

64-CHANNEL PRESSURE SCANNER SYSTEM

User Manual



WARNING

Read this document before using the product.

This is an experimental prototype, for measurement purposes only.

This system is not certified for use on aircraft.

Contents

1	INTRODUCTION.....	1
2	DETAILED SPECIFICATION	2
3	PHYSICAL CONNECTIONS.....	3
4	CARE AND HANDLING.....	5
5	SOFTWARE AND DRIVERS.....	5
6	SYNCHRONISATION OF MULTIPLE PRESSURE SCANNERS.....	9
7	TECHNICAL SUPPORT	12

Version Control

Version	Date	Summary of changes
1.0	05-2017	New document
2.0	09-2019	Updated content and specifications, reformatted. Addition of guidance on synchronisation of multiple scanners.
2.1	01-2020	Expansion of guidance on software and drivers.
2.2	04-2020	Updated multichannel connector pin assignment.

1 INTRODUCTION

Principle of operation

The system consists of a base unit (housing the base sensor array, the microprocessor and control hardware), a number of eight-channel pressure 'blades' designed to be self-detecting and customer-swappable, and a remote fluid temperature sensor and cable assembly. The base sensor array contains a pressure altimeter, a six-component inertial measurement unit, a case temperature sensor and a humidity sensor. The system's power and communications are all via USB.

System description

Multichannel pressure scanner system.

System components

1x Base system	The base system contains all of the control hardware to drive the pressure sensor blades.
(X) Sensor blades	The quantity and range of the sensor blades will depend on the customer order. One blade is typically included with the cost of the base system.
1x Temperature probe	A fluid temperature probe and cable assembly is included with the base system.
1x USB cable	A low-profile USB micro->A connector is bundled with the system.
Accessories	Accessories including an enclosure, pressure cables and connectors are available and may have been included in the shipment.

Please ensure that all the system components listed above have been supplied, and that there is no apparent damage from shipping.

System requirements

To interface with a computer, the scanner system requires 64-bit Windows 7 (or newer) operating system (not included). The scanner has been pre-loaded with firmware; the computer software drivers and data logging software will be provided electronically.

2 DETAILED SPECIFICATION

Product code	DPS14-160P	DPS14-1K0	DPS14-6K9
Pressure range (custom ranges available)	160 Pa FS	1 kPa FS	6.9 kPa FS
Maximum overpressure	33.5 kPa	37.5 kPa	69 kPa
Sensor repeatability ¹	± 0.024 % FS		
Sensor accuracy ² , inc. calibration	± 0.25 % FS		
Total error band after auto-zero ³	± 1.75 % FS	± 0.5 % FS	± 1 % FS
Ambient absolute pressure sensor specification	30-110 kPa FS, +/- 0.1 kPa		
Absolute pressure limits	0.2 - 1.5 atm		
Operational mode	Absolute and differential configurations available		
Operating temperature range ⁴ (extended ranges available)	-20° to +85° C non-condensing		
Compensated temperature range	0° to +50° C non-condensing		
Storage temperature range	-40° to +85° C		
Ambient temperature sensor specification	0°C - 65°C ± 0.5°C		
Remote temperature probe specification	-40°C - 150°C ± 0.5°C		
Vibration	Sensors rated to 15 g, 10 Hz to 2 Hz		
Maximum relative humidity	95 %		
Relative humidity sensor specification	0 % to 100 % RH, +/- 3%		
Communications interface	Data streaming via USB2.0, external trigger and clock ports for scalable multi-system synchronization		
Power	via USB, < 200 mA, 1 W		
Data acquisition rate	1 kHz simultaneous (equivalent)		
Digital resolution	14-bit pressure, 16-bit environmental and IMU		
System requirements	Windows 7 or later, minimum 3GHz & 4Gb RAM		
IMU specification	3 axis gyro, 245 °/s FS, ± 8.75 x10 ⁻³ °/s 3 axis accelerometer, 2g FS, ± 0.061 mg		

¹ Includes errors due to pressure non-linearity, pressure hysteresis and non-repeatability.

² Includes errors due to pressure non-linearity, pressure hysteresis, non-repeatability and calibration uncertainty.

³ Total residual error after auto-zero, excluding residual temperature sensitivity.

⁴ OEM configuration only. Nylon enclosure maximum temperature 65°C.

3 PHYSICAL CONNECTIONS

If the scanner was supplied in an enclosure, then all of the pressure connections have been factory-installed. In OEM configuration, the pressure ports are directly accessible, as barbs on the blade-mounted sensor units. The barbs are suitable for 1 mm ID silicone air lines.

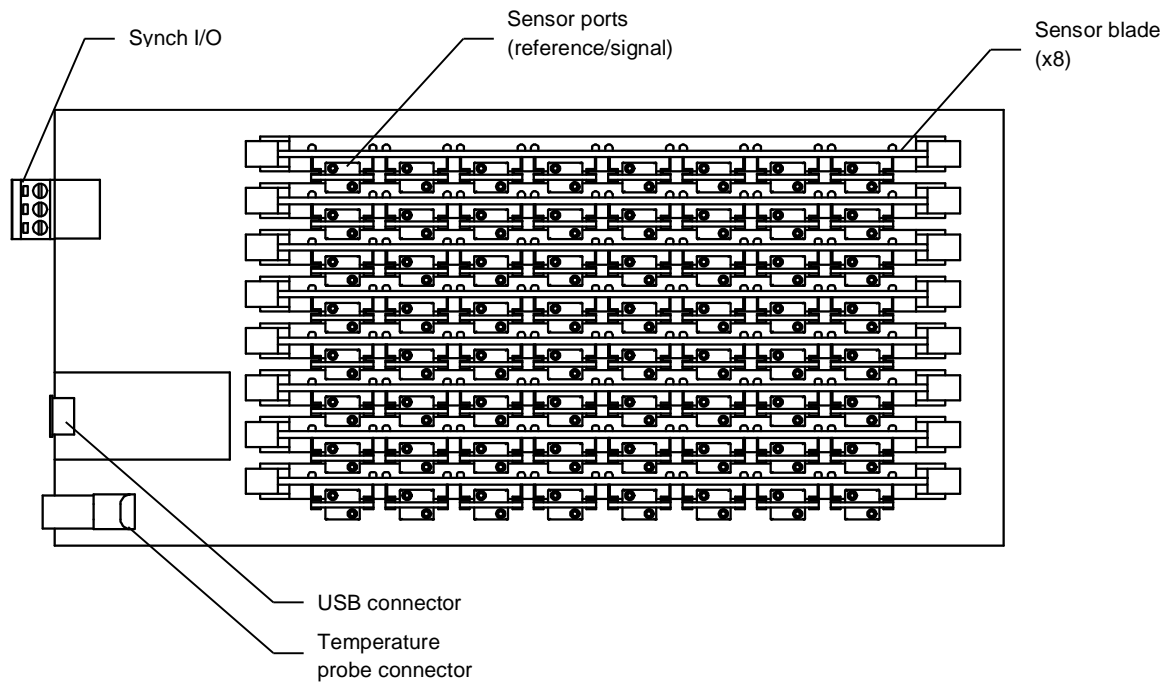


Figure 1: System configuration

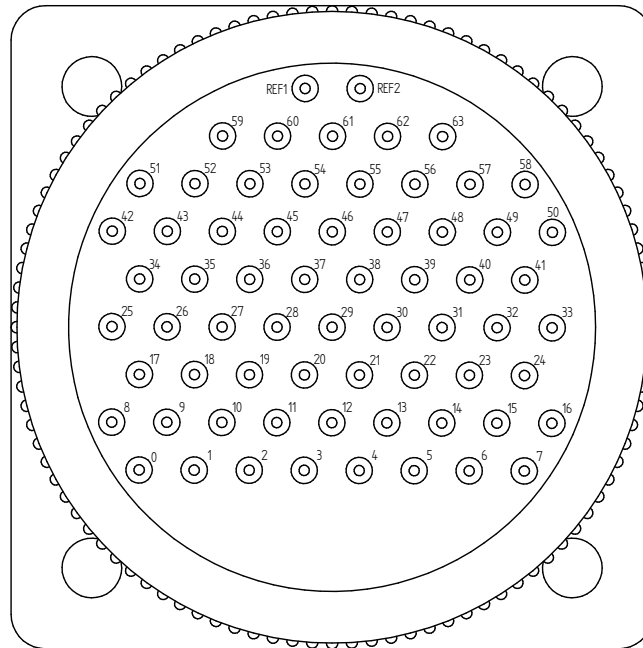
To insert a blade into the base unit, ensure that the retaining clips are in the 'open' position (pushed outward); align the blade with the socket, and apply gentle pressure to the blade card until it snaps into place. The retaining clips should toggle into the 'locked' position. An alignment tang on the socket prevents backwards insertion of the blades.

Note that sensor card slots must be filled sequentially from zero. The unit will not function properly otherwise.

WARNING: Do not apply force on the sensors themselves during blade insertion or removal, or damage may result.

To remove a blade from the base unit, gently push the retaining clips outward into the 'open' position. The blade will pop out of the socket and can then be gently removed.

If the scanner was shipped in an enclosure with a multichannel connector, then the system has been factory-assembled for you. In this case, the channels are numbered as shown below.



FRONT OF UNIT

Figure 2: Multichannel connector numbering convention

Table 1: Multichannel connector pin assignment

	Connector marking	Channel line
If using independent pressure reference for each channel	0	0
	1	0 (ref)
	2	1
	3	1 (ref)
	4	2
	5	2 (ref)
	6	3
	7	3 (ref)

	REF1	NC
REF2	NC	
If using common pressure reference	0	0
	1	1
	2	2
	3	3
	4	4

4 CARE AND HANDLING

WARNING: Do not allow any conductive materials to come into contact with the system, or it may be permanently damaged.

- The card is not protected with any electrically insulating coating. Do not allow any liquid onto the board. It is recommended to wear latex or similar gloves when handling the board to prevent deposits. Sensible ESD precautions should be taken before handling.
- During fitting of silicone tubing to scanner and pressure sensor ports, ensure that no dust, dirt or liquid enters the lines. This will alter the system performance. Any foreign material introduced into the sensors themselves may permanently damage the sensors.
- If not enclosed, ensure that a protective cover is placed over the system when not in use, and handle with care.
- Protect the sensors from moisture and dust, and store in an ESD-safe sleeve when not in service.
- Ensure that all electronic and pressure connections are appropriately strain-relieved.
- Do not use the pressure scanner system in wet or condensing conditions. Store in dry environment, or with desiccant pouch.

5 SOFTWARE AND DRIVERS

The system requires a USB connection with a computer in order to function.

Drivers

There are two external drivers which must be downloaded and installed on the computer in order for the PC to be able to interface with the system, in addition to the specific system driver.

- [National Instruments LabView Run Time Engine \(LVRTE\)](#)
- [National Instruments VISA Run-Time Engine \(NIVISA\)](#)

These drivers are freely available for download from National Instruments. Ensure that the 64-bit version of the Labview Run Time Engine is selected (note this is not the default option), and restart the computer following each installation. Correct download settings for each driver are shown in Figure 3 and 4 below.

Additionally, a further comms system install may be required for some older versions of Windows (not required for Windows 10).

Figure 3: Download settings for NI Labview Runtime Engine

Figure 4: Download settings for NI VISA Runtime Engine

Executable

An executable software package is provided with your system, which facilitates direct communication with a PC using the micro-USB connector. After launching the software, you should see the window reproduced below (Figure 5).

Starting procedure

- 1) Load the program. It will start in the [STARTUP & CONFIG] tab.
- 2) Press the white arrow near the top left corner of the window to run the application.
- 3) Using the [SERIAL PORT] drop down menu, note any existing COM ports.
- 4) Connect the computer to the system's USB socket using the included cable.
- 5) Using the [COM PORT] drop down menu, select [REFRESH] at the bottom of the menu ring. The new addition to the list is the scanner board, select this entry.
- 6) Click on the [MAIN POWER] button. The system will perform a power-on self-test, lasting a couple of seconds. If all tests pass, the on-board green LEDs and on-screen green indicators will illuminate. Note that if the scanner is in an enclosure, you will not be able to see these LEDs.
- 7) Ensure that there are no errors in the [ERROR] dialogue box. If an error has occurred at this stage, it is most likely an invalid COM port selection. If using an older Windows version this may alternatively be a compatibility error requiring the additional installation described above.

The configuration window allows you to set the operating parameters of the unit and provides some data from the on-board sensors.

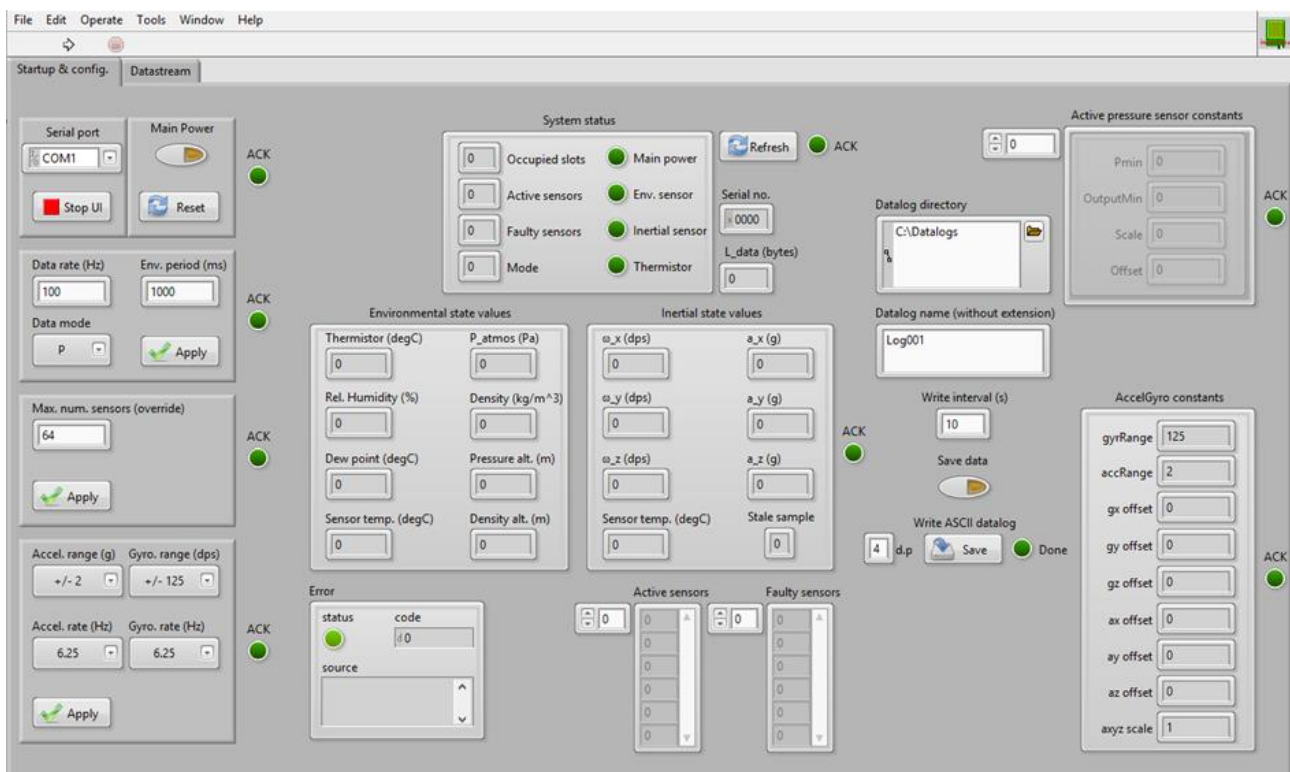


Figure 5: Start up/ configuration window

Available commands

- **Data rate:** Set the system acquisition data rate, in Hz.
- **Data mode:** Each pressure sensor has a co-located temperature sensor used internally for temperature corrections. Under normal operation, only the pressure sensor outputs are required (mode [P]). If you want to return the temperature sensor outputs as well for bespoke temperature corrections, select mode [P & T].
- **Max num. sensors (override):** The system will automatically return data from all of the installed sensors unless otherwise instructed. This feature allows channels to be disabled when not in use.
- **IMU configuration:** The installed IMU has user-definable ranges and sensitivities. These may be set manually.
- **System status:** This returns the results of the power-on self-test.
- **Environmental state values:** These are the values returned by the environmental sensors mounted on the base system.
- **Inertial state values:** These are the values returned by the IMU mounted on the base system.
- **Error:** This window will display any error codes returned.
- **Datalog directory:** This is the directory in which the collected data will be saved.
- **Datalog name:** This is the file name prefix for the data logs.
- **Write interval:** This is the frequency with which data is written to file from internal memory.
- **Save data:** If this button is unselected, the data will display on the screen but will not be written to file.
- **Write ASCII datalog:** This will store data in ASCII-readable format, with the selected number of decimal places.
- **Active pressure sensor constants:** This displays the calibration constants for each pressure channel.
- **AccelGyro constants:** This displays the constants for the IMU.

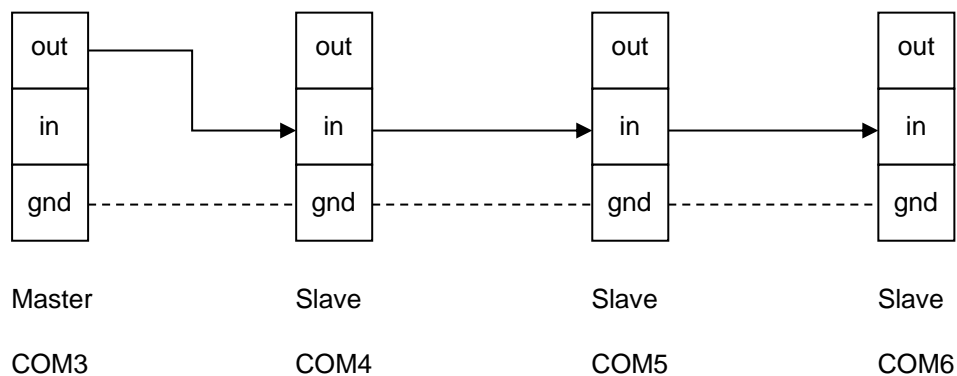
To begin collecting data, select the [DATASTREAM] tab and click [START]. The data will then begin streaming to memory (and file, if selected). For a finite number of samples, enter the number of desired samples in the [N SAMPLES] field and enable the [FINITE SAMPLES] switch. Individual traces will be displayed graphically on-screen; the check boxes may be used to enable or disable the display (this does not affect data recording).

6 SYNCHRONISATION OF MULTIPLE PRESSURE SCANNERS

Any number of pressure scanners can be tied together in order to start data acquisition simultaneously. This is achieved by making use of the green 3-way trigger I/O terminal opposite the USB connector. Since each scanner operates independently, the end-user is free to configure the master/slave relationship as desired. In fact, all pressure scanners could be slaves, with the start trigger coming from a separate system altogether.

Consider the following example of four pressure scanners, with one acting as master. The setup procedure would be as follows:

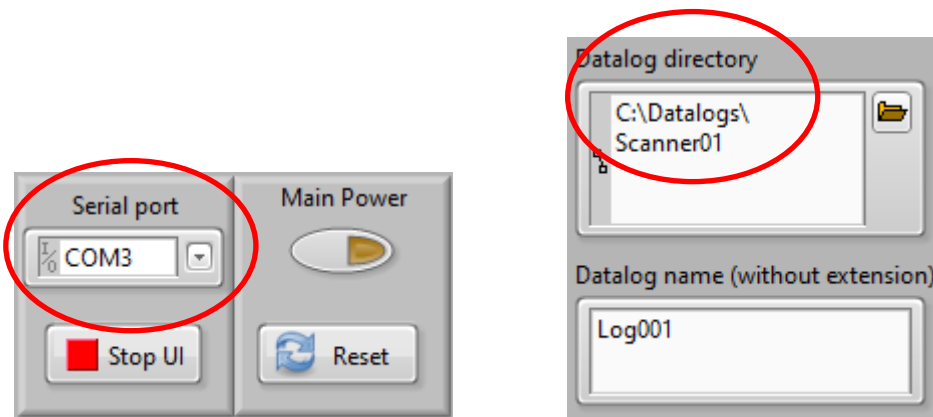
1. Ascertain the COM port number of each scanner. This is done by connecting one at a time and making a note of the COM port that appears under Windows device manager. Label the scanners as appropriate
2. Choose any one of these scanners to be the “master”. In this example, let it be COM3. Suppose that the three slaves are then COM4...6.
3. Wire the 3-way trigger terminals as illustrated below



The trigger output from the master is tied to the input of each slave. The ground terminal inter-connections are required only if the scanners are on separate grounds. If the scanners are running off the same PC or USB hub, then this is not required.

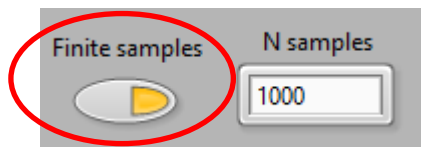
4. Create four distinctly named copies of the software panel executable and run each copy

- Configure the COM port and datalog directory and name for each scanner. Either use the same directory and different filenames or use the same datalog name under different directories for each scanner. For example, under the latter option this would be "C:\Datalogs\Scanner01" for the master and then "C:\Datalogs\Scanner02" through to "...Scanner04" for the slaves

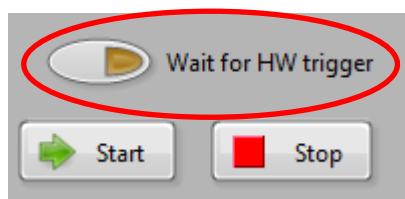


Master
COM3

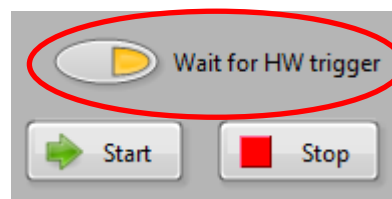
- Under the "Datastream" tab, ensure that the "Finite samples" button is enabled for all instances. Enter the required number of samples, also identical for all (though not required to be so)



- The final step in the setup is to ensure that the "Wait for HW trigger" button is enabled for all the slaves, but disabled for the master



Master
COM3



Slaves
COM4...6

Each scanner can now have its main power enabled, and any other configurations carried out identically on each instance (e.g. Data rate, "Save data" enabled).

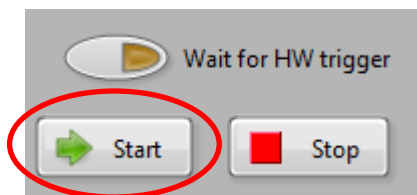
Once all scanners are ready, the data acquisition starting procedure is as follows:

1. For all the slave scanner instances, in any order, press the “Start” button under the “Datastream” tab. There should be no activity on the live traces as the slaves are now ready and waiting for the trigger from the master scanner



Slaves
COM4...6

2. On the master scanner instance press the “Start” button under the “Datastream” tab. The live traces for each scanner should now commence simultaneously. Data will stop streaming after the specified number of samples has been acquired, or if the “Stop” button is pressed on a given scanner instance. They can all be manually stopped by going through each instance and pressing the “Stop” button.



Master
COM3

Repeat the above two steps for all future data acquisition cycles. Once the measurement is complete, the “Save data” button can be disabled on all instances and the ASCII datalogs saved in the usual manner. The end-user can then combine the data from each scanner using their method of choice. The datalog directory and/or names can be changed and new measurements carried out as desired.

The modular nature of this system ensures that should one or more scanners suffer an error during a protracted measurement campaign, the data from the others will not be affected.

7 TECHNICAL SUPPORT

Full technical support is available for this product and its associated software.

If you experience any difficulty in installation or use, or if you need additional support in the operation of the system, please contact your Surrey Sensors Ltd. account manager or technical representative.

The content of this user manual is for general information only and is subject to change without notice. It may contain inaccuracies or errors and Surrey Sensors Ltd. expressly exclude liability for any such inaccuracies or errors to the fullest extent permitted by law. Your use of any information is entirely at your own risk, for which Surrey Sensors Ltd. shall not be liable.