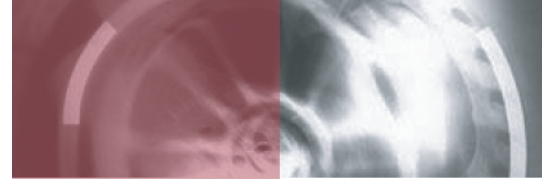




**White Paper**

**Published Article**



## **Integrated Distributed Motion Control**

## Increased Reliability and Functionality for Automation OEMs *Introducing the Next Generation of Integrated, Digital Motion Control*

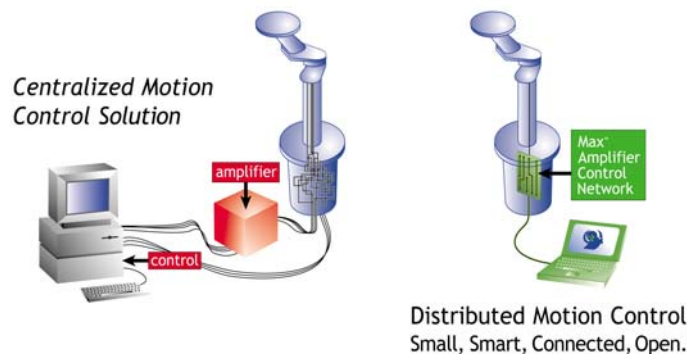
Manufacturing Automation

November 01, 2001

The continual 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. Similar challenges drive Robot manufacturers to search for solutions that provide increased reliability and functionality at a reduced cost. The motion control subsystem has always played an important role in the performance of assembly and automation equipment. Motion control choices in machine design also have a significant effect on system cost and reliability.

**Centralized Motion Control** solutions are generally bus-based with multi-axis motion controllers providing analog command voltages or PWM commands to servo amplifiers that may be a significant distance away. Some amplifiers still require potentiometers to be adjusted for the digital drives' position, velocity and current control. A range of application specific mixing and matching of these units is used to achieve various levels of satisfactory motion control results.

**Distributed Motion Control** solutions eliminate the motion controller and rely on placing the position controller next to the servo amplifier (in some cases combining the two) and thus place the intelligence for control out at the motors. Significant cabling is eliminated and noise reduced - resulting in better reliability at a reduced cost.

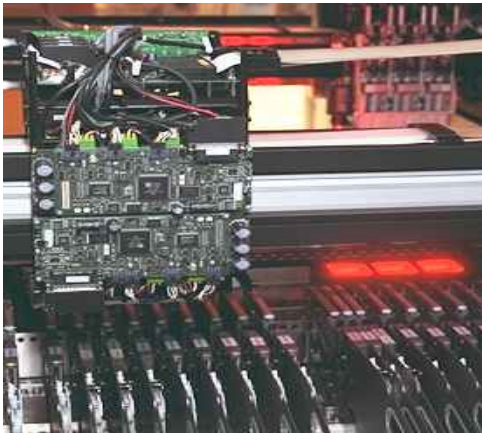


Traditional servo systems often consist of high-performance host computers that communicate to high-performance DSP-based, multi-axis motion controller cards, interfacing with a number of drives or amplifiers, which often have their own high-end processors on board. This can be expensive. In a number of these cases, the level 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. SMT assembly OEMs are typically in the first category, with point-to-point moves that, although simple, are demanding in their requirements for event-triggered motion at extremely high speed.

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.

## Integrated, Digital Motion Control



With integrated digital motion control, OEMs can now mount the motion controller and servo amplifiers directly in the gantry on the SMT heads, in the case of Chip Shooters. This provides what is referred to as a distributed system, 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 on the head, the unit can drive more than one motor independently, limited only by the processing power of the controller's DSP. (Left: Motion controller and servo amplifiers are now being integrated in the gantry, directly on the

SMT heads, as a distributed solution to motion control.)

In order to implement a distributed servo controller/amplifier, the module must meet the basic system requirements: processing power to control all aspects of a multi-axis move, fast and deterministic communication between the host computer and the servo controller/amplifier realized in an integrated module with small size and low mass.

Of course, market acceptance of this approach also demands that the distributed solution be reliable and economically viable which is now possible.

### Application Brief

Agile Systems has specialized in combining DigitalPower, control and networking in the smallest form factor since 1987, and continue to develop integrated multi-axis power and control modules that combine both the drive and motion control functions into a single compact package. In fact, in its second generation, the MAX™ controls and drives 3 Brushless DC motors up to 400 Watts each. With the encoders, hall sensors, multiple user I/O and limits connected directly to the MAX™ unit, the only external requirements are network cable for deterministic communication and a DC power source.

Embedded into the MAX™ are the current and position loops as well as an application layer for network interfacing. On-board S-curve trajectory generators are utilized for point-to-point applications and PVT streaming is utilized for complex and coordinated trajectory applications. Macros resident in Flash provide the ability to execute extensive stored sequences of motion; I/O and event-based motion that are critical for pick and place operations.

This revolutionary technology can be seen on the latest Samsung CP60 chip moulder for the SMT assembly process. Agile Systems MAX™ unit is one in a series of key technology advancements integrated in to the Samsung CP60. The MAX™ enables Samsung to mount the pick and place mechanisms entirely on the heads that move on



multiple gantries inside the system. Each 3-axis MAX unit, contained within a compact 3.0" x 8.0" package, integrates the 3 axes of control with 3400W integrated servo amplifiers, allowing the OEM to reduce wiring, increase reliability, decrease noise susceptibility and increase diagnostics visibility through the integration of the amplifier and controller.

### **Looking Forward**

As Automation and Assembly OEMs continue to deal with shorter time-to-market demands and ever increasing performance and quality standards, motion control subsystems will continue to be pushed to creatively viable alternatives. Advancements will accelerate with continued innovation, which at this point would best be supported through the integration of distributed motion control solutions