

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *MKS Instruments 260MF-1* at our website: *Click HERE*

MKS INSTRUMENTS, INC.

WARRANTY

for Type 260 Series Equipment

MKS Instruments, Inc. (**MKS**) warrants that the equipment described in the face of this warranty (the "equipment") manufactured by **MKS** shall be free from defects in materials and workmanship for a period of one year from date of shipment. For the period commencing with the date of shipment of this equipment and ending one year later, **MKS** will, at its option, either repair or replace any part which is defective in materials or workmanship without charge to the purchaser. The foregoing shall constitute the exclusive and sole remedy of the purchaser for any breach by **MKS** of this warranty.

The purchaser, before returning any equipment covered by this warranty, which is asserted to be defective by the purchaser, shall make specific written arrangements with respect to the responsibility for shipping the equipment and handling and other incidental charges with the **MKS** sales representative or distributor from which the equipment was purchased or, in the case of a direct purchase from **MKS**, with the **MKS** home office in Andover, Massachusetts, U.S.A.

This warranty does not apply to any equipment which has not been used in accordance with the specifications recommended by **MKS** for the proper and normal use of the equipment. **MKS** shall not be liable under any circumstances for consequential or incidental damages in connection with, or arising out of, the sale, performance, or use of the equipment covered by this warranty.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES BY **MKS**, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTY AGAINST INFRINGEMENT OF ANY PATENT.

3-93 106571-P1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

106571-P1
REV J, 8/93

MKS Type 260 Series
Modular Control System

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Copyright © 1993 by MKS Instruments, Inc.

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, except as may be expressly permitted in writing by MKS Instruments, Inc.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

260 CONTROL SYSTEM

TABLE OF CONTENTS

260 CONTROLLER

SECTION I	DESCRIPTION	I-1
SECTION II	SPECIFICATIONS	II-1
SECTION III	CONTROLS AND INDICATORS	III-1
	3.1 Front Panel Controls	III-1
	Figures 301 and 301	III-2
	3.2 Inside Controls	III-3
	3.3 Internal Switches	III-4
	Figures 303 and 304	III-5
	3.4 Rear Panel Connector	III-6
SECTION IV	INSTALLATION AND OPERATION	IV-1
	4.1 Please Read	IV-1
	4.2 Inspection	IV-1
	4.3 Mounting	IV-1
	4.4 System Design	IV-1
	4.5 Interconnections	IV-3
	4.6 Initial Set-up	IV-3
	Figures 401 and 402	IV-4
	4.7 Controller Tuning	IV-5
	Figure 403	IV-6
	4.8 Bias Control	IV-5
	4.9 Manual	IV-7
	4.10 Pressure Transducer	IV-8
	4.11 Valves	IV-9
	4.12 Flow Meters	IV-9
	4.13 Normal/Reverse Switch	IV-10
	4.14 Proportional Gain	IV-10
	4.15 Converting to Master and Slave	IV-11
SECTION V	THEORY OF OPERATION	V-1
SECTION VI	TROUBLESHOOTING	VI-1
SECTION VII	PARTS LIST AND SCHEMATICS	VII-1
SECTION VIII	ALIGNMENT PROCEDURE	VIII-1
	Table 1 Gauge Factors	VIII-4
	Table 2 Gas Corrections	VIII-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table of Contents
(Continued)

260 PS-1 POWER SUPPLY

Description	X-1
Schematic 260PS-1	X-2
Schematic 260PS-2	X-3

261/262 DISPLAY MODULES

Description	XI-1
Specifications	XI-1
Controls	XI-2
Figure 101	XI-3
Operation	XI-4
Tables 11 and 12	XI-5
261/262 P.C. Layout	XI-6
261/262 Schematic	XI-7

263 FLOW RATE SUMMER (TOTALIZER)

Description	XII-1
Cable Diagram	XII-2
Schematic	XII-3
P.C. Assembly	XII-4

264 MULTI-CHANNEL DISPLAY

Description	XIII-1
Schematic	XIII-2
P.C. Assembly	XIII-3

265 3 SET POINT SELECTOR

Description	XIV-1
Connections	XIV-2
Schematic	XIV-4
P.C. Assembly	XIV-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

260 CONTROLLER

SECTION I

GENERAL DESCRIPTION

The Type 260 Controller will accept an input signal from a pressure transducer and control either solenoid or Piezoelectric control valves to accurately maintain a set pressure or accept an input from a variety of flow transducers to provide closed-loop flow control in conjunction with the above control valves.

External signals can command the external set point, close the valve or switch to the manual control. Front panel controls allow the operator to zero the input (pressure or flow transducer), turn the controller ON or OFF, and change the set point. Internal accessible controls allow selection of input range, control loop tuning and manual valve control.

Front panel LED indicators show the level of valve drive signal, process limit status, and override (if the controller is off).

Two or more 260 controllers can be combined to provide multi-gas ratio control.

Pressure control is accomplished by continuously admitting the correct gas flow to a vacuum system to compensate for gas being removed by pumps or other gas removal mechanisms.

Typically, the pressure control system will consist of three basic parts: (1) the pressure sensor, (2) the controller and control valve, and (3) the system whose pressure is to be controlled. The pressure sensor will usually be an MKS Baratron® Capacitance Manometer whose output is 0-10VDC. Provision for other outputs (0-1VDC or 0-100mv) has been built into the controller so that other transducers may be used. The pressure (vacuum) system will consist of a chamber and a pumping system. Usually the user will wish to control the pressure of the chamber by the admission of a known gas through the control valve while the chamber is being pumped. In other systems, the chamber pressure may be controlled with one controller while a known mass flow is admitted with the aid of a laminar flow element and its separate controller.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The 260 controller will take the DC pressure signal, compare it to the set point, and position the valve in such a fashion as to drive the actual pressure to the set point pressure. The controller contains the three modes of control action found in most industrial controllers today: proportional plus derivative plus integral. Briefly, these functions are as follows:

1. Proportional gives a valve action (position) that is instantaneously a linear function of the error signal i.e.,

   Signal to valve = K_1 x Error (K_1 is adjustable by gain pot)

2. Derivative action provides a signal to the valve that is proportional to the rate of change of the error signal (up to some max) i.e.,

   $$\text{Signal to valve} = K_1 \times \frac{d\,(\text{Error})}{dt}$$

   A simple description of this mode of control is that it provides and anticipation element or the valve reaches its proper steady state position sooner than without derivative. This is easily seen when setting up a system in that this derivative or phase lead control tailors the under or overshoot; or said still another way, it cancels out the lags built into the vacuum system.

3. Integral action provides an additional valve signal which is proportional to the length of time that an error signal exists i.e.,

   $$\text{Valve Signal} = \int d\,(\text{Error})\,dt$$

   Stated another way, as time passes, the valve position will be changed to reduce the error signal to zero. The 260 controller has the integral and proportional control adjustment combined in one front panel pot, called GAIN.

   In addition to these classic controller modes, the 260 also has two functions (manual and bias) which allow the process to reach its final value quicker and maintain control stability even in the presence of large delays and/or transients.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION II

SPECIFICATIONS

Input Signal		0 to 10 VDC or 0 to 1 VDC or 0 to 0.1 VDC Switch selectable inside (200K input impedance)
Input Power	-	+15V and -15V (±2V) 100ma required for controller If solenoid valve is used another 100ma will be required
Ext. Set Point	-	0 to 5 VDC (100K load impedance) (0 to 1 VDC can be selected (40K load impedance))
Ext. Commands	-	OFF and MANUAL
Regulation	-	±0.25% of full scale (when using front panel control)
Repeatability	-	±0.1% of full scale
Temperature	-	0-40°C (32-104°F)
Display Output	-	0 to 1 volt
Valve Outputs	-	Current - 0 to 120MA for solenoid valves (Type 248, 148, etc.)
	-	Voltage - 0 to 105VDC for piezolelectric valves (Veeco and Max Tek)
Process Limit Output	1. Relay Closure -	Contacts are CLOSED when process is within limits. Contacts are OPEN when power is lost or process is outside limits.
	2. Logic Signal -	High (≈5V) when process is within limits. Low (≈0V) when process is outside limits.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION III

CONTROLS AND INDICATORS

3.1 FRONT PANEL (See Figure 301)

1. ZERO - Potentiometer which allows offsetting any initial zero errors in the transducer. With zero pressure (or flow) on the transducer, adjust the zero pot for zero reading on the display output.

2. ON - Indicates when controller is applying signal to the output (either control valve or other controllers). The intensity is indicative of the level of the output.

3. DEVIATION - Indicates when process is within process limit. Process limit is determined inside. See 3.2.4. Indicator is green when process is within limits and red when process is outside limits.

4. OVERRIDE - Indicates when controller is being commanded for other than automatic operation. Front panel switch in OFF or external OFF commands will light this LED.

5. SET POINT - The set point is the operator's input to the controller. The dial represents the fraction of the full scale range of the pressure (flow) transducer. The set point is set to the desired pressure (or flow) and the controller will maintain that pressure while in AUTO. For example, if the full scale pressure is 10^4 1 torr and the set point is set for .432 (32 indicated on the dial) then the controller will maintain a pressure of 432 microns.

6. OFF/AUTO - This turns the controller on. In OFF, all valve output signals are zero. In AUTO, the controller drives the output (usually a valve) according to the error signal and the PHASE and GAIN controls. The front panel switch MUST BE IN AUTO for the external control to be operative. If the front panel switch is in OFF, the controller will be off!

7. Thumbscrew to hold controller in rack.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

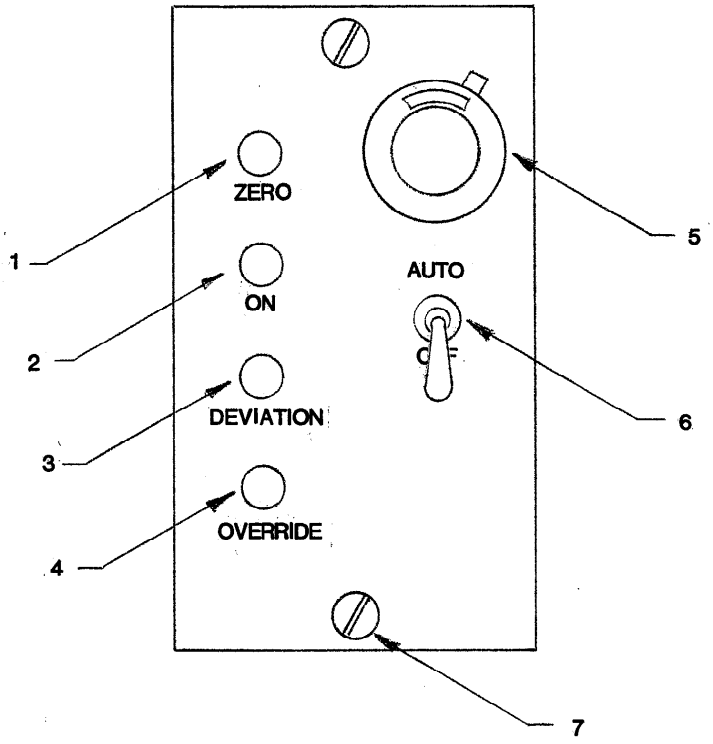


FIGURE 301

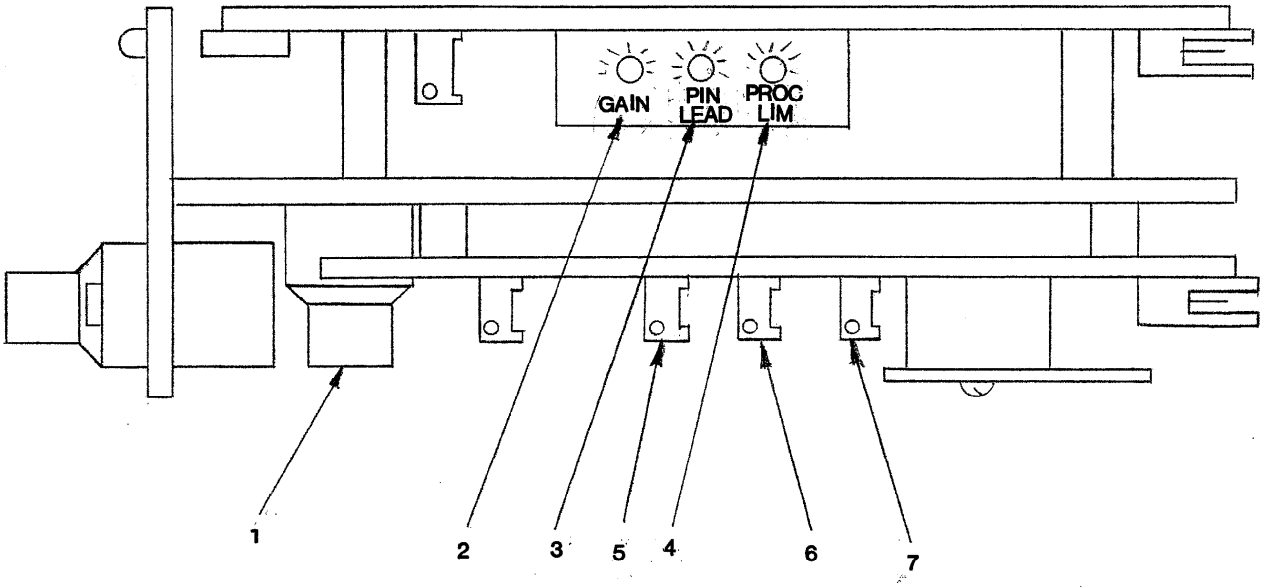


FIGURE 302

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2 INSIDE CONTROLS (See Figure 302)

The inside controls are reached by unscrewing the two front panel thumbscrews and sliding the controller out approximately 6 inches.

1. GAUGE FACTOR

   This controls the gain of the input amplifier so the controller and display output are in standard units (torr, sccm, etc.). Gas correction is also put into the gauge factor. See Table 1 at the rear of the controller portion of this manual for the proper setting of this control.

2. GAIN

   The GAIN setting determines the overall gain of the control loop and should be as high as possible without making the system unstable. The higher the gain, the smaller the dead band. See Section 4.7 for information on controller tuning.

3. PHASE LEAD

   The Phase Lead control allows the operator to compensate for the major lag in the control system. In pressure systems this lag is generally caused by the restrictions in the pumping line and the capacity of the pressure vessel. In flow systems, the lag is generally the time constant of the flow transducer.

   Too low a setting will cause overshoot; too high a setting well cause slow response. See Section 4.7 for information on controller tuning.

4. PROCESS LIMIT

   This control sets a band about the set point within which "in control" signals are produced (green LED on front panel, digital high output and closed relay contacts). Outside this band "out of control" signals are produced (red LED, digital low output and open relay contacts).

   The Process Limit is usually set at ±10% when shipped.

   The control calibration is in % of full scale.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. PROPORTIONAL GAIN

Proportional Gain determines the maximum gain of the integrator. Normally it is set fully CCW for minimum gain. See operating instructions Section 4.14 for further adjustment.

6. BIAS

The bias control adjusts the minimum voltage or current applied to the valve in the AUTO mode. Proper adjustment of the bias will improve the settling time at initial turn-on, reduce undershooting during oscillations or large changes in flow, and in some cases stop large oscillations. See "Operation" Section 4.8 for adjustment procedure.

Note that when a controller is used as a "Master Controller" for other controllers, the initial bias setting should be off (fully CCW).

7. MANUAL

The Manual control allows the operator to control the output signal directly without being effected by set point settings, process variables, etc. Since the Manual mode is not normally supplied in the 260 controllers, the manual controls primary function is to speed up the settling time during initial turn-on.

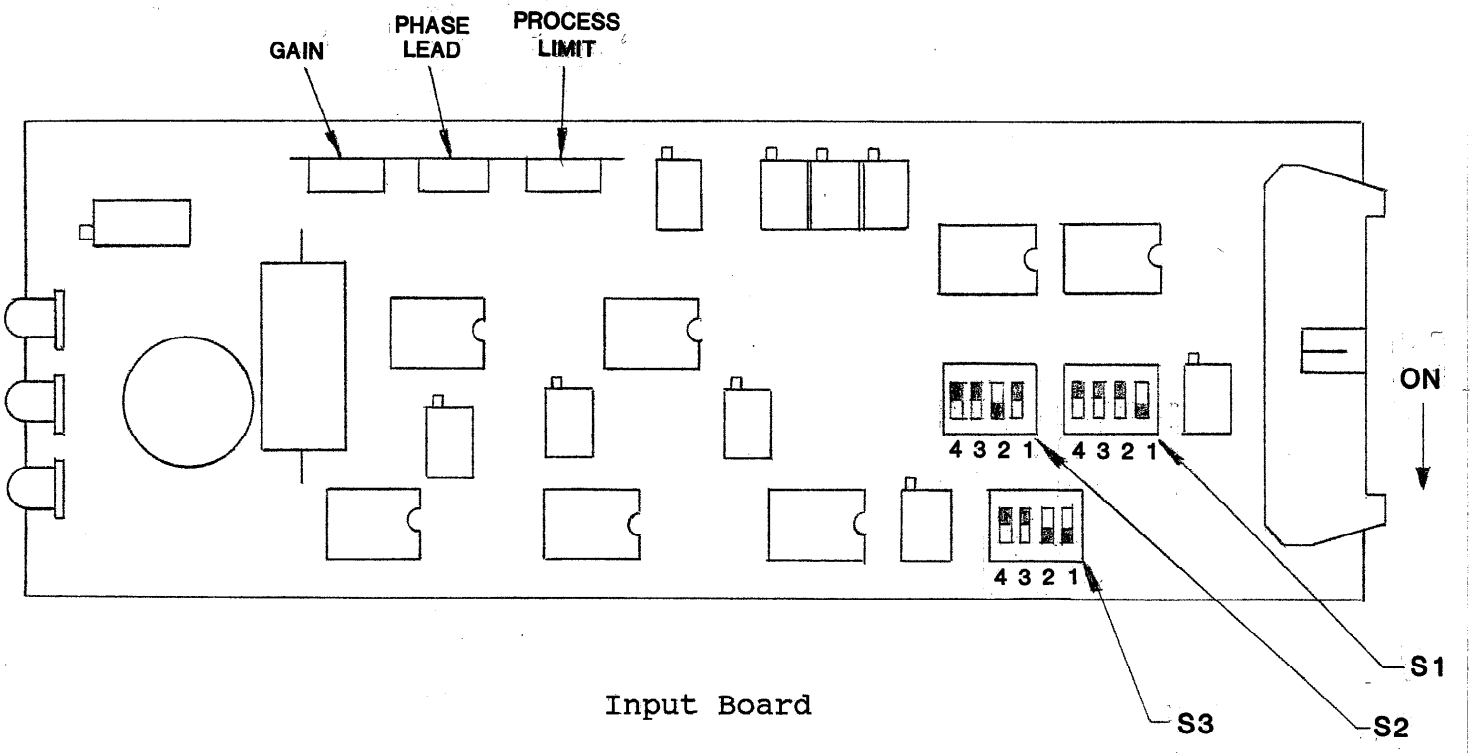
In "Master" controllers used in ratio systems, the Manual control is set for nominal output (generally 5V) at the controller output terminal.

3.3 INTERNAL SWITCHES (See Figure 303)

Internal switches are used to program the input range, external set point range and mode. These switches are located on the Input P.C. Board which is the board with the GAIN, PHASE LEAD and PROCESS LIMIT controls. There are three switches (S1, S2, S3), each of which has four poles (1, 2, 3, 4).

NOTE that on all three switches, ON IS down!!!

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



Input Board

FIGURE 303

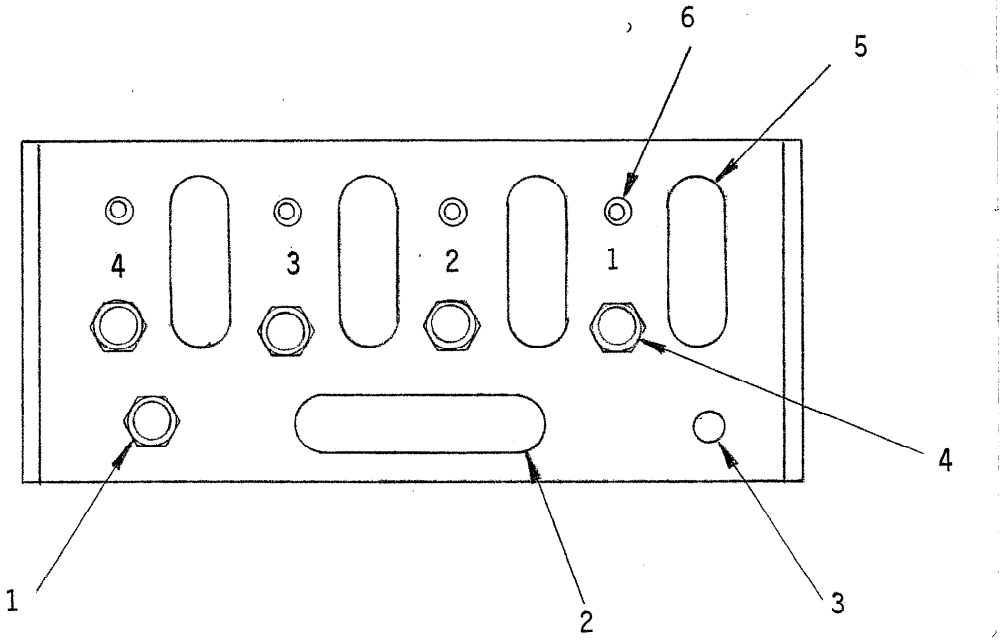


FIGURE 304

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

o = ON (Down)
x = OFF (Up)
No indication = Does not matter

Application	S1 Poles 1 2 3 4	S2 Poles 1 2 3 4	S3 Poles 1 2 3 4
Input Signal = 10 to 1.1v	o x x		
= 1 to 0.11v	x o x		
= 0.1V or less	x x o		
Set Point = Internal *	x	x o	
= Ext. (Ratio) *	x	o x	
= Ext. (Direct) *	o	x x	
= 5V F.S. *		x x	
= 1V F.S. *		o o	
Controller Operation			
= Normal			o o x x
= Reverse			x x o o

* NOTES:

1. Internal and Ext. (Ratio) settings utilize front panel dial for desired set point.
2. Ext. (Direct) setting bypasses front panel dial (leave dial at 10.0).
3. Slave channels should be set for 5V F.S. set point.

3.4 REAR PANEL CONNECTORS (See Figure 304)

1. POWER INPUT connector accepts ±15 VDC for distribution to the various controller or display modules and to the input transducers. Pin assignments are:

A - No Connection

B - Power Gnd

D - +15V

E - -15V

H - Chassis

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. INTERFACE connector(s) provides access to the miscellaneous outputs and inputs. Pin assignments are:

1.	Ch.1 ext. set point (+)	19.	Ext. set point (-)
2.	Ch.2 ext. set point (+)	20.	Power Gnd.
3.	Ch.3 ext. set point (+)	21.	Ch.1 Display out
4.	Ch.4 ext. set point (+)	22.	Ch.2 Display out
5.	Spare	23.	Ch.3 Display out
6.	Ch.1 Controller output	24.	Ch.4 Display out
7.	Ch.2 Controller output	25.	Spare
8.	Ch.1 Process Limit Digital out	26.	Ch.1 Relay N.O.
9.	Ch.2 Process Limit Digital out	27.	Ch.2 Relay N.O.
10.	Ch.3 Process Limit Digital out	28.	Ch.3 Relay N.O.
11.	Ch.4 Process Limit Digital out	29.	Ch.4 Relay N.O.
12.	Spare	30.	Spare
13.	Ch.1 OFF	31.	Ch.1 Relay Comm.
14.	Ch.2 OFF	32.	Ch.2 Relay Comm.
15.	Ch.3 OFF	33.	Ch.3 Relay Comm.
16.	Ch.4 OFF	34.	Ch.4 Relay Comm.
17.	Spare	35.	Spare
18.	Digital Gnd.	36.	Chassis

The listing above applies for the single INTERFACE connector on a half-rack main frame (MF-1) and for Channels 1 through 4 on a full rack main frame (MF-2).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The MF-2 also contains a second INTERFACE connector and its pin assignments are:

1.	Ch.5 ext. set point (+)	19.	Ext. set point (-)
2.	Ch.6 ext. set point (+)	20.	Power Gnd.
3.	Ch.7 ext. set point (+)	21.	Ch.5 Display out
4.	Ch.8 ext. set point (+)	22.	Ch.6 Display out
5.	Ch.9 ext. set point (+)	23.	Ch.7 Display out
6.	Ch.5 Controller Output	24.	Ch.8 Display out
7.	Ch.6 Controller Output	25.	Ch.9 Display out
8.	Ch.5 Process Limit Digital out	26.	Ch.5 Relay N.O.
9.	Ch.6 Process Limit Digital out	27.	Ch.6 Relay N.O.
10.	Ch.7 Process Limit Digital out	28.	Ch.7 Relay N.O.
11.	Ch.8 Process Limit Digital out	29.	Ch.8 Relay N.O.
12.	Ch.9 Process Limit Digital out	30.	Ch.9 Relay N.O.
13.	Ch.5 OFF	31.	Ch.5 Relay N.O.
14.	Ch.6 OFF	32.	Ch.6 Relay N.O.
15.	Ch.7 OFF	33.	Ch.7 Relay N.O.
16.	Ch.8 OFF	34.	Ch.8 Relay N.O.
17.	Ch.9 OFF	35.	Ch.9 Relay Comm.
18.	Digital Gnd.	36.	Chassis

3. POWER OUTPUT connector provides ± 15V to additional modules modules. Pin assignments are the same as the Power Input connector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. VALVE connectors provide output to the various valves. Different pins on the connector are used for different types of valves. The connections are:

A	-	Voltage (+)	For Piezoelectric
B	-	Voltage Low (Chassis)	type valves
C	-	Current (+)	For Solenoid
D	-	Current (Low)	type valves
E	-	Chassis	
F	-	Spare	
H	-	Spare	

5. INPUT connectors provide ±15V power to the input transducer and accepts the input signal. Pin assignments are:

1.	(+) input	8.	(-) input (connect to pin 12 at input source)
2.	Spare	9.	Spare
3.	Spare	10.	Spare
4.	Spare	11.	+15V output
5.	Spare	12.	Power Supply Gnd.
6.	Spare	13.	-15V output
7.	Spare	14.	Chassis

6. DISPLAY connectors serve as OUTPUTS for a controller module and INPUTS for display modules. Full scale signal is 1 volt.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION IV
INSTALLATION AND OPERATION

4.1 PLEASE READ AND UNDERSTAND ALL INSTRUCTIONS BEFORE OPERATING INSTRUMENT.

4.2 INSPECTION AFTER SHIPMENT

Reasonable care has been taken to pack the 260 in a manner such that it will reach you in perfect operating condition; however, you should check for dents, cracks or broken controls and connectors to be sure that it has not been damaged in shipping. If you find any damage, notify your carrier and MKS immediately.

4.3 MOUNTING

The 260 controller is intended to be mounted in a slide-in main frame; either half rack (MF-1) or full rack (MF-2). While the unit is designed and tested to be operated with no air circulation, it will run cooler if the top and bottom air slots are clear to allow convection air circulation. No special precautions are needed to protect the unit from ordinary mechanical shock or vibration.

4.4 SYSTEM DESIGN

There are several considerations that must be dealt with before initial operation.

4.4.1 The correct valve must be selected to allow reasonably fast time response. For example: given a system whose pumping speed is 150 liters/sec and volume is 100 liters, the pump down time constant will be 0.7 seconds. If you wish to control at 100μ or 0.1 torr, and furthermore wish to have an up T.C. = to down T.C. (in the practical case, which will rarely happen), then the quantity of gas that the pump is able to draw out at this pressure is 150 liters/sec x 100μ or 15000μ L/sec.

Converting this to sccm,

throughput = 1184 sccm

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Now, if we choose the 100 sccm valve, we would never get up to 100μ because the pump would be slightly faster than the valve (at 100μ), the valve would go wide open and the pressure would drop to the point where the valve throughput would equal the pump's throughput (somewhat less than 100μ pressure). We could do two things which would make the system work. The first and proper course of action (which maintains the systems' natural fast response) is to select a larger valve (5000 sccm), which on the upswing of pressure will swamp out the pump's T.C. The new T.C. will be the response T.C. of the pressure sensor to valve combination which happens to be Pin 50msec.

If overshoot is experienced, the down T.C. will be a combination of the pump and chamber T.C modified by the controllers T.C. as the control point is approached. Basically, if a large valve is selected, the speed of up control will be a function of the controller's speed and the down will be a function of the pump's speed.

The other course of action open to us is to reduce the pumping speed, but this approach (usually realized by partially closing a valve) slows down the entire system.

4.4.2 The second consideration which is related to the first is the range of pressures over which the system will work. We recommend that this be limited to 100 to 1 although we have controlled pressures five decades apart with a single valve.

4.4.3 A third consideration is one involved with removing RC networks (time constant networks or lag networks) that if built into a system will make stabilization impossible. The simplest one that can occur is to allow the 270 indicator switch to be placed in the Slow position (time constant = 400ms). It must be in the Normal position (40ms). The 270 should be in Normal (40Ms) or Fast (1ms) positions. Lag may be introduced pneumatically in two areas: the tubing to the sensor and the tubing to the valve. <u>BOTH TUBING RUNS MUST BE LESS THAN 6 INCHES LONG AND NO LESS THAN ¼ INCH IN DIAMETER</u>. Be very careful that fittings do not introduce extra lags (internal small drilled passages). Other lag networks such as antichambers off the main vacuum chamber will also cause problems and must be kept to a minimum. One advantage of this 260 system is that lags that are significantly larger in the main vacuum system will have only a slight affect upon the time stability response.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.4.4 One important consideration that will cause much grief to someone new to control in the vacuum industry is a peculiarity of all diffusion pumps, namely choking (jet breakdown). If too much gas is introduced at too high a pressure, the pumping speed changes radically and erratically. This behavior is easily recognized by lack of stability at control point and pneumatic noise making control sometimes impossible. Closing down the inlet to the pump is the only solution.

NOTE: Diffusion pumps should never be operated at inlet pressures above which the "top jet" will experience a pressure in excess of 5 x 10_{-4} torr.

4.5 INTERCONNECTIONS

Figure 401 and 402 show typical piping and cable interconnection diagrams. Figure 401 shows the usual setup for standard pressure control. The pressure transducer can be one of a number of units. See Section 4.9. The valve can be one of four types. See Section 4.10.

Figure 402 shows a two gas Ratio configuration with one controller as the Master. Pipe in valve and sensor using short connections with minimum restrictions. Six inches should be maximum ½" tubing. Never reduce the tubing size below that of the valve and transducer.

Connect the valve and transducer to the back of the controller and place the controller OFF.

4.6 INITIAL SET-UP

BEFORE TURNING ON THE POWER check Table 1 to verify that the GAUGE FACTOR is set properly. If a 261 or 262 display module is connected, its decimal point selection should be verified. ALSO MAKE PRELIMINARY SETTINGS as follows:

GAIN - - - - - - - - - - - - - - -	10%
PHASE LEAD - FLOW CONTROLLER -	3 2ecs
PRESSURE OR RATIO CONTROLLER -	5 secs
PROCESS LIMIT - - - - - - - - - -	10%

Plug in the power cord, turn on power. Allow the system to warm-up for at least 30 minutes. Turn off all valves and pump the vacuum system down. When the chamber pressure is less than the resolution of the transducer, zero the controller by adjusting ZERO for zero reading on the display.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PRESSURE CONTROL

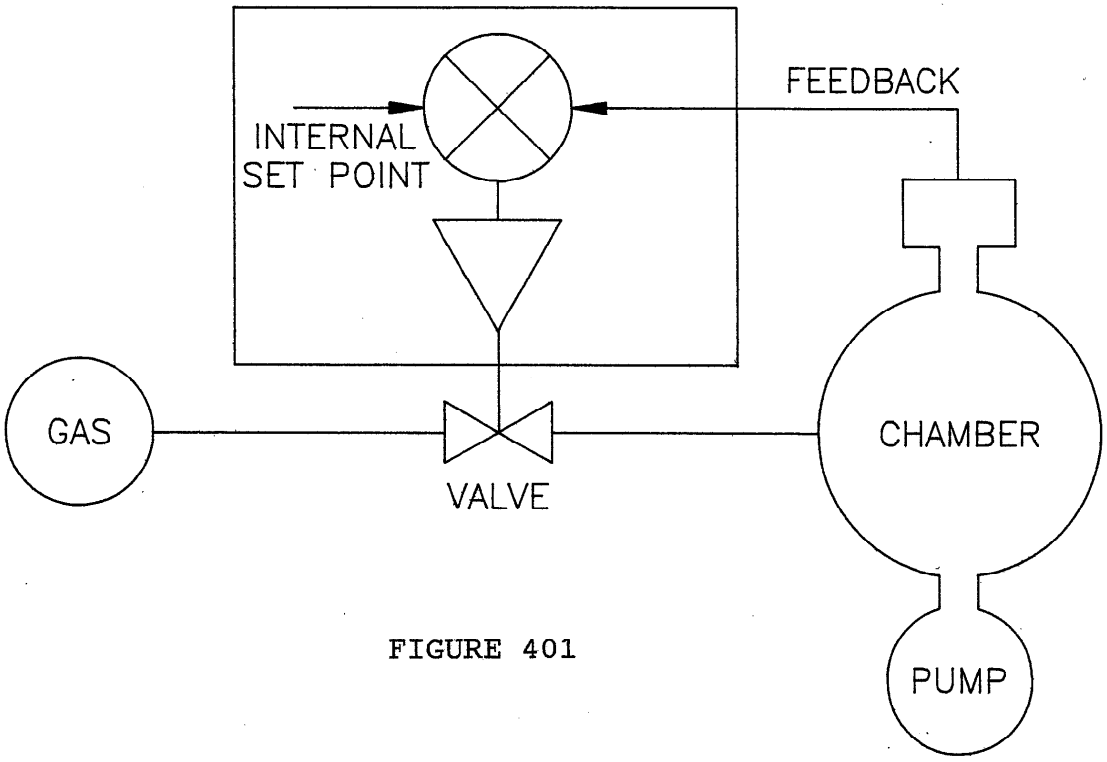


FIGURE 401

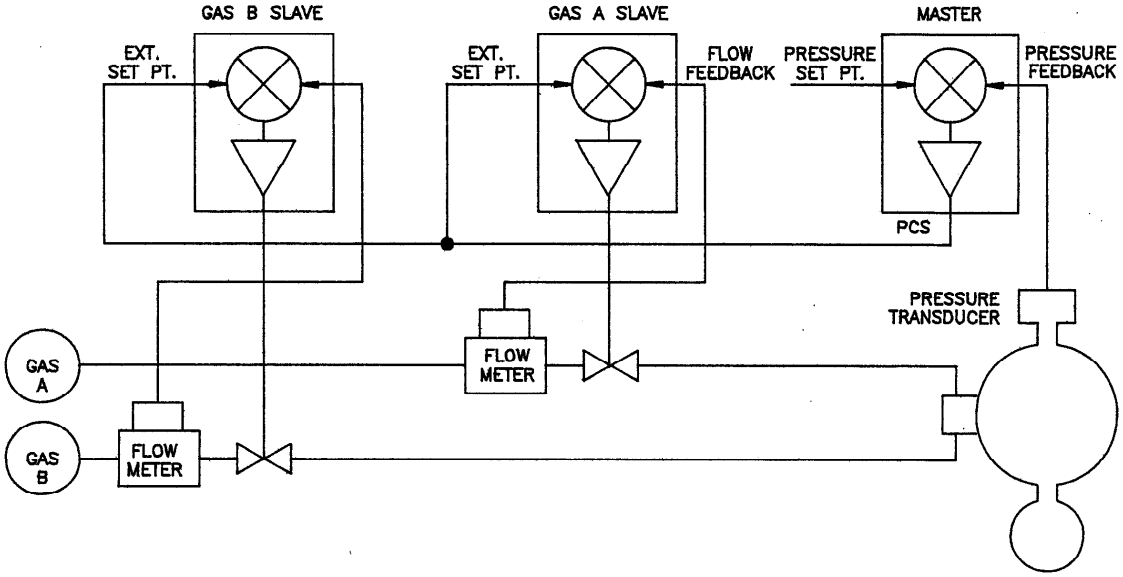


FIGURE 402

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Note, temperature-controlled transducers, such as the 390/270 need about four hours to completely stabilize. Also, if a 270 is used, the 270 zero control can be used for zeroing and the RESPONSE switch should be in the Normal position.

Turn on the gas source.

4.7 CONTROLLER TUNING

Turning the front panel switch to AUTO puts the controller into action. To tune the controller, turn the GAIN up until 0.1% oscillations are apparent. Minimize oscillation amplitude using PHASE LEAD settings. When oscillations cease, turn up GAIN and readjust PHASE LEAD if necessary. Check settings by changing the Set point control. Optimum response is for the pressure (flow) to move quickly to its final value, but with no overshoot. If the pressure (flow) oscillates the gain is too high and should be reduced. (The gain MAY be increased later when the PHASE LEAD is properly adjusted.) If the flow overshoots, but settles to the proper value, more PHASE LEAD is required. If the flow is slow rising to the proper value, less PHASE LEAD is required. If the flow settles at a steady value which is other than the set point flow, (greater than ±0.25% error) more GAIN is needed.

When making final adjustments, move the controls less than 10° to prevent overcontrolling. Various pressures may require different settings of GAIN and PHASE LEAD although pressures of up to a decade apart may be controlled using the same settings. Speed will be sacrificed for lower pressures.

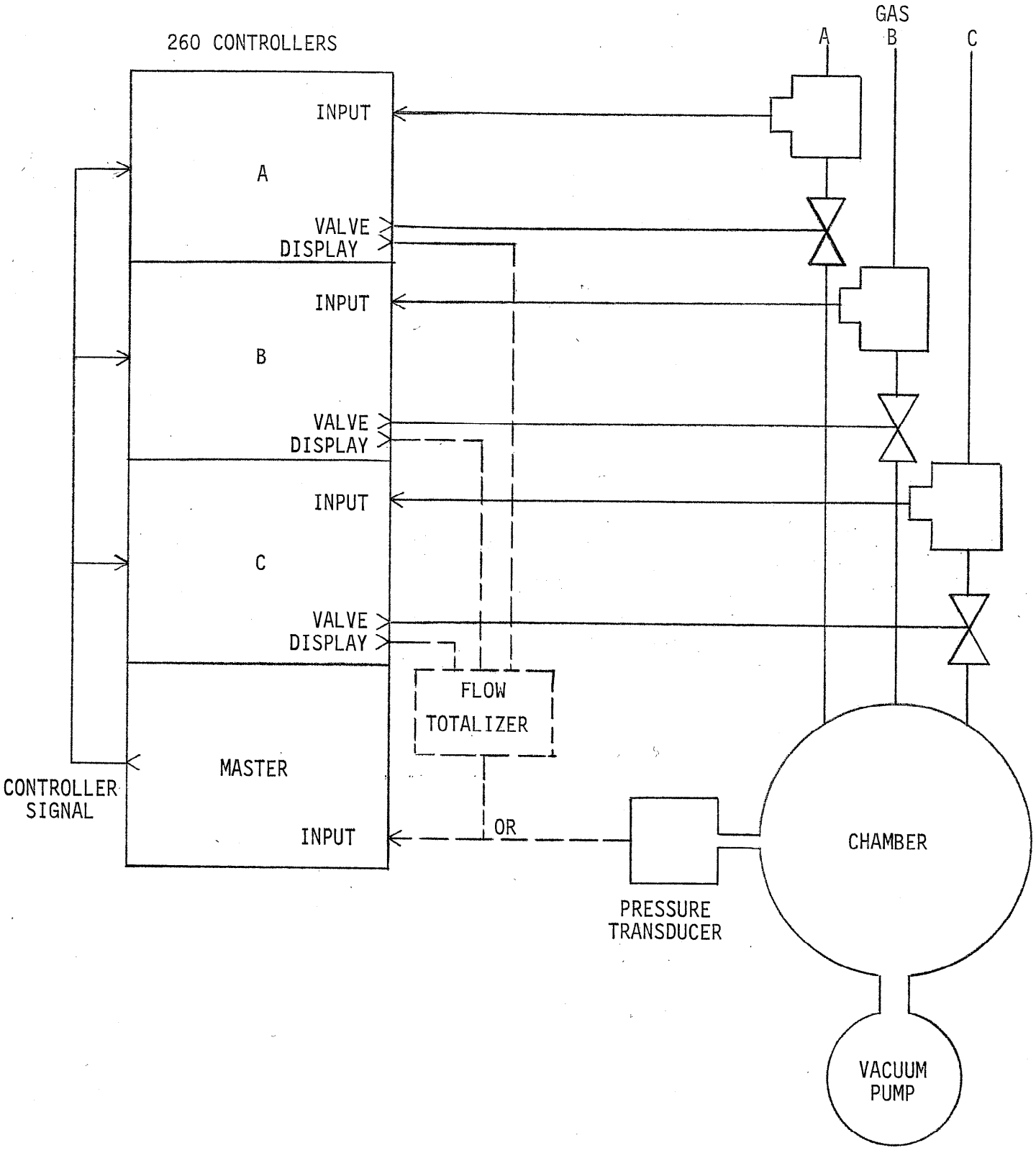
4.8 BIAS CONTROL

The purpose of the BIAS control is to establish a floor or minimum signal level to the valve which prevents the integrator from "winding-up" or going too far into saturation. The signal to the valve consists of the bias level plus the controller signal. In AUTO, the controller portion of the signal is determined by the error signal and the GAIN and PHASE LEAD controls.

It is important for good control, particularly during pressure transients, that the BIAS be set as high as possible. The factory bias adjustment is for 35% of output.

If the CONTROLLER CANNOT TURN THE VALVE COMPLETELY OFF, it may be due to the BIAS being set TOO HIGH.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



Pressure or Total Flow Control with 3 Gas Ratio

FIGURE 403

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If the bias control needs adjustment, do the following:

1. Turn Set point control to zero, turn the MANUAL control 25 turns CCW.

2. Turn controller OFF and check that there is no flow and the system can be pumped to zero pressure (flow).

3. Turn the controller to AUTO and there should still be no flow.

4. If there is flow, turn the BIAS control CCW until the flow stops and then two more turns CCW.

4.9 MANUAL

The MANUAL control works in cooperation with the BIAS control to provide fast start-up and quick stabilization at the set point level.

IF FAST START-UP IS NOT IMPORTANT the MANUAL can be left off, 25 turns CCW.

If fast start-up is important, tune the GAIN and PHASE LEAD controls as described in 4.7. Adjust the BIAS as described in 4.8. Then watch the response during turn-on. Then turn the MANUAL six (6) turns CW and observe the response again. Continue adding six turns to the manual control and observe the response until the quickest possible turn-on is achieved. Note that "quickest" in some large pressure vessels may be many seconds.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.10 PRESSURE TRANSDUCERS

Any pressure transducer which delivers at least 0.1 volt full scale can be used as the feedback element for total pressure control. A number of possibilities and the proper interconnecting cables are listed below:

Transducer	Recommended Pressure Ranges Available Torr	Interconnecting Cable	Output Voltage F.S. Volts
390/270	1,10,100,1000	CB250-6	10
220 or 220B	1,10,100,1000	CB254-10	10
220A	1,10,100,1000	CB254-4	10
221	10,100,1000	CB254-1	10
122	10,100,1000	CB254-2	10
127	1,10,100,1000	CB255-1	10
Any Sensor PDR-C-1B Readout	Determined by Sensor (as above)	CB254-12	10
Any Sensor with PDR Readout	Determined by Sensor (as above)	CB254-17	10

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.11 VALVES

The control valve can be any one of those listed below. The valve type can be changed at any time as long as the proper cable is used.

Type of Valve	Mfg'r	Mfg'g Part No.	MKS Part No.	Flow Range (sccm)	Inter-connecting Cable (or Connector)
Solenoid	MKS	248A	248A	0-100 to 0-50,000	CB251
All Metal Solenoid	MKS	148A	148A	0-100 to 0-10,000	CB251
Piezo-electric	Veeco	PV-10	170M-49	0-200	CB048
Piezo-electric	Max Tek	MV-112	249	0-500	CB260-2

4.12 FLOWMETERS

The best flow meter for the 260 system is the Type 258.

Transducer	Supply Required	F.S. Signal	Flow Range Sccm	Inter-connecting Cable
MKS	± 15V	5V	0-100 to 0-30,000	CB 258-1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.13 NORMAL/REVERSE SWITCH

Most applications will require that when the pressure (or flow is greater than the set point, the valve should have less drive to return the process to the proper value. This is "normal" operation and assumes that the output of the pressure (or flow) transducer increases positively for increasing pressure (or flow).

Reverse operations should be used if either (A) the pressure (or flow) transducer output decreases for increasing pressure (or flow) or (B) the valve drive signal should increase when the pressure (or flow) is greater than the set point (such as exhaust control).

4.14 PROPORTIONAL GAIN

Some (very few) control loops require additional gain so that provided by the normal GAIN control. An inside control on the output board labeled PRO. GAIN provides this additional gain. This control is normally off (fully CCW) but can be added in by turning it CW. This control is a 22-turn trimmer and the adjustment is not critical. A normal first step would be to turn it 12 turns CW and then try tuning the control loop with the PHASE LEAD and GAIN controls.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

260 CONTROLLERS

CONVERTING 260 CONTROLLERS TO MASTER AND SLAVES

4.15 The 260 controllers are configured as Independent controllers as they are shipped from the factory. However any 260 controller can also be configured as a Master or as a Slave controller.

DEFINITIONS

Independent

An independent controller is normally used to drive a valve. The front panel set point determines the control value and it operates off an internal reference voltage. The controller can still be turned off by externally shorting the "CLOSE" line.

Master

A Master controller does not drive a valve but its output voltage (PCS) (0 to 10 volts) is used as the external set-point for other controllers (Slaves). The input signal to a Master would be a pressure signal if total pressure control is desired or a total flow signal if total flow control is being used.

Slave

A Slave controller drives a valve and gets its set point from an external source. Typically the Slave is controlling flow.

MODIFICATIONS

Master

Pull the controller that is to be designated as the master part way out of the main frame and turn off the power. (Note that the Master controller should be in either Channel 1 or 2.) There are two wires which connect the front panel switch (AUTO/OFF) to the output board. Move the wire which is connected to the CLOSE terminal on the P.C. Board to the MANUAL terminal on the P.C. Board. Turn on the power and turn the BIAS control fully CCW (it may take as many as 25 times). Put the front panel switch in OFF and adjust the Manual pot (in the output board) for 5.0 volts at the controller output (labeled "PCS" at the Interface conn.).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Now when the front panel switch of the Master controller is switched to OFF, the controller will in fact be in Manual and provide a precise voltage with which the Slave controllers can work.

The controller output signal must now be wired to the different Slave controllers. This is achieved in the mating plug for the Interface connector. If the Master is in Channel 11 and Slave controllers are in Channels 2 and 3, then pins 6 (PCS), 2 (set point Ch.2), and 3 (set point Ch.3) of the Interface connector should be connected together. If a full 19" main frame is being used with the Master in Ch.1 and Slaves in 2,3,4,5,6 and 7 then pins 6,2,3 and 4 of Interface 1-4 must be connected together and also connected to pins 1 (Ch. 5 set point), 2 (Ch.6 set point), and 3 (Ch.7 set point) of the Interface 5-9 connector.

Slave

An Independent controller is converted to a Slave controller by switching from internal set point to external set point. Switch S2 on each Slave controller should have the INT SETPT turned off and the EXT. SETPT turned on. See schematic 106037 for location of S2 on the input board.

A Slave controller can be returned to an Independent controller by reversing the S2 position (INT on and EXT off). The wiring of the controller output of the Master controller can remain in place.

Any controller, whether it is a Master, Slave or Independent can be individually turned on or off with the CLOSE line. A typical application might have 6 flow channels but with only 2 on at any time. The others would be held off by holding the CLOSE lines to ground with either a relay contact or TTL drivers. When the CLOSE line is free to float high, the controller will be in AUTOmatic. Note that the MASTER controller can be externally commanded to Manual with the MANUAL input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION V

THEORY OF OPERATION

The 260 is a versatile controller capable of pressure, flow or flow ratio control. It is used for pressure control when a pressure transducer provides the feedback signal and flow control when a flow transducer provides the feedback. If a second flow transducer is used for external set point, flow ratio is controlled. Complex systems are possible with one 260 controller serving as master pressure or total flow control and other 260 controllers serving as individual gas ratio controllers.

5.1 BASIC CONTROL THEORY

The purpose of a controller is to compare the required input with the actual output and make appropriate corrections until the output equals the input.

Figure 401 is a simple pressure control loop consisting of an input signal, controller output valve, vacuum system and pressure transducer. The pressure transducer converts pressure to an electrical signal which is compared in the controller to the input signal (in most cases, a precision pot whose voltage output is changed by rotating the dial).

Any error between the input and output signals is amplified by the controller and feed to the valve. For example, if the pressure is higher than the set point, the controller will reduce the current to the valve, which will reduce the flow into the vacuum system, subsequently reducing the pressure.

An additional requirement of the controller is to provide a stabilizing or tuning control. This control (PHASE LEAD) allows the operator to compensate for the different delays or lags that vary from system to system.

Notice that in a simple pressure loop, the flow rate is not measured because it is not important.

5.2 RATIO CONTROL

In ratio control a "master" controller controls two or more "ratio" controllers (see Figures 402 and 403). The master controller can be using a pressure signal as feedback or a total flow signal as feedback. In either case, the master controller's output is used as the external reference by the ratio controllers. Each ratio control loop requires a control valve and flow rate transducers.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

When the master feedback is pressure, the total flow necessary to maintain that pressure depends on the pumping speed of the pump at that pressure. While the ratio controllers are maintaining gas RATIO, the absolute flow rates are determined by the physical characteristics of the system.

Conversely, when the master controller's feedback is total flow, the pressure in the chamber will depend on the pumping speed.

5.3 260 CONTROLLER

The 260 controller has two PC boards: Input and Output. Both boards are powered by ±15 volts.

THE INPUT BOARD (Schematic D106256)

This board contains the input amplifier, precision reference, comparator and controller tuning circuits and the process limit section. U1 is the input amplifier and the front panel ZERO (R16) is added to the pressure (or flow) feedback signal at this point. The gain of U1 is controlled by inside switches S1 (poles 1, 2 or 3) and the span pot (R17). S1 pole 1 is used when the full scale input is greater than the 1 volt but less than 10 volts. Pole 2 is used when the full scale input is greater than 100mv but less than 1 volt.

The GAUGE FACTOR control (R19) is used to normalize all inputs to 1.00 volts full scale. This one volt signal is sent to the display and also used by the difference amplifier.

U3A is the buffer amplifier for the external set point signal. It will accept either 5V or 1V full scale signals by selection of S2 poles 3 and 4.

VR1 is a precision 6.2 volt zener, which is reduced by R21 to 5.00 volts. This is buffered by U2A to become " + 5VA" which is used as a precision reference by the PROCESS LIMIT control (R78). The 5 volts is further reduced to 1 volt by R24, 25 and 26 and buffered by U3B which becomes the internal set point reference.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Proper selection of S1 pole 4, S2 pole 1 or 2 will allow the 260 to operate from either the internal, external ratio, or external direct. Whichever mode is selected, the set point signal is buffered by U4 which has a 1 volt full scale output.

S3 is the Normal-Reverse switch and usually would be in the normal mode. Reverse would be used if less flow is needed for greater pressure (such as exhaust valve control) or if the input transducers signal becomes less positive for increasing signal. To select reverse operation turn OFF poles 1 and 2 and turn ON poles 3 and 4.

The difference between the conditioned input signal and the set point signal is determined by U2B which also multiplies the difference by 2.5. This error signal is used by the controller circuits and the process limit circuit.

The PROCESS LIMIT circuit consists of absolute amplifier U7 (B and A) which provides a positive signal for any polarity error signal.

The full scale output of U7A is 5 volts which is compared by U8A to the output of the PROCESS LIMIT control (R78). U8B drives the front panel DEVIATION LED and relay driver Q1. U9 provides a +5V digital output.

The error signal from U2B is differentiated by U5 which has a variable inside control (R54) to allow the operator to determine the PHASE LEAD. The differentiated error signal is then amplified by U6 whose GAIN is also operator controlled.

The amplified and phase compensated error signal is now connected to the output board.

A floating 5.1V supply is developed across VR6 for use with the external commands (OFF and MANUAl). Diodes VR4 and VR5 prevent the floating ground (digital) from being pulled more than 6 volts from analog ground. Diodes VR2 and VR3 prevent the analog ground from being pulled more than 6 volts from chassis.

Also mounted on the input board are the ON and OVERRIDE indicators, but they are controlled from the output board.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

THE OUTPUT BOARD (Schematic D106257)

This board contains the controller integrator, external command inputs, bias circuit and output drivers.

The phase compensated error signal from the input board is integrated by U5 in the AUTO mode. In MANUAL or OFF, U4A drives the integrator to two times the voltage on the MANUAL pot (R21). The output of the integrator is combined with the BIAS voltage by U4B via Q4.

When the OFF command is active (either from the front panel or external), Q4 is turned OFF and Q4 is turned ON which produces a zero output at U4B.

U9A and B is an exclusive -or so that either polarity of digital input (positive true or low true) can be accepted. As shipped the controller will accept a low to turn the output OFF. U1A and B are level translators to allow isolation between the external (digital) ground and the internal (analog) ground. U2 and 3 are drivers for FETS Q1, 2, 4 and 5. If either U1B or the SELECT switch goes low, U3-7 goes high turning on Q1, and U3-2 goes low turning off Q2 which puts the integrator in manual. If either U1B or SELECT goes low, U2-7 goes high, turning on Q5, and U2-2 goes low turning off Q2 which puts the integrator in manual. If either U1B or SELECT goes low, U2-7 goes high, turning on Q5, and U2-1 goes low turning off Q4, putting the output in OFF. In OFF, U3 also switches (due to D9) which keeps the integrator at manual even though the output is off.

If either U1A or B or the SELECT switch is low, the OVERRIDE LED is turned on to indicate that the controller is not in AUTO.

The output of U4B is the "control output" (0 to 10 volts) which is available at the rear panel for ratio control or for speed control of blowers. The controller output is also the input to the two output drivers: one voltage (0 to 105 volts for piezoelectric valves), and one current (0 to 120ma for solenoid valves). The current driver consists of U6A as the gain stage and Q6 as the output driver. Current feedback is sampled by R57 and VR2 limits voltage transients across Q6. R58 limits short circuit current and reduces the power dissipation of Q6.

The voltage driver utilizes a pulse width modulator (PWM) chip (U7) and transformer T1 to step the voltage up to 100 volts. U8A and B translates the 0 to 10 volt input signal (referenced to analog ground) and 0 to 10 volt output signal (referenced to chassis) to a 0 to 5 volt signal (referenced to the U7 bias voltage (pin 1).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION VI

TROUBLESHOOTING

To locate the cause of trouble follow Steps 1, 2, 3 and 4 in sequence.

1. Check for obvious troubles such as power off, power cable unplugged, defective power cord, or LOOSE CONNECTIONS.

2. Check all control settings:

   Front Panel

   AUTO switch should be on.

   Set point at proper level.

   ON indicator should be on.

   OVERRIDE indicator should be off.

   DEVIATION indicator should be green.

   Inside

   GAIN - As required (Normally 10%)

   PHASE LEAD - As required (Normally 1 to 5 sec.)

   PROCESS LIMIT - As required (Normally 10%)

   S1 - Normally 10V (Pole 1 ON, Poles 2,3 and 4 OFF)

   S2 - Normally 1NT (Pole 2 ON, Poles 1,3 and 4 OFF)

   S3 - Normal (Poles 1 and 2 ON, Poles 3 and 4 OFF)

   Also check that the roll-up cable is securely connected inside the main frame and at the rear of both boards of the controller.

3. FAULT DETERMINATION

   3.1 ON indicator varies in intensity and/or DEVIATION indicator switches from red to green. (System oscillating)

   a. Readjust PHASE and GAIN controls (see Section 4.7).
   b. Raise Bias setting (see Section 4.8).
   c. If in RATIO, turn master controller to MANUAL and check that individual flow channels are stable.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2 Pressure (or Flow) lower than set point

a. Check gas supply.
b. Gas lines clogged?
c. GAIN too low? (see Section 4.7).
d. Does valve have sufficient throughput?
e. Zero pot(s) misadjusted in 260 (see Section VIII).

3.3 No Pressure (or Flow)

1. ON indicator full on

a. Check gas supply.
b. Gas lines clogged?
c. Valve cable connected?
d. Transducer malfunctioning?

2. ON indicator off

a. Switch in Auto?
b. NO OVERRIDE should be on.
c. Power Supply OK?
d. Normal-Reverse switch proper (see Section 4.13).
e. 260 malfunctioning (see Section VIII).

3.4 Pressure (or Flow) not zero when 260 is OFF

a. BIAS set too high? (see Section 4.8)
b. Control valve stuck open?
c. Zero input?

NOTE: Some flow transducers have zero drift of ±0.5% of FULL SCALE.

d. 260 malfunctioning (see Section VIII).

4. If you suspect the 260 controller module connect a known good controller in it's slot to verify that it is the controller and not a bad cable or connection.

If trouble is traced to the 260 controller module, contact any MKS Sales Office or the Home Office for repair instructions. If it is necessary to return the controller to MKS for repair, it is desirable to have an ERA number (Equipment Return Authorization) issued by MKS for identification purposes.

Repairs should only be made by qualified service personnel familiar with electronics equipment in general and the 260 in particular (see Theory of Operation, Section V).

See Service and Repair Facilities List at rear of manual.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SECTION VIII

ALIGNMENT PROCEDURE

The following alignment procedure should be followed to verify the zero and full scale alignment of the 260 controller. The controller can be tested on the bench or in the main frame chassis. Consult schematic for pin numbers. Note that the P.C. Boards have test pins (TPB1, TPB2-3 etc.) to speed testing.

8.1 Verify that + and -15 ±1 volt supplied are connected.

8.2 Equipment needed:

A. 0 to 10 volt source for input.

B. 100Ω 1 watt resistor for current output.

C. 4½ place Digital volt meter.

8.3 Connections:

A. Connect the input source to the INPUT connector pins 1 and 8 (pin 8 should also be connected to pin 12).

B. Connect the 100Ω resistor across pins C and D of the valve connector.

C. Verify that the Gauge Factor control setting is proper (see Table 1).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.4 Check the voltage at the following test points and readjust the appropriate control if necessary.

Condition	Test Point	Voltage	Control
A. Input = 0.000V	TPB1-4 (Input Bd)	0.000	ZERO (R16)
B. -	U2-1 (Input Bd)	5.000	5V (R21)
C. -	TPB1-2 (Input)	1.000	1V (R23)
D. Set point 000	TPB1-5 (Input)	0.000	S.P.Zero (R36
E. Input = 0.000 Set point = 000	TPB1-3 (Input)	0.000	Diff A.Z. (R45)
F. Input = 0.000 Set point = 000	TPB2-2 (Input)	0.000	Phase Zero (R52)
G. Input = 0.000 Set point = 000	U6-6 (Input)	0.000	Gain Zero (R62)
H. Input = 0.000 Set point = 000	TPB2-3 (Input)	0.000	Dev. Zero 1 (R71)
I. Input = 0.000 Set point = 000	TPB2-5 (Input)	0.000	Dev. Zero 2 (R77)
J. Input = 0.000 Set point = 000 Switch - AUTO	U5-6 (Output Bd)	Any voltage between 0 and 10v but it should hold CONSTANT	Integrator Zero (R20)
K. Switch - OFF	U5-6 (Output Bd)	Voltage should be controlled by Manual Pot (R21)	-
L. Switch - OFF	TPB1-4 (Output)	0.000 ± 0.01	-
M. Switch - AUTO Input = 0.000 Set point	TPB1-4 (Output)	3.5 volts (Bias Setting)	Bias (R29)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8.4 (Continued)

Check the voltage at the following test points and readjust the appropriate control if necessary.

Condition	Test Point	Voltage	Control
N. Switch - OFF	J1 pin 24	0 ± 3 volts	-
O. Switch - OFF	Across 100 current load resistor	0.5 ± 0.5 volts	-
P. Input 10.000 volts	TPB1-4 (Input)	10.000 volts	SPAN (R17)
Q. Input 10.000 volts Gauge Factor = 100	Display Output	1.000 volts	Gauge Factor
R. Set point = 1000	TPB1-5 (Input)	1.000 volts	1V (R23)
S. 1 volt @ Display 1 volt @ TPB1-5	TPB1-3 (Input)	0.000	Diff Ampl Cal (R41)
T. Input = 0.000 Set point = 100	TBP1-3 (Input)	0.25 ± .01	-
U. Input = 0.000 Set point = 100 Process Limit = 10%	Deviation LED should switch from red to green as set point is increased or de-creased.		

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE 1

INPUT SETTINGS

Input Full Scale	S1 Input Switch	Gauge Factor* (1000 = Full Scale)	Display (Full Scale) 1.00 Volts =
10V = 1 (torr, etc.)	10V	100	1.000
10V = 10	10V	100	10.00
10V = 100	10V	100	100.0
10V = 1000	10V	100	1000.
1V = 1	1V	100	1.000
0.1V = 1	0.1V	100	1.000
5V = 10 (sccm, etc.)	10V	200 *	10.00
5V = 20	10V	40 *	100.0
5V = 50	10V	100 *	100.0
5V = 100	10V	200 *	100.0
5V = 200	10V	40 *	1000.
5V = 500	10V	100 *	1000.
5V = 1000	10V	200 *	1000.
5V = 5000	10V	100 *	10,000.
5V = 10,000	10V	200 *	10,000.
5V = 5,000 **	1V	100 *	1000.

* If GAS CORRECTION is needed, the gauge factor must be multiplied by the GAS CORRECTION from TABLE 2.

** Using only the lower 20% (10 to 1000 sccm)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

EXAMPLE:

A flow transducer with 5V = 1000 sccm calibrated in air but being used with Argon.

Final Gauge Factor setting would be 200 (from Table 1) x 1.44 (from Table 2) = 288, which would appear as 88 on the ten turn Gauge Factor dial.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE 2

THERMAL FLOW METER GAS CORRECTIONS

	SYMBOL	SPECIFIC HEAT, Cp Cal/gm-°C	DENSITY G/1 a 0°C	GAS CORRECTION
Acetylene	C_2H_2	.383	1.1709	.61
Air	-	.248	1.2929	1.00
Ammonia	NH3	.5232	.7710	.68
Argon	A	.1253	1.7837	1.44
Arsine	A_sH3	.118	3.484	.66
Boron Trichloride	BC13	.134	5.22	.39
Boron Trifloride	BF3	.139	3.24	.61
Carbon Dioxide	CO2	.1989	1.9769	.74
Carbon Monoxide	CO	.2478	1.2504	1.00
Chlorine	$C1_2$	.115	3.214	.84
Diborane	B_2H_6	.5012	1.2352	.44
Dichlorosilane	SiH_2C12	.137	4.51	.44
Dichloro Methyl	(H^3) 2 SiCl2	.203	.575	.23
Ethane	C_2H6	.4097	1.3563	.43
Ethylene	C_2H4	.3592	1.2604	.60
Freon-12	$C1_2F2$	.155	5.398	.32
Freon-14	CF4	.1659	3.927	.42
Freon-22	$CHC1F_2$	.152	4.10	.44
Germane	GeH4	.1335	3.43	.60
Helium	He	1.248	.1785	1.43
Hydrogen	H2	3.389	.0899	1.02
Hydrogen Bromide	HBr	.0820	3.6445	1.04
Hydrogen Chloride	HC1	.1939	1.6392	.98
Hydrogen Fluoride	HF	.348	.893	1.00
Hydrogen Selenide	H_2Se	.100	3.612	.81
Hydrogen Sulfide	H_2S	.240	1.539	.79
Krypton	K1	.0600	3.700	1.49
Methane	CH_4	.5271	.7168	.72
Methanol	H_3OH	.3277	1.43	.58
Methyl	$(CH_3)SiCl_3$	.1647	6.67	.25
Nitric Oxide	NO	.2328	.3407	.99
Nitrogen	N_2	.2477	1.25	1.00
Nitrogen Dioxide	NO_2	.199	3.55	.41
Nitrous Oxide	N_{2O}	.2004	1.997	.73

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE 2

THERMAL FLOW METER GAS CORRECTIONS
(Continued)

	SYMBOL	SPECIFIC HEAT, Cp Cal/gm-°C	DENSITY G/1 a 0°C	GAS CORRECTION
Oxygen	O_2	.2177	1.4290	1.00
Phosphine	PH_3	.261	1.5178	.69
Propane	C_3H_8	.3882	2.0199	.35
Propylene	C_3H_6	.3541	1.46	.53
Silane	SiH_4	.3186	1.44	.59
Silicon	$SiCl_4$	.125	7.569	.29
Sulfur Dioxide	SO_2	.1516	2.927	.66
Sulfer Hexafluoride	SF_6	.1590	6.139	.28
Tungsten Hexafluoride	WF_6	.0954	13.296	.22
Tchlorosilane	$SiHCl_3$	.130	6.05	.35
Xenon	Xe	.0400	5.897	1.35

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

260PS-1

POWER SUPPLY

The 260PS-1 Power Supply can supply up to 1.5 amp of ±15 volts to power the 260 system of mini-modules. Each output (+15 and -15) has short-circuit protection so that the supply will not be damaged by an overload or short circuit.

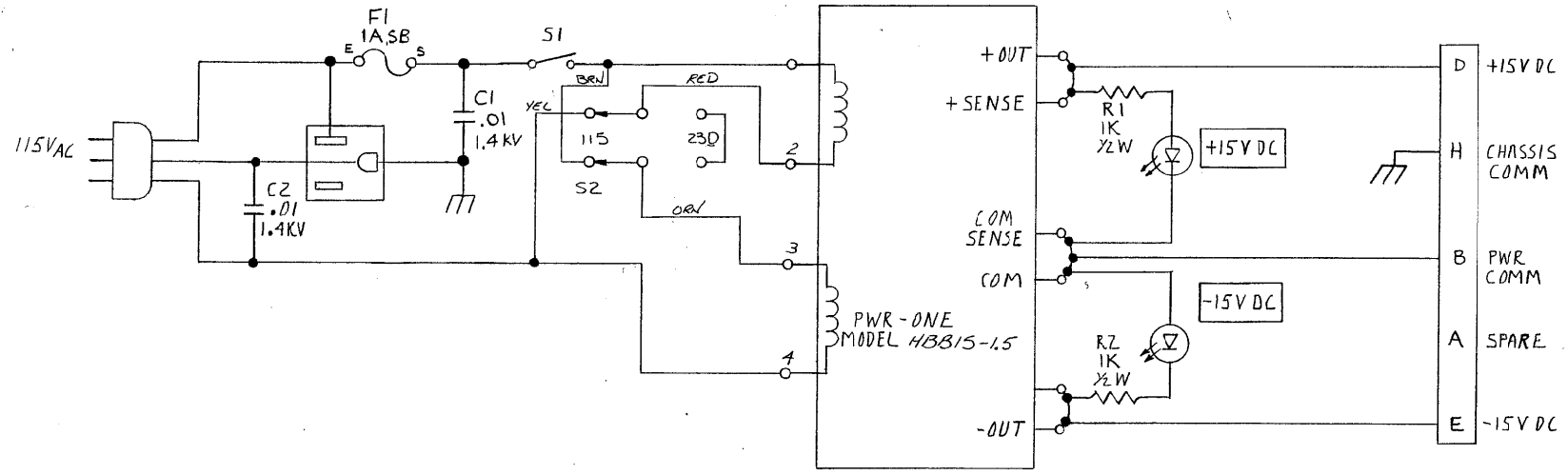
The 260PS-1 should be mounted securely and in such a manner that natural air circulation will be available for cooling. Both the top and bottom covers are ventilated and should not be blocked. If the 2670PS-1 is mounted by the front panel, this will aid in cooling the supply.

Plug in the power cord and verify that the line voltage selector on the rear panel is set for the proper voltage (115 or 230). Make sure the power switch is off and connect the power cable (CB260-1-6) between the 260PS-1 and the 260MF-1 main frame. Additional main frames can be powered from the "POWER OUT" connector of the first main frame.

When the power switch is turned on, both lights on the front panel should go on. If not, turn the switch off immediately and determine the cause of the short-circuit or overload.

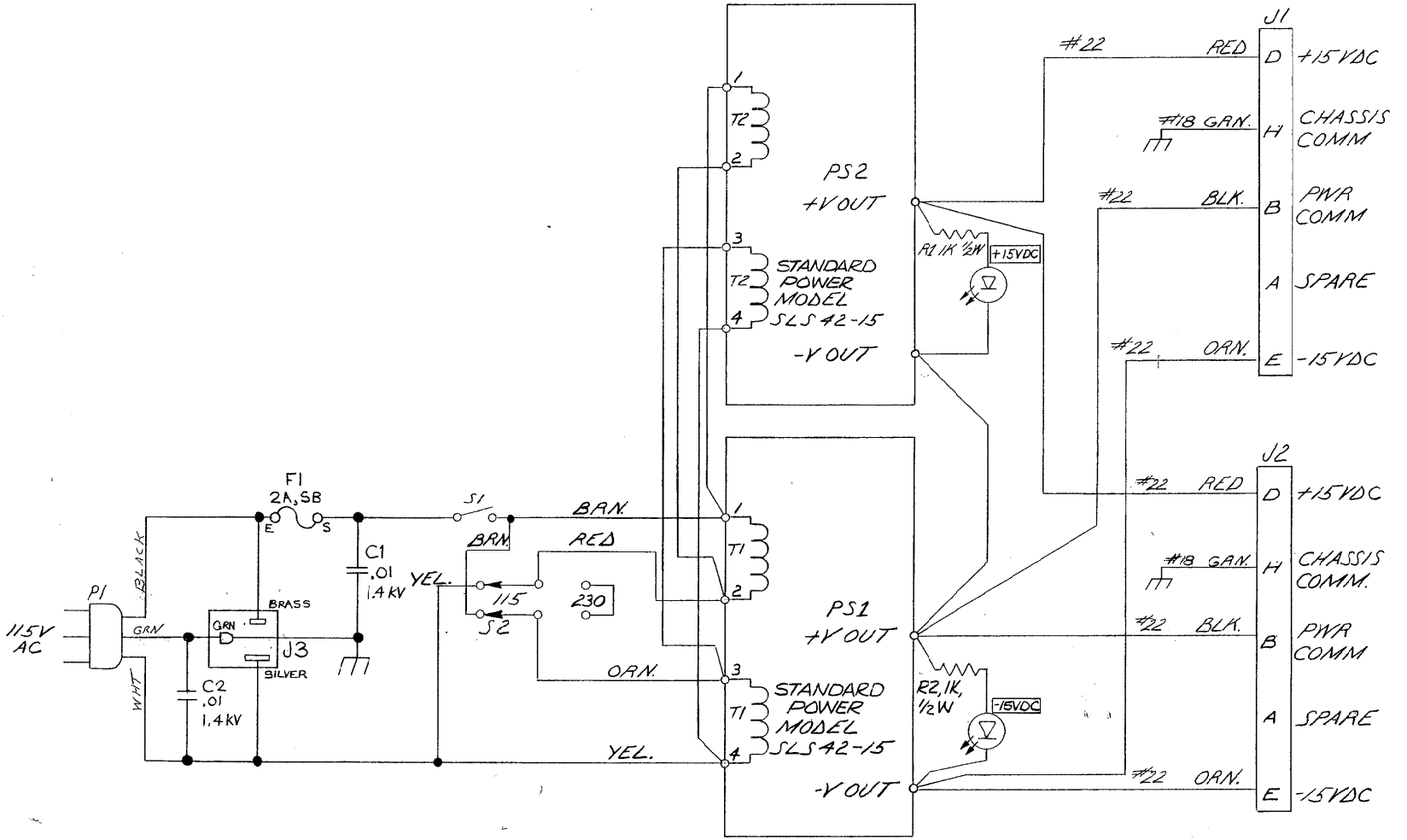
The power cable is 260-1-XX, where XX denotes the length in feet. An Amphenol 126-217 (MKS Part #112-3506) is the male connector and Amphenol 126-223 (MKS Part #112-3182) is the female connector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



SCHEMATIC 106671-C 260PS-1 POWER SUPPLY

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



SCHEMATIC 106880-B 260PS-2 POWER SUPPLY

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

261/262

The 261/262 display modules contain two digital displays, power converter and switches for decimal point selection. The 261 contains two 3½ digit volt meters (DVM). The 262 contains two 3½ DVM and one 4½ DVM. Otherwise both units are identical.

The 261/262 displays are packaged in a double-width (2B) module (3.45" wide) and are intended to mount in a standard main frame; MF-1 for 9½" wide and MF-2 for 19" wide.

SPECIFICATIONS

INPUT SIGNAL - 0 to 1 volt, 200K Input Impedance

- 0 to 0.1 or 0 to 0.01 can be internally selected.

INPUT POWER - + AND -15 ± 1 volts @ 250 ma each.

FULL SCALE READOUT	3½ DVM	4½ DVM
	1.000	1.0000
	10.00	10.000
	100.0	100.0
	1000.	1000.0
		10000.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CONTROLS

The only controls for the 261/262 are inside the module (See Figure 101). Note that for all switches, ON is DOWN!

1. DECIMAL POINT SELECTOR (S4) for the upper DVM. See Table 11 for settings.

2. DECIMAL POINT SELECTOR (S2) for the lower DVM. See Table 11 for settings.

3. GAIN SELECTOR (S1) for the upper DVM. Normally in X1 (pole 4 ON, all others OFF). See Table 12 for other settings.

4. GAIN SELECTOR (S3) for the lower DVM. Normally in X1 (pole 4 ON, all others OFF). See Table 12 for other settings.

5. ZERO control for the upper DVM. With zero input, adjust for 000 on the display.

6. SPAN control for the upper DVM. With full scale input (normally 1.000 volts), adjust for 1000 on the display.

7. ZERO control for the lower DVM. With full scale input (normally 1.000 volts), adjust for 1000 on the display.

8. SPAN control for the lower DVM. With full scale input (normally 1.000 volts), adjust for 1000 on the display.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

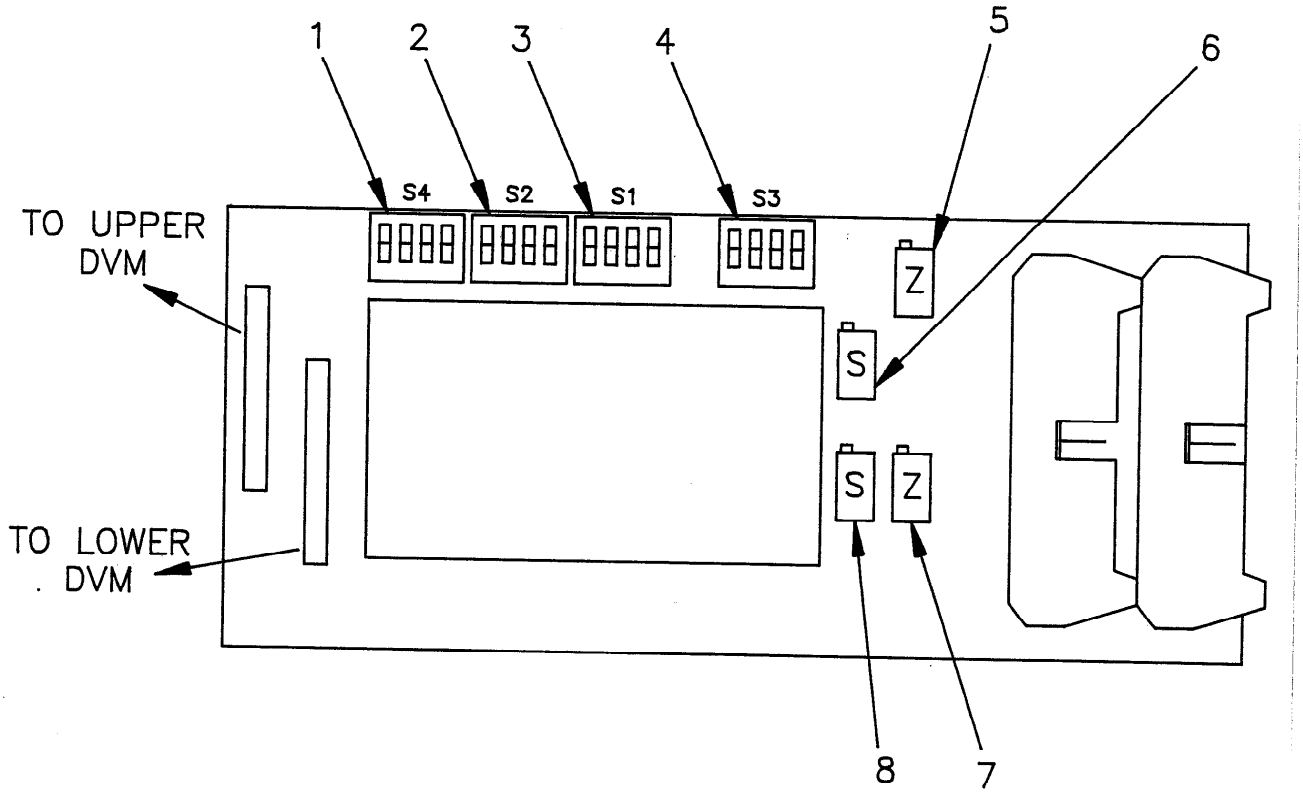


FIGURE 101

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPERATION

The 261/262 display module is placed in operation by connecting the two retracting cables from the rear of the module to the appropriate connectors in the main frame. The display inputs are connected to the DISPLAY connectors on the rear of the main frame. The left-most channel (as you look at the front of the module), connects to the upper DVM.

The ZERO and SPAN controls for each DVM have been adjusted at the plant and should not need adjustment. The GAIN switch has also been set for X1. Only the DECIMAL POINT select may need adjustment. It is set at the plant to 100.0. Set the appropriate control (S2 for upper DVM, S4 for lower DVM) according to Table 1 of this manual and the "DISPLAY (FULL SCALE) 1.00 volts = " column from Table 1 of the 260 controller manual.

THEORY OF OPERATION

The 261/262 display module contains two signal amplifiers, two DVMs and a power converter. The two signal amplifiers consist of U1 and U2 and appropriate zero and span controls. The decimal point switches program the display decimal point and have no effect on the gain of the amplifier.

Notice that the interconnecting cable between the PC Board and DVM is different for 3½ place DVM verses the 4½ place DVM.

A ±15V to 5V converter is used to reduce the 15V power supply to +5 volts for the DVMs.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE 11

261/262 DECIMAL POINT SETTINGS

Display Full Scale 1 Volt =	Decimal Switch Setting S2 - Upper DVM or S4 - Lower DVM
1	4
10	3
100	2
1000	1

TABLE 12

261/262 GAIN SWITCH SETTINGS

Gain	S1 - Upper DVM or S3 - Lower DVM
X1 (Normal)	4
X10	2
X100	1

NOTE: For all switches, ON is DOWN!

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

263

INSTANTANEOUS FLOW RATE SUMMER (TOTALIZER)

The Model 263 will instantaneously sum the flow rates of up to 4 channels and produce a 0 to 10 volt output proportional to this sum. This "total" flow signal can be used by a master flow controller for maintaining the total flow.

When adding flows from flow transducers of the same range, the 263 can be simply connected and used as long as the total flow of all four channels never exceeds the flow range. For example, if four 100 sccm transducers are being used, and the total of the four never exceeds 100 sccm then the unit can be used as shipped. If the total flow is going to exceed the flow range then all the input circuits should be changed to a lower range (X.1). Now the output flow signal will be one range higher than the input range. 1000 sccm for our example above.

If the flow transducers are of different ranges (for example 1000, 100, 10 and 10 sccm) then one channel can be left in X1 and connected to the highest range (1000 sccm). The next channel should be switched to X.1 (for the 100 sccm), and the last two channels would be X.015 for the 10 sccm). The output range would be 1000 sccm.

If your flow transducer is calibrated for a range other than decade (for example: 200, 300 or 500) then the "flow range" for that transducer is the next highest decade range (1000 for the three ranges above).

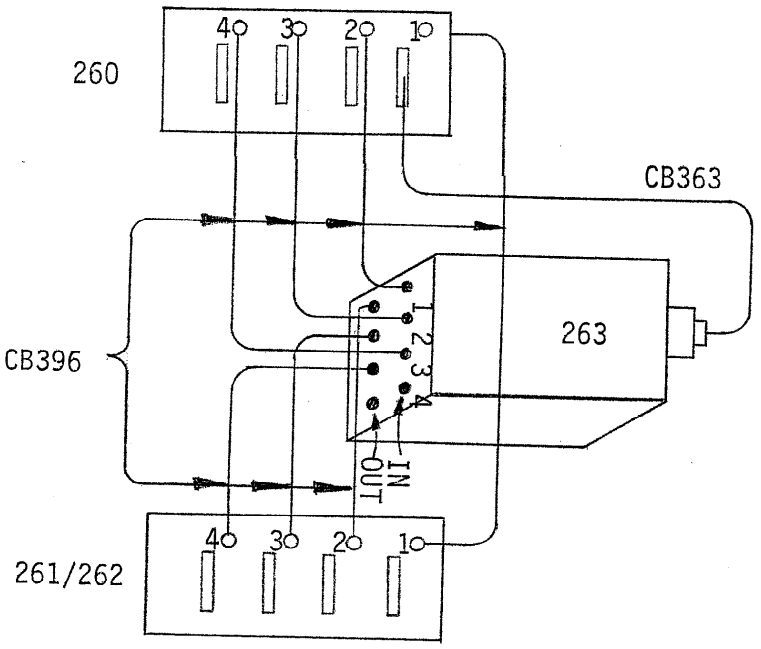
To change a range switch, remove the cover and find the DIP switch for that channel. Turn off the range that is on and turn on the range desired. Only one range should be on at any time.

The 263 has been adjusted at the factory and should not need further adjustment.

Connect the 263 per the attached drawings.

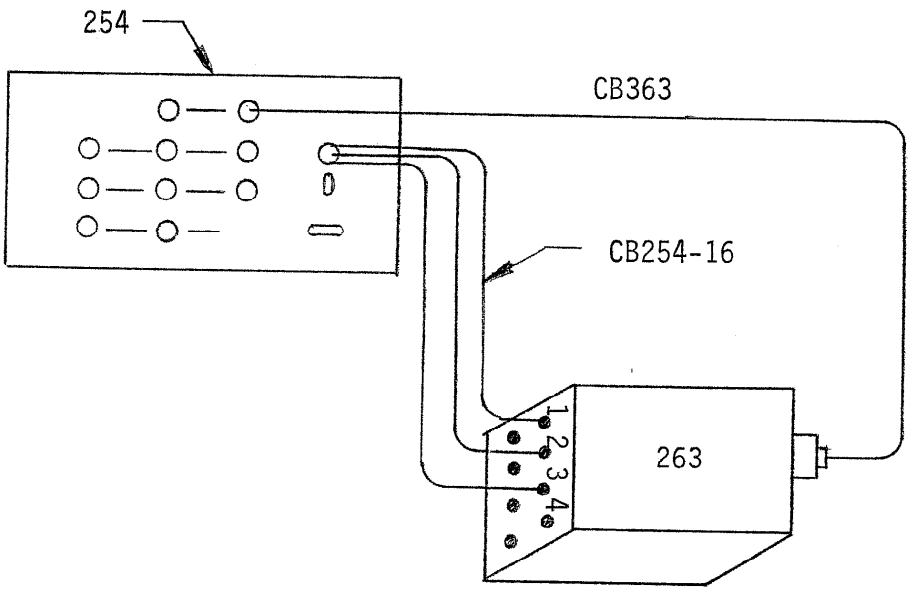
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

260 SYSTEM



CHANNEL 1 IS THE MASTER
(CONTROLLING TOTAL FLOW)

254 SYSTEM



CABLE DIAGRAMS
263 TOTALIZER

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

264A

MULTI-CHANNEL DISPLAY

The 264A Multi-Channel Display Module can display the input signals for up to 10 channels on a single 3½ DVM. The 264A displays these signals as sccm.

The various inputs are connected to the 264A via the INTERFACE connector. See table below for connection numbers. Note that the mini-phone jack DISPLAY connector is not normally used.

INPUT NUMBERS	INTERFACE (5-9) PIN NUMBERS	ORIGINAL DESIGNATION
1	1	Ch. 8 + Set point
2	11	Ch. 8 Deviation
3	29	Ch. 8 N.O. Relay
4	34	Ch. 8 Relay Common
5	16	Ch. 8 Close
6	5	Ch. 9 + Set point
7	12	Ch. 9 Deviation
8	30	Ch. 9 N.O. Relay
9	35	Ch. 9 Relay Common
10	17	Ch. 9 Close

NOTE: This table assumes 264A is in positions 8 and 9 of a 260MF-2. Cable CB264-2 provides these connections as well as making Ch. 1 a possible master controller.

Normal input signals are 0 to 1 volt full scale.

In order for the Display to appear in the proper units (sccm) each input position being used must have the proper decimal point selection. Ten switches (S1 thru S10) are provided for this function. S1 is to the rear of the PC Board on the top row of switches. S2 is the next switch toward the front, and S3 is next, etc. S7 is the forward-most switch on the top row. S8, 9, and 10 go down the front edge of the PC Card.

Each switch consists of four poles (1,10,100 and 1000) which are arranged rear to front (i.e., 1 is the rear-most pole of each switch). Each switch should be set to the appropriate input (S1 for #1, S2 for #2, etc.). The pole selected should correspond to the full scale input for that input. For example, a 100 sccm on #1 input should have the third pole (100) of S1 on.

The two DISPLAY inputs (Ch. 8 and Ch. 9) can be used as 1 volt full scale or 10 volt full scale inputs. In order to use these Display inputs, the wires from the front panel selector switch to the PC board connector will have to be moved to pick up the proper input (labelled Ch. 11 or Ch. 12. (See Schematic D106989).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPERATING INSTRUCTIONS

265
3-Set point SELECTOR

The Type 265 3-Set point Selector provides three set point controls which can be selected either from the front panel or remotely. When selected, each set point control provides a precision voltage for the 260 controller, which will maintain this control value of flow (or pressure).

The set point pots would be preset to any desired value within their control range and these values can be checked by use of the front panel selector switch. In the REMote position, an external programmer can select any of the preset values by connecting the appropriate line to digital ground.

Note that in addition to the three set point values, the 260 controller can also be turned OFF by remotely selecting its CLOSE line.

SETTINGS

The 265 set point pots are ten-turn precision controls with calibrated dials. Each pot covers the same range as the set point control in the 260 controller. The dial represents the fraction of full scale range. For example, if the transducer's full scale flow is 100 sccm and the set point pot is set for .342 ($\frac{3}{42}$ indicated on the dial), then when the setpoint is selected, the controller will maintain a flow of 34.2 sccm while in AUTO.

The pots can be adjusted at any time, whether they are ON or OFF.

Note that when the 265 is being used, the set point control on the 260 controller is not operative and should be left at 1000 (full scale).

SELECTION

When the front panel switch is selecting a particular set point, all remote select signals will be ignored. In REMote any and all remote select signals will be selected and it is IMPORTANT THAT ONLY ONE Set point BE SELECTED AT A TIME. As normally shipped, the remote lines are wired for negative true; that is, a short-to-digital ground will select the appropriate set point. When the lines are not shorted to ground, they are pulled up to +5 volts with a 5K resistor. If 15 volt logic is being used, three (3) jumpers (E1/E2, E3/E4 and E5/E6) can be cut and the remote select lines will then be pulled up to +15 volts with a 30K resistor.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If positive true logic is desired (that is a positive signal will select the appropriate set point) then a jumper (E7 to E8) should be installed near R13. Note that is positive true logic is used, ALL unused set point select lines MUST BE HELD AT DIGITAL GROUND.

As each set point is selected, a light next to the set point pot is illuminated.

CONNECTIONS

The remote set point select lines are brought out on the 260MF Interface connector. They will appear as CLOSE (Set point #1), Relay Common (Set point #2), and Relay N.O. (Set point #3) of the channel that the 265 is mounted in. Digital ground is pin 18 of the interface connector.

The + set point (output) of the 265 must be connected to the + set point (input) of the 260 controller. For example, if there is a 260 in Channel 1 and a 265 in channel 2, then on the INTERFACE connector (1-4) pin 1 (Channel 1 + set point) and pin 2 (Channel 2 + set point) should be tied together. Then to select set point #1, pin 14 (Channel 2 CLOSE) should be connected to pin 18 (Digital Ground). Set point #2 would be selected by connecting pin 32 (Channel 2 Relay Common) to pin 18. And set point #3 would be selected by connecting pin 27 (Channel 2 Relay N.O.) to pin 18.

260 SET-UP

The 260 has two forms of external set point, Direct or Ratio. In Direct, the external set point signal bypasses the front panel set point pot and goes directly to the controller section. In Ratio, the external set point signal goes through the front panel set point pot such that the front panel set point pot picks the ratio of the external set point signal. Normally with a 265, the Direct method of external set point is best because accidental change in the front panel pot will not affect the set point voltage. For Direct set point, S1, pole 4 on the 260 input board should be ON (down) and S2, poles 1 and 2 should be OFF. The front panel set point, should be set at full scale (1000).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

MKS Worldwide Calibration & Service Centers

UNITED STATES

MKS Instruments, Inc.
Corporate Service Center*
651 Lowell Street
Methuen, MA 01844
Phone: (978) 682-4567
Fax: (978) 682-8543

Sales and Service Offices
MKS Instruments, Inc.

1815 West First Avenue
Suite 119
Mesa, AZ 85202
Phone: (602) 655-9199
Fax: (602) 655-1461

10220 SW Nimbus
Suite K-12
Tigard, OR 97223
Phone: (503) 968-6600
Fax: (503) 968-6688

3019 Alvin Devane Boulevard
Suite 210
Austin, TX 78741
Phone: (512) 385-1800
Fax: (512) 385-4411

789 Grove Road
Suite 111
Richardson, TX 75081
Phone: (972) 231-0173
Fax: (972) 437-4127

3350 Scott Blvd. Bldg. 4
Santa Clara, CA 95054
Phone: (800) 428-9401
(408) 988-4020
Fax: (408) 988-4490

MKS Instruments, Inc.
HPS Division,
Vacuum Components,
Valves & Gauging
5330 Sterling Drive
Boulder, CO 80301
Phone: (303) 449-9861
(800) 345-1967
Fax: (303) 442-6880

CANADA

MKS Instruments, Canada Ltd.
30 Concourse Gate
Nepean, Ontario, Canada K2E 7V7
Phone: (613) 723-3386
(800) 267-3551 *(CAN only)*
Fax: (613) 723-9160

FRANCE

MKS Instruments, France s.a.
43, Rue du Commandant Rolland
B.P. 41
F-93352 Le Bourget, Cedex,
France
Phone: 33(1)48.35.39.39
Telex: 233817 F
Fax: 33(1)48.35.32.52

GERMANY/BENELUX

MKS Instruments,
Deutschland GmbH
Schatzbogen 43
D-81829 München, Germany
Phone: 49-89-420008-0
Telex: 5 29 997
Fax: 49-89-42-41-06

INDIA

Orbit Engineering Pvt., Ltd.
E/298 Greater Kailash-1
New Delhi 110048, India
Phone: 91-11-647-9374
Fax: 91-11-642-5922

ISRAEL

Israel Scientific Instruments, Ltd.
17 Pinhas Ruttenberg Street
Ramat Gan 52306, Israel
Phone: 972-3-6772051
Fax: 972-3-6770808

ITALY

G. Gambetti Kenologia Srl.
Via A. Volta No. 27
20082 Binasco (MI), Italy
Phone: 39-2-90093082
Fax: 39-2-905.2778

JAPAN

MKS Japan, Inc.
Harmonize Building
5-17-13, Narita-Higashi
Suginami-Ku, Tokyo 166-0015,
Japan
Phone: 81-3-3398-8219
Fax: 81-3-3398-8984

KOREA

MKS Korea Co., Ltd.
2nd Floor Shin Young Bldg.
257-4 Yangjae-Dong
Seocho-Ku
Seoul, 137-30 Korea
Phone: 82-2-529-0713/4
Fax: 82-2-529-0715

PEOPLE'S REPUBLIC OF CHINA

Silicon International, Inc.
Unit 4C, 8 Zun Yi South Road
Jin Min Building
Shanghai, P.R., China 200051
Phone: 86-21-62759312
Fax: 86-21-62191175

TAIWAN

Formosa UHV
Engineering Company., Ltd.
No. 86, Gong-Yuan Road
Hsinchu City, Taiwan
Phone: 886-03-5615-218
Fax: 886-03-5615-219

SINGAPORE

MKS Instruments, Inc. Singapore
Blk 5012, Ang Mo Kio Avenue 5
TechPlace II #04-11
Singapore 568976
Phone: (65) 483-3986
Fax: (65) 483-0089

UNITED KINGDOM

MKS Instruments, U.K. Ltd.
2 St. George's Court
Dairyhouse Lane
Altrincham, Cheshire
WA14 5UA, England
Phone: 44-161-929-5500
Fax: 44-161-929-5511

** For applications or sales support call 1-800-227-8766*

4/98

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP