



GFC-S | Gas Flow Controller

PRECISE CONTROL. UNPARALLELED PERFORMANCE.

Pivotal Systems' GFC-S paves the way for the future of gas flow control. The GFC-S combines Pivotal's patented, high accuracy GFM system with patented control valve technology. As such, it leapfrogs the current MFC technology by offering an order of magnitude improvement on key flow metrics, thereby enabling advanced wafer-manufacturing processes. At Pivotal Systems, we aim to significantly enhance fab productivity and capital efficiency by utilizing our innovative solutions.

Benefits of GFC-S

- Highly accurate NIST-traceable measurements run-to-run
- Significantly reduces downtime
- Wide flow range from 0.5 to 100% of F.S.
- Industry's best flow accuracy for entire flow range
- Advanced flow monitoring/self-diagnosis

Key Features

- No calibration required
- Innovative control technology
- Unaffected by variations in the upstream or downstream pressure or temperature
- No fixed orifice



Pivotal Systems & GFC-S Introduction

About Pivotal Systems

Pivotal Systems Corporation provides best-in-class monitoring and process control technology for the semiconductor manufacturing and high-tech industries. Pivotal's vision is to enable an order of magnitude increase in fab productivity and capital efficiency for current and future technology nodes. This vision is achieved through its real time in-situ process monitoring and control solutions. Founded in 2004 and based in Fremont, California, the company is led by veterans from the semiconductor and high-tech industries. For more information about Pivotal Systems, visit www.pivotalsys.com or send an email to info@pivotalsys.com.

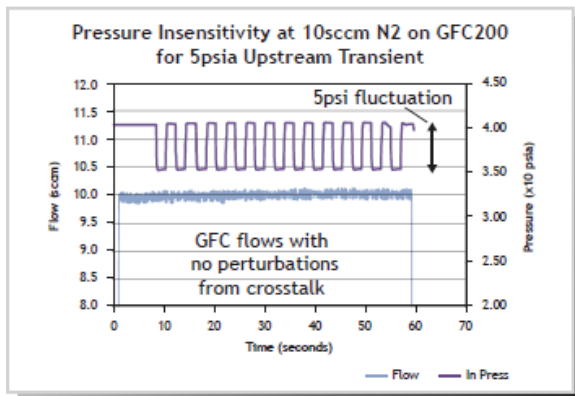
Introduction

As process geometries within the semiconductor industry continue to shrink to 2 nm and beyond, the need for highly accurate, responsive, and repeatable gas flow control during wafer processing is essential. Pivotal Systems' GFC-S paves the way for the future of gas flow control. The GFC-S combines a pressure rate-of-drop measurement with patented control valve technology. As such, it leapfrogs the current MFC technology by offering an order of magnitude improvement on key flow metrics, thereby enabling advanced wafer-manufacturing processes.

Feature Description

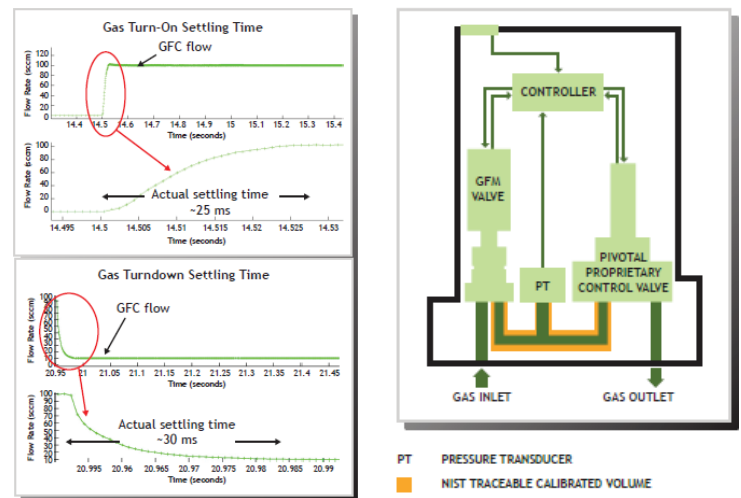
Pressure and Temperature

The unique design of the Pivotal valves results in the GFC-S being unaffected by variations in the upstream or downstream pressure or temperature. High-precision sensors monitor the gas pressure and temperature every millisecond and the control scheme accounts for any variations.



Settling Time

The GFC-S offers best-in-class settling times for flow controllers by providing settling times below 100 ms for both the gas turn-on and gas turndown. Refer to the following graphics.



Automated Calibration and In-Situ Diagnostics

The GFC-S executes a robust calibration sequence on every run. This feature, unique to the Pivotal GFC-S, results in highly accurate NIST-traceable measurements run-to-run and reduces downtime significantly.

GFC-S Specifications (GFC5™, GFC20™, GFC200™, GFC1000™, GFC2000™)

Performance	Flow Range (N ₂ Equivalent)	0.025 – 3,000* sccm (5 part numbers to cover this range), 0.5–100% F.S.
	Flow Accuracy	±0.5% of setpoint for actual gas: for 0.5% to 100% Bin F.S. 0.025 – 5 sccm (GFC5), 0.1 – 20 sccm (GFC20), 1 – 200 sccm (GFC200), 5 – 1,000 sccm (GFC1000), 10 – 3,000* sccm (GFC2000)
	Repeatability	±0.2% of setpoint for 0.5%–100% Bin F.S.
	Settling Time	10% – 100% Bin F.S. ≤ 100 ms, 0.5% – 10% Bin F.S. ≤ 300 ms**
	Leak Integrity	≤ 1E-9 atm-cc/sec (He)
	Leak By Rate	<0.05% F.S. 0.0025 sccm (GFC5), 0.01 sccm (GFC20), 0.1 sccm (GFC200), 0.5 sccm (GFC1000), 1.0 sccm (GFC2000)
Operating Conditions	Supply Pressure	Standard: 100 – 300kPaG (14.5 – 43.5 psig) Low pressure gases: BCl ₃ , C ₂ H ₃ F ₃ , C ₃ F ₆ , C ₃ H ₁₀ Si (TMS), C ₃ H ₂ F ₆ , C ₃ H ₈ O, C ₄ F ₆ , C ₄ F ₆ -q, C ₄ F ₈ , C ₄ F ₈ -i, C ₄ H ₁₀ , C ₄ H ₁₀ -i, C ₄ H ₂ F ₆ , C ₄ H ₉ F, C ₅ F ₈ , CF ₃ I, ClF ₃ , SiCl ₄ , SiH ₂ Cl ₂ , and WF ₆ . The inlet pressure can be as low as -81 kPaG (-11.7 psig) Refer to the gas bin table for the specific ranges.
	Downstream Pressure	Vacuum to 53 kPa (0 – 400 Torr), Vacuum for LP application
	Proof Pressure	2.07 MPaG (300 psig)
	Design Pressure (Burst Pressure)	2.65 MPaG (385 psig)
	Operating Temperature	Standard: 15–50°C, High Temperature Version: 15–70°C
Materials	Wetted Surface Finish	5 µin Ra, Semi F19 compliant
	Wetted Surface Material	SUS 316L UHP, Semi F20 compliant Hastelloy C276 Option-PCTFE in valve seat
	Seals	Metal
Electrical	ECAT	24 VDC
	DeviceNet	11 – 24 VDC, 5 W
	Analog* and RS-485	±15 VDC, 150 mA
	In-Rush Current	<200 mA

* Please see gas table for inlet pressure and gas requirements for flow rates greater than 2000 sccm

** There is a setpoint hold-time of 60 milliseconds during Analog control. This time is in addition to the reported settling time of this device. When running using Analog control, the GFC-S has a minimum setpoint sensitivity of ±50mV. The flow accuracy is unaffected. The measured setpoint and corresponding flow feedback may be different from the commanded setpoint by up to that amount. Analog calibration is recommended to align device input to the controller output.

GFC-S Product Description Codes

Code	Description	Option	Option Description
I	Base Model	GFC	Gas Flow Controller
II	Special Application	XX	Standard Application
		XT	High Temp GFC-S (70°C)
		LP	Low Pressure Gases*
		LT	Low Pressure Gases* & High Temp GFC-S (70°C)
III	Configurability	C	Multi-gas Standard Bins
		X	Gas Configured
IV	Gas or Standard Bins	XXXX XXXX	Specific Semi Gas Code and Range
		PS00-005C	Pivotal Systems Standard Bin 00 0.025-5 sccm N ₂ **
		PS01-020C	Pivotal Systems Standard Bin 01 0.1-20 sccm N ₂ **
		PS02-200C	Pivotal Systems Standard Bin 02 21-200 sccm N ₂ **
		PS03-001L	Pivotal Systems Standard Bin 03 201-1000 sccm N ₂ **
		PS04-002L	Pivotal Systems Standard Bin 04 1001-3000 sccm N ₂ **
V	Fitting & Body Width	01	1/4" VCR fitting, 1.125"
		02	C-Seal 1.125"
		03	W-Seal 1.125"
		04	C-Seal 1.125" with Poke Yoke
		05	W-Seal 1.5"
		06	1/4" VCR fitting, 1.125", PCTFE valve seats
		07	C-Seal 1.125", PCTFE valve seats
		08	W-Seal 1.125", PCTFE valve seats
		09	1/4" VCR fitting, 1.125", PCTFE in GFM valve seat only
		10	C-Seal 1.125", PCTFE in GFM valve seat only
		11	W-Seal 1.125", PCTFE in GFM valve seat only
		18	C-Seal 1.125", PCTFE in GFM valve seat only with Poka Yoke
		19	C-Seal 1.125", PCTFE valve seats with Poka Yoke
VI	Valve Configuration	C	Normally Closed
VII	Downstream Condition	V	Vacuum
		A	Atmospheric - This option can be used for all gases except low pressure gases. Inlet pressure must be ≥60 psia

* Required for low pressure gases C₃F₈, C₄H₈F, SiH₂Cl₂, C₃H₁₀Si, C₃H₂F₆, C₃F₈, ClF₃, SiCl₄, BCl₃, C₄F₈, C₄F₈-q, C₄F₈, WF₆.

** Not applicable when selecting Special Application LP (low pressure gases).

Note: If other configurations are required, please contact your sale representative.

GFC-S Product Description Codes

Code	Description	Option	Option Description											
VIII	Communication Options	Option	I/O	Connector	Power on State	Full Scale Setting	Full Scale Setting	Full Scale Setting	Poll I/O Instance Producer	Poll I/O Instance Consumer	Poll I/O State Transition	SP Delay in ms	External Baud Rate	Mac ID
		DA	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	2	7	Executing	0	500KB	63
		DB	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	7	Executing	0	500KB	63
		DD	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	21	8	Executing	0	500KB	63
		DF	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	7	Executing	0	500KB	63
		DG	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	3	7	Executing	0	500KB	63
		DI	DeviceNet	5 Pin Micro	Idle	SCCM	Float	6000h	14	19	Executing	0	500KB	63
		DJ	DeviceNet	5 Pin Micro	Idle	SCCM	Float	6000h	23	20	Executing	0	500KB	63
		DO	DeviceNet	5 Pin Micro	Idle	Count	Integer	6000h	22	8	Executing	0	500KB	63
		DQ	DeviceNet	5 Pin Micro	Idle	Count	Integer	7FFFh	1	8	Executing	0	500KB	63
		EA	EtherCAT	Comm: RJ45 Pwr: 5 pin Nano	INIT	NA	NA	NA	NA	NA	NA	NA	NA	0
		Analog DB9 Pin-Out												
		Option	I/O	Connector	Valve Override	Flow Feedback	Power Supply +	Power Supply Common	Power Supply -	Flow Setpoint	Signal Ground	RS 485 +	RS 485 -	Test Point
		AA	Analog	9-pin D	1	2	3	4	5	6	7	8	9	NA
		AB	Analog	9-pin D	1	2	3	4	5	6	7, 8	NA	NA	9
		AC	Analog	20-pin Honda	14	3	4	2	16	11	12	8	9	NA
		AD	Analog	20-pin Honda	14	3	4	2	16	5	12	8	9	NA
		AG	Analog	Card Edge-RJ11	J	3	4	2	F	A	B+C+IO	3, 4	2, 3	NA
		AH	Analog	DB9 to DB15	NA	NA	7	5	5	8	NA	NA	NA	NA
		AK	Analog	20-pin Honda	1	2	3	4	5	6	7, 8	NA	NA	NA
		AL	Analog	Card Edge	NA	3	4	2	F	A	B+C	NA	NA	NA
		AM	Analog	Card Edge - Purge Enabled	D	3	4	2	F	A	B+C	NA	NA	NA
		RA	RS-485	9-Pin D	NA	NA	3	4	5	NA	NA	8	9	NA
		RB	RS-485	9-Pin D	NA	NA	3	4	5	NA	NA	8	9	NA
		RC	RS-485	9-Pin D, RJ45	NA	NA	D3	D4	D5	NA	R1,2	R5	R4	NA
		RD	RS-485	9-Pin D										
		RE	RS-485	9-Pin D										
IX	Special Request	XXXX	Customer Special Request Number											
		-O113	Extended max. FS setting for Ar, N ₂ , F ₂ , N ₂ O, O ₂ , and 20%F ₂ in Ar mix at 3000 sccm on GFC2000. Inlet pressure range: 35.3 psig - 43.5 psig.											
		-O126	Allow higher max flow for following gases when at least 35.3 psig of inlet pressure is used: C ₂ F ₆ , CF ₄ , CH ₂ F ₂ , CH ₃ F, CHF ₃ , Cl ₂ , COS, COS-s, and SF ₆ .											

Sample Standard Application Model Code								
I	II	III	IV	V	VI	VII	VIII	IX
GFC	XX	X	PS02-200C	O1	C	V	AB	XXXX

Sample Blank Model Code								
I	II	III	IV	V	VI	VII	VIII	IX
GFC	XX	C	PS02-200C	O2	C	V	RA	XXXX

Sample Low Pressure Application Model Code								
I	II	III	IV	V	VI	VII	VIII	IX
GFC	LP	C	PS02-200C	O2	C	V	EA	XXXX

The Future of Flow Control is Now.

A decorative horizontal line with a wavy, undulating pattern. The top half of the line is orange, and the bottom half is a dark green color.