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MKS

Instruction Manual

112888-P1
REV E, 7/93

MKS Type 652A Throttle Valve Controller

SIX SHATTUCK ROAD, ANDOVER, MASSACHUSETTS 01810 (508) 975-2350 (800) 227-8766 FAX (508) 975-0093

MKS INSTRUMENTS, INC.

WARRANTY

for Type 652 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.

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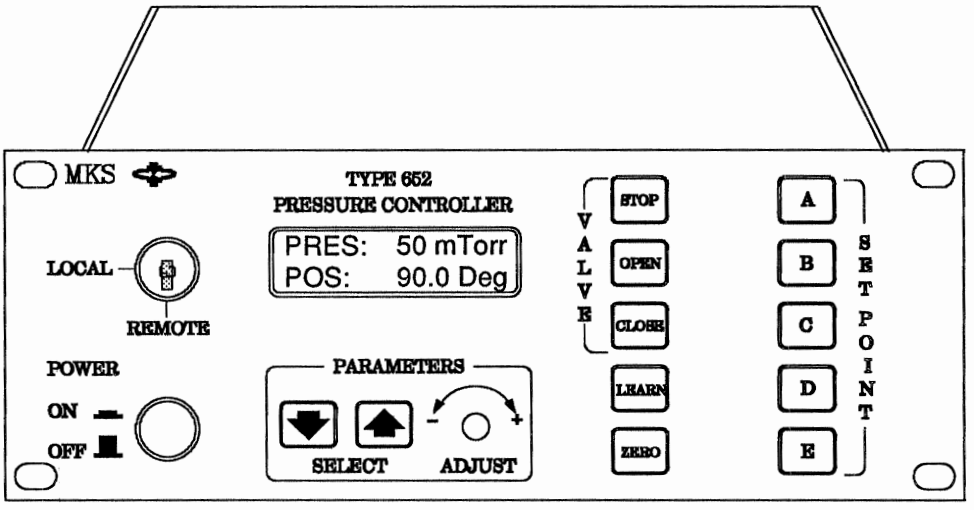
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MKS Type 652A
Throttle Valve
Controller



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Firmware Version 1.7

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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 the intended use of this instrument. 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.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation, is present.

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting it to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

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.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your product.
Use only a cord in good condition.

USE THE PROPER POWER SOURCE

This product is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors, or between either of the supply conductors and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

USE THE PROPER FUSE

Use only a fuse of the correct type, voltage rating, and current rating, as specified for your product.

KEEP AWAY FROM LIVE CIRCUITS

Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

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.

General Information

Introduction

The Type 652 instrument is a precision, downstream, pressure controller for throttle valves. It can also power and provide a readout for an attached capacitance manometer. The 652 instrument has a Self-Tuning feature which ascertains the system's characteristics and then determines the parameters necessary for control. This Self-Tuning feature takes into account time constants, transfer functions of the valve and plumbing, valve gain, pump speed, and many other parameters when determining the system characteristics.

All controls on the Type 652 instrument are accessible through the front panel, and remotely accessible via RS-232, TTL, or analog voltage. The default window display on the front panel shows the pressure readout and the valve position (in degrees). The pressure readout can be displayed in units of Torr, Bar, or Pascal. The 652 instrument has a high-powered driver to operate all MKS type throttle valves, including valves up to 4" (102mm) with vacuum shut-off capability, giving the unit a control range from 10^{-4} to 770 Torr with the appropriate pressure transducer. The MKS Type 653 valve, which has a faster step rate than other throttle valves, can also be driven by the Type 652 unit.

Located on the front panel is a key lock switch used to select front panel or rear panel control. The switch can lock the front panel controls as a safety measure to prevent accidental command entries. There is an optional valve failsafe battery backup available. The battery backup allows the 652 instrument to be user-configured to drive a valve open or closed, or maintain its position, upon an AC power failure.

Customer Support

Standard maintenance services are available at all of our regional MKS Calibration and Service Centers in North America, Europe, U.K., Japan, and Korea. As an extended courtesy, 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 652 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 assures 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.

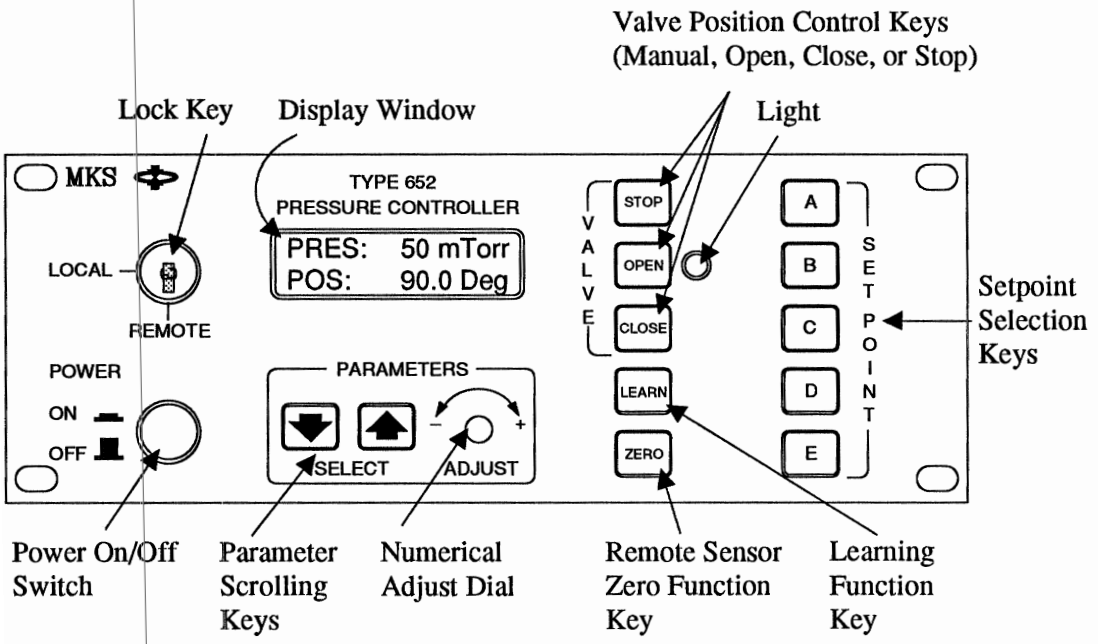


Figure 1: Front Panel of the Type 652 Instrument

Description

The Front Panel

Figure 1 on the facing page, s all the components found on the front panel of the 652 instrument. Table 1 below summarizes the functions of the front panel components.

Front Panel Component	Function
Power On/Off Switch	Turns power to the Type 652 unit On or Off.
Key Lock Switch	Switches between LOCAL (front panel), and REMOTE (rear panel), control. The switch must be set to REMOTE to remove the key.
Display Window	Displays pressure and the valve position by default. It can also display other information such as setpoints, trip limits, softstart rate, and battery voltage, depending on how the 652 unit is configured.
Valve Position Control Keys	Used to select the valve position. The possibilities are Open, Close, and Stop.
Lights	The lights on the front panel are not visible unless lit. They indicate which parameter(s) (ex. setpoint A), or function(s) (ex. Learn) is currently active.
Setpoint Selection Keys	Used to select which setpoint (A - E), is the active setpoint.
Learn Function Key	Used to enable the learning function within the 652 unit. When in a control system with a positive flow rate, the 652 learning function determines the system characteristics necessary for control. NOTE: The key must be held down for about 3 seconds, until the Learn light goes on.
Remote Sensor Zero Function Key	Used to zero an attached sensor.
Numerical Adjust Dial	Used to enter parameter values.
Parameter Scrolling Keys	Used to scroll through displays.

Table 1: Summary of Front Panel Components

Local and Remote Operation

The key lock switch is used to select front panel control (LOCAL), or rear panel control (REMOTE). When set to LOCAL, all *commands* must be entered through the front panel. Information *requests* (not commands), and 652 unit *responses*, however, may still be sent through the RS-232 connector on the rear panel.

When the key lock is set to REMOTE, the front panel becomes locked out. This is a useful feature for preventing accidental command entries. All commands must now be sent via TTL, analog voltage, or the RS-232 connector.

Refer to the *RS-232 Control* chapter, beginning on page 37, for RS-232 command protocol.

Self-Tuning/PID Control

The Type 652 instrument can control a vacuum system in one of two ways. When used with *Self-Tuning control*, the 652 unit determines control parameters based upon the system's characteristics. With Self Tuning control, lead and gain parameters are not required. The 652 instrument determines the system's characteristics when the LEARN button is pressed. The key lock switch must be set to LOCAL to use the LEARN button. After the 652 unit learns the system characteristics however, it can operate with the key lock switch set to LOCAL or REMOTE (refer to the *How To Activate Learn Mode* section, on page 28 for more information about the LEARN button).

When used with *PID control*, the 652 unit employs a **P**roportional, **I**ntegral, and **D**erivative (PID), algorithm for control. In the 652 unit, PID control requires the input of user-defined lead and gain values. Although there are default values for lead and gain, user-defined values must be supplied for good control. To provide user-defined lead and gain values, refer to the *How To View and Adjust Lead and Gain Parameters* section, on page 33. The key lock switch must be set to LOCAL to define lead and gain parameters. Once the lead and gain parameters have been defined, the 652 unit can operate with the key lock switch set to LOCAL or REMOTE.

Battery Backups

There are two types of batteries used in the 652 instrument - a lithium battery and an optional lead-acid battery. The lithium battery is included inside each 652 unit and is used to store configuration and learned system information while power is off. The optional lead-acid battery allows the 652 instrument to be user-configured to drive a valve open or closed, or maintain its position upon an AC power failure.

Front Panel Display

The front panel display shows pressure and valve position by default. If another display is scrolled to (with the arrow keys) the 652 unit automatically returns to the default display after about 45 seconds, if no other keys are pressed.

The up arrow [▲], scrolls to the next display in the display sequence. The down arrow [▼], selects the previous display in the display sequence.

The display sequence is determined by the key lock switch setting (LOCAL or REMOTE), whether or not the optional valve failsafe battery backup is installed, and how the 652 instrument is configured. As can be seen in Table 2 below, when the key lock switch is set to REMOTE, *Pressure and Valve Position* is the only display possible. When the key lock switch is set to LOCAL, however, there are many possible displays, as shown in Table 3 on the following page.

	REMOTE Key Lock Setting	
	Display Sequence	**Exceptions**
1.	Pressure and Valve Position	None

Table 2: Display Sequence when the Key Lock Switch is set to REMOTE

LOCAL Key Lock Setting	
Display Sequence	**Conditions**
1. Pressure and Valve Position	*The default display*
2. Setpoint A and Pressure	
3. Lead A and Pressure	Not displayed if using Self-Tuning Control
5. Gain A and Pressure	Not displayed if using Self-Tuning Control
6. Setpoint B and Pressure	
7. Lead B and Pressure	Not displayed if using Self-Tuning Control
8. Gain B and Pressure	Not displayed if using Self-Tuning Control
9. Setpoint C and Pressure	
10. Lead C and Pressure	Not displayed if using Self-Tuning Control
11. Gain C and Pressure	Not displayed if using Self-Tuning Control
12. Setpoint D and Pressure	
13. Lead D and Pressure	Not displayed if using Self-Tuning Control
14. Gain D and Pressure	Not displayed if using Self-Tuning Control
12. Setpoint E and Pressure	
13. Lead E and Pressure	Not displayed if using Self-Tuning Control
14. Gain E and Pressure	Not displayed if using Self-Tuning Control
15. Trip Limit 1 - High Limit	
16. Trip Limit 1 - Low Limit	
17. Trip Limit 2 - High Limit	
18. Trip Limit 2 - Low Limit	
19. Soft Start Rate	
20. Analog Setpoint	Only displayed if Remote Source Type is Analog
21. Battery Voltage	Only displayed if the Valve Battery Backup is installed

Table 3: Display Sequence when the Key Lock Switch is set to LOCAL

Installation

Unpacking the 652 Unit

Care has been taken to pack the Type 652 Throttle Valve Controller so that it will reach you in perfect operating condition. Upon receiving the unit, however, you should check for defects, cracks, broken controls and 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 instrument 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.

Parts Checklist

Standard Parts

1. The 652 instrument.
2. A power cord.
3. A key for the front panel key lock switch.
4. Connectors for the rear panel of the unit (25 pin female and male connectors, 15 pin male).
5. One connector cover for each connector supplied.
6. Four screwlock assemblies for each connector cover supplied.
7. User's Instruction Manual.

Optional accessories.

1. Valve failsafe battery backup (installed in the unit at the factory).
2. Cables for supported sensors.
3. Cables for MKS Type 253A (standard valve) or 653A valves.
4. RM-6 Rack Mount option.

Note 

If a Valve battery backup is ordered after the 652 unit is received, the unit must be sent back to your local MKS Service Center to have the battery backup system installed. Before returning the instrument to MKS, obtain an ERA Number (Equipment Return Authorization Number) from an MKS Service Center. Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Product Location and Requirements

1. Operating ambient temperature must be in the range of 15° - 40° C.
2. Humidity must be kept between zero and 95%, non-condensing.
3. Proper clearance must be supplied so that the unit can operate within product environmental specifications.
4. The 652 unit can be mounted in a panel cutout or in a 19 inch rack when supplied with the RM-6 Rack Mount option.
5. Input Power requirements are 90-132VAC or 198-264VAC, 50/60 Hz and 80VA max.
6. A 1.0 ASB 250V fuse is required for 110V or 120V operation, and a 0.5 ASB 250V fuse is required for 220V or 240V operation.

Caution



1. Be sure the voltage setting is correct for your local electrical source.
2. Be sure the fuse type is appropriate for your voltage setting.

   Refer to the *Checking the Voltage Setting and Fuse Type* section, on page 22, for instructions.

7. The maximum pressure in the vacuum system in which the 652 unit is installed must not exceed atmospheric pressure due to the requirements of the throttle valve.
8. A solid system ground should be maintained for proper operation and safety to personnel.

Type 652 Set Up

Internal Switches

If a full configuration sheet was filled out when the Type 652 controller was ordered, the unit will arrive with all dipswitches set correctly. However, if a configuration change is made in the system after the unit arrives, some dipswitch settings inside the 652 unit may need to be changed.

There are three dipswitch banks inside the 652 unit which are used to customize its configuration. One dipswitch bank (SW1), is located on the RS-232 board. The next two dipswitch banks are located on the Sensor I/O board (SW1 and SW2). To access the dipswitch banks, the 652 unit must be opened.

Warning  **The 652 unit has lethal voltages inside. To avoid the danger of electrical shock, the power line must be disconnected before opening the unit.**

Opening/Closing the 652 Controller

1. Turn the power off.
2. Disconnect the AC power cord.
3. Remove the top two phillips screws and washers on the rear panel.

Caution  **To avoid damage to sensitive internal components, personnel should be grounded while working inside the 652 unit.**

4. Remove the top cover by firmly pulling it towards the back of the unit.

   The three dipswitch banks are now accessible.

   After changing the dipswitch settings, close and power up the 652 unit in the reverse order of steps (that is, start with step 4 and go to step 1). The new dipswitch settings are recognized.

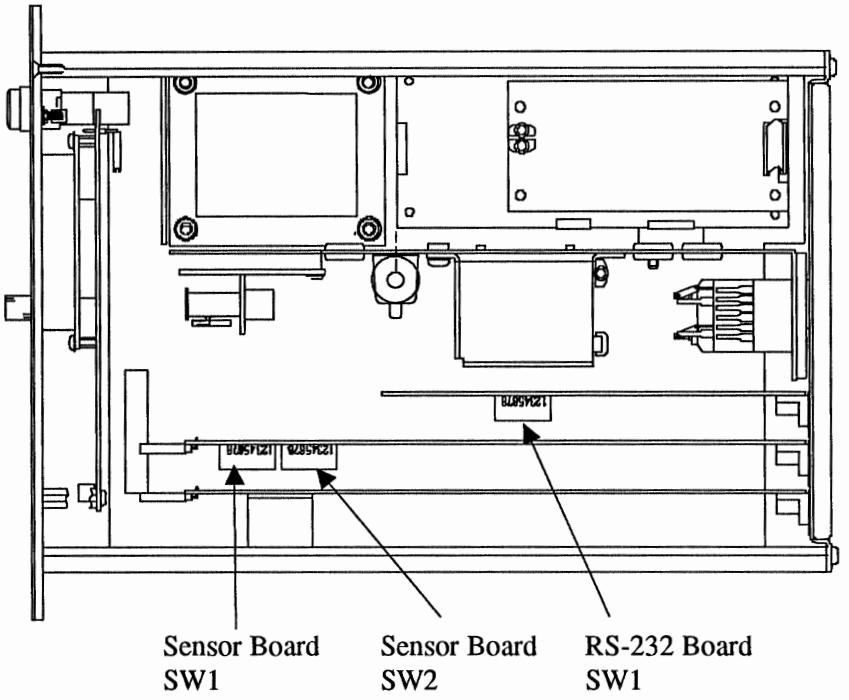


Figure 2: Dipswitch Bank Locations

Refer to Figure 2 above for the location of the three dipswitch banks. The switches in each dipswitch bank are numbered from 1 to 8. Each dipswitch bank has the word **OPEN** written on it (refer to Figure 3 below). Push each switch towards the word **OPEN** when a Dipswitch Bank table (located on the following pages), lists an O , and away from the word **OPEN** when the table lists a C (for Closed).

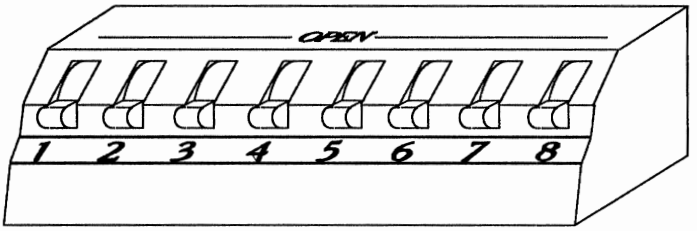


Figure 3: Example of a Dipswitch Bank
In this example, all dipswitches are set in the Closed position.

The following three pages show the proper switch settings for the three dipswitch banks inside the Type 652 controller.

Dipswitch Bank Settings

RS-232 Board Dipswitch Bank SW1									
Function	**Choices**	**Switches**							
RS-232 Baud Rate		**1**	**2**	**3**	**4**				
The five choices for baud rate are listed here.	300	O	C	O	O				
	1200	O	O	C	O				
	2400	O	O	O	C				
	4800	O	C	C	O				
	9600	C	C	C	O				
RS-232 Parity						**5**	**6**		
The three choices for parity checking are listed here.	Odd					C	O		
	Even					O	C		
	None					C	C		
RS-232 Character Length								**7**	
The two choices for character length are listed here.	8 bits							O	
	7 bits							C	
RS-232 Stop Bits									**8**
The two choices for the number of stop bits are listed here.	1 Stop Bit								O
	2 Stop Bits								C

Table 4: Switch settings for SW1 on the RS-232 Board

Sensor I/O Board Dipswitch Bank SW1									
Function	**Choices**	**Switches**							
Self -Tune/PID Selection		**1**							
With Self-Tune, the Learn Key has full capabilities. With PID, lead & gain should be user-defined, and the LEARN key has no effect.	PID	O							
	Self-Tune	C							
Analog Setpoint Full Scale			**2**						
Full scale analog setpoint input can be configured as 10 volts or 5 volts.	10 volt		O						
	5 volt		C						
Analog Output Full Scale				**3**					
Full scale analog output can be configured as 10 volts or 5 volts.	10 volt			O					
	5 volt			C					
Analog Output : Pressure/Valve Position					**4**				
The analog output can be configured to reflect either pressure or valve position.	Position				O				
	Pressure				C				
Softstart Enable/Disable						**5**			
Softstart can be permanently enabled or disabled with this function.	Enable					O			
	Disable					C			
Setpoints D and E: Pressure/Valve Position							**6**		
Setpoints D and E can be configured as pressure or valve-position setpoints.	Position						O		
	Pressure						C		
Remote Source: None/Analog/RS-232/TTL								**7**	**8**
The 652 controller can be remotely operated using TTL digital, RS-232, or an analog setpoint signal. If none of these signal types is chosen, then control goes to the front panel and there is no remote setpoint.	None							O	O
	Analog							O	C
	RS-232							C	O
	TTL							C	C

Table 5: Switch Settings for SW1 on the Sensor I/O Board

Sensor I/O Board Dipswitch Bank SW2								
Function	**Choices**	**Switches**						
Battery Backup: Valve Failsafe Option		**1**	**2**					
If the Battery Backup option is installed, a rechargeable battery provides full valve drive capability for about 1 minute after an AC power failure. Upon AC power loss, the 652 unit can be set to drive the valve open, closed, or hold it in its current position.	Hold Position	O	O					
	Drive Open	C	O					
	Drive Closed	O	C					
	Not Installed	C	C					
Valve Selection		**3**						
The step rate for the 653 valve is faster than the rate of a standard valve.	Type 653 valve	O						
	Standard valve	C						
Sensor Range				**4**	**5**	**6**		
Acceptable ranges for a capacitance manometer connected to the 652 unit are listed here. The acceptable units are Torr (as shown here) and mBar.	100 mTorr			C	C	C		
	1 Torr			O	C	C		
	2 Torr			O	C	O		
	10 Torr			C	O	C		
	100 Torr			O	O	C		
	1000 Torr			C	C	O		
Pressure Display Units							**7**	**8**
The choice of pressure units (displayed in the front panel window) is listed here. See *About the Pressure Display Units*, on page 15, for more information.	Bar						O	C
	mBar						O	O
	Pascal						C	O
	Torr						C	C

Table 6: Switch Settings for SW2 on the Sensor I/O Board

Note If the Type 653 valve is selected (see switch 3 in Table 6 on the previous page), a jumper must be placed across the two pins in each set of pins (labeled P_3 and P_4) on the motor driver board. The motor driver board is the rightmost board when looking straight at the 652 front panel.

About the Pressure Display Units

The units available for the pressure display are Torr, Pascal, Bar, and mBar. The mBar units are available for systems which use a sensor calibrated in Bars (as opposed to a sensor calibrated in Torrs). For example, if *mBar* is selected as the pressure display unit and 100 Torr is selected as the sensor range, the 652 unit displays 100 *mBar* at full scale. If however, *Bar* is selected as the pressure display unit and 100 Torr is again selected as the sensor range, then the 652 unit displays 133.3 *mBar* at full scale because 100 Torr = 133.3 mBar.

Example 1: For use with a sensor calibrated in Torrs.

To configure the Type 652 unit to display pressure in units of Torr and to have a 2 Torr sensor range, select Torr as the pressure display unit (switches 7 and 8 as C,C) and select 2 Torr as the sensor range (switches 4, 5, and 6 as O,C,O). The 652 unit displays 2 Torr at full scale.

Example 2: For use with a sensor calibrated in Bars.

To configure the Type 652 unit to display pressure in units of Bar and to have a 2 mBar sensor range, select mBar as the pressure display unit (switches 7 and 8 as O,O), and select 2 Torr as the sensor range (switched 4, 5, and 6 as O,C,O). The 652 unit displays 2000 µBar at full scale.

The Rear Panel

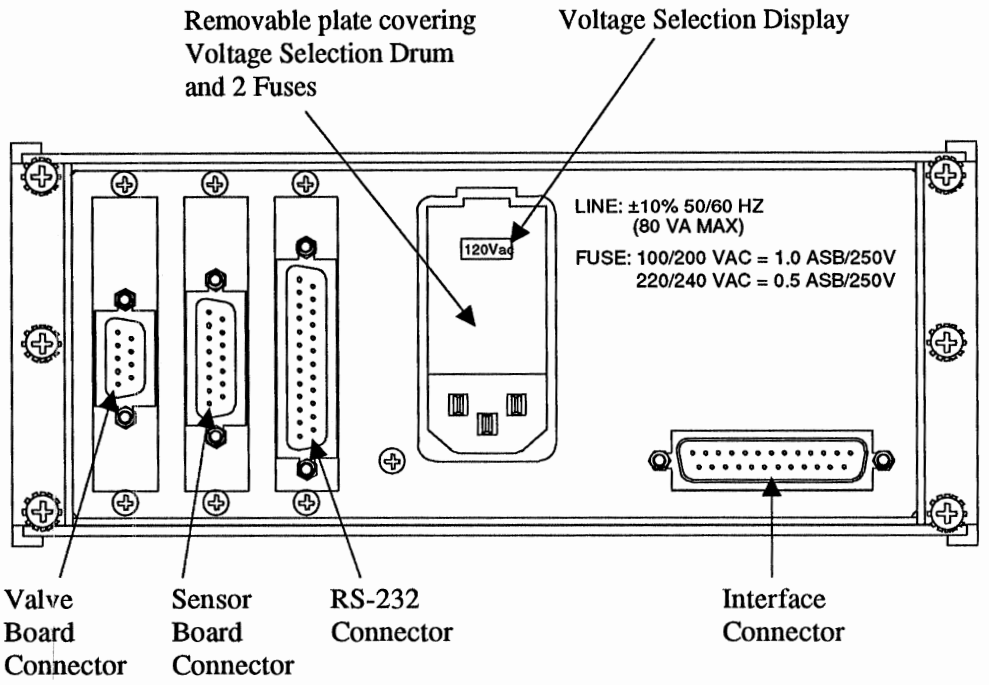


Figure 4: Rear Panel of the Type 652 Instrument

There are four Type D connectors on the back of the Type 652 controller. Figure 4 identifies each connector type. The connectors/board slots are also identified on the bottom ledge of the rear panel as follows: The valve board slot is labeled **1**, the sensor board slot is labeled **2**, the RS-232 board slot is labeled **RS-232**, and the interface connector is labeled **INTERFACE**. Table 7 through Table 15 list the connector pinouts.

Table 13 through Table 15 pinouts are available only when the 652 controller is configured in Analog or TTL remote control. Refer to the *Remote Source Type: None/Analog/RS-232/TTL* section on page 15, to learn how to configure the 652 unit for RS-232, Analog, or TTL remote control.

Also on the rear panel is a little window referred to as the *Voltage Selection Display*. The Voltage Selection Display allows the selected voltage (which should be appropriate for the local electrical source) to be viewed. For instructions on how to change the voltage selection, refer to the *Checking the Voltage Setting and Fuse Type* section on page 22.

Valve Board Connector	
Pin #	**Function**
1	Motor Drive Top Winding (High)
2	Motor Drive Top Winding (Low)
3	Limit Switch Common
4	Open Limit Switch Contact
5	Closed Limit Switch Contact
6	Motor Drive Base Winding (High)
7	Motor Drive Base Winding (Low)
8	No Connection
9	No Connection

Table 7: Valve Board Connector Pinout

Valve Type Number	Cable Number
253A	CB652-2-10
653A	CB652-1-10

Table 8: Cable Number for MKS Type 253A/653A Throttle Valves

Sensor Board Connector	
Pin #	**Function**
1	No Connection
2	Pressure Signal (+)
3	No Connection
4	No Connection
5	± 15 Volt Common
6	- 15 Volt Output (500 mA max.)
7	+ 15 Volt Output (500 mA max.)
8	No Connection
9	No Connection
10	No Connection
11	No Connection
12	Pressure Signal Common
13	No Connection
14	No Connection
15	Chassis Ground

Table 9: Sensor Board Connector Pinout

Sensor Type Numbers	Cable Numbers
122	CB112-2-10
127	CB259-5-10
128	CB259-5-10
220	CB112-10-10
221	CB112-14-10
223	CB112-2-10
124,224,225	CB112-2-10
120	CB120-1-10(B)

Table 10: Cable Numbers for MKS Capacitance Manometers

RS-232 Connector	
Pin #	**Function**
1	Chassis Ground
2	TXD Output
3	RXD Input
4	RTS Output
5	CTS Input
7	Signal Ground
20	DTR Output
	All other Signals are No Connection

Table 11: RS-232 Connector Pinout

Interface Connector	
Pin #	**Function**
1	Chassis Ground
2	Reserved
3	Digital Input, low activates softstart
4	Digital Input (see Table 14)
5	Digital Input, low initiates sensor remote-zero
6	Digital Ground
7	Analog Ground
8	Reserved
9	Reserved
10	No Connection
11	Relay 2, Normally Open Contact
12	Relay 2, Common
13	Relay 2, Normally Closed Contact
14	Digital Input (see Table 13)
15	Digital Input (see Table 13)
16	Digital Input (see Tables 14 and 15)
17	Digital Input (see Table 14)
18	Digital Ground
19	No Connection
20	Analog Output
21	Analog Setpoint Input
22	Reserved
23	Relay 1, Normally Open Contact
24	Relay 1, Common
25	Relay 1, Normally Closed Contact

Table 12: Interface Connector Pinout

Interface Connector Analog/TTL Control				
Pin #	**Valve Open**	**Valve Close**	**Valve Hold**	**Analog/TTL Setpoint**
14	Low	High	Low	High
15	High	Low	Low	High

Table 13: Interface Board Valve Drive Signals (Digital Input)

The 652 controller *must be* set to Analog or TTL Remote Control for these pinouts (refer to Table 5 to learn how to configure the 652 for Analog or TTL remote control).

The three valve positions (Open, Close, and Hold) are activated whether the 652 unit is configured for Analog or TTL remote control. The last column in Table 12, however, shows two possible setpoints. An analog setpoint is selected if the 652 unit is configured for Analog remote control, and a TTL setpoint (A through E), is selected if the unit is set up for TTL remote control.

Interface Connector TTL Control of Setpoint Selection					
Pin #	**Setpoint A**	**Setpoint B**	**Setpoint C**	**Setpoint D**	**Setpoint E**
4	High	Low	High	Low	Low
16	Low	High	High	Low	High
17	High	High	Low	Low	Low

Table 14: Interface Board TTL Activated Setpoints (Digital Input)

The 652 controller *must be* set to TTL Remote Control for these pinouts (refer to Table 5).

Interface Connector Analog Control		
Pin #	**Position Control**	**Pressure Control**
16	Low	High

Table 15: Interface Board Analog Setpoint Type (Digital Input)

The 652 controller *must be* set to Analog Remote Control for these pinouts (refer to Table 5).

Checking the Voltage Setting and Fuse Type

On the rear panel of the 652 unit is a small window (Voltage Selection Display) which displays the currently selected voltage (refer to Figure 4: *Rear Panel of the Type 652 Instrument*, on page 18). The selected voltage should be appropriate for the local electrical source.

To change the voltage setting, or access the fuses, follow these steps:

1. Turn power off.
2. Remove the power cord.
3. Remove the plate on the rear panel which covers the voltage selection drum and two fuses.

   Refer to Figure 4: *Rear Panel of the Type 652 Instrument*, page 18, for the location of this plate. The plate is removed by inserting a small flat screwdriver in the slot at the top of the plate, and flipping it open.
4. Remove the voltage selection drum by pulling it straight out of the 652 unit.

   Notice that there are four possible selections printed on the drum:

   100 Vac for 100 volts AC ± 10%.
   120 Vac for 120 volts AC ± 10%.
   220 Vac for 220 volts AC ± 10%.
   240 Vac for 240 volts AC ± 10%.
5. Rotate and replace the drum so that the desired voltage setting will be visible through the Voltage Selection Window.
6. Remove the two fuse holders by pulling straight out on the two small squares marked with white arrows.
7. Check/replace the fuses with fuses appropriate for your voltage setting.

   1.0 ASB 250 V fuses are required for 100 or 120 volt operation.

   0.5 ASB 250 V fuses are required for 220 or 240 volt operation.
8. Replace the fuse holders so that the white arrows on the holders point to the right.
9. Close the plate cover by flipping it up and pushing it until it snaps into place.
10. Replace the power cord.
11. Turn the power back on.

Front Panel Operation

How To View and Adjust Setpoints

The 652 instrument provides five user-definable setpoints (setpoint A - setpoint E). Each setpoint can be shown in the front panel window if the key lock switch is set to LOCAL. Scroll to different setpoint displays with the arrow keys. Setpoints A, B, and C are displayed as pressure setpoints only. Setpoints D and E can be configured as *pressure* setpoints, or valve *position* setpoints.

If a configuration sheet was filled out when ordering the Type 652 instrument, then setpoints D and E are already set up in your preferred configuration (pressure or valve position). Refer to the *Setpoints D and E: Pressure/Valve Position* section in Table 5, page 15 to change the configuration.

Only one setpoint can be designated as the active setpoint. Refer to the *How To Activate Setpoints* section on page 30, to designate which setpoint is to be the active (controlling) setpoint. The active setpoint (or valve position) is indicated by a light on the front panel next to the appropriate parameter.

Pressure setpoints can be shown in units of Torr, Pascal, or Bar. Refer to the *Pressure Display Units* section in Table 6, page 16 to select pressure units.

1. Be sure the key lock switch is set to LOCAL.

2. Use the arrow keys to scroll to different setpoint displays.

   A sample display of setpoint A (SP A:) is shown below. In this example, setpoint A is defined as 100.0 mTorr, and the system pressure is also at 100 mTorr.

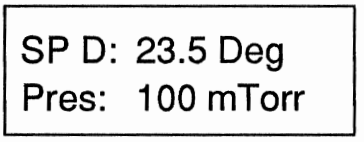
   SP A: 100 mTorr
   Pres: 100 mTorr

   Example of a *Position* Setpoint

3. Adjust the displayed setpoint with the ADJUST dial on the front panel.

   The 652 unit responds by immediately storing the setpoint value. The system pressure does not change however, unless the displayed setpoint is the active setpoint.

The display pictured below provides another example of a setpoint display. In this case, setpoint D is shown (SP D:), and is configured as a valve position setpoint. The valve position is indicated in units of degrees where 0 = Closed, and 90 = Open.



Example of a Valve *Position* Setpoint

In this example, Setpoint D is configured for a valve position of 23.5 degrees, and the system pressure is shown as 100 mTorr.

How To Control the Valve

The 652 unit can drive the throttle valve to full open or full close, or freeze it at its current position.

To drive the valve to full OPEN:

1. Turn the key lock switch to LOCAL.
2. Press the OPEN button.

   The 652 unit responds by turning a light on next to the OPEN button, and driving the throttle valve to full open. The front panel window returns to the default display of pressure and valve position, if it is not already showing the default display. The OPEN command overrides the active setpoint.

   Pressing any other button on the front panel (except zero or learn), cancels the OPEN command.

To drive the valve to full CLOSE:

1. Turn the key lock switch to LOCAL.
2. Press the CLOSE button.

   The 652 unit responds by turning a light on next to the CLOSE button, and driving the throttle valve to full close. The front panel window returns to the default display of pressure and valve position, if it is not already showing the default display. The CLOSE command overrides the active setpoint.

   Pressing any other button on the front panel (except zero or learn), cancels the CLOSE command.

To STOP the valve in its current position:

1. Turn the key lock switch to LOCAL.
2. Press the STOP button.

   The 652 unit responds by turning a light on next to the STOP button, and freezing the throttle valve in its current position. The front panel window returns to the default display of pressure and valve position, if it is not already showing the default display. The STOP command overrides the active setpoint.

   Pressing any other button on the front panel (except zero or learn), cancels the STOP command.

How To Activate Learn Mode

The learn mode, activated by pressing the LEARN button, causes the 652 unit to identify important system characteristics for self-tuning control. Use learn mode whenever the 652 controller is used in a new gas system. Also, use learn mode if the error message **RAM Error** appears on power up. This message indicates parameters have been lost. The learning process may take several minutes to complete.

Note The system pressure varies during the Learn cycle to as low and high as is possible for the current flow rate.

1. Turn the key lock switch to LOCAL.
2. Initiate the proper gas flow into the system.
   A. Gas flow rate should be close to that used for the actual process.
   B. If more than one gas flow is needed, use the higher rate for learning.
   C. Do not vary the gas flow rate during learning.
3. Press and hold the LEARN button for at least three seconds.

   The 652 unit responds by turning on a light next to the LEARN button, and initiating the learning process. The front panel window presents the following three messages as the learning process progresses, and then returns to the default display of pressure and valve position.

Learning valve Please wait . . .

Measuring . . .

Searching . . .

How To Zero a Sensor

Zeroing a sensor is performed to correct sensor zero offsets.

1. Turn the key lock switch to LOCAL.
2. Turn off the gas flow.
3. Fully open the control valve.
4. Wait until the system is pumped down to base pressure.

   Base Pressure should be less than the sensor resolution. If base pressure is greater than 2% of full range, the sensor will not be zeroed.
5. Press and hold the ZERO button for at least three seconds.

   The 652 unit responds by flashing on a light next to the ZERO button, and zeroing the sensor. The front panel window shows a pressure reading of zero.

   The front panel display changes to reflect a change in system pressure as soon as a change occurs.

How To Activate Setpoints

Activating a setpoint causes the 652 unit to control with that setpoint. Setpoints A through C are pressure setpoints. Setpoints D and E can be configured as either pressure setpoints, or valve position setpoints. Refer to *Setpoints D and E: Pressure/Valve Position*, in Table 5, page 15, to configure setpoints D and E. Setpoint values (whether pressure or valve position) are user-defined. Refer to the *How To View and Adjust Setpoints* section on page 23, to define setpoints A through E.

1. Turn the key lock switch to LOCAL.

2. Press the appropriate setpoint button (A through E).

   The 652 unit responds by controlling according to the selected setpoint, and turning a light on next to the setpoint button. The front panel display changes to reflect the activated setpoint. That is, the pressure reading changes to match the new setpoint, and the setpoint display changes into units of degrees if the selected setpoint is configured for valve position control.

   The light remains lit next to the setpoint button until another setpoint (or valve function), is chosen.

How To View/Adjust and Enable/Disable a Process Limit Relay

There are two process limit relays in the 652 controller. Each relay has two trip limits: a high trip limit, and a low trip limit. Refer to Table 12, page 22, for the pinout of the interface connector to determine which pins are for relay one, and which are for relay two. Use the pins on the interface board to configure the relays for normally-open or normally-closed operation.

Whenever the measured pressure crosses above the high trip point, or below the low trip point, the corresponding relay becomes actuated (switches contacts). When actuated, a normally-open relay becomes closed, and a normally-closed relay becomes open.

To View/Adjust a Process Limit Relay:

1. Turn the key lock switch to LOCAL.
2. Use an arrow key to scroll to the associated display.

   The 652 unit responds by scrolling through displays. Examples of relay one's high and low trip point displays, are shown below.

Trip Limit 1 High: 50.0 mTorr

Trip Limit 1 Low: 30.0 mTorr

3. Use the numerical adjust dial to adjust the displayed trip point.

To Enable/Disable a Process Limit Relay

1. A high limit trip point is disabled by setting it to full scale.
2. A low limit trip point is disabled by setting it to zero.

How To View the Analog Setpoint

The 652 controller is capable of accepting one analog setpoint through the interface connector on the rear panel. When controlling with the analog setpoint and configured for PID control, the 652 unit also uses the lead A and gain A tuning parameters.

Refer to the *Self-Tune/PID Selection* section, in Table 5, page 15, to configure the 652 unit to control with PID algorithms or self-tuning parameters. Refer to the *How To View and Adjust Lead and Gain Parameters* section, on page 33, to learn how to define lead A and gain A.

The analog setpoint display is enabled only when the 652 controller is configured to accept an analog setpoint. Refer to *Remote Source Type: None/Analog/RS-232/TTL,* in Table 5, page 15, to configure the 652 unit to control with an analog setpoint.

The analog setpoint can be configured for 5 volt or 10 volt full scale input. Refer to *Analog Setpoint Full Scale* in Table 5, page 15, to select the full scale value.

The analog setpoint can be configured as a pressure or valve position setpoint. Refer to Table 5, page 15, to learn how to configure the analog setpoint input as a pressure or valve position setpoint.

1. Turn the key lock switch to LOCAL.
2. Use an arrow key to scroll to the analog setpoint display.

   An example display is shown below.

Analog Setpoint 13.5 mTorr

Notice that the Analog Setpoint is displayed in pressure units, not volts.

How To View and Adjust Lead and Gain

When the 652 unit is configured for PID control, separate lead and gain parameters are maintained for each pressure setpoint. Setpoint A is associated with Lead A and Gain A. Setpoint B is associated with Lead B and Gain B, and so forth.

When an analog setpoint is used with PID control, Lead A and Gain A are always associated with it. If a setpoint is configured as a valve position (only possible for setpoints D and E), then no lead or gain parameters are associated with it. Refer to *Self-Tune/PID Selection* and *Remote Source: None/Analog/RS-232/TTL* in Table 5, page 15, to configure the 652 unit for PID control and to enable analog setpoint control.

By careful adjustment of the lead and gain parameters, it is possible to achieve good control throughout a wide range of pressure regions.

1. Turn the power off.
2. Disconnect the power cord.
3. Remove the top two phillips screws and washers on the rear panel.

Caution  **To avoid damage to sensitive internal components, personnel should be grounded while working inside the 652 unit.**

4. Remove the top cover by firmly pulling it toward the back of the unit.
5. Configure the 652 instrument for PID control by setting dipswitches on the Sensor I/O board dipswitch bank SW1 (refer to Table 5, page 15).
6. Replace the top cover, and the two screws and washers on the rear panel; reconnect the power cord and turn power back on.
7. Turn the key lock switch to LOCAL.
8. Use an arrow key to scroll through the tuning parameters.

   The 652 unit responds by scrolling through the sequence of displays. Examples of Lead A and Gain A displays are shown below.

Lead A:	1.25 Sec
Pres:	350 mTorr

Gain A:	25.0%
Pres:	350 mTorr

9. Use the numerical adjust dial to adjust the displayed tuning parameter.

How To View and Adjust Softstart

The softstart feature is used to reduce the rate at which a control valve moves toward setpoint. The rate is given as a percent of full speed. The setpoint can be expressed as a pressure or valve position.

The softstart feature can be enabled or disabled. To enable/disable the feature when using LOCAL control, use the dipswitches inside the 652 controller (refer to Table 5: *Switch Settings for SW1 on the Sensor I/O Board*, on page 15). To enable/disable the feature when using REMOTE control, use the appropriate RS-232 command (refer to Table 16, page 38), or use a TTL/Analog signal (Table 12: *Interface Connector Pinout*, page 22).

Just because the softstart feature is enabled, does not mean that the 652 instrument is controlling with softstart control. In other words, the softstart feature may be enabled, but not currently in use (when in use it is said to be activated). The 652 instrument may be in a non-controlling state. A non-controlling state is when the 652 unit is not using a setpoint. The 652 unit is in a non-controlling state when holding the control valve is any of the three fixed valve positions (OPEN, CLOSE, or STOP).

Softstart control applies (is activated) when the softstart feature is enabled AND there is a transition from a non-controlling state to a controlling state. Generally, controlling states are when setpoints are being used (either pressure/analog setpoints or valve position setpoints). In these controlling states, the 652 unit is controlling the valve position in order to reach setpoint. The other condition considered a controlling state is when changing from a fixed CLOSE position to a fixed OPEN position. As the valve moves towards a fixed OPEN position, it does so at a softstart rate.

The reduction in valve speed remains until setpoint is reached, and then the valve is free to move at full speed. Softstart control is then said to be deactivated. Softstart control is also deactivated when the 652 unit changes from a controlling to a non-controlling or different state. For example, if the 652 instrument is governing the control valve according to a setpoint and then the front panel CLOSE button is pressed, then the 652 unit will be going from a controlling to a non-controlling state.

Deactivated softstart control should not be confused with when the softstart feature is disabled. When the softstart feature is disabled, the control valve will not be under softstart control regardless of whether or not the 652 unit is in a controlling or non-controlling state.

If the softstart feature remains enabled, softstart control is activated (re-introduced) again at the next transition from a non-controlling to a controlling state.

1. Turn the power off.
2. Disconnect the AC power cord.
3. Remove the top two phillips screws and washers on the rear panel.

Caution  **To avoid damage to sensitive internal components, personnel should be grounded while working inside the 652 unit.**

4. Remove the top cover by firmly pulling it towards the back of the unit.

   The three dipswitch banks are now accessible.

5. Configure the 652 instrument for softstart control by setting dipswitches on the Sensor I/O board dipswitch bank SW1.

6. Replace the top cover, and the two screws and washers on the rear panel; reconnect the power cord and turn power back on.

   The 652 unit responds by enabling display of the softstart rate.

7. Turn the key lock switch to LOCAL.

8. Use an arrow key to scroll through the sequence of displays.

   An example of the softstart rate display is shown below.

   ```
   SoftStart
   Rate:   30 %
   ```

9. Use the numerical adjust dial to adjust the displayed softstart rate.

   Values of 5 to 30% are usually effective.

   The 652 unit will now use new softstart rate.

RS-232 Control

An RS-232 port is available on the rear panel of the Type 652 controller. Refer to Table 11, page 21, for a pinout of this connector. The key lock switch (on the front panel), determines how commands can be set to the 652 unit. When the key lock switch is set to REMOTE, all *commands* must be sent via the RS-232 connector, or as TTL or analog voltage signals through the Interface connector. Also, the front panel becomes locked.

When the key lock switch is set to LOCAL, all *commands* must be entered through the front panel. Information *requests* and 652 controller *responses*, however, may still be sent through the RS-232 connector on the rear panel.

Tables 16 and 17 on the following pages, list the RS-232 protocol for sending commands/requests to the 652 unit. It is not necessary to add any spaces between command/request elements. In both tables, each command/request element is separated with square brackets [ ] for clarity. For example, the command (shown in Table 16, page 38) to assign setpoint A a value of 20 is:

[S1][*Value*][CR][LF] and the actual keys pressed would be:

S120[CR][LF] where [CR] is carriage return, and [LF] is line feed.

Table 16, page 38 lists commands which can be sent to the 652 unit. A command performs a task (such as assigning a setpoint value), but does not get any information in return.

Table 17, page 39 lists requests which can be sent to the 652 unit. A request causes the 652 instrument to send back information. For example, the first request listed is for information about the Analog Setpoint. When this request is sent, the 652 unit responds by sending back the Analog Setpoint value.

The range for the [*Value*] in most RS-232 commands is obvious. For example, a Setpoint value must be within the range of the sensor. The acceptable [*Value*] entries for the two softstart commands in Table 16, page 38, however, need some explanation.

To enable/disable the softstart feature, use the following command protocol:

[SS][*Value*][CR][LF] where [*Value*] is 0 (zero) to disable softstart, and [*Value*] is 1 (one) to enable it.

The range for the softstart rate is 1.0 to 100.0 inclusive, and is entered using the following command:

[SR][*Value*][CR][LF]

RS-232 Command Protocol	
Command Protocol	**Function**
[S1][*Value*][CR][LF]	Setpoint A
[S2][*Value*][CR][LF]	Setpoint B
[S3][*Value*][CR][LF]	Setpoint C
[S4][*Value*][CR][LF]	Setpoint D
[S5][*Value*][CR][LF]	Setpoint E
[L1][*Value*][CR][LF]	Lead A
[G1][*Value*][CR][LF]	Gain A
[L2][*Value*][CR][LF]	Lead B
[G2][*Value*][CR][LF]	Gain B
[L3][*Value*][CR][LF]	Lead C
[G3][*Value*][CR][LF]	Gain C
[L4][*Value*][CR][LF]	Lead D
[G4][*Value*][CR][LF]	Gain D
[L5][*Value*][CR][LF]	Lead E
[G5][*Value*][CR][LF]	Gain E
[O][CR][LF]	Open the valve
[C][CR][LF]	Close the valve
[H][CR][LF]	Hold the valve
[D1][CR][LF]	To setpoint A
[D2][CR][LF]	To setpoint B
[D3][CR][LF]	To setpoint C
[D4][CR][LF]	To setpoint D
[D5][CR][LF]	To setpoint E
[SS][*Value*][CR][LF]	Enable/disable softstart
[SR][*Value*][CR][LF]	Set softstart rate

Table 16: RS-232 Protocol for Sending Commands to the 652 Controller

RS-232 Request and Return Messages Protocol		
Request Protocol	**Function of Request**	**Return Message Displayed as:**
[R0][CR][LF]	Analog Setpoint Value	[S0][*Value*][CR][LF]
[R1][CR][LF]	Setpoint A Value	[S1][*Value*][CR][LF]
[R2][CR][LF]	Setpoint B Value	[S2][*Value*][CR][LF]
[R3][CR][LF]	Setpoint C Value	[S3][*Value*][CR][LF]
[R4][CR][LF]	Setpoint D Value	[S4][*Value*][CR][LF]
[R5][CR][LF]	System pressure Value	[P][*Value*][CR][LF]
[R6][CR][LF]	Valve Angle Value	[V][*Value*][CR][LF]
[R7][CR][LF]	System status	[M][*Value*][CR][LF] [M111]
[R][CR][LF]	Reports all the above	[as above]
[RA][CR][LF]	Setpoint E Value	[S5][*Value*][CR][LF]
[RB][CR][LF]	Lead A Value	[L1][*Value*][CR][LF]
[RC][CR][LF]	Gain A Value	[G1][*Value*][CR][LF]
[RD][CR][LF]	Lead B Value	[L2][*Value*][CR][LF]
[RE][CR][LF]	Gain B Value	[G2][*Value*][CR][LF]
[RF][CR][LF]	Lead C Value	[L3][*Value*][CR][LF]
[RG][CR][LF]	Gain C Value	[G3][*Value*][CR][LF]
[RH][CR][LF]	Lead D Value	[L4][*Value*][CR][LF]
[RI][CR][LF]	Gain D Value	[G4][*Value*][CR][LF]
[RJ][CR][LF]	Lead E Value	[L5][*Value*][CR][LF]
[RK][CR][LF]	Gain E Value	[G5][*Value*][CR][LF]
[RL][CR][LF]	Softstart status	[*Value*][CR][LF]
[RM][CR][LF]	Softstart rate	[*Value*][CR][LF]

Table 17: RS-232 Protocol for Receiving Messages from the 652 Controller

Battery Maintenance

Lithium Battery (for memory backup)

The Type 652 instrument contains a BR-2/3A type lithium battery (MKS part # 003-0005 [1]) which is specified to provide at least seven years of memory storage under all operating conditions. No maintenance should normally be required for at least this seven year period. The memory storage saves all user-editable and *learned* configuration parameters during power downs.

Eventually, the battery will need to be replaced. If the 652 unit continually requires relearning at each power cycle (power off then on again), replacement may be necessary. If the battery is tested and found to be good, the 652 unit should be returned to MKS to determine the reason why it requires frequent relearning. If the battery is tested and found to need replacement, the 652 unit may be returned to any MKS Service Center, or the battery may be replaced in the field by following these instructions.

Warning 

The 652 unit has lethal voltages inside. Servicing of the unit must be performed by qualified personnel only.

To avoid the danger of electrical shock, the power line must be disconnected before opening the unit.

1. Turn the power off.
2. Disconnect the AC power cord.
3. Remove the top two phillips screws and washers on the rear panel.

Caution 

To avoid damage to sensitive internal components, personnel should be grounded through a safety impedance while working inside the 652 unit.

4. Remove the top cover by firmly pulling it towards the back of the unit.

   The lithium battery is now accessible.

[1] The type BR-2/3A battery is also available from Panasonic Battery Sale Division, P.O. Box 1511, Secaucus, NJ, and Rayovac Corporation, 601 Rayovac Dr., Madison, WI.

5. Test the battery by using a voltmeter to measure the voltage across the battery holder terminals (the top terminal is positive).

   A. If the voltage is greater than 2.75 volts, the battery is good. If the reason for checking the voltage is that the 652 unit requires relearning at each power cycle, return the instrument to MKS for servicing.

   B. If the voltage is less than 2.75 volts, the battery should be replaced.

6. Remove the lithium battery from its holder (refer to Figure 5 for the location of the lithium battery).

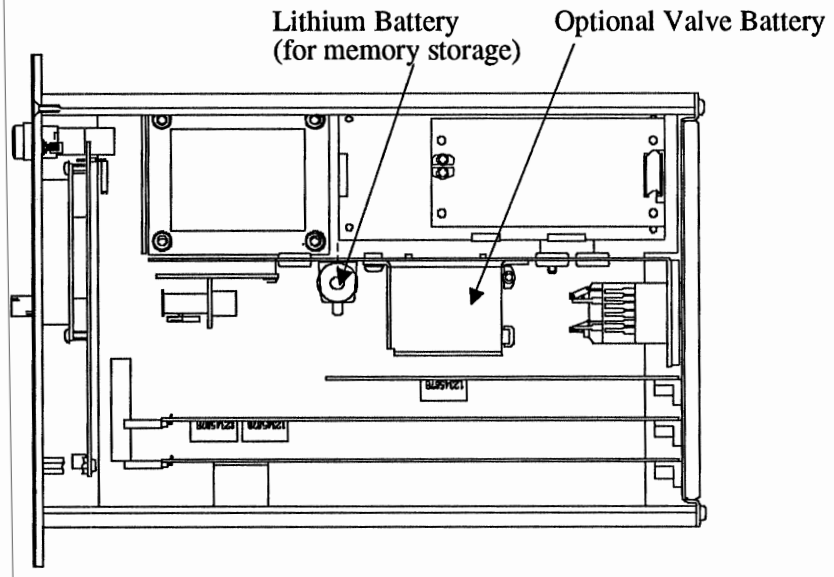


Figure 5: Location of the Lithium and Optional Lead-acid Batteries

7. Place a new lithium battery (with the positive side up) in the holder.

8. Check to make sure the battery holder contacts are firmly pressing against the battery terminals and providing a good electrical contact.

   If necessary, the battery holder contacts may be squeezed tighter to provide a better electrical contact.

9. Replace the top cover.

10. Replace the top two phillips screws and washers on the rear panel.

11. Reconnect the AC power cord.

12. Turn the power on.

Note All user configuration settings may have to be reset and the control system may have to be relearned after replacement of the lithium battery.

Optional Lead-acid Battery (for valve failsafe)

An optional Valve Failsafe Battery Backup is available which provides full valve drive capability for about one minute after an AC power failure. The 652 instrument can be set to drive the valve open, closed, or hold it in its current position upon a power loss. This optional battery is a rechargeable, 6 volt, 1 amp-hour, sealed lead-acid battery (MKS part # 003-1109451 [1]).

The lead-acid battery is continually recharged while the 652 unit is powered and operating. The battery, therefore, is typically maintenance free and only needs attention when it must be replaced (refer to Table 18, page 45 for expected battery life).

Note 

If a Valve Failsafe battery backup is ordered after the 652 unit is received, the unit must be sent back to your local MKS Service Center to have the battery backup system installed. Before returning the instrument to MKS, obtain an ERA Number (Equipment Return Authorization Number) from an MKS Service Center.

Battery Label

If a Valve Failsafe Battery Backup is installed, an ATTENTION label is affixed to the side of the 652 unit. The label states that the unit contains a lead-acid battery which is maintained in a properly charged state while the instrument is powered on. Basic maintenance information is also provided.

General Maintenance

Since the battery is sealed, the only maintenance required is what is stated below:

- Recharge after each AC power failure (this is automatic once the unit is powered on).
- Recharge before any prolonged storage (this is automatic once the unit is powered on).
- Recharge every 6 to 9 months of storage to prevent permanent loss of capacity.
- To prolong storage life between recharging, store the 652 unit or its batteries at 50°F (10°C) or less.
- Periodically check the battery voltage level to determine if replacement is necessary.

[1] The lead-acid battery is also available from Power Sonics (p/n PS-610), 3106 Spring St., Redwood City, CA, and Yuasa (p/n NP1-6), 131 Industrial Ave., Hasbrouck Heights, NJ.

How To Check Battery Charging Voltage

If the optional Valve Failsafe Battery Backup is installed, it is possible to display the battery's charging voltage in the front panel window.

1. With power to the 652 unit on, press the down arrow on the front panel.

   The 652 unit responds by displaying the current battery charging voltage (provided by the battery charger). A reading of about 6.7 (volts) indicates a fully charged battery. A reading higher than 6.9 indicates that the battery is currently recharging after a typical partial discharge. A reading less than 6.6 volts indicates a greater than typical battery discharge has occurred.

Battery Response After an AC Power Failure

When AC power is lost, the valve battery backup drives the valve to full open or full closed within 20 seconds, or holds it in its current position. Refer to *Battery Backup: Valve Failsafe Option*, in Table 6 on page 16, to determine which dipswitch configuration to use to drive the valve open, closed, or freeze it.

An AC power failure typically results in a 30% discharge of the battery. Under this condition, the battery life is at least 1000 cycles, and should be able to recharge within a few hours after power returns. Battery life under several conditions is listed in Table 18 below.

Expected Cycles	% Discharge with each Battery Use
1000	30
400	50
200	100
5 years if unused and charge is maintained	

Table 18: Expected Battery Life given a Percent Discharge from Battery Use

When AC power returns, the battery recharges, provided that the 652 instrument is turned on. From a full discharge condition, the voltage typically increases from about 5.5 volts to 7.3 volts over a five hour period. The voltage is maintained at about 7.2 volts for another five hours then gradually drops to 6.7 volts. The 6.7 volt charge is maintained in a trickle charge state (a top charged state) until there is an AC power failure. The recharge time for a completely discharged battery is 12 hours maximum. Figure 6 on page 46, shows the typical time required for battery charge and discharge.

Note 

After a typical AC power failure (30% battery discharge), the charging cycle begins at about the 5th or 6th hour condition (as shown in Figure 6) when the 652 unit is powered *and* turned on.

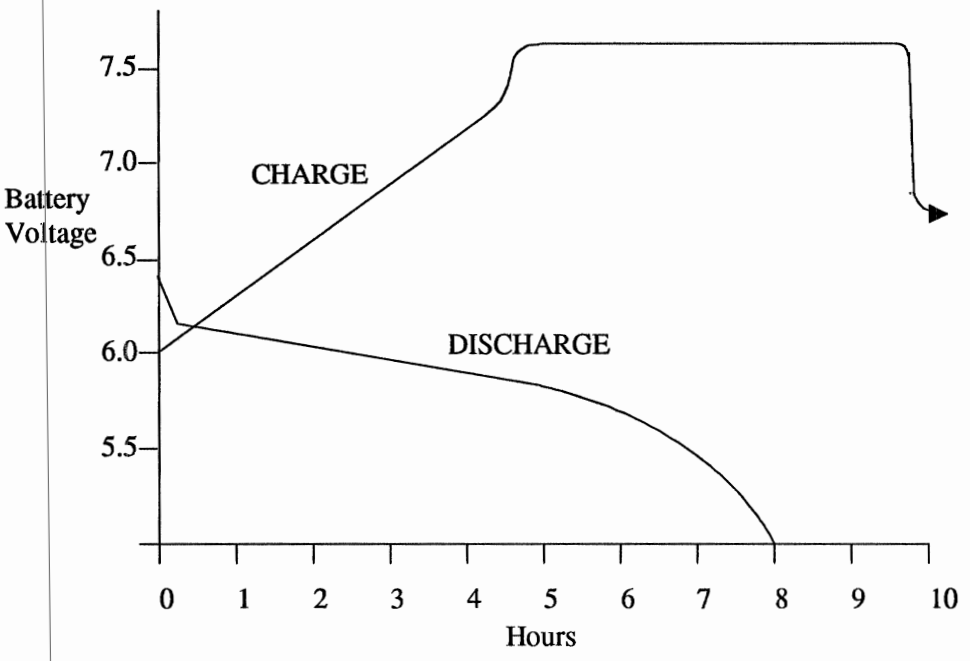


Figure 6: Typical Battery Discharge and Charge Time Requirements

Battery Replacement

Eventually, the battery will need to be replaced. The 652 instrument may be returned to any MKS Service Center for battery replacement, or the battery may be replaced in the field by following these instructions.

Warning 

The 652 unit has lethal voltages inside. Servicing of the unit must be performed by qualified personnel only.

To avoid the danger of electrical shock, the power line must be disconnected before opening the unit.

1. Turn the power off.
2. Disconnect the AC power cord.
3. Remove the top two phillips screws and washers on the rear panel.

Caution 

To avoid damage to sensitive internal components, personnel should be grounded through a safety impedance while working inside the 652 unit.

4. Remove the top cover by firmly pulling it towards the back of the unit.

   The lead-acid battery is now accessible. Refer to Figure 5, page 42 for the location of the optional valve battery.

5. Using a small phillips screwdriver, remove the two phillips screws and their washers which are holding the bracket covering the valve battery.
6. Lift the bracket off the battery.
7. Using a pair of pliers, remove the two lug connectors located on the back of the battery.

Caution 

To avoid damage to the wires, grip the lug connectors at the connector end and not by the wires.

8. Remove the battery.

9. Connect the two lug connectors to the terminals on the new battery.

Note

The red connector connects to the red terminal.

The black connector connects to the black terminal.

Be sure both wires pass through the grommet in the power supply chassis, and that neither wire passes over the battery.

10. Place the battery in the 652 unit so that the connectors face the back of the unit.
11. Place the bracket over the battery.
12. Secure the bracket with the two washers and phillips screws.
13. Replace the top cover by placing it in the grooves provided and pushing it towards the front of the unit.
14. Replace the top two phillips screws and washers on the rear panel.
15. Reconnect the AC power cord.
16. Turn the power on.
17. Press the down arrow on the front panel.

    The 652 unit responds by displaying the current battery charge. Based upon the battery charge displayed, the amount of time required to achieve full charge can be estimated (refer to Figure 6, page 46).

Note

Remember, the battery should always be stored in a fully charged state. If the 652 unit is powered and turned on for a sufficient amount of time, it will become fully charged.

Appendix A

Product Specifications

Pressure Input Signal	0-10 Volts or 0-1 Volt, selectable
Input Power	90-132 or 198-264 VAC, 50/60 Hz (80VA max)
Fuses	1.0 ASB 250 V fuses for 100 or 120 volt operation. 0.5 ASB 250 V fuses for 220 or 240 volt operation.
External Setpoint Signal	0 to 5 Volts, or 0 to 10 Volts
Ambient Temperature	15 - 40° C (60 - 104° F)
Controller Repeatability	±0.1% of F.S.
Output Power	±15VDC @ 0.5Amps max.
Analog Signal Output	Standard: 0-10VDC for 0 to 100% position Optional: 0-10VDC for 0 to 100% pressure
Relay Contact Rating	30 Volts at 1 Amp
Size	3.47"H x 9.47"W x 12.06"D (88mm x 241mm x 306mm)
Lithium (memory backup) Battery: Voltage Life	 3 Volts At least 7 years
Lead-acid (valve backup) Battery: Voltage Recharge Time Shelf Life Battery Life	 6.5 Volts 12 hours maximum for dead battery 3 months at 30°C to 50% charge 1000 cycles @ 30% discharges /cycle 400 cycles @ 50% discharges/cycle 200 cycles @ 100% discharges/cycle 5 years if unused and charge maintained

Specifications subject to change without notice

MKS Worldwide

Customer Support Centers

MKS Instruments, Inc.
Six Shattuck Road
Andover, MA 01810
Phone: (508) 975-2350/(800) 227-8766
Telex: (910) 240-8005
Fax: (508) 975-0093

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

MKS Instruments France s.a.
43, Rue de Commandant Rolland
F-93352 Le Bourget, CEDEX, France
Phone: 33(1)48.35.39.39
Telex: 233817 F
Fax: 33(1)48.35.32.52

MKS Instruments
Deutschland GmbH
Schatzbogen 43
81829 Munchen, West Germany
Phone: 089/42 00 08-0
Telex: 5 29 997
Fax: 089/42 41 06

Chell Instruments, Ltd.
Tudor House, Grammar School Road
North Walsham, Norfolk
NR28 9JH, England
Phone: (0692) 402488
Telex: 97198 Chell G
Fax: (0692) 406177

Israel Scientific Instruments, Ltd.
27 Pinhas Street
Ramat Gan 52306, Israel
Phone: 972-3-772051
Fax: 972-3-770808

MKS Instruments, Inc.
789 Grove Road
Suite 111
Richardson, TX 75081
Phone: (214) 231-0173
Fax: (214) 437-4127

MKS Instruments, Inc.
3350 Scott Blvd., Bldg. 3
Santa Clara, CA 95054
Phone: (408) 988-4020
Fax: (408) 988-4490

MKS Japan, Inc.
1-20-32, Miyamae
Suginami-Ku
Tokyo 168, Japan
Phone: 03-3247-3121
Fax: 03-3247-3464

Zeus Co., Ltd.
4th Floor, Zeus Building
3-16, Yangjae-Dong Seocho-Ku,
Seoul, 137-130 Korea
Phone: (02) 577-3181/6
Telex: K27508 ZEUSCO
Fax: (02) 576-3199

Nikko Shoji Taiwan Co., Ltd.
6F-5, No.246 Kuang Fu Road
Sec. 2
Hsinchu, Taiwan
Phone: (035) 723-185
Fax: (035) 726-202

G. Gambetti Kenologia S.N.C.
Via A. Manzoni, 5
20082 Binasco (Milano), Italy
Phone: 02 9055660/9052240
Telex: 315340 KENOL I
Fax: 02 9052778

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