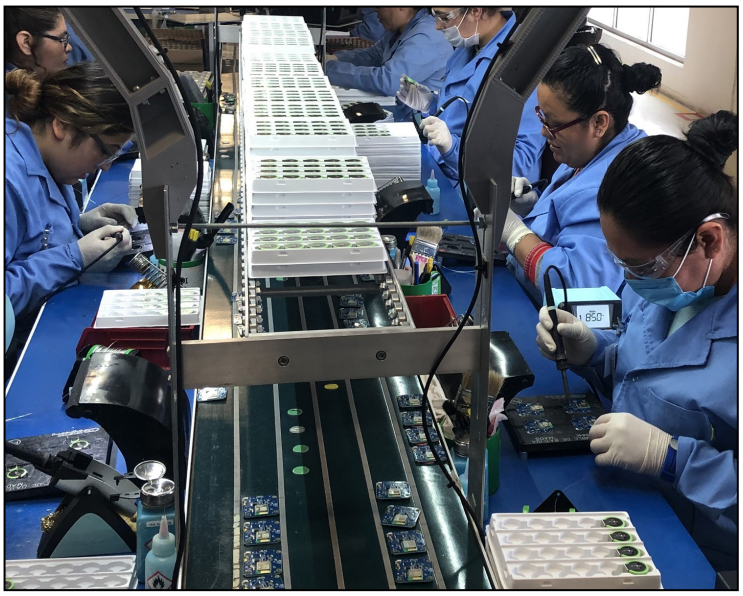
The New Year Reflects a Growing Sales Backlog

Milwaukee Electronics is off to good start in terms both new and existing sales revenue for 2019. Double digit growth is expected in existing sales and the first new account of the year has also been added. The project involves printed circuit board assembly (PCBA) manufacturing for a leading display manufacturer, who sources a portion of its outsourcing in the U.S. The project is launching at Milwaukee Electronics' Portland, Oregon facility in Q2 and is expected to represent over $1 million in annualized sales.

Scalable Solutions

(Continued from page 1)

was a printed circuit board assembly (PCBA) with a plastic housing that collects user data and communicates that data to a remote server. The product is sold to companies who then provide it to customers as part of the services they sell.



A conveyorized line helps improve throughput.

Initially, the project started at a volume of 10,000 a week. The engineering team at Milwaukee Electronics made a panelization design change as part of its manufacturability (DFM) recommendations, increasing the number of PCBAs per panel to reduce assembly takt time in the SMT process. They also made design for assembly (DFA) recommendations in the structure of the final assembly work cells. The customer provided the programming and functional test equipment as they wanted to keep that part of the design as proprietary as possible. Due to the relatively low volumes, the work cells were designed to be a manual process which capitalized on Mexico's fairly low labor costs. The final assembly process involved adding a battery to the PCBA, heat welding an enclosure, programming, testing, labelling and packing in trays.

The project quickly grew to 12,500 a week which was an optimum volume logistically for pallet size. The engineering team performed another DFA analysis which enhanced throughput in the final assembly work cells. In the second year of the project, volumes increased to 40,500 per week. Within a four-week time period, the Tecate team had added two additional work cells and hired and trained the required assembly personnel. By the middle of that year, volumes increased to 96,000 a week. This created a strain on customer-provided test fixtures designed for much lower volumes and Milwaukee Electronics test engineering team provided a solution for that issue. By Q4 of that year volumes had jumped to 104,000 a week, requiring five additional production work cells. However, at the end of the year it became apparent that work cell design would need to be modified to ensure repeatable quality at this high a volume level.

Test and programming has also been redesigned to support higher volumes.

Tecate's team decided that the best approach was to use this opportunity to poka-yoke or mistake-proof the entire final assembly process, as well as begin incorporating the automation now cost justifiable at sustained higher volumes. The design of the final assembly areas was conveyorized to improve throughput, since the process was also modified to include a one-piece flow approach to the programming, test and labelling process. Today, the Tecate team is building an annualized 6 million units a year.

"Our semi-automated work cell design has more checks and balances in the process to eliminate variation and reduces production operator requirements by 37.5 percent. We are now developing a solution that will more fully automate the process for a next generation product. Our ability to develop a scalable solution based on Lean manufacturing principles combined with the speed of our response to changes in volume has enabled us to support this customer's transition from relatively small lots to significantly higher volumes. The end result has been additional business and a stronger partnership among our teams," said Ricardo Del Castillo, Tecate's Manufacturing Operations Manager.

San Diego PCB Takes User Groups into the 21st Century

User groups have been around for decades. They helped usher in the personal computer, use of the internet and have been an integral part of advances in printed circuit board (PCB) design and layout. The premise is that a bunch of local users get together, rub shoulders, and build upon each other's experience. San Diego PCB regularly hosts user groups at its facility to promote the interaction that comes from peers interacting with peers.

On March 12th, the Company hosted the San Diego Chapter of the IPC Designer's Council. Michael Goode, a staff application engineer at Cadence Design Systems gave a presentation on IC Package Design. The presentation focused on an Integrated Circuit Packaging (ICP) methodology that emphasizes co-design among the IC, package and board, to reduce costly errors and accelerate new product introduction. It also looked at co-simulation methodologies to better address the challenges associated with continuing increases in data and processing bandwidth driven by products such as autonomous driving vehicles, 5G networks and other innovations.

However, the challenge with any regional user group isn't just finding cutting edge topics. It also involves keeping member conversations about those topics fresh. The core benefit of user groups is that exchange of ideas and expertise. However, the PCB layout community in any region of the country is a relatively small niche. Two meetings and everyone knows everyone else.

User groups have traditionally focused on face-to-face interactions. In spite of technological innovations that make a variety of videoconferencing options as simple as holding up a phone, user groups have stayed old school, mixing and mingling in person. The other downside to this method is that while a good topic can provoke new ideas, those ideas remain within the group and may be lost if the individuals driving those conversations retire.

(L-R) IPC San Diego Designer's Council Officers: Bill Gebhardt, Treasurer; Ben Savage, Vice Chairman; Luke Hausherr, Chairman; Bob Griffith past Chairman; John Carney, past Education Director; and Judy Warner Education Director.

"Years ago, I helped our founder, Mike Creedan, with an article titled, 'Where is the Next Generation PCB Designer?' The conclusion in that article was that you needed to make them. Today, that need is even more critical, but that next generation of designers has integrated technology far more deeply into their interactions with others. In short, our 'old school' user group interaction methods may be excluding a generation of designers who like to eliminate the commute and videochat. Not only are we not helping to share expertise and 'make them'; we are also segregated from the fresh ideas they can bring," said David Carmody, San Diego PCB Division Manager.

With those thoughts mind, San Diego PCB's April 17th hosted user group event with the Altium User Group (AUG) will be captured on video, edited and made available to a wider audience. Over time this may evolve to a live stream or more interactive format.

"This new format gives us two big benefits. First, we have a vehicle that enables us to reach that next generation of designers in a format that fits their preferred interaction style. Second, great conversations that share expertise are no longer lost in time. If a challenge at work comes up six months from now that a user group discussion addressed, it is easy for a designer to click on a link and listen to that conversation again and apply that knowledge to the problem at hand. And, over time I hope our use of technology will evolve to a point where we are fully interactive in a streamed format so we can completely break down the silos that generational differences in meeting format have created," added David.

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