SPC4050
PRESSURE CALIBRATOR

OPERATION MANUAL

Scanivalve

Instrumentation Devices

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PREFACE

WARNINGS, CAUTIONS AND NOTES

The WARNING! symbol indicates that danger of injury for persons and the environment and/or considerable damage (mortal danger, danger of injury) will occur if the respective safety precautions are not taken.

The CAUTION ! symbol indicate danger for the system and material if the respective safety precautions are not taken.

The ESD note symbol indicates that proper precautions for handling Electrostatic Sensitive Devices needs to be taken when performing the related operation. This includes the use of grounded work surfaces and personal wrist straps to prevent damage to sensitive electronic components.

WARRANTY

Scanivalve Corporation, Liberty Lake, Washington, hereafter referred to as Seller, warrants to the Buyer and the first end user that its products will be free from defects in workmanship and material for a period of twelve (12) months from date of delivery. Written notice of any claimed defect must be received by Seller within thirty (30) days after such defect is first discovered. The claimed defective product must be returned by prepaid transportation to Seller within ninety (90) days after the defect is first discovered. Seller's obligations under this Warranty are limited to repairing or replacing, at its option, any product or component part thereof that is proven to be other than as herein warranted.

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OPERATION OF LAW OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND IN NO EVENT SHALL SELLER BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

In the event of a failure:

1) Notify Scanivalve Corporation, Customer Service Department. Include model number and serial number. On receipt of this information, service data or shipping instructions will be forwarded. This may be transacted by telephone or e-mail.

2) On receipt of shipping instructions, forward the product, transportation prepaid. Repairs will be made and the product returned.

3) All shipments should be made via "Best Way". The product should be shipped in the original packing container or wrapped in protective material and surrounded by a minimum of four (4) inches of a shock absorbing material.

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Packaging for Shipment

If the product must be shipped, whether being returned to Scanivalve or relocated to another location it must be packaged properly to minimize the risk of damage. The recommended method of packing is to place the instrument in a container, surrounded on all sides with at lease four inches of shock attenuating material such as Styrofoam peanuts.

Important Notice

Please note that the product specifications and other information contained in this manual are subject to change without notice. Scanivalve Corporation makes an effort and strives to provide complete and current information for the proper use of the equipment. If there are any questions regarding this manual or the proper use of the equipment, contact Scanivalve Corporation.

Contact Information

If there are any questions or concerns regarding the SPC4050, Pneumatic Logic Unit (SPCPLU) or any Scanivalve product please do not hesitate to contact us at the following:

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SECTION 1: INTRODUCTION

System Overview

The SPC4050 calibration system consists of three components; the SPC4050 calibrator, the Pneumatic Logic Unit (SPCPLU) and PressCal, Scanivalve's free calibration software. Reference the PressCal manual for operation details of the PressCal software.

The Scanivalve SPC4050 Pressure Calibrator is a multi-channel, multi-range pressure system based off of Mensor's CPC6050. For detailed instructions, see the Mensor CPC6050 manual. The SPC4050 is a direct replacement for the SPC4000 calibrator. It is designed to test and calibrate all of Scanivalve's pressure measurement equipment. The SPC4050 can have two independent control channels, each with its own pressure regulator. Each control channel can have up to two transducers.

Scanivalve's Pneumatic Logic Unit (SPCPLU) is a compliment to the SPC4050 Pressure Calibrator and allows the SPC4050 to perform automated calibrations on any DSA, ZOC or MPS modules.

Scanivalve's PressCal calibration software is included with the purchase of every SPC4050 and is capable of controlling the SPC4050, the SPCPLU and communicating with the Scanivalve module being calibrated. This software can be downloaded at no cost on the Scanivalve website.

The SPC4050 system (SPC4050 calibrator and SPCPLU) is capable of calibrating multiple modules of different ranges during the same automated calibration without any operator intervention.

Unpacking The SPC4050 System

Upon receiving your SPC4050 system, the first thing you should do is unpack, inventory and inspect all of the included components of the SPC4050 system. Before it left the Scanivalve factory, the SPC4050 system was subjected to many hours of testing and inspection. Please look over all included components and inspect for any damage that might have occurred during shipping. Report any visible damages to the shipper and to Scanivalve immediately. Once you have inspected all included components for any signs of damage, it is important that you do an inventory check and ensure that all components and accessories were included in the shipment. The shipment should include:

1) SPC4050 Calibrator
2) Pneumatic Logic Unit (SPCPLU)
3) Certificate of calibration
4) Digital Out cable 155662-01 (1 or 2)
5) Power Cord
6) Swagelok® to bulge-tube adaptors (1/8" & 1/16")
7) Helical spring-clamps (1/8" & 1/16")
8) Nylon tubing (25' - 1/8"; 25' - 1/16")
9) SPC4050 Resource drive

FIGURE 1.1 - SCANIVALVE SPC4050 FRONT PANEL

SPC4050 FRONT PANEL

The SPC4050 front panel includes and 8.9 inch color SVGA display featuring touch screen technology. Operator input is accomplished by pressing the words or symbols presented on the display. There are no discrete keypads or switches on the front panel aside from the power control.

To gain access to the internal modules simply loosen the two screws on the right hand edge of the front panel and swing it open (Figure 1.2). In the front of the instrument directly below the electrical module are slots to accommodate two pressure transducer modules on each control channel. Each transducer can be removed and reinstalled through the front panel opening. See Section 6: ***Maintenance***, for additional information on module removal and replacement.

FIGURE 1.2 - INTERNAL ACCESS

SPC4050 REAR PANEL

Up to eight pneumatic pressure ports are located horizontally across the rear panel (Figure 1.3). Positioned to the right of the pressure ports are the Ethernet and RS-232 connectors, USB connectors, and line fuses.

Figure 1.3 shows a rear panel containing two solenoid valve regulator pneumatic modules. Rear panels may differ slightly depending on what modules are installed in the SPC4050 chassis.

FIGURE 1.3 -REAR PANEL

SPC4050 DISPLAY

When the SPC4050 is powered up it takes about one minute for initialization, then it displays a screen similar to Figure 1.4. The display is made up of rectangles which display text or symbols.

Buttons, Labels and Windows: The SPC4050 touch screen has many buttons with relevant graphic icons or text which, when touched, will open a related window where changes can be made or information viewed. Some of these buttons will toggle from one state to another, others present choices or display a numerical data entry screen. Text or icons that are displayed, but do not respond to being touched, are called labels or windows. Operators will quickly become accustomed to the particular characteristics of the frequently used buttons.

Auxiliary Displays: The optional display is a window near the pressure label. This window can be set up to be blank, or to display any one of the following:

- Peak Pressure – minimum and maximum
- Rate of change of a measured pressure
- Barometer reading

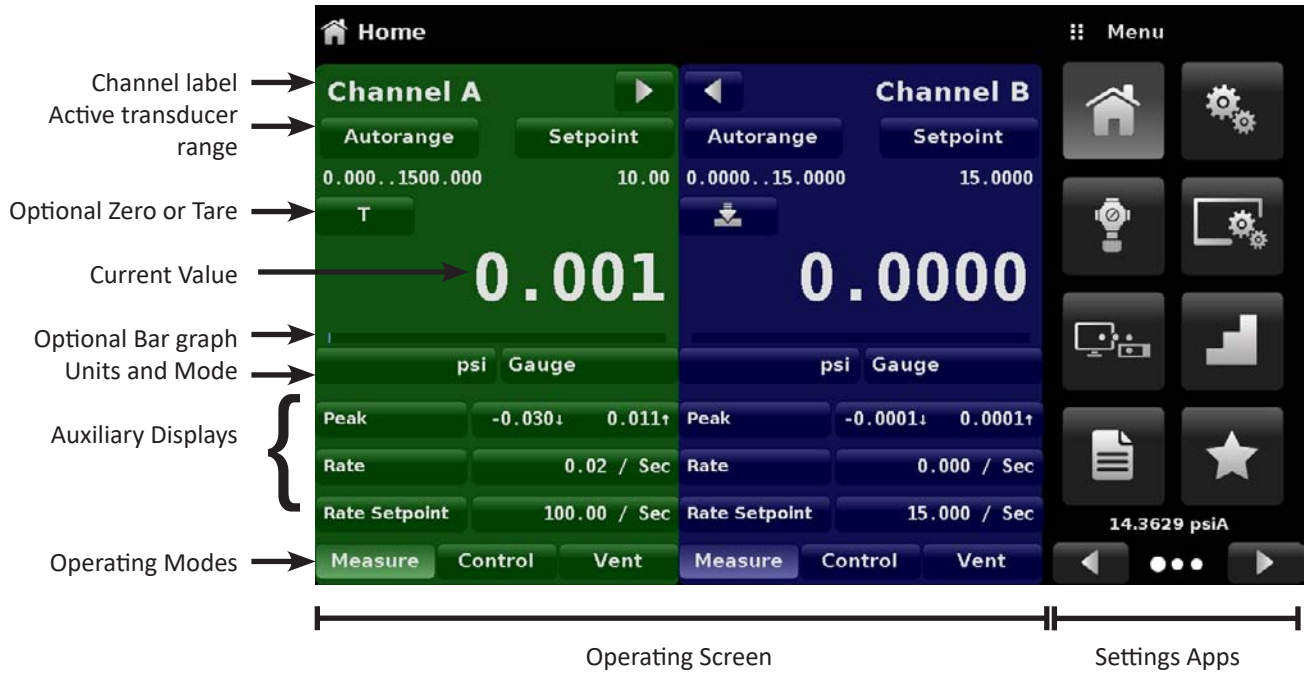


FIGURE 1.4 - TERMINOLOGY OF SCREEN ELEMENTS

SPC4050 ELECTRICAL MODULE

The electrical module is illustrated below with the instrument lid removed (Figure 1.5). All program information to run the system resides on a solid state disk module located on this module. The power switch and line fuses are situated on the rear of the electrical module such that they are accessible on the rear of the fully assembled SPC4050.

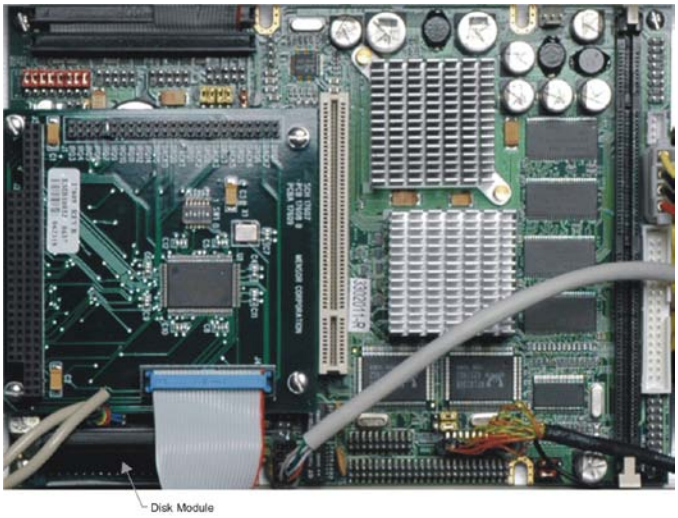


FIGURE 1.5 - ELECTRICAL MODULE

SPC4050 PNEUMATIC MODULE

Pneumatic modules come in two types and are referred to in this manual as the "Pump Regulator" or the "Solenoid Valve Regulator". The pump regulator is used with low pressure sensors specified in Section 2: ***Specifications***. The solenoid valve regulator is used with higher pressure sensors and comes in three varieties:

High Pressure Solenoid Valve Regulator (HPSVR)
Medium Pressure Solenoid Valve Regulator (MPSVR)
Low Pressure Solenoid Valve Regulator (LPSVR)

Pressure limits for all of these are specified in Section 2: ***Specifications***.

Each pneumatic module (Figure 1.6) includes platforms for up to two high performance pressure transducers which are traceable to NIST standards. Both of these transducers can be used in conjunction with the highly stable pressure regulator to produce a precise pressure output. Each transducer includes its own on-board compensation and calibration data so that any transducer can be replaced in the instrument without requiring a recalibration.

SVR Module Pump Module

FIGURE 1.6 - PNEUMATIC MODULE

SPC4050 CHASSIS ASSEMBLY

The chassis assembly acts as the housing for the system. The electrical and pneumatic modules are each self-contained inside the chassis, and either can be replaced using basic hand tools. In addition, each pressure transducer is individually removable without tools. Instructions for transducer and module removal are provided in Section 6: ***Maintenance***.

The only moving parts in the SPC4050 are the fan, the pneumatic flow controller diaphragms and valves, the pump/motor, and the solenoid valve plungers. There are no internal user adjustments or setup switches.

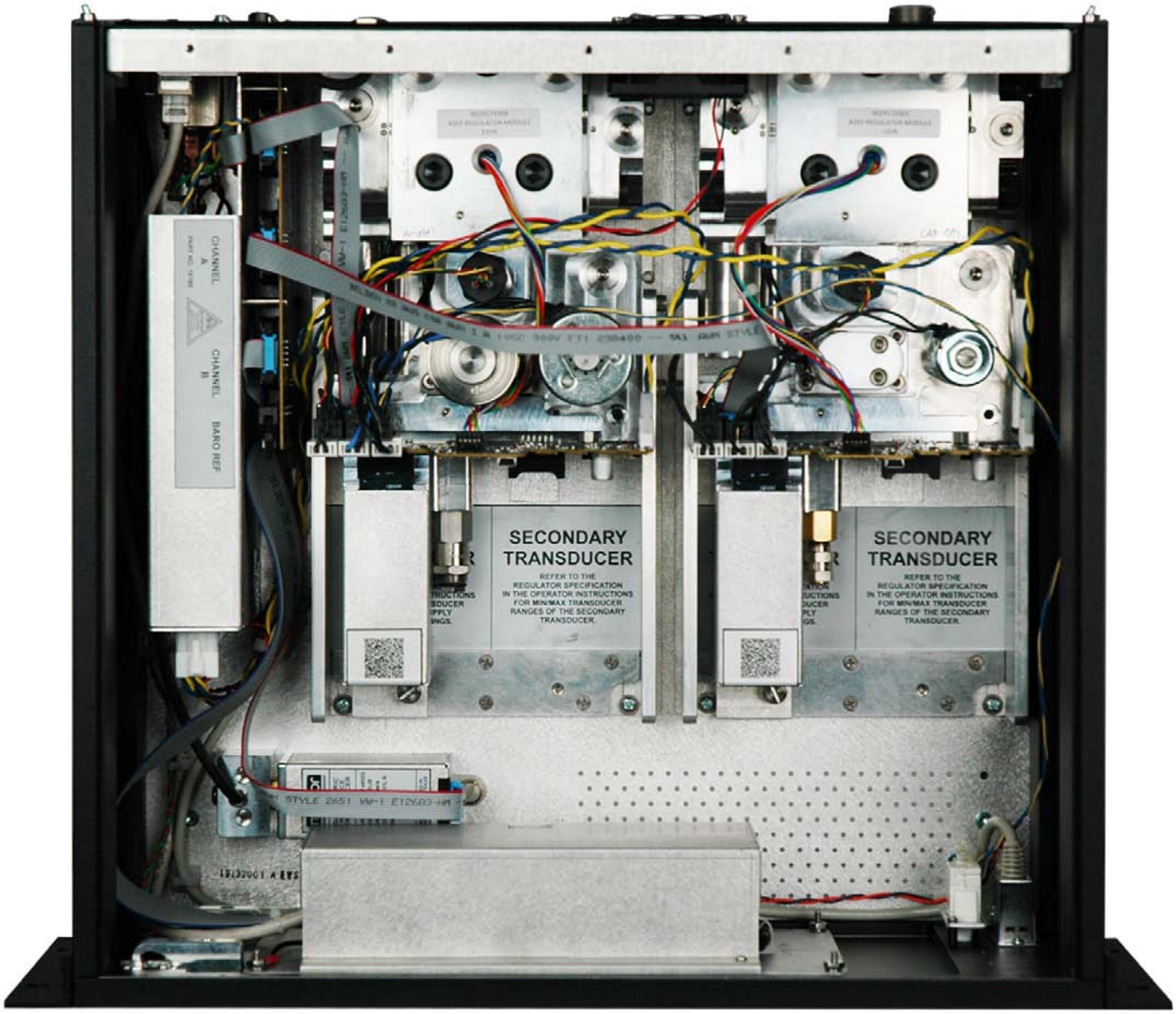


FIGURE 1.7 - CHASSIS ASSEMBLY

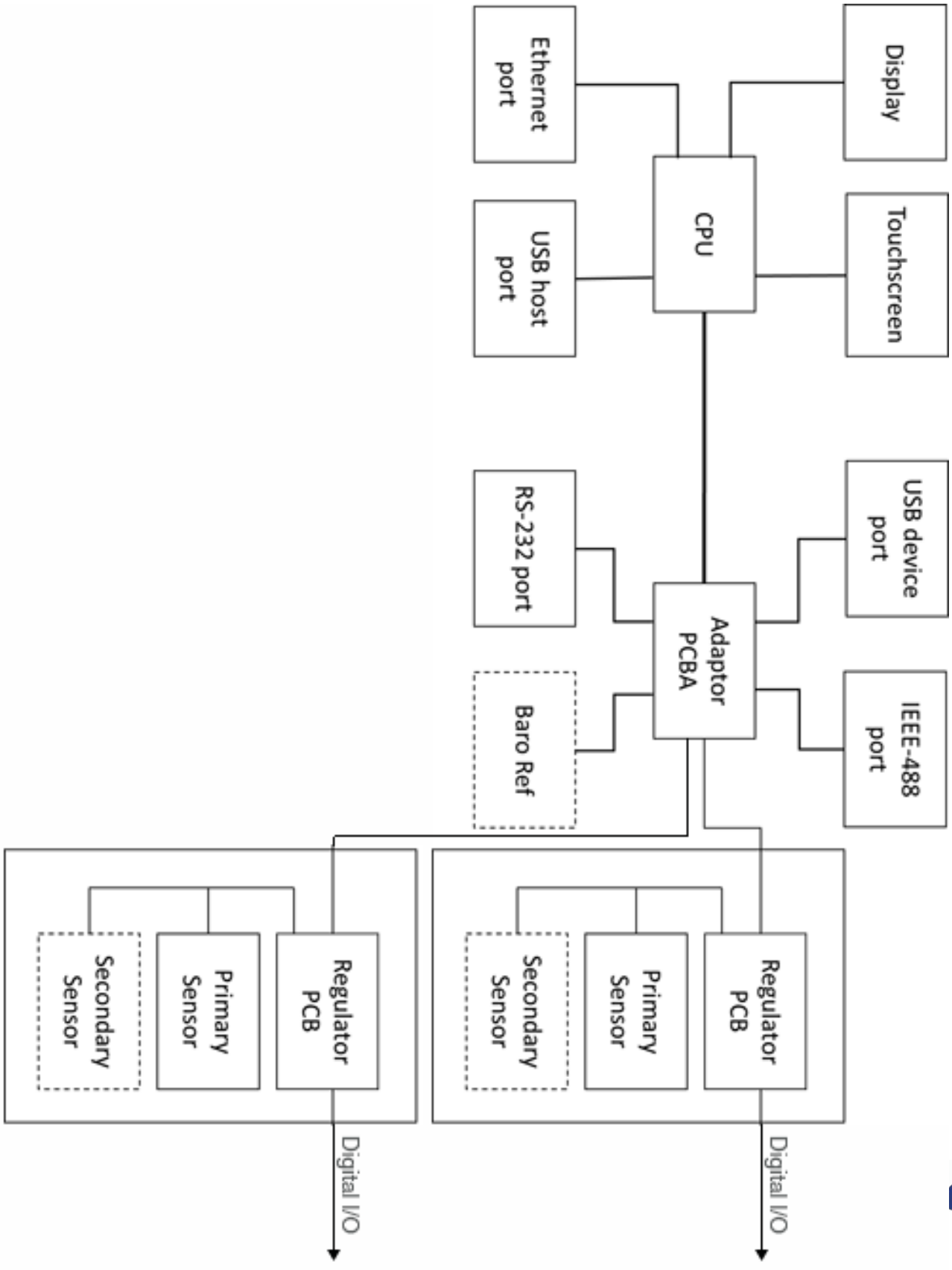


FIGURE 1.8 - SPC4050 ELECTRICAL BLOCK DIAGRAM

SPCPLU OVERVIEW

The Pneumatic Logic Unit (SPCPLU) is required for automated calibrations of DSA, MPS and ZOC modules. The SPCPLU is designed to orchestrate all of the pneumatic switching required during the calibration. It contains all required pneumatic solenoid valves and manifolds to perform both single and multi-range calibrations as well as zero offset corrections. The SPCPLU is dependant on the SPC4050 for configuration and is controlled by 3 digital outputs per channel from the SPC4050.

The SPCPLU is capable of segregating four individual calibration pressure ranges to allow modules of varying pressure ranges to be calibrated together during a single automated calibration procedure. Figure 1.9 depicts the internal pneumatic logic of the SPCPLU as well as how it interacts with the SPC4050 calibrator and the module being calibrated

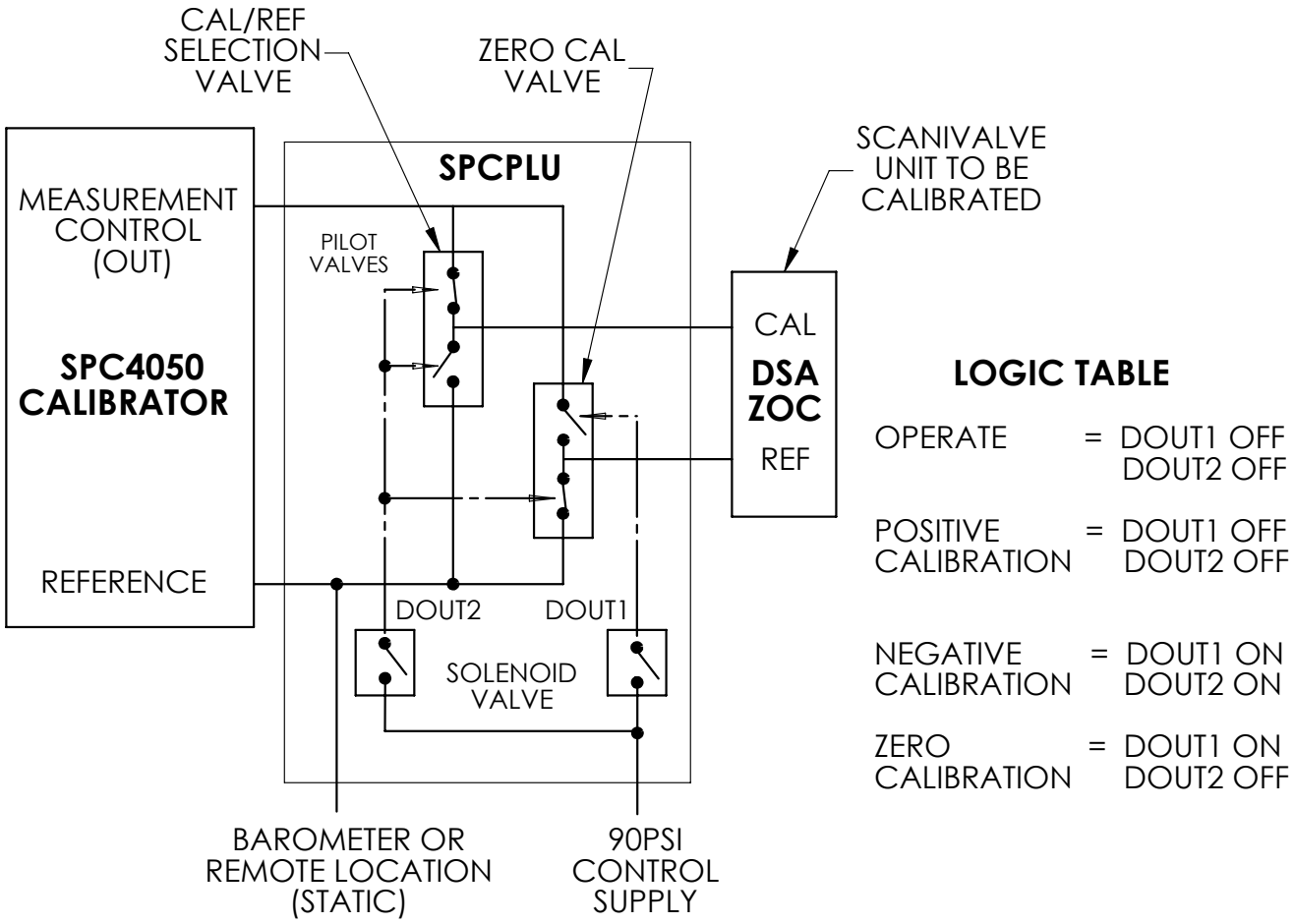


FIGURE 1.9 - SPCPLU PNEUMATIC LOGIC

SPCPLU FRONT PANEL

The front panel of the SPCPLU (Figure 1.10) displays its current configuration using 6 LEDs. Each of the LEDs represent the current state of each one of the internal solenoid valves. Included on the front panel of the SPCPLU is a truth table explaining each of the SPCPLU's configurations and the digital outputs associated with each.

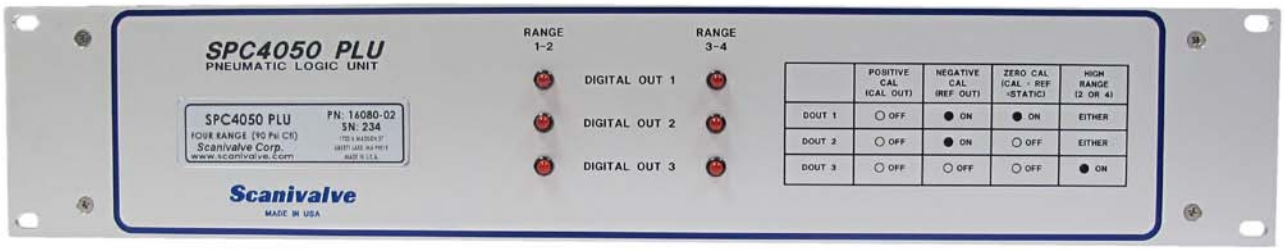


FIGURE 1.10 - SPCPLU FRONT PANEL

SPCPLU REAR PANEL

All of the pneumatic interfaces for the SPCPLU are located on the rear panel of the SPCPLU (Figure 1.11). These include input pressures, control pressure inputs, reference output and calibration output. Also located on the rear panel of the SPCPLU are the digital input/output connections. Each of the pneumatic fittings on the rear of the SPCPLU are 1/4" Swagelok® fittings. It is important that any pneumatic input or output not being used should be plugged.

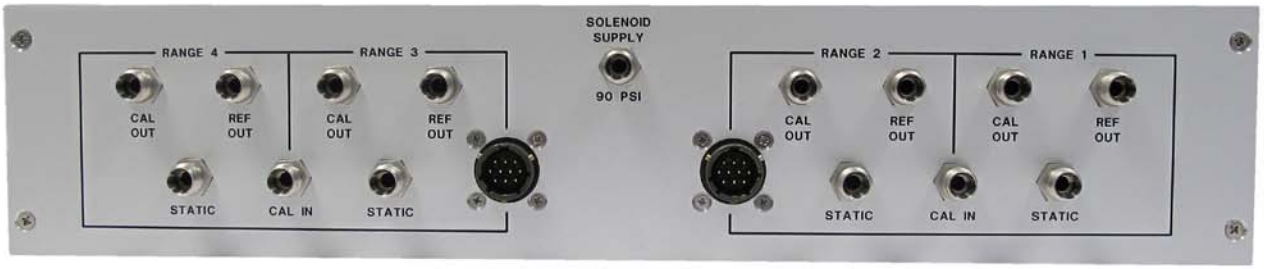


FIGURE 1.11 - SPCPLU REAR PANEL

SPC4050 SYSTEM OVERVIEW

In order to fully exploit the capabilities of the SPC4050 calibrator, it must be used in the SPC4050 system which includes the SPCPLU and PressCal software. Figure 1.12 shows the SPC4050 with the SPCPLU. This configuration allows fully automated, multiple range calibrations to be performed.

FIGURE 1.12 - SPC4050 SYSTEM

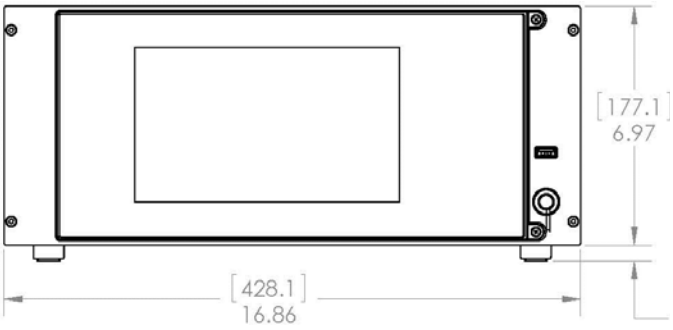
SECTION 2: SPECIFICATIONS

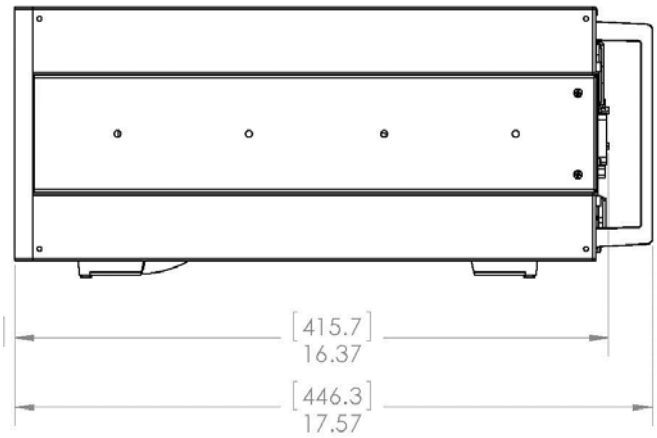
GENERAL SPECIFICATIONS- SPC4050

Size (WxHxD)	16.86” x 6.97” x 17.57” (42.82 cm x 17.7 cm x 44.63 cm)
Weight	50lbs - with all internal options (22.7 kg)
Power Requirements	100-240 VAC, 50/60 Hz, 210VA max
Pneumatic Interfaces	1/4” Swagelok®
Particle Filters	The instrument has 40-micron filters on all pressure ports through the manifold. The baro metric transducer has no filters.
Overpressure Protection	Protected by safety relief valves.
Compensated Temperature Range	15°C to 45°C
Operating Temperature Range	0°C to 50°C
Storage Temperature Range	-20°C to 70°C
Local User Interface	8.9” color LCD display with resistive touch screen.
Remote User Interface	Ethernet, USB, RS-232, IEEE-488
Warm-up Period	Approximately 15 minutes for full accuracy
Mounting Position	Horizontal
Operating Environment	5 to 95% RH non-condensing

GENERAL SPECIFICATIONS - SPCPLU

Size (WxHxD)	19” x 3.5” x 13” (48.3 cm x 8.9 cm x 33 cm)
Weight	6.9 lbs - SPCPLU-1 (3.13 kg) 11.5 lbs - SPCPLU-2 (5.22 kg)
Pneumatic Interfaces	1/4” Swagelok®
Control Pressure	
SPCPLU-1 & -2	90-120 psi - user supplied
SPCPLU-3 & -4	60-70 psi - user supplied





CONTROL SPECIFICATIONS FOR PUMP REGULATOR

Source Requirements	110% of highest pressure
Stability of Controlled Pressure	0.003% FS of active range, typically better than 0.001% of span 10 seconds after displaying stable flag.
Available Sensor Range	0-.36 psig to 0-15 psig
Minimum Controlled Pressure	0.05% FS or 0.5 psi over exhaust pressure, whichever is greater
Control Time	25 seconds to stable flag for 10% FS step pressure change into 50cc volume. Larger volumes can lengthen this time.
Measure to Control Offset	<0.0005% Span
Overshoot	<0.3% FS

CONTROL SPECIFICATIONS FOR SOLENOID VALVE REGULATOR

Source Requirements	110% of highest pressure or 10 psi, whichever is greater
Stability of Controlled Pressure	0.003% FS of active range, typically better than 0.001% of span 10 seconds after displaying stable flag.
Available Sensor Range	
LPSVR	0-1 psig to 0-50 psig
MPSVR	0-10 psig to 0-150 psig
HPSVR	0-75 psig to 0-850 psig
Minimum Controlled Pressure	0.05% FS or 0.025 psi over exhaust pressure, whichever is greater
Control Time	15 seconds to stable flag for 10% FS step pressure change into 50cc volume. Larger volumes can lengthen this time.
Overshoot	
Low overshoot mode	<0.05%FS
High speed mode	<0.15%FS

MEASURE SPECIFICATIONS

Accuracy	±0.01% FS
Calibration Period	365 days (15 psi +) 365 days (0-14.9 psi)
Precision	0.004% FS
Pressure Ranges***	0.36 psig 1 psig 5 psig 15 psig 50 psig 100 psig 200 psig 500 psig 750 psig 850 psig
Resolution	4 to 6 significant digits, user selectable
Optional Barometer Range	11 to 17 psia
Optional Barometer Uncertainty	±0.01% FS
Optional Barometer Calibration Period	180 days
Pressure Media	Clean, dry, non-corrosive, non-combustible, non-oxidizing gases. Not for oxygen use.

*** Nominal pressure ranges listed. Actual transducer pressure range will be 10-20% greater.

SECTION 3: INSTALLATION

MOUNTING

The SPC4050 system is intended to be mounted in a standard 19” rack. If desired however, it can be used in a bench top application. Installing the SPC4050 system into a rack requires the rack mount (included). The SPC4050 and the SPCPLU must be installed in the rack mount before being installed in a 19” rack.

The special sensors used in the SPC4050 are relatively insensitive to tilt and vibration. However to further assure stability and accuracy, avoid mounting the instrument on surfaces subject to excessive motor or machinery vibration.

CAUTION! Improperly installing the SPC4050 calibrator or the SPCPLU could result in damage to the components.

PNEUMATIC CONNECTIONS

All pneumatic connections on the SPC4050 and the SPCPLU are 1/4” Swagelok® fittings. A variety of 0.125” and 0.063” Swagelok® to bulge-tube adaptors are provided with the SPC4050 to provide a means of connecting smaller tubing to the 1/4” Swagelok® fittings. If desired, either Swagelok® nut and ferrule or a Scanivalve X-lok adaptor fittings can be used in place of the Swagelok® to bulge-tube adaptors. When making the pneumatic connections, it is important to not use any form of sealant on the O-ring sealed connections. Take great care when making the connections, as even a small leak can cause errors in the pressure measurements.

Refer to Figure 3.1 and Figure 3.3 for a layout of all connections of the SPC4050 and the SPCPLU.

SUPPLY PORT

Connect a source pressure to the SUPPLY port of each channel. A source pressure is not required if using a Pump Regulator, however if the SPC4050 will be required to supply pressures to large volumes (300cc +) it is recommended that a source pressure is provided. See “Source Pressure” in Section 2: Specifications, for supply pressure requirements for various pressure ranges. Keep in mind, a well regulated supply pressure will aid in providing more stable, accurate output from the calibrator.

CAUTION! Separate supply pressures should be applied to each of the independent control channels based on the maximum pressure range of each channel. Applying source pressure higher than the recommended pressure can cause permanent damage to the control channel.

FIGURE 3.1 - SPC4050 SYSTEM REAR VIEW

MEASURE/CONTROL/CAL PORT

The Measure/Control/Cal port is the output pressure from the SPC4050 calibrator. Connect this port to the 'Cal In' port on the SPCPLU for the related channel. In addition to outputting a precisely controlled pressure out of this port, when the SPC4050 is in 'Measure' mode, the calibrator will measure and display the pressure at this port.

A pressure value can be selected using the on-screen keypad. That pressure will then be output to the MEASURE/CONTROL/CAL port by switching to the CONTROL mode of operation.

EXHAUST PORT

If sub-atmospheric control pressure is required a vacuum pump must be connected to the EXHAUST port. Otherwise, this port may be left open to atmosphere.

CAUTION! Improper use of this equipment may impair protection provided by this instrument.

REFERENCE/STATIC PORT

This port is connected to the reference side of the transducer. This port is normally left open to atmosphere but should be connected to a known reference or static source for low pressure calibrations.

WARNING! HIGH NOISE LEVELS! As pressure decreases compressed gas will escape out the exhaust port. For ranges above 500 psi high noise levels may result during such pressure releases. To overcome objectionable exhaust noise either install a muffler or route the port to a remote location.

VENT PORT

Built up calibration pressure is vented through this port. It can be left open to local atmosphere, or it can be routed to a remote venting location.

SPCPLU STATIC PORT

The SPCPLU has an individual static port for each range. This port is used when a zero calibration is performed on the Scanivalve module being calibrated. It should be plumbed to the same location as the reference/static port on the SPC4050 calibrator is plumbed to. That is, for low pressure modules, to some form of stable static reference location and for higher pressure modules left open to local atmosphere. Either case, it is very important that the SPCPLU static port and the SPC4050 reference/static port are tied to the same location. If any of the Static Ports are not being used, ensure that the fitting is plugged.

SPCPLU SOLENOID SUPPLY PORT

There is one solenoid supply port on the SPCPLU. This is the supply pressure for the pneumatic solenoids within the SPCPLU. It is very important that adequate control pressure is supplied to the SPCPLU (90psi for SPCPLU-1&-2, 65psi for SPCPLU-3&-4 minimum). Anything less than this may not be sufficient for proper function and switching of the internal pneumatic solenoids.

SPCPLU CAL OUT PORT

Each range on the SPCPLU has a dedicated Cal Out port. This is the calibration port that needs to be connected to the positive calibration port on the module being calibrated. If any of the Cal Out ports are not being used, ensure that the fitting is plugged.

SPCPLU REF OUT PORT

Each range on the SPCPLU also has a dedicated Ref Out Port. This needs to be connected to the negative, or reference calibration port on the module being calibrated. If any of the Ref Out ports are not being used, ensure that the fitting is plugged.

DIGITAL I/O CONNECTIONS

After all pneumatic connections have been made, connect the Digital Output(s) from the SPC4050 calibrator to the Digital Input(s) on the SPCPLU. These Digital I/O's allow the SPC4050 calibrator to communicate with and control the SPCPLU. Make sure that the Digital I/O's are connected to the correct output channel from the SPC4050. Range 1 & 2 on the SPCPLU must be connected to Digital I/O's of Channel A on the SPC4050, and range 3 & 4 on the SPCPLU must be connected to Channel B.

COMMUNICATIONS CONNECTIONS

If the SPC4050 system is to be operate remotely, communications connections must be made to the SPC4050. Connect either an Ethernet cable to the Ethernet port, or a serial cable to the RS-232 port. For more information on remote communications with the SPC4050, see Section 4: ***Remote Operations***.

POWER UP

After the pressure connections are secure and the communication connection is made, connect the power cord first to the SPC4050. After the power cord is securely connected to the SPC4050, apply power to the calibrator. Push the power button located on the front of the SPC4050.

The calibrator will go through an initialization process and system check during the power up cycle. As soon as the system check is completed, the system will default to an operating screen similar to Figure 3.2. Before performing any critical calibrations or pressure measurements, allow the system to warm up for at least 15 minutes.

WARNING! EARTH GROUND!
Any power adaptors or surge protection devices that negate the protective earth ground should not be used.

SYSTEM OPERATION AND LEAK CHECK

After they SPC4050 has warmed up (minimum 15 minutes) and before any calibrations are attempted, ensure that the system is leak tight. The 'Cal' and 'Ref' ports on the SPCPLU either need to be plumbed to a Scanivalve pressure module or plugged for this test. Apply a positive pressure (reference Section 5: ***Local Operations*** for instructions on controlling the calibrator's output locally), allow the pressure to stabilize and then put the SPC4050 into 'measure' mode. This traps the system. Monitor the pressure to see if any leaks are present. Repeat the test with a negative pressure applied. Also verify that the DOUT indicator LED's on the front of the SPCPLU match the configurations shown in the truth table on the front panel of the SPCPLU. If any problems or leaks are detected, reference Section 6: ***Maintenance*** for troubleshooting information or contact Scanivalve.

WARNING! VENTILATION!
Do not block airflow to ventilation fan located on the rear of the instrument.

FIGURE 3.2 - DEFAULT DISPLAY SCREEN

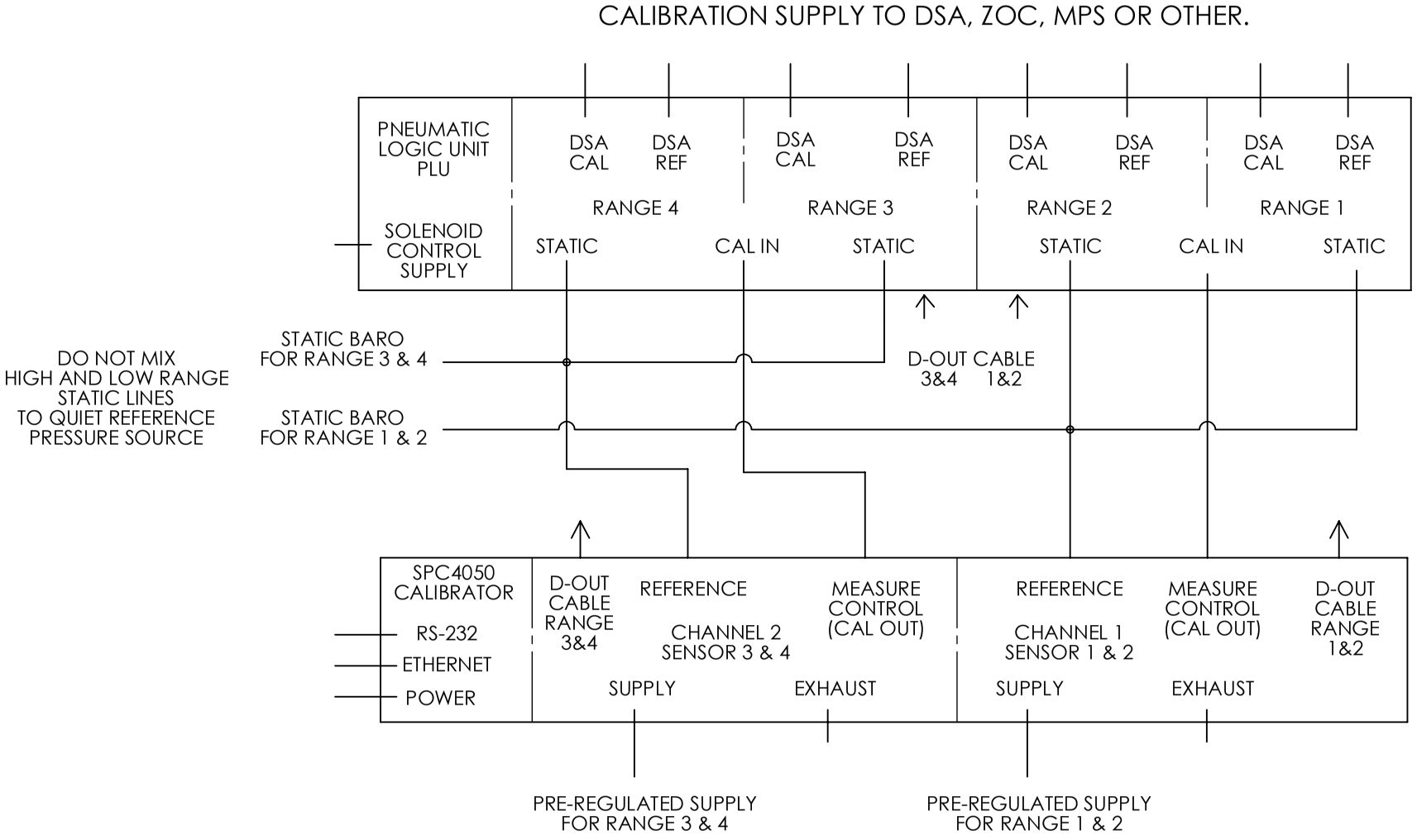


FIGURE 3.3 - SPC4050 / SPCPLU CONNECTIONS

SECTION 4: REMOTE OPERATIONS

REMOTE APPLICATION

Use the following screens to set the operating parameters for the Ethernet and RS-232 serial ports.
Press the [Remote] key located on the menu tab and a new display appears with another set of tabs as shown in Figure 4.1.

FIGURE 4.1 - INSTRUMENT SETUP SCREEN

SERIAL SETUP SCREEN

Press the [Baud], [Serial Format] and [Echo] tab to set up the serial port parameters (Figure 4.2). These parameters should be set up to match your host computer. Default settings are: 57600, 8,1, none parity, and no echo.

If the Echo check box is checked, the SPC4050 will immediately echo back characters sent over the serial port.

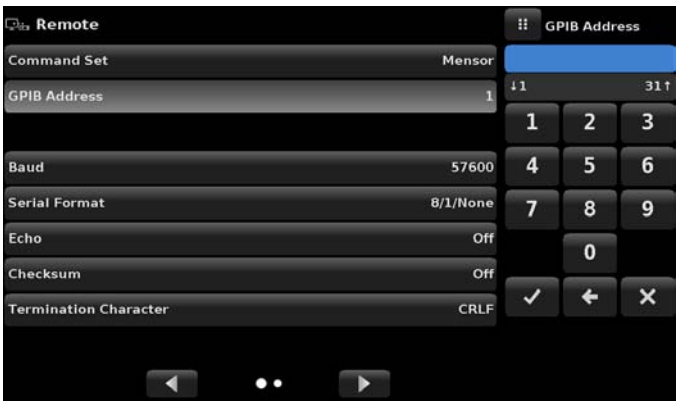


FIGURE 4.2 - SERIAL SETUP SCREEN

ETHERNET SETUP SCREEN

Press the Next Page tab to set up the Ethernet parameters (Figure 4.4). Select a parameter to make a corresponding adjustment. These parameters should be set up to match your host computer.
When the correct values have been selected for all parameters simply touch any of the keys across the top or the bottom of the screen to move on to another function.

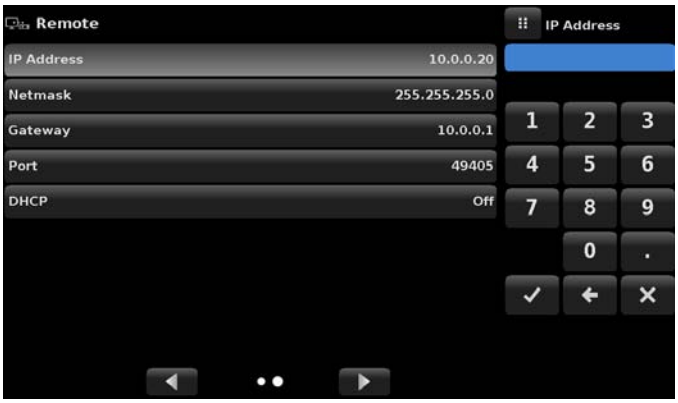


FIGURE 4.3 - ETHERNET SETUP SCREEN

ETHERNET COMMUNICATIONS

The Ethernet communication port allows the SPC4050 to communicate with computers using 10/100Based-T specifications. Ethernet communications are transmitted over a standard RJ-45 cable.

Prior to first time use of Ethernet communication, the four parameters, IP, Netmask, Gateway, and Port must be setup or verified.

CAUTION! Please consult your Computer Resources Department prior to connecting this instrument to your network to verify there are no conflicts with existing IP addresses.

RS-232 SERIAL COMMUNICATIONS

The serial communication port allows the SPC4050 to communicate in RS-232 format with computers, terminals, or similar hosts.
RS-232 communications are transmitted over a three conductor, shielded cable terminated in a standard DB9 connector on the instrument end, and typically the same connector on the host end. Figure 4.4 illustrates the proper pin-outs. When replacing an older model DPG2100, the serial cable should be replaced with a straight cable or a null modem inserted in the line.

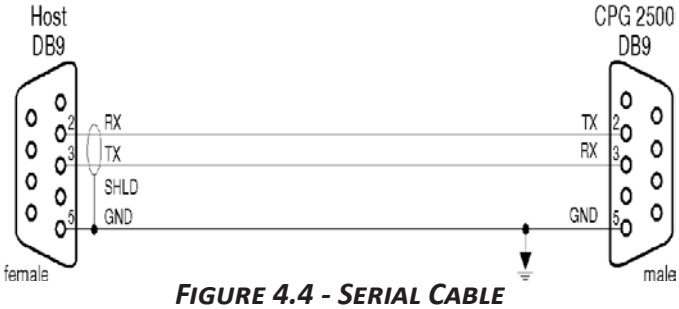


FIGURE 4.4 - SERIAL CABLE

COMMAND/QUERY FORMAT

Commands must be sent in ASCII format and terminated with either a carriage return (<cr>), linefeed (<lf>) or both. Commands are not case sensitive. Each query returns a response. If an error is detected the response will include an error flag.

One of the first commands issued when starting remote communications should be “Keylock Yes”. This will disable the on-screen keys and tabs, and place the “Keylock” label on the screen. Turning keylock on prevents the potential conflicts that could occur if someone pressed an on-screen key, either intentionally or by accident.

Command/Query Field: Unless otherwise specified, commands are typically converted to queries by appending a question mark to the command. Table 4.1 lists all of the SPC4050 command/query keywords.

Data Field: The data field is either in ASCII {string} or numeric {value} form. In the case of multiple data fields, commas are required to separate the fields. Queries do not have a data field. String (text) or value (numeric) data are acceptable in any of the following formats:

Examples of {string} data:	ON	OFF	mBar
Examples of {value} data:	1	1.0	-5.678

COMMAND SET DEFINITIONS

In this manual a data entry made up of alpha characters is defined as a string, as opposed to data containing only numbers, such as “Enter 1 for ON or 0 for OFF” where 1 and 0 are defined as values.

Command: Any command or query listed in Table 4.1.

Separator: Space <SP>.

Data: ASCII representations of numbers, {value}, or alpha characters, {string}, data as defined above. When sending code a literal variable replaces the braces and the enclosed character(s) shown in the following examples.

Termination: Linefeed (LF) or carriage return (CR) is used to signal the end of a command statement.

Always send commands in one of the following formats:

1. [Command] [Termination];
2. [Command] [Separator] [Data] [Termination];
3. Queries are special instructions in the form: [Command?] [Termination] where the question mark, “?”, immediately precedes the terminator.

When a valid query is received, the SPC4050 will return {data} terminated by CR and LF.

Floating point data is returned in the current engineering units in exponential format.

Channel specific commands are sent to only the active channel. See ‘CHANNEL’ command. Exceptions are GP, GN, RP, RP/C, IC and ZO commands when preceded by a specific range/transducer number.

Commands that are included in the “Scanivalve” command set are specific to the SPC4050 and are indicated in the following table in bold font. When any of these commands are received, the SPC4050 will return a prompt as defined by the current setting of the “SM” command.

Table 4.1 - SPC4050 Commands and Queries		
Command	**Data**	**Function / Response**
Autozero	none	Re-zero all ranges that can measure the vented pressure. These adjustments are not password protected and are not saved through power cycles. This command takes approximately 60 seconds.
Autozero?	S,T,X,X	Returns autozero data where S represents state (responses can be 0 = complete, 1 = local autozero, or 2 = remote autozero), T represents the estimated remaining time to complete in seconds, and X is a (0) character since this data location is not used at this time.
Autozero-abort	none	Aborts autozero.
Baro?	<sp>{value}<cr><lf>	Returns reading from barometric sensor.
Channel	**{A or B}**	**Sets the active channel on the instrument.**
Chan?	<sp>{A or B}<cr><lf>	Returns which channel is active.
Decpt	<sp>{4, 5 or 6}<cr><lf>	Sets the number of significant digits displayed.
Decpt?	<sp>{value}<cr><lf>	Returns the number of significant digits displayed for the active channel.
Default	none	Sets the default values. This command takes approximately 20 seconds.
Error?	<sp>{string}<cr><lf>	Returns a description of an error.
Errorno?	<sp>{string}<cr><lf>	Returns SPC4050 error code and text.
Filter	{Off, Low, Normal, High}	Sets the reading filter.
Filter?	<sp>{string}<cr><lf>	Returns the reading filter.
GN	**<sp>{value}**	**Sends the SPC4050 to control mode and a desired negative pressure (value). Precede with a 1, 2, 3 or 4 for a specific range.** **EX: 2gn 10**
GP	**<sp>{value}**	**Sends the SPC4050 to control mode and a desired positive pressure (value). Precede with a 1, 2, 3 or 4 for a specific range.** **EX: 3gp 53.47**
IC	**none**	**Places the specified channel in a "trap" mode closing all valves internally in the SPC4050 including the supply, vent measure/output solenoids. This leaves the module being calibrated in a no-flow condition.** **Precede with a 1, 2, 3 or 4 for a specific range.** **EX: 1ic**
ID?	<sp>MENSOR,600,{ssssss},{v.vv}<cr><lf>	Returns the instrument identity where {ssssss} is the serial number, and {v.vv} is the software version number.
IP	{string e.g. nnn.nnn.nnn.nnn}	Sets the IP address of the instrument.
IP?	<sp>{string}<cr><lf>	Returns the IP address of the instrument.
Keylock	{Yes or No}	YES to lock, or NO to unlock the on-screen keys.
Keylock?	<sp>{Yes or No}<cr><lf>	Returns current keylock status as YES or NO.

Table 4.1 - SPC4050 Commands and Queries		
Command	**Data**	**Function / Response**
Listcal?	<sp>PRI,{sn},{td},{mm/dd/yyyy},{td},{mm/dd/yyyy};SEC,{td},{mm/dd/yyyy},{td},{mm/dd/yyyy}<cr> <lf>	Returns the serial number of each installed transducer and calibration dates for each range.
Listrange?	<sp>PRI,{td},{min},{max},{td},{min},{max};SEC,{td},{min},{max},{td},{min},{max}<cr><lf>	Returns the minimum and maximum ranges of all installed sensors for the active channel.
Locale?	<sp>{string}<cr><lf>	Returns current language and Country locale.
Measure	**none**	**Instrument placed in Measure or trap mode.**
Measure?	<sp>{Yes or No}<cr><lf>	Returns YES if active channel is in Measure mode; NO if otherwise.
Mode?	<sp>{string}<cr><lf>	Returns the operation mode of the active channel.
Netmask	{nnn.nnn.nnn.nnn}	Sets the Ethernet network mask.
Netmask?	<sp>{nnn.nnn.nnn.nnn}<cr><lf>	Returns the Ethernet network mask.
Peakmax?	<sp>{value}<cr><lf>	Returns the maximum pressure since peakreset was sent.
Peakmin?	<sp>{value}<cr><lf>	Returns the minimum pressure since peakreset was sent.
Peakreset	none	Resets the peak values.
Port	{value}	Sets the Ethernet port of the instrument.
Port?	<sp>{value}<cr><lf>	Returns the Ethernet port of the instrument.
RangeMax?	<sp>{value}<cr><lf>	Returns the maximum range of the active transducer and turndown in the current units.
RangeMin?	<sp>{value}<cr><lf>	Returns the minimum range of the active transducer and turndown in the current units.
Rdecpt?	<sp>{value}<cr><lf>	Returns the number of rate decimal points for the active channel. See: Resolution
Repeat	None	Repeats output continually over serial port only.
Resolution	{4 to 6}	Sets the number of significant digits. See: decpt
Resolution?	<sp>{value}<cr><lf>	Returns the number of significant digits.
RP	**None**	**Returns the current pressure read by a transducer. Precede with a 1, 2, 3 or 4 to specify the transducer being measured. EX: 1RP**
RP/C	**None**	**Continuously returns the current pressure read by a transducer. Precede with a 1, 2, 3 or 4 to specify the transducer being measured. EX: 4RP/C <esc><cr> to terminate**
Rsetpt	{value}	Sets the rate setpoint of the active channel in current units per second. Must be a value inside the current sensor range.
Sbaud	{9600, 19200, 38400, 57600}	Sets the serial baud rate.
Sbaud?	<sp>{value}<cr><lf>	Returns the serial baud rate.
Sdata	{7 or 8}	Sets the serial data bits.
Sdata?	<sp>{value}<cr><lf>	Returns the serial data bits number.

Table 4.1 - SPC4050 Commands and Queries		
Command	**Data**	**Function / Response**
Sensor	C, X	Sets the active sensor where C = Primary or Secondary and X is the turndown.
Sensor?	<zp>C, X<cr><lf>	Returns the active sensor using the same format as Sensor cmd
Sensorid?	<sp>{Address}<sp>MENSOR ,<sp>600SNSR,<sp>{Serial No.},V{V.VV}<cr><lf>	Returns the active sensor's serial number and firmware version.
SM	**{pcode}N**	**Sets the type of prompt returned after each "Scanivalve" command sent. It signals the user that the calibrator is ready to accept a new command. It also determines if the incoming characters are echoed back to the host.** **{pcode} - 2 = <CR><LF>;** **3 = <CR><LF> >** **EX: To set the SPC4050 to return a ">" prompt after a command is received, send the command:** **1SM3N**
Sparity	{Even, ODD , NONE}	Sets the serial parity.
Sparity?	{<sp>{string}<cr><lf>	Returns the serial parity.
Sstop	{1 or 2}	Sets the serial stop bits.
Sstop?	<sp>{value}<cr><lf>	Returns the serial stop bits.
Stabledelay	{0 to 65535}	Sets the stable time to the number of seconds specified.
Stabledelay?	<sp>{value}<cr><lf>	Returns the stable time.
Stabletime	{0 to 65535}	Sets the stable time to the number of seconds specified.
Stabletime?	<sp>{value}<cr><lf>	Returns the stable time.
StableWin	{%fs value}	Sets the stable window as a %FS.
StableWin?	<sp>{value}<cr><lf>	Returns the stable window in % of Span.
Units	{units code, or output format text from Measurement Units Table 11.1 in the Appendix Section}	Sets the instrument engineering units.
Units?	<sp>{string}<cr><lf>	Returns the instrument units in a text string.
Versions?	<sp>{string}<cr><lf>	Returns the versions of the firmware for the instrument, gpib driver, gate array, installer, and the graphics library.
Volume	{value in cc}	Sets the system volume in cc's – only applicable if the active channel is a low pressure regulator.
Volume?	<sp>{value}<cr><lf>	Retuns the current system volume in cc's – only applicable if the active channel is a low pressure regulator.
ZO	**None**	**Vents any pressure in the system and pneumatically shorts the positive and negative side of any transducers together within the module being calibrated.** **Precede with a 1, 2, 3 or 4 for a specific range.** **EX: 1zo**

SECTION 5: LOCAL OPERATIONS

GENERAL

This section describes the procedures for operating the SPC4050 from the font panel. Instructions for operating the calibrator remotely can be found in Section 6: ***Remote Operations***. The SPC4050 features a full color 8.9" touch screen that allows for intuitive local operations.

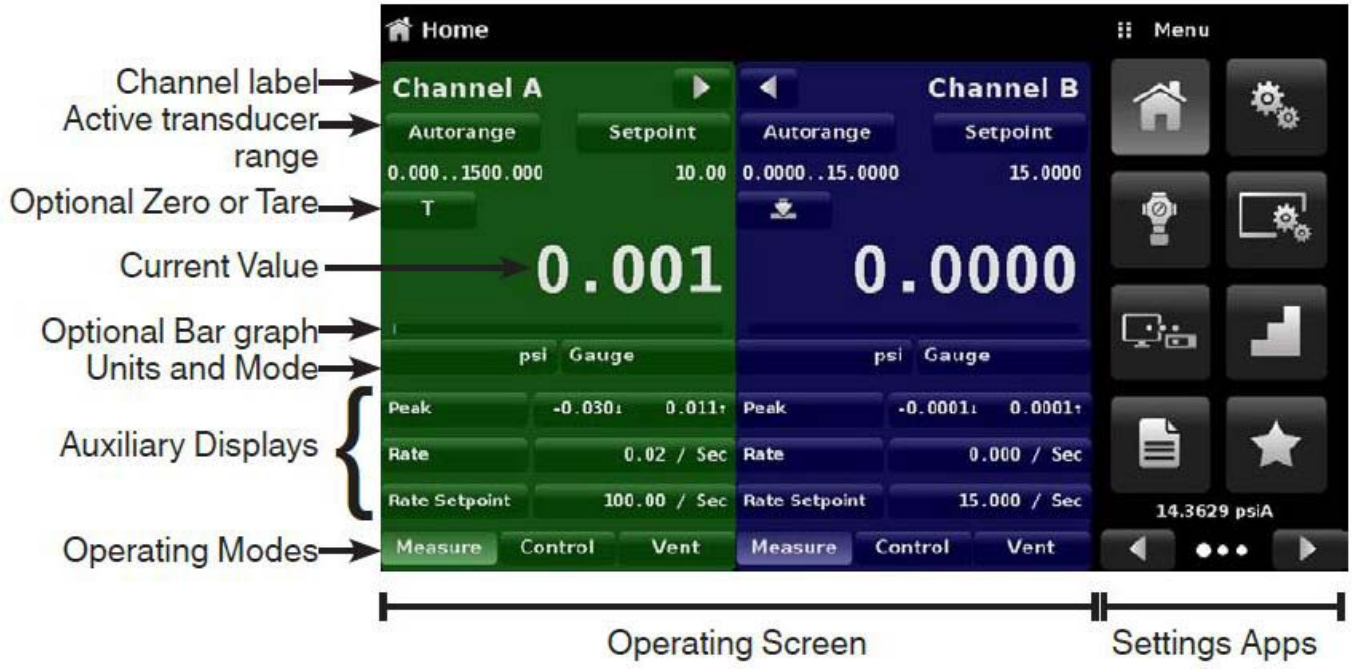


FIGURE 5.1 - DISPLAY SCREEN FEATURES

KEYS AND TABS

Local operation is accomplished by observing the data presented in the display, then pressing the on-screen [key] or [tab] for the desired function. Throughout this manual characters enclosed inside square brackets [ ] represent the associated on-screen touch point.

DISPLAY SCREEN FEATURES

Figure 5.1 provides a brief description of the features shown on a single channel display.

Figure 5.2 is an example of a typical display after initialization. To expand the selected channel to a single channel operation screen as shown in Figure 5.1, press the [>] key. To expand or return to a dual channel operation screen press the [<] or [>] key.

FIGURE 5.2 - TYPICAL OPERATION SCREEN

All of the SPC4050 screen features are described in more detail in the rest of this section.

CONTACT INFORMATION BUTTON

Touch the information button (Figure 5.3) to display a pop-up window listing various Scanivalve contact information and SPC4050 serial number and version information.

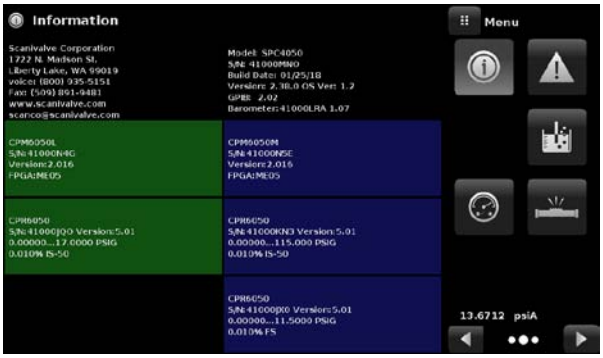


FIGURE 5.3 - CONTACT INFORMATION BUTTON

LANGUAGE SELECTION

The language selection can be found under the settings tab. Select the Language option for a pop-up window displaying several national flags and languages (Figure 5.4). Touch any one of these [Flags] to effect the language change.

The current language selections available are:

Language	Country Flags
English	USA
German	Germany
German	Switzerland
English	Great Britain
Chinese	China
English	Canada
French	France
French	Switzerland
English	Ireland
Korean	Korea
French	Canada
Italian	Italy
Russian	Russia
Polish	Poland
Japanese	Japan
Spanish	Mexico
Spanish	Spain

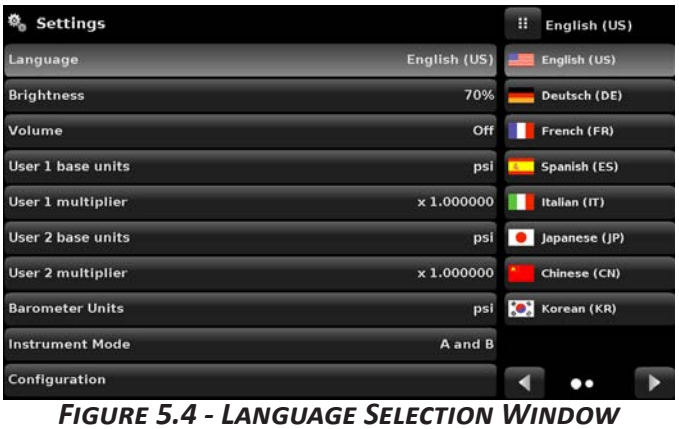


FIGURE 5.4 - LANGUAGE SELECTION WINDOW

[>] AND [<] KEYS

The [>] and [<] keys will expand the selected channel to single channel operation screen, or return to dual channel operation screen.

FIGURE 5.5 - CHANNEL SCREEN SELECTION BUTTONS

RANGE SELECTOR KEY

The label in the upper left portion of Figure 5.6 describes the current active range as “Autorange 0.0000 .. 11.5000”. The label, when touched, becomes the [Range] key. The currently active range is highlighted with a lighter background shade. Touch any range other than the highlighted one to select a different range as shown in Figure 5.7. The last selection in this range selector is [Autorange], which will automatically switch to the most accurate range in the system capable of measuring the current pressure. Each change is immediately reflected in the turndown label. There is also a label beside the current active range to show if you are in range hold or autorange.

Some pressure units can cause a number to be too long for the value window. In those cases the value will be abbreviated with an “m” (milli), “k” (kilo), or “M” (mega) multiplier appended to the range in the range drop list.

An important feature of the SPC4050 is that transducers can easily be changed. A transducer can be replaced in the SPC4050 in less than 30 seconds, with only a screwdriver required. Each installed transducer identifies itself to the system using its on-board stored data. Among the items stored in this data are the transducer serial number, curve characterizations and calibrations for each turndown, the dates of calibration, and the transducer’s software version.

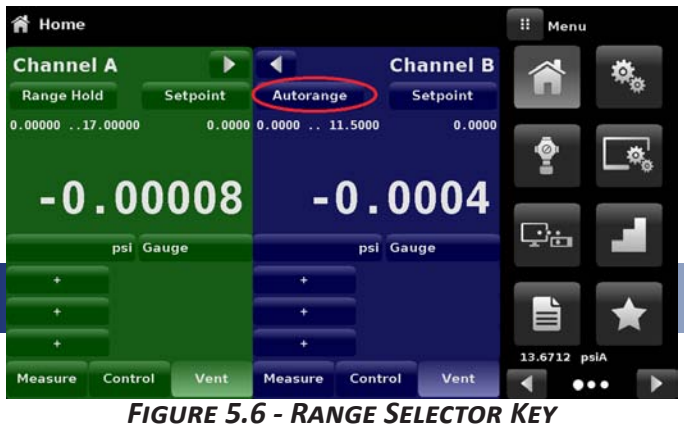


FIGURE 5.6 - RANGE SELECTOR KEY

PRESSURE LABEL

Below the turndown label shown in Figure 5.6 is a larger label showing the measured pressure value of “-0.0004”. This large label always displays the current pressure reading.

PRESSURE UNITS KEY

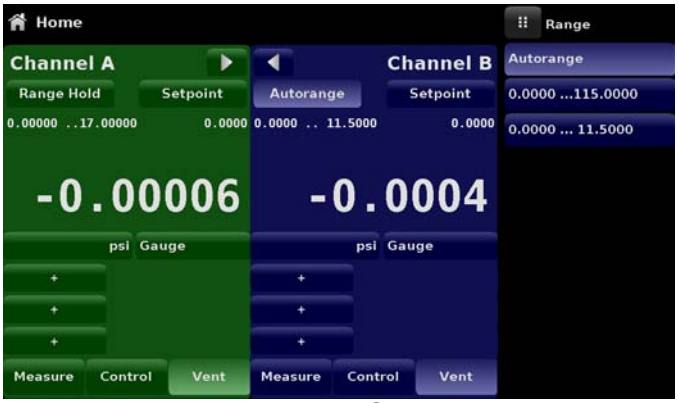


FIGURE 5.7 - RANGE SELECTOR MENU

Below the right of the pressure label is the [Units] key, shown in Figure 5.6 as [PSI]. Touch [PSI] and a pop-up menu of pressure units will appear as in Figure 5.8. This menu includes [User 1] and [User 2] keys allowing the user to enter customized pressure units. Touch [Pascals] and it will toggle to Pascal.

The [gauge] key below the pressure value allows emulation mode if an optional barometric sensor is installed.

Touch any [Pressure Units] key to enable change and return to previous operation screen. All of the displayed pressure values will have changed to correspond to the newly selected units at the correct conversion ratio.

FIGURE 5.8 - UNITS SELECTION WINDOW

AUXILIARY DISPLAY KEYS

Auxiliary Displays can be chosen by the user to suit their application needs. The [+] keys below the pressure unit enable the Auxiliary Display menu as shown in Figure 5.9.

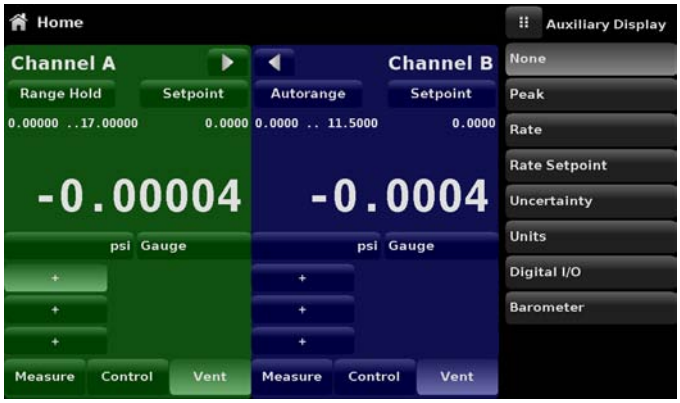


FIGURE 5.9 - AUXILIARY DISPLAY SCREEN

CONTROL PRESSURE / SETPOINT VALUE

The number displayed inside the [Setpoint Value] key is the setting for a controlled pressure output. When the [Control] key at the bottom of the active channel screen is switched to [On] the regulator will attempt to present that precise pressure to the Measure/Control port on the rear panel. The setpoint number is changed either by using the [\/] and [/\] keys, or by touching the [Setpoint Value] key to input a new number. It should be noted that when negative pressures are commanded, a positive pressure is supplied from the SPC4050 to the SPCPLU, which is then directed to the appropriate reference outlet port to the module.

If the displayed number is beyond the range of a selected turndown in range hold mode, the number will change to a control value within the limits of the turndown. The setpoint will change in value automatically, but it will not be restored automatically if the previous turndown is re-selected.

[Measure] key: When this key is ON the active sensor and the Measure/Control port are connected and isolated from the rest of the internal pneumatics.

[Control] key: When this key is ON the unit will attempt to control to the setpoint displayed.

[Vent] key: When this key is ON the internal pneumatics are open to atmosphere.

FIGURE 5.10 - SETPOINT VALUE WINDOW

PROGRAM KEY

The SPC4050 is capable of creating and storing multi-step, pre-programmed sequences. This feature is of limited functionality compared to the capability of the included calibration software, PressCal. However, if a program is to be used, it is accessible through the [Program] key. The [Program] key on the bottom left of the Menu screen (see Figure 5.1) enters the main program creation/edit screen shown in Figure 5.11. Programs can be entered and edited from this screen. There are sample programs available in the instrument that can be edited and renamed. A saved program can be executed by entering the [Favorite] screen annotated by a star on the menu, adding a program to the Favorites, selecting that program and pressing the play button. The SPC4050 can store up to 64 programs with up to 100 steps in each program.

The large key at the top of this screen contains the program name of the currently active program that can be run or edited. If this key is pressed, a list of saved programs will be displayed as shown in Figure 5.12. The left and right arrow keys display additional pages of programs. To select a program to run or edit, simply press the name of the program. To create a new program sequence, select a blank line and press [Edit] in the lower left corner of the display.

EDITING OR CREATING A PROGRAM

To edit or create a program, select a program name from the Program Selection Screen and press [OK]. This brings up the main program screen. Below the [Name] key is a table that shows a synopsis of the program steps. There are also up and down arrow keys to display additional pages of program steps.

To edit the selected program press the [Edit] key. This displays the program editing screen shown in Figure 5-13. Each program line shown in Figure 5.13 only executes one function or command. Each line has an index number associated with it. For example, if a program has 30 commands, the first command index is 01 to represent that it is command 1 of 30 to be executed.

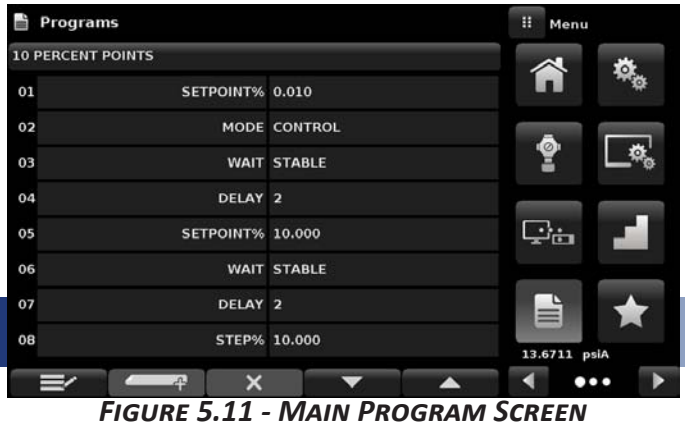


FIGURE 5.11 - MAIN PROGRAM SCREEN

To edit individual program lines, select the index number of the program line to edit.

[Insert] key: inserts a new program line before the selected one. This also re-scales the index numbers accordingly.

[Delete] key: deletes the selected program line and re-scales the index numbers accordingly.

FIGURE 5.12 - PROGRAM SELECTION SCREEN

[Edit] key: displays the program line edit screen as shown in Figure 5.15 . Its functionality is described in the following text.

FIGURE 5.13 - PROGRAM EDITING SCREEN

To change the name of the program, press the [Name] key. This displays a keyboard screen shown in Figure 5.14. Enter the name of the program and press [OK] to return to edit the program steps.

The Program Line Edit Screen (Figure 5.15) sets the function of each program line. Each program line performs the function selected from the ones displayed in the left-most column.

FIGURE 5.14 - KEYBOARD SCREEN

[Mode] key: The [Mode] key selects the operation mode of the SPC4050.

[Units] key: This key selects the pressure units.

[Setpoint] key: This key allows the control pressure to be set with the key just to its right. Because of the flexibility of the SPC4050, it should be noted that to make the SPC4050 control at this setpoint there needs to be another program line that puts the SPC4050 into the control mode.

[Setpoint%] key: The [Setpoint%] key sets the control pressure at the entered percentage of the range of the currently active transducer.

[Delay] key: The [Delay] key delays the execution of the program for the entered number of seconds.

[Wait] key: The [Wait] key delays the execution of the program until the instrument measures a stable pressure, or the control pressure stabilizes within the control parameters or pauses until the operator presses a key to continue the program execution.

[Start] key: The [Start] key causes execution of the program to begin at the first program line. This is useful for running a program repeatedly until the stop key (the key with the black filled square) is pressed by the operator.

RUNNING A PROGRAM

To run a stored program, select the favorites icon and add a program as a favorite. Once added as a favorite, the program may be run by selecting the program and hitting the play button on the home screen as shown in figure 5.16. When a program has been selected, the line below the program name key shows the current program line that is or will be executed. The right-most box on this line shows the time at which the program has been on the current program line.

FIGURE 5.15 - PROGRAM LINE EDIT SCREEN

The three keys below this control the operation of the program.

The [^] key steps one command line back.

The [V] key steps one command line forward.

The [>] key begins execution of the program at the first program line. It is also used to re-start a program at the current line after a wait/pause program line.
The next key shows a black square. Pressing this key stops execution of the program and resets the program to the first program line.

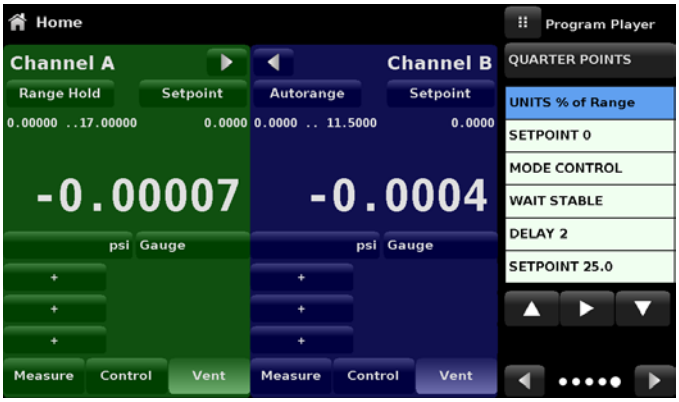


FIGURE 5.16 - MAIN OPERATION SCREEN IN PROGRAM MODE

CONTROLLER SETTINGS

The Control Settings App allows the user to select and configure the control parameters for each channel's pressure regulating module (Pump Module or SVR Module). The display color of the Control Settings App changes based on the selected channel. The display is green for Channel A, and blue for Channel B. Figure 5.17 shows Controller Settings for Channel B.

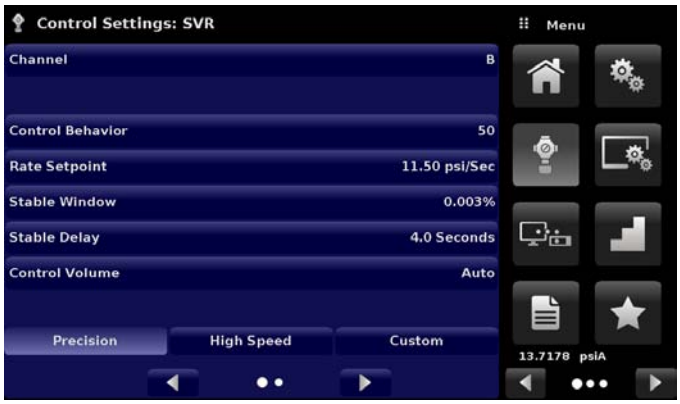


FIGURE 5.17 - CONTROLLER SETTINGS

External Supply for Pump Modules: The Controller Settings for the Pump Module are slightly different from the SVR Module. The "External Supply" button in the "Control Settings: Pump" screen provides a place for the user to switch between the pump assisted by an external supply (external supply on), to the pump generating pressure without the external supply (external supply off). When the external supply pressure is turned on, the Pump Module pressure output will move between set points more quickly. As the set point is approached, the external supply is shut off and the pump continues to increase or decrease the pressure into the set point with precision. When the external supply pressure is turned off, the pump output pressure will increase or decrease more slowly into the set point.

Control Behavior for SVR Modules: The Control Behavior button in the Control Settings App provides a choice between different levels of control behavior ranging from "0" to "100" where "0" represents lowest overshoot control mode and "100" represents High Speed control mode. The Control Behavior is preset to "50" for Precision control mode and to "100" for High Speed control mode. The Control Behavior can be changed using the sliding scale. This will change the control mode to "Custom".

Control Behavior for Pump Modules: The Control Behavior for the Pump Module only differs from the SVR Module in that it does not have the preset buttons for Precision, High Speed and Custom. Otherwise, its function is identical to that of the SVR Module explained above.

Rate Setpoint: The Rate Setpoint (SVR Module only) button allows the user to set the rate of pressure change when the SPC4050 is controlling up or down to a setpoint. The rate is limited from 0.001% to 10% of span of active range of the transducer / second.

Stability Parameters: Stability parameters for the controlled pressure can be configured using the Stable Window and Stable Delay buttons (SVR Module and Pump Module). When the controller enters a stable condition the pressure indication color on the Home App will change from white to green. The Stable Window button allows the user to enter a value as a percentage of the highest range transducer. This value represents the pressure window within which any setpoint value would be considered stable by the user. The Stable Delay button lets the user add a desired delay until the pressure value is considered stable while being in the stable window.

Control Volume: The Control Volume button (SVR Module and Pump Module) in the Control Settings App allows the user to set the control pressure volume in cubic centimeters (cc). The SPC4050 is capable of automatically identifying the control pressure volume and adjusting the control parameters based on it. By default this button is set on "Auto".

Control Limits: The Maximum and Minimum Limit buttons (SVR Module and Pump Module) in the Control Settings App (second page) provide a place to limit the set point value that can be chosen in the Home App. These limits can only be set within +/- 0.1% of the range of the active transducer. When the channel is in Autorange the limits can only be set within +/- 0.1% of the range of the primary transducer which, by convention, will have the widest range. The minimum limit must be lower than the maximum limit. The user cannot enter set points and thereby not control to pressures outside of these limits.

Vent Rate (SVR Module only): The Vent Rate button in the Control Settings App allows the user to determine the rate at which pressure will vent in vent mode. By default the rate of the vent is set similar to the control rate.

Rate Stability Parameters (SVR Module only): Rate parameters for the control rate can be found in the Control Settings App and can be configured using the Rate Stable Window and Rate Stable Delay buttons. The Rate Stable Window button allows the user to enter a value as a percentage of the active range of transducer. This value represents the pressure window within which the control rate value would be considered stable by the user. The Rate Stable Delay

button lets the user add a desired delay until the control rate is considered stable while being in the rate stable window.

Detection Flags: The SPC4050 is equipped with three detection flags (SVR Module only) that can be enabled or disabled by the user as needed. These detection flags appear in the Control Settings App. The primary purpose of these detection flags is to protect the instrument and to ensure desired operation. Each of these flags can be turned "On" or "Off" as per user's need.
-Supply Detection Enable: If turned "On", this flag allows the user to check for sufficient supply pressure at the Supply Port of the instrument. In case the supply pressure is less than 10% of the control setpoint, an error is reported which can be seen in the Troubleshoot App by clicking the error symbol. This flag is turned "Off" by default.
-Burst Detection Enable: If turned "On", this flag allows the user to protect the instrument against sudden bursts in the pressure at the Measure/ Control Port. In case a burst is detected, an error is reported which can be seen in the Troubleshoot App. This flag is turned "On" by default.
-Measure Regulation Enable: If turned "On", this flag allows pressure to be controlled while the instrument is in "Measure" mode to prevent pressure leaks in the system over time. This will turn on the internal pressure regulator periodically to control pressure in a certain range of the measured pressure value. This flag is turned "Off" by default.

SECTION 6: MAINTENANCE

Any maintenance outside of the information provide in this section is not recommended by the customer. Contact Scanivalve customer support if further maintenance or support is required.

TRANSDUCER REMOVAL

CAUTION: ESD PROTECTION REQUIRED. The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge damage to sensitive electronic components.

1. **VENT THE SYSTEM!** Then turn off the power.
2. Loosen the screws on the front panel (Figure 1.2), and swing the panel open.
3. Unscrew the thumb screw holding in the transducer (Figures 6.1).
4. Apply a light inward pressure against the bottom of the transducer case, just below the range label, while tilting the case upward to clear the clamp plate and screw head.
5. Pull the transducer module outward, through the front opening.

   NOTE: Always store loose transducers and PC boards in static protective bags or containers.

CAUTION! Do not install a high pressure transducer into a low pressure SPC4050. It is acceptable to install a low pressure transducer in a high pressure instrument, but control stability will be degraded.

Removing a transducer disengages the electrical and pneumatic connections and seals off the pressure on the pneumatic module. This permits the SPC4050 to be turned on with the supply pressure connected even with no transducers installed.

CAUTION! There must be a transducer installed in the "Primary Transducer" berth for the system to function properly. If the system is operated with the primary berth empty the results will be unpredictable.

Each control channel has pressure control limits. Typically, the pump regulator modules have a maximum limit of 15 psig and the solenoid valve regulator modules have limits of 50-150 or 1500 psig. If a sensor is placed into a control channel where the sensor has a higher upper pressure range than the control module, the maximum control limit will be limited to the maximum range of the control module.

While any sensor can be installed in any control channel, the results may not always be optimum. It is not recommended to install a low pressure transducer in a high pressure channel. A high pressure transducer should not be installed in a low pressure channel.

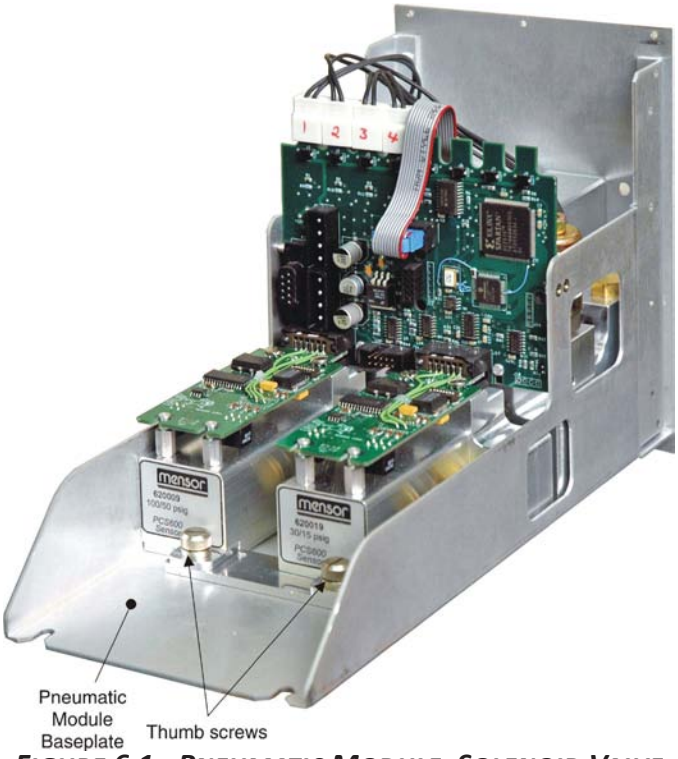


FIGURE 6.1 - PNEUMATIC MODULE, SOLENOID VALVE REGULATOR

TRANSDUCER INSTALLATION

CAUTION: ESD PROTECTION REQUIRED. The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge damage to sensitive electronic components.

To replace a transducer first make sure that it is going into the proper transducer berth in the pneumatic module. Each berth is clearly marked on the pneumatic module baseplate (see Figure 1.6). **The "PRIMARY TRANSDUCER" must be the transducer with the highest pressure range.**

To install a transducer with the front panel already open:

CAUTION! When transducers are replaced and the unit is rebooted, the default parameters will be loaded. If you are using custom settings they must be reloaded after transducer installation.

1. Rest the transducer on the baseplate and the retention bar. The transducer will be tilted down slightly.
2. Slide the transducer inward until resistance is felt. Then apply enough pressure against the transducer for it to clear the clamp so that it clears the retention bar and is fully seated and level on the baseplate.
3. Tighten the thumb screw to secure the transducer.
4. Swing the front panel closed and secure it by tightening the two captive screws.

PNEUMATIC MODULE REMOVAL

CAUTION: ESD PROTECTION REQUIRED. The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge damage to sensitive electronic components.

1. **VENT THE SYSTEM!** Then turn off the power.
2. Remove top cover.
3. Remove all external pressure connections.
4. Remove the 6 slotted 2.5mm screws that fasten the pneumatic module rear panel to the chassis.
5. Inside the pneumatic module disconnect one 9-pin D-sub connector at the regulator, and the two connectors on the power cable.
6. Slide the pneumatic module out through the rear and clear of the chassis.

NOTE: Pneumatic modules have EMI containment strips that may necessitate some force to remove modules. See Figures 6.3 and 6.4 for pneumatic schematics of the pneumatic modules.

PNEUMATIC MODULE INSTALLATION

To install or replace the pneumatic module, simply reverse the steps taken for its removal.

CAUTION! System pressure should not be drive above the range of the primary transducer. The valve isolating the secondary transducer should be closed before the system pressure is driven above the range of the range of the secondary transducer.

FIGURE 6.2 - CHASSIS INTERIOR, FRONT VIEW

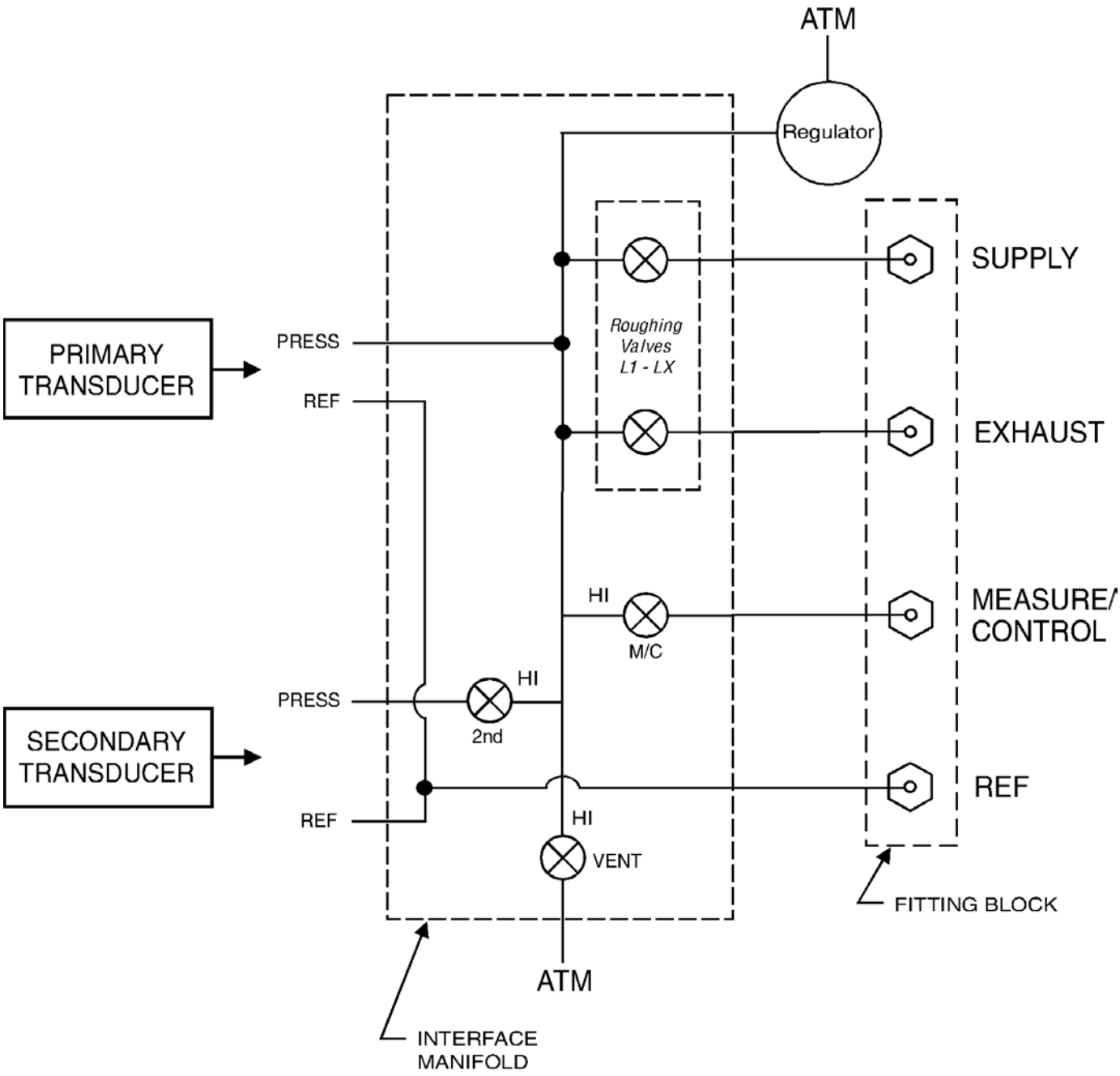


FIGURE 6.3 - PNEUMATIC SCHEMATIC - PUMP REGULATOR

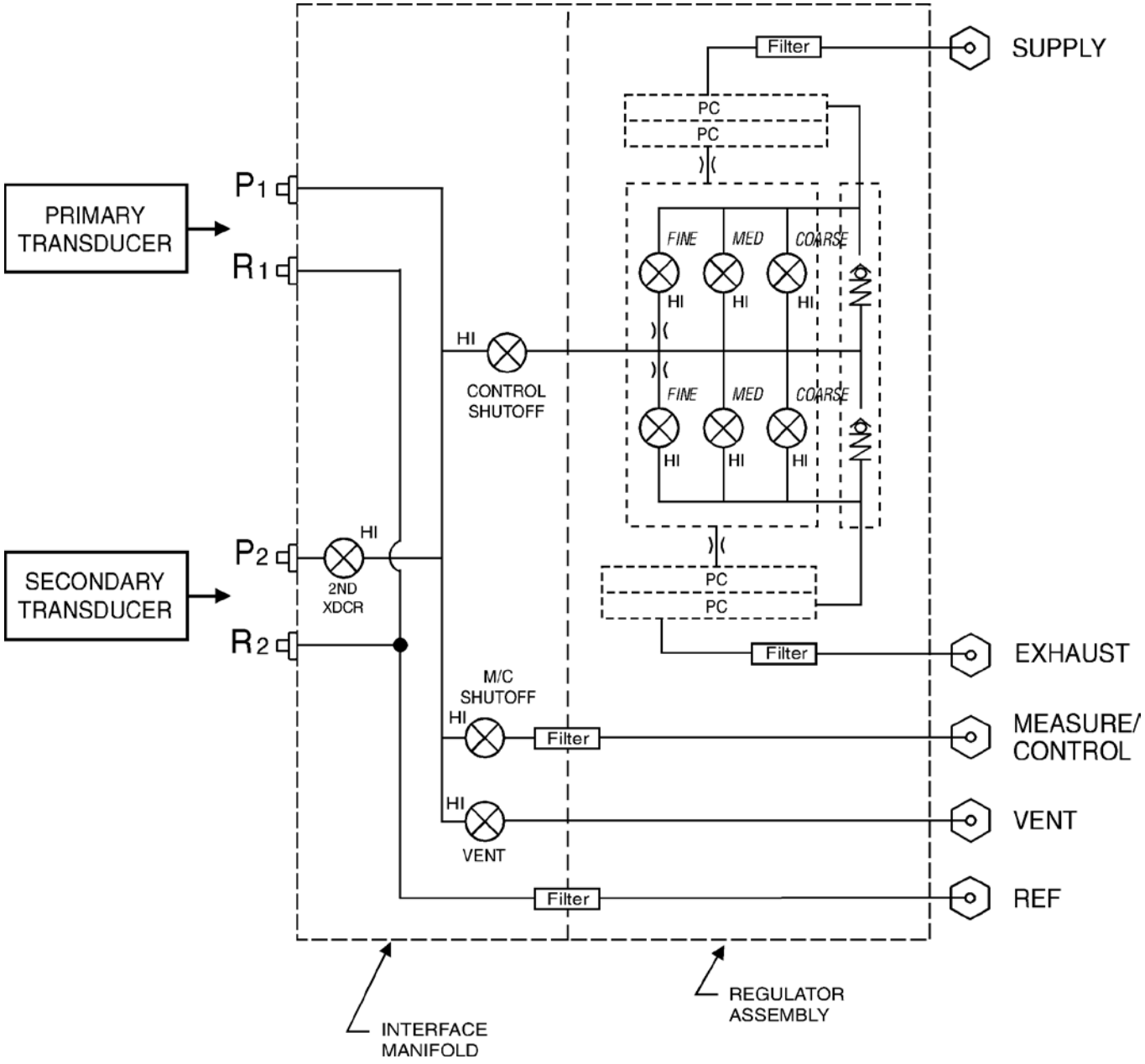


FIGURE 6.4 - PNEUMATIC SCHEMATIC - SOLENOID VALVE REGULATOR

SPCPLU DIAGNOSTICS

Figure 6.5 depicts the internal pneumatic schematic of the SPCPLU. This can be used to diagnose and locate any pneumatic logic errors or pressure leaks.

The best technique for diagnosing problems with the SPCPLU is to use pressure generated by the SPC4050 calibrator and cap off the pressure outputs (CAL OUT and REF OUT) from the SPCPLU. By systematically capping off and opening the various pressure outlets while working through the various pneumatic logic states of the SPCPLU one can determine where a leak is or determine if a solenoid is faulty.

The LED's on the front panel of the SPCPLU (Figure 1.10) also serve as a useful diagnostic tool. Confirming the LED's logic matches the expected logic confirms that the digital out signals are being properly sent from the SPC4050 calibrator.

One of the most common causes of problems with the SPCPLU is due to insufficient solenoid supply pressure. For SPCPLU-1&-2, a minimum of 90psi is required, 120psi maximum. For SPCPLU-3&-4 60psi minimum is required, 70psi maximum.

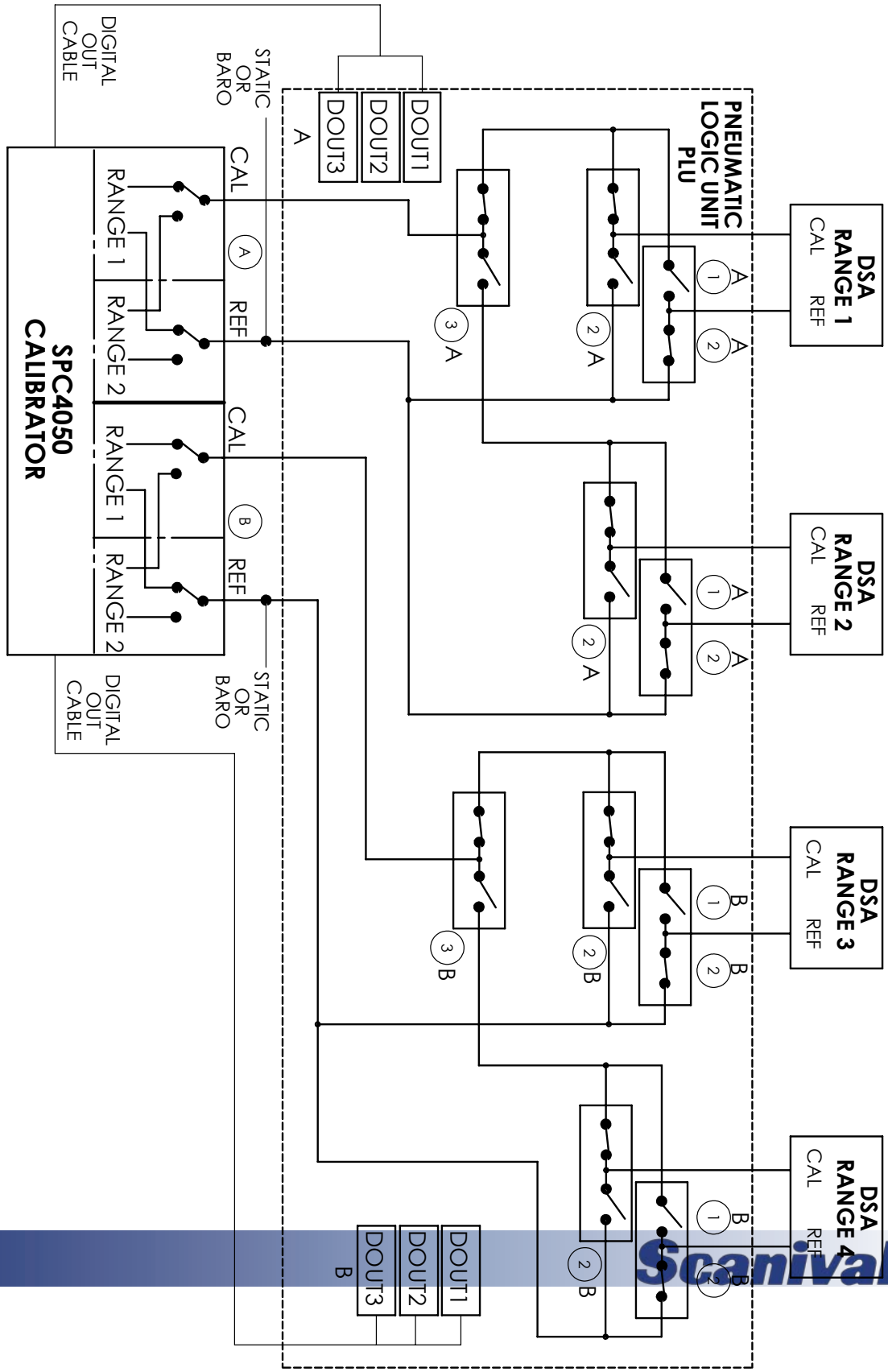


FIGURE 6.5 - SPCPLU PNEUMATIC SCHEMATIC

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SECTION 7: CALIBRATION

General

The SPC4050 automatically adjusts the pressure reading for the effects of temperature and non-linearity within the calibrated temperature range of 15-45°C. The process is referred to as dynamic compensation because each reading is so adjusted before it is output to the display or to a communication bus. Thus, a calibrated SPC4050 operated within its temperature band, and with proper zero and span adjustments, will provide accurate pressure measurements.

The SPC4050 should have the calibration verified periodically to ensure stability. The recommended calibration cycle is one year or six months depending on the transducer range.

Environment

For maximum accuracy, allow the SPC4050 to warm up for a minimum of 15 minutes in an ambient temperature within the compensated range prior to commencing a calibration. In addition the instrument should be at rest on a stable platform that is free of excessive vibration and shock.

Pressure Standards

Scanivalve recommends the use of appropriately accurate primary pressure standards when calibrating this instruments. Such standards should be sufficient so that when the techniques of the ISO Guide to the Expression of Uncertainty in Measurement (GUM) are applied, the instrument meets its accuracy statements as required by ISO/IEC 17025:2005, or other applicable standards.

Media

The recommended calibration medium is dry nitrogen or clean dry instrument air. A height variation between the standard and the SPC4050 can cause significant errors. See “Head Pressure Correction” for further information.

Setup

Figure 7.1 - Calibration Setup illustrates a typical setup for either local or remote calibration for a gauge pressure instrument. In the illustration the ‘Optional Computer’ is required only for performing a remote calibration.

The ‘Pressure Standard’ is normally a deadweight test instrument, and the ‘Volume Controller’ refers to a hand operated variable-volume pressure vernier device.

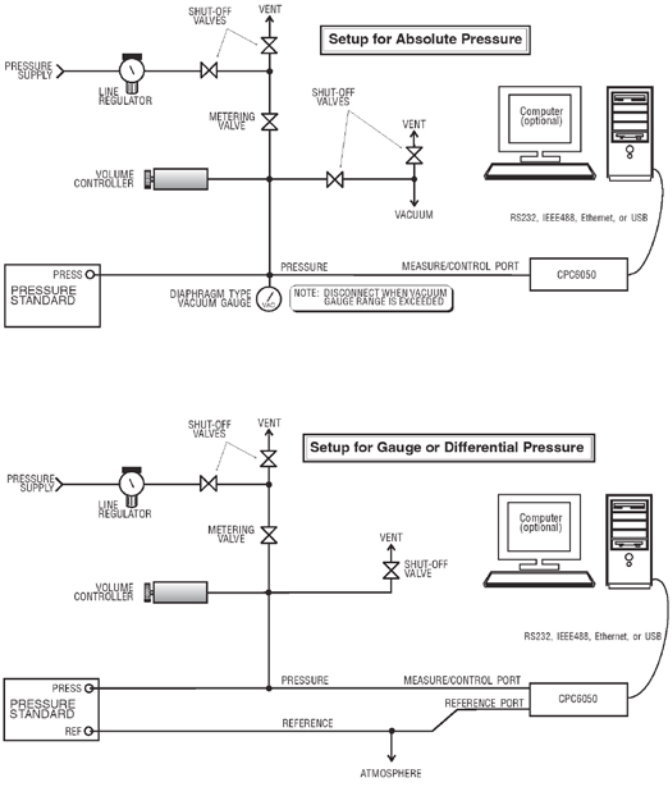

Figure 7.1 - Calibration Setup

SERVICE APPLICATION

The service application is a password protected area where calibration of all connected transducers can be accomplished. In addition, this is where the passwords for entering this area can be changed. The service application allows access to the transducer calibration and head pressure applications. The password installed at the factory was 1 2 3 4 5 6, but the user can change this as needed.

CAUTION! The password is seldom used and is easily forgotten. After a change write down and save the new number. If the password is lost, contact Scanivalve. The default password is 123456.

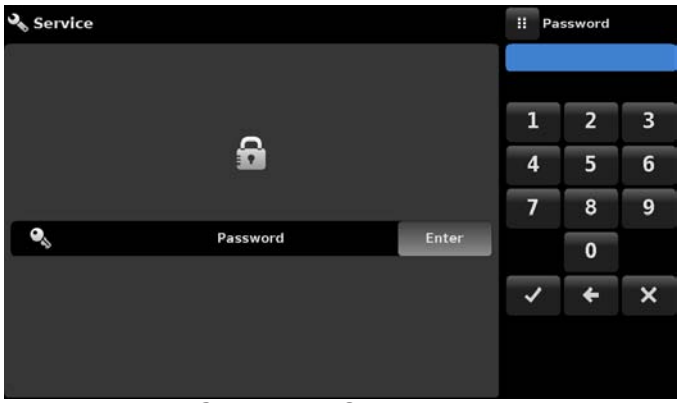

FIGURE 7.2 - LOCKED SERVICE APPLICATION

CALIBRATION DATA

The Calibration Data Application is where the calibration data for each transducer is stored and amended. The serial number (S/N), Accuracy, zero offset (Zero) and span offset (Span) can be seen in this screen. The date of calibration, the calibration interval and the certificate number can be entered by pressing the corresponding button, then saved by pressing the Check button. To revert back to the factory calibration, press the "Restore Factory Cal" button. To view the calibration data for each transducer press the "Channel" button at the top and choose a transducer from the resulting channel selection menu.

RESTORING FACTORY CALIBRATION

To revert back to the factory calibration, press the "Restore Factory Cal" button. In the Calibration Data menu located in the unlocked Service application. See Figure 7.3.

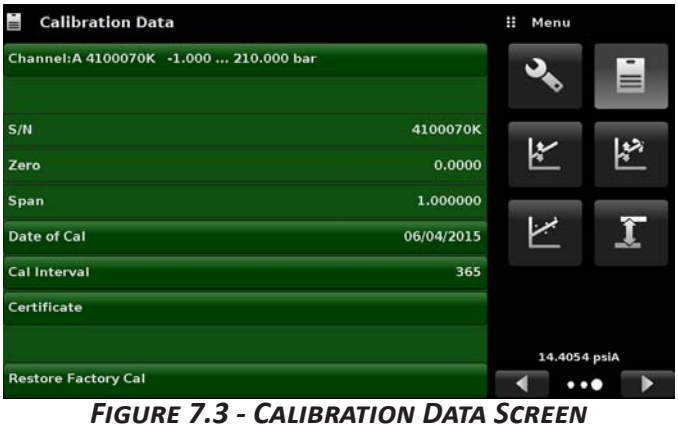

FIGURE 7.3 - CALIBRATION DATA SCREEN

1 POINT CALIBRATION

A single point calibration (usually a zero point calibration) of each transducer installed can be accomplished in "One Point Cal" Application. The transducer channel is chosen by pressing the "Channel" button at the top of this screen, and then selecting from the list of installed transducers. For gauge pressure simply expose the reference and the Measure/Control port of the SPC4050 to atmospheric pressure and then press the "New Value" button and enter zero (0) using the keypad. For an absolute transducer, apply a known reference pressure between 600 mTorr absolute and 20% of the active transducer's span to the Measure/Control port of the SPC4050, press the "New Value" button and then enter the reference pressure (known true pressure) using the keypad. If you want to save the value in the transducer, press Save. See Figure 7.4 for the One Point Calibration Application.

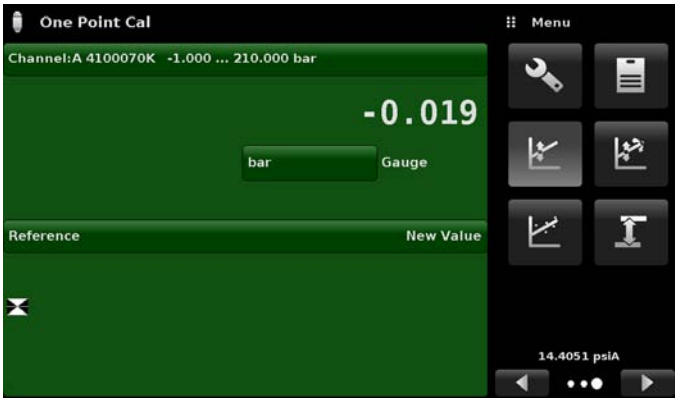

FIGURE 7.4- ONE POINT CALIBRATION

2 POINT CALIBRATION

The Two Point Cal Application provides a place to adjust the Transducer Zero and Span (sometimes referred to as the offset and slope).

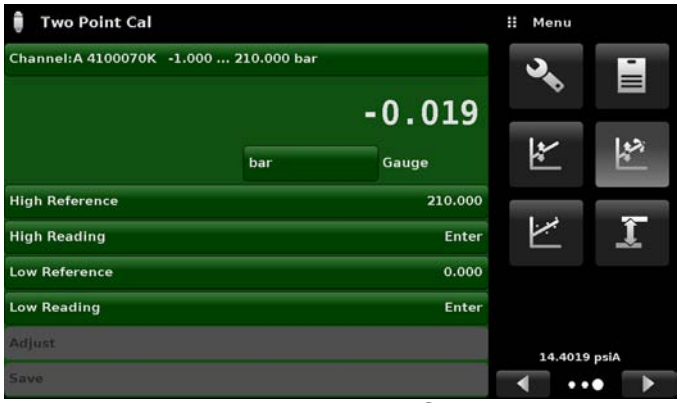

FIGURE 7.5 - TWO POINT CALIBRATION

Follow the steps below for a complete Two Point Calibration:

Select a Transducer to calibrate by pressing the Channel button at the top of the screen.

To calibrate the "Low Point":

1. The Measure/Control port of the SPC4050 being calibrated should be supplied with a suitable, "Low point" pressure.
2. For a gauge transducer, this low point pressure can be achieved by opening the Measure/Control and reference ports to atmospheric pressure.
3. For an absolute transducer a suitable source of vacuum should be applied to the Measure/Control port along with a high accuracy vacuum standard or a pressure calibration standard can be connected to the Measure/Control port that can generate and measure a stable pressure value between 600 mTorr absolute and 20% of the active transducer's span.
4. When the pressure is stable, record the live reading shown on the Two Point Cal screen and enter this value as the "Low Reading" by pressing the Low Reading button and entering the number followed by the check mark. Record the "true pressure" obtained from the reference standard and enter it as the "Low Reference" value in the same manner.

To calibrate the"High Point":

5. The "High Point" Calibration is done in a similar way as the "Low Point".
6. Supply a pressure to the Measure/Control Port of the SPC4050 being calibrated, using a pressure standard. This pressure should be as close as possible to the full scale value of the selected transducer or at least within 20% of the active transducer's span.
7. After the pressure stabilizes, record the live reading shown on the Two Point Cal screen and enter this value as the "High Reading" by pressing the High Reading button and entering the number followed by the check mark [ ]. Record the "true pressure" obtained from the reference standard and enter it as the "High Reference" value in the same manner.
8. After all four values (High Reference, High Reading, Low reference, & Low reading) have been entered, the Adjust button will become active. Press the Adjust button to check and accept the calibration data then press the Save button. The instrument will then prompt with the question "Save Cal Data?". Pressing the check mark in this screen will save the calibration to the memory of the transducer.

HEAD PRESSURE CORRECTION

The Head Pressure Application is accessed from the menu. Four parameters may be set to reflect conditions at the operator's site. The head height should be set at zero before calibrating the SPC4050 transducers. Figure 7.6 shows the Head Pressure Application screen.

The four parameters are:

Height: Enter the difference in height between the center of the measure/control port of the SPC4050 and the reference level of the Device Under Test (DUT). If the reference level of the DUT is lower than the center of the measure/control port of the SPC4050, enter a positive height. If it is higher, enter a negative height.

Gas Density: If nitrogen (N2) or dry air are being used as a pressure media, press the appropriate selection. If another gas is being used, enter the density for the gas at standard pressure and temperature in either lb/cubic foot (english) or kg/liter (metric) units.

Gas Temperature: Enter the average gas temperature in degrees F or C. If unsure of the gas temperature, use 68 F.

Local Gravity: Enter the local gravity acceleration value.

Head Pressure Correction Limits	
Height	±1200 inches
Density	0 to 1 lb/cu ft
Temperature	0 to 120 °F
Gravity	32 to 32.4 ft/sec²

FIGURE 7.6 - HEAD PRESSURE APPLICATION SCREEN

LINEARIZATION

The Linearize Application provides a place to record upscale and downscale calibration data and to linearize each transducer using that data. An “as found calibration” can be performed by connecting a suitable pressure standard to the Measure/Control port of the SPC4050 being calibrated, and supplying between 3 and 11 pressure points across the complete range. The pressure points may be entered using both upscale and downscale pressure points, or only one direction. The record of the pressures from the pressure standard and the corresponding reading from the instrument’s transducer can be recorded and transcribed into the Linearization Matrix shown in Figure 7.8. Linearization of each transducer can be performed from this screen by selecting each transducer range from the setup screen (Figure 7.7).

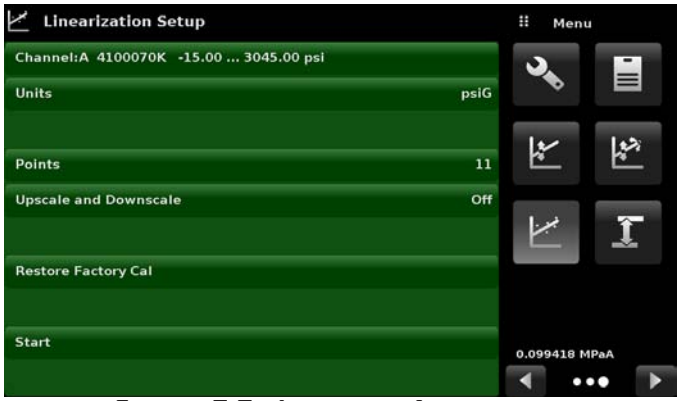

FIGURE 7.7 - LINEARIZE APPLICATION

The Linearization Application automatically populates the screen with equidistant increments from the low to high pressure corresponding to the range of the transducer selected. These values can be changed to reflect the values generated by the reference standard and the corresponding readings taken from the SPC4050. Each value from the reference standard can be entered under the reference column, corresponding Upscale and Downscale readings from the instrument can be entered in the “Actual” column or “Upscale” and “Downscale” columns. To enter a value simply press the number and a key pad will appear where the number can be entered. Press the check mark to accept each value. The “Average” column automatically averages the upscale and downscale values.

Figure 7.8 shows some typical values that might be seen in a linearization calibration. In the bottom right hand corner of this screen is the Graph Icon that, when pressed, reveals a Linearization Error Graph (figure 7.9) that gives a visual representation of the errors associated with the values entered in the Linearization screen.

This Linearization error graph shows a scaling that corresponds to the maximum error calculated from the data entered in the Linearization Matrix. It is a good indication of the overall error of the transducer, and will quickly reveal any gross data entry errors that have been made. To revert back to the Linearization Matrix press the Matrix Icon.

FIGURE 7.8 - LINEARIZATION VALUES

When satisfied that all values have been entered correctly, press the adjust button and then the save button to save the new calibration data in the transducer memory.

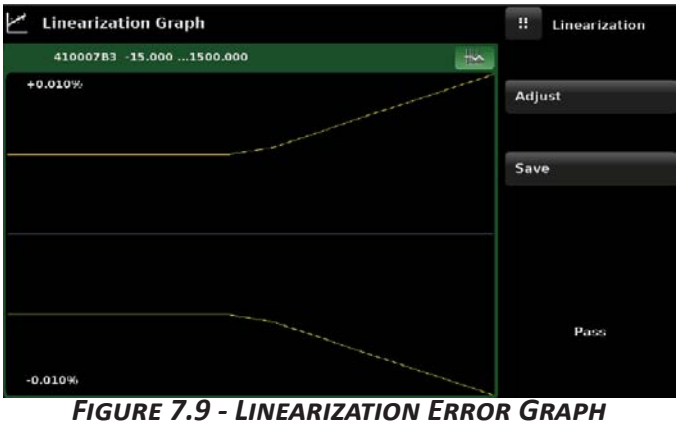

FIGURE 7.9 - LINEARIZATION ERROR GRAPH

APPENDIX

MEASUREMENT UNITS

The Units command selects the measurement units to be output on the bus and the display.

Table 1 - Measurement Units

Code	Description	Output Format
1	pounds per square inch	PSI
2	inches of mercury @ 0°C	inHg 0°C
3	inches of mercury @ 60°F	inHg 60°F
4	inches of water @ 4°C	inH_2O 4°C
5	inches of water @ 20°C	inH_2O 20°C
6	inches of water @ 60°F	inH_2O 60°F
7	feet of water @ 4°C	ftH_2O 4°C
8	feet of water @ 20°C	ftH_2O 20°C
9	feet of water @ 60°F	ftH_2O 60°F
10	millitorr	mTorr
11	inches of seawater @ 0°C 3.5% salinity	inSW
12	feet of seawater @ 0°C 3.5% salinity	ftSW
13	atmospheres	ATM
14	bars	Bar
15	millibars	mBar
16	millimeters of water @ 4°C	mmH_2O 4°C
17	centimeters of water @ 4°C	cmH_2O 4°C
18	meters of water @ 4°C	MH_2O 4°C
19	millimeters of mercury @ 0°C	mmHg 0°C
20	centimeters of mercury @ 0°C	cmHg 0°C
21	torr	Torr
22	kilopascals	kPa
23	pascals	PA
24	dyne per square centimeter	Dy/cm^2
25	grams per square centimeter	gm/cm^2
26	kilograms per square centimeter	kg/cm^2
27	meters of seawater @ 0°C 3.5% salinity	MSW
28	ounce per square inch	OSI
29	pounds per square foot	PSF
30	tons per square foot	TSF
31	percent of full scale	%FS
32	micron HG @ 0°C	µHg 0°C
33	ton per square inch	TSI

Table 1 - Measurement Units		
Code	**Description**	**Output Format**
34	n/a	n/a
35	hectopascals	hPa
36	megapascals	MPa
37	millimeters of water @ 20°C	mmH_2O 20°C
38	centimeter of water @ 20°C	cmH_2O 20°C
39	meters of water @ 20°C	MH_2O 20°C
n/a	User Units 1	User defined
n/a	User Units 2	User defined

CONVERSION FACTORS, PSI

The values listed in the column "To convert from PSI" are the values imbedded in the instrument program. The values listed under "To convert to PSI" are internally calculated approximations based on the imbedded values.

Table 2 - Conversion Factors, PSI			
Code	**Pressure Unit**	**To convert from PSI**	**To convert to PSI**
1	PSI	1	1
2	inHg 0°C	2.036020	0.4911544
3	inHg 60°F	2.041772	0.4897707
4	inH_2O 4°C	27.68067	0.03612629
5	inH_2O 20°C	27.72977	0.03606233
6	inH_2O 60°F	27.70759	0.03609119
7	ftH_2O 4°C	2.306726	0.4335149
8	ftH_2O 20°C	2.310814	0.4327480
9	ftH_2O 60°F	2.308966	0.4330943
10	mTorr	51715.08	0.00001933672
11	inSW 0°C 3.5% salinity	26.92334	0.03714250
12	ftSW 0°C 3.5% salinity	2.243611	0.445710
13	ATM	0.06804596	14.69595
14	Bar	0.06894757	14.50377
15	mBar	68.94757	0.01450377
16	mmH_2O 4°C	703.0890	0.001422295
17	cmH_2O 4°C	70.30890	0.01422295
18	MH_2O 4°C	0.7030890	1.422295
19	mmHg 0°C	51.71508	0.01933672
20	cmHg 0°C	5.171508	0.1933672
21	Torr	51.71508	0.01933672
22	kPa	6.894757	0.1450377
23	PA	6894.757	0.0001450377
24	Dy/cm^2	68947.57	0.00001450377

Table 2 - Conversion Factors, PSI			
Code	Pressure Unit	To convert from PSI	To convert to PSI
25	gm/cm^2	70.30697	0.01422334
26	kg/cm^2	0.07030697	14.22334
27	MSW 0°C 3.5% salinity	0.6838528	1.462303
28	OSI	16	0.0625
29	PSF	144	0.006944444
30	TSF	0.072	13.88889
31	%FS	(PSI / RANGE) x 100	(% FS x RANGE) / 100
32	µHg 0°C	51715.08	0.00001933672
33	TSI	0.0005	2000
35	hPa	68.94757	0.01450377
36	MPa	0.006894757	145.0377
37	mmH_2O 20°C	704.336	0.001419777
38	cmH_2O 20°C	70.4336	0.01419777
39	MH_2O 20°C	0.704336	1.419777

CONVERSION FACTORS, MILLITORR

The following table lists factors which should be used as multipliers when converting other pressure units to or from millitorr.

Table 3 - Conversion Factors, Millitorr			
Code	Pressure Unit	To convert to from millitorr	To convert to millitorr
1	PSI	0.00001933672	51715.08
2	inHg 0°C	0.00003936995	25400.08909
3	inHg 60°F	0.00003948117	25328.53093
4	inH_2O 4°C	0.0005352534	1868.273977
5	inH_2O 20°C	0.0005362028	1864.966281
6	inH_2O 60°F	0.0005357739	1866.458778
7	ftH_2O 4°C	0.00004460451	22419.25773
8	ftH_2O 20°C	0.00004468356	22379.59744
9	ftH_2O 60°F	0.00004464783	22397.50637
10	mTorr	1.0	1.000000022
11	inSW 0°C 3.5% salinity	0.0005206091	1920.827359
12	ftSW 0°C 3.5% salinity	0.00004338408	23049.92831
13	ATM	0.000001315786	760002.2299
14	Bar	0.000001333220	750063.6259
15	mBar	0.001333220	750.0636259
16	mmH_2O 4°C	0.0135954	73.5540997
17	cmH_2O 4°C	0.001359544	735.5409971
18	MH_2O 4°C	0.00001359544	73554.09971
19	mmHg 0°C	0.001	1000.000022

Table 3 - Conversion Factors, Millitorr			
Code	**Pressure Unit**	**To convert to from millitorr**	**To convert to millitorr**
20	cmHg 0°C	0.0001	10000.00022
21	Torr	0.001	1000.000022
22	kPa	0.0001333220	7500.636259
23	PA	0.1333220	7.500636259
24	Dy/cm^2	1.333220	0.750063626
25	gm/cm^2	0.001359506	735.561166
26	kg/cm^2	0.000001359506	735561.166
27	MSW 0°C 3.5% salinity	0.00001322347	75623.11663
28	OSI	0.0003093875	3232.1992
29	PSF	0.002784488	359.132477
30	TSF	0.000001392244	718265.0575
32	µHg 0°C	1.0	1.000000022
33	TSI	n/a	n/a
35	hPa	0.001333220	750.0636259
36	MPa	0.0000001333220	7500636.259
37	mmH_2O 20°C	0.01361955	73.42388114
38	cmH_2O 20°C	0.001361955	734.2388114
39	MH_2O 20°C	0.00001361955	73423.88114

CONVERSION FACTORS, PASCAL

The following table lists factors which should be used as multipliers when converting other pressure units to or from Pascal.

Table 4 - Conversion Factors, Pascal			
Code	**Pressure Unit**	**To convert from Pascal**	**To convert to Pascal**
1	PSI	1.450377E-04	6.894757E+03
2	inHg 0°C	2.952997E-04	3.386390E+03
3	inHg 60°F	2.961339E-04	3.376850E+03
4	inH_2O 4°C	4.014741E-03	2.490820E+02
5	inH_2O 20°C	4.021862E-03	2.486410E+02
6	inH_2O 60°F	4.018645E-03	2.488400E+02
7	ftH_2O 4°C	3.345622E-04	2.988980E+03
8	ftH_2O 20°C	3.351551E-04	2.983692E+03
9	ftH_2O 60°F	3.348871E-04	2.986080E+03
10	mTorr	7.500636E+00	1.333220E-01
11	inSW 0°C 3.5% sal	3.904899E-03	2.560885E+02
12	ftSW 0°C 3.5% sal	3.254082E-04	3.073062E+03
13	ATM	9.869230E-06	1.013250E+05
14	Bar	1.00000E-05	1.00000E+05
15	mBar	1.00000E-02	1.00000E+02

Table 4 - Conversion Factors, Pascal			
Code	**Pressure Unit**	**To convert from Pascal**	**To convert to Pascal**
16	mmH_2O 4°C	1.019744E-01	9.806378E+00
17	cmH_2O 4°C	1.019744E-02	9.806378E+01
18	MH_2O 4°C	1.019744E-04	9.806378E+03
19	mmHg 0°C	7.500636E-03	1.333220E+02
20	cmHg 0°C	7.500636E-04	1.333220E+03
21	Torr	7.500636E-03	1.333220E+02
22	kPa	1.00000E-03	1.00000E+03
23	PA	1.00000E+00	1.00000E+00
24	Dy/cm^2	1.00000E+01	1.00000E-01
25	gm/cm^2	1.019716E-02	9.806647E+01
26	kg/cm^2	1.019716E-05	9.806647E+04
27	MSW 0°C 3.5% sal	9.918444E-05	1.008222E+04
28	OSI	2.320603E-03	4.309223E+02
29	PSF	2.088543E-02	4.788025E+01
30	TSF	1.044271E-05	9.576052E+04
32	µHg 0°C	7.500636E+00	1.333220E-01
33	TSI	7.251885E-08	1.378951E+07
35	hPa	1.00000E-02	1.00000E+02
36	MPa	1.00000E-06	1.00000E+06
37	mmH_2O 20°C	1.021553E-01	9.789017E+00
38	cmH_2O 20°C	1.021553E-02	9.789017E+01
39	MH_2O 20°C	1.021553E-04	9.789017E+03

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