

Customer Profile



Industry & Application

- Electronics manufacturing
- Automotive subassembly mfg

Location & Web Site

- West Palm Beach, FL
HQ — Montreal, Canada
- www.cmac.com

Key Benefits

Rapid Development

- Flowchart programming took 50% less time than ladder logic would
- Rapid system startup due to advanced simulation capability and application debugging tools

Cost Savings

- Hardware costs reduced by 40% by using embedded Think & Do platforms

Fast, Distributed Control

- Each of 13 stations has embedded control with HMI
- Central PC has peer-to-peer connectivity with each station
- Central PC maintains and archives flowchart logic for each station



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WHILE the sun shines at West Palm Beach, C-MAC's Florida location is busy manufacturing components for numerous industries. Headquartered in Montreal, Canada, C-MAC is a leading internationally diversified supplier of integrated electronic systems and engineering solutions. It is primarily focused on serving global markets for communications, automotive, instrumentation, defense and aerospace equipment.

With its wide range of available technologies and products in many different other markets (defense, telecom, instrumentation, aerospace,...), C-MAC's Automotive Business Unit (ABU) can support all electronic automotive applications including actuators, sensors, electronic controls, under-the-hood applications (power train, gearbox,...), and body electronics. C-MAC's Automotive Business Unit (ABU) sought to manufacture electronic control modules for one of the world's leading automotive component and system companies.



Project Goals Defined

The customer's requirements included high volume, high quality, and low cost. After a thorough analysis, C-MAC determined a fully automated line was required to meet all the objectives. C-MAC invited their Advanced Machine Development Group, an internal systems group, to design their new automotive line. The project is right on track, according to Eric Price, Supervisor for Machine Design of C-MAC's Advanced Machine Development Group. "In the past, we had islands of automation which relied on operators to manage product flow from one station to the next. Now the Think & Do system manages product flow from one step to the next, enabling the operator to manage multiple machines. For instance, one of the operator's tasks is to make sure each station has enough parts to keep the line running smoothly. With this fully automated system, we have lowered product costs and improved repeatable quality for our customer."

Think & Do exhibited high value with its ability to control the process using flowchart programming. Tim Labuhn, Senior Design Engineer from C-MAC's Automotive Division was the lead programmer for the electronic control module automation project. According to Labuhn, "Think & Do was intuitive to work with. Software design is typically done with flowcharts, so it was easy for me to learn and program quickly with this product." One example of the ease-of-use aspect that Labuhn noted was that, "When programming, the access to tagnames (program variables) was quick and easy; I can get to the variable list from any tool that I was working with. This saved me time. I estimated that it took only 50% of development time as compared to programming this project in ladder logic."

Affordable, Distributed Control

When choosing a hardware platform, Price was faced with automating multiple manufacturing stations that make up the control module assembly process. The production speed was targeted for 1000 modules per hour (one control module every 3.6 seconds). So, he chose a distributed control approach using an embedded PC called the "WinPLC@" from

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Automationdirect.com. Each WinPLC control platform comes pre-loaded with Windows® CE operating system and Think & Do's runtime software. Microsoft developed Windows CE for use in small, real-time embedded systems, which is rapidly emerging as the preferred real-time operating system for industrial applications where disk-less operation, small size, and/or very low cost are important considerations.

The WinPLC fits in an I/O base and controls I/O points directly via the backplane. Since the WinPLC is about the size of a deck of playing cards, the human interface device must be external. Price chose to use an *Automationdirect.com* DirectTouch panel, a low-cost, 5.7" LCD touchscreen which integrates easily with the WinPLC. Each panel features a 320 x 240 pixel display and can support up to 1,024 screens.

By using a WinPLC and a DirectTouch panel at each station, he had affordable, high-speed distributed control. Price estimates, "By using WinPLC platforms and DirectTouch Operator Panels, we saved approximately 40% in hardware costs compared to standard PLC solutions we considered."

13 Steps to Success...

C-MAC's electronic control module's manufacturing process has 13 different steps. Therefore, a control module line has 13 WinPLCs and 13 DirectTouch operator panels. The discrete I/O for each line totals approximately 1500 points. An industrial PC (pictured above) serves as the system development interface which can down-load flowcharts and I/O configurations to each WinPLC.

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C-MAC's electronic control module line during project development, with industrial PC (lower right) displaying Think & Do's ProjectBinder

The steps for manufacturing an electronic control module are:

1. A robot station puts a heat sink on the *assembly carrier*, a precision-machined aluminum
2. A station prints glue on the heat sink with squeegee swipe method
3. A robot inserts a bead of epoxy to the outer edge of heat-sink and then places the plastic housing over the heat sink on the squeegee glue.
4. A robot station puts a circuit board on the heat sink's bead of epoxy.
5. A station diverts units to a 10-board accumulator. A full accumulator box is then pushed into the oven.
6. The oven bakes modules for about one hour. A cooling conveyor takes them to the next station.
7. A bonding robot takes each unit and ultrasonically welds (bonds) wiring to the board.
8. Conformal coating is put on each module for protection from corrosion.
9. A sealant is put on as a bead around the edge of the housing.
10. A lid is placed on the glue so that the unit housing is sealed.
11. Units are then loaded in a second oven and baked for one hour.

12. A robot then takes each control module and tests the circuitry, which is still hot from the oven.

13. A cooling conveyor takes the modules to the next station, which runs a cold temperature electronics test.

The final product inspection uses a vacuum test to confirm that the control module is sealed. The units are then sent to post processing, which includes labeling and shipping of "passed inspection" products. Price plans to automate some of these tasks in the next phase of the project with new final assembly equipment.

Development Tools Provide Head Start

Project startup went smoothly, since the control system was pre-tested before the machines were in place. Labuhn was most complimentary of Think & Do's debugging and simulation tools. AppTracker is a multi-paned application debug tool that is designed to give the programmer a clear picture of the whole project. It indicates active flowcharts with active data values. With its color-coding of the execution path, you are quickly able to understand I/O and control logic status simulating the manufacturing process using just the software. As Labuhn explains, "I was able

to write and debug the code while machines were being ordered. Sometimes it is hard to pinpoint problems during startup. But, with Think & Do's simulation tools, I was confident on how the program worked. During the startup with my pre-tested program, I was able to help others debug the wiring and machine issues."

Each operator station has an overview status screen for that station, in addition to fault and operator information screens. The DirectTouch panel is configured and programmed using Windows-based ScreenCreator™ Software. ScreenCreator is an advanced graphics editor with 64 pre-built parts of keypads, meters, graphs and numbers, and text and time display fields that C-MAC was able to quickly develop

for their operator panel screens. For value, the touch panel has great capabilities such as global and static internal values, built-in clock, built-in fault alarm, and screen password protection. In addition, the 16 levels of undo and redo are helpful for the screen developer to recover and/or save keystroke time during screen development.

Summary

Price concludes, "We chose Think & Do's solution because of its high value and cost-effectiveness. We met our project's objectives with this solution. We eliminated the previous islands of automation and maximized the operator's efforts. In fact, because of the control module line's success, we are looking at

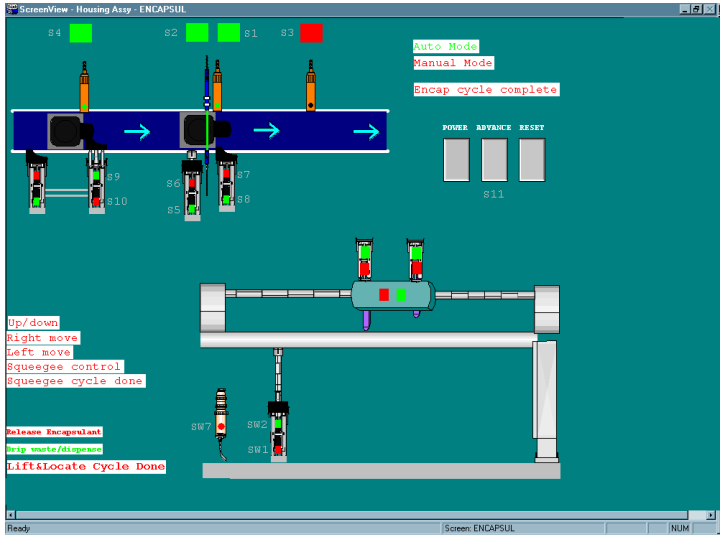
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other applications within the plant to use Think & Do's solution."

For more information on how Think & Do can help solve your application, visit our website at www.thinkndo.com, or call (800) 722-6875.



At Station 1: Robot places heat sink on carrier for subsequent assembly



At Station 2: Think & Do ScreenView operator screen for the Heat Sink Glueing Station



At Station 5: Oven Loader Controller with Think & Do WinPLC (at left center)