

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.

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. 6,668,642, 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 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.

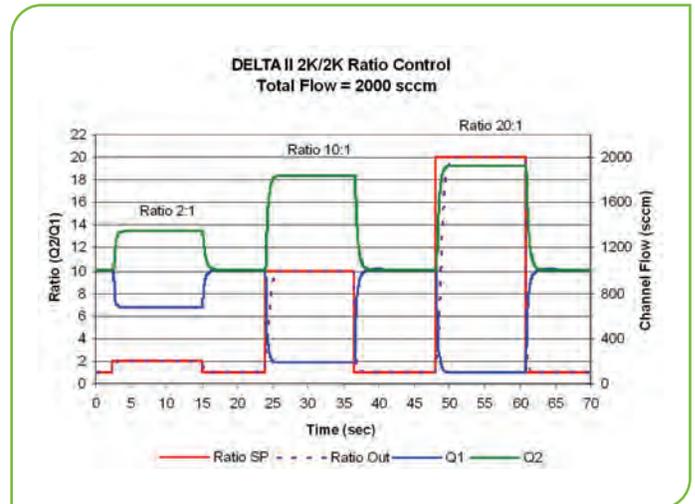


Figure 1 — Ratio Response
The DELTA II ratio controller has a dynamic ratio range of up to 20:1 with ratio response times under 2 seconds.

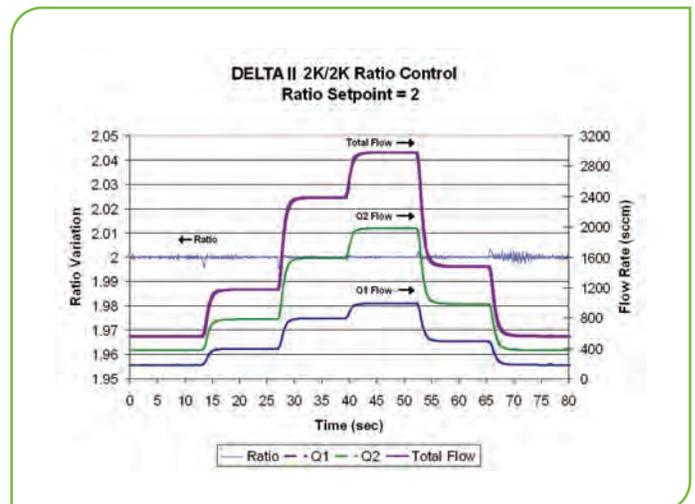


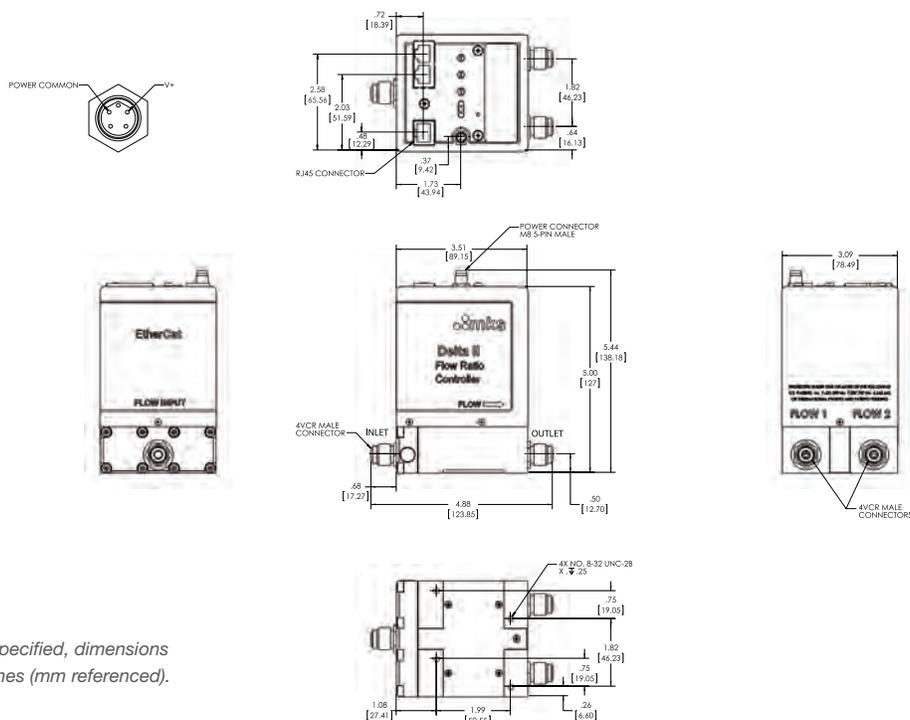
Figure 2 — Flow Response
The DELTA II ratio controller maintains ratio while input flow is changed.

Performance	
Full Scale Ranges (each channel nitrogen equivalent - Q)	500, 1000, 2000, 3000, 5000 and 10000 sccm
Ratio Accuracy (includes non-linearity, hysteresis, and non-repeatability)	±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
Ratio 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 (highest to lowest pressure channel)
Normal Operating Pressure Differential	<150 Torr (<450 Torr for 10000/10000)
Ratio Settling Time	<3 seconds (typical dependent on downstream conductance matching)
Maximum Inlet Pressure	150 psig (non-operational)
Temperature Coefficients	Zero Span <ul style="list-style-type: none"> • <0.05% Full Scale/°C (500 ppm) • <0.08% of Reading/°C (800 ppm)
Warmup Time	
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	CE (an overall metal braided, shielded cable, properly grounded at both ends, is required during use).
Mechanical	
Fittings	Inlet Outlet <ul style="list-style-type: none"> • Swagelok® 4 VCR® • Male (non-rotatable) • Male (non-rotatable)
Leak Integrity	External (scc/sec He) Through Closed Valve <ul style="list-style-type: none"> • <1x10⁻¹⁰ • < 2% of Channel Full Scale 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®
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 II 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 II 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 Code: DLT2B052183R110	Code	Configuration
Model		
DELTA II Flow Ratio Controller	DLT2B	DLT2B
Reserved		
Reserved	0	0
Channel Full Scale Flow Ranges (Flow 2/Flow 1)		
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)		
1:1	1	1
Connector		
EtherCAT	8	8
Control I/O		
EtherCAT (units must select 3)	3	3
Control Type		
Ratio: Q ₂ /Q ₁ or Q ₁ /Q ₂	R	R
Control Channel		
Q1 Control: Q ₁ /Q ₂	1	1
Q2 Control: Q ₂ /Q ₁	2	
Firmware		
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).