Solid State TECHNOLOGY
Insights for Electronics Manufacturing

How SEMI Standard E175 is saving energy and cutting costs

Industry experts answer questions about the new standard in a virtual roundtable.

In recent years, energy consumption has decreased due to several innovations that have helped to improve the energy efficiency of process tools and sub-fab equipment, but an increase in the number of processes and the growing complexity of processing at the current node has resulted in a spike in energy consumption in the fab. Approximately 43% of the energy consumed in the fab is due to the processing equipment and, of this, 20% is vacuum and abatement (8% overall).

A new standard from SEMI, E175, defines energy saving modes, which combined with the EtherCAT signal-ing standard, can help fabs save energy and other gas/utility costs when the tool is not processing and with no impact on subsequent wafer processing.

EtherCAT, based on industrial Ethernet, provides high- speed control and monitoring. It is the communication standard of choice for the latest semiconductor tool controllers to connect to sensors and actuators around the tool, including vacuum and abatement systems.

SEMI E175 defines how process tools communicate with sub-fab equipment, such as vacuum pumps and gas abatement systems, to reduce utility consumption at times when wafers are not being processed by the tool, and returning to full performance when the tool is again required to process wafers. It builds on SEMI E167, which defines communication between the fab host/ WIP controller and the process tools for the pur-pose of utility saving.

Collaboration between the E175 and EtherCAT groups has seen a harmonization of the communication stan-dards to provide co-ordinated energy saving across devices in the fab.
We invited experts in this area to answer a few questions in a virtual roundtable. The participants are:

• **GERALD SHELLEY**, Senior Product Manager Communication and Control at Edwards, and the EtherCAT Chair Abatement / Roughing pump working groups, E175 task force.

• **MIKE CZERNIAK**, Environmental Solutions Business Development Manager at Edwardsm Co-Chair of SEMI International Standards E167 & E175, and campaigner for energy saving

• GINO CRISPIERI, Applied Materials – Past Co-chair of E175 (originally SEMATECH/ISMI, then indepen-dent consultant, prior to Applied Materials)

• MARTIN ROSTAN, Executive Director, EtherCAT Technology Group

• Q: Please explain what drove the standards work on energy saving and the achievements to date.

• SHELLEY: There is increased pressure on the industry to reduce energy and utility saving from both a cost and environmental standpoint. Subfab equipment is a major consumer of utilities, which is wasted when a tool is not in use. Different manufacturers have implemented energy saving solutions, with minimal direct connection to the tool. However, direct tool connection has emerged as the best way to maximize saving without any risk to wafer processing.

• CZERNIAK: This work originated in the ISMI part of SEMATECH as a follow-on to generic work aimed at re-ducing the overall utilities footprint of modern fabs. In response to this and requests from customers, Ed-wards developed vacuum pumps and gas abatement systems that had energy-saving functionality. However, it soon became clear that the limitation to implementing such savings was the absence of standardised sig-nalling between the process tool and sub-fab equipment.

CRISPIERI: Participation and collaboration from the EtherCAT Working Group was critical to accelerate the implementation and adoption of the standard. Dry Contacts and EtherCAT communication protocol mes-sages were added to two Related Information sections and included in the SEMI E175 standard at the time of its publication.

CZERNIAK: This enables a “richer” signalling environment than simple dry contacts (which are also support-ed) that enables even greater utility savings to be made.

Q: How has EtherCAT been able to support the require- ments of the tool and Semi E175?

CZERNIACK: By providing timing information; the longer the time the tool is inactive, the greater the savings possible.

ROSTAN: As the control network of choice for the latest semiconductor tools, EtherCAT has been ideally placed to support enhancements, such as the energy saving connectivity increasingly being requested by the fabs. In particular, it was good to see the Pump and Abatement Task Groups of the existing Semiconductor Technical Working Group formulate an E175 compliant solution within the timescales of the second release of the EtherCAT semiconductor device profiles. The EtherCAT Technology Group was also more than happy to support the publication of extracts of the EtherCAT standards being used as protocol examples in the Im-ple- mentation guidelines of the Semi E175 document.

SHELLEY: EtherCAT has the fast / deterministic connec- tivity and proven integration with tool controllers that allows E175 functionality to be easily added without any loss of performance. By including the require-ments of Semi E175 in the EtherCAT standards, both equipment suppliers and tool vendors can establish en-ergy saving communication quickly and easily.

CRISPIERI: The coordination between EtherCAT Working Group and the SEMI ESEC task force group was conducted by Mr. Gerald Shelley from Edwards Vacuum. With his help and leadership, we reached effortless-ly agreement and acceptance for the required messages, parameters and values into the EtherCAT respec-tive Pump and Abatement Profile documents. Havingworking usage scenarios and support from the Ether-CAT Working Group has been invaluable.

Q: Why is energy saving important to the industry?

CRISPIERI: A SEMATECH project around 2009 started to look into opportunities for saving energy in the semiconductor factories. At that time, suppliers of pumps and abatement systems already had started initia-tives to provide their own solutions to the initiative. Since that time, the industry has adopted two new stan-dards: SEMI E167 Specification for Equipment Energy Saving Mode Communication (between factory and semicon- ductor equipment) and SEMI E175 Specification for Subsystem Energy Saving Mode Communica-tion (between semiconductor equipment and subsystems).

Q: Please describe how the energy saving task force was born and why you decided to get involved.

CRISPIERI: Back in 2009 while working for SEMATECH in Austin, Texas, prior to SEMATECH’s move the New York, Thomas Huang an assignee for GlobalFoundries to the EHS Program approached and asked me if I would be interested in helping him drive a standard for equipment suppliers to enable their equipment to save energy during idle times. Because of my previous experience working with equipment suppliers and de-veloping standards for equipment and factory communication, I accepted to chair a task force to drive the equipment supplier’s new capability requirement into a standard. At first, we thought it would be an easy task and that everyone would jump to help create and approve the standard in a short amount of time because of its benefits. A two phase approach was defined to drive the standardization process and engage semicon-ductor and sub-fab equipment suppliers accordingly. It took almost three years to complete the Phase I
(2013) and another three to complete the Phase II (2016) standards.

SHELLEY: The task force was an extension of E167 which previously defined the communication into the tool from the supervisory systems, however to achieve maximum benefit signalling to tool subsystems was key and the E175 task force was the result.

CZERNIAK: Following-on from the above, the ISMI working group became a SEMI Standards Task Force and began work at developing a standard, initially for Host to process tool (E167) and then from tool to sub-fab (E175), which I was co-chair for to ensure continuity and clear the signalling “roadblock”.

Q: How have suppliers collaborated on E175?

CRISPIERI: Compared with the suppliers who partic- ipated in SEMI E167 development, the suppliers in-volved in the development and approval of SEMI E175 were more committed to make it happen and helped drive the standardization process to conclusion much more efficiently. Edwards, AMAT, TEL, Hitachi-Kokusai and DAS-Europe regularly participated and provided inputs to standardize behavior and require- ments for their own equipment. We run into some difficulty getting aligned with other standard activities that were dri-ven by SEMI’s EHS Committee because their changes affected our standardization process. I must note that the overall participation was excellent in particular from Edwards Vacuum and AMAT.

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