Micrel Case Study:
Reducing Costs for Industrial Gas Cylinders Management
14 January 2008

CHALLENGE:

- **Micrel owns a 150mm fab which has a capacity of 30,000 wafer starts per month. This fab was constructed in the 1980's and is considered a legacy fab without full benefit of current automation technology.**

- **They constantly assess technology upgrades to reduce cost and improve productivity to remain competitive. Managing the use of process gases, which is labor intensive and prone to gas shortages and/or waste, was identified as a key area of potential improvement.**

SOLUTION:

- **Micrel installed new automation technology which did not incur any disruption to ongoing processes and required minimal installation cost. The solution, a non-invasive wireless sensor which "clips-on" to existing gauges and/or transducers, costs 70% less than using traditional transducers.**

RESULTS:

- **Based on the first two months of use, Micrel estimates annual savings to be in the range of $215,000, which correlates to an investment payback time of approximately 7 months.**

Situation/Background

As new semiconductor fabs continue to be built globally, there are over a hundred "mature" fabs in the United States and many more worldwide that are still the workhorses of the industry. These legacy fabs are often twenty years or older, and produce millions of chips for a huge array of electronics every day. And while many newer fabs have automation features built in to enable peak efficiency and performance, older fabs seek new solutions to increase productivity, reduce downtime, and decrease operating costs.

One such company is Micrel, based in San Jose, California, a leading IC solutions manufacturer for the analog, Ethernet and high bandwidth markets. The company manufactures high performance analog, power, advanced mixed-signal and radio frequency

semiconductors, high speed communication, clock management, and Ethernet switch and physical layer transceiver integrated circuits. End markets served include cell phones, portable and enterprise computing, enterprise and home networking, wide area and metropolitan area networks and industrial equipment. Founded in 1978, Micrel has been profitable for 25 of its 26 years with revenues of $280M and regional sales and support offices, sales offices, distributors and technology design centers throughout the Americas, Europe and Asia.

Challenge: Gas Level Monitoring

For Micrel, it is critical to minimize unplanned downtime at its core San Jose 150mm fab. At this facility, which has a capacity of 30,000 wafer starts per month and houses 500 semiconductor manufacturing tools, wafer production requires hundreds of process recipes that use various combinations of gases to produce the desired chips. It is critical that the required gases are provided for each wafer process step or the output will be unusable and system downtime occurs as a result. Essentially, semiconductor production hinges on the availability of these gases so no chances can be taken -- ever. The gases themselves, supplied by about 300 different cylinders (Figure 1), are a precious commodity, ranging in cost from $800 to $17,000 per cylinder.

Figure 1 – Micrel Gas Cylinder Area (typical)

For years, like many older fabs, monitoring gas cylinder levels has been a manual process. At Micrel, once every 12-hour shift, an employee armed with paper and clipboard went to each gas cylinder location to manually check the pressure regulator gauges and/or the weigh scale depending on the gas type. This process took about four hours each time or about eight labor-hours per day. By 2001, a bar code system was employed to identify each gas cylinder, but an employee was still required to manually read and record each data point, so the process was labor-intensive and error-prone.

In addition to monitoring gas levels manually, to further reduce risk of low or empty cylinders, gases were typically replaced on a regular schedule – which meant a given cylinder may be changed out even if it is a quarter or even a third full. Despite these

precautions, gas supply disruptions still periodically occurred due to unforeseen circumstances and were not discovered with the manual rounds (e.g. cold weather impacts which can condense a gas). Such disruptions often resulted in lost yield and process downtime, which translated into additional operational expense.

Altogether, these labor, gas, and downtime related expenditures, year after year, were continuing to add up and needed to be addressed to keep the fab competitive. Operations management sought new ways to better utilize manpower, ensure gases were expended before replacing bottles, and proactively detect situations which cause downtime.

Evaluation of Traditional Automation Solution

Micrel considered replacing manual gauges with all-new transducer based gas panels, which would automate the monitoring of gas levels. However, making this change would require Micrel to stop the affected production line for up to a few days or even weeks while it reconfigures gas piping and retests for leaks and safety. This can also involve a much larger rework of the entire wiring system to conform to the latest safety and fire codes when a legacy subsystem is significantly modified.

Micrel chose not to implement this solution due to the prohibitive cost of the equipment, the installation and rework labor, and most of all, the associated downtime and lost production, which altogether approached $4,000 per gas cylinder (or more than $400,000 to instrument 100 cylinders).

The Cypress Systems Solution

In 2007, Micrel learned of new Wireless Gauge Reader and Wireless Transducer Reader technologies that provide automated gas cylinder monitoring without the high cost and disruption of installing traditional transducer based panels. The Wireless Gauge Readers non-invasively "clip" onto the front of the legacy manual gauge, and transmit the reading wirelessly to a central server (Figure 2). Similarly, the Wireless Transducer Readers simply attach to existing gas weigh scales without the need to remove or replace the scale. Pre-set alarms of low gas levels may be programmed to alert operator stations, pagers, or cell phones.

Figure 2 – Non-Invasive Mounting for Wireless Gauge Reader

Micrel decided to implement the Cypress solution because it incurred no process downtime, required minimal installation labor and training, and did not need retesting and revalidation for leaks. The installed cost at $1,250 per point (or $125,000 to instrument 100 cylinders) is just 35% of the cost of traditional transducer panels (Figure 3).

Figure 3 – Comparison of Installed Cost per Point for Traditional Transducers vs. Wireless Gauge Reader

	Wireless Gauge Reader	Wired Transducer
Process Downtime (Est.)*	$0	$1,000
Transducer/Sensor	$1,200	$300
Installation/Wiring Labor, Materials, Design	$50	$1,500
Bring legacy system up to present day safety/fire codes (where applicable)	$0	$1,000
I/O Panel Termination	$0	$200
Total Cost (per point)	$1,250	$4,000

Benefits

In the fall of 2007, Micrel decided to install a mix of 100 Wireless Gauge Readers and Wireless Transducer Readers from Cypress Systems to monitor its most critical process gases, along with the Cypress Systems' Blue Box Receiver, which sends the data to Micrel's existing network and operator stations. Each data point required between 10 and 30 minutes to install, and did not involve breaking any pressure seals anywhere in the gas system or any process downtime. Additionally, future integration of the data with existing operator software is also possible via industry standard OPC and/or BACNet protocols. Within the first two months of operation, the following benefits were identified:

- Reduce the manpower devoted to making gas rounds by one full-time equivalent technician, who could then be redeployed to other tasks.
- Decrease gas consumption by approximately 10% annually, by using more gas in each cylinder before change-out.
- Minimize unplanned downtime. (e.g. the system detected loss of gas pressure/gas condensation due to unseasonably cold weather – situation which can now be anticipated and avoided in the future).

The combined operational savings are estimated to be in the range of $215,000 per year (Figure 4). The resulting investment payback period is only seven months (for $125,000 initial installed cost).

Figure 4 – Savings from Wireless Gauge Reader and Wireless Transducer Reader

	Annualized Savings
Labor Savings: One Full-time equivalent technician	$95,000
Gas Savings: 10% of gas usage	$80,000
Reduced Downtime: $5,000 per incident, avg. 8 per yr	$40,000
Total Savings per Year:	***$215,000***

Figure 5 – Payback Analysis for Wireless Gauge Reader and Wireless Transducer Reader

Cost per point for WGR's	$1,250
Number of Points installed	100
Total Cost of WGR System	$125,000
Payback period (based on annual savings of $260,000)	***7.0 Months***

About Cypress Systems Corporation:

Cypress Systems is a subsidiary of Cypress Semiconductor (NYSE: CY) with a mission to provide leading edge technologies to legacy buildings , with minimal cost and disruption. The company produces products and solutions to optimize energy and water use, improve uptime, reduce scrap, and lower maintenance costs.

Cypress Systems combines the latest technology knowhow from Cypress Semiconductor with our team's extensive industry and automation experience to deliver solutions with tangible savings.

For more information, please visit: http://www.cypress.com/systems or call (408) 943-2644.
For more information about Micrel, visit http://www.micrel.com