

#### APPLICATIONS:

## Semiconductor Manufacturing Facility



# Wireless Sensor Network Streamlines Semiconductor Manufacturing Operations

#### SUMMARY:

In their Silicon Valley semiconductor wafer facility, Linear Technology uses a SmartMesh IP wireless sensor network to streamline manufacturing operations—monitoring gas cylinder levels to proactively schedule replenishment and ensure uninterrupted supply.

**CHALLENGES:** For semiconductor wafer facilities, optimizing uptime and increasing operational efficiency results in increased production output. Installation must be non-disruptive, fit within existing space confines and work reliably in the metal and concrete structure.

**SOLUTION:** Linear Technology installed a SmartMesh IP wireless mesh network to monitor gas cylinder usage and relay real-time readings to plant management software. This data enables quick and accurate gas usage estimation, ensuring timely replenishment, reducing downtime and wasted gas. Data points are logged and used to aid capacity planning.

#### THE CHALLENGE

Semiconductor companies carefully manage their semiconductor wafer fabrication facilities (“fabs”) to maximize uptime, yield and throughput. Plant operations teams are constantly looking for new ways to squeeze even fractions of a percent more efficiency out of the manufacturing process.

At Linear Technology Corporation’s Silicon Valley fab, over 175 specialty gas cylinders are used in the wafer manufacturing process. These gas cylinders must be closely monitored to ensure uninterrupted supply. An unplanned interruption of gas supply would result in hundreds of thousands of dollars of wafer scrappage, revenue loss and unacceptable delay in product shipments to customers. To avoid downtime, technicians manually log the pressure of each gas cylinder in the fab three times a day. This manual process is prone to human error and is expensive to maintain.

This is still done manually because communications wiring is expensive and impractical in the fab. Cylinders are located throughout the facility, and for most of the cylinders, there are no AC outlets or Ethernet jacks nearby. The building is constructed of concrete walls for safety reasons, making it cost-prohibitive to install new wires. Furthermore, a large construction project to install power and communications wires would disrupt the manufacturing process, causing factory downtime.



#### THE SOLUTION

A 32-node SmartMesh IP™ wireless mesh network has been deployed to monitor gas pressure in the gas bunker. Every node is powered by a pair of lithium AA L91 batteries for an approximate 8-year battery life, so no additional wiring and no unnecessary downtime was required to install the network. Despite the concrete construction and prevalence of metal structures in the fab, the network has proven to be extremely reliable. As of this write-up (December 2015), the network has been up continuously for over 83 days, and has transmitted over 26 million data readings with >99.99999% reliability, which is 100 times better than the stringent “5 nines” reliability expected of high availability communication and computer systems.

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In the gas bunker, each cylinder is measured for both tank pressure and regulated pressure and these readings are communicated to a central monitoring system via the SmartMesh® network. Each SmartMesh node is connected to a pair of cylinders and sends readings through the wireless mesh network to a web server across the building. In the control room, the fab's site management software tools display real-time readings and automatically calculate run rates to establish regular schedules for cylinder replacements. In addition, low-pressure thresholds are set to alert facility technicians if cylinders reach low levels prior to the replacement schedule. Alerts are displayed on the control room monitor and via Internet messaging on a 24/7 basis.

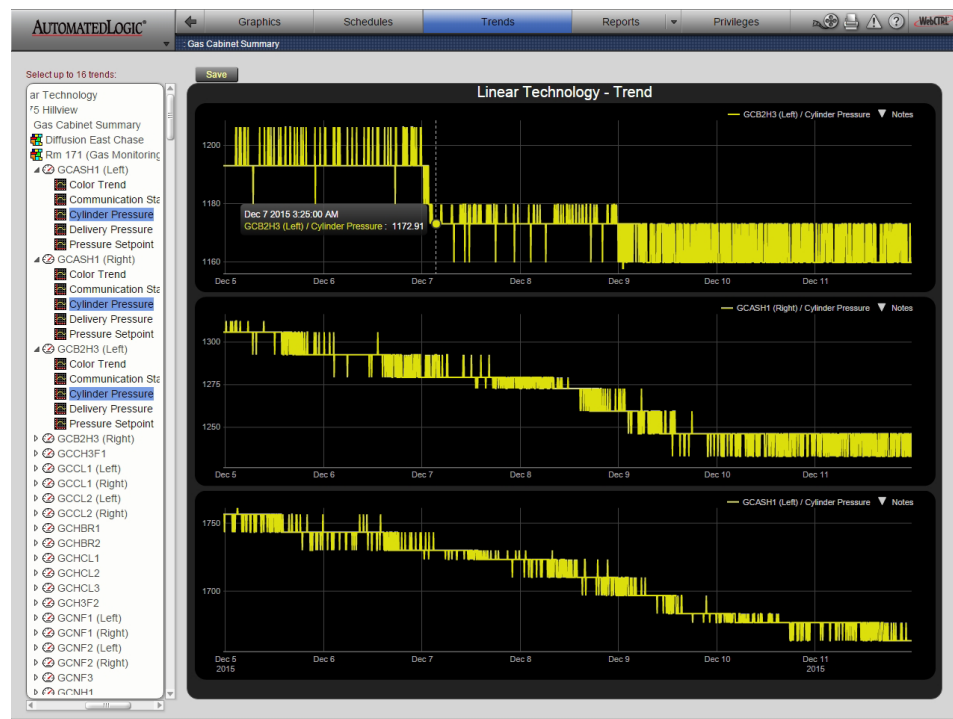
### RESULTS

By using real-time gas consumption rates, technicians can precisely predict when gas cylinders will need to be replaced, reducing waste from unused gas due to premature cylinder changes. The benefits extend beyond efficiencies in day-to-day operations. By centrally collecting gas usage data and making it readily available to plant management, this system enables trend analysis which further identifies opportunities to streamline plant operations by correlating readings with specific semiconductor fab processes and geometries. This helps to optimize fab capacity growth as the need arises.

"The efficiency gains have more than justified the installation of the SmartMesh gas cylinder monitoring network. As a result, we plan to expand this wireless mesh system across the entire plant to gain further efficiency in our operations," stated Alex McCann, Chief Operating Officer of Linear Technology.

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— Alex McCann,  
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Linear Technology



### DUST NETWORKS

Linear Technology's Dust Networks® products are chips and pre-certified PCB modules complete with wireless mesh networking software. When embedded into customers' sensor and gateway products, the resulting wireless connection achieves >99.999% data reliability and ultra-low power consumption, enabling sensors to be placed in tough Industrial Internet of Things (IIoT) environments. Dust Networks' products are field proven, with over 50,000 customer networks deployed in 120 countries.

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