Flow Solutions

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DELTA™ II EtherCAT®

DLT2B - FLOW RATIO CONTROLLER
PROCESS OPTIMIZATION THROUGH PRECISE FLOW RATIO CONTROL

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.

Features & Benefits

Improves Process Performance

- Wider dynamic ratio control range and faster gas flow response resulting in shorter process cycle time and increased throughput
- Accurately controls flow ratio providing for better process optimization and repeatability
- Digital control loop provides rapid response to set point independent of the gas mix
- 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

Easy to Integrate and Operate

- Straightforward configuration and diagnostics through Ethernet interface
  - — Uses standard web browser, no special software required
  - — Includes remote PC application

Reduces Costs and Complexity

- Fewer components than dual MFC arrangements reducing critical I/O costs
- Smaller footprint

Protected under one or more of the following U.S. patents: No. 6,668,642, No. 7,007,007, US07621290B2 or International Patents and Patents pending.

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 patented 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.

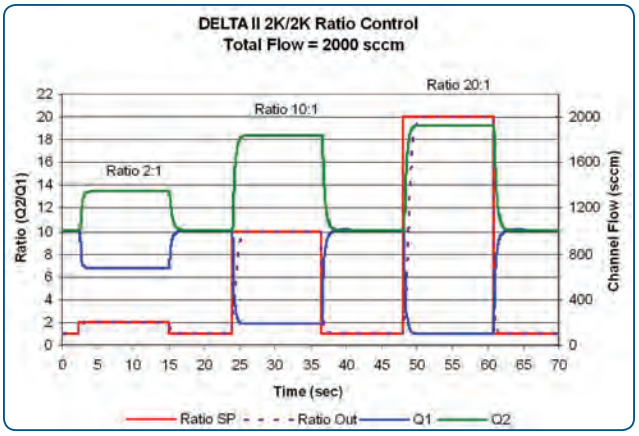


Figure 1 — Ratio Response

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

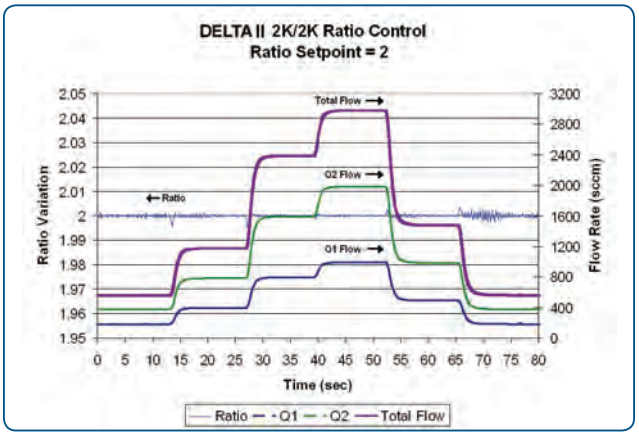


Figure 2 — Flow Response

The DELTA II ratio controller maintains ratio while input flow is changed.

Specifications

Performance

Full Scale Ranges (each channel) (nitrogen equivalent – Q)	500, 1000, 2000, 3000, 5000 and 10000 sccm
Percentage Accuracy[1]	±2% set point (for percent set points above 10%)
Channel Flow Control Range	0, 5 to 100% Full Scale
Input Ratio Range	1:1 to 20:1 and 20:1 to 1:1
Percentage Repeatability	±0.3% of set point
Resolution	0.02% of channel Full Scale
Maximum Operating Outlet Pressure	200 Torr at maximum flow rate through all channels
Maximum Allowable Outlet Pressure Differential (highest to lowest pressure channel)	50 Torr with the same percentage flow through all channels
Normal Operating Pressure Differential	<150 Torr (<450 Torr for 10000/10000)
Percentage Settling Time	<3 seconds (typical dependent on downstream conductance matching)
Maximum Inlet Pressure	150 psig (non-operational)
Temperature Coefficients	
Zero	<0.05% Full Scale/°C (500 ppm)
Span	<0.08% of Reading/°C (800 ppm)
Warm Up Time	60 minutes (minimum with device powered and at equilibrium with ambient)
Normal 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
Compliance[2]	CE

[1] Includes non-linearity, hysteresis, and non-repeatability.

[2] An overall metal braided, shielded cable, properly grounded at both ends, is required during use.

Mechanical

Fittings	Swagelok® 4 VCR®
Inlet	Male (non-rotatable)
Outlet	Male (non-rotatable)
Leak Integrity	
External (scc/sec He)	$<1x10^{-10}$
Through Closed Valve	< 2% of Channel F.S. at 400 Torr differential to < 1 Torr
Wetted Materials	316 S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality); 316 S.S., Inconel®, KM-45, PTFE, Hastelloy® (sensor tube only)
Surface Finish	5 microinch average Ra
Weight	Less than 5 lbs. (2.3 kg)

Electrical

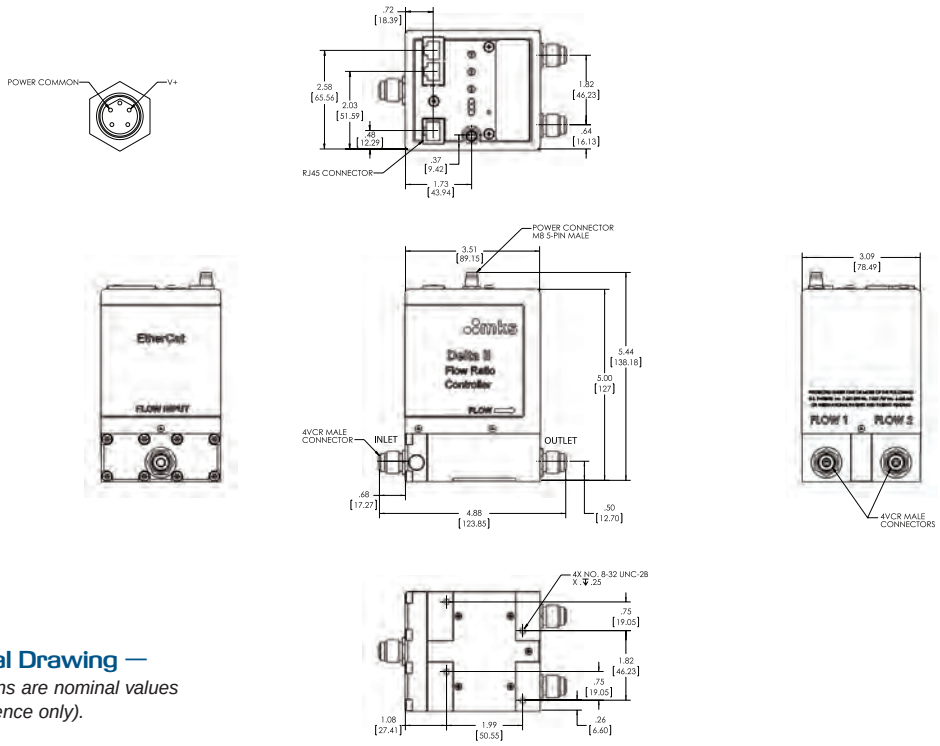
	EtherCAT®
Input Power Required	+24 VDC ±10% (10 Watts)
Connector	2 x RJ-45 (comm.) male, M8 male, 5 pin (power)
Data Rate Switch/Selection	No switch
Comm. Rate(s)	100 Mbps
MAC ID Switches/Addresses	3 switches, 16 positions
Network Size	Up to 4095 nodes
Visual Indicators	LED Power (green), LED Run (green), LED Error (red), LED Comm (green)

The MKS DELTA III Flow Ratio Controller shall not be used with any gas mixture which will react with each other as gas reactions are likely to affect the device flow measurements and may damage the device.

The MKS DELTA III Flow Ratio Controller uses thermal sensors which add heat energy to the gas (and gas mixture) which may cause the gas to decompose and a mixture to react. Please consult MKS Applications Engineering if this is a concern for the intended application of the device.

Ordering Information

Ordering Code Example: DLT2B052183R110	Code	Configuration
DELTA II Flow Ratio Controller	**DLT2B**	DLT2B
Reserved		
Reserved	0	0
Channel Flow Ranges (Flow 2/Flow 1) (XX)		
500/500	52	52
1000/1000	13	
2000/2000	23	
3000/3000	33	
5000/5000	53	
10000/10000	14	
For other ranges, consult factory.		
Ratio (Flow 2:Flow 1) (Y)		
1:1	1	1
Connector (B)		
EtherCAT	8	8
Control I/O (C)		
EtherCAT *(units must select 3)*	3	3
Control Type (A)		
Ratio: Q_2/Q_1 or Q_1/Q_2	R	R
Control Channel (Z)		
Q1 Control: Q_1/Q_2 or $Q_1/(Q_1+Q_2)$	1	1
Q2 Control: Q_2/Q_1 or $Q_2/(Q_1+Q_2)$	2	
Firmware (QQ)		
Firmware Revision	10	10
Unless otherwise specified, MKS will ship firmware revision current to date.		



Dimensional Drawing —

Note: Dimensions are nominal values in inches (reference only).

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