



Application Note:
#8411

Use of one (1) PCU to calibrate more than one range of Pressure Scanner

Abstract: Under certain circumstances, System 8400 users wish to have one PCU calibrate more than one range of scanners. This document delineates when it is permitted, the procedure to implement the feature, and potential consequences of these actions. Some problems are almost certain to arise, and countermeasures are presented. In particular, an external valve is required to isolate the lower range scanners when the higher range scanners are being calibrated.

Introduction: Many users of the PSI System 8400 need (and have) pressure scanners in the 10 inch water column and/or 20 inch water column range. These customers typically use 1-PSID PCUs to calibrate these scanners. A problem arises when a facility wishes to use scanners from both pressure ranges (10 and 20 inches water column) at the same time. In this situation, the user normally elects to have two (2) PCUs, both in the 1-PSID range, but keyed to different outputs. This permits the two ranges of scanners to be calibrated simultaneously and independently. This is the general, recommended, and preferred solution. There are, however, times when only a single PCU is available, and the system requires that some calibration procedure be performed. This document presents a procedure that will safely perform the calibration.

There are several factors to be considered when using one PCU to calibrate multiple ranges of scanners. First, there is the danger of over-pressuring the scanners and causing physical damage and/or calibration shift. Second is the advisability of using a PCU that might not be a suitable range to calibrate the test scanners. Third is the danger of one or more ports saturating the multiplexers and corrupting data on other channels. And fourth, there is the issue of A/D converter saturation which can also corrupt data on other channels.

When the PCU is a 1-D PCU, and the scanners are 10 and 20 inches water column range, the first two factors are generally not a concern. Specifically, a 10 inch water column scanner can safely take 20 inch water column pressure without danger of physical damage or calibration shift. The 1-D PCU would be the PCU of choice for each of these ranges, and is not detrimental to the accuracy of the calibration.



The last two factors cause considerable concern. When 20 inches water pressure is applied, a 10 inch water column scanner will produce approximately 9.2 volts. This voltage will certainly saturate the A/D converter, and potentially could damage the A/D converter. At the very least, the A/D converter's internal calibration is at risk. As a result of these concerns, a situation where ports that are at saturation levels for long periods of times should be avoided. It may or may not saturate the multiplexers, thereby corrupting other data on the system, depending upon system configuration. Incidental saturation of a limited number of ports during data acquisition does not put the hardware at risk, but could affect data quality of other ports, and should be avoided.

As a result of these concerns, we strongly recommend that the 10 inch water column scanners be pneumatically isolated from the 20 inch water column scanners while the 20 inch water column scanners are being calibrated. An external valve is recommended.

Consider another example: If a user wishes to calibrate 10 inch water column scanners and 2.5 PSID scanners, using a 5-D PCU, there would be several areas of concern. The 10 inch water column pressure ports could probably withstand the 2.5 PSI pressures without damage, but would most certainly have "zero shift" problems. Also, a 5-D PCU is not a good choice for calibrating 10 inch water column scanners. When 2.5 PSI calibration pressures are applied, the output voltage from the 10 inch water column scanners will exceed 10.5 volts, and there is significant risk of damage to the multiplexers and the A/D converters. Data quality from the 2.5 PSI scanners would be at high risk from "multiplexer bleed-through" and "A/D saturation effects" even if physical damage did not occur.

WARNING: Lower range scanners MUST be pneumatically isolated from higher range scanners while the higher range scanners are being calibrated. An external isolation valve is recommended.

Summary: Ask yourself the following questions:

1. Is it reasonable to use this PCU to calibrate both ranges of scanners? If there is ANY question, please contact PSI for advice. (757) 865-1243
2. Is my company willing to install a valve to isolate the lower range scanners from the calibration pressures while calibrating the higher range scanners?
3. Is my company willing to incur the time penalty and cost of "back-to-back" calibrations?

If the answer to each of these questions is **YES**, then you may consider using one PCU to calibrate the two ranges of scanners.

Procedure:

1. Initialize the system, assigning each range of scanner a unique number.
(EXAMPLE: 2 scanners of 10 inch water column, and 2 scanners of 20 inch water column: SD1 111 (1-2, 32, 1) (3-4, 32, 2)

2. Finish the SDU initialization per normal usage. You may use either SEQ or PAM scan methods. Considering the example:

```
SD2 111 1 64, 0, 1, 0, Free, SEQ 2
SD3 111 1 101-132 201-232 301-332 401-432
```

3. Initialize the PCU only for the **LOW RANGE** scanners.

```
PC1 1 DIFF 0.0001 1
PC2 1 -0.36 -0.18 0.00 0.18 0.36
```

4. Set the external valve so that calibration pressures may flow to the **LOW RANGE** scanners.
5. Command the system to calibrate only the **LOW RANGE**.

```
CA3 1
```

6. Re-initialize the PCU for only the **OTHER** range. Note that the **LOGICAL RANGE NUMBER** of the PCU changes.

```
PC1 113 2 DIFF 0.0001 1
PC2 2 -0.72 -0.36 0.00 0.36 0.72
```

7. Set the external valve so that the calibration pressure **MAY NOT FLOW** to the **LOW RANGE** scanners.
8. Command the system to calibrate only the **HIGH RANGE**.
9. The system is now fully calibrated and ready for use. These procedures are necessary and sufficient to safely calibrate multiple ranges of scanners using a smaller number of PCUs, and may be scaled as necessary.

While not absolutely required, PSI strongly recommends the calibration coefficients and voltages be retrieved and examined at each stage. This will ensure that the system is functioning correctly.

With this in mind:

Step 5.5 would be:	OP4	113		
	OP1	111	1	101-132
	OP1	111	1	201-323
	OP3	111	1	101-132
	OP3	111	1	201-232

Step 8.5 would be:	OP4	113		
	OP1	111	1	301-332
	OP1	111	1	401-423
	OP3	111	1	301-332
	OP3	111	1	401-432

- Conclusions:**
1. When it is necessary to calibrate multiple ranges of scanners using a fewer number of PCUs, external valves are **REQUIRED** to prevent calibration pressures from over-pressuring the “lower range” scanners.
 2. “Back-to-back” calibrations are required.