119956-P1
Rev A, 10/98
Instruction Manual

MKS Type 1253E
Throttle Valve Controller

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WARRANTY

Type 1253E Equipment

MKS Instruments, Inc. (**MKS**) warrants that the equipment described above (the "equipment") manufactured by **MKS** shall be free from defects in materials and workmanship for a period of one year from date of shipment and will for a period of two years from the date of shipment, correctly perform all date-related operations, including without limitation accepting data entry, sequencing, sorting, comparing, and reporting, regardless of the date the operation is performed or the date involved in the operation, provided that, if the equipment exchanges data or is otherwise used with equipment, software, or other products of others, such products of others themselves correctly perform all date-related operations and store and transmit dates and date-related data in a format compatible with **MKS** equipment. THIS WARRANTY IS **MKS'** SOLE WARRANTY CONCERNING DATE-RELATED OPERATIONS.

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This warranty does not apply to any equipment which has not been installed and 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 indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the equipment covered by this warranty.

MKS recommends that all **MKS** pressure and flow products be calibrated periodically (typically every 6 to 12 months) to ensure accurate readings. When a product is returned to **MKS** for this periodic re-calibration it is considered normal preventative maintenance not covered by any warranty.

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This manual is for firmware/software version: 1.1x

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Symbols Used in This Instruction Manual

Definitions of WARNING, CAUTION, and NOTE messages used throughout the manual.

Warning 

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in injury to personnel.

Caution 

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.

Note 

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

Symbols Found on the Unit

The following table describes symbols that may be found on the unit.

Definition of Symbols Found on the Unit			
On (Supply) IEC 417, No.5007	 Off (Supply) IEC 417, No.5008	 Earth (ground) IEC 417, No.5017	 Protective earth (ground) IEC 417, No.5019
 Frame or chassis IEC 417, No.5020	 Equipotentiality IEC 417, No.5021	 Direct current IEC 417, No.5031	 Alternating Current IEC 417, No. 5032
 Both direct and alternating Current IEC 417, No.5033-a	 Class ll equipment IEC 417, No.5172-a	 Three phase alternating Current IEC 617-2 No. 020206	
 Caution, refer to accompanying documents ISO 3864, No. B.3.1	 Caution, risk of electric shock ISO 3864, No. B.3.6	 Caution, hot surface IEC 417, No. 5041	

Table 1: Definition of Symbols Found on the Unit

Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electrical shock.

GROUND AND USE PROPER ELECTRICAL FITTINGS

Dangerous voltages are contained within this instrument. All electrical fittings and cables must be of the type specified, and in good condition. All electrical fittings must be properly connected and grounded.

USE THE PROPER POWER SOURCE

This product is intended to operate from a power source that does not apply more voltage between the supply conductors, or between either of the supply conductors and ground, than that specified in the manual.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation.

Chapter One: General Information

Introduction

The Type 1253E "Smart" Throttle Valve Controller is designed for use in downstream pressure control applications with the MKS Type 253 Throttle Valve. The 1253 unit includes a microprocessor, RS-232 communication connections, and driver circuits. The driver circuits eliminate the need for a separate controller box.

The 1253 controller contains a digital pressure/position control algorithm that directs the 253 valve to the proper position for either pressure or position control. The pressure or position set point may be an external voltage applied to the input connector, or sent as a digital RS-232 message. The 1253 unit reads the pressure signal used for control applications directly from a pressure transducer.

Power for the 1253 unit can be a single DC supply of +15 to +30 Volts. You can use a +15 VDC, +24 VDC, or +28 VDC supply. The unit requires approximately 5 Watts of power.

Note  Use a ±15 V supply to power the 1253 unit if you plan to power a transducer from the 1253 unit.

When the controller is turned off, or experiences an unexpected power loss, all calibration constants and the last valve position are saved in non-volatile memory. Therefore, when you repower the unit, it will be calibrated and ready for operation.

A switch on the front of the controller allows for off-line operation of the valve for troubleshooting. Dipswitches inside the controller allow you to configure the controller's operating parameters; refer to *Internal Controls*, page 23, for more information.

How This Manual is Organized

This manual is designed to provide instructions on how to set up, install, and operate a Type 1253 unit.

Before installing your Type 1253 unit in a system and/or operating it, carefully read and familiarize yourself with all precautionary notes in the *Safety Messages and Procedures* section at the front of this manual. In addition, observe and obey all WARNING and CAUTION notes provided throughout the manual.

Chapter One, *General Information*, (this chapter) introduces the product and describes the organization of the manual.

Chapter Two, *Installation*, explains the environmental requirements and describes how to mount the instrument in your system.

Chapter Three, *Overview*, gives a brief description of the instrument and its functionality.

Chapter Four, *Operation,* describes how to use the instrument and explains all the functions and features.

Chapter Five, *Maintennace and Troubleshooting*, describes basic maintenance procedures and troubleshooting procedures should the 1253 unit malfunction.

Appendix A, *Product Specifications*, lists the specifications of the instrument.

Appendix B, *Model Code Explanation*, describes the instrument's model code.

Customer Support

Standard maintenance and repair services are available at all of our regional MKS Calibration and Service Centers, listed on the back cover. In addition, MKS accepts the instruments of other manufacturers for recalibration using the Primary and Transfer Standard calibration equipment located at all of our regional service centers. Should any difficulties arise in the use of your Type 1253 instrument, or to obtain information about companion products MKS offers, contact any authorized MKS Calibration and Service Center. If it is necessary to return the instrument to MKS, please obtain an ERA Number (Equipment Return Authorization Number) from the MKS Calibration and Service Center before shipping. The ERA Number expedites handling and ensures proper servicing of your instrument.

Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Warning  **All returns to MKS Instruments must be free of harmful, corrosive, radioactive, or toxic materials.**

Chapter Two: Installation

How To Unpack the Type 1253 Unit

MKS has carefully packed the Type 1253 unit so that it will reach you in perfect operating order. Upon receiving the unit, however, you should check for defects, cracks, broken connectors, etc., to be certain that damage has not occurred during shipment.

Note 

Do *not* discard any packing materials until you have completed your inspection and are sure the unit arrived safely.

If you find any damage, notify your carrier and MKS immediately. If it is necessary to return the unit to MKS, obtain an ERA Number (Equipment Return Authorization Number) from the MKS Service Center before shipping. Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Caution 

Only qualified individuals should perform the installation and any user adjustments. They must comply with all the necessary ESD and handling precautions while installing and adjusting the instrument. Proper handling is essential when working with all highly sensitive precision electronic instruments.

Unpacking Checklist

Standard Equipment:

- Type 1253 Unit
- Type 1253 Instruction Manual (this book)

Optional Equipment:

- Electrical Connector Accessory Kit:
  1253E-K1
- Power Supply:
  260 PS-1 (± 15 V, 1.5 Amps)
  260 PS-3 (± 15 V, 3.2 Amps)
- PT-1A Portable RS-232 Terminal
- Interface Cables (refer to Table 2, page 8)

Interface Cables

As of January 1, 1996, most products shipped to the European Community must comply with the EMC Directive 89/336/EEC, which covers radio frequency emissions and immunity tests. In addition, as of January 1, 1997, some products shipped to the European Community must also comply with the Product Safety Directive 92/59/EEC and Low-Voltage Directive 73/23/EEC, which cover general safety practices for design and workmanship. MKS products that meet these requirements are identified by application of the CE mark.

To ensure compliance with EMC Directive 89/336/EEC, an overall metal braided shielded cable, properly grounded at both ends, is required during use. No additional installation requirements are necessary to ensure compliance with Directives 92/59/EEC and 73/23/EEC.

Note

1. Overall metal braided shielded cables, properly grounded at both ends, are required to meet CE specifications.
2. To order metal braided shielded cables, add an "S" after the cable type designation. For example, to order a standard cable to connect the 1253 unit to a 627 transducer, use part number CB152-7-10; for a metal braided shielded cable, use part number CB152S-7-10.

System Interface Cables

The MKS system interface cables connect the 1253 unit to the instruments listed in Table 2.

System Interface Cables		
To Connect the 1253 Unit To...	**Use the MKS Cable...**	
	Standard	**Shielded**
Type 260PS-1 and 260PS-3 (power input)	CB153-1-10	CB153S-1-10
Type 270/690 system	CB153-6-10	CB153S-6-10
Type 127, 128, 624, 625, 626, 627, and 628 transducers	CB153-7-10	CB153S-7-10
Type 122, 124, 622, and 623 transducers	CB153-8-10	CB153S-8-10
Type 146 unit (with a power supply)	CB153-13-10	CB153S-13-10
"Y" RS-232C cable	CB153-18-10	CB153S-18-10
Type 253B valve	CB651-30-10	CB651S-30-10
PT-1 Portable RS-232 Terminal	Attached Type "D" connector cable	---
PT-1 unit to the 253 valve	CB153S-18-1	CB153S-18-1

Table 2: System Interface Cables

Generic Shielded Cables

MKS offers a full line of cables for all MKS equipment. Should you choose to manufacture your own cables, follow the guidelines listed below:

1. The cable must have an overall metal *braided* shield, covering all wires. Neither aluminum foil nor spiral shielding will be as effective; using either may nullify regulatory compliance.
2. The connectors must have a metal case which has direct contact to the cable's shield on the whole circumference of the cable. The inductance of a flying lead or wire from the shield to the connector will seriously degrade the shield's effectiveness. The shield should be grounded to the connector before its internal wires exit.
3. With very few exceptions, the connector(s) must make good contact to the device's case (ground). "Good contact" is about 0.01 ohms; and the ground should surround all wires. Contact to ground at just one point may not suffice.
4. For shielded cables with flying leads at one or both ends; it is important at each such end, to ground the shield *before* the wires exit. Make this ground with absolute minimum length. (A ¼ inch piece of #22 wire may be undesirably long since it has approximately 5 nH of inductance, equivalent to 31 ohms at 1000 MHz). After picking up the braid's ground, keep wires and braid flat against the case. With very few exceptions, grounded metal covers are not required over terminal strips. If one is required, it will be stated in the Declaration of Conformity or in the instruction manual.
5. In selecting the appropriate type and wire size for cables, consider:
   A. The voltage ratings;
   B. The cumulative I^2R heating of all the conductors (keep them safely cool);
   C. The IR drop of the conductors, so that adequate power or signal voltage gets to the device;
   D. The capacitance and inductance of cables which are handling fast signals, (such as data lines or stepper motor drive cables); and
   E. That some cables may need internal shielding from specific wires to others; please see the instruction manual for details regarding this matter.

Setup

Dimensions

Note All dimensions are listed in inches with millimeters referenced in parentheses.

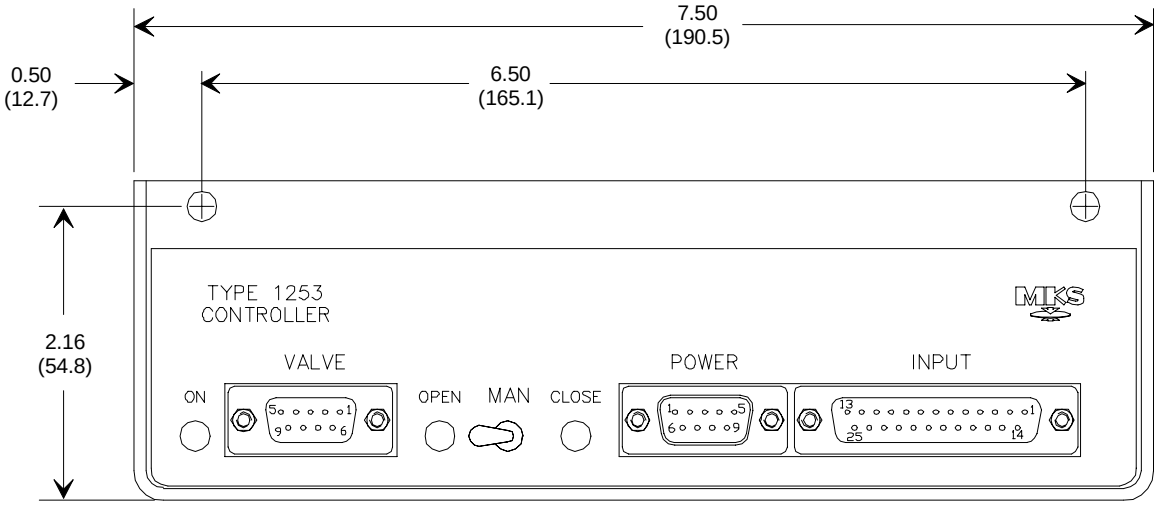

Figure 1: Front Panel Dimensions

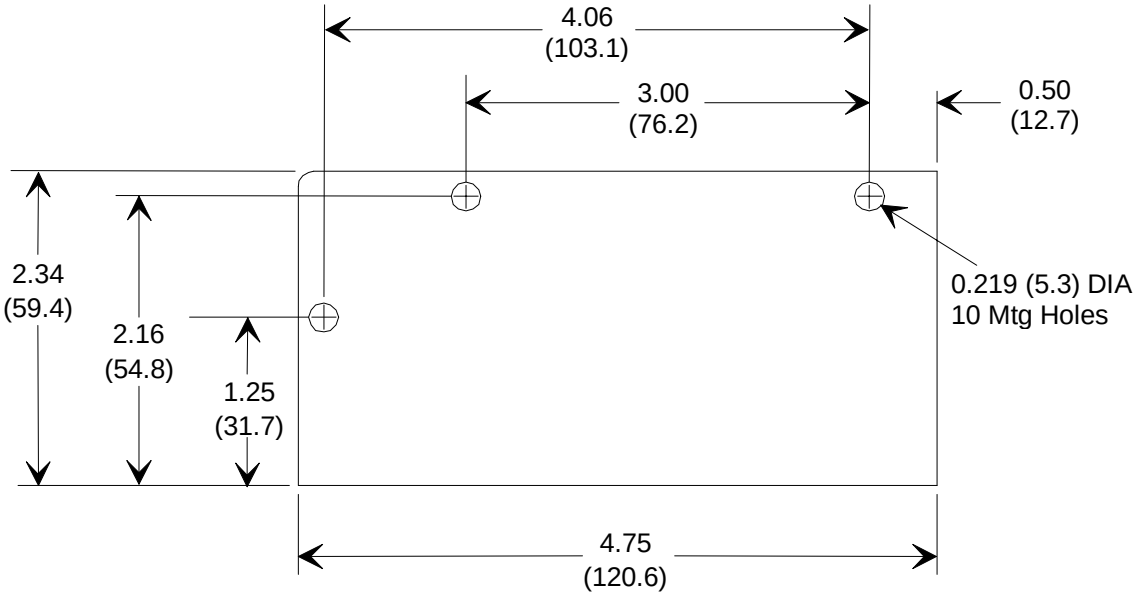

Figure 2: Side Panel Dimensions

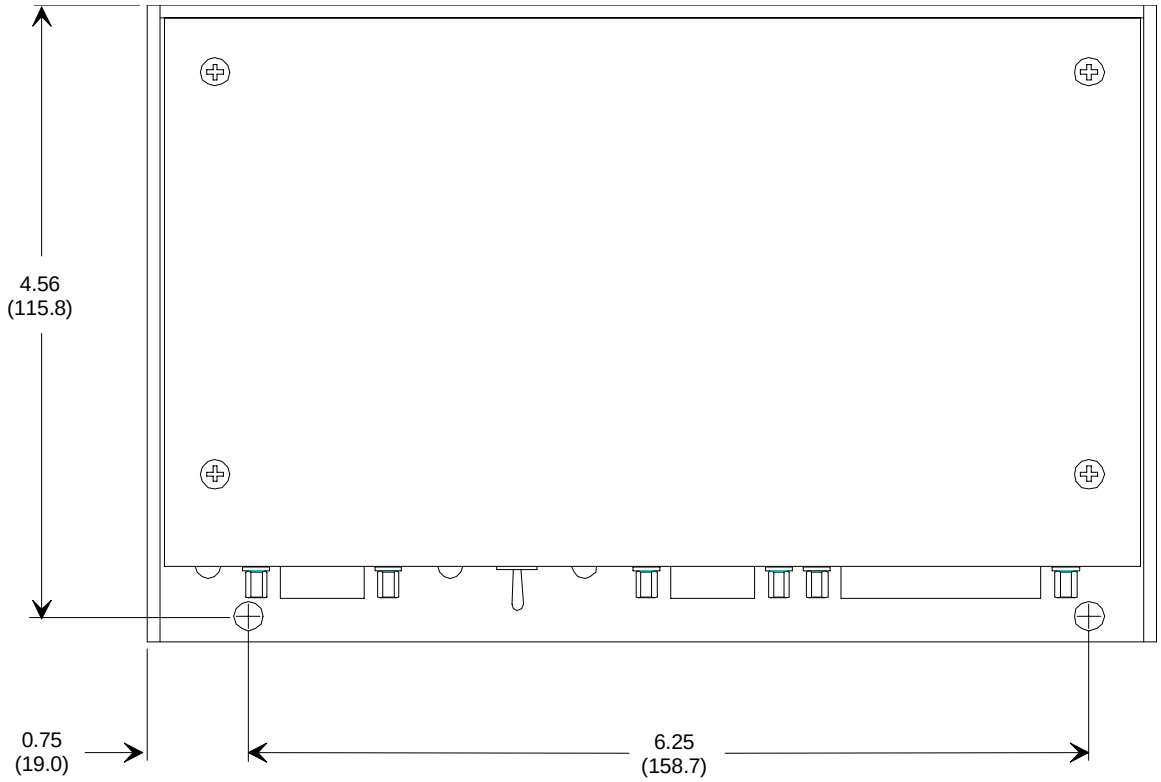

Figure 3: Top Panel Dimensions

Power Requirements

Power for the 1253 unit can be a single DC supply of +15 to +30 Volts. You can use a +15 VDC, +24 VDC, or +28 VDC supply. The unit requires approximately 5 Watts of power.

Note  Use a ±15 V supply to power the 1253 unit if you plan to power a transducer from the 1253 unit.

System Considerations

For best pressure control, locate the pressure transducer and exhaust valve as close as practical to the process chamber. This minimizes the time constants associated with these items. Use tubing that is less than 6 inches long and no less than ¼ inch in diameter to connect the transducer and chamber. If the distance must exceed 6 inches, use larger diameter tubing to compensate for conductance losses.

System Design

The 1253 unit controls an external 253 valve (not included). This valve can be sized for a wide variety of applications. The size of the valve is dictated by the size of the vacuum exhaust line and the range of conductance necessary for the pressure and flow rates being used.

Mounting Instructions

The 1253 controller can be mounted in any position. For optimum performance, mount the power supply and 1253 unit near the valve. This reduces the length of cable necessary to connect the valve to the unit and thereby reduces the amount of voltage loss in the valve drive cables. Refer to the 253 Instruction Manual for directions on mounting the valve.

Grounding

The 1253 controller uses true differential inputs for the pressure and set point input signals. You must connect the return leads to the power supply ground at a single point. Grounding at multiple points will produce ground loops and IR drops which will degrade performance.

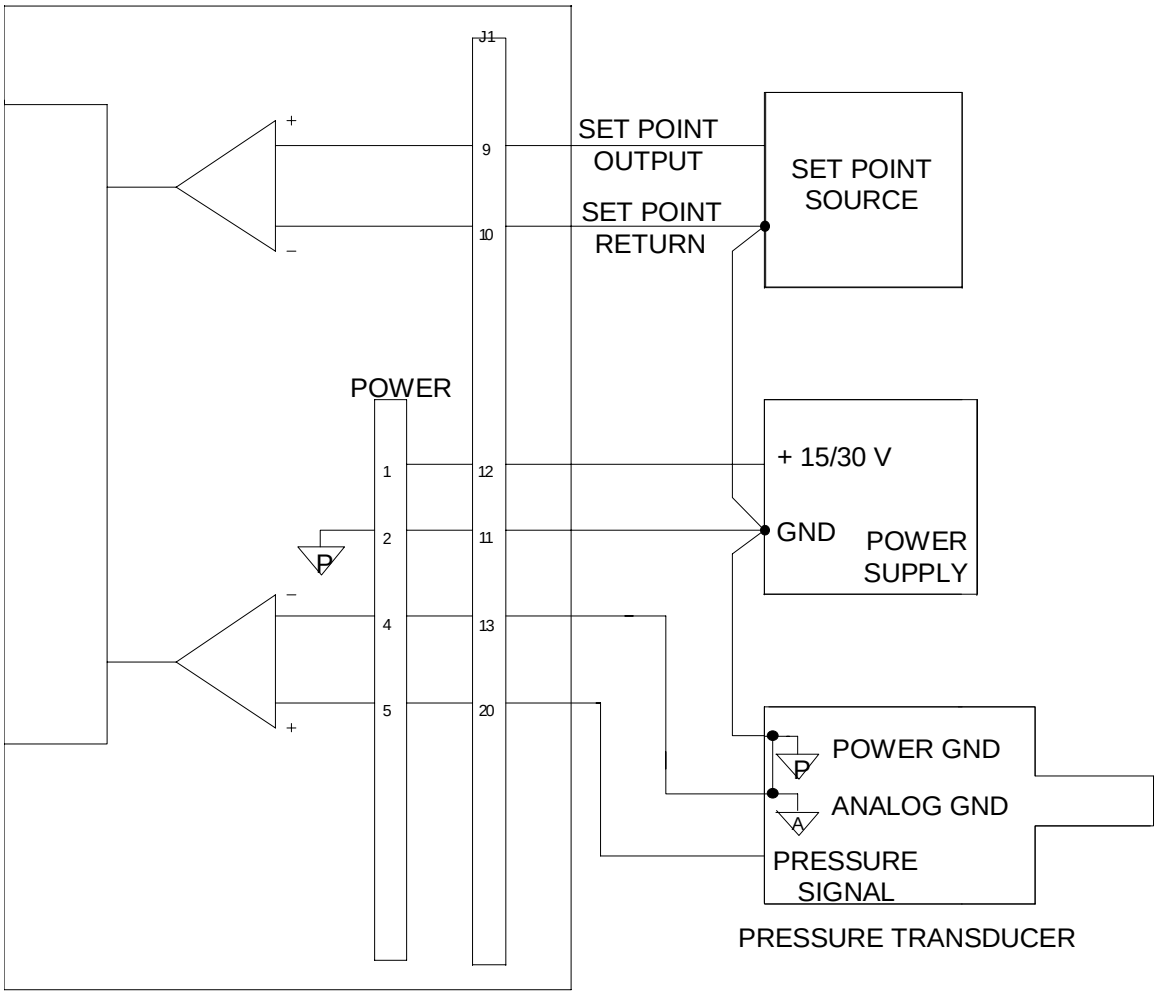

Figure 4: Returned Leads Tied to System Ground

Connectors and Cables

There are three connectors located on the front panel of the 1253 controller (refer to Figure 7, page 21). The controller can be configured in variety of ways; the system interface cables supplied by MKS are listed in Table 2, page 8.

Valve Connector (J3)

The 9-pin female Type "D" connector allows you to connect the 1253 controller to a 253B throttle valve. The connector includes pins for the valve drive motor and limit switches. Use the minimum length of cable to prevent voltage loss between the 1253 unit and the valve.

Valve Connector (J3) Pinout	
Pin	**Assignment**
1	Motor upper winding (Lo side)
2	Motor upper winding (Hi side)
3	Digital Ground
4	Open Limit-Switch
5	Close Limit-Switch
6	Motor lower winding (Lo side)
7	Motor lower winding (Hi side)
8	+5 VDC for opto switches
9	Motor return

Table 3: Valve Connector (J3) Pinout

Power Connector (J2)

This 9-pin male Type "D" connector serves as the power connector. It contains pins for power input, pressure input, and the limit switch outputs.

Power Connector (J2) Pinout		
Pin	**Assignment**	**Also connects to J2 Pin**
1	+15 to +30 Volt DC Power Supply Input	12
2	Power Supply Common (return for power supply)	11
3	-15V (External supply to transducer)	21
4	Pressure Signal Common (Lo side)	13
5	Pressure Signal Input (Hi side)	20
6	Limit-Switch Common	24
7	Open Limit-Switch Output	22
8	Close Limit-Switch Output	23
9	Chassis Ground	1, 25

Table 4: Power Connector (P2) Pinout

Input Connector (J1)

This 25-pin female Type "D" connector contains the pins for pressure input, set point input, RS-232 communications, power supply input, and the limit switch outputs.

Input Connector (J1) Pinout		
Pin	**Assignment**	**Also connects to J2 Pin**
1	Chassis Ground	9
2	TX (RS-232)	
3	RXD (RS-232)	
4	No Connection	
5	No Connection	
6	No Connection	
7	Digital Common	
8	+5 Volt Output (Powers portable terminal)	
9	Set Point Input (Hi side)	
10	Set Point Return (Lo side)	
11	Power Supply Common (return for power supply)	2
12	+15/30V Power Supply Input	1
13	Pressure Signal Common (Lo side)	4
14	No Connection	
15	No Connection	
16	No Connection	
17	No Connection	
18	Manual Close Command Line	
19	Manual Open Command Line	
20	Pressure Signal Input (Hi side)	5
21	-15V (External supply to transducer)	3

Table 5: Input Connector (J1) Pinout

(Continued on next page)

Input Connector (J1) Pinout *(Continued)*		
Pin	**Assignment**	**Also connects to J2 Pin**
22	Open Limit-Switch Output	7
23	Close Limit-Switch Output	8
24	Limit-Switch Common	6
25	Chassis Ground	9

Table 5: Input Connector (J1) Pinout

Note The "No Connection" pin assignment refers to a pin with no internal connection.

RS-232 Communications Cable

To connect your 1253 controller to a computer you must use a *null modem* RS-232 cable.

A null modem cable has pins 2 & 3 reversed from one end of the cable to the other. Any commercial RS-232 cable may be used as long as the pin reversal is made. Figure 5 shows the pin assignments on a null modem cable.

Connect the null modem cable from your computer to the Input connector on the 1253 unit (refer to *Input Connector (J1)*, page 16, for more information).

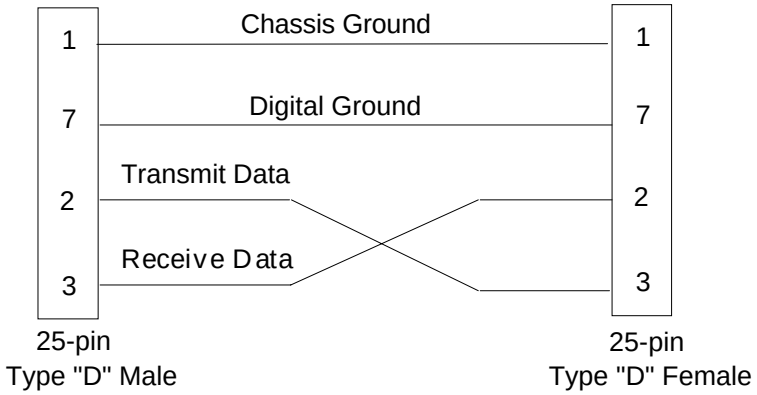

Figure 5: Null Modem RS-232 Communication Cable

Portable RS-232 Terminal (PT-1)

The MKS Type PT-1 unit is shipped with its RS-232 communication cable attached. To connect the PT-1 unit to the 1253 controller, plug the Type “D” connector from the cable on the PT-1 unit into the Input connector on the 1253 unit.

The default communication parameters for the 1253 unit configure it to communicate with the PT-1 unit. The default settings are listed in Table 7, page 28.

Chapter Three: Overview

General Information

The 1253 controller can accept a set point signal from either an external (analog) voltage source or a RS-232 (digital) source. In either case, the Input connector acts as the interface.

The 1253 unit can accept the pressure signal through either the Input or Power connector. When the pressure signal is received through the Power connector, a split power supply cable can be used to interface the pressure transducer and the controller through the Power connector. This leaves the Input connector empty to interface with the RS-232 port on an external computer.

The pressure and set point inputs to the 1253 controller are both differential inputs that are not internally referenced to ground. Tie the returns to the system ground at a single point (refer to *Grounding*, page 13, for more information).

The 1253 unit requires +15 to +30 Volts. If you need to power a pressure transducer through the 1253 unit, you must supply ±15 VDC to the 1253 unit. The controller uses the +15 V and sends the ±15 V on to the pressure transducer through the Input connector. Figure 6, page 20, shows the ±15 Volts being supplied from an MKS Type 260 Power Supply through the appropriate cable to the 1253 unit. The pressure transducer power and pressure signal connections are made through the Input connector.

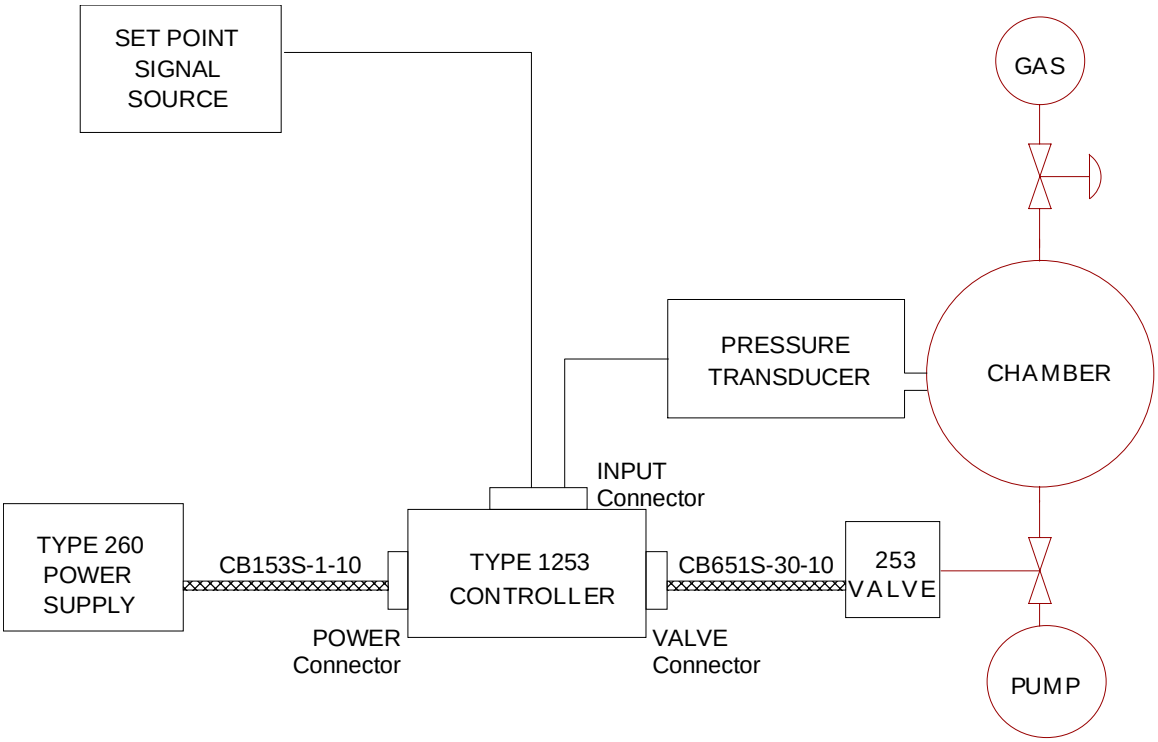

Figure 6: Example Piping and Cable Connections for the 1253 Controller

External Connectors and Controls

Figure 7 shows the location of the controls on the front panel of the 1253 controller.

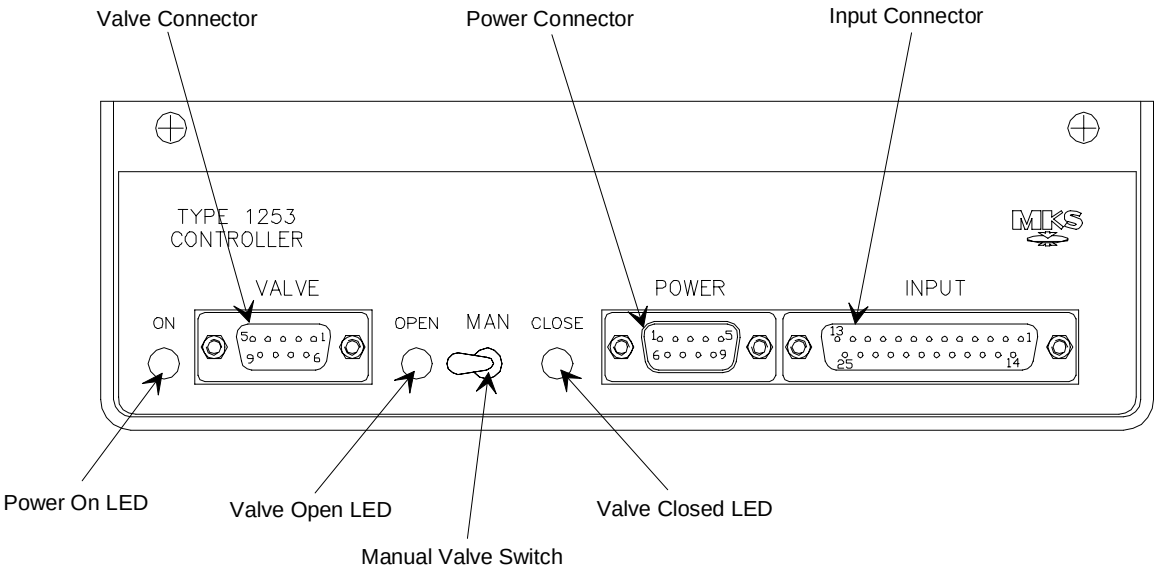

Figure 7: Front Panel of the 1253 Controller

Power ON LED

This LED indicator illuminates green when the unit is powered on.

Valve Connector

This 9-pin female Type "D" connector allows you to connect the 1253 controller to a 253B valve. The connector includes pins for the valve drive motor and limit switches.

Refer to Table 3, page 14, for the Valve connector pinout.

Valve Open LED

The OPEN indicator light illuminates red when the valve is fully open.

Manual Valve Switch

This switch (labeled MAN) allows you to manually drive the valve to the open or closed position.

Valve Closed LED

The CLOSE indicator light illuminates red when the valve is fully closed.

Power Connector

This 9-pin male Type “D” connector serves as the power connector. It contains pins for power input, pressure input, and the limit switch outputs.

Refer to Table 4, page 15, for the Power connector pinout.

Input Connector

This 25-pin female Type “D” contains the pins for pressure input, set point input, RS-232 communications, power supply input, and the limit switch outputs. The connector enables you to connect the 1253 controller to a transducer by accepting the input pressure signal.

Refer to Table 5, page 16, for the Input connector pinout.

Internal Controls

Dipswitch Bank

The dipswitch bank, located on the CPU board inside of the 1253 controller, provides the connections for all internal controls. Refer to Figure 8 for the location of the dipswitch bank on the CPU board.

The dipswitch bank contains eight switches which are used to change or set the operating parameters for 1253 unit. The functions assigned to each dipswitch and their initial settings are listed in Table 6, page 24.

Note 

Refer to *How To Change the Dipswitch Settings*, page 29, for instructions on how to access the CPU board and change the dipswitch settings.

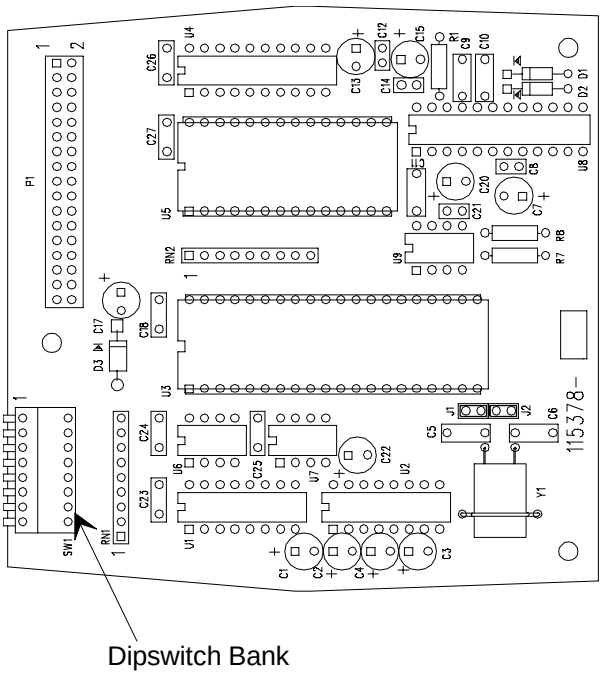

Figure 8: Location of the Dipswitch Bank on the CPU Board

Dipswitch Functions and Settings			
Dipswitch	**Function**	**Switch Position**	
		OFF (Open)	**ON (Closed)**
8	Control Type	Position Control	Pressure Control*
7	Set Point Type	Digital	Analog*
6	Operating Protocol	Standard RS-232	Terminal Protocol*
5	Parity	None*	Even
4	Baud Rate	1200	9600*
3	End-of-Line Delimiter	Carriage return (CR)*	Carriage return line feed (CRLF)
2	Set Point Entry	Sxxx.x	S1xxx.x*
1	Set Point Control	Reverse	Normal*
**Initial setting*			

Table 6: Dipswitch Functions and Settings

Switch 8: *Selects the method of control.* When the switch is OFF, the 1253 unit acts as a position controller; the set point is read by the position of the valve. When the switch is ON, the valve acts as a pressure controller; the set point is triggered by a pressure measurement.

Switch 7: *Selects the source of the set point signal.* When the switch is OFF, the 1253 controller expects to receive a digital set point signal through the RS-232 interface. When the switch is ON, the controller expects an external analog voltage set point signal on the Input connector. You can override the analog set point by sending an RS-232 signal to the 1253 controller. Use the standard protocol "A" command to revert back to an analog set point. Refer to *RS-232 Operating Commands*, page 30, for more information.

Switch 6: *Establishes the RS-232 operating protocol.* When the switch is OFF, standard RS-232 protocol is accepted. When the switch is ON, the controller uses the portable terminal (PT-1) protocol.

Switch 5: *Toggles the parity setting.* The OFF setting selects no parity. The ON setting selects even parity.

Switch 4: *Sets the baud rate.* When OFF, the baud rate is 1200. When ON, the baud rate is 9600.

Switch 3: *Selects the end-of-line delimiter.* When the switch is OFF, the delimiter is a Carriage Return (CR). When the switch is ON, the delimiter is a Carriage Return Line Feed (CRLF).

Switch 2: *Controls the RS-232 compatibility for the set point entry.* When the switch is OFF, the set point entry command is Sxxx.x. When the switch is ON, the set point entry is S1xxx.x. The extra "1" makes this entry downwardly compatible with other MKS instruments such as the Type 152, 153, and 112 units.

Switch 1: *Selects the set point control action.*

When the switch is OFF, a zero to full scale set point produces an open to close valve action. Pressure above the set point causes the valve to move toward *close* position. This is "reverse" operation and assumes that the output of the pressure transducer (or process variable) *decreases* for increasing pressure.

When the switch is ON, a zero to full scale set point produces a closed to open valve action. Pressure above the set point causes the valve to move toward *open* position. This is "normal" operation and assumes that the output of the pressure transducer *increases* positively for increasing pressure.

Power-Down Constants

The 1253 unit saves the several constants in non-volatile RAM when the power is turned off. When the power is restored, the 1253 unit "remembers" these settings.

The parameters are:

- Number of valve steps
- Analog set point zero
- Analog pressure zero
- Analog set point full scale
- Analog pressure full scale
- Lead
- Gain
- Present valve position

The following conditions apply at power-up:

- The processor checks the position of all switches on the dipswitch bank.
- The operational mode is determined by dipswitches 7 and 8.

  If dipswitches 7 and 8 are ON, the unit "wakes up" in pressure control mode and uses an analog set point.

  If dipswitches 7 and 8 are OFF, the unit "wakes up" in position control mode and uses a digital set point.

The stored constants are recalled and used in all subsequent operations.

Chapter Four: Operation

General Information

The 1253 controller can communicate with an external computer or a portable terminal (PT-1) through the RS-232 interface. Although the setup varies slightly, operation is the same regardless of whether you are using a computer or the PT-1. The computer can read pressure, valve position, and tuning parameters. It can also change the set point, open and close the valve, and change the tuning parameters.

The 1253 controller accepts pressure or position set points from an external computer, through RS-232 communications or an external analog voltage source, and uses an internal digital "PID" algorithm to determine valve position.

When the set point is under pressure control, the feedback is an analog pressure signal. This signal is normally 0 to +10 Volts, but the zero and full scale voltages can be adapted to individual applications. The Gain and Lead constants used in the control algorithm are set at the factory but are adjustable via RS-232 commands, using either a computer or a portable terminal.

When the set point is under position control, the valve is moved as a result of the position control command, and no feedback signal is generated.

RS-232 Communication Parameters

The initial RS-232 communication parameters for the 1253 unit are listed in Table 7. Ensure that *both* your 1253 controller and your computer are configured with the same parameters.

Initial RS-232 Communication Parameters	
Parameter	**Value**
Stop Bit*	1
Data Bits*	8
Handshaking*	None
Parity**	None
Baud Rate**	9600
End-of-Line Delimiter**	CR
Operating Protocol**	Standard RS-232 *or* Terminal Protocol (initial)
* *These parameters are factory set and cannot be adjusted.* ** *These parameters are user-adjustable; refer to Table 6, page 24, for more information.*	

Table 7: Initial RS-232 Communication Parameters

To change any of the user-adjustable parameters, you must change the dipswitch settings on the CPU board. Refer to *How To Change the Dipswitch Settings*, page 29, for instructions on how to access the CPU board and change the dipswitch settings.

The communication parameters are identical regardless of your choice of hardware, except for the operating protocol. Ensure that you specify whether you are using a remote computer or the PT-1 portable terminal, by setting dipswitch 6 to the desired position as listed in Table 6, page 24

Note .When using the PT-1 unit, the 1253 unit must be configured with the default dipswitch settings (refer to Table 6, page 24). When configured properly, the 1253 unit accepts RS-232 characters from the PT-1 *without needing the shift key* on the portable terminal.

How To Change the Dipswitch Settings

The dipswitches located on the CPU board (refer to Figure 8, page 23) control the operating and communication parameters for the 1253 controller. To set or change any parameter, you must change the position of the appropriate dipswitch. Refer to Table 6, page 24, for a complete listing of the functions assigned to each dipswitch and their initial settings.

To change the dipswitch settings:

1. Disconnect the power source from the 1253 controller.

Warning  **To avoid an electrical shock, disconnect the power cord *before* opening the unit.**

2. Unscrew the 16 screws (6 screws on the front, 2 on the bottom, and 8 on the top) on the unit and lift off the cover.

3. Locate the CPU board and the dipswitch bank.

   There are two boards inside of the 1253 unit; the CPU board in the small, top most board. Refer to Figure 8, page 23, for the location of the dipswitch bank.

4. Change the position of any of the dipswitches as required.

   Refer to Table 6, page 24, for a complete listing of the functions assigned to each dipswitch and their initial settings.

5. Replace the cover of the unit and the secure it in place with the 16 screws.

6. Power up the 1253 controller.

Note  You must repower the system before any changes to the dipswitch setting are recognized by the 1253 unit.

RS-232 Operating Commands

The operating commands, listed in Table 8, are the same, regardless of whether you are using a remote computer or the portable terminal (PT-1).

RS-232 Operating Commands	
Command	**Assignment**
A*	Go to analog set point level and control*
B	Resets the controller, relearns the valve, and uses the operating parameters listed in Table 10, page 33.
C	Close the valve
D	Same as A
F1	Learn analog set point full scale
F2	Learn analog pressure full scale
G xxx.x	Set controller gain (in percent)
H	Hold valve position
L xxx.x	Set controller lead (in percent)
O	Open the valve
P xx.x	Set valve position (in degrees)
Ry**	Report following data**
S xxx.x	Set pressure set point (in percent)
V	Learn valve steps
X	Reports valve position continuously (for PT-1 only)
Z1	Learn analog set point zero
Z2	Learn analog pressure zero
**Dipswitch 7 (set point control) must be in the default ON (Closed) position (analog).* ***Report responses are listed in Refer to Table 9, page 31.*	

Table 8: RS-232 Operating Commands

RS-232 Requests and Response Messages

The RS-232 requests and response mesasges are listed in Table 9.

RS-232 Request and Response Messages			
Request (R_y)	**Parameter**	**Responses**	**Units**
R_1	Digital Pressure Set Point	S xxx.x	Percent
R_2	Gain	G xxx.x	Percent
R_3	Lead	L xxx.x	Percent
R_4	Analog Set Point	A xxx.x	Percent
R_5	Pressure	P xxx.x	Percent
R_6	Position	V xxx.x	Degrees
R_8	Slipped	C x where 0 = OK 1 = slipped	none
R_{10}	Set Point Zero	ZA xxx.x	Percent
R_{11}	Pressure Zero	ZB xxx.x	Percent
R_{12}	Set Point FS	FA xxx.x	Percent
R_{13}	Pressure FS	FB xxx.x	Percent

Table 9: RS-232 Request and Response Messages

How To Learn the Valve

Since the valve is external to the 1253 controller and it is not always possible to match the controller to the valve at the factory, you must instruct the unit to *learn* the valve it is controlling to ensure proper control.

The learn process is initiated using RS-232 commands, on either a PC or a MKS PT-1 portable terminal. Refer to *RS-232 Communication Parameters,* page 28, for more information.

Note Regardless of the communication device used, the control characters used are identical.

1. Ensure that your system is configured to withstand the change in valve position from the fully open to fully closed position.

   Otherwise, your system may be damaged during this procedure.

2. Verify that the 1253 unit is powered on and connected to the correct valve with cable.

   The system interface cables are listed in Table 2, page 8.

3. Enter the command:

   V ENTER

   The 1253 unit initiates the learn process. During the learning mode, the 1253 unit drives the valve from the fully closed to the fully open position.

4. Enter the command:

   C ENTER

   The 1253 unit drives the valve to the fully closed position.

Refer to *How To Calibrate the Controller,* page 35, for more information on the commands.

How To Reset the 1253 Controller

The "B" command resets the controller, relearns the valve, and establishes settings for the lead, gain, set point, and the full scale and zero voltage levels for both the pressure input and set point input.

Note The learn procedure causes the valve to move to the full open and full close positions. Be sure that your system can withstand these valve positions *before* issuing the "B" command.

Table 10 lists the operating values used by the "B" command. You may need to reset the lead, gain, and set point values to the values used prior to resetting the controller. To reset the zero and full scale settings, refer to *How To Calibrate the Controller*, page 35.

Operating Values Established by the "B" Command	
Parameter	**Value**
Lead	4.%
Gain	90.0%
Set Point	0.0%
Pressure Zero	0.0 Volts
Set Point Zero	0.0 Volts
Pressure Full Scale	10.0 Volts
Set Point Full Scale	10.0 Volts

Table 10: Operating Values Established by the "B" Command

How To Tune the Controller

1. Apply power to the 1253 unit and turn on the upstream gas source(s).

2. Apply the desired analog set point signal or an RS-232 message.

   The 1253 unit responds by changing the pressure smoothly to the desired value. If the pressure is slow changing to the desired value (over 30 seconds), or oscillates, then adjust the LEAD and/or GAIN. Use the RS-232 communication link to change the LEAD and GAIN values. Refer to *RS-232 Operating Commands*, page 30, for a description of the control characters to use.

3. Increase the LEAD setting if the pressure overshoots the selected value.

   If there is no overshoot, and particularly if the pressure is slow approaching the set point value, then reduce the LEAD setting. Repeat this test to confirm that the LEAD setting is appropriate. Note that the correct LEAD setting for a rise in pressure is normally *not* the same LEAD setting for a drop in pressure. Therefore, duplicate the test for the LEAD parameter with the same set point and direction as required in the process.

4. Reduce the GAIN setting if the pressure oscillates about the correct value.

   The highest possible GAIN setting produces the best pressure control, therefore reduce the GAIN setting in very small increments.

Note 

The speed of pressure response is relative and depends on chamber size and absolute pressure. Lower pressures (less than 10 microns) are usually slower because of the slower molecular flow and reduced pumping speed.

The maximum rate of rise of pressure is determined by the following formula (with the exhaust valve fully closed).

$$Pr = F/V$$

Where: Pr = pressure rate of rise in Torr/sec.
F = flow in Torr-liters/sec.
V = volume in liters

Consequently, in systems with small input flows and relatively large volumes, the pressure will rise slowly even when the control valve is fully closed.

If the controller cannot achieve good control, the problem may be caused by improper pneumatic connections. Refer to *System Considerations*, page 12, to read about factors which effect pressure control.

How To Calibrate the Controller

The 1253 unit can perform five calibrations. They are:

- Learn the analog set point zero
- Learn the analog set point full scale
- Learn the analog pressure zero
- Learn the analog pressure full scale
- Learn the number of valve steps

You must issues these commands via RS-232 communications. To do this, connect a computer or a MKS PT-1 unit to the 1253 controller.

How To Calibrate the Analog Set Point

How To Learn the Analog Set Point Zero

1. Supply zero input voltage to pin 9 on the Input connector.

   Refer to Table 5, page 16, for the Input connector pinout.

2. Send the *Learn Analog Set Point Zero* command:

   Z1 ENTER

   The 1253 controller learns the input voltage that corresponds to an analog set point zero value. The analog set point zero value is set to 0.0 Volts at the factory.

How To Learn the Analog Set Point Full Scale

1. Supply full scale input voltage to pin 9 on the Input connector.

   Refer to Table 5, page 16, for the Input connector pinout.

2. Ensure that the input voltage is at least 9% of the 10 V full scale voltage.

   If the voltage is less than 9% of the typical full scale voltage, the controller ignores the learn command and retains the previous value. This eliminates the possibility of learning an erroneous voltage value.

3. Send the *Learn Analog Set Point Full Scale* command:

   F1 ENTER

   The 1253 controller learns the input voltage that corresponds to the analog set point full scale value. The analog set point full scale value must be between +1 V and +10 Volts; it is set to +10.0 Volts at the factory.

How To Calibrate the Transducer Range

When a voltage enters the 1253 controller as a calibration signal, for a pressure zero or pressure full scale reading, the controller scales the signal to allow for a slightly overrange or underrange signal. The controller does not convert the signal back to a full 0 to 10 V range. Therefore, when you query the controller for a pressure zero or pressure full scale reading, it will return the offset value, rather than the true zero or full scale voltage reading.

How To Learn the Analog Pressure Zero

1. Warm-up the transducer and pump it below its resolution.

   Refer to the appropriate transducer manual for the time required to warm up the unit and the proper zero pressure.

2. Send the *Learn Analog Pressure Zero* command:

   Z2 ENTER

   The 1253 controller verifies that the pressure transducer is properly warmed-up and pumped below its resolution. The 1253 controller learns the pressure input that corresponds to the analog pressure zero value. The analog pressure zero value is factory set to 0.0 Volts.

How To Learn the Analog Pressure Full Scale

1. Warm-up the transducer and set up the pressure system for full scale pressure.

   Refer to the appropriate transducer manual for the time required to warm up the unit and the proper zero pressure.

2. Ensure that the input voltage is at least 9% of the 10 V full scale voltage.

   If the voltage is less than 9% of the typical full scale voltage, the 1253 controller ignores the learn command and retains the previous value. This eliminates the possibility of learning an erroneous voltage value.

3. Send the *Learn Analog Pressure Full Scale* command:

   F2 ENTER

   The 1253 controller raises the pressure to the full scale value of the transducer. The unit learns the pressure input that corresponds to the analog pressure full scale value. The analog pressure full scale value is factory set to +10.0 Volts.

How To Learn the Number of Valve Steps

The 1253 controller opens and closes the valve, so be sure that it will not affect your system.

1. Send the *Learn Number of Valve Steps* command:

   V ENTER

   The unit is factory set for the attached valve.

How To Connect the Controller to the Type 146 Cluster Gauge™

The Type 146 Cluster Gauge can be used to control the 1253 unit. To configure the 1253 unit to communicate with the 146 instrument, leave the dipswitches at the default settings (refer to Table 6, page 24) *except* for switch 8. Set switch 8 to the OFF (Closed) position, so the unit will act as a position controller. The system will then use the PID control on the 146 instrument to control the valve. Refer to *How To Change the Dipswitch Settings,* page 29, for instructions on how to change the position of switch 8.

Note  The 146 instrument must contain the optional "M" board (Control Board) to control the 1253 unit.

1. Connect the 1253 controller to the "M" board (Control Board) in the 146 instrument using the appropriate cable.

   The Control Board has two 9-pin Type "D" connectors: one male and one female. The cable uses the 146 instrument to power the 1253 unit and provides the analog voltage to position the valve to control pressure. The system interface cables are listed in Table 2, page 8.

2. Use the Setup Mode Code 14x, on the 146 instrument to select the control action (direct for downstream control) and the pressure reference channel.

3. Use the Open and Close commands on the 146 instrument to move the valve from fully open to fully closed.

4. Watch the Open and Close LED lights on the 1253 unit.

   If the appropriate light is illuminated when the valve is in position, the zero and full scale settings are correct. If the appropriate light is not illuminated correctly, proceed to step 5.

5. Calibrate the 1253 controller using either a remote computer or a PT-1 portable terminal.

   The 1253 unit will learn the new values for zero and full scale for the controller and transducer. Refer to *How To Calibrate the Controller,* page 35, for details.

Chapter Five: Maintenance and Troubleshooting

General Information

If the 1253 instrument fails to operate properly upon receipt, check for shipping damage, and check the cables for continuity. Any damage should be reported to the carrier and MKS Instruments immediately. If it is necessary to return the unit to MKS, obtain an ERA number (Equipment Return Authorization Number) from a MKS Service Center before shipping. Please refer to the inside back cover of this manual for a list of MKS Calibration and Service Centers.

Maintenance

Periodically check for wear on the cables and inspect the enclosure for visible signs of damage.

Troubleshooting

Valve Slippage Signal

The 1253 unit has a "Valve Slipped" signal that can be useful when diagnosing exhaust valve or system problems. The Valve Slipped signal is only available through the RS-232 interface.

When the 1253 unit contacts either of the limit switches, the internal position signal should equal the appropriate valve position (0 for close, 100% for open). If the position signal is more than 3% different from the appropriate value, the Valve Slipped signal is set to "1" (meaning slipped).

When message R8 is sent to the 1253 unit, the unit returns either C0 or C1 (refer to Table 9, page 31). C0 indicates the valve has not slipped. C1 indicates the valve has slipped *since the last request* (R8). The signal is reset to 0 when it is read by the computer or PT-1.

Situations that can cause the valve to slip include:

- The flapper is moved while the 1253 unit is turned off
- The flapper is rubbing or contacting part of the plumbing
- Particulates are depositing on the wall and slowing the flapper motion

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Appendix A: Product Specifications

CE Mark Compliance[1]	EMC Directive 89/336/EEC
Connectors	One 25-pin "D" female for input signals and power input One 9-pin "D" male for power input or output, and signal inputs
Control Lines	OPEN and CLOSE Valve control lines (Activated by an active low TTL) Hi input maximum voltage is 30 Volts and drawing less than 200 μA of leakage current
Display	1 Red LED for OPEN Limit Switch 1 Red LED for CLOSE Limit Switch 1 Green LED for Power
Input Power Requirements	+14 VDC to maximum +30 VDC @ less than 5 Watts (minimum) If a transducer is connected to the unit, its power can be supplied by the same external supply used by the unit, or by a separate external supply.
Manual Valve Switch	Toggle switch directs valve to OPEN or CLOSE position
Operating Temperature	15° to 50° C (59° to 122° F)
Outputs	Opto-coupled Limit Switch (L.S.) One for Open, one for Close 30 V maximum, 10 mA maximum
Power Loss	Unit saves calibration constants and valve position
Pressure Input Signal	0 to +10 Volts DC (normally) Can be calibrated to any full scale voltage from 1 to 10 Volts

[1]Overall metal braided shielded cables, properly grounded at both ends, are required during use.

RS-232	Bi-directional communication Input - set point and learn commands (in 0.1% increments) Output - (on request) actual position, pressure (in 0.1% increments) "Out of Sync" - Valve Slipped
Set Point Input Signal	0 to +10 Volts DC (normally) Can be calibrated to any full scale voltage from 1 to 10 Volts
Valve Speed - OPEN to CLOSE	Normal - 7.5 seconds Fast - 1.8 seconds (Ref SP021-84)

Due to continuing research and development activities, these product specifications are subject to change without notice.

Appendix B: Model Code Explanation

Model Code

The 1253 controller is identified as the Type 1253E.

Portable RS-232 Terminal

The hand-held RS-232 terminal used for setup and diagnostics is ordered separately and is identified as the Type PT-1A.

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