

## INTEGRATING THE DYCOR RGA WITH A CLUSTER TOOL

# Dycor Dymaxion; Dycor LC-D Residual Gas Analyzers

The Dycor Mass Spectrometer is a versatile instrument that can provide process engineers, as well as equipment and maintenance personnel in the semiconductor and other vacuum related process industries, with valuable information on the state of their process and vacuum equipment. Commonly referred to as a residual gas analyzer (RGA), the Dycor Dymaxion RGA, with System 2000 operating software (up to and including Windows 10), can be used for a myriad of applications and can be configured to match the process tool, and extent of automation, the user requires.

### EQUIPMENT MONITORING

The Dycor RGA can be used for equipment monitoring on multi-chamber process tools to reduce downtime after maintenance and return the tool to production. In this application, the RGA is used to qualify the tool by performing tests which verify the cleanliness (e.g. absence of residual materials such as photo resist), and vacuum integrity (whether the tool is leak tight) of the tool. This is accomplished through leak testing with helium as well as conducting pump-down and rate-of-rise tests. Finally, when the equipment is verified to be clean and at base pressure,

the RGA is used to “fingerprint” the vacuum state for future reference and comparison.

The Dymaxion RGA is installed on a multi-chamber tool for equipment monitoring (Figure 1). The RGA mounted to the transfer chamber is a 1-100 AMU range instrument with Faraday cup and electron multiplier detectors. It has an open ion source, which provides the most sensitivity for finding small air leaks when qualifying the tool for return to process after maintenance.

### PROCESS MONITORING

With semiconductor fabs manufacturing 300 mm wafers with feature sizes less than 0.25 microns, it is important to have real-time control of processes using RGAs for insitu measurements of gas species. The Dycor RGA can interface to a multi-chamber tool in several ways:

- **Direct interface of RGA to tool I/O**
- **Host PC controlling tool and RGAs**
- **RGAs integrated with tool using SECS/GEM protocol**

#### DIRECT INTERFACE OF RGA TO TOOL I/O

One method for interfacing the RGA to the tool is a direct connection from the tool I/O module to the optional Dymaxion I/O board in the sensor electronics unit.

This permits data from the RGA to be correlated with the production run data, as well as providing advanced alarm capabilities that protect the process from “out of specification” process events.

## INTEGRATING THE DYCOR RGA WITH A CLUSTER TOOL

**1. Pre-Run Qualification** – RGA analog scan indicates if there are any gas partial pressures that are out of specification, air leaks, or contaminants that would prevent the start of a run.

- Digital input from the tool to the RGA starts a full analog scan
- Digital output from the RGA to the tool indicates analog scan is complete and any alarm outputs from the RGA are now valid

**2. Stop Process Alarm** – During the process, if any gas partial pressures are out of specification, an alarm is activated to stop the process.

- Digital output from the RGA to the tool indicates an alarm condition (this could be due to an air leak, indicated by the ratio of the 28 to 32 peaks being 5:1)

**3. Operator Flagging** – During process, if any gas partial pressures are out of specification, an alarm is activated to flag an operator. The current run continues, but the next process is not started.

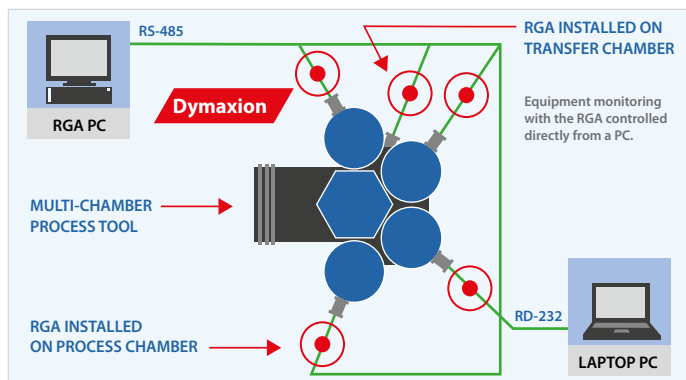
- Digital output from the RGA to the tool indicates an alarm condition. This may be due to an increase in hydrogen during the run, indicating the deterioration of the pumping speed of a cryopump that needs regenerating. The process can continue, but the pump should be regenerated prior to the next run.

### HOST PC CONTROLLING TOOL AND RGAs

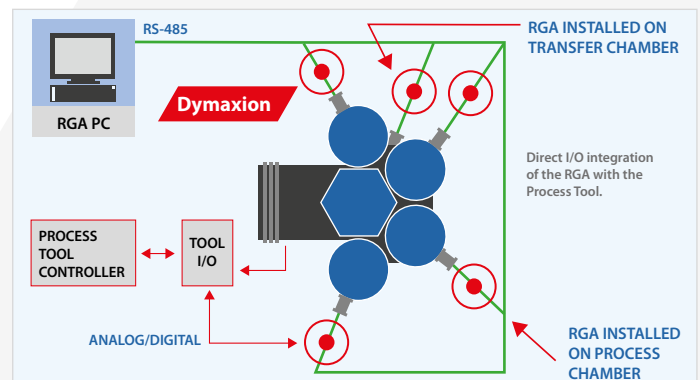
Another method for interfacing the RGA with the tool is by using a host PC running both the System 2000 operating software and a Windows-compatible control software package. The PC communicates with the RGAs by using either dynamic data exchange (DDE), or OPC automation, (Figure 3).

### RGAs INTEGRATED WITH TOOL USING SECS/GEM PROTOCOL

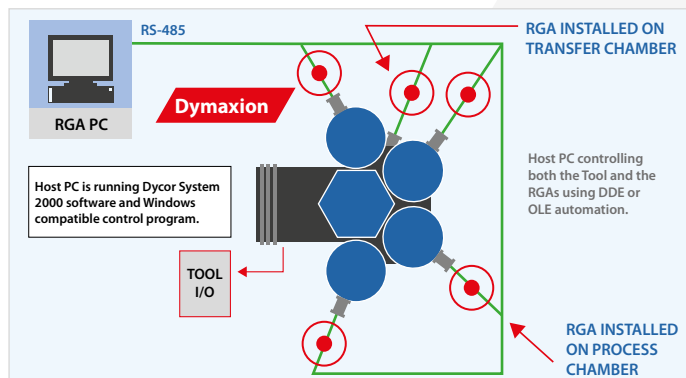
A Semi Equipment Communications Standard (SECS) or Generic Equipment Model (GEM) interface protocol may be used for communication between the tool controller and the RGA PC, (Figure 4).



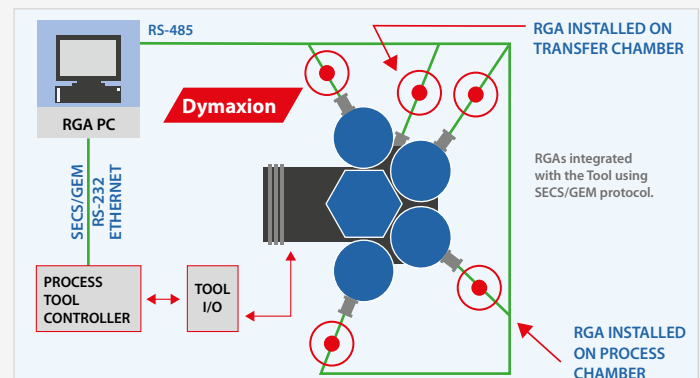
**Figure 1.** Multiple RGAs are controlled directly from a PC running System 2000 software. They are connected using a RS-485 loop. Any of the RGAs can be connected to a laptop for local control through the RS-232 port



**Figure 2.** Direct interface to a multi-chamber process tool – four RGAs on four different chambers are running simultaneously and are controlled from one PC. Each chamber is running independently from the others, with its own unique set of process requirements



**Figure 3.** Host PC controlling tool and RGAs



**Figure 4.** RGAs integrated with tool using SECS/GEM protocol

## NOTE

System 2000 software has advanced alarm capabilities to remedy the problem of false alarms shutting down a system. The user can set a count value, so the alarm limit must be exceeded a consecutive number of times before an alarm is triggered. This protects the system from short, transient events and noise spikes that can trigger false alarms. All the advantages of insitu gas analysis using an RGA will be lost, if the instrument shuts down the process because of false alarms due to transient events or noise spikes.

Utilizing the real-time calculation capability of System 2000, alarms can be set for ratios of two different gases, or other inputs, providing more system intelligence. For example, rather than using one gas partial pressure, such as oxygen (O<sub>2</sub>), to indicate an air leak, the ratio of nitrogen to O<sub>2</sub> may be a more reliable indicator. More protection from false alarms is provided by a master alarm feature which combines two or more individual alarms using Boolean logic.

## SUMMARY

There are currently no standards in place that can be used to integrate RGAs with semiconductor manufacturing tools. Each user must decide which method best serves their particular needs. In the future, RGA vendors must work more closely with manufacturers of process tools to develop more standard integration techniques.

AMETEK Process Instruments offers the flexibility and software capability to facilitate integration of the Dycor RGAs with the process tool using several integration techniques, each having their own advantages depending on the application.

### SALES, SERVICE & MANUFACTURING

#### USA - Pennsylvania

150 Freeport Road  
Pittsburgh PA 15238  
Tel: +1 412 828 9040  
Fax: +1 412 826 0399

#### USA - Delaware

455 Corporate Blvd.  
Newark DE 19702  
Tel: +1 302 456 4400  
Fax: +1 302 456 4444

#### Canada - Alberta

2876 Sunridge Way NE  
Calgary AB T1Y 7H9  
Tel: +1 403 235 8400  
Fax: +1 403 248 3550

### WORLDWIDE SALES AND SERVICE LOCATIONS

#### USA

Tel: +1 713 466 4900  
Fax: +1 713 849 1924

#### Brazil

Tel: +55 19 2107 4100

#### France

Tel: +33 1 30 68 89 20  
Fax: +33 1 30 68 89 99

#### Germany

Tel: +49 2159 9136 0  
Fax: +49 2159 9136 39

#### India

Tel: +91 80 6782 3200  
Fax: +91 80 6780 3232

#### Singapore

Tel: +65 6484 2388  
Fax: +65 6481 6588

#### China

Beijing  
Tel: +86 10 8526 2111  
Fax: +86 10 8526 2141  
Chengdu  
Tel: +86 28 8675 8111  
Fax: +86 28 8675 8141  
Shanghai  
Tel: +86 21 5868 5111  
Fax: +86 21 5866 0969



© 2018, by AMETEK, Inc. All rights reserved. Printed in the U.S.A. A-0236 Rev 6 (1018)  
One of a family of innovative process analyzer solutions from AMETEK Process Instruments. Specifications subject to change without notice.

