DELTA™ II Analog

DLT2B - 2 Zone Flow Ratio Controller

Enabling Process Optimization for Critical Deposition and Etch Processes

The DELTA™ II Flow Ratio Controller is a critical process control instrument in the MKS line of digital control, web-enabled products providing the latest in gas flow ratio measurement and control technology necessary to meet the demands of multi-channel flow distribution.

The DELTA II mass flow ratio controller divides and controls mixed process gas flows to either multiple chambers or zones within a process chamber at ratios specified by the user to maximize process uniformity and repeatability. The DELTA II flow ratio controller with its improved performance and more compact design is the second generation of MKS industry leading DELTA controllers enabling process gas flow ratio control.

Widely used in a variety of flow splitting applications such as etch, strip, and CVD, the DELTA II provides the user with the ability to distribute gas or gas mixtures to two different zones in a process chamber. Send the DELTA II a gas – or any mixture – and a ratio set point and the DELTA II will split the gas into two separate output channels automatically and precisely.

Product Features

- Wider dynamic ratio control range and faster gas flow response resulting in shorter process cycle time and increased throughput
- Embedded e-diagnostics increases tool uptime through reduction of "No Problem Found" product replacements
  - — Ability to check functionality without removing the controller
  - — Allows monitoring of performance parameters during operation
- Straightforward configuration and diagnostics through Ethernet interface
  - — Includes remote PC application
- Fewer components than dual MFC arrangements reducing critical I/O costs

Protected under one or more of the following U.S. patents: No. 6,418,954, No. 6,766,260, No. 7,007,007, US07621290B2 or International Patents and Patents pending.

Key Benefits

- Accurately and repeatably control flow ratio providing for better process optimization
- Digital control loop provides rapid response to channel set point independent of the gas mix
- Uses standard web browser – no special software required

Throughput and process control have always been critical to the semiconductor device manufacturer. With the advent of 300 mm wafers and dual process chambers, new methods of control gas flow distribution have become increasingly needed. 300 mm wafer processing often requires tunable control of gas distribution across the wafer to provide better process uniformity. Dual process chambers require proper gas distribution for chamber matching from single source gas panels.

The DELTA II flow ratio controller is the second generation of MKS DELTA controllers enabling process gas flow ratio control. The DELTA II has a wider dynamic ratio control range and faster development of chamber flow while being more adaptive to different tool and process conditions. MKS has developed a unique patent pending ratio control algorithm enabling ratio and flow response times of less than two (2) seconds (See Figure 1). This control algorithm also enables a twenty to one ratio control range, more than double its industry leading predecessor. The DELTA II maintains tight ratio control while input flow is changed (See Figure 2). All this in a more compact package with the additional features of web enabled setup and diagnostics.

The DELTA II's diagnostic feature allows the user to check the DELTA's performance in-situ, lowering costs through reduced removal of "No Problem Found" devices. This feature is enabled through a web browser utility accessed through the device's Ethernet port. This utility uses a standard web browser – no special software is required.

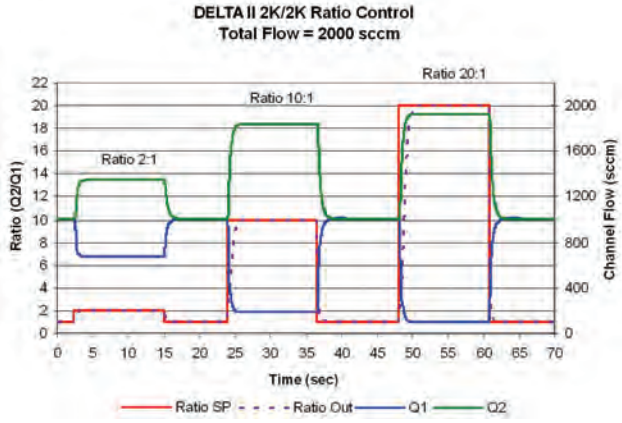


Figure 1 — Ratio Response
The DELTA II ratio controller has a dynamic ratio range of up to 20:1 with ratio response times under 2 seconds.

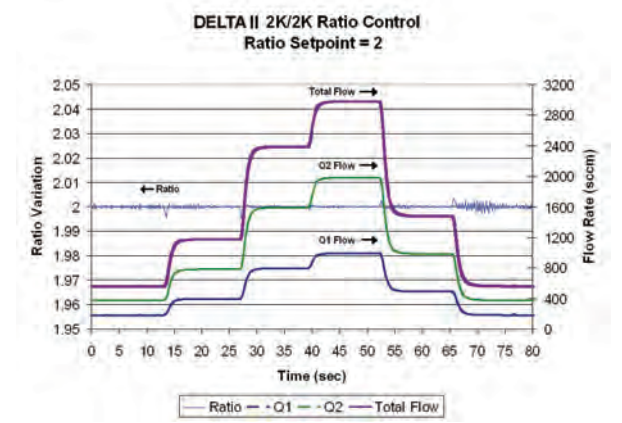
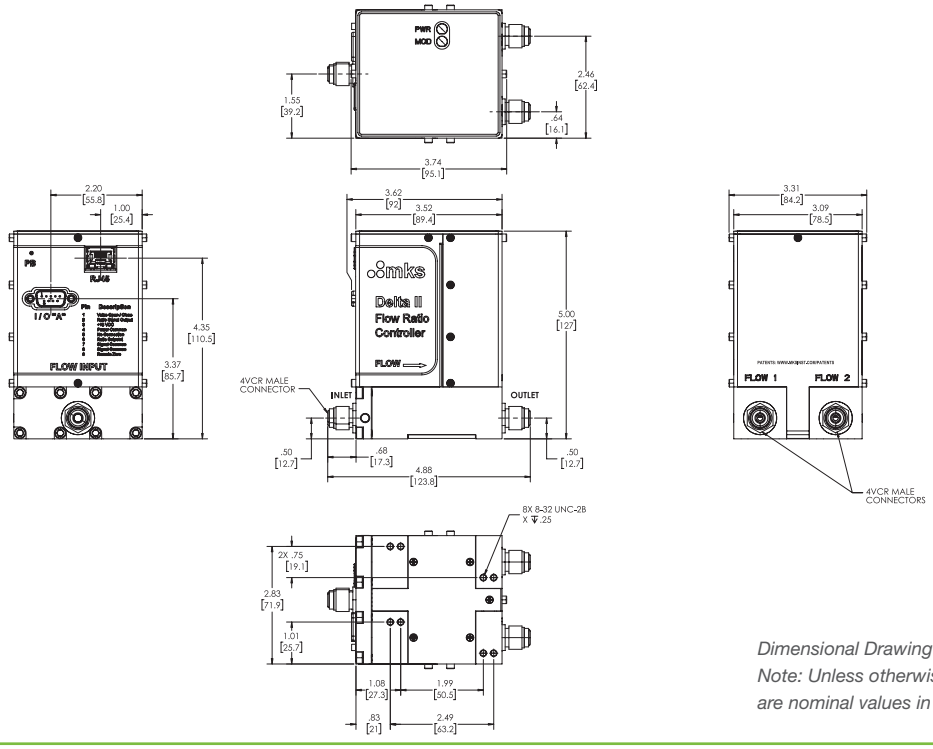


Figure 2 — Flow Response
The DELTA II ratio controller maintains ratio while input flow is changed.

Performance	
Full Scale Ranges (N_2 equivalent)	500/500 sccm; 1000/1000 sccm; 2000/2000 sccm; 3000/3000 sccm; 5000/5000 sccm 10000/10000 sccm
Maximum Operating Outlet Pressure[1]	200 Torr
Maximum Allowable Outlet Pressure Differential	50 Torr (between Q_1 and Q_2)
Normal Operating Pressure Differential (N_2)	<150 Torr (<450 Torr for 10000/10000)
Proof Pressure	1000 psig
Burst Pressure	1500 psig
Input Flow Range (N_2 equivalent)	5 to 100% of each channel Full Scale rating
Ratio Control Range	1:1 to 20:1 and 20:1 to 1:1
Ratio Accuracy (includes non-linearity, hysteresis, and non-repeatability)	±2% of ratio set point
Ratio Repeatability	0.3% of ratio set point
Resolution	0.02% of channel Full Scale
Temperature Coefficient (per channel) **Zero** **Span**	 • 0.05% Full Scale/°C • 0.08% Reading/°C
Ratio Settling Time	<2 seconds
Warm-Up Time	30 minutes
Normal Ambient Operating Temperature	10 to 60°C
Storage Temperature	-20 to 65°C
Storage Humidity	0 to 95% relative humidity, non-condensing
Temperature Accuracy	±2°C
Temperature Resolution	0.1°C
Mechanical	
Fittings **Inlet** **Outlet**	 • Swagelok® 4 VCR® • Male (non-rotatable) • Male (non-rotatable)
Leak Integrity **External (scc/sec He)** **Through Closed Valve**	 • $<1x10^{-10}$ • <2% of Channel Full Scale at 400 Torr differential
Wetted Materials	316 S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality); 316 S.S., Inconel®, KM-45, PTFE
Surface Finish	5 microinch average Ra
Weight	Less than 5 lbs. (2.3 kg)
Electrical	**Analog**
Connector	9 pin D male
Input Voltage	+15 to 24 VDC ±5%
Power Consumption	<9 Watts
Set Point and Output Signals	0 to 5 VDC or 0 to 10 VDC

[1] *The Delta II will operate with outlet pressures above 200 Torr. For device performance at higher pressures, consult factory.*

Ordering Code: DLT2B0231A1R110	Code	Configuration
Model		
DELTA II Flow Ratio Controller	DLT2B0	DLT2B0
Channel Full Scale Flow Ranges (Flow 2/Flow 1) (XX)		
500/500 1000/1000 2000/2000 3000/3000 5000/5000 10000/10000	52 13 23 33 53 14	23
Ratio (Flow 2: Flow 1) (Y)		
1:1	1	1
Connector (B)		
Analog - 9-pin Type "D" (MKS pinout)	A	A
Control I/O (C)		
0 to 5 VDC (analog devices) 0 to 10 VDC (analog devices)	1 2	1
Control Type (A)		
Ratio: Q_2/Q_1 or Q_1/Q_2 Percentage: $Q_2/(Q_1+Q_2)$ or $Q_1/(Q_1+Q_2)$	R P	R
Control Channel (Z)		
Q_1 Control: Q1/Q2 (Ratio) Q1/(Q2 + Q1) (Percentage) Q_2 Control: Q2/Q1 (Ratio) Q2/(Q2 + Q1) (Percentage)	1 2	1
Firmware (QQ)		
Firmware Revision (Unless otherwise specified, MKS will ship firmware revision current to date).	10	10



Dimensional Drawing
Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced).

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