EP&P
March 2003
ELECTRONIC PACKAGING & PRODUCTION

Upgrading to Micro-Volume Dispensing

Jeffrey Fugere, DL Technology, Haverhill, Mass.

The trend toward micro-assembly continues. For the most popular electronic applications (PCs, pagers, cell phones), circuit densities are increasing, while component and package sizes are getting smaller — all in an effort to pack more functionality into available real estate. For area array devices, such as ball grid arrays (BGAs), chip scale packages (CSPs), and flip chips, dispensing materials like conductive epoxies and solder paste, often calls for dot sizes approaching 10 mils (0.010 in.) in diameter. Diameters less than 10-mils, in fact, are not uncommon.

PREVIEW

MICRO-VOLUME DISPENSING CAN BE ACHIEVED BY UPGRADING THE PLATFORM WITH A MICRO-VALVE PUMP, CONICALLY CHAMFERED NEEDLES AND A PROGRAMMABLE, CLOSED-LOOP INTERFACE.

Figure 1: DispenseLink control system for micro-volume pump.

Conventional dispensing pumps

Conventional dispensing pumps, regardless of the configuration, needle size and technique, are hard-pressed to achieve dot sizes below 12 mils (0.012 in.). In addition to achieving this dot size, the challenge is to maintain upper and lower limits for 3-sigma performance in terms of accuracy and repeatability. Conventional pumps are acceptable for dispensing adhesives, solder paste and epoxies in mounting most leaded devices, where volumes are larger and some tolerance variation can be accepted. For the precise volumes required for micro-dispensing (0201 devices, BGAs, CSPs and flip chips), however, such pumps are often unsuitable. Where manufacturers attempt dot sizes below 12 mils with these pumps, "babysitting" of the equipment is typically required for any hope of success, and rejects can be significant.

Microcomponents mandate micro-volume dispensing

This means three things. First, a pump with the electro/mechanical design and programmable control is needed to

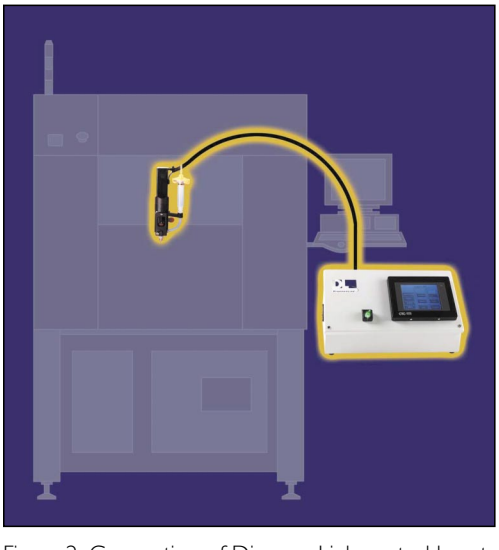

Figure 2: Connection of DispenseLink control box to micro-volume pump and standard platform.

consistently dispense pastes of various viscosities in volumes as little as 10 mils (0.010 in.) or less, without variation in dot profile. The pumps are called micro-volume pumps, and the need for such a capability by manufacturers is becoming paramount in high-density interconnect and semiconductor packaging.

Second is the requirement for precision-machined, stainless steel needles with a conically chamfered tip to ensure complete transfer of material from the needle to the substrate or package.

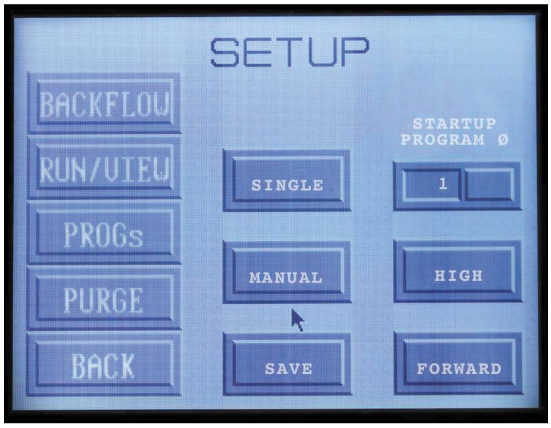

Figure 3: SETUP screen for control system.

Retrofitting micro-dispensing capability to a standard platform is straightforward; control over the pump shifts from the platform to the micro-controller

Third is the need for a control system. Until recently, access to micro-dispensing required the acquisition of new platforms specifically designed for micro-dispensing because conventional SMT platforms cannot support the electronics for programming and controlling the action of the micro-volume pump. There is now, however, a way to retrofit a standard platform for micro-dispensing by using DispenseLink technology, consisting of a valve, needles and micro-controller.

DispenseLink technology

Retrofitting micro-dispensing capability to a standard platform is straightforward; control over the pump shifts from the platform to the micro-controller. The pump is mounted on the standard dispensing platform, replacing the conventional pump and is connected by cable to an interface port on a control box (Figure 1). The cable typically plugs into the output connector on the platform. Alternatively, it can be wired into the platform electronics. Special needles, machined from stainless steel and featuring chamfered tips, complete the system.

X-Y-Z movement

The platform remains responsible for point-to-point X-Y-Z movement of the table and head, signaling DispenseLink to commence dispensing when the pump is in position. The controller sends and receives signals to and from the pump, via an encoder, which precisely defines the required rotation of the auger in the pump. (See the sidebar comparing the micro-volume pump with conventional linear displacement and auger pumps.)

Installation of the micro-controller is shown in Figure 2. The controller stores programs in memory; the system is capable of controlling the dispensing dots, lines, fill routines and any combination of the above.

And because the micro-valve is not based on dispensing material for a prescribed amount of time, but rather on the exact increment of rotation of the auger (see the sidebar for details), extremely precise amounts can be dispensed.

In operating the micro-volume pump, a display appears on the controller after power-up, enabling either manual or timed purging of the pump, and password information entry. The SETUP screen (Figure 3) can then be selected, which permits the dispensing of dots or lines to be specified and controlled directly via a RUN/VIEW screen. The PROGs screen is selected to access one of the stored programs, using a numeric keypad. Each of the programs can then be viewed and edited, as necessary, or run.

DispenseLink can also be run and programmed directly on the dispensing platform's monitor by using a Windows-based interface.

Retrofitting on standard platforms

In today's competitive climate, substrate and component manufacturers face the challenge of accommodating higher densities and smaller components and packages. For dispensing solder paste to form interconnects, dot diameters are approaching 10 mils (0.010 in.) or less, necessitating the use of micro-volume dispensing systems for precision and repeatability.

With a recent development, micro-volume pumps can now be retrofitted on standard platforms, thus saving the capital expense of a complete micro-dispensing system. Using a micro-controller cabled to the pump via an interface port, programming and operating the pump is possible for dispensing of micro-volume dots, lines, and underfill.

EP&P

Jeffrey Fugere, founder and president of DL Technology, Haverhill, Mass. can be reached at 978-374-6451 or jfugere@ditechnology.com.