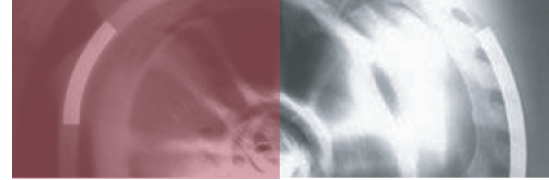




White Paper

Published Article



Increasing PCB Throughput Reliability

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The continuous pressure to reliably increase throughput despite increasingly complex PCB's, leaves SMT manufacturers constantly driving for better, faster, less expensive ways to build their machines. One area often considered to assist in meeting these challenges is motion control.

Some motion control solutions operate on multiple platforms and buses with units providing analog output to a conventional amplifier, as well as units that provide current control and direct pulse width modulation (PWM) output for as many as 32 motors simultaneously.

There are amplifiers that still require potentiometers to be adjusted for the digital drives' position, velocity and current control. A plethora of application specific mixing and matching of these units is used to achieve various levels of satisfactory motion and control results.

Advances in hardware continue to make possible motion control solutions that operate faster and more precisely. More interestingly, new microprocessors and digital signal processors (DSP's) provide the tools necessary to create an advanced feature, function, performance set at a more attractive price point. These feature and functionality enhancements, such as increasing the number of axes on a motion controller or adding position controls to a drive, can be traced back to advances in the electronics involved.

As dedicated servo and motion control performance has improved, the system-level requirements have likewise increased. Machines that perform servo actions now routinely operate with more advanced software and more complex functions on their host computers. Companies that provide servo or motion systems differentiate themselves from their competition by the quality of the operating systems they deliver to their customers.

Motion Complexity

Traditional servo systems often consist of high-power front-end computers that communicate to high-power DSP-based, multi-axis motion controller cards, interfacing with a number of drives or amplifiers, which often have their own high-end processors on board. In a number of these cases, the levels of communication between the high-end computer and the motion controller can be broken down into three categories: simple point-to-point moves with non-critical trajectories; moves requiring coordination and blending, with trajectory generation being tied to the motion of the machine; and complex moves with the trajectories that are critical to the process or machine.

The three basic levels of motion complexity require different features and functions from the distributed servo controller/amplifier. The first level, point-to-point moves with non-critical trajectories, typically applies to “pick and place” robots, which is the focus of this discussion. So let's take a closer look at the requirements as they apply to this example.

It is possible to envision two types of distributed servo controller/amplifiers for point-to-point moves with non-critical trajectory applications: those for repetitive point-to-point moves with external event generated conditions and others for point-to-point destinations that vary based on user or machine generated events. The requirements for a distributed servo controller/amplifier involve determining a trajectory based on current location and requiring either a user destination or a preprogrammed destination. Effectively, the only user requirement is to set acceleration, velocity, and jerk parameters (for S-curve), and a series of final points.

As a unit, there are minimal communication requirements between host and controller, with simple commands and feedback. Such communication requirements include a resident motion program for path planning; support for I/O functionality; support for terminal interface via RS-232; use without resident editor/compiler; and stand-alone motion control. A complete motion control application is programmed into the distributed control module for “stand alone mode” control of 3-axis applications. This mode is typically used for machines that require simple, repetitive sequences operating from an RS-232 terminal.

Communications for the stand-alone mode can be simple and often not time-critical. Simple point-to-point RS-232 communication is often acceptable for applications requiring few motors. Multi-drop RS-485 or RS-1394 is suitable for applications with many axes of motion and motor networks.

Distributed Motion Control

A compelling case had been made, and preliminary tests completed, for integrating motion control functionality into one compact module to enable, in the case of SMT equipment, mounting directly in the gantry on the SMT heads. This provides what is referred to as a “distributed system”. Centralizing the communications link to the computer from the controller/amplifier, resulting in a solution with significantly reduced wiring harness and the associated electrical noise, thereby reducing cost and improving reliability. By increasing the number of power stages, the unit can drive more than one motor independently, limited only by the processing power of the DSP.

In order to implement a distributed servo controller/amplifier, the module must meet the basic system requirements: enough processing power to control all aspects of a multi-axis move, fast enough communications between the computer and the servo controller/amplifier to do the task and an integrated module with small enough size, low enough mass to satisfy distributed-system requirements. Of course, market acceptance of this approach also demands that the distributed solution be reliable and economically viable which, today, we have seen this proven.

Application Brief

Agile Systems has developed an integrated power and control module that combines both the drive and motion control functions into a single compact package. The MAX™ controls and drives 3 Brushless DC motors up to 400 Watts each. With the encoders, hall sensors, and multiple user I/O and limits connected directly to the MAX™ unit, the only external requirements are for a serial network for communication purposes and a DC power source.

Embedded into the MAX are the current and position loops as well as an application layer for greater than 50 user commands. An S curve trajectory generation is utilized in point to point applications and a profile-streaming mode is utilized in complex trajectory applications. As well, embedded macros provide the ability to execute stored sequences of motion or I/O, which increases further, machine throughput.

This revolutionary technology can be seen on the latest Samsung component placer targeted for the PCB assembly process. Agile’s MAX™ unit is one in a series of key technology advancements integrated in to the Samsung CP60. This application enables Samsung to mount the pick and place mechanisms entirely on the “heads” that move on multiple gantries inside the system. Each MAX unit, contained within a compact 3.0" x 8.0" package, allows the user to reduce wiring, increase reliability, decrease noise susceptibility and increase diagnostics.

Looking Forward

As electronics manufacturers continue to deal with shorter time-to-market demands and ever increasing quality standards, pressures will continue to push motion controls to creatively viable alternatives. Advancements in the microprocessor will support these initiatives allowing for continued innovation through digital power.