DSA5000 SERIES PRESSURE SCANNER

DIGITAL SENSOR ARRAY

OPERATION AND SERVICE MANUAL

SOFTWARE VERSION 1.10

Scanivalve

PREFACE

WARNINGS, CAUTIONS, AND NOTES

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

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

The ESD note symbol indicates that proper precautions for handling Electrostatic Sensitive Modules need 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.

Surface transportation charges covering any repaired or replacement product or component part shall be at Seller's expense; however, inspection, testing and return transportation charges covering any product or component part returned and redelivered, which proves

not to be defective, shall be at the expense of Buyer or the end user, whomever has returned such product or component part.

This Warranty does not extend to any Seller product or component part thereof which has been subjected to misuse, accident or improper installation, maintenance or application; or to any product or component part thereof which has been repaired or altered outside of Seller's facilities unless authorized in writing by Seller, or unless such installation, repair or alteration is performed by Seller; or to any labor charges whatsoever, whether for removal and/or reinstallation of the defective product or component part or otherwise, except for Seller's labor charges for repair or replacement in accordance with the Warranty. Any repaired or replacement product or component part thereof provided by Seller under this Warranty shall, upon redelivery to Buyer, be warranted for the unexpired portion of the original product warranty.

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ARISING

BY 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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LabVIEW® is a registered trademark of National Instruments.

All other brand and product names are trademarks or registered trademarks of their respective companies.

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 any Scanivalve product, please do not hesitate to contact us at the following:

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Liberty Lake, WA 99019
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Fax: (509)891-9481
scanco@scanivalve.com
www.scanivalve.com

Scanivalve Corporation is an ISO 9001:2015 certified company.

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SECTION 1: SPECIFICATIONS

DSA5000

DSA Base Size:

Width (W)	3.875" [98.43mm]	
Length (L)	7.625" [193.68mm]	
Height* (H)		
Gas	3.732" [94.79mm]	
All-Media	3.859" [98.02mm]	

Optional Size Additions:

QD Header	H + 0.093" [2.36mm]
Shock Mount kit	H + 0.315" [8.00mm]
	L + 2.875" [73.03mm]

*Fittings will add to overall height. Due to the various fitting sizes, overall height may vary. Add

Weight**:

DSA Base	
Gas	5.45lbs [2.47kg]
All-Media	4.00lbs [1.8kg]
QD Header	0.40lbs [181g]
Shock Mount Kit	0.56lbs [254g]
Heater	0.10lbs [45g]

**Fittings will add to overall weight. Due to the various fitting sizes, overall weight may vary.

Number of Pressure Inputs:

Standard	16
True Differential	8

Base Input Fitting: 5/16"-24 female thread (SAE J1926-1†)

† SAE J1926-1 is equivalent to ISO 11926-1 for 5/16" x 24 o-ring sealing straight thread fittings.

Input Fitting Kit Options:

SS Tubulations	0.042", 0.063", 0.125"
Compression	1/16" or 1/8"
Quick-Coupler	Scanivalve 063

Control Pressure Requirements: 90-120psi

I/O and Mating Connectors:

Ethernet 1Gb	M12, X-Code, 8-pin
Power	M12, A-Code, 8-pin
Ring Ethernet (In/Out)	M8, A-Code, 4-pin

Power Requirements:

DSA5000 w/o Heater	9Vdc to 36Vdc @ 12W
DSA5000 w/Heater	24Vdc @ 85W up to 36Vdc @ 180W

Ingress Protection: IP67

Typical Communications:

Ethernet	1000/100Base-T
RS232	9600 BAUD

Communications:

Ethernet IEEE802.3

TCP/IP	HTTP, Telnet, FTP
UDP/IP	
Precision Time Protocol	IEEE1588-2008v2

Scanivalve Synchronous Ethernet Protocol (SSEP)

iDDS (optional)

Maximum Data Acquisition Rate‡

TCP/SSEP

ASCII	1kHz (samples/chan/sec)
Binary	5kHz (samples/chan/sec)
SSEP (binary only)	1kHz (samples/chan/sec)

‡ Maximum data output may vary based on network limitations

Storage Temperature:	-30 to 80°C

Operating Temperature:

Without Heater	0 to 70 °C
Gas with Heater	-60 to 70 °C
All-Media with Heater:	-25 to 70 °C

Compensated Range:	0 to 72 °C

Total Thermal Error:	Less than ±0.001% FS/°C

Humidity:

Operation	5 to 95% RH, Non-Condensing
Storage	5 to 95% RH, Non-Condensing

Shock & Vibration: MIL-STD-810G, Cat 24

Shock	10G
Vibration	10G

Acceleration:	10G

Media: Media compatible with Silicon, Silicone, Gold, Alumina Ceramic, Nylon Plastic, Aluminum, Stainless Steel, and Buna-N Orings. Alternate O-ring options Viton, HNBR, Neoprene available.

Standards: CE & RoHS v3

DSA5000 Pressure Ranges and Accuracies

Full-Scale Pressure Range[1] PSI	kPa	Proof Pressure[2]	Burst Pressure[3]	Maximum Reference Pressure (PSIG)	Differential (Gas Only) Measurement Range[4] −PSI	to +PSI	% Full-Scale Error[5]	Gauge (All-Media Only) Measurement Range[4] (PSIG) 0 to	% Full-Scale Error[5]	Absolute (Gas Only) Measurement Range[4] (PSIA) 0 to	% Full-Scale Error[5,6]
0.145	1	8 psi	10 psi	5 psi	−0.145	0.145	±0.20				
0.36	2.48	8 psi	10 psi	5 psi	−0.36	0.36	±0.15				
1	6.89	10 psi	15 psi	10 psi	−1	1	±0.10	1	±0.15		
2.5	17.24	10 psi	15 psi	10 psi	−2.5	2.5	±0.05	2.5	±0.08		
5	34.47			10 psi	−5	5	±0.04	5	±0.06		
15	103.4	45 psi	75 psi	45 psi	−15	15	±0.04	15	±0.06	15	±0.04
30	206.8	90 psi	150 psi	90 psi	−15	30	±0.04	30	±0.06	30	±0.04
50	344.7	125 psi	150 psi	125 psi	−15	50	±0.04	50	±0.06	50	±0.04
100	689.5	250 psi	300 psi	250 psi	−15	100	±0.04	100	±0.06	100	±0.04
250	1724	650 psi	750 psi	250 psi	−15	250	±0.04	250	±0.06	250	±0.04
300	2086	800 psi	900 psi	250 psi	−15	300	±0.04	300	±0.06	300	±0.04
500	3447	1250 psi	1500 psi	250 psi	−15	500	±0.05	500	±0.08		
750	5171	1250 psi	1500 psi	250 psi	−15	750	±0.05	750	±0.08		
1000	6895		1500 psi	250 psi	−15	1000		1000			
1500	10342	1650 psi	1800 psi	250 psi	−15	1500	±0.15	1500	±0.20		

1 Standard ranges available. Custom ranges may be available, but may not adhere to the stated accuracies. Please consult Scanivalve for more information.
2 Proof Pressure is the maximum pressure that may be applied without changing the performance or characteristics of the pressure sensors.
3 Burst Pressure is the maximum pressure that may be applied without physically damaging the unit.
4 Modules cannot be used to measure pressure beyond 110% of the listed measurement range or custom calibrated range.
5 Including linearity, hysteresis, and repeatability.
6 With barometric correction (CALB).

NOTES:
1. ALL DIMENSIONS IN INCHES [MM].

SSEP ETHERNET
CONNECTORS
(IN AND OUT)

GIGABIT ETHERNET
CONNECTOR

POWER/SERIAL/TRIGGER
INPUT

4X ⌀ .209 [5.31]
MOUNTING HOLES

LED STATUS
INDICATORS

STANDARD MODULE CONFIGURATION

[82.55]
3.250

[181.61]
7.150

[38.10]
1.500

[38.10]
1.500

[247.65]
9.750

[88.90]
3.500

[193.68]
7.625

[95.52]
3.761

CONFIGURED WITH OPTIONAL QUICK-DISCONNECT (QD) HEADER AND SHOCK MOUNT KIT

6X .250 [6.35] X .438 [11.11]
MOUNTING HOLES

[96.91]
3.815

[266.70]
10.500

[103.53]
4.076

[98.43]
3.875

[98.43]
3.875

CASE
VENT

[8.89]
.350

FIGURE 1.1 - DSA5000 TCP/GAS BUILD OUTLINE DRAWING
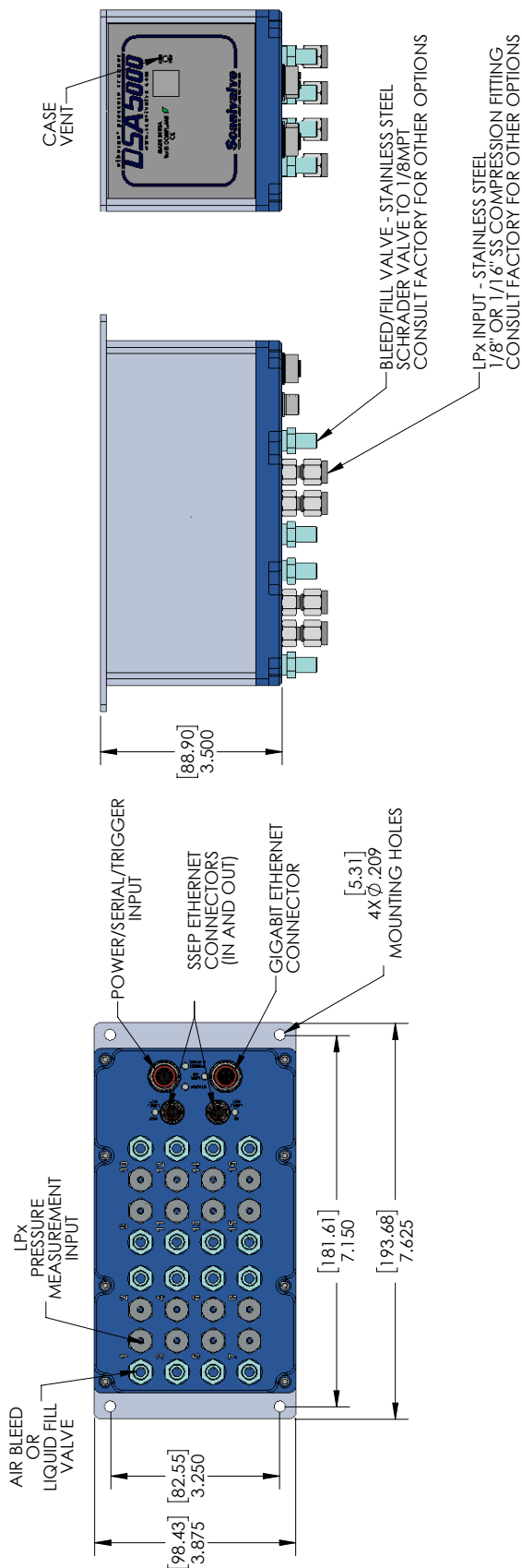
FIGURE 1.1 - DSA5000 TCP/ALL-MEDIA BUILD OUTLINE DRAWING

CASE VENT

BLEED/FILL VALVE - STAINLESS STEEL
SCHRADER VALVE TO 1/8MPT
CONSULT FACTORY FOR OTHER OPTIONS

LPx INPUT - STAINLESS STEEL
1/8" OR 1/16" SS COMPRESSION FITTING
CONSULT FACTORY FOR OTHER OPTIONS

[88.90]
3.500

POWER/SERIAL/TRIGGER INPUT

SSEP ETHERNET CONNECTORS
(IN AND OUT)

GIGABIT ETHERNET CONNECTOR

[5.31]
4X Ø.209
MOUNTING HOLES

LPx
PRESSURE
MEASUREMENT
INPUT

AIR BLEED
OR
LIQUID FILL
VALVE

[181.61]
7.150

[193.68]
7.625

[82.55]
3.250

[98.43]
3.875

NOTES:
1. ALL DIMENSIONS IN INCHES [MM].

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NOTES:
1. ALL DIMENSIONS IN INCHES [MM].

STANDARD MODULE CONFIGURATION
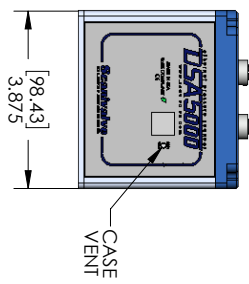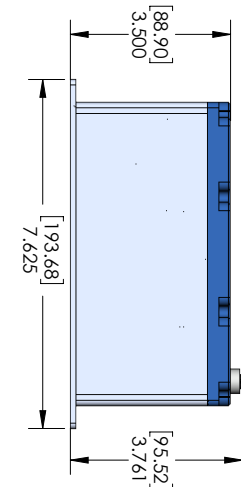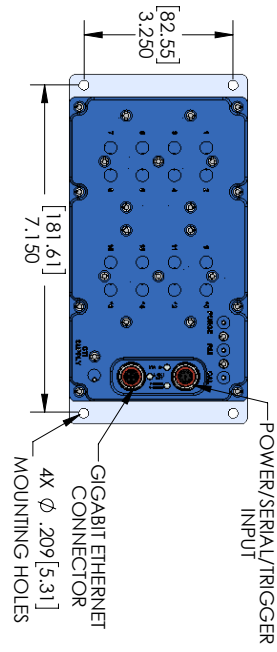
CONFIGURED WITH OPTIONAL QUICK-DISCONNECT (QD) HEADER AND SHOCK MOUNT KIT

LED STATUS INDICATORS

POWER/SERIAL/TRIGGER INPUT

GIGABIT ETHERNET CONNECTOR

4X ⌀ .209 [5.31] MOUNTING HOLES

6X .250 [6.35] X .438 [11.11] MOUNTING HOLES

CASE VENT

[38.10] 1.500
[38.10] 1.500
[247.65] 9.750
[82.55] 3.250
[181.61] 7.150
[88.90] 3.500
[193.68] 7.625
[95.52] 3.761
[98.43] 3.875
[96.91] 3.815
[266.70] 10.500
[103.53] 4.076
[98.43] 3.875
[8.89] .350
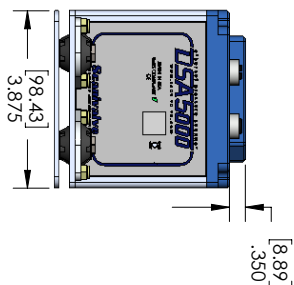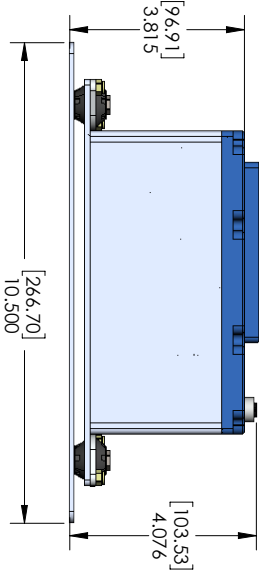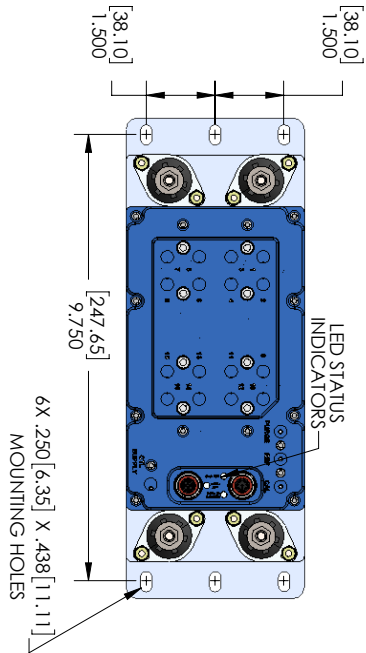
FIGURE 1.1 - DSA5000 iDDS/GAS BUILD OUTLINE DRAWING

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SECTION 2: INTRODUCTION

GENERAL DESCRIPTION

The Digital Sensor Array (DSA) is a stand-alone electronic pressure scanner which can accept up to 16 pneumatic inputs. Each DSA incorporates 16 discrete, temperature compensated, piezoresistive pressure sensors, a 24-bit Analog-to-Digital converter and RTD per sensor, and a microprocessor. Each pressure sensor is characterized over a full-scale pressure range, and over temperature. This information is stored in EEPROM memory and enables the module to directly output temperature corrected, pressure data in engineering units.

These modules were specifically designed for use in applications where long calibration intervals, simple operation, and high accuracy pressure measurements are required.

MODULE OVERVIEW

The DSA5000 is a highly customizable 16 channel pressure scanner that can be customized to fit and adhere to many different applications and requirements. All pneumatic and hardware configurations will operate using the same software commands, and offer temperature corrected pressure data output directly in engineering units.

The DSA5000 base is an aluminum, splash resistant enclosure that provides electronic connections and open-thread pneumatic connections.

There are two main types of pressure measurement builds: Dry Gas and All-Media / Liquid. The primary differences between the two builds are:
- Gas builds can measure any dry media.
- Gas builds include internal valving for Calibrate/Isolate/Purge modes using built-in solenoids.
- Gas builds use Differential or Absolute measurements. All-Media builds use Gauge sensors.
- Gas builds can be configured in several pneumatic configurations.
- Dry Gas modules can be built to include the optional QD Input Header.

Along with the measurement builds types, there are two types of communication packages available: Native Scanivalve TCP/SSEP and iDDS. The native Scanivalve builds primarily use TCP/IP for communications. iDDS builds use iDDS for communications, along with a different set of commands and functions, and do not allow for the use of Scanivalve Synchronous Ethernet Protocol (SSEP).

GAS DSA5000 BUILD FEATURES

The gas DSA can be configured in any of the following pneumatic configurations:
- Standard or Common Differential, 16Px
- Dual Range, Standard Differential, 16DR
- True Differential, 8DPx
- Individual Reference, 16IR
- Dual Range, True Differential, 8DDR
- Absolute, 16APx
- Dual Range Absolute , 16ADR

All gas DSA modules will have isolated channel inputs for each transducer installed. Most pneumatic configurations will also include pneumatic connections (when applicable) for:
- Calibration port, CAL
- Reference port, REF
- Purge Supply port, PRG
- Control Supply port, CTL Supply

The sensors within each DSA5000 series module are arranged in groups of eight (8). Each block of eight (8) sensors has its own calibration valve. This calibration valve has four (4) modes of operation and allows the DSA module to perform measurement, calibration, and purge functions. The four (4) modes are:

- Measurement
- Calibrate
- Isolate
- Purge

Each DSA is installed with three (3) internal pneumatic solenoids. These solenoids orchestrate the application of the control pressure supply, which can place the DSA into one (1) of the four (4) modes. These solenoids are controlled digitally from the DSA's internal software using software commands.

A single control pressure source of 90-120 psi control pressure is required to properly operate the internal valves. The DSA calibration valve utilizes "Normally Px" valve logic where the valves default to measurement mode when no control pressures are applied or when all integral solenoids are off (closed).

DSA5000 gas modules can be configured with a Quick-Disconnect (QD) input header. This QD input header option creates a removable header for all pressure inputs channels 1 through 16. This allows all plumbing to the Px input measurement ports to be disconnected at one time and

swapped with another module or header. This is ideal for pre-plumbing models or test articles without the DSA5000 present, or for changing modules without having to change plumbing.

UNIVERSAL DSA5000 BUILD FEATURES

The pneumatic inputs on the DSA5000 base model are 5/16"-24 female thread matching the SAE J1926-1 standard. The SAE J1926-1 is equivalent to ISO 11926-1 for 5/16"-24 o-ring sealing, straight thread fittings. While these threaded fittings are standard, Scanivalve allows the user to select the pneumatic termination of these ports with a DSA5000 Fitting Kit. These fitting kits can be installed into the female threaded fittings and can provide one of the following termination options:

- Bulged Stainless Steel Tubulations
- Brass and Stainless Steel Compression Fittings
- Scanivalve's Quick-coupler 063 Fitting

Individual fittings or fitting kits can be purchased separately to have an assortment of options on hand for quick changes or a variety of pneumatic connections per module. As an option, no fittings or fitting kit can be supplied with a DSA to allow a user to install their own fittings using the 5/16"-24 female threads.

For pressure measurement applications where the ambient temperature around the DSA is to extend below the temperature compensated range of the DSA module, the DSA can be equipped with internal heaters to regulate the internal temperature. This provides measurement stability when the module is subjected to temperatures below 0°C in flight test, wind turbines, or other sub-zero applications.

For pressure measurement applications where a high shock or vibration environment is a consideration, the DSA5000 can be equipped with a Shock Mount Kit. The shock mount kit can be removed or installed in the field. This shock mount's base plate matches the footprint and mounting layout of the legacy DSA3218. This makes the shock mount a great option if replacing legacy DSA3218s in the field.

DSA5000 COMMUNICATION OPTIONS

DSA5000s can be built in two communication configurations: TCP/SSEP or iDDS.

TCP/SSEP use the native Scanivalve TCP/IP protocol and communications outlined in **Section 5: Software** of this manual. With the standard protocol, Scanivalve's SSEP, or Scanivalve Synchronous Ethernet Protocol, is available for use with the two additional IN/OUT connectors on the top of the module. This feature allows for one module to communicate with several downstream modules in order to configure, communication, and collect data.

iDDS, or Instrumentation Data Distribution Service, is a data abstraction protocol designed specifically for data acquisition and control instruments. iDDS was developed on DDS, or Data Distribution Service, but adds definitions specific to instrumentation. iDDS was developed to be a plug-and-play type system, where timestamping happens at the source to remove latency and jitter (using IEEE1588). It was first introduced by Rolls Royce and developed in partnership with MDS Aero. Dozen of aerospace and measurement companies have adapted iDDS into their systems and products, including Scanivalve and the DSA5000.

The only hardware difference between the two communication builds is the SSEP IN/OUT electrical connector. These connectors are only available on the TCP/SSEP builds. All other hardware aspects in this manual can be used for iDDS builds, however commands, webserver use, and similar software items may not be relevant when using iDDS.

DSA5000 GAS PNEUMATIC CONFIGURATIONS

DSA5000 STANDARD 16PX

The DSA5000 Standard 16Px module provides 16 channels of the same pressure range sensors. These 16 pressure transducers are configured into two (2) groups of eight (8) each. Each group of eight (8) transducers shares a common calibration valve and a common reference manifold. Single range modules tie the two reference manifolds together, and the two calibration valves together internally to provide the user with a single reference and a single calibration port. In this configuration, all pressure values provided by the sensors will be a 'differential' pressure value between the Px Inputs and the common reference port. If the common reference port is left open to atmospheric pressure, the pressure values at the Px ports will be a 'gauge' measurement value. Figure 2.1 depicts the top panel of a DSA5000 Standard 16Px.
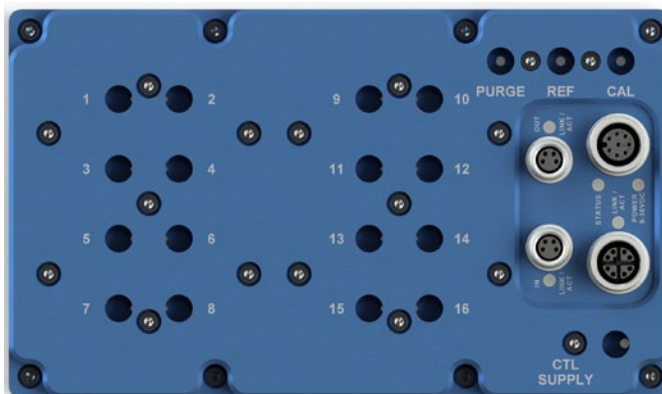
FIGURE 2.1 - DSA5000 STANDARD 16PX TOP VIEW

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DSA5000 DUAL RANGE 16DR

The DSA5000 Dual Range 16DR module is available as a dual pressure range module, offering eight (8) channels of one pressure range and eight (8) channels of a different pressure range. Like a standard DSA5000, each group of eight (8) transducers share a common calibration valve and a common reference manifold. However, in dual range modules the reference manifolds and the calibration valves are not tied together internally, and a separate reference and calibration port are provided on the top of the module for each range. These ports are labeled CAL H and REF H (high, channels 9-16), and CAL L and REF L (low, channels 1-8). Standard configuration will place the lower pressure range in the "low" side, channels 1-8. This can be altered at the customers request. Figure 2.2 depicts the top panel of a DSA5000 Dual Range 16DR module.
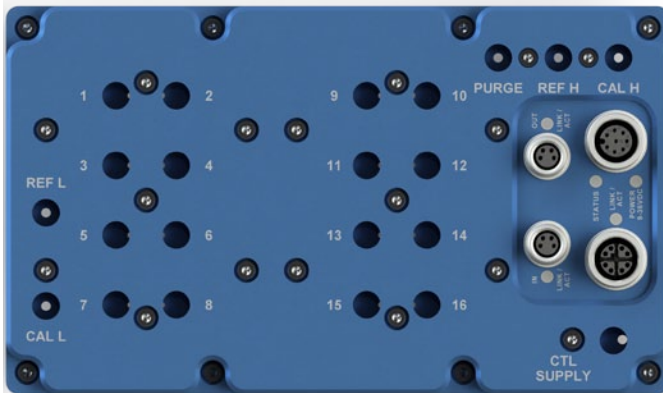
FIGURE 2.2 - DSA5000 DUAL RANGE 16DR TOP VIEW

DSA5000 TRUE DIFFERENTIAL 8DPx

For true differential pressure measurement applications, the DSA5000 can be configured with eight (8) true differential pressure transducers. They are arranged into two (2) groups of four (4) transducers. Each transducer will have a discrete input for the positive and negative side of the transducer for a true differential pressure measurement between two points. Like the DSA5000 Standard 16Px, each group of transducers has a dedicated calibration valve that allows the input pressures to be blocked off during any calibration, including a zero offset calibration (CALZ). In calibrate mode, the reference ports will all be manifolded to a single reference port. Figure 2.3 depicts the top panel of a DSA5000 True Differential 8DPx module.
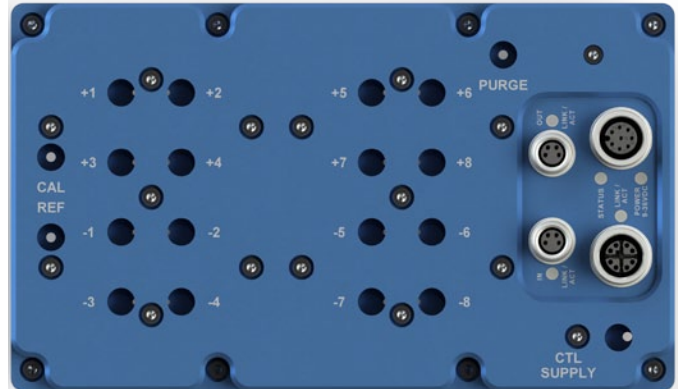
FIGURE 2.3 - DSA5000 TRUE DIFFERENTIAL 8DPx TOP VIEW

DSA5000 INDIVIDUAL REFERENCE 16IR

For true differential pressure measurement applications where the internal calibration valve is not required to control the reference pressure, the DSA5000 Individual Reference 16IR provide two (2) discrete inputs for each sensor (positive and negative), and 16 channels total (32 total inputs). A calibration valve is provided for each group of eight (8) sensors; however, unlike the DSA5000 Standard 16Px or True Differential 8DPx modules, a separate reference port is provided for all sixteen (16) transducers which are not controlled by the internal calibration valves. This means that a zero offset calibration (CALZ) must be performed with no pressure applied to the module, and calibrations must be performed using an external manifold to tie all reference ports together. Figure 2.4 depicts the top panel of a DSA5000 Individual Reference 16IR module.

NOTE: The Individual Reference 16IR cannot be configured with the Quick-Disconnect (QD) header option.
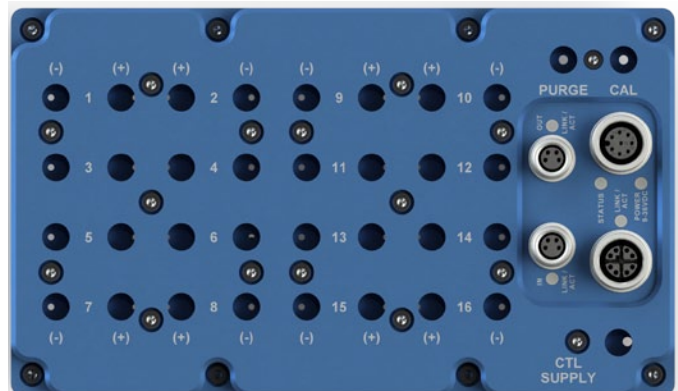
FIGURE 2.4 - DSA5000 INDIVIDUAL REFERENCE 16IR TOP VIEW

DSA5000 DUAL RANGE, TRUE DIFFERENTIAL 8DDR

For true differential pressure measurement applications where two pressure ranges are required, the DSA5000 Dual Range, True Differential 8DDR provides two (2) ports for each sensor, and 8 channels total (16 total inputs). They are arranged into two (2) groups of four (4) transducers. Each group can be of a different pressure range. A calibration valve is provided for each group of four (4) sensors. Similar to the True Differential module, each group of transducers has a dedicated calibration valve that allows the input pressures to be blocked off during any calibration, including a zero offset calibration (CALZ). In calibrate mode, the reference (negative inputs) will be shorted to a single reference port per group. Like the Dual Range 8DR module, the common ports are labeled CAL H and REF H (high, channels 5-8), and CAL L and REF L (low, channels 1-4). Standard configuration will place the lower pressure range in the "low" side, channels 1-8. This can be altered at the customers request. Figure 2.5 depicts the top panel of a DSA5000 Dual Range, True Differential 8DDR module.

NOTE: The Dual Range, True Differential 8DDR cannot be configured with the Quick-Disconnect (QD) header.
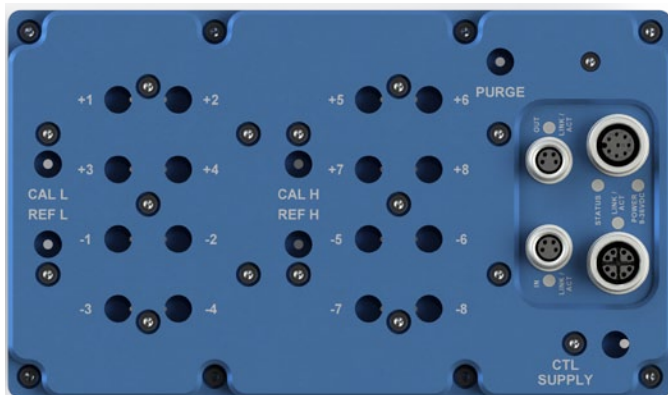
FIGURE 2.5 - DSA5000 DUAL RANGE, TRUE DIFFERENTIAL 8DDR TOP VIEW

DSA5000 ABSOLUTE 16APx

The DSA5000 Absolute 16APx module can be used for absolute pressure measurement when equipped with absolute pressure transducers. A calibration valve is provided for each group of eight (8) sensors (no reference port). All sixteen (16) transducers are tied a single calibration port. An absolute module will provide pressure values as an absolute value. Figure 2.6 depicts the top panel of a DSA5000 Absolute 16APx pressure module.
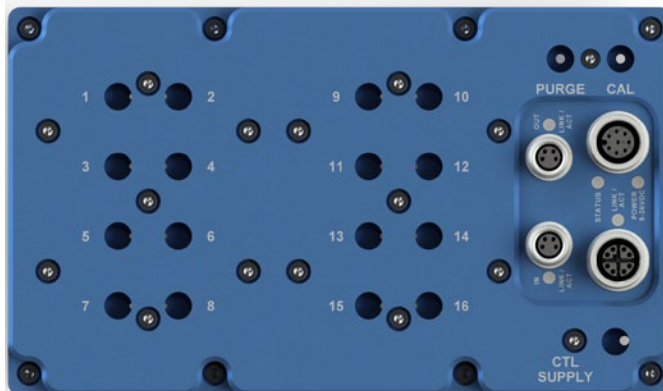
FIGURE 2.6 - DSA5000 ABSOLUTE 16APx TOP VIEW

DSA5000 DUAL RANGE ABSOLUTE 16ADR

The DSA5000 Dual Range Absolute 16ADR module can be used for absolute pressure measurement, offering eight (8) channels of one pressure range and eight (8) channels of a different pressure range. Like a standard absolute DSA5000, each group of eight (8) transducers share a common calibration valve. However, in absolute dual range modules the calibration valves are not tied together internally, and separate calibration ports are provided on the top of the module (no reference ports). They are labeled CAL H (high, channels 9-16)and CAL L (low, channels 1-8). Standard configuration will place the lower pressure range in the "low" side, channels 1-8. This can be altered at the customers request. Figure 2.7 depicts the top panel of a DSA5000 Dual Range Absolute 16ADR pressure module.
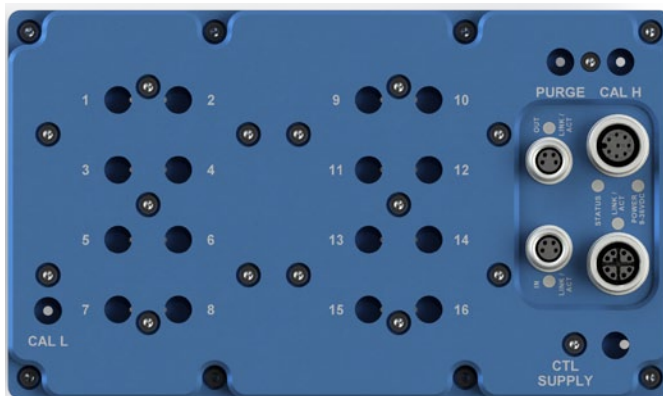
FIGURE 2.7 - DSA5000 ABSOLUTE, DUAL RANGE 16ADR TOP VIEW

DSA5000 QUICK-DISCONNECT (QD) HEADER

DSA5000 gas modules can be ordered with the Quick-Disconnect (QD) header option. When this option is added, the DSA5000's input connections will be on a single, removable header that can be quickly separated from the DSA5000. This allows for quick test setup changes or module swaps, and minimizes both time and leak liabilities.

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FIGURE 2.8 - QUICK DISCONNECT (QD) HEADER

FIGURE 2.9 - DSA5000 STANDARD 16PX QD HEADER TOP VIEW

This option works great for applications where:
- Plumbing from the test article or model must be done prior to installation of the pressure module. Plumbing can be fixed to the removable header, and installed on the module when ready for testing. This allows the module to be stored in a safe location when working with models or test articles prior to testing.
- Module changes are required often, whether switching pressure ranges using the same inputs, or when changing out modules for routine maintenance or calibrations. Modules sent to the calibration lab will typically not require the removable input header which can stay fixed to the test article.
- Modules are shared between multiple facilities. Plumbing from different test fixtures can remain in place with separate headers and modules can easily be moved from one test station to another. This also benefits facilities that use different input fittings. For instance: 1/8" Compression fittings in Area A, and 0.063" Tubulations at Area B. Each header can be equipped with the appropriate input fitting kit.

The Px inputs on the header retain the same 5/16"-24 female threads, and each fitting can be installed with any variety of available fittings. The QD header option is available for all pneumatic configurations except individual reference (16IR) or true differential, dual range (8DDR) modules. Figures 2.9 through 2.13 show the top view for the QD header configuration options.

Separate QD input headers can be purchased separately to supplement the one provided with a purchased module. A blank QD header can be purchased to cover the input ports on the DSA for storage, transport, and protection. A blanking adaptor can also be purchased to cap the QD header.

FIGURE 2.10 - DSA5000 DUAL RANGE 16DR QD HEADER TOP VIEW

FIGURE 2.11 - DSA5000 TRUE DIFFERENTIAL 8DPX QD HEADER TOP VIEW

Figure 2.12 - DSA5000 Absolute 16Px QD Header Top View

Figure 2.14 - DSA5000 Standard 16LPx Top View

These modules are identified by the DSA52xx or DSA55xx model number. They can also be identified physically having no CTL Supply port, installed Schrader valves, upside down label, and non-recessed electronics area.

Environmental Considerations

DSA5000 modules are constructed with a rugged, corrosion resistant aluminum case. This case is designed with withstand normal industrial, flight test, educational, wind tunnel or similar environments.

Extended Temperature Ranges

The DSA module should not be mounted in a location where it may be subjected to extreme temperature shifts or ambient temperatures outside of the specified operating range of the module. Keep in mind that the internal temperature of the module will run several degrees warmer than ambient temperature.

For applications where the module may be subjected to temperatures below 0°C, the DSA5000 series module can be equipped with an internal heater for cold environment applications. The heater option can increase the DSA5000's operational ambient temperature range to -60°C to 70°C for gas modules, or -25°C to 70°C for all-media modules, by maintaining the internal temperature to reside within the temperature compensated range (0°C to 70°C). With a heater installed, the power requirements for the DSA5000 module increase to 24Vdc @ 85W (and up to 36Vdc @ 180W). The actual power consumption of the module will vary based on the internal temperature of the module as the DSA5000 will auto-regulate the internal temperature of the module.

Shock and Vibration

For pressure measurement applications where the DSA5000 may be subjected to a high shock or vibration environment, a Shock Mount Kit can be installed on the

Figure 2.13 - DSA5000 Absolute, Dual Range 16ADR QD Header Top View

DSA5000 All-Media Configurations

DSA5000 All-Media 16LPx

The DSA5000 All-Media 16LPx module provides 16 channels of the same pressure range sensors. These 16 pressure transducers have discrete pressure inputs. Each of the channels has a dedicated air bleed or fill valve for bleeding air, or filling the lines with media. This a standard Schrader valve inside a NPT style housing. The NPT housing is installed at the factory and cannot be removed. The Schrader valve itself can be removed, changed, or replaced. Figure 2.14 depicts the top panel of a DSA5000 Standard 16Px.

Note: All possible configurations of the DSA5000 All-Media build will have the same pneumatic inputs. This includes single or dual-range configurations. For multi-ranges, the lowest range will always start in the first channels (starting Channel 1), and the highest range at the last channels (ending Channel 16).

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DSA5000. The shock mount kit can be removed or installed in the field, and the base plate of the shock mount matches the footprint and mounting layout of the legacy DSA3218 providing the user the easily ability to drop a DSA5000 into the same space.

The DSA5000 with the shock mount kit is tested to meet MIL-STD 810G, Category 24, Figure 514.6.

FIGURE 2.15 - DSA3218 (LEFT) AND DSA5000 (RIGHT)

The isolators install on the shock mount kit have a natural resonance frequency in the 37-40Hz range. The actual frequency varies due to the number of configurations of the DSA5000 (fittings, valves, number of sensors, etc). Other considerations should be made if the shock mount will be used in environments where it may be subjected to a vibrations in this range.

INGRESS PROTECTION

Each DSA5000 is IP67 rated under the condition that all pneumatic and electrical connections are established appropriately. While IP67 rated, it is recommended to keep the module dry as possible.

Improper use or user disassembly of the DSA5000 pressure scanner may negate the IP67 rating. Some seals used to maintain the DSA5000 IP67 rating are not user-serviceable. If an application dictates a frequent IP67 requirement, Scanivalve recommends yearly factory inspection and repair of all seals/gaskets to maintain the IP67 rating.

The IPx7 ingress rating is specific to water ingress. For All-Media modules, this may not protect against ingress of other types of media.

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SECTION 3: OPERATION

UNPACK & INVENTORY

When you first unpack the DSA module, begin by inspecting and inventorying the contents of the package. If any visible damage is immediately noticed or if any contents are missing, contact Scanivalve before proceeding. Standard modules are shipped with the following contents as a minimum:

1. DSA5000 Module
2. DSA5000 Accessory Kit
3. Certificate of Calibration
4. Full Calibration Report
5. DSA Resource Drive

Module's may include spare input fittings dependent on the configuration. Fittings may not be installed on modules.

MOUNTING

CAUTION! Mounting the DSA module inadequately or in an environment that does not conform to the recommendations may result in permanent damage to the module.

A standard DSA5000 module comes with a 1/8" (3.175mm) mounting plate attached to the bottom. This plate provides four (4) mounting holes 0.209" (5.31mm) in diameter for mounting hardware. The DSA module can be mounted in any orientation as any offsets caused by gravity will be removed by a zero offset calibration (CALZ). Ensure that the DSA module is mounted in an environment that conforms to the requirements described in the "Environmental Considerations" section.
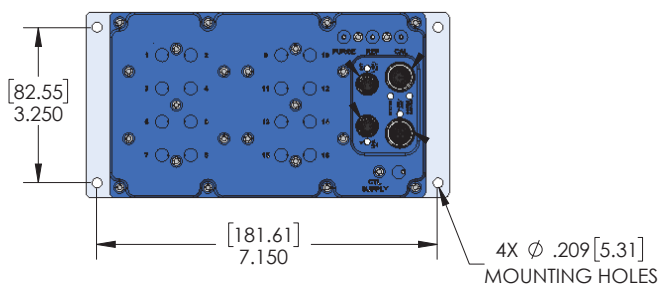
FIGURE 3.1 - STANDARD MOUNTING FOOTPRINT

For mounting environments where the DSA5000 may be subjected to high shock and/or vibration, the DSA5000 Shock Mount kit can be installed. The shock mount kit comes with a 0.090" (2.29mm) mounting plate attached to the bottom. This base plate uses the same mounting footprint as the legacy DSA3218 providing six (6) 0.250 x 0.438 (6.35mm x 11.11mm) slot holes for mounting hardware. The Shock Mount kit can be installed in the field if needed.
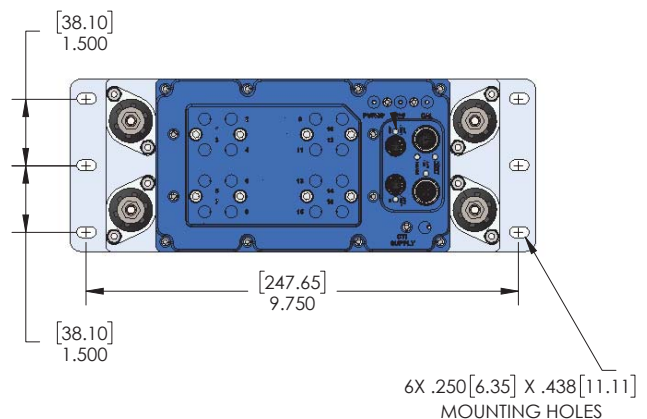
FIGURE 3.2 - SHOCK KIT MOUNTING FOOTPRINT

DSA5000 gas modules can be mounted in any orientation. It is recommended that DSA5000 all-media modules are mounted with the input fittings pointing down at the ground. Alternately, the module can be mounted with the fittings pointed perpendicular to the ground. This is to prevent potential leaks at the input fittings from leaking onto the DSA5000 case and potentially into the case. The IP67 rating is specific to water and may not protect the DSA5000 from other types of media ingress.

WARM-UP

After applying power to the DSA module, it is recommended to allow time for the module temperature to become stable before collecting data. Due to the design of the DSA5000, accuracy is minimally impacted by the module warming up after initially being powered. The module can take up to 3 hours to fully warm up (in a 25°C ambient environment) but throughout that warm-up the errors in the accuracy of the pressure readings are negligible.

It is generally recommended that the module be allowed to warm up for a minimum of 30 minutes before collecting data, but this is not mandatory. If time allows, the warm-up period should be extended to 60 minutes.

COMMUNICATIONS

The DSA module is designed primarily for Ethernet communications. This provides a means to configure the DSA module, scan and collect data from the module. A serial RS-232 port is also provided through the power connector. The serial connection is designed to be used to configure the module, provide emergency communications for troubleshooting, collect scan data (ASCII only at limited rates), and find/change the DSA's IP address if it is unknown.

SERIAL COMMUNICATIONS

Every DSA5000 module has an RS-232 serial output. It is available through the Power/Serial/Trigger connector on the top of the module. This connector on the module is an M12, 8-pin, A-Code style connector. All DSA modules are shipped with a mating connector that can be used to fabricate a Power/Serial/Trigger cable. Alternately, a Power/Serial/Trigger cable (power use from PDM) can be ordered from Scanivalve using the Scanivalve part number 156147 which provides an DB9 RS-232 connector and BNC connector for serial and trigger connections. The wiring diagram for the power/serial/trigger connector can be found in Section 4: Hardware.

Settings for establishing a serial connection to the DSA module are as follows:

    Bits per second: 9600 BAUD
    Data bits: 8
    Parity: none
    Stop bits: 1
    Flow control: none

A serial and Ethernet connection can be established simultaneously. All commands listed in Section 5 are accepted via serial communications.

The serial connection is designed to be used to configure the module, provide emergency communications for troubleshooting, collect scan data (ASCII only at limited rates), and find/change the DSA's IP address if it is unknown. For information on changing the communication parameters, including the module's Ethernet IP address, see "Changing the IP Address" procedure.

The Power/Serial/Trigger Communications port also serves as the input for the power and external trigger connections. For more information on externally triggering scans, see "Scanning with an External Trigger" on page 12.

ETHERNET COMMUNICATIONS

The primary means of communication with the DSA5000 module is the 1000Base-T Ethernet port with MDIX autocrossing. The DSA uses a M12, 8-Pin, X Code connector for 1Gb Ethernet connection. This is a latching or threaded connector to prevent the connector from becoming unseated when subjected to vibration. Ethernet cables for the DSA5000 can be ordered from Scanivalve in any length up to 100 feet (30 meters). Scanivalve's part number for these cables is 156145.

M12 cables, connectors, and parts can also be purchased off-the-shelf from third party vendors. Custom Ethernet cables can be built using the mating connectors and a shielded Category 6 rated or better cable. The wiring diagram for the Ethernet connector can be found in Section 4: Hardware.

SCANIVALVE SYNCHRONOUS ETHERNET COMMUNICATIONS

A unique feature of the DSA5000 series is the ability to link multiple modules together and allow a single 'controller' unit to control settings and data collection from all connected modules. This Ethernet protocol, Scanivalve's Synchronous Ethernet Protocol, or SSEP, is based around industrial or "real-time" Ethernet systems where a single 'controller' unit will discover, control, and align data from all 'responder' modules on an isolated network. Using SSEP with Scanivalve 5000 modules provides an easy way to collect synchronous data from multiple modules, with the ease of controlling the system and receiving all scan data from a single 'controller' module.

In this configuration, a single 'controller' unit communicates with a host computer using the standard Gigabit Ethernet connection. All modules in the SSEP isolated network can be controlled through the single 'controller' unit. When scan data is collected, all data is processed by the 'controller' unit, synchronized, organized, and output from the 'controller' unit's Gigabit Ethernet network connection. This scan data packet will include header information about the scan, packet size, and number of modules, as well as the scan data from each module connected in the SSEP network. More information on using SSEP can be found in the Scanivalve Synchronous Ethernet Protocol section.

The SSEP in and out connectors on the DSA5000 support connections to other 5000 series modules. The SSEP I/O connectors do not support standard Ethernet input or output, and can only be used to communicate with other supported Scanivalve 5000 series modules. The SSEP I/O connections are M8, 4-pin, A-Code connectors. These cables or connectors can be purchased through Scanivalve using the Scanivalve part number 156151 at any length up to 100 ft (30 meters).

M8 Ethernet cables, connectors, and parts can also be purchased off-the-shelf from third party vendors. Custom Ethernet cables can be built using the mating connectors

and a shielded Category 6 rated or better cable. The wiring diagram for the Ethernet connector can be found in Section 4: Hardware.

Setting Up an Ethernet Connection

Before an Ethernet connection can be established, the IP address must be configured for the users network. This can be done manually with a static IP address. If a static IP address is desired, the IP address of the DSA must be set manually. The IP address assigned to the DSA must be compatible with the network/host computer.

DSA5000 modules are shipped with a pre-configured IP address that uses the following format:
        191.30.130.xxx

The first two octets used are common to all Scanivalve products (191.30). The third octet is the module family code (130). The fourth octet is the last three digits of the DSA's serial number (*"xxx" is only a placeholder in the example as all modules will have different serial numbers*).

Using a Static IPv4 address

If a static IP address is desired, the IP address must be manually configured. The IP address that is configured in the DSA must be compatible with the network that the DSA is being connected to. If simply connecting the DSA directly to a host computer, the IP address of the DSA and the host computer must be compatible, which may require manual configuration of the DSA and/or computer.

The range of compatible IP addresses is defined by the subnet mask. The standard default subnet mask is 255.255.0.0. This default subnet mask requires that the IP address of the module and host computer must share the first two octets, or sets of numbers. The third and fourth octets of the IP address are variable with this subnet. It is typically recommended that the third octet also be shared between the host computer and the module.

The subnet mask digits of "255" define that the two IP addresses must have matching digits in those positions, and the subnet mask digit of "0" allows the two IP addresses to have unique values for those octets and still be compatible. No two modules on a single network can share the same IP address. Below are some examples of compatible and non-compatible IP addresses:

Example of matching the first three octets:
        Subnet mask: 255.255.255.0
        Host computer: 191.30.130.90
        DSA module: 191.30.130.100
Example of matching the first two octets:

        Subnet mask: 255.255.0.0
        Host computer: 191.30.1.1
        DSA module: 191.30.130.125
Example of NON-COMPATIBLE IP addresses:
        Subnet mask: 255.255.255.0
        Host computer: 191.30.1.1
        DSA module: 191.30.130.5

When configuring the network, the IP address of the DSA module can be modified to match the network, or the IP address of the host computer can be modified to be compatible with the DSA module.

The IP address of a Windows 7, 8, or 10 host computer can be changed[*] under:
    Control Panel -> Network and Sharing Center -> Local
    Area Connection/Ethernet -> Properties -> Internet
    Protocol Version 4 (TCP/IPv4) -> Properties

[*] Changing the IP address of the host computer may require administrative rights.

The IP address of the computer can quickly be found using Windows Command Prompt and the command "ipconfig." Remember that this will show all available network connections, including WIFI and, if applicable, multiple Ethernet ports.

Based on the information above, the host computer can be configured to communicate with the default shipped IP address of the DSA.

In situations where the IP address of the host computer cannot be altered, or if the DSA must be integrated into an preexisting network, the DSA's address must be changed to establish an Ethernet connection. The DSA's IP address is set with the **IP** variable under the IP group (**LIST IP**). This can be changed through an existing Ethernet connection or via serial connection.

If an existing Ethernet connection can be established (by changing the host computer's IP address, using an alternate computer, or by some other means), it is the preferred method for changing the IP address of the DSA. If Ethernet communication is not possible, a serial connection must be established with the DSA following the guidelines in the "Serial Communications" section.

If the IP variable is changed either through an Ethernet connection or a serial connection, the new address will not be effective until a **SAVE IP** command has been issued and the power is cycled. For more information on changing the **IP** variable, see the "Changing the IP Address" procedure.

DSA NETWORK CONFIGURATIONS

The DSA may be configured in three basic network arrangements:

ISOLATED NETWORK

The isolated DSA network provides the fastest possible data throughput because other network traffic has been eliminated. DSA commands are issued from the network client/host and data is directed to the network client/host in user-configured format. This configuration is ideal for high speed data transfer with data reduction that is handled by the network client/host.

INTEGRATED WITH SYSTEM NETWORK

The integrated DSA provides the most accessible data to all network clients. Any client/host on the network may control any or all of the DSA's. Depending on the data transfer protocol, network throughput may be reduced because of other network traffic or network speed limitations. This configuration is ideal for systems that can tolerate slower data transfer rates but require easy access by multiple client/hosts to each DSA unit.

SUB-NETWORK WITH GATEWAY

The DSA sub-network allows high speed data transfer of the sub-network while allowing access by a larger network. The gateway is most effective as a multi-homed client/host that can store the DSA data for later access by client/hosts on the main system network.

CLIENT/HOST OPTIONS

Once the module has been connected and the IP address has been configured, communications can be established with the DSA module. Communications can be made through several software packages including:

- PC - Web Server
- PC - TCP/IP
- PC - UDP
- PC - ScanTel
- PC - DSA5000Link
- PC - Windows HyperTerminal

PC - WEB SERVER

An integral Web Server is embedded in the DSA5000 to provide an easy way to communicate and collect data from the DSA. The Web Server can be accessed using a web browser; including Google Chrome and Mozilla Firefox. All functionality available in the DSA can be accessed using the Web Server including additional features such as a terminal window for simple command-line communication and the ability to update the DSA's firmware and coefficient tables. This is the recommended means of communications for

most users.

An internet connection is not required when accessing the DSA's Web Server. Not all web browsers are supported. Please see the section dedicated to the Web Server for more information.

PC - TCP/IP

The user may write their own TCP/IP interface using the software specification portion of this manual. Any programming language can be used. This interface could allow the user to:

- Issue commands to any or all DSA modules on the network.
- Display returned information from the DSA module(s).
- Write returned information to the client/host in TCP/IP format.
- Determine the addresses of DSA module(s) on the network.

Quick Tip: Many programming languages have Telnet drivers, toolboxes, or other examples that can provide a jump start when interfacing with the DSA5000.

PC - UDP

The user may write their own UDP interface using the software specification portion of this manual. Any programming language can be used. This interface should allow the user to:

- Display returned information or scan data from the DSA module(s).
- Write returned information or scan data to the client/host in UDP format (no handshaking).

PC - SCANTEL

ScanTel is a free communications utility designed by Scanivalve to communicate with Scanivalve products including DSA modules. It is a text based, command line program that allows users to connect to a single DSA module, modify the configuration variables, and collect data using both TCP and UDP protocol. ScanTel is often the go-to choice for troubleshooting any Scanivalve module. ScanTel can be downloaded from www.scanivalve.com.

PC - DSA5000LINK

DSA5000Link is a free LabVIEW® based program specifically developed for the DSA5000 series. This program allows users to change variables, scan and collect data to the screen or to a CSV file with an easy to use graphical interface. While the standalone program can be installed and used easily, all VIs used to create the program are included. These VIs can be used as examples for user looking

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to create a custom LabVIEW® program to operate the DSA5000, or for integrating the DSA5000 into a preexisting LabVIEW® environment.

DSA5000Link and associated VIs can be downloaded from www.scanivalve.com.

PC - HyperTerminal

HyperTerminal is a Windows program included as part of Windows 2000, XP, and Vista Operating Systems. It is a text based, command line program. This program permits a users to connect to a single DSA module, modify the configuration variables, format the internal memory, or can be used troubleshooting. HyperTerminal provides a means for both Serial RS-232 and Ethernet connections.

Alternate terminal emulators, such as PuTTY, can be downloaded for free from various sources online if Hyper-Terminal is not available.

Scanning

Once the DSA module has been installed, powered on and allowed to thermally stabilize, data can be collected. There are several configuration variables that control how the DSA module samples data pressure and how the data is output.

Scan Rate

The scan or data rate is controlled by the variable: **RATE**. Rate is expressed in Hertz (Hz), which can be described as samples per channel per second, or more simply, frames per second. Because the DSA5000 has one analog-to-digital converter per transducer, all pressure samples per channel will be taken synchronously.

Example: If rate is set to 10Hz, the DSA will sample a pressure value from every channel, every 0.1 seconds. This data is packaged into a 'frame' of data and output to the configured destination at the same rate.

Scan Duration

The length of the scan, or number of frames output per scan, is controlled by the variable: **FPS**. A frame of data typically consists of a frame number, time stamp, and one averaged pressure and temperature sample for each sensor in the DSA.

Example: If frames per second is set to 100, and the scan rate is set to 10Hz, the DSA will output 100 frames of data at 10Hz. This scan will last 10 seconds and only 100 frames of data will be output. The scan will end when 100 frames are output.

Example: If frames per second is set to 0, and rate is set to 5Hz, the DSA will output data at 5Hz indefinitely. The scan must be stopped manually by the user.

Scan Data Format

The data output for ASCII data collection is controlled by the variable: **FORMAT**. Format only applies to ASCII data collection via the Telnet connection, and will not affect binary data collection, or data collection via FTP or UDP.

Example: If format is set to C (CSV), the DSA will output the scan data in a Comma Separated Variable ASCII format.

Scan Data Units

The pressure and temperature unit values output in each frame of data are controlled by the variable: **UNITS**. The DSA supports a number of pressure engineering units including PSI, Pascals, Bar, and more. Temperature is limited to degrees Celsius.

Example: If units is set to PSI, the pressure values for each channel will be output in PSI engineering units, and the temperature for each channel will be in degrees Celsius.

Starting a Scan

Once the DSA has been configured for scanning, the DSA will start sampling and outputting data after the **SCAN** command is issued to the DSA module. The DSA will then enter SCAN mode and will beginning sampling data at each sensor. Data will output continuously at the configured rate until the frames per scan (FPS) term is met or until the user has manually stopped the scanning process. Once the scan has been completed or terminated, the DSA will return to **READY** mode and will be ready for the next command. This scenario is an example of a free-run, internal rate scan (**TRIG 0**). Data will be output from the DSA module over the Ethernet connection and can be collected in the ASCII format.

There are several ways that the DSA can scan and collect data. These options include:
- Internal rate, software scan triggered
- Internal rate, hardware scan triggered
- External rate, hardware frame triggering
- External rate, software frame triggering
- Internal rate, scan-on-startup
- Internal rate, PTP time triggered

There are several ways that the DSA can output scan data. These options include:
- ASCII data via TCP or FTP
- Binary data via TCP, UDP, or FTP

These options makes the DSA an extremely versatile and configurable unit. All different scanning and data output methods will be described in this manual. For more information on the commands used in this section, please refer to Section 5: Software. For a list of data destinations, formats, and relative variable settings, please see Appendix B.

Scanning with an External Trigger

The DSA5000 can be configured to scan with an external hardware or software trigger. This provides a simple means of synchronizing the data collection between multiple DSA units or legacy Scanivalve products when an IEEE1588 PTP infrastructure is not in place. It also provides a means of synchronizing DSA scanners with other third-party equipment that may not be IEEE1588 PTP compatible.

The voltage input connection for any external hardware trigger voltage is through pins 3 & 4 of the power connector. The DSA accepts a trigger voltage that is between +5 and +15Vdc at 6.5mA. A wiring diagram for the power/serial/trigger cable can be found in Section 4: Hardware. If a Power/Serial/Trigger cable (Scanivalve part number 156147) is supplied with the DSA5000, the BNC connect is provided for the trigger input (center positive).

DSA5000 has several options for external triggering, which is controlled by the variable: **TRIG**. The external trigger can be use in one of three ways:
1. Hardware Frame Trigger
2. Software Frame Trigger
3. Hardware Scan Trigger

Options 1 & 2: the "Frame Trigger" options allow an external trigger to release a single frame of data per pulse sensed by the DSA. This means for each trigger pulse (or software command) the DSA will return a single frame of data. The rate of which the data is output is based on this external pulse rate.

For optimal external frame triggering, the internal rate of the DSA should be set ≥25% higher than the external trigger rate. If a hardware trigger is being used, it must adhere to the DSA's trigger voltage requirement. A duty cycle of 50% is recommended, and the "low" voltage must be as close to 0Vdc as possible.

The software frame trigger is a command sent to the DSA that will release a one frame of data per command received. The trigger can be one of two commands; either a **TRIG** command or a <tab> character (9 Hex or Control I). This works similar to external hardware trigger.

Setting up an External Frame Trigger

To configure the DSA5000 to scan with an external frame trigger (hardware or software):
1. Set the variable **TRIG** to 1
2. Set the **RATE** variable to a rate that is approximately 25% or faster than the intended external trigger rate
3. Set the DSA into "scan" mode by sending the command: **SCAN**
4. Supply a trigger; either hardware trigger pulse or a software trigger. For each trigger pulse, the DSA will output a single frame of data to the configured destination

Option 3: the " Hardware Scan Trigger" option allows for a SCAN to be initiated using an external voltage. When the DSA senses that the trigger input level is "high" (5Vdc≤voltage≤15Vdc), the DSA will enter scan mode where it will scan and continuously collect data based on its set internal rate. The DSA will continue to scan at this rate until any of the following conditions are met:
- The trigger input level is switched to "low" (<5Vdc)
- The FPS variable is met (frames output = FPS)
- The scan is manually stopped by the user (software command or powering off the unit)

Setting up an External Scan Trigger

To configure the DSA5000 to scan with an external scan trigger:
1. Set the variable **TRIG** to 2
2. Set the **RATE** variable to the desired data collection rate
3. Supply a "high" voltage (5Vdc<voltage<15Vdc). The DSA will collect and output data at the defined rate until the trigger input voltage is lowered below the 5Vdc trigger threshold level.

Scan-on-Startup Option

When **TRIG** is set to 3, the scan-on-startup feature is enabled. This commands the DSA5000 to start scanning after the power up sequence has completed. The data output and destination for this feature must be set as FTP or UDP.

In the event that the FTP server is not ready to handle a connection from the DSA5000 during power up, the DSA will attempt to connect until it succeeds, a STOP command is received from the serial connection, or a STOP is received from the Ethernet connection. Once scanning is started, data output continues until a STOP is received, as described above.

Simply shutting off the DSA will stop the sending of data. Normally this will cause the FTP server to begin a time out

period waiting for data. After the time out period, the FTP server should close the connection, flush any unsaved data to disk and close the file. The time out period of the FTP server is usually configurable. FTP servers may vary in their operation so check your FTP server manual for settings.

For UDP output, the DSA will output data to the UDP configured destination until a STOP command is received from the serial or Ethernet connection, the FPS variable has been met, or the DSA is powered down.

Scan Data Output Methods

ASCII TCP Scan Data Transfer
The default method of ASCII data collection and transfer is configured using the default Telnet server (port 23) using a TCP client. Programs like ScanTel, HyperTerminal, or PuTTY can be used to display and collect the ASCII data to the screen or to a file. If an alternate data output is not enabled, and the **SCAN** command is sent to the Telnet port, the DSA will typically return data to the host from where the command was sent.

ASCII data can be formatted using the **FORMAT** variable under **LIST S**. The three formats available are:
- Unformatted, column based (scrolling)
- Formatted, VT100 terminal style (updating)
- Comma Separated Variable, CSV (scrolling)

Data output follows the specified ASCII packet structure listed in Section 5: Software.

Binary TCP Scan Data Transfer
The DSA5000 provides a binary TCP server designed to support any computer based TCP client, such as LabVIEW. All scan data transferred is in binary format. The structure of the binary packet sent from the binary server is expressed in Section 5: Software**.**

The Binary TCP server expects a connection on port 503. Only one connection instance to this server is allowed. Additional attempts to connect to port 503 when an existing connection is present will be refused.

Because all configuration settings may be handled via the Telnet server (port 23), the binary server only supports starting and stopping a scan. Sending the binary representation of the integer "1" will start a scan, and sending the binary representation of the integer "0" will stop the scan. The scanning will also stop if the FPS variable has been met, the DSA scan buffer overflows, or when the binary client disconnects from the DSA. The scan still adheres to the variables configured in the DSA; **RATE**, **FPS**, and **TRIG**.

FTP Scan Data Transfer
The DSA5000 can transfer scan data using FTP protocol to an applicable FTP server. The user may set up any suitable server or NAS capable of running as a FTP server.

When **FTP** is set to a non-zero value, and a scan is started, the software will attempt to connect and open a file on the FTP server as configured by the FTP variables. The time and date that is indicated by the **TIME** command is used in the construction of the file name.

The file that is saved on the server is assembled as follows:

<**FILEFTP** value><date>_<time>.<type>

Where <type> is:
- ".DAT" for binary
- ".TXT" for Unformatted ASCII
- ".CSV" for ASCII CSV

The file is closed when the scan stops. If the file cannot be opened on the server when the scan starts, the scan is stopped before any data is output and the DSA will report an error.

UDP Scan Data Transfer
The DSA5000 can transfer scan data using UDP protocol to an applicable UDP client. The user may set up any suitable UDP client for this operation. Data output follows the specified packet structure listed in Section 5: Software.

UDP output supports a multicast address following the standard UDP multicast address group, using a UDP address of 224.0.0.0 through 239.255.255.255 and any valid port.

IEEE1588v2 Precision Time Protocol

The DSA5000 is compliant with IEEE1588v2 Precision Time Protocol (PTP). The DSA's PTP engine can be configured as follows:
- Disabled
- Enabled as a PTP slave module

When configured as a PTP slave module, the DSA will listen for PTPv2 packets being multicasted on the network. This allows for the DSA's internal time and date to be set and synchronized when a PTP Grandmaster is active on the same network. This synchronization will also adjust the internal scan rate of the module to pace with the PTP Grandmaster time.

Note: Only one PTP Grandmaster or PTP master can be present on a network at any given time, unless unique domains are specified.

When the DSA's PTP engine is disabled, the DSA's time and date can be manually set using the **TIME** command. The time in the DSA5000 when not synchronized with a PTP Grandmaster can be thought of as "naive time."

Other PTP related commands, including PTP statistical information, debug output, and setting the UTC offset to correct for time zones, can be referenced in the PTP Commands section under Section 5: Software.

PTP TRIGGERED SCAN
The IEEE1588 protocol allows DSA5000 units to start scanning at a preset time and date while keeping their data samples time synchronized. This allows a user to synchronize the scan start time across multiple units. A scan start time and date in the future can be configured in the DSA5000 using the Scan Start Date (**SSD**) and Scan Start Time (**SST**) variables. After a **SCAN** command is issued, the DSA will enter scan mode but will not output data. Once the **SST** and **SSD** time has been met (based on the internal time of the DSA), the time will trigger the DSA to start releasing frames of data at the set internal rate. If **SST** and **SSD** are set for a time in the past (based on the internal time of the DSA), a **SCAN** command will execute a scan and the DSA will release data immediately.

The following table describes a start scan time with two DSA5000 units when setting SSD and SST for a time in the future.

Two (2) DSA5000s configured with: SST = 12:00:00, SSD = 2021/2/10, RATE = 1Hz						
1588 Date (hh:mm:ss)	1588 Time (YYYY/MM/DD)	Event	DSA 1 Frame #	DSA 2 Frame #	DSA 1 PTP Time Stamp (seconds)	DSA 2 PTP Time Stamp (seconds)
11:59:55	2021/2/10	SCAN to DSA 1				
11:59:56	2021/2/10					
11:59:57	2021/2/10	SCAN to DSA 2				
11:59:58	2021/2/10					
11:59:59	2021/2/10					
12:00:00	2021/2/10					
12:00:01	2021/2/10		1	1	1612987201	1612987201
12:00:02	2021/2/10		2	2	1612987202	1612987202
12:00:03	2021/2/10		3	3	1612987203	1612987203

Note: Due to high scan rate ability and the high-accuracy of PTP time stamps, it is possible to have a scan start variance of up to 125us when using SST/SSD to start data sampling. While the scan may not start exactly on the time requested,

the PTP timestamps in the frame of data will reflect the exact time the data was sampled.

The following table describes a start scan time with two DSA5000 units when SSD and SST are a time in the past.

Two (2) DSA5000s configured with: SST = 12:00:00, SSD = 2021/2/10, RATE = 1Hz						
1588 Date (hh:mm:ss)	1588 Time (YYYY/MM/DD)	Event	DSA 1 Frame #	DSA 2 Frame #	DSA 1 PTP Time Stamp (seconds)	DSA 2 PTP Time Stamp (seconds)
12:59:55	2021/2/10	SCAN to DSA 1				
12:59:56	2021/2/10		1		1612990796	
12:59:57	2021/2/10	SCAN to DSA 2	2		1612990797	
12:59:58	2021/2/10		3	1	1612990798	1612990798
12:59:59	2021/2/10		4	2	1612990799	1612990799
1:00:00	2021/2/10		5	3	1612990800	1612990800

ZERO OFFSET CALIBRATIONS

The DSA's internal calibration valve incorporates a zero offset correction feature (Quick Zero). This feature provides a simple and quick means to correct for the minor zero drift problems inherent to piezoresistive sensors. Even with pressure applied to the Px ports, the calibration valve can be configured into Calibrate mode, providing a pressure to be exposed to the positive and negative side of all transducers. At that point, with the sensor at its natural zero state, any offset can be read and recorded. This can then be factored into the engineering unit conversion and mathematically removed. Quick Zero calibrations can be performed in under 10 seconds.

Due to the nature of the piezoresistive sensors used in the DSA modules, it is recommended that a quick zero calibration be performed at least daily. Performing a quick zero more often will not cause any problems and is highly encouraged. There are no issues using the quick zero calibration each time before data is collected. Keep in mind, if the temperature of the module changes more than 5°C, a fresh quick zero should be performed.

Zero offset corrections may become obsolete after several hours or after the module has changed temperatures. While the deltas can be saved through a power cycle, changes in the environment may cause the deltas to be obsolete.

DIFFERENTIAL MODULES
For differential modules, a quick zero offset calibration can

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be executed using the simple command: **CALZ**.

In order for the calibration valve to successfully switch and place the module into Calibrate mode, 90-120 psi clean, dry instrument grade control pressure air must be supplied to the CTL SUPPLY port. In the modules default configuration, the internal solenoids will automatically switch the valve state to Calibrate mode before the internal calibration is performed. If control pressure is not applied, the DSA will remain in Measurement (PX) mode when the **CALZ** is executed.

For typical zero offset correction operation, the CAL and REF ports on the module be plumbed to the same static location. For modules with a 15psi range or lower, the CAL and REF lines should be terminated in a dampened static environment using a static bottle or similar.
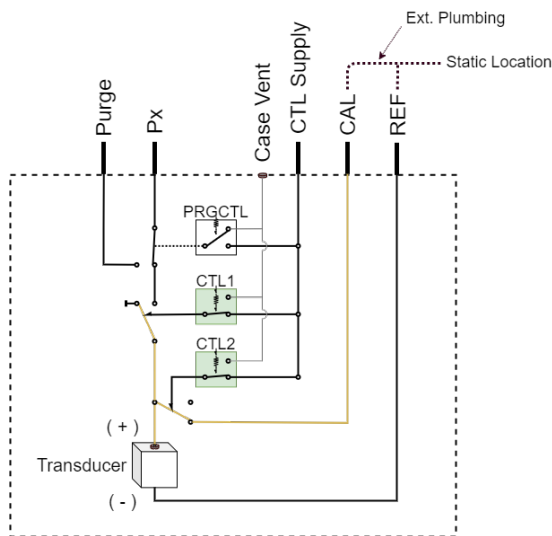
FIGURE 3.6 - STANDARD CALZ VALVE LOGIC (NC)

If it is not desired to switch to Calibrate mode when performing a **CALZ**, the alternate command **MCALZ** can be performed. When **MCALZ** is used, a quick-zero offset will be performed in the current valve state of the module and will not switch the internal solenoids. Note that if pressure is applied to the transducers in this state, the DSA will assume that the pressure during the **MCALZ** is "zero."

Once a **CALZ** has been issued, the DSA will save the results of the **CALZ** in **LIST DELTA** and apply these corrections. The corrections in **LIST DELTA** are updated with every **CALZ** command issued. These deltas can be disabled at any time. The deltas created by **CALZ** can also be maintained through a power cycle. These settings are controlled with the **CALZ** variable.

ABSOLUTE MODULES

Absolute pressure modules have a similar zero offset correction feature. The command **CALB** can be issued, followed by the current known barometric pressure to perform a zero offset calibration of absolute pressure sensors. Calibrate zero barometric follows many of the same guidelines as the **CALZ** command.
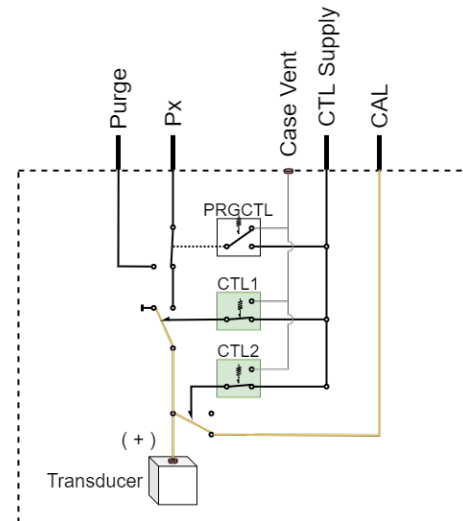
FIGURE 3.7 - ABSOLUTE CALB VALVE LOGIC

More information on both the **CALZ** and the **CALB** software commands can be found in Section 5: Software.

Note: Absolute All-Media builds do not include a valve and do not use control pressure. All CALB commands are performed in 'measurement mode'.

GAUGE MODULES

For gauge modules, a quick zero offset calibration can be executed using the **CALZ** or **MCALZ** command. Gauge sensors are only found in All-Media builds and do not contain internal valving. All zero-corrections are performed in measurement mode.

PURGING

All Gas DSA modules incorporate an internal calibration valve that allows the user the ability to purge the input lines connected to the DSA. One of the configurations of this valve allows for an 'isolate-purge' feature. This permits the pressure measurement (Px) lines to be purged with pressures beyond the full-scale pressure range of the unit. This is a very useful feature when the DSA module is used in applications where corrosive gasses, dust, debris, or moisture may be present in the input lines. By isolating the pressure sensors from the purge pressure, purge pressure can be applied through the module to clear the input lines and keep the sensors free of any damaging media.

Purge pressures used typically should not exceed 5 times the pressure range of the module or 100psig, whichever is less. Note that 100psig can be to static, ambient pressure, or 100psig higher than the input test pressure. For example if the incoming pressure to the inputs is 100psi, 200psi could be used to purge. The maximum pressure that the DSA5000 can handle for purging is 500psia.

It is generally recommended that purging be performed with lower pressure for longer durations, rather than higher pressure for shorter durations. Empirical testing is the best way to determine the required purge pressure and duration as all applications will be unique.

In order to configure the DSA module for purge mode 90-120 psi of clean, dry instrument grade control pressure air must be applied to the CTL SUPPLY port prior to purging. An automated purging sequence is added in the DSA firmware to carry out purge functions. The **PURGE** command will carry out the steps and valve changes required for typical purging. Additional variables are required to be set to control dwell times and purge time, which can be found under **LIST V.**

If required, purging can be accomplished manually using commands to change the valve state of the DSA module for proper purge sequencing. **The Purge sequence must be established in a set order to protect the sensor and calibration modules from damage.**

CAUTION! Modules that use the Quick-Coupler 063 fitting kit must **NEVER** purge the inputs when no tubing is connected. Without tubing, purge pressures may cause parts to blow free of the fitting.

Configuring for purging:
1. Set the calibration valve for isolate and calibration mode by issuing the command: **VALVE CAL**. Allow time for the control pressure change to settle.
2. Set the calibration valve for purge mode by issuing the command: **VALVE PRG**. Allow time for the control pressure change to settle.
3. Apply purge pressure to the PRG port and purge for the intended duration.

Re-configuring after a purge:
1. Shut off the purge pressure feeding the PRG port. Allow sufficient time for the input lines to stabilize. The specific time required will depend upon the physical layout and characteristics of the system.
2. Set the calibration valve back to calibration mode first by issuing the command: **VALVE CAL**. Allow time for the control pressure change to settle.
3. Set the calibration valve back to measurement mode by issuing the command: **VALVE PX**. Allow time for the control pressure change to settle.

CAUTION! Failing to follow the above procedure while entering or exiting the purge mode could allow the sensors to see the high purge pressure and could cause damage.

FREON APPLICATION OPERATIONS

When using DSA5000 gas modules in Freon Applications, special considerations must be taken. In order to prevent premature deformation of the seals within the DSA5000's valve, it is important to leave the module in the following 'dormant' state.

- Apply control pressure and issue the commands: **VALVE FRE**
- Ensure no Px pressures are applied
- Freon present must be vaporized

Any time the module will be left inactive for a significant period of time it should be left in this state. Adhering to this procedure will help ensure long life and prevent any premature maintenance requirements.

This is not required in All-Media builds.

HEATER OPERATION

DSA5000 modules can include integrated heaters for use in applications where the ambient temperature will drop below 0°C. The added heater allows DSA5000 modules to be used safely and accurately in environments with temperatures down to -60°C.

The primary purpose of the integrated heater is to auto-regulate the internal temperature of the module so that the pressure sensors stay within the compensated temperature range (0°C to 70°C). All regulation is handled internally and automatically using two cartridge heaters, an isolated RTD with built-in protection circuit, and a digital control loop. The heater control function is built in to the DSA5000's firmware and uses the sensor temperature, in combination with the isolated RTD temperature, to

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proportionally control the amount of power being supplied to the heater cartridges.

Heater auto operation is set using the command: **HEATER**. The command allows the user to disable or enable the heater function. When enabled, the DSA5000 uses the configured set point as a marker for heating regulation. When the temperature of the module drops below the set point, the DSA5000 will auto-regulate the needed power to the heaters to increase and maintain a temperature near the set point.

The set temperature point for the heater is relative and not an accurate representation of the ambient temperature. The goal of the heater is to regulate the temperature internal to the module to be within the sensors compensated range. The module may never reach the set point accurately.

The ability to regulate and maintain the internal temperature of the DSA5000 is dependent on a number of factors which include the modules power input (Vdc), ambient temperature and stability, and the internal set point. At colder ambient temperatures, the DSA5000 may not be able to reach the configured set point, but still has the ability to keep the temperature of the sensors in the compensated range, which is the primary function.

More information on the **HEATER** command and response can be found in Section 5: Software.

MINIMUM OPERATING TEMPERATURE
The minimum temperature at which the DSA5000 can be used with the heaters is -60°C when using the power requirements of 24-36Vdc. Information on total power consumption can be found in Section 4: Hardware. In situations where the available DC voltage is lower than the specified required range, the heater can still be utilized with reduced minimum operational temperature. Figure 3.8 shows the minimum operating temperature of the DSA5000 with a heater based on the supplied DC voltage.
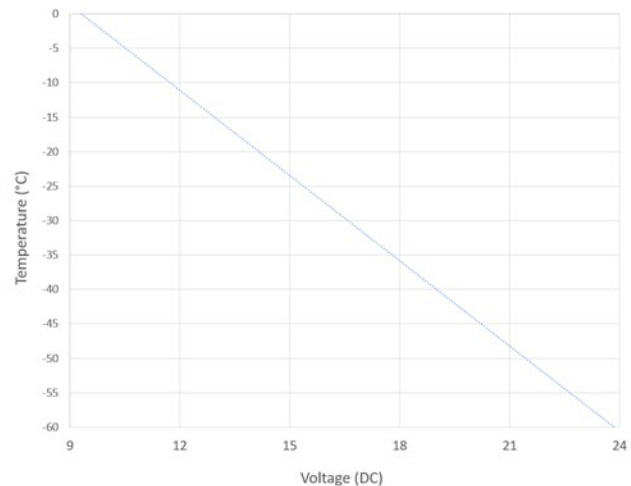
FIGURE 3.8 - MINIMUM OPERATING TEMPERATURE

The following equation can be used to find the approximate minimum operating temperature based on the DC voltage when the voltage is less than 24Vdc:

$$\text{Minimum Temp (°C)} = -4.1274x + 38.467$$

Where x is the DC voltage supplied.

Any supplied voltage between 24Vdc and 36Vdc have the same minimum operating temperature of -60°C.

HEATER AND MODULE PROTECTION
If the internal temperature exceeds approximately 75°C, the heater circuit will shut down power to the heaters to prevent overheating of the module. If this happens, the DSA5000 must cool down at least 15°C before the heater can be used again.

The heater controller board also utilizes a ceramic slow-blow fuse (125V, 5A, 6.1mm x 2.69mm x 2.69mm) for circuit protection.

WEB SERVER

The DSA5000 is equipped with a single user Web Server application which provides a simple method for communication, configurations, and operations from virtually any host computer. The Web Server requires no additional software be installed on the host computer and provides a simple graphical interface for the user to upload coefficient files, update the firmware, or change and save settings.
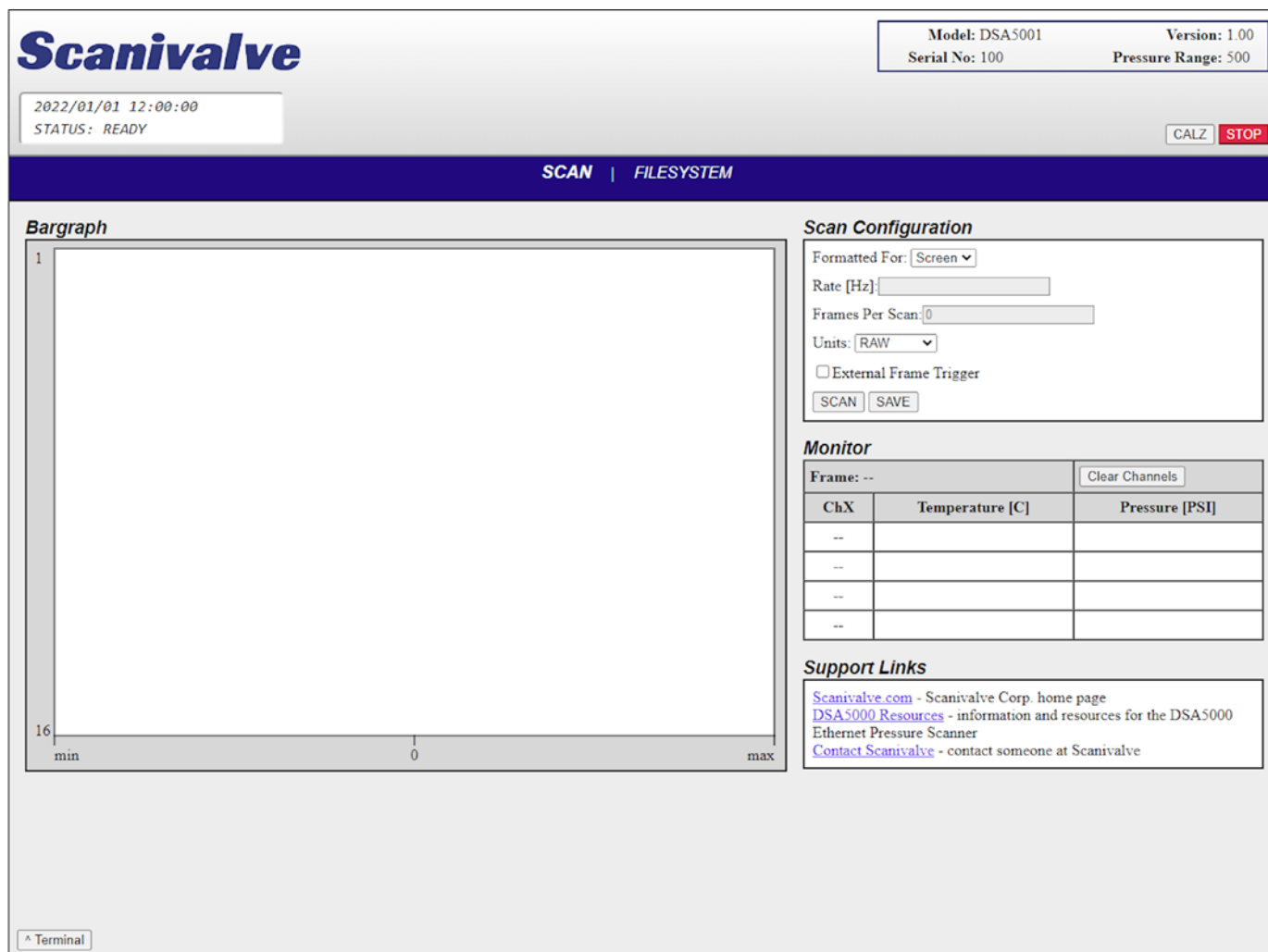
FIGURE 3.9 - WEB SERVER HOME SCREEN

The Web Server has been tested with several web browsers to verify functionality and compatibility. Those that were tested are:

Google Chrome
Microsoft Edge
Mozilla Firefox

To connect to the DSA5000's Web Server, simply open one of the supported browsers and enter the DSA's IP address into the address bar. Once connected, the Web Server's Home screen will be displayed as shown in figure 3.8.

Basic module information will be displayed in the top right corner of the window. This will include the model number and current firmware version.

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WEB SERVER: MAIN DISPLAY

The top portion of the Web Server is the "Main Display." This display will remain constant through all pages of the Web Server. This display provides information about the module, universal functions, and a status window that will display the current status, time and date in the DSA. The main display is updated once per second to reflect the most current status of the DSA.
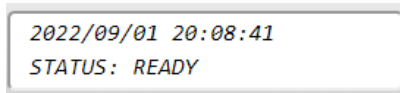
    -- This area shows the DSA's date and time, and current status.

    -- This area shows information about the module, including:
- Model Number
- Firmware Version
- Serial Number
- Nominal Pressure Range (in PSI)
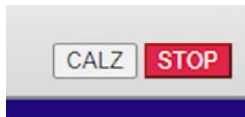
    -- This area contain universal functions that can be run from any page.
       STOP   - This button can be used to stop any function in the DSA, including scans.
       CALZ   - This button will initiate a CALZ (zero offset correction).

The main display also provides the links to the other pages available in the Web Server:
SCAN and **FILESYSTEM**.
Each of these pages will be discussed in the following sub-sections.

The bottom of each page will contain a "Terminal" pop-up option. This button will enable a terminal emulator window that is available on any page. This allows the user to send command-line based commands to the DSA module, similar to using ScanTel, HyperTerminal, or PuTTY. Most commands are accepted via the Terminal.

Once the window has been opened, the information in the terminal can be cleared with the "Clear" button. The "v Minimize" button will hide the terminal from the screen.

The terminal is available on all pages in the DSA web server. If the terminal is open, it will stay open when navigating between pages.

Note: the PROMPT variable does not effect the response in the terminal.

WEB SERVER: SCAN

The Scan page is used for configuring the scan data, displaying scan data to the screen, or collecting scan data to a file. *Note: This page will be disabled for any module operating in an SSEP network (controller or responder) or in emulation mode.*
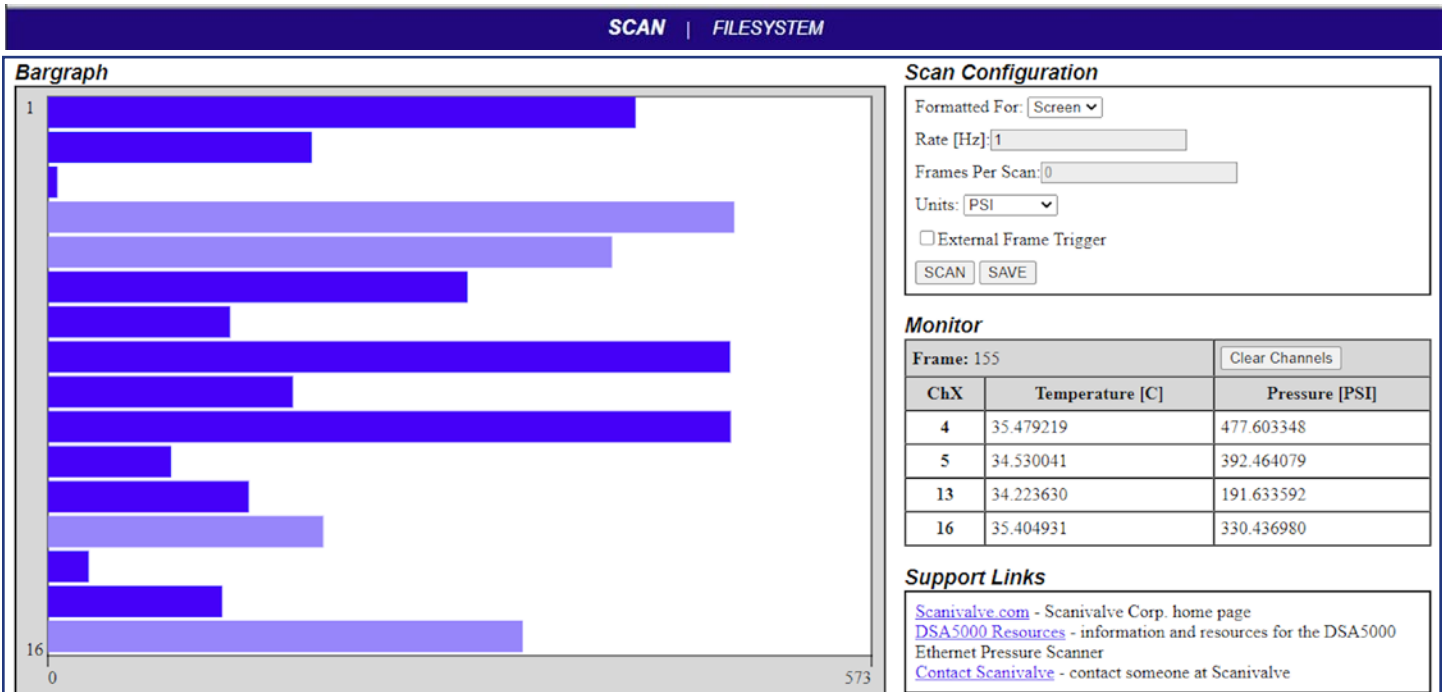
BARGRAPH -- This area of the Scan page can display pressure data for each channel in the DSA when scanning. Data will only be displayed if "Formatted For:" is set to "Screen."

The X-Axis will auto-scale based on the highest pressure value from the channels, and will always display a "0.000". The max and min values will always scale 20% higher than the highest measured pressure value from any channel. The units are based on the "Units:" setting.

The bar graph will only update at 2Hz, regardless of the set Rate in the DSA. Each of the blue bars represents one channel, starting with channel 1 at the top of the graph and channel 16 at the bottom.
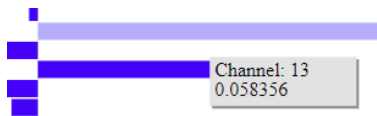
Hovering the mouse over a bar will display the channel number and pressure value (based on the "Units:" setting).

Clicking on a bar (channel) will highlight this channel (light blue) and report that channel's pressure and temperature value in the right hand table in the Monitor Section.

SCAN CONFIGURATION -- This area of the Scan page allows for the scan configuration variable to be set when collecting data in the web server.

Formatted For: This selection will direct the collected data to a destination in the selected format.

-- Screen. This will display the scan data in the web server Bar Graph and Monitor table.

-- CSV. This will collect and format the data in ASCII CSV format. The file will be auto-downloaded.

-- TXT. This will collect and format the data in ASCII scrolling format. The file will be auto-downloaded.

-- DAT. This will collect and format the data in Binary format. The file will be auto-downloaded and must be converted in a separate software program (such as ScanTel).

Note: Screen and ASCII formats are limited to scan rates of 100Hz or less. Binary is limited to 1000Hz.

Rate [Hz]: This the scan rate, expressed in Hz.

Frames Per Scan: This is the setting for frames per scan (FPS variable). *"0" cannot be used when scanning to a file.*

Units: This sets the Engineering Units used for the pressure data.

External Frame Trigger: This will enable the use of an external frame trigger. See external triggering for more information. Scan triggering is not possible in the webserver.

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WEB SERVER: SCAN (CONT.)

Note: This page will be disabled for any module operating in an SSEP network (controller or responder) or in emulation mode. The pop-up terminal is always accessible.

SCAN BUTTON -- The SCAN button can be used to initiate data collection from the DSA. The scan will adhere to the configuration settings (Format, Rate, FPS, Units, External Triggering).

When in SCAN mode, the status bar at the top will report STATUS: SCAN. All buttons (except STOP) and fields will be disabled until the scan has completed. Use the STOP button to interrupt any scan and return the DSA to ready mode.

SAVE BUTTON -- The SAVE button can be used to save the current scan configuration settings to the DSA memory.

Note: when changing the Scan Configuration variables, it will not set the variables in **LIST S**. These settings are only applied to Web Server scans. The settings in **LIST S** will be maintained unless the SAVE button is used.

MONITOR -- This area provides scan information when the scan data is formatted for the screen. The following data will be displayed:

Frame: The current frame number for the displayed data.

ChX: When a channel is selected in the bar graph, the channel number will display in this column.

Temperature [C]: Table to hold up to 4 channels of sensor temperature data. This table will start blank until channels are selected in the bar graph. When a bar or channel is selected, the bar will turn light blue and the temperature value will be displayed in this column.

Pressure [UNITS]: Table to hold up to 4 channels of pressure data. This table will start blank until channels are selected in the bar graph. When a bar or channel is selected, the bar will turn light blue and the pressure value will be displayed in this column. The units will be set by the Units setting.

Only 4 channels can be selected at a time. In order to select different channels, the current selected channels must be cleared with the "Clear Channels" button.

SUPPORT LINKS-- This section provides links that will direct to different resources on the Scanivalve website. These pages can provide general information, DSA5000 resources (such as links to download manuals or data sheets), and a link to Scanivalve's contact form.

Note: These hyperlinks will only work successfully if an internet connection is available.

WEB SERVER: FILE BROWSER

The File Browser page is used to view files stored in the DSA, edit and save configuration files, upload files, and update the DSA's firmware.

FILESYSTEM

Filesystem

Filename	Size	Download	Delete
Dsa.cfg	267B	⬇	🗑
0_96_135.dsa	2097168B	⬇	🗑
Cal_11.cfg	11393B	⬇	🗑
lp.cfg	66B	⬇	🗑

Upload File

[Choose File] No file chosen   [Upload]

This section displays all files that are currently in the DSA's memory. There is also a section where files can be uploaded.

FILENAME -- This column displays the names of the files.
SIZE -- This column displays the size of the file in bytes (B).
DOWNLOAD -- This column provides a link that will initiate a download of a file to the host computer.
DELETE -- This column provides a link that will delete a file.

Only .cfg, .emu, and .dsa (DSA application) files will be displayed in this table. All cfg files contain DSA settings, including the IP address. Deleting these files may have adverse effects.

All files can be double clicked to activate a function:
CONFIG (.cfg) FILES -- When a file is double clicked, it will open the file as a "text editor" in the adjacent console. The contents of this file will be displayed. This file can be edited, saved, and loaded in the console. Remember that editing or changing these files may have adverse effects.

EMULATOR (.emu) FILES -- When a file is double clicked, it will open the file as a "text editor" in the adjacent console. The contents of this file will be displayed. This file can be edited, saved, and loaded in the console. This file can only be created or saved if EMULATE is not zero.

APPLICATION (.dsa) FILE -- When the .dsa file is double clicked, a dialog box will appear. Double clicking will begin a firmware update. Press OK to continue or CANCEL to cancel. Once firmware has been updated, this file may be deleted. This file does not have to be stored on the DSA for operation. Note that the name of the file is the firmware version string.

File Viewer

Filename: [_____]   [Load] [Save]

FILE VIEWER -- This window will allow you to view or edit coefficients tables or configuration files.

FILENAME -- This field will display the filename of the script file. Filenames must include the file extension. The filename cannot exceed 32 characters and cannot contain spaces.

LOAD -- This button is used to load the current selected file into temporary memory (for applying new settings or new coefficients).

SAVE -- This button is used to save the file being created or edited.

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SCANIVALVE SYNCHRONOUS ETHERNET

OVERVIEW

Scanivalve Synchronous Ethernet Protocol (SSEP) is a proprietary communication protocol developed for Scanivalve's 5000 series measurement instrumentation. The engineering behind SSEP was developed around industrial or "real-time" Ethernet, and provides the benefits of the "real-time" processing to achieve module discovery, parameterization, delay correction, synchronization, and data processing.

This protocol allows for multiple Scanivalve 5000 series scanners to operate on a small, isolated network of modules. The SSEP architecture operates where a 'controller' module communicates, orchestrates, synchronizes, and organizes data from all discovered 'responder' modules connected in the isolated network. This real-time processing and control performs all timing correction and data processing as the modules are busy collecting pressure or temperature data.

SSEP in the DSA5000 allows a user to connect many Scanivalve 5000 series modules together in a line type architecture. The connection between modules uses the SSEP Input and Output connections. These connections use a standard M8, 4-pin, A Code Ethernet cable. Standard Ethernet (IEEE 802.3, etc.) can not be input or output from these ports. These connections will only support connections to other Scanivalve 5000 series modules.

When SSEP is used, the user must only connect and communicate with the single 'controller' module using the Gigabit Ethernet connection and a client. The 'controller' module will detect all 5000 series modules connected to the SSEP connectors. The 'controller' essentially becomes the control hub of the isolated network and performs the following duties:

- Auto-discovers all modules in the SSEP network and monitors their connections
- Configures all settings in each connected and discovered module
- Orchestrates Scanning, CALZs, and other main functions
- Collects, processes, organizes, and synchronizes all scan data output from the connected modules and organizes the data packet before outputting the data to the Gigabit Ethernet connection
- Compensates for latency, jitter, and cycle time when synchronizing the scan data from 'responder' modules

Using SSEP with Scanivalve 5000 modules provides an easy way to collect synchronous data from multiple modules, with the ease of controlling the system and receiving the data from a single 'controller' module - turning multiple modules into a single high-channel count measurement module.

* SSEP is not available on iDDS builds.
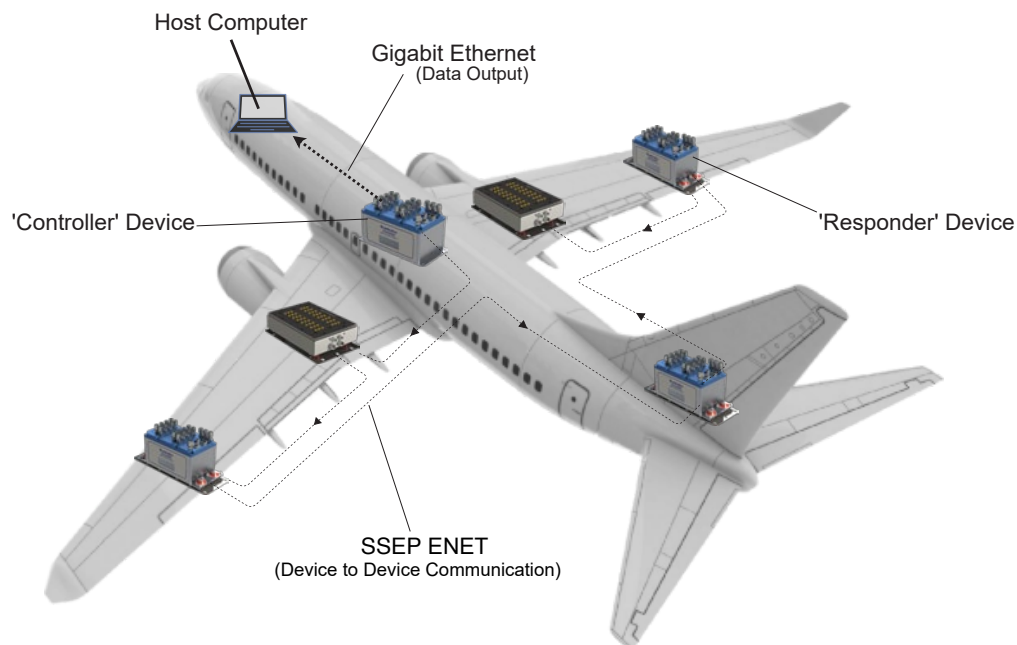
FIGURE 3.9 - SCANIVALVE SYNCHRONOUS ETHERNET ARCHITECTURE

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SSEP TOPOLOGY

Scanivalve Synchronous Ethernet Protocol (SSEP) supports a 'line' network topology. This allows modules to be daisy-chained together. Once multiple modules are physically connected together through the SSEP connections, it is referred to as an 'SSEP system'. An SSEP system consists of one (1) controller and at least one (1) responder. While the controller requires power, Gigabit Ethernet, and SSEP Ethernet connections, responders only require Power and any applicable SSEP connections. A Gigabit Ethernet cable or connection is not required.

The SSEP IN and OUT (I/O) connections are M8, 4-pin, A-Code connectors. These connections can not be used for any alternate method of communication with the modules. See Section 4: Hardware for more information on the physical connections.

The SSEP system connections start at the controller module. The controller module's SSEP Out port is used to send traffic to and from found responders. The SSEP In port is not utilized on a controller.

For the first responder in the SSEP system, the controller's SSEP Out port must be connected to the first responder's SSEP In port. This would allow for two (2) total modules in an SSEP system, replicating a single 32-channel module.

If additional responders are added to the system, the SSEP network connection from one responder to the next follows the same pattern:

> Responder *n* SSEP Out port is connected to responder *n*+1 SSEP In port.

The last responder in the network typically will not have a physical connection at the SSEP Out port. No return cabling is needed from the SSEP Out port of the last responder to any other module.

Note: As of version 1.05, only eight (8) total modules are supported in an SSEP System (one controller, seven responders).

SSEP MODULE ASSIGNMENT

All 5000 Series module are shipped, by default, to act as a standalone module. This means that a module will operate as a singular module as outlined in this manual, and ignore all information at the SSEP I/O. For SSEP operation, modules must be assigned to an SSEP mode for the SSEP architecture to be possible. Module assignment is assigned automatically or manually.

The module assignment or method is determined by the variable: **SSEP**. This setting allows for the automatic or manual SSEP assignment of each module. There are four (4) assignments, or modes, that can exist in a 5000 module:

- Standalone Mode: The module acts and behaves and a standalone or singular module. All SSEP activity is suspended, which includes the ability to listen at the SSEP In and Out connections. The module will ignore any data, connections, or activity at these ports.

  This mode can be used for single module use, independent of the physical SSEP I/O ports. It can also be used as a means to troubleshoot modules that are currently connected in an SSEP network.

- Controller Mode: The module behaves as an SSEP controller. It duties include discovering other SSEP enabled modules, configuration, control, synchronization and data merging for all discovered responders.

  When this mode is manually forced, it will deactivate the SSEP In port. It will ignore any data, connections, or activity at this port.

- Responder Mode: The module behaves as an SSEP responder. Its duties are to listen and respond to requests made by a controller module (if one exists). It will return any status information, settings, or scan data to the controller as requested.

  When Middle Responder mode is forced, both ports will be active and listening. When Last Responder mode is forced, only the SSEP In will be listening and the SSEP Out port is deactivated and will ignore any data, connections, or activity at this port.

  Last Responder mode can be used to limit the number of modules used in an SSEP network even if they are physically connected. For example, if eight (8) total modules are connected in an SSEP system, responder number 3 can be set to SSEP 4) Last Responder), which will break the SSEP Out connection and result in an SSEP system with one (1) controller and three (3) responders, and all downstream modules beyond responder 3 are ignored.

  Note: When a module is in any responder mode, control functions at the local module are disabled and will result in an Error. This includes Scan and Calz. If a responder needs to be used as a standalone module, it must be forced.

AUTOMATIC ASSIGNMENT
Not Implemented

Modules will automatically determine their assignment based on the SSEP ports at the module, and whether an SSEP network is present or not. For this operation, the SSEP variable must be set to 0.

For example, if a module's SSEP variable is set to 0, and an active connection is found at both the SSEP In and Out ports, the module will be assigned to a Responder automatically. If a connection is removed, it will attempt to change assignment.

MANUAL ASSIGNMENT

Modules SSEP assignment can be manually assigned. Doing so will force the module to deactivate or activate the SSEP physical ports, regardless of the current activity or state of the connections. This will force a module to act as the designated assignment.

Example: if a module has an active connection at both the SSEP In and Out ports, but SSEP is set to 1, this will deactivate both ports and force the module to Standalone mode. This module will ignore all information at the SSEP connections. Even if the module is physically connected via SSEP to a controller, the controller will not be able to locate the module.

SSEP MODULE DISCOVERY

Module discovery is only handled by the controller in an SSEP network. A controllers duty is to locate any modules connected via SSEP, designate these modules as responders, and index the responders with a value based on where they are connected in the SSEP network. The discovery process is automatic and is triggered by multiple events, which include:

- Any time a module is powered on and boots as a controller (will start discovery when READY).
- Any time a module's assignment changes from non-controller to controller.
- Any time there is a detected change in the SSEP network connections i.e., a new module is added to the end of an existing SSEP network, or a module is disconnected from an existing SSEP network.
- Any time a controller detects a new module i.e., a previously connected responder is powered on/off or a previously connected module's assignment changes from non-responder to responder.

The discovery process is disabled when a module is in non-ready mode. If a module returns from ready from any other mode, the discovery process will start.

SSEP MODULE CONFIGURATION

SSEP configuration is the process of the controller module configuring or updating all discovered responders in the SSEP network without user intervention. This auto-configuration makes operation transparent between the use of a single module, or a controller in an SSEP network.

There are only four (4) variables that a controller will set in responders. Those variables are:
RATE
CALZ
UNITS
VALVE

All other controller variables are not sent to the responders as they do not affect SSEP operation.

There are many events that will trigger an auto-configuration routine or responder update. However, the responder updates will take different actions depending on the event that triggers them.

All events that trigger the discovery process will trigger a "full" responder update. This means that all configuration variables current in the controller will be sent to all responder modules, with the exception of the valve state (**VALVE**).

Example: if a controller has the following settings:
RATE 5
CALZ 1
UNITS PSI

Anytime a discovery event is detected, the controller will configure all responders found with its current settings.

When any of these variables are changed in the controller, a "partial" responder update will be triggered. The partial responder update will only update the variable that was modified in the controller.

Example: if the controller has the same settings as the previous example, but **RATE** is changed to 10, it will trigger the partial responder update to only update **RATE 10** in all responders.

Note: Changing the valve state is the only method that will update the valve state on all discovered SSEP modules. Changing the valve state of the controller will also force the valvestate in all found responders to follow the change. Discovery events or full responder updates will not change the valve state of responders.

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Due to the constant monitoring of responders on the network, the controller will also detect if a variable is inadvertently changed in a responder module and reissue the responder update.

Example: if a user were to make a Gigabit Ethernet connection to a responder in an SSEP network, and change the RATE setting in the responder, the controller detects the change and auto-update the responders.

Note: Responders variables should not be changed during normal SSEP operations. For troubleshooting tips, see SSEP Troubleshooting.

SSEP MODULE CONTROL

In a configured SSEP system, the controller is responsible for controlling all found responders as required. Control relates to certain function commands that initiate or execute a function, like scanning. Module control commands include **SCAN**, **STOP**, and all variations of the **CALZ** / **CALB** commands.

SSEP SCANNING

Configuring and executing a scan in an SSEP system is nearly identical to scanning a single module. All scan settings, data output routing, and scan options - including hardware and software triggering, and IEEE1588 PTP - are available and follow the same guidelines as single module, or standalone, use. Only the controller must be configured according to the end-use application.

The major differences / limitations when SSEP are in use are as follows:

- Binary data format is the only supported method of data output. ASCII data output is not supported. Binary data can still be routed to a TCP, UDP, or FTP destination.

- Scan Rates are limited to the total number of modules on the network. Currently, 1000Hz is supported with up to eight (8) total modules; one controller, seven (7) responders.

- The binary data packet becomes dynamic based on the total number of modules in the SSEP system at the start of a scan. The header of the binary packet will include information on how many modules are included in the data. This can be used to adjust for the total binary packet size and parsing purposes. See the Binary Data packet Table 5.1 and 5.2 for more information.

- In the event that a responder is lost by the controller during a scan, the scan will be terminated and return all modules to ready. Losing a responder can include a responder being powered off, a SSEP cable being connected/disconnect, or a responder becoming unresponsive. If a scan is terminated because of this, an error is reported by the controller and the discovery process will update the responders found in the system.

- If IEEE1588 PTP is to be used with an SSEP system, only the controller must be enabled as a PTP Slave module. When PTP is enabled, the PTP Grandmaster will govern the internal clock of the controller, which will drive the synchronization of all responders in the SSEP network. SSEP is sensitive to PTP instability, and requires PTP to be stable and jitter free in order to operate correctly. In the event of PTP instability during a Scan, the scan will terminated and the SSEP system returned to ready. An error will be output if PTP instability was the source of the scan stoppage.

- Due to nature of the internal SSEP synchronization, frame triggering will not trigger a single sample, and instead will output the next available frame of data. When a scan is executed, data is passed between modules in the SSEP network before they get back to the responder. When a trigger is sensed, the controller must gather this frame from all responders which can take the interval of 1/RATE. This means that the next sampled frame is what is output rather than the frame at the trigger.

  The workaround to alleviating triggering delays in this architecture is configuring the controller with a higher internal rate to increase the resolution of the next sampled frame method. The higher the rate set in the controller, the more accurate the trigger time and data output based on that trigger will be.

For more information on scanning, please see Section 3: Scanning.

SSEP QUICK-ZERO CALIBRATION (CALZ)

Performing a quick-zero offset calibration (CALZ) in differential modules, or a barometric offset calibration (CALB) in absolute modules is available to be used in the SSEP network. Once the controller receives the command to perform the zero-offset correction, all modules will enter CALZ mode and perform the zero calibration. When all modules are completed, the controller will revert to ready mode.

CALZ, MCALZ, CALB, and MCALB operate the same as a standalone module including automatic valve control and

accepting the correct process based on the configuration of the module: CALZ/MCALZ only performs a offset calibration on differential modules, and CALB/MCALB only performs a barometric calibration on absolute modules.

In an SSEP network, a controller will accept any CALZ command to control all SSEP modules - not just limited to the pressure type of the controller. However, if the module is not configured as the correct pressure type for the command received, it will not populate correction values.

Example: in a mixed system comprised of half absolute and half differential modules, the controller will accept a CALZ and all modules will enter CALZ mode. Only the differential modules will perform the calibration, and all absolute modules will do nothing. The controller will also accept the CALB command and will enter CALZ mode, but only the absolute modules will perform the calibration.

For any mixed system of pressure types, both commands must be sent for a proper zero offset calibration.

For more information on zero offset calibrations, please see Section 3: Zero Offset Calibrations.

SSEP TROUBLESHOOTING

There are several utility commands for the SSEP system for general use or troubleshooting.

SSEP UTILITY COMMANDS

There are two main commands that can be used to provide more information about the current SSEP system. Detailed information on the command syntax, response, and notes can be found in Section 5: SSEP Commands. This section will explain general use cases of the command.

LIST SYS

This command can be used at any module to show the current SSEP system that is detected. Anytime this command is issued to a non-controller module, the response will only include information about itself. Anytime this command is issued at a controller module, the current discovered SSEP system is output, which includes all responders found, along with general information about each module.

Information provided by the **LIST SYS** command includes the designated index number, which is the designated SSEP address for each module. Address "0" is always the module that receives the command. Module's indexed in this list are listed in the order they are connected. You will also find each module's setting for Model, Serial Number (SN), Nominal Pressure Range (NPR) and Label.

This command can be used to confirm the current connected system, located and identify modules in the binary packet, and prepare for the data being transmitted by the controller.

LIST SYS *

This command is an alternate version of the previously discussed **LIST SYS** command. Using the asterisk will provide more fields in the **LIST SYS** response along with the fields in the standard **LIST SYS** command. This includes fields to show each modules current firmware version, scan rate (RATE), current valvestate (VALVE), engineering units setting (UNITS), conversion factor (CVTUNITS), zero correction setting (ZC), and the current IP address of the module. Please note that the Label column will always be last, regardless if the asterisk is used or not.

This command can be useful if there are mismatched settings between the modules in the system, which can include the valve or firmware versions. This command can also be used to find the IP address of other modules if they are not known and the module needs to be connected to via the Gb Ethernet.

SMODE

SMODE, or SSEP Mode, will provide details about the current state or mode with regards to SSEP. This command can be used if a module is not operating as intended based on current configurations.

The response includes:
- The module's current mode, shown as Unit, which can be Standalone, Controller, or Responder (Middle/Last).
- The address field will indicate the current index value designated by a controller, as long as the module's mode is responder. Controller or Standalone modules will only report 0. Modules assigned as responders should show a non-zero number.
- Number of responders is only used by a module designated as a controller to display the number of responders the controller has found. For all other modes, it will be an "X" as it is not applicable.
- The link status field will show the current status of the SSEP In and Out connections and whether the port is Up or Down. If the port is Up, an active connection is found to another module. If the port is Down, no active connection at the port exists (due to being forced off from the SSEP setting, or because no physical connection to another module exists).

TROUBLESHOOTING

In the event that modules are missing from the SSEP system, or pressure data does not contain the total expected channel count, return the system to ready for troubleshooting (STOP command). Most troubleshooting can be performed from the controller.

When the controller is in READY mode, use the **LIST SYS** command to verify the current found SSEP system. If the expected modules in the system are not being reported correctly by the controller, or modules are missing, check the following items:

- All modules in the SSEP system have a power connection to a DC power supply.
- All modules that are connected in the SSEP system are powered on and ready (observe the Power and Status LEDs on each module).
- All SSEP cables are connected properly, according to the supported line topology.
- The applicable SSEP I/O LEDs are flashing and are not off or solid.
- All SSEP cables used are in working condition. You may need to use a cable tester or similar to validate that the pin-out is correct, and there are no breaks in the cable itself.
- The module designated as the "controller" has the **SSEP** variable set to 2 (**LIST M**).
- Connect a Gigabit connection to each responder module, and attempt to ping or establish a Telnet/Web Server connection.
- Validate that each responder has the **SSEP** variable set to 3, or is set to 4 for the last module in the line (optional). If you have to adjust any of these variables, it is best to issue a **SAVE** to ensure this is persistent.
- Use the **SMODE** command to ensure the module is reporting its mode and address information correctly.

If you have found and resolved an issue based on any of these items, return to the controller module and issue the **LIST SYS** command to see if the SSEP System has been updated accurately.

In the event that one or more of the modules is not outputting data as you expect, return the controller to ready mode and use the **LIST SYS *** command to ensure all configuration settings in each module are properly configured as expected.

For further single module troubleshooting, modules assigned as controllers or responders can be connected to via the Gigabit Ethernet connection and forced to Standalone mode to operate the module as a standalone unit for diagnostics. This requires the **SSEP** variable is set to 1. SSEP operation in the module will be deactivated and removed from any SSEP network. The module can now be subjected to the General Checkout procedure to check basic functionality. Once the module has been checked out and is ready to be returned to the SSEP system, restore the previous SSEP value and disconnect from the module. The module will reenter the SSEP network automatically.

SSEP QUICK-START

These procedures are based on the current firmware version of the DSA5000. Please review the previous sections for all current limitations.

1) Designate a single module as a 'Controller' and connect all modules together via the SSEP I/O connections in a line topology.

Controller's SSEP Out Port >>> Responder 1 SSEP In Port
Responder 1 SSEP Out Port >>> Responder 2 SSEP In Port
Responder 2 SSEP Out Port >>> Responder 3 SSEP In Port
Repeat for total number of modules.

2) Make a power connection to all modules.

3) [Optional] If using an external trigger, connect the external trigger source to the controller only.

4) Make a Gigabit Ethernet connection to the controller module.

5) Power on all modules and wait about 30 seconds for the boot process to complete.

6) Make a TCP/IP Telnet connection, or connect to the Web Server (and use the pop-up Terminal) of the 'Controller' Module and issue the following commands:
>   **SSEP 2**
>   **SAVE**

This will designate the module as a controller and save the setting.

7) Connect a Gigabit Ethernet connection to a responder, make a TCP/IP Telnet connection or a connect to the Web Server and use the pop-up terminal, and issue the following commands:
>   **SSEP 3**
>   **SAVE**

This will designate the module as a responder and save the setting.

Repeat this step for each responder in the SSEP System. Once the setting is set and saved, you can disconnect from the module and remove the Gigabit Ethernet connection as it will no longer be needed.

Note: The SAVE command is only required once unless the SSEP System is to be changed, or a new controller is to be used.

Note: [Optional] the last module in the system can be set to: **SSEP 4**

This can also be set to shorten the total size of your SSEP System regardless of the physical connections.

8) Using the pre-existing Gigabit connection at the 'Controller', issue the command:
>   **LIST SYS**

Verify that all modules that are physically connect are found.

If all expected modules are not found, check all connections, verify that SSEP 2 has been set in the controller, and SSEP 3 has been set in all responders (or SSEP 4 for the 'last responder'). If this does not resolve the issue, check the SSEP Troubleshooting section for more information.

9) Configure the 'Controller' with the scan and data output settings required for the application. This can include the scan rate, Engineering Units, duration (FPS), triggering setting, PTP Synchronization, and output destination (FTP, UDP, TCP). Refer to Section 3: Scanning for more information.

10) Perform a zero calibration:

For systems with differential units only, issue the command:
>   **CALZ**

For systems with absolute units only, issue the command:
>   **CALB <baro>**
where <baro> is the current barometric pressure in PSIA

For mixed pressure type systems, issue the **CALZ** command, wait for STATUS: READY and then the **CALB <baro>** command.

Note: optionally, the "M" can be prefixed to perform the zero calibration without changing the valve state.

11) [Optional] Set the valve state of all modules for measurement mode by issuing the command:
>   **VALVE PX**

12) Begin data collection by issuing the command:
>   **SCAN**

Scanning will begin and data will be output to the configured destination with the scan configuration set at the controller.

Parse and convert the binary data appropriately using Table 5.1 and 5.2.

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SECTION 4: HARDWARE

PNEUMATIC CONNECTIONS

The DSA5000 allows for several different pneumatic connections. All pneumatic connections are located on top of the module. There are four basic groups of pneumatic connections found across different modules: pressure measurement connections (Px, CAL, REF), purge supply connection (PRG), configuration pressure connections (Control Supply), and for All-Media builds, bleed/fill connections. A universal fitting type was used for all pneumatic inputs to provide flexibility and versatility.

FITTING TYPES

All pneumatic connections, at the base level, on the DSA5000 module are 5/16"-24 female threads (SAE J1926-1). SAE J1926-1 is the same as ISO 11926-1 for 5/16"-24 o-ring sealing straight thread fittings. This standardized threaded input allows for several different fittings to be installed or changed at any time by Scanivalve or by the user in the field.

When a DSA5000 module is ordered, a input fitting kit can be included and installed on the module for shipment. These fitting kits provide a 5/16"-24 threaded fitting that adapts to more common pneumatic connections. The fitting kits include all fittings for all pneumatic connections to be the same. Users can also order additional fittings or fitting kits to mix and match the pneumatic connections.

FIGURE 4.1 - PNEUMATIC CONNECTION OPTIONS

Scanivalve offers the following pneumatic fittings:
- 5/16"-24 to Bulged Stainless Steel Tubulation:

0.042", 0.063", or 0.125" OD
- 5/16"-24 to Stainless Steel or Brass Compression Fitting: 1/16" or 1/8"
- 5/16"-24 to Scanivalve Quick-Coupler QC-063 *(for inserting smooth 0.063" tubulations)*

MAKING BULGED TUBULATION CONNECTIONS

Begin by applying a small amount of Scanivalve SLNT2 pipe sealant to the outside of the tubulation. Carefully slide the tubing over the outside of the stainless steel tubulation (Scanivalve's tubing push-on tool TPOTL-XXX makes this job easy). Ensure that the end of the Urethane, Vinyl, Nylon or Teflon tubing extends at least 1/16" beyond the bulge on the tubulation. Finally, slide the helical spring clamp over the outside of the tubing, ensuring that the spring clamp ends up over the bulge. Helical spring clamps are recommended for all pressure ports that will see over 50psi and are highly recommended for all tubulation style pneumatic connections. When using Teflon tubing, spring clamps are recommended on all connections no matter what the measurement pressure is.
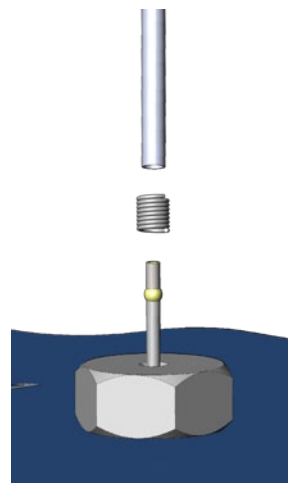
FIGURE 4.2 - TUBULATION PNEUMATIC CONNECTIONS

MAKING COMPRESSION FITTING CONNECTIONS

Each compression fitting includes 4 parts: the nut, the front ferrule, the back ferrule and the body. Slide the nut and both ferrules up on the tubing, then insert it all of the way into the body. Tighten the nut finger tight, to the point where the tube cannot be removed by hand. Finally, with a wrench tighten the nut 3/4 to 1 1/4 more turns. There is no need to tighten the nut any more than this. The smooth side of Scanivalve stainless steel tubulations can also be installed into the fitting to provide a bulged tubulation input. Scanivalve's TUBN-063 can be installed into 1/16" compression fittings, and TUBN-125 can be installed into

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1/8" compression fittings.
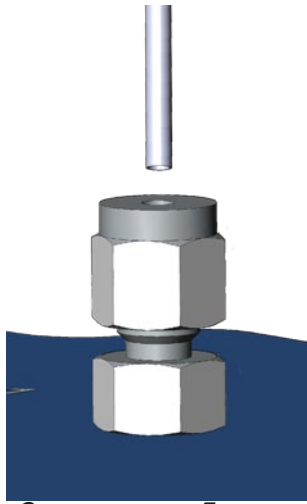
FIGURE 4.3 - COMPRESSION FITTING CONNECTION

MAKING SCANIVALVE QUICK-COUPLER CONNECTIONS

The Scanivalve Quick-Coupler (QC-063) makes connecting and changing ports easy. A smooth, bulge and burr free 0.063" OD tubulation can be inserted into the brass collar and pressed down until the tubulation bottoms out. The tubulation will be sealed with an internal o-ring and held by the collar. To remove the tubulation, remove the applied pressure, depress the brass collar and remove the tubulation.

The maximum pressure rating of the QC fittings is 750psi. The tube inserted into the fitting MUST be smooth, bulge and burr free or else the internal o-ring may be torn or ripped or the tube may get stuck in the collar. The TUBN-063 used in the fitting must be at least 1" long.
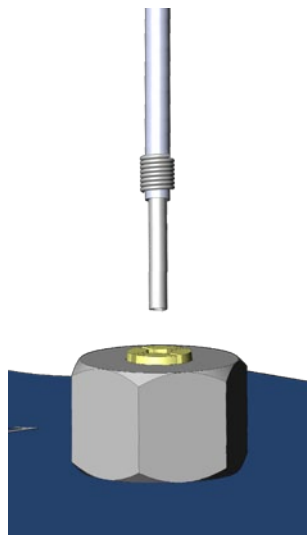
FIGURE 4.4 - SCANIVALVE QC CONNECTIONS

GAS BUILD PNEUMATICS

The pressure measurement ports are the 16 ports labeled 1-16 on the top of the module. For true differential modules, the ports will be labeled 1 through 8 and -1 through -8. For individual reference, they will be labeled 1 through 16 and -1 through -16. These ports are connected to the pressure transducers within the module. Each transducer will have it's own measurement port (standard modules will only have a positive Px input, whereas true differential and individual reference will have a positive Px input and a negative Px input).

Also included in the pressure measurement ports are the CAL and REF ports. Dual range modules will have CAL L and CAL H, and REF L and REF H port (for each group of ranges). "L" means low, or the low channels one (1) through eight (8). "H" means high, or the high channels nine (9) through sixteen (16). Absolute modules will only have CAL ports. There is no REF port on an absolute module. The CAL ports are used for applying a single, known pressure to all transducers in the DSA during calibrations. The REF ports are connected to the negative side of all differential transducers. The REF port is used as a single reference pressure during normal data collection and calibrations.

It is very important that all pressure measurement connections are completely leak tight. Any minor leak may cause an error in the measured pressure.

There is a single purge supply connection on the DSA labeled PRG. This port allows for a purge pressure to be supplied to the DSA in order to blow air through the module and out of the Px inputs, clearing the lines of any debris. Purge pressure can only be passed through the module when the valve state is in purge mode.

There is a single control port on the DSA. This port is used for configuring the module's valve state. It is recommended that all air supplied to the control supply port be instrument grade, clean dry air. Nitrogen is a very good alternative for when instrument grade air is not available.

PRESSURE MEASUREMENT (PX) PORTS

Each DSA module has 8 to 16 pressure measurement ports, or Px ports. They will be labeled 1 to 16 for most units. True differential modules will be labeled 1 to 8, and -1 to -8. Each of these ports are connected to a discrete pressure transducer. If any Px ports are not being used, it is recommended that they be plugged to prevent dust or debris from clogging the port or contaminating the internal calibration valve.

CALIBRATION (CAL) PORT

For each pressure range the DSA module has, there will be a CAL port. Most modules will only have one CAL port, but dual range modules will have two (labeled CAL L and CAL H). The CAL port provides a means to apply a known calibration pressure to a single port and have it manifolded to all of the transducers of the related pressure range. During normal operations, with no control pressures applied this port in internally blocked off. Any pressure applied to the CAL port will not reach the transducers unless the internal calibration valve has been configured to direct the calibration pressure to the transducers.

For low pressure modules (below 15 psi) the CAL port should be routed to a known, stable static location when not being used to apply calibration pressures. It is typically recommended that the CAL and REF ports be routed to the same location, or tied together. This ensures that when a zero offset calibration (CALZ) is performed no unwanted offsets are introduced.

REFERENCE (REF) PORT

For each pressure range the DSA module has, there will be a REF port. Most modules will have one REF port, but dual range modules will have two (labeled REF L and REF H). There is no REF port on absolute or individual reference pressure modules. The REF port ties into a manifold that connects the back side (or negative side) of all transducers of the same pressure range together. The REF port for all modules are unaffected by the valve state with the exception of True Differential builds.

For most applications, the REF port of pressure modules should be routed to a known, stable static pressure location that will be used as the differential "Reference" pressure. For pressure ranges below 15psi, the reference port should be controlled using a static bottle or dampener to slow the rate at which the reference pressure changes. This ensures that when a zero offset calibration (CALZ) is performed no unwanted offsets are introduced.

During field and full calibrations, positive pressures can be applied to the REF port to perform the negative portion of the calibration.

CONTROL SUPPLY (CTL SUPPLY) PORT

The Control Supply port is the input for the control pressure supply that is directed internally using electronic solenoids to switch the calibration valve state of the DSA5000. The supplied control pressure must be 90 to 120psi, and must always be clean, dry instrument grade air or nitrogen. Changing the mode is operated using software commands.

When the valve state of the DSA is in Px (measurement) mode, all solenoids will be closed (off) and the control pressure supply will be blocked. Control pressure is not needed for Px (measurement) mode. When the DSA's valve state is changed (solenoids are opened), control pressure will not flow, and instead will fill a volume. When the valve state is changed and the solenoids are changed, the pressure will vent through the "Case Vent" on the front of the DSA5000.

PURGE SUPPLY (PRG) PORT

The purge supply (PRG) port is the input for the pressure that will be used to purge the pressure measurement (Px) lines. The supplied purge pressure can be up to 100 psi, and must always be clean, dry instrument grade air or nitrogen.

It is recommended that purging be performed with lower pressure for longer durations, rather than higher pressure for shorter durations. Empirical testing is the best way to determine the required pressure and duration as all applications will be unique. Please see Section 3: Operation for more information on purging.

QUICK-DISCONNECT INPUT HEADER

DSA5000 modules can be ordered with the Quick-Disconnect (QD) header option. When this option is added, the DSA5000's input connections will be on a single removable header that can be quickly separated from the DSA5000. This allow for quick test setup changes, or module swaps, and minimizes both time and leak liabilities.

The Px inputs on the header retain the same 5/16"-24 female threads, and each fitting can be installed with any variety of available fittings. The QD header option is not possible with individual reference or true differential, dual range modules.

The QD header is fixed to the DSA body with eight (8) specially manufactured captive screws, Scanivalve Part No. 21516-1. A 5/32" or #4 hex head screwdriver or Allen wrench is required to remove these screws.

FIGURE 4.5 - QUICK DISCONNECT (QD) HEADER

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VALVESTATE AND SOLENOIDS

Each DSA module has two internal calibration valves. The calibration valve's state, or mode, can be configured by supplying an appropriate control supply pressure and using one of the software commands to control the internal solenoids. The two calibration valves cannot be operated independently. The calibration valves are configured such that no control pressures are required for normal Px or measurement operations.

The DSA5000 provides a single Control Supply input for control pressures to be applied. The supplied control pressure must be 90 to 120psi, and must always be clean, dry instrument grade air or nitrogen. Changing the mode is operated using software commands.

The standard solenoids in most DSA5000 configurations are Normally Closed (NC). Only DSA5000's whose model number ends with 25 through 28 use solenoids that are Normally Open (NO). Both types use the same valve commands and control pressures.

If a control supply is not present, regardless of solenoid type or setting, the DSA5000 will be default to Measurement (Px) mode.

Figure 4.6 shows the valve logic for most differential DSA gas modules (normally closed solenoids).
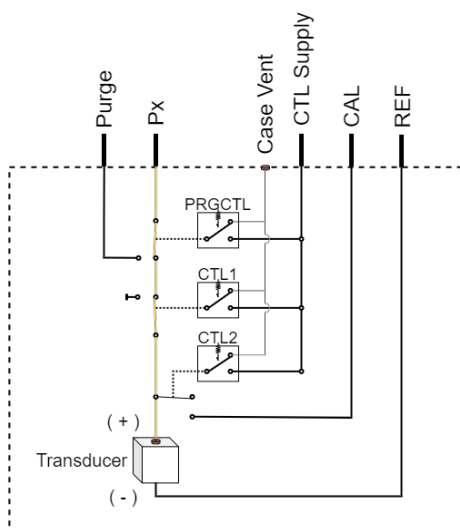
FIGURE 4.6 - STANDARD NC VALVE LOGIC (PX MODE)

Figure 4.7 shows the valve logic for absolute DSA gas modules.
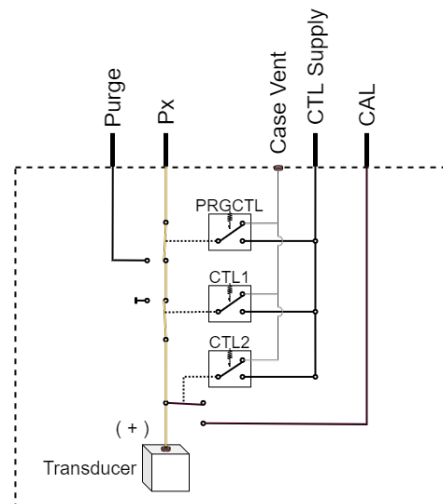
FIGURE 4.7 - ABSOLUTE NC VALVE LOGIC (PX MODE)

Figure 4.8 shows the valve logic for Normally Open, Standard Differential DSA gas modules.
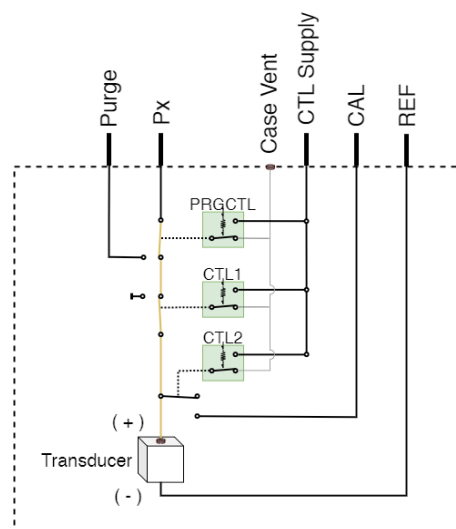
FIGURE 4.8 - STANDARD NO VALVE LOGIC (PX MODE)

The valve logic modes for the different build configurations can be found in Appendix C.

These are the DSA Calibration Valve solenoid states and corresponding modes:

TABLE 4-1: STANDARD, NORMALLY CLOSED (NC) MODELS				
MODE	COMMAND	CTL1	CTL2	PRGCTL
OPERATE	VALVE PX	Off	Off	Off
CALIBRATE	VALVE CAL	On	On	Off
PURGE	VALVE PRG	On	On	On
ISOLATE	VALVE ISO	On	Off	Off

TABLE 4-2: STANDARD, NORMALLY OPEN (NO) MODELS

MODE	COMMAND	CTL1	CTL2	PRGCTL
OPERATE	VALVE PX	On	On	On
CALIBRATE	VALVE CAL	Off	Off	On
PURGE	VALVE PRG	Off	Off	Off
ISOLATE	VALVE ISO	Off	On	On

Note: All solenoids can be operated independently using the commands CTL1, CTL2, and PRGCTL, if necessary. These commands only energize the solenoids. Solenoids must be correctly energized based on the solenoid type, with the proper sequence, to place the module into the different modes.

CONTROL 1 (CLT1) SOLENOID

Control 1 (CTL1) is the 'isolation' control. When 90-120psi is supplied to the Control Supply port and solenoid 1 is correctly energized, the control pressure closes a normally open (flow) valve and configures the internal calibration valves into isolate mode, isolating the inputs from the transducers. This means that pressures applied to the pressure measurement ports (Px 1-16) will not reach the transducers. Solenoid CTL1 controls both internal calibration valves simultaneously, and they cannot be operated separately.

DSAs can be placed into isolate mode using the command: **VALVE ISO**.

CONTROL 2 (CTL2) SOLENOID

Control 2 (CTL2) is the 'calibration' control. When 90-120psi is supplied to the Control Supply port, and solenoid 2 is correctly energized, the control pressure opens a normally closed (no flow) valve and configures the internal calibration valve into calibration mode. When CTL1 and CTL2 are applied together, pressures applied to the 'CAL' port(s) will reach the transducers. Solenoid CTL2 controls both internal calibration valves simultaneously, and they cannot be operated separately.

DSAs can be placed into calibrate mode using the command: **VALVE CAL**.

PURGE CONTROL (PRGCTL) SOLENOID

For applications where the pressure measurement ports (Px ports) may become plugged or contaminated, the DSA module is equipped with a purge valve state. When 90-120psi is supplied to the Control Supply port, and solenoids 1 and 3 are correctly energized, the control pressure places the internal calibration valve into purge mode by opening the 'Purge Supply' port to the Px ports. Solenoid PRGCTL controls both internal calibration valves simultaneously, and they cannot be operated separately. Note that its common for CTL2 to be active in the purge state, as well.

DSAs can be placed into purge mode using the command: **VALVE PRG**.

CAUTION! Applying PRGCTL after or without CTL1 applied can allow sensors to see the purge pressure potentially causing serious damage to the module. The solenoids should be operated in a step fashion, starting with CTL1.

For recommendations on purging, please see Section 3: Operation.

ALL-MEDIA BUILD PNEUMATICS

The pressure measurement ports are the 16 ports labeled 1-16 on the top of the module. These ports are connected to the pressure transducers within the module. Each transducer will have it's own measurement port isolated from other inputs.

Each of the 16 pressure measurement inputs is connected to a bleed/fill valve. This Schrader valve can be used to bleed air out of the measurement lines, or to fill the lines with media. The valve is housed in an NPT fitting and is permanently installed in the DSA top plate. The Schrader valve body can be removed, if required.

All-Media builds do not include CAL, REF, PRG, or Control inputs. There is no internal valving for Calibrate, Isolate, or Purge states. Figure 4.9 shows the valve logic for most differential DSA gas modules.
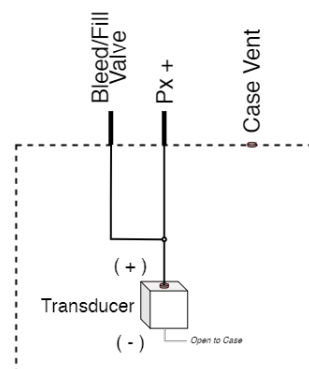
FIGURE 4.9 - ALL-MEDIA CHANNEL FLOW PATH

ELECTRICAL CONNECTIONS

There are four electrical connectors on the DSA5000 that house a number of different connections for power and

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communications. All four connectors are found on the top of the DSA5000. The Power/Serial and Ethernet Connections can be found on all builds. The SSEP connection are only found on TCP builds (non-iDDS modules). Figure 4.10 shows all possible electrical connections (Gas/TCP build shown).
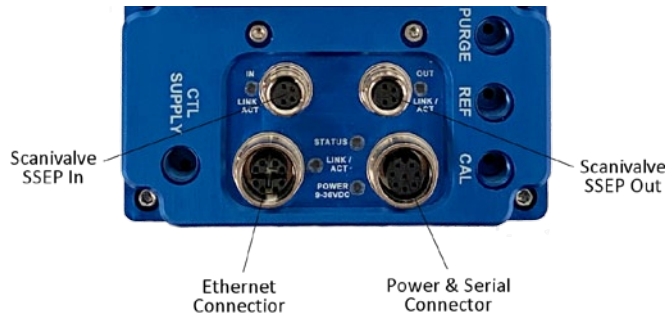
FIGURE 4.10 - DSA5000 ELECTRICAL CONNECTIONS

POWER/SERIAL/TRIGGER CONNECTION

The power/serial/trigger connector is located in the right hand corner, nearest to the CAL port. The DSA uses a M12, 8-pin, A Code connector. This is a latching or threaded connector to prevent the connector from becoming unseated when subjected to vibration. The pin-out diagram for the power connection can be found in figure 4.11.
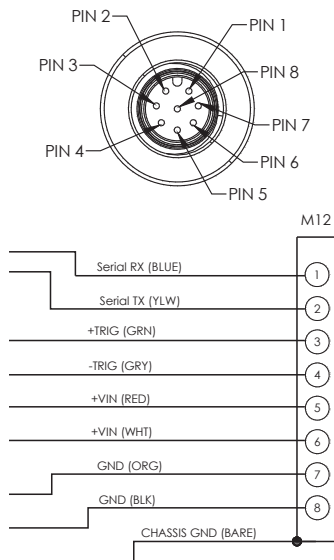
FIGURE 4.11 - DSA5000 POWER/SERIAL CABLE PINOUT

A standard DSA5000 without an integrated heater requires +9-36Vdc power and will consume no more than 12W. Power consumption will be at the greatest when all solenoids are active and the DSA is scanning at the max rate.

CAUTION! Do not make or break the power connection with power applied. Doing so risks damage to the module.

The DSA5000 with an integrated heater requires 24-36Vdc power to use at the minimum operating temperature range. Power consumption will be greatest when all solenoids are active, the DSA is scanning at the max rate, and the heaters are on at 100%. The power consumption will drop and self-regulate when the module has reached a temperature near to the configured set point. If the DSA is used in an environment where the ambient temperature is constantly 0°C or less, power requirements could continuously remain near the max wattage requirement.

For modules with an installed heater, both power pins (VIN/GND) must be utilized to support the possible current draw of the heater. Bifurcating the DC power cable to connect to similar pins is acceptable e.g., DC+ connects to pins 5 and 6, DC- or RTN connects to pins 7 and 8.

Maximum power consumption with the integrated heater varies based on the DC voltage being used to power the module. Figure 4.12 illustrates the max power consumption when the heater is operating at 100% capacity.
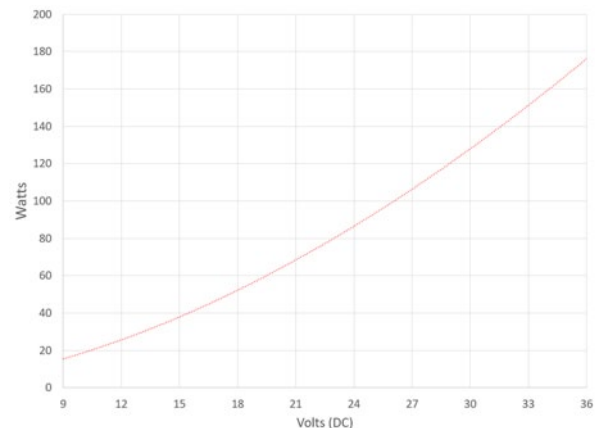
FIGURE 4.12 - MAX POWER CONSUMPTION

Approximate maximum wattage can be found using the equation:

$$\text{Watts} = 0.3277x^{1.7545}$$

Where *x* is the DC voltage supplied (9 to 36).

Not all supplied voltages will allow the module to operate

at the minimum operating temperature of -60°C. For more information on heater operation and minimum operating temperatures, see Section 3: Heater Operation.

ETHERNET CONNECTION

The primary means of communication with the DSA5000 module is the 1000Base-T Ethernet port with MDIX auto-crossing. The DSA uses a M12, 8-Pin, X Code connector for 1Gb Ethernet connection. This is a latching or threaded connector to prevent the connector from becoming unseated when subjected to vibration. Additional Ethernet cables for the DSA5000 can be ordered from Scanivalve in any length up to 100 feet (30 meters). Scanivalve's part number for these cables is 156145.

M12 cables, connectors, and parts can also be purchased off-the-shelf from third party vendors. Custom Ethernet cables can be built using the mating connectors and a shielded Category 6 rated or better cable. The Ethernet pin-out diagram is show in figure 4.13.
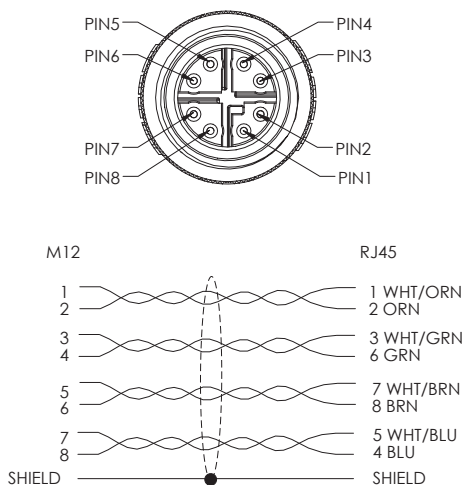
FIGURE 4.13 - DSA5000 ETHERNET CABLE PINOUT

SCANIVALVE SSEP I/O CONNECTIONS
TCP Builds only

There are two connectors that provide the means for SSEP (Scanivalve Synchronous Ethernet Protocol) connections to other 5000 series modules to create an isolated network topology of Scanivalve 5000 series modules. When used, multiple modules can be connected to a single controller unit, in which all commands, settings, and scan data will be synchronized and output by a single 'controller' module through the 1Gb Ethernet connection. These connections and SSEP are not available on iDDS modules.

The Scanivalve SSEP (Scanivalve Synchronous Ethernet Protocol) "In" connector is located in the left hand corner of figure 4.8, nearest to the channel inputs 14 and 16. The

SSEP "Out" connector is located in the right hand corner of figure 4.8, nearest to the PURGE pneumatic connector.

Both connectors use a M8, 4-pin, A-Code connector. This is a latching or threaded connector to prevent the connector from becoming unseated when subjected to vibration. This connector can only be used to connect to another Scanivalve 5000 series module. These connections cannot be used for standard Ethernet input or output. For more information on the use of these connectors, please see the SSEP section of this manual.

SSEP Ethernet cables for the DSA5000 can be ordered from Scanivalve in any length up to 100 feet (30 meters). Scanivalve's part number for these cables is 156151.

These cables, connectors, and parts can also be purchased off-the-shelf from third party vendors. Custom Ethernet cables can be built using the mating connectors and a shielded Category 5e rated or better. The Ethernet pin-out diagram is show in figure 4.14 and the wiring it straight through (pin to pin).
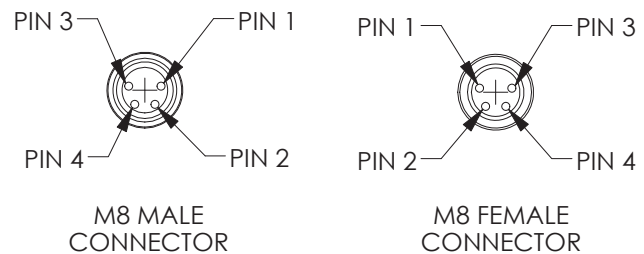
FIGURE 4.14 - DSA5000 SSEP CABLE PIN-OUT

STATUS INDICATORS (LED)

There are five (5) LEDs physically located on the module, near the electrical connectors. The LEDs can provide quick information about the current state of the module.

POWER: This LED indicator will turn on when DC is power is detected at the module.

LINK / ACT: This LED indicator will blink when network activity is detected. Sending commands or transmitting data may cause the LED to be on constantly.

STATUS: This LED reports the current status of the modules firmware.
  Solid Green: Module is in READY mode.
  Flashing Green: Module is scanning.
  Off: Module is not in ready mode, which could include CALZ mode, SAVE mode, or other.

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IN LINK / ACT: This LED reports network activity for the SSEP In connector. It will flash when activity is detected. It will be solid if a connection is found, but no activity is present.

OUT LINK / ACT: This LED reports network activity for the SSEP Out connector. It will flash when activity is detected. It will be solid if a connection is found, but no activity is present.

SECTION 5: SOFTWARE

OVERVIEW

The DSA5000 is a single user network server that supports connections from a Telnet Client and Web Browser Client. The operation of a DSA module is controlled by sending commands to selected modules by network addressing via the network. The DSA returns data or information over the network to the requesting client/host.

The DSA5000 also supports serial communication that can be used to set configuration variables, diagnostics and trouble-shooting, or used when the DSA's IP address is not known.

The section on DSA Commands lists each command and explains its function.

DSA COMMANDS

The DSA software must run as embedded software on the DSA pressure scanner hardware. It performs the following general tasks:

1. Read and filter the raw A/D counts that represent pressure and temperature.
2. Convert the pressure A/D counts to user chosen pressure units.
3. Receive and execute commands from the Ethernet link.
4. Allow configurations to be saved through power down.
5. Output converted data, status, setup and calibration data over the Ethernet Link.
6. Set the DSA Physical Ethernet Address(MAC Address).
7. Data transfer protocol to be TCP, UDP, or FTP.
8. Support the user in troubleshooting the DSA hardware and system.

TCP/IP does not guarantee that packet boundaries will be maintained between a host and a DSA module. Therefore, all commands from a host must be terminated properly with one of four options. The DSA will detect and adjust to the termination option being used by a host.

The four options are:
- CR (ASCII 13)
- LF (ASCII 10)
- LF-CR (ASCII 10 - ASCII 13)
- CR-LF (ASCII 13 - ASCII 10)

When a DSA module is not in "READY" mode, most commands are disabled or not accepted. Examples of when the DSA module may not be in "READY" mode could be:
- During CALZ
- While Saving
- While Scanning

The exceptions to this rule are the commands STOP, STATUS, TRIG, and all commands to change the valve state. These commands will have a note listed in the following sections if they are accepted when the DSA is not "READY."

The maximum string length for commands sent to the DSA5000 is 79 characters. Any command received that is longer than 79 characters will be discarded and an error will be generated.

When a communications variable is modified, such as IP, MAC, Gateway, or Subnet, the configuration must be saved, and the DSA5000 software must be restarted in order for the changes to take effect.

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DSA5000 BUFFER DESCRIPTION

The ring buffer on the DSA5000 sits between the scan task and the binary output task. It is 32768 elements in size with each element holding 160 bytes, making the total ring buffer 5,242,880 bytes. At 5000Hz, the DSA can buffer approximately 6.55 seconds of data (32768 / 5000). The binary output task has a lower priority than the scan task. This is necessary so that input scan data is not missed.

The buffer is the liaison between the scan task and the scan output task. The scan output task has a higher priority than the scan task. Under initial conditions, when the buffer is empty, the scan task places one frame of data in the buffer. It then signals the scan output task to read the buffer until it is empty. However, when multiple frames of data are in the buffer, the output task continues until the buffer is empty. Multiple frames of data will accumulate if the scan output task is blocked by the network while outputting data.

DSA DATA OUTPUT DEFINITIONS

When requested the DSA sends an application packet to the client. Each packet sent to the client starts with a Packet Type Word. This word defines the packet type. All packet data will be received as signed.

HOST TO DSA COMMAND PACKET

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
ASCII command data. Refer to the command section of this manual for more information.	1 to 80	String	Unique to packet. Each line/command must be terminated with a <CR>, <CR-LF> or <LF-CR>

DSA TO HOST ASCII PACKET

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
ASCII data*. Refer to the Command Section of this manual for the proper Command return formats.	1 to 1492	String	Unique to packet and varies. Line and response are terminated based on prompt setting**.

*This packet will be transmitted when the host issues one of the following commands (excluding a return prompt, if set):
1. SCAN from Telnet connection
2. Any Get command type
3. STATUS
4. LIST or TYPE with argument
5. FDISK
6. An Error message if ERRORLOG = 0, or the error log when ERRORLOG = 1 and ERROR command is used.

DSA response behavior is user configured by setting the **PROMPT variable. The prompt variable requires one argument for the line terminator, and an optional argument for a prompt character. Every line response from the DSA will end in the line terminator set (excluding scan data which is hard coded - see next page). The optional prompt character will only output after all responses or processes in DSA are completed and the DSA is ready to accept the next command.

Single line response: If the DSA is ready and **PROMPT** is set to 3 with no character, a **STATUS** command would respond as:
    STATUS: READY<CR><LF>

Multi-line response: If the DSA is ready and **PROMPT** is set to 2 with a ">" character, a **LIST IP** command would respond as:
    IP 191.30.95.1<LF>
    SUBNET 191.30.95.1<LF>
    GW 0.0.0.0<LF>
    >

ASCII SCAN DATA EXAMPLES

The DSA5000 can be configured to output ASCII scan data in several formats. The format is configured with the **FORMAT** variable. Once a scan has stopped and all data has been returned, the output will be followed by the optional return prompt argument in the **PROMPT** configuration (after the DSA has changed from the SCAN state to the READY state).

All ASCII data examples below are dynamically built. For single module operation, only 16 channels will be output. When using SSEP, modules will be added in groups of 16 in repeating structures in place of the ellipses (...) in the following section examples. After the last module, the entire structure will repeat with a new frame.

UNFORMATTED ASCII

When **FORMAT** is set to A, data is displayed in a column type format and is scrolling at the set rate.

```
Frame # <number><CR><LF>
<mod sn>-<channel 1> <pressure> <temperature><CR><LF>
<mod sn>-<channel 2> <pressure> <temperature><CR><LF>
     ::      ::       ::       ::       ::
<mod sn>-<channel 16> <pressure> <temperature><CR><LF>
...
```

If **UNITS** is set to an engineering unit value; <pressure> will be a value in EU, <temperature> will be in °C.
If **UNITS** is set to RAW; <pressure> will be a raw A/D pressure count, <temperature> will be a raw A/D temperature count.

FORMATTED ASCII

When **FORMAT** is set to F, Data is displayed in a VT100 terminal style (using ANSI escape codes) and will update at the set rate.

```
Frame=<number>
<mod sn>-<chan1>=  <press>    <mod sn>-<chan2>=  <press>    <mod sn>-<chan3>=  <press>
<mod sn>-<chan4>=  <press>    <mod sn>-<chan5>=  <press>    <mod sn>-<chan6>=  <press>
<mod sn>-<chan7>=  <press>    <mod sn>-<chan8>=  <press>    <mod sn>-<chan9>=  <press>
<mod sn>-<chan10>=  <press>   <mod sn>-<chan11>=  <press>   <mod sn>-<chan12>=  <press>
<mod sn>-<chan13>=  <press>   <mod sn>-<chan14>=  <press>   <mod sn>-<chan15>=  <press>
<mod sn>-<chan16>=  <press>    ...
```

If **UNITS** is set to an engineering unit value; <press> will be a value in EU, <temperature> will be in °C.
If **UNITS** is set to RAW; <press> will be a raw A/D pressure count, <temperature> will be a raw A/D temperature count.

COMMA SEPARATED VARIABLE ASCII

When **FORMAT** is set to C, Data is output in comma separated variable and is scrolling at the set rate. This data can be captured, saved, and opened as a .CSV file. At the beginning of any CSV scan, a header row will be output to label each column's data.

```
<frame number>,<ptp time seconds>,<ptp time nanoseconds>,<press 1>,<press 2>,
<press 3>,<press 5>,<press 6>,<press 7>,<press 8>,<press 9>,<press 10>,<press 11>,<press 12>,
<press 13>,<press 14>,<press 15>,<press n>,<temp 1>,<temp 2>,<temp 3>,<temp 5>,<temp 6>,
<temp 7>,<temp 8>,<temp 9>,<temp 10>,<temp 11>,<temp 12>,<temp 13>,<temp 14>,<temp 15>,
<temp 16>...<LF>
```

If **UNITS** is set to an engineering unit value; <press *n*> will be a value in EU, <temp *n*> will be in °C.
If **UNITS** is set to RAW; <press *n*> will be a raw A/D pressure count, <temp *n*> will be a raw A/D temperature count.

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BINARY SCAN DATA FORMATS

When the DSA is configured to output a binary data packet, the binary data packet will be output as a modular packet structure that is determined by the number of modules in a system. If Scanivalve Synchronous Ethernet is not being used (SSEP), there will only be one module. Table 5.1 defines a full, single packet and its size. The "Module Data" will be repeated per number of modules. The module data is shown in table 5.2.

Binary data formats follow network byte order (big endian). Be aware that some host receivers will revert to host order when received (little endian).

TABLE 5.1 - BINARY DATA PACKET

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
Packet ID	2	Unsigned Int	200 Hex
Number of Modules	2	Unsigned Int	Modules in packet, used to determine packet length
Frame Number	4	Unsigned Int	The current frame number if in the scan mode. Resets at start of scan.
Time Stamp [Sec]	4	Unsigned Int	PTP formatted time-stamp at time of data sample, seconds
Time Stamp [ns]	4	Unsigned Int	PTP formatted time-stamp at time of data sample, nanoseconds
Spare	12	--------	Empty (future use)
Module Data (n)	140	Structure	Module data for one module. Repeat structure for number of modules*. Please see table 5.2 for details.

TABLE 5.2 - MODULE DATA

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
Module Type and Serial Number	2	Unsigned Int	Bit 15: DSA = 1, DTS = 0 Bit 14 to 0: Serial Number
Responder Address	1	Unsigned Int	Controller is always 0, Responder may be 1 - 255
Status	1	Unsigned Int	Bit 1: Packet ID, 0 = Info, 1 = Scan Bit 0: Unused
Reserved	8	---------	Reserved for internal use
DSA Pressure	64	Float	Engineering Unit values set by Units
DSA Temperature	64	Float	Degrees Celsius for each RTD

* Note - when SSEP is used, the first module structure (module 1) will be the data for the 'Controller' module. Every repeated structure of 140 bytes will be appended to the binary packet as a 'responder' module, identified by the serial number.

STANDARD VS TRUE DIFFERENTIAL NOTES

When the DSA is configured as a standard differential module, 16 channels of pressure and temperature data will be output in a frame of data. When the DSA is configured as a true differential module, 16 channels will still be output; however, only channels 1 through 8 will provide real pressure and temperature data. Channel 9 through 16 are "dummy" channels and do not exist in the hardware. In the scan data (ASCII or Binary), channels 9 through 16 will always read an error value in the data (9999.0000 for EU, 8388607 for RAW).

COMMAND FORMAT

All of the commands accepted by the DSA are explained with the following sections: command, syntax, parameters/arguments, description, returns, examples, and default values and notes when applicable. The table below is the standard format for describing all available commands in the DSA. Please review this for information on each section of each command.

COMMAND	Lists the name of the command.

TYPE	Lists the type of command. There are three types of commands in the DSA:
	    Get - a Get type command retrieves information.
	    Set - a Set type command will set configurations and variables. There commands typically require one or more arguments or a value.
	    Function - a Function command will case the DSA to start a process or function. These commands may not return any data.
	
	A command can be one or more types.

DESCRIPTION	Describes the function of the command.

SYNTAX	Lists the format of the command. The following conventions are used:
	    BP - Boldface letters indicate command keywords and operators. Within the discussion of syntax, bold type indicates that the text must be entered exactly as shown.
	    <parameter> - Words in < > indicate place holders for arguments, parameters, or values that must be supplied.
	    [<parameter>] - Parameters in [ ] indicate place holders for optional arguments that are not required.
	    data - Example return data is shown in *italics*.
	    data - Example commands are show in **bold**.
	    , - Commas separate options, only one of the options may be used.

RETURNS	Lists the format of the information that the unit returns to the host. This manual shows all examples as if **PROMPT 3 >** is configured (but will not show <CR><LF> as it is implied). See the prompt variable or DSA Data Output Definitions for more information.
EXAMPLE	Example commands and do not necessarily apply to all applications. When "//" is used, this indicates a comment to explain the commands that proceed it and are not used in the command sequence.
NOTES	Additional comments or notes relevant to the command or arguments.

GENERAL COMMANDS

DSA FIRMWARE VERSION

COMMAND	VERSION
TYPE	Get
DESCRIPTION	Retrieves the current software version.
SYNTAX	**VER**
RETURNS	The version string followed by the prompt when ready to accept a new command.
EXAMPLE	**VER** *1.00* *>*

STATUS

COMMAND	STATUS
TYPE	Get
DESCRIPTION	Displays the current mode of the DSA.
SYNTAX	**STATUS**

RETURNS	STATUS: <mode>
	
	Where <mode> is:
	    READY = Ready mode
	    SCAN = Currently scanning
	    CALZ = Performing a zero calibration
	    SAVE = Performing a save
	    FLASH = Firmware is being updated
	
	Followed by a prompt when ready to accept a new command.

EXAMPLE	**STATUS** *STATUS: READY* *>*
EXAMPLE	// If the DSA is scanning **STATUS** *STATUS: SCAN* *>*
NOTES	This command is accepted at all times.

SCAN

COMMAND	SCAN
TYPE	Function
DESCRIPTION	Commands the DSA to being sampling values from the transducers and outputs the data to the designated target. The DSA will enter SCAN mode.
SYNTAX	**SCAN**
RETURNS	The scan data, followed by a prompt when the scan is completed.
EXAMPLE	**SCAN** *::: [Scan Data] :::* *>*
NOTES	Output is based on formatting. Please see DSA Data Output Definitions for more information.

COMMAND	STOP
TYPE	Function
DESCRIPTION	Cancels all commands or functions and returns the DSA5000 to READY mode.
SYNTAX	**STOP** or <ESC>
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**STOP** >
NOTES	This command is accepted at all times.

List

COMMAND	LIST
TYPE	Get
DESCRIPTION	Commands the DSA to list all settings, or a specified group of settings, that are stored in RAM.

SYNTAX	**LIST** <group>
	
	Where <group> is:
	    S = scan groups variables
	    PTP = PTP variables
	    UDP = UDP output variables
	    FTP = FTP output variables
	    M = misc. variables
	    ID = module identification variables
	    DELTA = zero-correction deltas
	    TEMP = temperature coefficient table
	    PGA = programmable gain settings
	    T = EU coefficient conversion values
	    IP = the IP or communication settings stored
	    FC = field calibration correction terms
	    V = valve related settings
	    DSA = all settings in Dsa.cfg
	    CAL = all settings in Cal.cfg
	    SYS = Discovered SSEP system

RETURNS	<setting> <variable> ::: ::: ::: ::: <setting> <variable> Followed by a prompt when ready to accept a new command.
EXAMPLE	**LIST S** *RATE 100* *FPS 0* *UNITS PSI* *FORMAT A* *TRIG 0* *CALZ 1* >
NOTES	Detailed responses from each LIST can be found later in the software section.

Save

COMMAND	SAVE
TYPE	Function
DESCRIPTION	Saves all configurations to flash, or a selected group of configurations.
SYNTAX	**SAVE** [<group>] Where <group> is: 　　DSA = all variables stored in Dsa.cfg (LIST S, FTP, UDP, PTP, M, V) 　　CAL = all variables stored in Cal.cfg (LIST ID, T, TEMP, PGA) 　　FC = all variables stored in Fc.cfg 　　IP = the IP settings stored in Ip.cfg When the optional group is not used, the DSA will list all settings except Ip.cfg, and when CALZ == 2, the Delta.cfg file. If CALZ does not equal 2, Delta will not be saved.
RETURNS	Prompt when saving is complete and ready to accept a new command.
EXAMPLE	**SAVE** >
NOTES	The IP group can only be saved with a SAVE IP command.
NOTES	Cal and Fc groups insert the current serial number of the module into the file name.

Load Configuration

COMMAND	LOAD
TYPE	Function
DESCRIPTION	Commands the DSA to load settings stored in a file on the flash to RAM.
SYNTAX	**LOAD** <group> Where <group> is: 　　Dsa.cfg = generic dsa variables 　　Cal_<sn>.cfg = the full coefficient file 　　Fc_<sn>.cfg = the field calibration correction terms file 　　Ip.cfg = the IP settings
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**LOAD Cal_13.cfg** >
NOTES	<sn> is the serial number of the module, defined by the SN variable.

File Contents

COMMAND	TYPE
TYPE	Get
DESCRIPTION	Commands the DSA to list all settings, or a specified group of settings, that are stored on the flash.
SYNTAX	**TYPE** <filename> Where <filename> is the name of the file including the extension.
RETURNS	The file contents and a prompt when ready to accept a new command.
EXAMPLE	**TYPE Ip.cfg** *IPADD 192.168.0.240* *SUBNET 255.0.0.0* >

ERROR

COMMAND	ERROR
TYPE	Function
DESCRIPTION	The ERROR command is used to query the error log when enabled. The error log is enabled or disabled using the ERRORLOG variable.
SYNTAX	**ERROR**
RETURNS	Any errors stored in the log if enabled, or an error if the log is disabled, followed by a prompt when ready to accept a new command.
EXAMPLE	// if ERROR is set to 0 **ERROR** *ERROR: Error log is disabled* >
EXAMPLE	// if ERROR is set to 1 and there are no errors in the log **ERROR** *ERROR: No Errors* >
EXAMPLE	// if ERROR is set to 1 and there are errors in the log **ERROR** *ERROR: Invalid Command scasn* >

CLEAR

COMMAND	CLEAR
TYPE	Function
DESCRIPTION	Commands the DSA to clear any errors in the error log.
SYNTAX	**CLEAR**
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**CLEAR** >

FLASH DIRECTORY CONTENTS

COMMAND	DIR
TYPE	Get
DESCRIPTION	Returns the files saved on the flash memory.
SYNTAX	**DIR**
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**DIR** *215 Dsa.cfg* *41640 Cal_123.cfg* *3720 Fc_123.cfg* >

DELETE FILE

COMMAND	DELFILE
TYPE	Function
DESCRIPTION	Deletes a selected file from flash memory.

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SYNTAX	**DELFILE** <filename>
	Where <filename> is the name of the file on the flash, including the extension.
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**DELFILE Dsa.cfg**
	>

FORMAT FLASH

COMMAND	FDISK
TYPE	Function
DESCRIPTION	Erases and formats the internal memory. <u>WARNING: All data will be lost, including configuration files.</u> Once the command is issued, the DSA will respond with a confirmation message to approve the FDISK command or to cancel.
SYNTAX	**FDISK**
RETURNS	Type FDISKCONFIRM to confirm FDISK or STOP to cancel Prompt when ready for next command.
EXAMPLE	**FDISK** *Type FDISKCONFIRM to confirm FDISK or STOP to cancel* >
NOTES	FDISK will not remove the installed firmware application.
NOTES	FSIDKCONFIRM will trigger a *Format Completed!* message.

REBOOT

COMMAND	REBOOT
TYPE	Function
DESCRIPTION	Reboots the DSA (soft reboot).
SYNTAX	**REBOOT**
RETURNS	Nothing.
EXAMPLE	**REBOOT**

RESET

COMMAND	RESET
TYPE	Function
DESCRIPTION	Commands the DSA to reset all settings in RAM for a specific group. Variables will be set to the factory defaults.
SYNTAX	**RESET** <group>
	Where <group> must be one of the groups in the DSA; S, IP, PTP, UDP, FTP, T, ID, TEMP, PGA, FC, etc. The argument ALL can also be used to reset all settings.
RETURNS	A prompt when ready to accept a new command.
EXAMPLE	**RESET S** >
NOTES	Caution! This could result in unexpected behavior as the settings from the specified list will be reset to default settings in RAM. This includes IP, Rate, Coefficients, etc.

SCAN VARIABLES

The Scan Group variables control different aspects of scanning, data collection, data format, and more. For the CALZ variable in this group, see the **CALZ** command.

LIST SCAN SETTINGS (LIST S)

COMMAND	LIST S
TYPE	Get
DESCRIPTION	Retrieves all scan configurations stored in temporary memory.
SYNTAX	**LIST S**
RETURNS	<setting> <variable> ::: ::: ::: ::: <setting> <variable> Followed by a prompt when ready to accept a new command.
EXAMPLE	**LIST S** *RATE 10.00000* *FPS 0* *FORMAT C* *UNITS PSI* *TRIG 0* *CALZ 0* *>*

SCAN RATE (RATE)

COMMAND	RATE
TYPE	Get/Set
DESCRIPTION	Sets the scan rate of the DSA, or retrieves the current setting. This value is expressed in Hertz (Hz) or samples per channel per second. The DSA uses internal averaging for rate settings less than 500 (Hz). This means that the DSA will take *n* amount of samples and average these values before outputting a single pressure value in the data packet. When RATE is greater than or equal to 500, the average will always be 1 (no averaging). The internal AD Rate will be equal to the set RATE. When RATE is less than 500, the internal AD rate and number of averages can be calculated using the following equations: $\qquad$ AVG = ceil (500 / RATE) $\qquad$ ADrate = RATE × AVG where ceil(x) finds the next integer greater than x
SYNTAX	**RATE** <rate> Where <rate> is the number of samples per seconds for all channels in Hz (sample/channel/second). Valid values are 0.25 to 5000.
RETURNS	RATE <rate> - and/or - Prompt when ready to accept a new command.
DEFAULT	1

EXAMPLE	// To configure the DSA output of data to 100Hz **RATE 100** >
EXAMPLE	// To retrieve the current setting **RATE** *RATE 150* >
NOTES	Scan rate may be limited based on output format.

FRAMES PER SCAN (FPS)

COMMAND	FPS
TYPE	Get/Set
DESCRIPTION	Sets the number of frames to output during a scan, or retrieves the current setting. Once this number of frames is met, the DSA will stop scanning and return to READY mode. A Frame contains a sampled pressure value per channel output (8 or 16 channels total) plus time stamp, frame number, temperatures, and other additional information defined by the data output configured in the DSA. The FPS variable can be used to scan for a timed duration using the following equation: 　　　FPS = RATE x TIME (in seconds)
SYNTAX	**FPS** <number of frames> Where <number of frames> is the number of frames per scan. Valid values are 0 to 4294967295. If number of frames is set to 0, the DSA will scan indefinitely until the scan is manually stopped using the STOP command.
RETURNS	FPS <number of frames> - and/or - Prompt when ready to accept a new command.
DEFAULT	1
EXAMPLE	// To configure the DSA to output 100 frames of data per scan **FPS 100** >
EXAMPLE	// To retrieve the current setting **FPS** *FPS 1200* >

ASCII FORMATTING (FORMAT)

COMMAND	FORMAT
TYPE	Get/Set
DESCRIPTION	Sets the scan data output format for Telnet (ASCII output only), or retrieves the current setting.
SYNTAX	**FORMAT** <format code> Where <format code>: 　F = VT100 Terminal Emulator 　A = Unformatted ASCII 　C = Comma Separated Variable (CSV)

RETURNS	Format <format code> - and/or - Prompt when ready to accept a new command.
DEFAULT	A
EXAMPLE	// To configure the format to unformatted ASCII **FORMAT A** >
EXAMPLE	// To retrieve the current setting **FORMAT** *FORMAT C* >
NOTES	See page 88 for scan format details.

SCAN UNITS (UNITS)

COMMAND	UNITS
TYPE	Get/Set
DESCRIPTION	Sets the scan units, or retrieves the current setting.

SYNTAX	**UNITS** <units> [<user cv>]
	
	Where <units> is one of the following:
	
	    PSI ATM BAR CMHG
	    CMH2O DECIBAR FTH2O GCM2
	    INHG INH2O KNM2 KGM2
	    KGCM2 KPA KIPIN2 MPA
	    MBAR MH2O MMHG NM2
	    NCM2 OZIN2 OZFT2 PA
	    PSF TORR USER RAW
	
	When <units> is set to USER, the user must enter a conversion value from PSI for <user cv>.

RETURNS	UNITS <units> [<user cv>] - and/or - Prompt when ready to accept a new command.
DEFAULT	PSI
EXAMPLE	// To configure the EU output to PSI **UNITS PSI** >
EXAMPLE	// To configure a user conversion value **UNITS USER 1.50** >
EXAMPLE	// To retrieve the current setting **UNITS** *UNITS RAW* >

TRIGGER (TRIG)

COMMAND	TRIG
TYPE	Get/Set/Function
DESCRIPTION	This command is used to set the external triggering function of the DSA, retrieve the current setting, or is used as a software command to trigger the DSA to release a frame of data when the DSA is configured for external frame triggering.

SYNTAX	**TRIG** [<value>]
	
	Where <value>:
	   0 = External triggering is disabled. The DSA will scan using an internal trigger based on the set rate.
	   1 = External frame trigger is enabled. The SCAN command must be used to place the DSA into SCAN mode. Once in scan mode, the DSA will wait for an external hardware trigger pulse to release one frame of data, a **TRIG** command, or a <TAB> character code (9 HEX or Control I). For every pulse or command received, the DSA will release one frame of data. The DSA will return to READY mode when a STOP command is issued, or FPS has been met.
	   2 = External scan trigger is enabled. The DSA will accept an applicable external voltage to execute a SCAN and stop the scan. The DSA will scan using an internal trigger based on the set rate. Software commands (SCAN, STOP, etc) can also be used with the external scan trigger.
	   3 = Autostart is enabled. The DSA will start to scan and send data after power up. There is a 30 second delay from the final initialization and the data transfer.

RETURNS	A frame of scan data when used without modifiers. - or - TRIG <value> , and a prompt when ready to accept a new command. - or - Prompt when ready to accept a new command when value is set.
DEFAULT	0
EXAMPLE	// To find the current setting when in READY mode **TRIG** *TRIG 1* *>*
EXAMPLE	// To set the trigger to external scan **TRIG 2** *>*
EXAMPLE	// To trigger the release of a frame of data when the DSA in is SCAN mode **TRIG** *::: [1 frame of scan data] :::*
NOTES	**TRIG** with no arguments is accepted when the module is in SCAN mode and TRIG is set to 1.

CALIBRATION COMMANDS

QUICK-ZERO OFFSET CALIBRATION (CALZ)

COMMAND	CALZ
TYPE	Set/Function
DESCRIPTION	Commands the DSA to perform a quick zero calibration, enable or disable the quick-zero offset correction terms, or retrieves the current setting. The CALZ function produces A/D count values for each pressure channel that is subtracted from the raw pressure counts before converting to the chosen pressure units. The data is stored in the DELTA configuration variable array. After a CALZ is completed, the values stored in delta are activated. The CALZ function only zero's channels that are defined as non-absolute sensors. If a channel is defined as an absolute channel, the software will not perform a CALZ on that channel. Setting the CALZ variable will enable or disable the values used in the DELTA array. When the zero correction deltas are set (enable or disable) the DSA will not perform a CALZ function. The CALZ variable can be found under **LIST S**. The CALZ function will automatically configure the internal solenoids to place the module into CALIBRATE mode. This will only happen if pressure is supplied to the CTL SUPPLY port. If no control pressure is present, the solenoids will still operate, however the module will remain in measurement mode. After changing the valve state to CALIBRATE mode, it will dwell for a set time to allow for control pressure to settle. This dwell time is set by the **CALZDLY** command under **LIST S**. If you would like to perform a CALZ without switching the solenoids, see the MCALZ command.

SYNTAX	**CALZ** [<status>]
	
	Where <status>:
	    0 = The zero offset terms in DELTA are disabled and not used.
	    1 = The zero offset terms in DELTA are enabled (auto-set if the CALZ function is performed).
	    2 = The zero offset terms in DELTA are persistent and are maintained through a power cycle. Subsequent CALZ functions will be saved in the flash, loaded and applied on power up.

RETURNS	CALZ <status> - and/or - Prompt when ready to accept a new command.
DEFAULT	1
EXAMPLE	// To perform a quick-zero offset calibration **CALZ** >
EXAMPLE	// To disable the zero offset correction **CALZ 0** >
NOTES	If CALZ == 0 and a CALZ function is performed, CALZ will automatically be set to 1. When CALZ == 1, every CALZ function will update the deltas in RAM and maintain CALZ 1. When CALZ == 2, every CALZ function will update the deltas in RAM, save deltas to permanent memory, and maintain CALZ 2 (CALZ set to 2 must be saved for the delta file to be loaded on power-up).
NOTES	The MODEL variable will dictate if the CALZ or CALB command is accepted (based on sensor configuration).

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MANUAL QUICK-ZERO OFFSET CALIBRATION (MCALZ)

COMMAND	MCALZ
TYPE	Function
DESCRIPTION	Commands the DSA to perform a quick zero calibration, and enable the quick-zero offset correction terms without changing the current valvestate of the DSA (internal solenoids are left as is). The CALZ function produces A/D count values for each pressure channel that is subtracted from the raw pressure counts before converting to the chosen pressure units. The data is stored in the DELTA configuration variable array. After a CALZ is completed, the values stored in delta are activated. The CALZ function only zero's channels that are defined as non-absolute sensors. If a channel is defined as an absolute channel, the software will not perform a CALZ on that channel.
SYNTAX	**MCALZ**
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	// To perform a quick-zero offset calibration without switching the internal solenoids **MCALZ** >
NOTES	MCALZ still conforms to the settings of the CALZ variable. See the CALZ command for more information.

QUICK-ZERO OFFSET BAROMETRIC CALIBRATION (CALB)

COMMAND	CALB
TYPE	Function
DESCRIPTION	Commands the DSA to perform a quick zero barometric calibration. The pressure entered as the barometric pressure must be in PSIA (with up to 6 decimal places). The CALB function produces A/D count values for each pressure channel that is subtracted from the raw pressure counts before converting to the chosen pressure units based on the current pressure, and the entered barometric pressure. The data is stored in the DELTA configuration variable array. After a CALB is completed, the values stored in delta are activated. NOTE: In order for the correction to be active, CALZ must be set to 1. The CALB function only uses the entered pressure for channels that are defined as absolute sensors. If a channel is not defined as an absolute channel, the software will not perform a CALB on that channel.
SYNTAX	**CALB** <barometric pressure in psia>
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	// To perform a quick-zero offset calibration, and the current barometric pressure is 14.1psia **CALB 14.1** >
NOTES	Similar to the MCALZ command, MCALB <barometric pressure> is supported as a method to calibrate barometric without changing the internal solenoids.
NOTES	The MODEL variable will dictate if the CALZ or CALB command is accepted (based on sensor configuration).

UDP Variables

The UDP settings control the target and enable the transfer of scan data out using UDP protocol.

List UDP Settings (List UDP)

COMMAND	LIST UDP
TYPE	Get
DESCRIPTION	Returns all of the UDP settings
SYNTAX	LIST UDP
RETURNS	All of the settings, followed by the prompt.
EXAMPLE	**LIST UDP** *ENUDP 0* *IPUDP 224.0.1.2 7000* *>*

UDP Output Control (UDP)

COMMAND	ENUDP
TYPE	Get/Set
DESCRIPTION	Enables or disables UDP data output by the DSA, or retrieves the current setting.

SYNTAX	**ENUDP** <status>
	
	Where <status>:
	   0 = UDP output is disabled
	   1 = UDP output is enabled. Scan data format is binary.

RETURNS	ENUDP <status> - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Enable UDP output **ENUDP 1** *>*
EXAMPLE	// To find the current setting **ENUDP** *ENUDP 0* *>*

UDP Output Destination (IPUDP)

COMMAND	IPUDP
TYPE	Get/Set
DESCRIPTION	Configure the data destination for UDP output by the DSA, or retrieves the current setting.
SYNTAX	**IPUDP** <ip address> <port> Where <ip address> is any valid IPv4 address, including multicast addresses. Where <port> is the UDP port from 1 to 65535.
RETURNS	IPUDP <ip address> <port> - and/or - Prompt when ready to accept a new command.
DEFAULT	0.0.0.0 0

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EXAMPLE	// Configure a multicast UDP destination **IPUDP 224.1.10.134 23** >
EXAMPLE	// To find the current setting **IPUDP** *IPUDP 191.30.100.100 4000* >

FTP VARIABLES

The FTP settings are used to control the FTP client connection to the FTP server and enable of transfer of scan data using FTP protocol.

LIST FTP SETTINGS (LIST FTP)

COMMAND	LIST FTP
TYPE	Get
DESCRIPTION	Returns all of the FTP settings
SYNTAX	**LIST FTP**
RETURNS	All of the settings, followed by the prompt.
EXAMPLE	**LIST FTP** *ENFTP 0* *USERFTP admin* *PASSFTP password* *PATHFTP /File* *IPFTP 10.0.1.222* *FILEFTP Scan* *>*

FTP OUTPUT CONTROL (FTP)

COMMAND	ENFTP
TYPE	Get/Set
DESCRIPTION	Enables or disables FTP data output by the DSA or retrieves the current setting. An optional argument is provided to change the scan data format that is output when enabled.

SYNTAX	**ENFTP** <status> [<format>]
	
	Where <status>:
	    0 = FTP output disabled
	    1 = FTP output enabled.
	Where the optional <format>:
	    A = Scan data format is Unformatted ASCII (creates .txt file)
	    B = Scan data format is Binary (creates .dat file)
	    C = Scan data format is CSV ASCII (creates .csv file)
	
	If the optional format argument is not provided and FTP output is enabled, the default format with be Binary (**ENFTP 1** and **ENFTP 1 B** result in the same configuration).
	If FTP output is disabled, the format is cleared and must be set again next time FTP is enabled (if needed).

RETURNS	FTP <status> [<format>] - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Enable FTP output using binary data output **ENFTP 1** >
EXAMPLE	// Enable FTP output using CSV data output **ENFTP 1 C** >

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FTP User Name (USERFTP)

COMMAND	USERFTP
TYPE	Set/Get
DESCRIPTION	Sets the name of the user login on the FTP server.
SYNTAX	**USERFTP** <username>
RETURNS	USERFTP <username> - and/or - Prompt when ready to accept a new command
DEFAULT	admin
EXAMPLE	// set FTP username to "scanivalve" **USERFTP Scanivalve** >

FTP Password (PASSFTP)

COMMAND	PASSFTP
TYPE	Set/Get
DESCRIPTION	Sets the name of the user password for login on the FTP server.
SYNTAX	**PASSFTP** <password>
RETURNS	PASSFTP <password> - and/or - Prompt when ready to accept a new command
DEFAULT	password
EXAMPLE	// set FTP password to "password" **PASSFTP password** >

FTP Path (PATHFTP)

COMMAND	PATHFTP
TYPE	Set/Get
DESCRIPTION	Set the directory path of the scan data file on the FTP Server, expressed in URL Style. The argument does not require the use of a drive letter e.g., C: or D:.
SYNTAX	**PATHFTP** <directory path> The <directory path> must start with a "/". Using only the "/" will send data to the root folder of the FTP server in most cases.
RETURNS	PATHFTP <directory path> - and/or - Prompt when ready to accept a new command
DEFAULT	/disk1/share
EXAMPLE	// set folder path to /Scanivalve_Data/Test1 **PATHFTP /Scanivalve_Data/Test1** >

FTP IP Address (IPFTP)

COMMAND	IPFTP
TYPE	Set/Get

DESCRIPTION	Set the IP address of the FTP destination server.
SYNTAX	**IPFTP** \<nnn.nnn.nnn.nnn\> Where \<nnn.nnn.nnn.nnn\> is any valid IP address (each octet within 0 - 255).
RETURNS	IPFTP \<nnn.nnn.nnn.nnn\> - and/or - Prompt when ready to accept a new command
DEFAULT	10.0.0.1
EXAMPLE	// set the FTP servers IP address to 10.0.1.222 **IPFTP 10.0.1.222** >

FTP FILE NAME PREFIX (FILEFTP)

COMMAND	FILEFTP
TYPE	Set/Get
DESCRIPTION	Set the base name for the scan data when transferred to the FTP server. The full file name will have the time and date appended to the value set here. The file extension is based on the data format.
SYNTAX	**FILEFTP** \<prefix\> Where \<prefix\> can be any ASCII character, and up to 63 characters. Spaces can not be handled.
RETURNS	Prompt when ready to accept a new command
DEFAULT	SCAN
EXAMPLE	// set the FTP filename prefix to "DSA_117_" **FILEFTP DSA_117_** >

IP VARIABLES

The IP settings are used to control the static IP address, subnet, MAC address, and gateway for communications with the DSA module. These variables can only be saved using the **SAVE IP** command, and changes do not take effect until a **SAVE IP** has been completed, followed by a power cycle.

LIST IP SETTINGS (LIST IP)

COMMAND	LIST IP
TYPE	Get
DESCRIPTION	Returns all of the IP or bootloader settings
SYNTAX	**LIST IP**
RETURNS	All of the settings, followed by the prompt.
EXAMPLE	**LIST IP** *IP 191.30.130.1* *SUBNET 255.255.0.0* *MAC 0:60:5d:82:0:04* *GW 192.168.0.1* *>*

IP ADDRESS (IP)

COMMAND	IP
TYPE	Get/Set
DESCRIPTION	Sets the IPv4 address of the DSA, or retrieves the current setting. A SAVE IP and REBOOT must be performed for changes to take effect.
SYNTAX	**IP <nnn.nnn.nnn.nnn>** Where <nnn.nnn.nnn.nnn> is any valid IP address (each octet within 0 - 255).
RETURNS	IP <nnn.nnn.nnn.nnn> - and/or - Prompt when ready to accept a new command.
DEFAULT	191.30.xxx.yyy Where xxx is the model assignment: 130 = DSA5000 Where yyy is the last three digits of the serial number.
EXAMPLE	// Retrieve the current IP address of the DSA **IP** *IP 191.30.130.2* *>*
EXAMPLE	// Set the IP address of the DSA **IP 192.168.0.1** *>*

SUBNET MASK (SUBNET)

COMMAND	SUBNET
TYPE	Get/Set
DESCRIPTION	Sets the IPv4 Subnet Mask of the DSA, or retrieves the current setting. A SAVE and REBOOT must be performed for changes to take effect.

SYNTAX	**SUBNET** <nnn.nnn.nnn.nnn> Where <nnn.nnn.nnn.nnn> is any valid subnet mask setting (each octet within 0 - 255).
RETURNS	SUBNET <nnn.nnn.nnn.nnn> - and/or - Prompt when ready to accept a new command.
DEFAULT	255.255.0.0
EXAMPLE	// Set the subnet mask of the DSA **SUBNET 255.255.255.0** >
EXAMPLE	// To retrieve the current rate setting **SUBNET** *SUBNET 255.255.0.0* >

ETHERNET MAC ADDRESS (MAC)

COMMAND	MAC
TYPE	Get/Set
DESCRIPTION	Sets the hardware's MAC address, or retrieves the current setting.
SYNTAX	**MAC** <xx:xx:xx:xx:xx:xx> Where <xx:xx:xx:xx:xx:xx> is any valid MAC address in hex format.
RETURNS	MAC <xx:xx:xx:xx:xx:xx> - and/or - Prompt when ready to accept a new command.
DEFAULT	0:60:5d:82:xx:xx Where xx.xx is the serial number of the DSA in hex format.
EXAMPLE	// To set the MAC address **MAC 0:60:5d:82:0:02** >
EXAMPLE	// To retrieve the current frames per second setting **MAC** *MAC 0:60:5d:82:0:04* >
NOTES	The last two hex values may be modified by a user, but it is recommended that they not be modified. The first four hex values MUST NOT be modified. These values (0:60:5d:82) represent a setting registered to Scanivalve Corp.

DEFAULT GATEWAY (GW)

COMMAND	GW
TYPE	Get/Set
DESCRIPTION	Sets the IP Address to be used to access the server if the server IP address is an IP address outside the DSA subnet, or retrieves the current setting.
SYNTAX	**GW** <nnn.nnn.nnn.nnn> Where <nnn.nnn.nnn.nnn> is any valid IP address (each octet within 0 - 255).

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RETURNS	GW <nnn.nnn.nnn.nnn> - and/or - Prompt when ready to accept a new command.
DEFAULT	0.0.0.0
EXAMPLE	// To set the gateway IP address **GW 123.443.657.43** >
EXAMPLE	// To retrieve the current frames per second setting **GW** *GW 0.0.0.0* >

IDENTIFICATION VARIABLES

The identification variables group help define specific module properties, including the serial number, model, label and nominal pressure range. This list is saved as a part of the Calibration coefficient file (Cal.cfg). Many of these variables are used as identifiers, such as in the Web Server, SSEP, and file naming.

LIST IDENTIFICATION SETTINGS (LIST ID)

COMMAND	LIST ID
TYPE	Get
DESCRIPTION	Retrieves all identification configurations stored in temporary memory.
SYNTAX	**LIST ID**
RETURNS	\<setting> \<variable> ::: ::: ::: ::: \<setting> \<variable> Followed by a prompt when ready to accept a new command.
EXAMPLE	**LIST ID** *SN 1* *MODEL DSA5000* *LABEL UNDEFINED* *NPR 5 -5* *XITE 0* *>*

SERIAL NUMBER (SN)

COMMAND	SN
TYPE	Get/Set
DESCRIPTION	This sets the serial number of the module, or retrieves the current setting. This is typically set at the factory and should not be altered in the field.
SYNTAX	**SN** \<value> Where \<value> is any valid integer 0 - 65535.
DEFAULT	100
RETURNS	SN \<value> -and/or- Followed by a prompt when ready to accept a new command.
EXAMPLE	// Set the serial number to 1234 **SN 1234** >
EXAMPLE	// Retrieve the current serial number **SN** *SN 100* >
NOTES	This value will get printed to the name of the Cal.cfg and Fc.cfg file when a SAVE is issued. Format for the file is \<group>_\<sn>.cfg.

MODEL NUMBER (MODEL)

COMMAND	MODEL
TYPE	Get/Set

DESCRIPTION	This sets the model number of the module, or retrieves the current setting. This is typically set at the factory and should not be altered in the field. This variable may control specific functionality inherent to the DSA5000.
SYNTAX	**MODEL** DSA5\<build\>\<config\> Where \<build\> can be any integer 0 - 5, and \<config\> any two digit integer from 00 - 29.
RETURNS	MODEL DSA\<build\>\<config\> - and/or - Prompt when ready to accept a new command.
DEFAULT	DSA5000
EXAMPLE	// set the DSA model to a DSA5124 **MODEL DSA5124** >
EXAMPLE	// Retrieve the current model setting **MODEL** *MODEL DSA5001* >

NOTES	This variable:
	    Defines the installed sensor configuration (differential or absolute) and determines whether the **CALZ** or **CALB** command is accepted.
	    Defines if a heater is installed, and determines if the **HEATER** command accepts an argument.
	    Defines if a module is a Standard (common) or True Differential module.
	    Defines the solenoid type in Standard Differential modules (Normally Closed or Open).

NOTES	For some of the functionality, this variable may require a save and power cycle for changes to take affect.

LABEL (LABEL)

COMMAND	LABEL
TYPE	Get/Set
DESCRIPTION	Allows for a custom label to be added to identify the particular DSA, or retrieves the current setting.
SYNTAX	**LABEL** \<value\> Where \<value\> can be up to 32 ASCII characters. Spaces can not be used. If more than 32 characters are entered, the DSA will truncate the entered value.
RETURNS	LABEL \<value\> - and/or - Prompt when ready to accept a new command.
DEFAULT	UNDEFINED
EXAMPLE	// set the label to identify the module **LABEL BoundaryWall_1** >
EXAMPLE	// Retrieve the current label **LABEL** *LABEL 5PSI_LeftWing* >

NOMINAL PRESSURE RANGE (NPR)

COMMAND	NPR
TYPE	Get/Set
DESCRIPTION	Sets the nominal pressure range of the unit, both min and max, or retrieves the current setting. This variable is set at the factory and should not be altered in the field.
SYNTAX	**NPR** <npr1p> <npr1n> [<npr2p> <npr2n>] Where: <npr1p> = the maximum nominal pressure <npr1n> = the minimum nominal pressure If the optional <npr2p> <npr2n> are entered, the DSA will identify as a dual range unit (lowest range as 1 and highest range as 2). The variables will then be identified as: <npr1p> = the maximum nominal pressure for channels 1 - 8 <npr1n> = the minimum nominal pressure for channels 1 - 8 <npr2p> = the maximum nominal pressure for channels 9 - 16 <npr2n> = the minimum nominal pressure for channels 9 - 16
RETURNS	NPR <npr1p> <npr1n> [<npr2p> <npr2n>] - and/or - Prompt when ready to accept a new command.
DEFAULT	15 -15
EXAMPLE	// set the NPR for a single range 100PSI unit **NPR 100 -15** >
EXAMPLE	// Retrieve the current NPR **NPR** *NPR 5 -5* >
EXAMPLE	// set the NPR for a dual range 15/50PSI unit **NPR 15 -15 50 -15** >
NOTES	This variable will not change the measurable range of the module, only the valid data bounds. Invalid pressure data will be shown as 9999 errors in the channel data.

SENSOR EXCITATION POLARITY (XITE)

COMMAND	XITE
TYPE	Get/Set
DESCRIPTION	Determines the polarity of the excitation voltages applied to the sensors, or retrieves the current setting.

SYNTAX	**XITE** <value>
	
	Where <value>:
	    0 = negative
	    1 = positive

RETURNS	XITE <value> - and/or - Prompt when ready to accept a new command.
DEFAULT	1

EXAMPLE	// set the sensor excitation to negative **XITE 0** >
EXAMPLE	// Retrieve the current setting **XITE** *XITE 1* >
NOTES	This variable is set at the factory and should not be altered in the field. Altering this variable will cause data to be invalid.

MISCELLANEOUS VARIABLES

The Miscellaneous Group variables are variables that have no direct relation to each other or a specific group. This list of groups of variables may have additions or removals at any time and may never be the same from version to version.

LIST MISCELLANEOUS SETTINGS (LIST M)

COMMAND	LIST M
TYPE	Get
DESCRIPTION	Retrieves all miscellaneous configurations stored in temporary memory.
SYNTAX	**LIST M**
RETURNS	<setting> <variable> ::: ::: ::: ::: <setting> <variable> Followed by a prompt when ready to accept a new command.
EXAMPLE	**LIST M** *PROMPT 0* *ERRORLOG 1* *HEATER 0 25* *SSEP 1* *>*

ERROR LOG (ERRORLOG)

COMMAND	ERRORLOG
TYPE	Get/Set
DESCRIPTION	This sets the behavior of errors as they are generated, or retrieves the current setting. When the error log is enabled, errors will be stored here. The error log can be cleared using the CLEAR command. A maximum of 30 errors can be stored in the log.
SYNTAX	**ERRORLOG** <status> Where <status> is the error log setting, and can be set as: 　　0 = Errors are immediately reported back to the client and not stored in a log 　　1 = Errors are not reported back to the client and are stored in an error log 　　2 = Errors are immediately reported back to the client and stored in the error log
DEFAULT	1
RETURNS	ERRORLOG <status> -and/or- Followed by a prompt when ready to accept a new command.
EXAMPLE	// Turn off the error log **ERRORLOG 0** *>*
EXAMPLE	// Retrieve the current error log setting **ERRORLOG** *ERRORLOG 1* *>*
NOTES	When ERRORLOG is 0 or 2, data is returned to the client from where the last command came. If the client does not exist, it attempts to return the error to the Telnet connection. If no Telnet connection exists, it sends the error to serial.

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RETURN PROMPT CONFIGURATION (PROMPT)

COMMAND	PROMPT
TYPE	Get/Set
DESCRIPTION	Determines how the DSA terminates responses, or retrieves the current setting. This also allows you to configure a character that can be output after the DSA's response is terminated and the DSA is ready to accept the next command.
SYNTAX	**PROMPT** <value> [<character>] Where <value>: 　　0 = default (CR-LF, no optional character) 　　1 = CR 　　2 = LF 　　3 = CR-LF Where <character> is optional, and can be any valid ASCII character. If a character is entered in this field, the character will be sent after the value setting, once the DSA is ready to accept the next command. Only one character can be set. A character can not be set when PROMPT == 0.
RETURNS	PROMPT <value> [<character>] - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// set the DSA response to output one CR followed by a ">" **PROMPT 1 >** >
EXAMPLE	// Retrieve the current prompt setting **PROMPT** *PROMPT 3 >* >

HEATER CONTROL (HEATER)

COMMAND	HEATER
TYPE	Get/Set
DESCRIPTION	Allows for heater control and configuration, or retrieves the current settings which include the current heater RTD temperature and power consumption (for the heater only). Heater control is limited to modules that are built as heater modules.
SYNTAX	**HEATER [**<status> <setpoint>] Where <status>: 　　0 = Heaters are disabled. 　　1 = Heater auto-control is enabled. Where <setpoint> is any temperature between and including 10°C to 65°C.
DEFAULT	0 25

RETURNS	HEATER \<status> \<setpoint> RTD:\<temp>C PWR:\<power>W
	Where \<temp> is the current heaters RTD temperature in degrees Celsius.
	Where \<power> is the current heater power consumption in watts.
	-and/or-
	Followed by a prompt when ready to accept a new command.
EXAMPLE	// Turn off the heater control
	HEATER 0
	>
EXAMPLE	// Retrieve the current error log setting
	HEATER
	HEATER 1 25 RTD:24.55C PWR:0.12W
	>
NOTES	If the module is not defined as a heater model, \<temp> and \<power> will always display "--" in the HEATER response. If the module is defined as a heater model but the heater controller cannot be read, \<temp> and \<power> will display "ERR" (error).
NOTES	The HEATER command will not accept any arguments if MODEL is not defined as a heater model (no heater controller present). However, the command without arguments will always return information regardless of the configured model.

SSEP ASSIGNMENT (SSEP)

COMMAND	SSEP
TYPE	Get/Set
DESCRIPTION	This sets the assignment of the module in regards to the SSEP functionality. Assignment can be determined automatically or manually based on the SSEP setting.
SYNTAX	**SSEP** \<value>
	Where \<value> is the current module assignment, and can be set as:
	0 = Automatic Assignment (not implemented)
	1 = Module is forced into Standalone mode.
	2 = Module is forced into Controller mode.
	3 = Module is forced to be a Middle Responder.
	4 = Module is forced to be the Last Responder.
	See the SSEP section of the manual for the explanation and behavior of each assignment.
DEFAULT	1
RETURNS	SSEP \<value>
	-and/or-
	Followed by a prompt when ready to accept a new command.
EXAMPLE	// Force the module to act as a standalone module
	SSEP 1
	>
EXAMPLE	// Retrieve the current error log setting
	SSEP
	SSEP 3
	>

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PRECISION TIME PROTOCOL VARIABLES (LIST PTP)

The precision time protocol settings control the PTP 1588 settings of the DSA5000. The PTP configuration is accessed by the command LIST PTP.

LIST PRECISION TIME PROTOCOL SETTINGS (LIST PTP)

DESCRIPTION	Returns all of the PTP settings
SYNTAX	LIST PTP
RETURNS	All of the PTP setting followed by the prompt.
EXAMPLE	**LIST PTP** *PTPEN 1* *STAT 0* *SST 0:0:0.000000* *SSD 1971/1/1* *UTCO -7:00:00* *MAXOFM 0* *>*

PTP ENABLE (PTPEN)

COMMAND	PTPEN
TYPE	Set/Get
DESCRIPTION	Enables the precision time protocol engine in the DSA5000, or retrieves the current setting. When enabled, the DSA will listen for PTP information on the network and communicate with any found PTP Grandmasters.

SYNTAX	PTPEN <status>
	Where <status> is:
	   0 = PTP engine disabled
	   1 = PTP engine enabled

RETURNS	PTPEN <status> - and/or - Prompt when ready to accept a new command.
EXAMPLE	// enable the DSA to listen for PTP information on the network **PTPEN 1** >
EXAMPLE	// Retrieve the PTP engine status **PTPEN** *PTPEN 0* >
DEFAULT	0

PTP STATISTICAL OUTPUT (STAT)

COMMAND	STAT
TYPE	Set/Get
DESCRIPTION	Sets the destination of PTP statistical output, or retrieves the current setting.

SYNTAX	**STAT** <level code>
	Where <level code> is:
	   0 = off
	   1 = serial

RETURNS	STAT <level code>
	- and/or -
	<statistical ptp data>
	- and/or -
	Prompt when ready to accept a new command.
	
	The statistical data is output in the following format:
	<ofm>, <msd>, <smd>, <mpd>, <obc>
	    ofm = Offset From Master. Time that slave and master differ in units of microseconds
	    msd = Master to Slave Delay. Filtered packet delivery time from master to slave
	    smd = Slave to Master Delay. Filtered packet delivery time from slave to master
	    mpd = Mean Path Delay. Filtered mean path delay time
	    obc = Observed Correction. The observed correction of the internal clock in nanoseconds

EXAMPLE	// Set stat output off **STAT 0** >
EXAMPLE	// Monitor the current PTP statistic output via serial connection **STAT** *STAT 1* >
DEFAULT	0
NOTES	Once set, the DSA will stream this data until STAT 0 is issued. A STOP command will not stop this stream of data.

SCAN START TIME (SST)

COMMAND	SST
TYPE	Set/Get

DESCRIPTION	Sets the time that will begin scan data transfer as referenced to the internal time of the module, or retrieves the current setting. Used in combination with SSD.
	
	When a SCAN is executed, the DSA will only use the value of SST (scan start time) and SSD (scan start date) to initiate scan data transfer under two conditions:
	    1) PTPEN is set to a non-zero number.
	    2) The combination of SST and SSD are set to a future time and date as compared to the DSA's
	      current internal time.
	
	When met, the DSA will remain in SCAN mode without transferring scan data to the configured destination until the internal time has met the values of SST and SSD.
	
	When these two cases are not met, the DSA will immediately transfer the scan data to the configured destination.

SYNTAX	**SST** <hh:mm:ss.fffff>
	
	Where:
	    hh = Hours (24 hour format)
	    mm = Minutes
	    ss = Seconds
	    ffff = fractions of a second

RETURNS	SST <hh:mm:ss.fffff> - and/or - Prompt when ready to accept a new command.

DEFAULT	0:0:0.0000
EXAMPLE	// set scan start time of 13:00:00 **SST 13:00:00.000** >
EXAMPLE	// Retrieve the current scan start time **SST** *SST 8:10:00* >
NOTES	The internal time and date of the DSA, when PTP is enabled (PTPEN == 1), may be synchronized to a PTP Grandmaster's time as long as PTP Grandmaster packets are discovered on the network by the DSA.

SCAN START DATE (SSD)

COMMAND	SSD
TYPE	Set/Get
DESCRIPTION	Sets the time that will begin scan data transfer as referenced to the internal time of the module, or retrieves the current setting. Used in combination with SST. When a SCAN is executed, the DSA will only use the value of SST (scan start time) and SSD (scan start date) to initiate scan data transfer under two conditions: 1) PTPEN is set to a non-zero number. 2) The combination of SST and SSD are set to a future time and date as compared to the DSA's current internal time. When met, the DSA will remain in SCAN mode without transferring scan data to the configured destination until the internal time has met the values of SST and SSD. When these two cases are not met, the DSA will immediately transfer the scan data to the configured destination.
SYNTAX	**SSD** <yyyy/mm/dd > Where: yyyy = Year mm = Month dd = Day
RETURNS	SSD <yyyy/mm/dd > - and/or - Prompt when ready to accept a new command.
DEFAULT	1971/1/1
EXAMPLE	// set the scan start date **SSD 2016/08/10** >
EXAMPLE	// Retrieve the current scan start date **SSD** *SSD 2022/03/11* >
NOTES	The internal time and date of the DSA, when PTP is enabled (PTPEN == 1), may be synchronized to a PTP Grandmaster's time as long as PTP Grandmaster packets are discovered on the network by the DSA.

UTC OFFSET (UTCOFFSET)

COMMAND	UTCOFFSET
TYPE	Set/Get
DESCRIPTION	Sets the time offset from the received PTP Network time, or retrieves the current setting. Can be used to offset from UTC time or adjust for timing differences like leap seconds.

SYNTAX	**UTCOFFSET** <hh:mm:ss>
	
	Where:
	    hh = Hours from -12 to 12
	    mm = Minutes from 0 to 59
	    ss = Seconds from 0 to 59

RETURNS	UTCOFFSET <hh:mm:ss> - and/or - Prompt when ready to accept a new command.
DEFAULT	0:0:0
EXAMPLE	// Retrieve the current internal UTC offset **UTCOFFSET** *UTCOFFSET -8:00:00* *>*
EXAMPLE	// Set the UTC offset for leap seconds **UTCOFFSET -0:0:37** *>*

MAX OFFSET FROM MASTER TOLERANCE (MAXOFM)

COMMAND	MAXOFM
TYPE	Set/Get
DESCRIPTION	Sets an acceptable tolerance in microseconds for the Offset From Master value, or retrieves the current setting. This tolerance will generate an error flag in the binary packet when the DSA's offset from master exceeds this value. This will notify the user of PTP time instability and will indicate that the time-stamp in the frame of data may not be accurate. The flag will not appear if the OFM is within this tolerance.
SYNTAX	**MAXOFM** <tolerance> Where <tolerance> is in microseconds. Valid values are 0 to 1000. If set to 0, this setting is disabled and the error flag will always be false.
RETURNS	MAXOFM <hh:mm:ss> - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Retrieve the current internal UTC offset **MAXOFM** *MAXOFM 1000* *>*
EXAMPLE	// Set a MAXOFM tolerance of 1 millisecond **MAXOFM 1000** *>*

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**PTP Domain (DOMAIN)**

COMMAND	DOMAIN
TYPE	Set/Get
DESCRIPTION	Sets the PTP Domain value. Allows the DSA PTP engine to listen for specific domains when multiple PTP time sources are available.
SYNTAX	**DOMAIN** <value> Where <tolerance> is 0 to 127.
RETURNS	DOMAIN <value> - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Retrieve the current internal UTC offset **DOMAIN** _DOMAIN 0_ _>_
EXAMPLE	// Set the PTP domain to 40 **DOMAIN 40** _>_

PTP (Precision Time Protocol) Commands

**Grandmaster UTC Offset**

COMMAND	GETUTCO
TYPE	Get
DESCRIPTION	Retrieves the offset and validity of the offset from the Grandmaster's PTPv2 packets.
SYNTAX	**GETUTCO**

RETURNS	GMO <x> <y> <z>
	
	Where <x> is the current difference between TAI time and UTC time, in seconds, as supplied by the local grandmaster. Note: this offset it not automatically adjusted for in the DSA.
	
	Where <y> is:
	    0 = the Grandmaster does not exist or is not valid
	    1 = the Grandmaster exists and is valid
	
	Where <z> is:
	    0 = the value for <x> is not valid
	    1 = the value for <x> is valid
	
	Followed by a prompt when ready to accept a new command.

EXAMPLE	**GETUTCO** _UTC Offset 37 1 1_ _>_

**Internal Time**

COMMAND	TIME
TYPE	Get/Set

DESCRIPTION	Sets or retrieves the current internal time of the DSA. TIME cannot be set if PTP is enabled and a PTP Grandmaster is on the network. If the DSA is receiving PTP information, this time will update according to the time/date received.
SYNTAX	**TIME** <YYYY/MM/DD> <hh:mm:ss>

Where <YYYY/MM/DD> is a valid date after 1970/1/1:
    YYYY = year
    MM = month
    DD = day

Where <hh:mm:ss> is a valid time using the 24-hour clock:
    hh = hour from 0 to 24
    mm = minute from 0 to 60
    ss = second from 0 to 60 |
| RETURNS | TIME <YYYY/MM/DD> <hh:mm:ss>
- and/or -
Prompt when ready to accept a new command. |
| DEFAULT | 2015/1/1 00:00:00 |
| EXAMPLE | // To set the internal time when no PTP Grandmaster is present on the network
TIME 2021/1/20 7:30:00
> |
| EXAMPLE | // To retrieve the current internal time
TIME
TIME 1970/1/1 00:01:12
> |
| NOTES | The DSA does not maintain the time through a power cycle. When the unit is first powered on, it will revert to the default time setting. If a PTP Grandmaster is on the network, it will update as soon as it can. |

PTP STATISTICS

COMMAND	PTPDEBUG
TYPE	Set
DESCRIPTION	Configures the output of an advanced PTP Statistical or debug information via serial connection only.
SYNTAX	**PTPDEBUG** <hex pattern>

Where <hex pattern> is:
    Bit 0 = Displays Content of PTP event messages
    Bit 1 = Displays content of PTP general messages
    Bit 2 = Displays the time stamps of PTP messages
    Bit 3 = Displays the offset time (in nanoseconds) from the Grandmaster
    Bit 4 = Displays the announce packet Grandmaster's identity
    Bit 5 = When set, uses a "0" as the time stamp for Frame 1 when starting a scan. When not set, uses the current PTP time as the time stamp for Frame 1 |
| RETURNS | PTP debug information and then prompt when ready to accept a new command. |
| DEFAULT | 0 |

EXAMPLE	// To set the statistical output to send information to the network **PTPDEBUG 8** > *1123.55, 41, 40, 124* *592.81, 40, 40, 124* *2.23, 40, 40, 125*
EXAMPLE	// To stop the statistical PTP output **PTPDEBUG 0** >
NOTES	The statistical output will be directed to the serial connection. It can only be stopped by sending the command: PTPDEBUG 0

CURRENT PTP OFFSET

COMMAND	PTPSTAT
TYPE	Get
DESCRIPTION	Retrieves the current difference between the DSA's time and the Grandmasters time.
SYNTAX	**PTPSTAT**
RETURNS	PTPSTAT <second>,<nanoseconds> Followed by a prompt when ready to accept a new command.
EXAMPLE	**PTPSTAT** *PTPSTAT,123345,34210* >

VALVE CONTROL COMMANDS

VALVESTATE

COMMAND	VALVE
TYPE	Get/Set
DESCRIPTION	Turns on/off solenoids to set the DSA into one of the many valve states, or retrieves the DSA's current states. The internal valves will only change modes when 90-120psi control pressure is available at the DSA control pressure input. This is the recommended command for changing valvestate as it is universal to all module configurations.

SYNTAX	**VALVE** <mode>
	
	Where <mode> is:
	    PX = enables measurement mode
	    ISO = enables isolate mode
	    CAL = enables calibrate mode
	    PRG = enables purge mode
	    FRE = enables dormant Freon mode

RETURNS	VALVE <mode> [<solenoid pattern>] Where <mode> is one of the options above. Where [<solenoid pattern>] is a 3 digit bit code for the enable/disable of the three solenoids, where CTL1 is the least significant bit (only seen when <mode> is UNK). - and/or - Prompt when ready to accept a new command.
DEFAULT	PX
EXAMPLE	// Change the valve state to PRG mode **VALVE PRG** >
EXAMPLE	// Retrieve the current DSA mode (when not in a typical mode) **VALVE** *VALVE UNK 0x4* >
EXAMPLE	// Retrieve the current DSA mode **VALVE** *VALVE CAL* >
NOTES	The DSA will not accept UNK or a bit value as an argument.
NOTES	To see the solenoid patterns for the different modes, refer to Tables 4-1 and 4-2.

SOLENOID 1 CONTROL

COMMAND	CTL1
TYPE	Get/Set
DESCRIPTION	Turn on or off solenoid number 1 (CTL1), or retrieve the current status.

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SYNTAX	**CTL1** \<state\>
	
	Where \<state\> is:
	   0 = off
	   1 = on

RETURNS	CTL1 \<state\> - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Enable solenoid 1 **CTL1 1** \>
EXAMPLE	// Check the current status of solenoid 1 **CTL1** *CTL1 0* \>
NOTES	This command only energizes the solenoid. Valve state or mode will depend on the solenoid type, sequence, and presence of control pressure. See <u>Valvestates and Solenoids</u> for more information.

SOLENOID 2 CONTROL

COMMAND	CTL2
TYPE	Get/Set
DESCRIPTION	Turn on or off solenoid number 2 (CTL2), or retrieve the current status.

SYNTAX	**CTL2** \<state\>
	
	Where \<state\> is:
	   0 = off
	   1 = on

RETURNS	CTL2 \<state\> - and/or - Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Enable solenoid 2 **CTL2 1** \>
EXAMPLE	// Check the current status of solenoid 2 **CTL2** *CTL1 0* \>
NOTES	This command only energizes the solenoid. Valve state or mode will depend on the solenoid type, sequence, and presence of control pressure. See <u>Valvestates and Solenoids</u> for more information.

SOLENOID 3 CONTROL

COMMAND	PRGCTL
TYPE	Get/Set
DESCRIPTION	Turn on or off solenoid number 3 (PRGCTL), or retrieve the current status.

SYNTAX	**PRGCTL** \<state>
	Where \<state> is:
	0 = off (disabled)
	1 = on (enabled)
RETURNS	PRGCTL \<state>
	- and/or -
	Prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	// Disable solenoid 3
	PRGCTL 0
	>
EXAMPLE	// Check the current status of solenoid 3
	PRGCTL
	PRGCTL 1
	>
NOTES	This command only energizes the solenoid. Valve state or mode will depend on the solenoid type, sequence, and presence of control pressure. See <u>Valvestates and Solenoids</u> for more information.

PURGE

COMMAND	PURGE
TYPE	Function
DESCRIPTION	Commands the DSA to perform a purge sequence. This command can be used for quick or automated purge sequences.
	When the purge command is received, the follow events will occur, in sequence, automatically:
	Valve state is changed to Calibrate (CAL) mode
	The DSA will dwell in this mode for the amount of time configured in **PGSEQDLY**
	Valve state is changed to Purge (PRG) mode
	The DSA will dwell in this mode for the amount of time configured in **PGDLY**
	If purge air is supplied, it will be flowing through the module and out the inputs
	Valve state is changed to Calibrate (CAL) mode
	The DSA will dwell in this mode for the amount of time configured in **PGSEQDLY**
	Valve state is changed to the state it was prior to the PURGE command and the DSA will be
	ready for the next command.
SYNTAX	**PURGE**
RETURNS	Prompt when completed and ready to accept a new command.
EXAMPLE	// To perform an automated purge sequence
	PURGE
	>
NOTES	For more information on purging, or a manual method for purging without using the PURGE command and variable, please see the section on Purging.

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VALVE CONTROL VARIABLES

The valve control settings include variables that control dwell times and valve boot up states.

LIST VALVE SETTINGS (LIST V)

COMMAND	LIST V
TYPE	Get
DESCRIPTION	Returns all of the valve control settings
SYNTAX	LIST V
RETURNS	All of the settings, followed by the prompt.
EXAMPLE	**LIST V** *VALVEPU PX* *CALZDLY 3* *PGDLY 10* *PGSEQDLY 5* *>*

VALVE POWER-UP STATE (VALVEPU)

COMMAND	VALVEPU
TYPE	Get/Set
DESCRIPTION	Sets the default state of the valve on power up only. Only the accepted valve states in the VALVE command can be used.
SYNTAX	**VALVEPU** \<state\> Where \<state\> can be any of the accepted VALVE argument / states: PX, CAL, ISO, PRG, FRE.
RETURNS	VALVEPU \<status\> - and/or - Prompt when ready to accept a new command.
DEFAULT	PX
EXAMPLE	// Set the power up valvestate to boot into purge mode **VALVEPU PRG** *>*
EXAMPLE	// To find the current setting **VALVEPU** *VALVEPU PX* *>*

CALZ DELAY TIME (CALZDLY)

COMMAND	CALZDLY
TYPE	Get/Set
DESCRIPTION	Configures the delay time before the DSA executes the CALZ or CALB correction. This value is used for the control pressure dwell as the valve state changes when the CALZ command is issued.
SYNTAX	**CALZDLY** \<seconds\> Where \<seconds\> is any valid value between 1 and 30.
RETURNS	CALZDLY \<seconds\> - and/or - Prompt when ready to accept a new command.

DEFAULT	3
EXAMPLE	// Configure the CALZ delay to be 10 seconds **CALZDLY 10** >
EXAMPLE	// To find the current setting **CALZDLY** *CALZDLY 3* >
NOTES	For more information on this variable, see the **CALZ** or **CALB** command.

PURGE DELAY TIME (PGDLY)

COMMAND	PGDLY
TYPE	Get/Set
DESCRIPTION	Configures the duration of the purge portion of the automated purge command. The DSA will be in a purge condition.
SYNTAX	**PGDLY** <seconds> Where <seconds> is any valid value between 0 and 3600. When 0 is used, purge mode will stay in effect indefinitely until the purge process is terminated using the STOP command.
RETURNS	PGDLY <seconds> - and/or - Prompt when ready to accept a new command.
DEFAULT	10
EXAMPLE	// Configure the purge duration to be 10 seconds **PGDLY 10** >
NOTES	For more information on this variable, see the PURGE command.

PURGE SEQUENCE DELAY TIME (PGSEQDLY)

COMMAND	PGSEQDLY
TYPE	Get/Set
DESCRIPTION	Configures the delay time for switching valve states when the automated purge command is used. When the purge command is received, it will switch to a pre-purge condition (Calibrate) and dwell for this amount of time. It will also use this value again after PGDLY has been met.
SYNTAX	**PGSEQDLY** <seconds> Where <seconds> is any valid value between 1 and 30.
RETURNS	PGSEQDLY <seconds> - and/or - Prompt when ready to accept a new command.
DEFAULT	5
EXAMPLE	// Configure the PGSEQDLY delay to be 10 seconds **PGSEQDLY 10** >
NOTES	For more information on this variable, see the PURGE command.

CONVERSION TABLE COMMANDS

LIST CONVERSION TABLE

COMMAND	LIST T
TYPE	Get
DESCRIPTION	Retrieves the current polynomial terms and error correction coefficients being used in the RAM of the DSA.
SYNTAX	**LIST T**
RETURNS	K <channel> <k1> <k2> <k3> <k4> <k5> <k6> A <channel> <a1> <a2> <a3> <a4> B <channel> <b1> <b2> <b3> <b4> C <channel> <c1> <c2> <c3> <c4> C <channel> <d1> <d2> <d3> <d4> Where: <channel> is the channel number <kn> is the least-squares coefficient value as used in the conversion equation <a, b, c, dn> is the error correction coefficient use in the background task to obtain the respective A, B, C, D coefficients for the current temperature Followed by a prompt when ready to accept a new command.
EXAMPLE	// Retrieves the full coefficient table **LIST T** *SET K 1 5.526097E-02 1.113042E-04 1.068045E-07 1.908862E-10 -1.825929E-07 5.010776E-16* *::: <channels 2 through 16> :::* *SET K 32 1.824528E-02 1.728427E-05 1.125552E-07 1.937218E-10 8.462436E-08 6.297182E-16* *SET A 1 5.418055E-29 -1.750566E-26 1.211565E-24 6.328985E-23* *SET B 1 -1.037300E-22 -5.255588E-21 2.689422E-18 5.163233E-17* *SET C 1 7.753362E-17 1.316558E-13 -9.490233E-12 6.842524E-11* *SET D 1 4.354304E-10 2.671218E-08 -5.311249E-06 6.469795E-05* *::: <channels 2 through 15> :::* *SET A 16 -1.042455E-28 -8.901835E-28 9.933755E-25 8.592377E-23* *SET B 16 -5.249502E-22 4.515980E-20 7.136923E-19 -2.463333E-18* *SET C 16 4.681487E-16 1.250421E-13 -1.269469E-11 8.363017E-11* *SET D 16 -2.882084E-09 4.051924E-07 -1.732523E-05 1.873441E-04* *>*

DELETE COEFFICIENTS

COMMAND	DELETE
TYPE	Function
DESCRIPTION	Deletes all coefficient points in LIST T.
SYNTAX	**DELETE**
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	// Delete all coefficients **DELETE** >

LIST DELTA

COMMAND	LIST DELTA
TYPE	Get

DESCRIPTION	Retrieves the current DELTA settings stored in RAM.
SYNTAX	**LIST DELTA**
RETURNS	DELTA <channel> <adc counts> <psi offset> Where: <channel> is the channel number from 1 to 16 <adc counts> are the A/D counts calculated during the CALZ <psi offset> the correct value in psi calculated from the CALZ scan and the coefficient table Followed by a prompt when ready to accept a new command.
DEFAULT	0 0 0.000000
EXAMPLE	**LIST DELTA** *DELTA 1 29620 -4.909885* *DELTA 2 29771 -4.919517* *DELTA 3 31021 -5.038708* *DELTA 4 30051 -4.960324* *DELTA 5 29264 -4.805893* *DELTA 6 30518 -4.913097* *DELTA 7 29166 -4.914162* *DELTA 8 29475 -4.815095* *DELTA 9 29473 -4.916035* *DELTA 10 28260 -4.681326* *DELTA 11 30171 -4.959721* *DELTA 12 30003 -4.996899* *DELTA 13 30365 -4.981768* *DELTA 14 29158 -4.795256* *DELTA 15 29459 -4.802479* *DELTA 16 30802 -5.011322* *>*
NOTES	The deltas used in RAM may be different than the deltas stored on flash. Use the TYPE command plus the file name to find the deltas stored in flash.

SET DELTA POINT

COMMAND	DELTA
TYPE	Set
DESCRIPTION	Sets the deltas for each channel using A/D counts and PSI offset. This is automatically performed by the DSA when performing a CALZ. Deltas should not be modified manually.
SYNTAX	**DELTA** <channel> <adc counts> <psi offset> Where: <channel> is the channel number from 1 to 16 <adc counts> the A/D correction value <psi offset> the PSI correction value
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**DELTA 1 29620 -4.909885** *>*
NOTES	This command can modify or change the coefficient table which may result in inaccurate or unusable data. This command should not be used in the field.

LIST TEMPERATURE POINTS

COMMAND	LIST TEMP
TYPE	Get
DESCRIPTION	Retrieves the current RTD temperature conversion settings stored in RAM which are used for temperature compensation of the EU data.
SYNTAX	**LIST TEMP** <channel> Where <channel> is the channel number 1 to 16.
RETURNS	TEMP <channel> <temp index> <temperature> <adc count> Where: <channel> is the channel number from 1 to 16 <temp index> is the temperature plane point from 0 to 14 <temperature> is the temperature in °C <adc counts> is the A/D counts at the specified pressure, as a signed integer from −8,388,608 to 8,388,607 Followed by a prompt when ready to accept a new command.
DEFAULT	0
EXAMPLE	**LIST TEMP 1** *TEMP 1 0 0.800000 1860902* *TEMP 1 1 8.500000 2289760* *TEMP 1 2 15.900000 2721584* *TEMP 1 3 24.000000 3151634* *TEMP 1 4 32.000000 3578521* *TEMP 1 5 40.000000 4001856* *TEMP 1 6 48.000000 4418741* *TEMP 1 7 56.000000 4832482* *TEMP 1 8 72.000000 5652026* *TEMP 1 9 100.000000 0* *TEMP 1 10 100.000000 0* *TEMP 1 11 100.000000 0* *TEMP 1 12 100.000000 0* *TEMP 1 13 100.000000 0* *TEMP 1 14 100.000000 0* *>*
NOTES	The temp conversions used in RAM may be different than the temp conversions stored on flash. Use the TYPE command plus the file name to find the temp conversions stored in flash.

SET TEMPERATURE POINT

COMMAND	TEMP
TYPE	Set
DESCRIPTION	Set a temperature conversion point. These values are created during a full temperature calibration, and should not be modified manually.

SYNTAX	**TEMP** \<channel\> \<temp index\> \<temperature\> \<adc count\>
	
	Where:
	   \<channel\> is the channel number from 1 to 16
	   \<temp index\> is the temperature plane point from 0 to 14
	   \<temperature\> is the temperature in °C
	   \<adc counts\> is the A/D counts at the specified pressure, as a signed integer from −8,388,608
	    to 8,388,607

RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**TEMP 1 6 48.000000 4418741** >
NOTES	This command can modify or change the coefficient table which may result in inaccurate or unusable data. This command should not be used in the field.

LIST PROGRAMMABLE GAIN SETTINGS

COMMAND	LIST PGA
TYPE	Get
DESCRIPTION	Retrieves the current programmable gain settings for all channels.
SYNTAX	**LIST PGA**

RETURNS	PGA \<channel\> \<gain\>
	   :: :: :: ::
	PGA \<channel\> \<gain\>
	
	Where:
	   \<channel\> is the channel number from 1 to 16
	   \<gain\> is the gain multiplier
	
	Followed by a prompt when ready to accept a new command.

DEFAULT	Varies
EXAMPLE	**LIST PGA** *PGA 1 1* *PGA 2 1* *PGA 3 1* *PGA 4 1* *PGA 5 1* *PGA 6 1* *PGA 7 1* *PGA 8 1* *PGA 9 1* *PGA 10 1* *PGA 11 1* *PGA 12 1* *PGA 13 1* *PGA 14 1* *PGA 15 1* *PGA 16 1* >
NOTES	The temp conversions used in RAM may be different than the temp conversions stored on flash. Use the TYPE command plus the file name to find the temp conversions stored in flash.

COMMAND	PGA
TYPE	Set
DESCRIPTION	Set the current programmable gain settings. These settings are set by Scanivalve at the factory and should not be modified manually.
SYNTAX	**PGA** [<channel>] <gain>

Where:
<channel> = is optional, and is used to select the channel number from 1 to 16
<gain> = the gain multiplier

If only one argument is provided, the DSA assumes this to be the gain setting for all channels. |
| RETURNS | Prompt when ready to accept a new command. |
| DEFAULT | Varies |
| EXAMPLE | // set PGA to 1 for channel 4
PGA 4 1
> |
| NOTES | This command can modify or change sensor behavior which may result in inaccurate or unusable data. This command should not be used in the field. |

COMMAND	LIST INSERT
TYPE	Get
DESCRIPTION	Retrieves the current points coefficient stored in the RAM of the DSA.
SYNTAX	**LIST INSERT** [<start temp> <end temp> [<channel>]]

Where optional arguments:
<start temp> is the lowest temp plane to be returned from 0 to 72
<end temp> is the highest temp plane to be returned from 0 to 72
<channel> is channel number from 1 to 16 |
| RETURNS | INSERT <raw temp> <channel> <press> <adc counts>
::: ::: ::: :::
INSERT <raw temp> <channel> <press> <adc counts>

Where:
<raw temp> is the raw temp counts
<channel> is the channel number
<press> is the pressure in PSI
<adc counts> is the A/D counts at the specified pressure

Followed by a prompt when ready to accept a new command. |
| EXAMPLE | // Retrieves the full coefficient table
LIST INSERT
INSERT 100234 1 -5.958100 -215944
::: ::: ::: :::
INSERT 502345 16 5.958100 301360
> |
| NOTES | While optional, <start temp> and <end temp> must be used together. |

SET CONVERSION POINT

COMMAND	INSERT
TYPE	Set
DESCRIPTION	Inserts one EU pressure to ADC pressure counts entry into the points conversion table, per channel and temperature range. These points are created during a full temperature calibration, and should not be modified manually. These terms are used to create a polynomial fit coefficient using the CONVERT command and are not used for EU conversions.
SYNTAX	**INSERT** <raw temp> <channel> <pressure> <adc counts> Where: <raw temp> is the raw A/D counts that represent the temperature of the module <channel> is the channel number from 1 to 16 <pressure> is the pressure in PSI (real value) <adc counts> is the A/D counts at the specified pressure, as a signed integer from −8,388,608 to 8,388,607
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	// Insert a master point for channel 1 at 30°C (raw counts read 1234422). The applied pressure is 11.9998 psi, the measured counts are 2416376 **INSERT 1234422 1 11.9998 2416376** >
NOTE	This command can modify or change the coefficient table which may result in inaccurate or unusable data. This command should not be used in the field.

CONVERT CONVERSION POINT

COMMAND	CONVERT
TYPE	Function
DESCRIPTION	Retrieves the current INSERT settings and uses these points to create the least-squares conversion values (K) along with the error correction values (A, B, C, D).
SYNTAX	**CONVERT INSERT [**<num temps>] Where <num temps> is the number of temperatures in the insert list.
RETURNS	Prompt when ready to accept a new command.
EXAMPLE	// after inserts have been loaded into RAM, convert these points into the EU conversion terms **CONVERT INSERT** >
NOTE	This command can modify or change the coefficient table which may result in inaccurate or unusable data. This command should not be used in the field unless instructed by a Scanivalve representative.

FIELD CALIBRATION VARIABLES

The field calibration variables are responsible for storing correction terms created after a field calibration. Refer to Section 6: Calibration and Validation Overview for more information on field calibrations.

LIST FIELD CALIBRATION SETTINGS (LIST FC)

DESCRIPTION	Returns the field calibration correction coefficients and the field calibration correction status.
SYNTAX	LIST FC

RETURNS	All field calibration correction coefficients, plus the field calibration correction status.
	FCENABLE <status>
	FC <channel> <fc1> <fc2> <fc3>
	
	    Where:
	    <status> - is the status of the field calibration corrections.
	    <channel> - is the pressure channel 1 to 16.
	    <fc*n*> - the coefficient terms used in calculating the field calibration offset for correcting the EU
	        pressure after conversion

EXAMPLE	**LIST T** SET FCENABLE 1 SET FC 1 -2.397058E-05 3.163599E-11 -6.514663E-18 SET FC 2 4.611204E-04 2.498326E-11 -1.436391E-17 ::: *<channels 3 through 14>* ::: SET FC 15 5.109234E-03 6.208174E-11 1.013237E-17 SET FC 16 1.061724E-03 3.800963E-11 -1.320103E-17 >

SET FIELD CALIBRATION CORRECTION STATUS

COMMAND	FCENABLE
TYPE	Set/Get
DESCRIPTION	Enables or disables the use of the stored field calibration correction coefficients.

SYNTAX	**FCENABLE** <status>
	    Where <status> is:
	    0 = disabled (the standard coefficients are used)
	    1 = enabled (the field calibration correction terms are in use)

RETURNS	Prompt when ready to accept a new command.
EXAMPLE	**FCENABLE 1** >

SET FIELD CALIBRATION COEFFICIENTS

COMMAND	FC
TYPE	Set
DESCRIPTION	Sets the field calibration correction coefficients.

SYNTAX	**SET FC** <channel> <fc1> <fc2> <fc3>
	    Where:
	    <channel> - is the pressure channel 1 to 16.
	    <fc*n*> - the coefficient terms used in calculating the field calibration offset for correcting the EU
	        pressure after conversion.

RETURNS	Prompt when ready to accept a new command.
NOTES	These values should **never** be manipulated manually.

SSEP COMMANDS

These utility commands are for SSEP summary and diagnostic use.

LIST SSEP SYSTEM

COMMAND	LIST SYS
TYPE	Get
DESCRIPTION	Commands the DSA to retrieve all discovered modules in the current SSEP network. This command is typically only used when a module is designated as an SSEP Controller to find information on the current connected module, and can be used for SSEP troubleshooting.
SYNTAX	**LIST SYS** [*] Where the asterisk is an optional argument to reveal additional information and settings.

RETURNS	NDX -MODEL- -SN- -NPR- [-VERSION- -RATE- -VALVE- -UNITS- -CVTFACT- -ZC- -IP-] -LABEL-
	<module information for module found at index 0>
	[<module information for module found at index *n*>]
	
	Notes:
	  All information for each module found are the settings reported by the found module.
	  The header row may include additional hyphens (-) around the names of the variable columns to provide each column with enough space to show maximum module values. It has been reduced in this example for space.
	  Module information in index 0 is always the module that receives the command.
	  Each row below index 0 is a module found in the SSEP network as a responder, only if the module responding to the command is a controller. It will show a new row for each module found in the SSEP network.
	  When the option asterisk is used, all additional columns in the [ ] will be displayed.
	  The LABEL column will always be last due to the dynamic and maximum length of the field.
	  NDX is Index, SN is Serial Number, NPR is Nominal Pressure Range (positive full-scale values only), CVTFACT is the conversion value (PSI to UNITS), ZC is the CALZ variable.
	
	Followed by a prompt when ready to accept a new command.

EXAMPLE	**LIST SYS**
	NDX -MODEL- --SN-- ------NPR------ --LABEL--
	  0 DSA5001 7 1.00 1PSI-WING
	  1 DSA5002 6 0.14 UNDEFINED
	  2 DSA5001 3 5.00 INLET-LEFT
	>

EXAMPLE	**LIST SYS ***
	NDX -MODEL- -SN- -NPR- -VERSION- -RATE-- -VALVE- -UNITS- -CVTFACT- -ZC- ------IP------- --LABEL--
	  0 DSA5001 7 1.00 1.05 1.0000 PX RAW 1.0000 1 191.30.130.7 NONE
	  1 DSA5002 6 0.14 1.05 1.0000 PX RAW 1.0000 1 191.30.130.6 LEFT
	  2 DSA5001 3 5.00 1.05 1.0000 PX RAW 1.0000 1 191.30.130.3 MOD4
	  3 DSA5003 9 1.00 1.05 1.0000 PX RAW 1.0000 1 191.30.130.9 RESP3
	  4 DSA5001 16 100.00 1.05 1.0000 PX RAW 1.0000 1 191.30.130.16 RESP4
	  5 DSA5002 14 1.00 1.05 1.0000 PX RAW 1.0000 1 191.30.130.14 NONE
	  6 DSA5002 5 0.36 1.05 1.0000 PX RAW 1.0000 1 191.30.130.5 END

NOTES	Column data are always separated by white space.

SSEP Mode

COMMAND	SMODE
TYPE	Get
DESCRIPTION	Debugging utility command to show current SSEP status information at the module.
SYNTAX	**SMODE**
RETURNS	Unit: <module mode> Address: <index> Number of responders: <responders> LinkStatus: In <in status> Out <out status> Where: <module mode> is the current modules mode. Values can be Standalone, Controller, Middle or Last Responder. <index> is the current modules index value, or address number in the SSEP network. This will be "0" for standalone or controller mode, or a valid integer. <responders> is the number of responders found in the SSEP network by the controller. Valid values are any integer, and will be an "X" if a module is not configured as a Controller. <in status> is the current status of the SSEP IN connection. If a connection is found, it will report UP. If no connection is found, it will report DOWN. <out status> is the current status of the SSEP OUT connection. If a connection is found, it will report UP. If no connection is found, it will report DOWN. Followed by a prompt when ready to accept a new command.
EXAMPLE	**SMODE** *Unit: Controller* *Address: 0* *Number of responders: 6* *LinkStatus: In DOWN Out UP* *>*
EXAMPLE	**SMODE** *Unit: Middle Responder* *Address: 3* *Number of responders: X* *LinkStatus: In UP Out UP* *>*
EXAMPLE	**SMODE** *Unit: Standalone* *Address: 0* *Number of responders: 0* *LinkStatus: In DOWN Out DOWN* *>*
NOTES	Link Status may not indicate the current physical connection of a cable. When a modules module is forced, the IN and OUT ports may be deactivated to force the mode and will show DOWN for the status.

EMULATION

Emulation mode allows the DSA5000 to emulate similar type pressure scanners. This provides a solution for the DSA5000 to operate, under certain limitations and conditions, in software systems designed around other intelligent pressure scanners. The following emulation modes are supported:

DSA3200 Emulator
Emulates Scanivalve DSA3200 series scanners, such as the DSA3217, DSA3218, and similar DSA-PTP series.
Available in firmware versions 1.08 and up

The EMULATE variable dictates the emulation mode and configuration of the DSA. When this variable is set or changed, it is automatically saved in the profile.cfg file. When the module is booting, this file will determine the mode that the DSA will load. The only method of saving this variable is by changing it.

EMULATE MODE

COMMAND	EMULATE
TYPE	Set/Get/Function
DESCRIPTION	Commands the DSA to enter or exit emulation mode, or retrieves the current setting. When set to a valid setting, the variable is saved in permanent memory.

SYNTAX	**EMULATE** <model>
	
	Where <model> is valid or supported emulation model:
	    0 = disabled or the native DSA5000 mode (default)
	    3200 = Scanivalve DSA3200 emulation mode

RETURNS	EMULATE <model> - and/or - Prompt when ready to accept a new command, or the prompt/termination setting of the emulated model.
EXAMPLE	// to return DSA5000 back to the native mode and reload all saved DSA5000 settings **EMULATE 0** >
EXAMPLE	// enable DSA3200 emulation mode. There is no prompt return in this particular setting. **EMULATE 3200**
NOTES	Anytime this variable is changed, it is permanently saved. It will always boot in the set mode until it is changed.
NOTES	When set, the DSA will reload all associated settings with the configured model. If settings are not found in permanent memory, default settings will be loaded (for native or emulated mode).

All settings related to the emulation mode can be saved to permanent memory using the save command native to the emulation mode. When the emulator is set, all settings are saved to a single file that uses the ".emu" extension. The filename will be the set emulation mode (based on the valid settings for the EMULATE variable). The emulator configuration file or configuration variables cannot be saved when the emulator is disabled.

Some native commands may be available when emulation mode is set. Refer to the model emulation for more information on the limitations.

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DSA3200 EMULATOR

OVERVIEW

The DSA5000 supports a DSA3200 emulation mode. When enabled, the DSA5000 will accept limited commands and return data similar to the Scanivalve DSA3200 pressure scanner series. This allows the DSA5000 to operate in most software environments that support communication and data collection from DSA3217, DSA3218, DSA3207, and DSA3200-PTP series pressure scanners.

The DSA3200 emulator was based on the latest firmware version of the different DSA3200 series scanners:
         DSA3200 version 1.23
         DSA3200-PTP version 2.01

All previous versions of DSA3200 software cannot be validated against the DSA3200 Emulator to be 100% operational. Older versions of the DSA3200 may be missing features, contain software issues, or may not function the same as the latest firmware version.

The purpose of the DSA3200 emulator was to allow for DSA5000 modules to communicate, scan, and collect data in ways that would allow for backwards compatibility. Not all commands, variables and functions are supported, such as variables that perform self calibrations, and variables unrelated to general scan data collection.

The following sections will explain the general use and supported functions of the DSA3200 emulator. For additional information on the commands, variables, communications and data output in these sections, please see the DSA3200 or DSA-PTP User Manuals.

COMMUNICATION

The DSA3200 emulator uses the same connection and communication protocols as the DSA3200 series scanners. All communications are TCP/IP over port 23. The scanner is a simple Telnet server ready to accept commands and return responses. The UDP Telnet server for general communications found on older versions of DSA3200 is not supported. Below is a summary of communication types available.

COMMUNICATION AND DATA TRANSFER			
TYPE	FULL	PARTIAL	NOTES
TCP	X		Telnet Server Binary and ASCII Data Output
UDP		X	Binary Data Output Only
FTP		X	Binary Data Output Only

SUPPORTED COMMANDS

The following commands are supported in the DSA3200 emulation mode. The commands supported here will function as described in the DSA3200 User Manual unless otherwise noted.

FUNCTION COMMANDS		
COMMAND	FULL	NOTES
SCAN	X	
CALZ	X	Command will change internal valve as per DSA5000 operation.
CALB		
STOP	X	
SET	X	Used to configure supported configuration variables.
ERROR	X	
CLEAR	X	
TRIG	X	Only accepted in SCAN mode
STATUS	X	When BIN=0, response is ASCII. When BIN=1, response is binary. When BIN=1, ENFTP=1, response is ASCII.
LIST S	X	Output is formatted to match DSA3200
LIST I	X	
LIST PTP	X	
LIST FTP	X	
GETTIME	X	Date/time includes leading zeros
SETTIME	X	
GETUTCO	X	

SUPPORTED VARIABLES

The Configuration Variables table will show the supported variables and which list group they are contained under. Notes will be provided depending on if the variable is fully, partially, or not supported. The variables checked as "Full Support" will function as described in the DSA3200 User Manual.

All other DSA3200 and DSAPTP Lists and Variables not mentioned in this table are not supported and will not function, output information or change settings.

In the event there is a variable or list group that is native to the DSA5000, but also accepted by DSA3200 series scanners, the DSA5000 output and format will replace the DSA3200 output. This includes **LIST M**, **LIST IP**, and **LIST TEMP**. Any of these list commands will be output according to the native DSA5000 format. All variables in the group are subject to the standard DSA5000 protocol.

CONFIGURATION VARIABLES					
GROUP	VARIABLES	FULL	PARTIAL	NONE	NOTES
LIST S	PERIOD	X			
	AVG	X			
	FPS	X			
	XSCANTRIG	X			
	FORMAT	X			DSA3200 and DSAPTP
	TIME	X			DSA3200 and DSAPTP
	EU	X			DSA3200 and DSAPTP
	ZC	X			
	BIN	X			
	SIM			X	
	QPKTS			X	
	UNITSCAN	X			
	CVTUNIT	X			
	PAGE			X	
LIST I	ECHO			X	
	MODEL		X		Will display 5000 series
	PORT			X	
	HOST	X			
LIST PTP	PTPEN		X		0 or 1 (2 not supported)
	STAT		X		0 or 1 (2 not supported)
	SST	X			
	SSD	X			
	UTCOFFSET	X			
LIST FTP	USERFTP	X			
	PASSFTP	X			
	ENFTP	X			
	PATHFTP	X			
	IPFTP	X			
	FILEFTP	X			

DATA OUTPUT FORMATS				
PACKET NAME	PACKET ID	FULL	NONE	NOTES
SCAN	1Hex		X	
SCAN RAW	4Hex		X	
SCAN EU	5Hex	X		BIN == 1, EU == 1, TIME == 0
SCAN RAW W/TIME	6Hex		X	
SCAN EU W/TIME	7Hex	X		Time Stamps in milliseconds or microseconds BIN == 1, EU == 1, TIME == 1 or 2
SCAN EU FPT	9Hex	X		Floating Point Temperatures, No Time BIN == 1, EU == 2
SCAN - PTP	AHex	X		Supports EU Only with PTP Time BIN == 1, EU == 1, TIME == 3
ASCII (Varies)	20Hex	X		Supports RAW and EU FORMAT == 0, 1, 2 BIN == 0, TIME == 0, 1, 2, 3

SUPPORTED PRESSURE DATA OUTPUT

The following data output formats are supported when scan data is requested. If a scan packet is not listed, it is not supported.

The structure of the data can be found in the DSA3200 or DSA-PTP User Manual. This includes both ASCII and Binary packet types and structure.

All supported binary packets can be output via TCP, UDP or FTP. ASCII is only available via TCP Telnet connection.

OPERATION LIMITATIONS

When the 3200 Emulator is in use, several of the DSA5000 functions and features may not be supported. The Emulator was designed to act and respond as a DSA3200, which does not include many of the feature native to the DSA5000.

- Many of the native DSA5000 commands and variables are available in 3200 emulation mode. Using the commands must follow the DSA5000 syntax described in the software section of this manual. This includes commands like **VALVE** to change the valve state, **HEATER** to enable or disable the integrated heater (if installed), and more.

  The following lists and commands are not supported when in emulation mode:
  - DSA5000 formatted output from LIST S, LIST FTP, and LIST PTP.
  - SSEP, ERRORLOG, and PROMPT variables under LIST M.
  - CALZ, TRIG, and RATE under LIST S.
  - MODEL under LIST M/LIST I

- The following native DSA5000 features are disabled when the 5000 is in emulation mode:

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- SSEP or Scanivalve's Synchronous Ethernet Protocol
- Scan Triggering (TRIG 2)
- Auto-start (TRIG 3)
- Configurable Prompt
- Persistent CALZ (CALZ 2)
- Scan rates above 850Hz
- Webserver Scanning

The following procedures must be carried out using the native DSA5000 procedures with emulation off. If any of these processes must be performed, disable the emulator, perform the action, and then reset the emulator as needed.

- Changing the IP address or any boot variables (LIST IP).
- Performing a calibration or validation using Scanivalve software. PressCal cannot be used to calibrate a DSA5000 in 3200 emulation mode.
- Updating the DSA5000 firmware.
- Uploading or changing the coefficients.

EMULATOR CONSIDERATIONS

The hardware and electronics in the DSA5000 series scanners are more powerful than the DSA3200 and DSA-PTP series scanners. All processes are handled, processed and converted faster than any previous scanner. Due to this, there may be timing discrepancies between the DSA5000 in 3200 Emulation mode, and a DSA3200 or DSA-PTP. However, timing discrepancies can be negated with proper use of the scanners.

- The DSA5000 will always respond faster to commands and communications. In most cases, this will not affect software systems.

- The timing from the SCAN command to the first frame of data output to the network will vary based on the scan speed and configured destination. The DSA5000 will always output the first frame of data faster than the DSA3200 and DSA-PTP.

  To alleviate any issues with data alignment, data should be aligned based on timestamp, frame or timestamp when using PTP to trigger the scan start, or based on when the data was received by the data receiver. Using only Frame number may not allow for proper data alignment between the DSA5000 and DSA3200/PTP modules.

- The zero-correction process (CALZ or CALB) is handled differently across generations and firmware. The timing of the zero-corrections may also

vary based on the scan rate settings.

To alleviate issues with zero correction timing discrepancies, the STATUS command should be used to poll for STATUS: READY after a CALZ or CALB is executed. After all devices are READY, processes can continue.

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SECTION 6: MAINTENANCE

CALIBRATION

The DSA5000 series uses a well proven, very stable, temperature compensated piezoelectric pressure sensor. The use of this series of sensors, along with the ability to perform frequent, online zero offset calibrations (CALZ) allows the DSA to hold published accuracy for up to 6 months. Scanivalve recommend validating the DSA with a high-accuracy pressure standard on 6 month intervals and recalibrating the unit as required.

Every DSA module is calibrated from the factory over a series of temperatures between 0°C and 72°C. At each temperature, multiple pressures are applied to associate an accurate, known pressure value to the raw readings of the sensor. All of these values are stored and used to create the conversion tables for each channel.

When recalibrating a DSA module, there are three types of calibrations that can be performed:

FULL CALIBRATIONS

A full calibration deletes all current calibration coefficients and re-applies accurate, known pressures over a series of temperatures. This duplicates exactly what is performed at the factory during the module's original manufacture and calibration. This calibration requires an environmental chamber capable of accurately reaching stable temperatures in the entire 0°C and 72°C range. This also requires a suitable and highly accurate pressure standard. The recommended accuracy of the pressure standard should be 3 times more accurate than the DSA module's full-scale accuracy.

It is typically recommended that for full calibrations, module be returned to Scanivalve or a certified Scanivalve Representative.

FIELD CALIBRATIONS

As an alternative to Full Calibrations, Scanivalve offers a free software program that allows any metrology lab with a suitable pressure standard to perform a "Field Calibration." During a field calibration, a series of pressures are applied to the module at a single temperature. The temperature of the module does *not* have to be controlled to a specific temperature. This software calculates a new set of correction coefficients for that given temperature and applies this correction to the pressure coefficients across all temperatures. These terms are then stored under LIST FC, and these corrections can be enabled or disabled at any time.

This technique is suitable for maintaining modules long term and has been proven to be just as accurate as a full calibration when performed properly.

DSA5000s can be field calibrated and validation in the field using the software "CalExpress." CalExpress is an easy-to-use program to help maintain scanners. CalExpress can be downloaded from the Scanivalve website.

ZERO OFFSET CALIBRATION

In all piezoelectric pressure sensors, zero drift is the single largest contributor to long term errors. Because of this, all DSA5000 modules are equipped with internal calibration valves, and a software command (CALZ) that allows for a zero offset calibration to be performed easily and frequently. CALZs are performed quickly and do not require a known pressure standard or environmental chamber. More information on the Zero Offset Correction calibrations can be found in "Zero Offset Calibration" in Section 3, and information on the **CALB** and **CALZ** commands can be found in Section 5.

TEMPERATURE COMPENSATED PRESSURE CONVERSION

The DSA5000 produces Engineering Unit values in PSI using a polynomial function with respect to temperature and pressure A/D counts:

$$PSI = f_{EU}(x, y) : x = temperature\ ADC,\ y = pressure\ ADC$$

Each DSA5000 will have a unique table of coefficients which define the EU conversion function. These coefficients are calculated by fitting the surface in three-dimensional space given by the temperature AD counts, pressure AD counts and actual pressure values obtained during the calibration routine. A second-phase correction is then applied to remove small offset errors in the fit to produce the final pressure value.

For any other configured Engineering Unit (other than PSI, as set by the **UNITS** variable), the DSA will preform a third conversion from PSI to the configured units using engineering unit pressure constants. These constants can be found in Appendix A of this manual. The RTD temperatures for each channel will always be provided in Degrees Celsius.

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Special Procedures

This section contains the procedures to update the firmware, add calibration coefficients to memory, or to change the IP address of the DSA. The DSA should be in the READY mode while these changes are being made. This will have no effect on the operation.

DSA Firmware Installation

NOTE: Some web browsers will block pop-ups. Please ensure your web browser is set to allow all pop-ups.

1. Connect a host computer to the Ethernet port and open a web browser of choice. Google Chrome or Microsoft Edge recommended.

2. In the Address Bar, type:
   <IPAddress><Enter>
   Where: <IPAddress> is the IP Address of the DSA.

   The web browser will open the DSA's web server and navigate to the File Browser page.
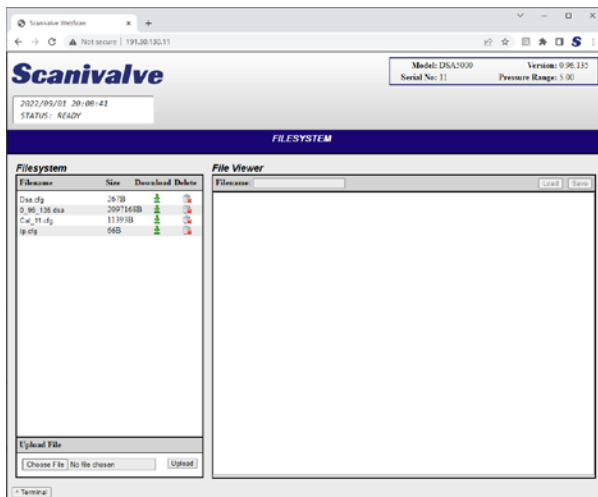
Figure 6.1 - DSA File Browser

3. Delete any existing firmware files. The DSA firmware file is titled "<version string>.dsa." To delete this file, click the 'trash can' icon next to the file name under the "Filesystem" section.

   A pop-up will open asking to confirm deleting the file. Click OK. A new pop-up window will open while the file is being deleted. The window will close when the operation is completed.
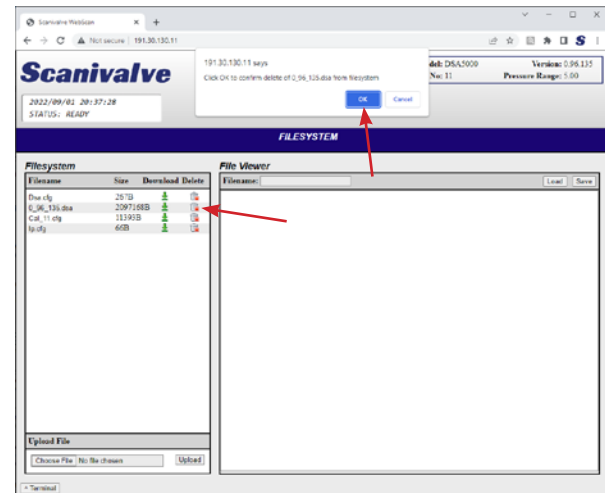
Figure 6.2 - Delete DSA Firmware

If an existing firmware file does not exist, skip this step.

4. Under the "Upload File" section, click Choose File. Navigate to the file directory location where the new DSA firmware file is located.
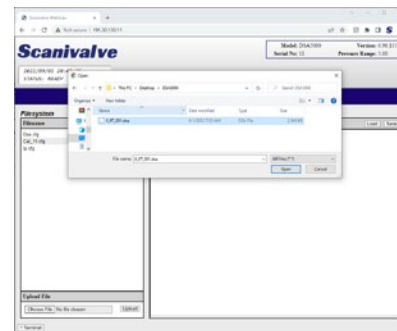
Figure 6.3 - DSA Firmware File

Select the file and click Open.

5. Click the Upload button in the "Upload File" section.
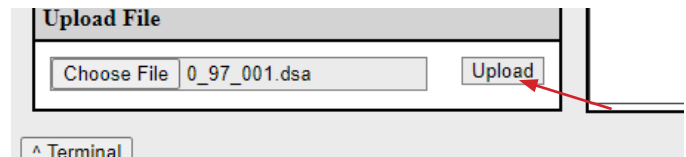
Figure 6.4 - Upload File

A pop-up window will appear indicating that the file is being uploaded. The window will close when the upload is complete, and the file will now appear in the "Filesystem" section.

6. Double click on the newly uploaded firmware file. A new pop-up will appear asking to confirm the firmware update. Click OK.
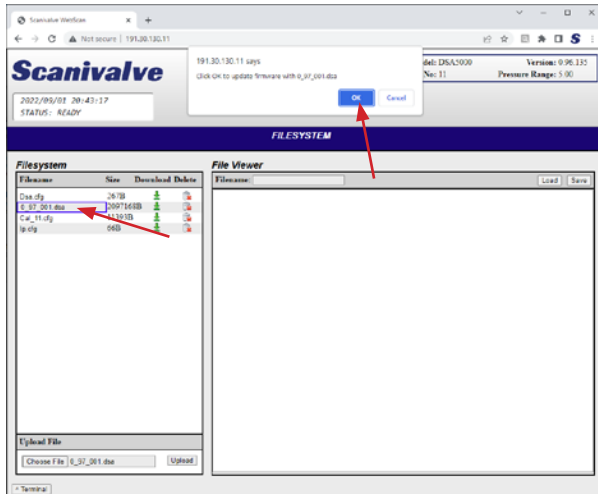
FIGURE 6.5 - UPDATE FIRMWARE

A new pop-up window will open while the firmware
is being updated. The window will close when the
upload is completed and the DSA will automatically
soft reboot. The web browser should eventually refresh
once the DSA is booted again. If not, please wait a few
moments and then click Refresh.

Once the process is complete, the new firmware version
will appear in the top right corner of the File System
page.

NOTE: The Firmware file in the file system can be deleted
at any time. It is not required to be in the file system for
normal operation.

DSA Coefficient Upload

NOTE: Some web browsers will block pop-ups. Please ensure your web browser is set to allow all pop-ups.

1. Connect a host computer to the Ethernet port and open a web browser of choice. Google Chrome or Microsoft Edge recommended.

2. In the Address Bar, type:
    <IPAddress><Enter>
Where: <IPAddress> is the IP Address of the DSA.

The web browser will open the DSA's web server and navigate to the File Browser page.
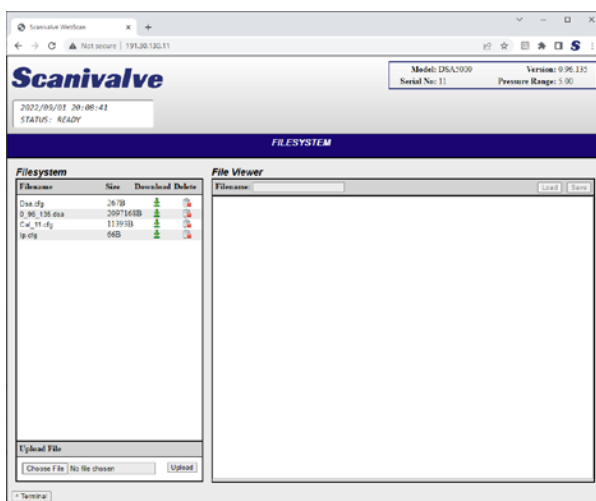
FIGURE 6.7 - DSA FILE BROWSER

3. Under the "Upload File" section, click Choose File. Navigate to the file directory location where the last known good coefficient file for the module is located. The file must be named "Cal_<sn>.cfg" where the <sn> will be the serial number of the module with no leading zeros. The serial number of the file must match the serial number of the module.

As long as the filename of the Cal file being uploaded matches the file in memory, it will overwrite the old file. There should only be one file Cal file in memory.

If there are two files that start with Cal, delete the old file and keep or re-upload the new file.

This file can be provided by Scanivalve if the last known good file cannot be located.
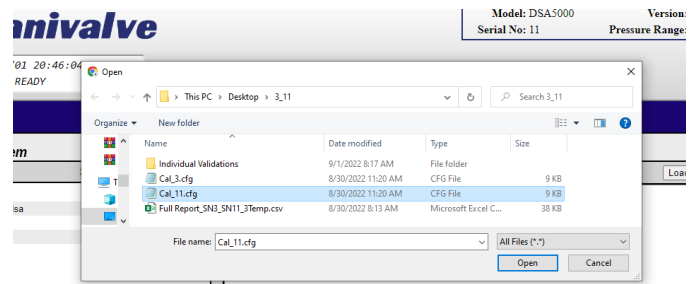
FIGURE 6.8 - DSA COEFFICIENT FILE

Select the file and click Open.

4. Click the Upload button in the "Upload File" section.
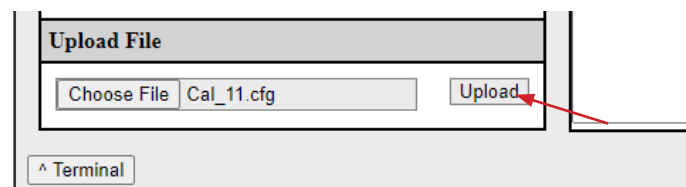
FIGURE 6.9 - UPLOAD FILE

A pop-up window may appear indicating that the file is being uploaded. The window will close when the upload is complete, and the file will now appear in the "Filesystem" section. Often time, smaller files can be uploaded without the pop-up interruption.

5. The new file must be loaded into RAM by one of the following methods:
   - Double click on the new Cal.cfg file and click the LOAD button.
   - Power cycle the DSA
   - Execute a **REBOOT** command
   - Execute a **LOAD <cal filename>** command
   where <cal filename> is the name of the Cal file

CHANGING THE IP ADDRESS

The following procedure will change the IP address of the DSA5000 using a terminal emulator (ScanTel, HyperTerminal, puTTY, etc).

1. Establish a connection to the DSA5000 using a serial or Ethernet connection and appropriate software, or via Web Server. For initial connection information, please see Section 3: Operation.

2. Issue the command:
   IP<ENTER>
   The IP address variable and values will be displayed.

3. Issue the command:
   IP xxx.xxx.xxx.xxx<ENTER>
   (*where* **xxx.xxx.xxx.xxx** *is the desired IP address*)

4. Issue the command:
   IP<ENTER>
   Confirm that the IP address set is correct.

5. [Optional] If the physical MAC address or Gateway must be changed, please do so in the same steps as 2 - 4 using the commands **MAC** and **GATEWAY**.

5. Issue the command:
   SAVE IP<ENTER>
   The IP address has now been saved.
   Issue the command:
   REBOOT<ENTER>
   or cycle the DSA power

The DSA will now boot with the new IP address.

FORMATTING THE MEMORY

In the event that the DSA is not operating as expected, a file has become corrupted, Ethernet communications are not possible, or all files and settings must be deleted, the DSA's memory can be reformatted.

WARNING: This procedure will erase all files, settings, and configurations.

1. Establish a connection to the DSA5000 using a serial or Ethernet connection (if applicable) and appropriate software. For initial connection information, please see Section 3: Operation.

2. Issue the command:
   FDISK<ENTER>

3. The will respond with the message:
   Type FDISKCONFIRM to confirm FDISK or STOP to cancel

4. Issue the command:
   FDISKCONFIRM<ENTER>
   To confirm the format. If you do not want to proceed, issue the **STOP** command.

5. Once completed, the IP address must be reset and saved so that it does not revert to a factory default IP address. Follow the procedure "Changing the IP address" procedure, steps 2 through 5.

6. Power cycle the DSA5000. Please allow for 15-30 seconds for the DSA to reboot.

7. Connect to the web server and upload any files or settings required using the "File Browser" page. Use the DSA Coefficient Upload to restore the modules last known coefficients as this is usually the most important.

DSA5000 Shock Mount Kit Installation

The DSA5000 has an optional shock mount kit that can be used for more rugged testing applications where the DSA module may be exposed to a high degree of shock or vibration. The shock mount kit can be added or removed at any time.

CAUTION! ESD protection is required for this procedure. Failing to follow ESD protection guidelines could cause permanent damage to the DSA electronics.

The following equipment is required:
   ESD protection
   DSA5000
   DSA5000 Shock Mount Kit
   1/16" Hex head screw driver or allen wrench

FIGURE 6.10 - REQUIRED EQUIPMENT

1. **Remove the bottom mounting plate.**
   Tilt the DSA on its side and remove the 8 screws that attach the bottom mounting plate using the 1/16" hex screwdriver or allen wrench.

   NOTE: The electronics will be exposed once the mounting plate has been removed. Please keep the are clean around the DSA5000 to prevent debris from entering the DSA5000 body. Please used caution when working around the DSA5000.
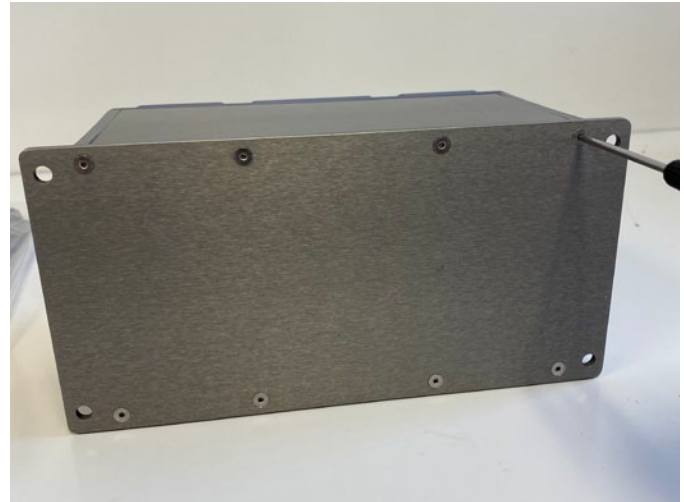
FIGURE 6.11 - REMOVE BOTTOM MOUNTING PLATE

2. **Prepare shock mount kit.**
   There is a small gasket that is fitted in a channel around the base plate of the shock mount kit. Inspect the gasket to make sure it is correctly inserted into the channel before installing. If the gasket is missing or not aligned properly, this will prevent the DSA5000 module from being IP rated.
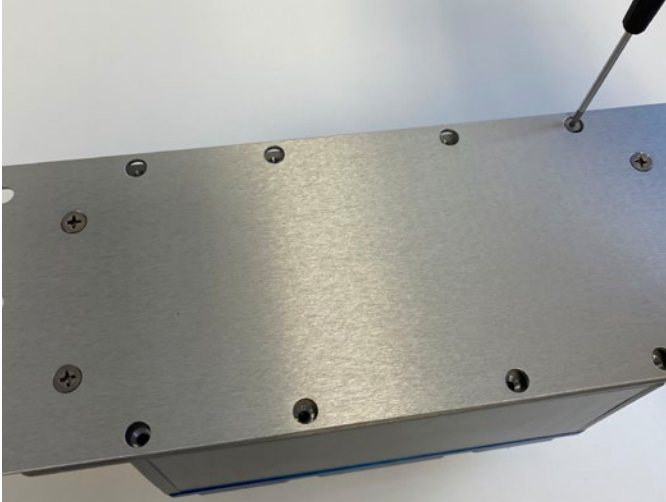
FIGURE 6.12 - MOUNTING PLATE GASKET

3. **Install Shock Mount.**
   Place the Shock mount kit against the DSA body and reattach using the new screws provided with the shock mount kit. Before inserting the screws, verify that the small O-ring is still fixed to the screw otherwise the DSA5000 module may no longer be IP rated.

   Tighten screws so that mounting plate gasket compresses to the body. Torque specifications: 10in-lbs.

FIGURE 6.13 - INSTALL SHOCK MOUNT

The procedure is now complete. The DSA5000 standard mounting plate can replace the Shock mount using the same steps in reverse.

FIGURE 6.14 - DSA WITH SHOCK MOUNT

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DSA5000 GENERAL CHECKOUT PROCEDURE

The following is a checkout procedure for the DSA5000 series modules. This procedure can be used as a verification that the module is fully functional before implementing it into a system, or as a diagnostic check if it is suspected that the module is not functioning correctly. Ensure that the module has been warmed up for at least 1 hour before beginning this procedure. This procedure will not verify the accuracy of the module. If the module fails this procedure in any way, please contact Scanivalve.

This procedure is best performed using a TCP/IP connection using ScanTel. This is will help isolate potential software issues.

Begin by establishing a connection, and configuring the module for the test by issuing the following commands:
    SSEP 1<ENTER>
    FORMAT A<ENTER>
    RATE 2<ENTER>
    FPS 1<ENTER>
    ENFTP 0<ENTER>
    ENUDP 0<ENTER>
    PTPEN 0<ENTER>

1.   Check raw pressure and temperature readings.
    Send the following commands:
    UNITS RAW<ENTER>
    CALZ 0<ENTER>
    SCAN<ENTER>

    The raw pressure readings in the second column should all be near or less than ±1,000,000 counts.
    The raw temperature readings (at room temp) should be greater than 0 and up to 4,000,000 counts.

    Repeat the scan command several times. Values should not be:
        Exactly 0 after multiple scan attempts.
        A value of ±8.3 million.
        A non-changing value after multiple scan attempts.

2.   Verify the CALZ function. Send the following commands:
    CALZ<ENTER>
    (wait 10-15 seconds for the CALZ to complete)
    SCAN<ENTER>

    The raw pressure readings should all be near 0 and between ±500 counts. Temperature will remain unchanged.

3.   Verify the Engineering Unit Conversion

Send the following commands:
    UNITS PSI<ENTER>
    SCAN<ENTER>

The pressure readings should be very close to 0.0psi
The temperature readings should be near the ambient room temperature in degrees C. Depending on how long it has been powered up, there may be as much as a +15°C difference due to self heating.

4.   Verify the reference (REF) response. Send the following commands:
    FORMAT F<ENTER>
    FPS 0<ENTER>
    SCAN<ENTER>

    The output format will change to an updating, VT100 style format. All channels should still be near 0.0psi.

    With the unit scanning, apply between 75% and 100% of positive full scale pressure (or 15psi maximum) to the reference port(s) on the module.
    This should result in an even, negative reading across all channels.

5.   Check for leaks in the reference plumbing. With the unit still scanning, apply and trap the pressure on the reference port(s).

    Monitor the pressures for 60 seconds. A pressure drop of up to 0.1% of full scale is acceptable.

    Vent the pressure off of the reference port(s) when complete.

6.   Verify individual Px response. With the unit still scanning, apply between 75 and 100% of full scale pressure individually to all Px (measurement) inputs.

    This should result in a believable positive pressure on the channel with pressure applied. Test each channel.

7.   Verify the calibration input (CAL) response.
    Apply 90-120psi to the CTL SUPPLY port. Issue the following commands:
    VALVE CAL<ENTER>

    With the unit still scanning, apply between 75 and 100% of full scale pressure to the CAL port(s)
    This should result in a believable positive pressure across all channels.

8.   Check for leaks in the calibration plumbing.
    With the unit still scanning, apply and trap the pressure

on the calibration port(s).

Monitor the pressures for 60 seconds. A pressure drop of up to 0.1% of full scale is acceptable.

Vent the pressure off of the calibration port(s). Issue the command:
STOP<ENTER>
Or use the ESC key to stop the scan.

9. Check for drifting/unstable sensors. Send the following commands:
UNITS RAW<ENTER>
CALZ<ENTER>
(wait 10-15 seconds for the CALZ to complete)
SCAN<ENTER>

Monitor all 16 channels. All sensor readings should stay stable within ±2000 counts for 1 minute. These counts may be higher for lower pressure modules (<1psid). Then issue the command:
STOP<ENTER>
Or use the ESC key to stop the scan.

10. Check for noisy output. Send the following commands:
RATE 50<ENTER>
SCAN<ENTER>

Monitor all 16 channels for 1 minute, watching for any unusual "spiking" data. All readings should stay within ±1000 counts from the original reading for the duration of the 1 minute test. These counts may be higher or may appear to be more "noisy" for lower pressure modules (<1psid) due to the sensitivity of the sensors. Then issue the command:
STOP<ENTER>
Or use the ESC key to stop the scan

11. [OPTIONAL] Check Purge operation. Send the following commands:
RATE 2<ENTER>
VALVE CAL<ENTER>
(Wait a few moments for control pressure to stabilize)
VALVE PRG<ENTER>
SCAN<ENTER>

For all modules with a range less than 5PSI, apply a low purge pressure to the PRG port and slowly increase the pressure. During the increase, monitor the scan data to ensure the pressure is not being sensed by the sensor. If the sensors are not registering the pressure, increase the purge pressure to the desired purge pressure (15PSI recommended).

For all modules with a range greater than 5PSI, apply 15PSI to the PRG port.

Verify that purge pressure is flowing out of all 16 Px input ports.
Verify that there is no purge pressure flowing out of any other port.
Verify that the sensors are not responding to the purge pressure.

At the completion of the test, vent the purge supply pressure, **STOP** the scan, and step the unit out of purge mode:
VALVE CAL<ENTER>
(Wait a few moments for control pressure to stabilize)
VALVE PX<ENTER>

APPENDIX

APPENDIX A: ENGINEERING UNIT CONVERSION CONSTANTS

UNITS Setting	Engineering Unit	PSI to EU 1 PSI =	EU to PSI 1 EU =
ATM	Atmospheres	0.068046 A	14.6960 psi
BAR	Bars	0.068947 b	14.5039 psi
CMHG	Centimeter of Mercury	5.17149 cmHg	0.193368 psi
CMH2O	Centimeter of Water	70.308 cmH2O	0.014223 psi
DECIBAR	Decibar	0.68947 db	1.4504 psi
FTH2O	Foot of Water	2.3067 ftH2O	0.43352 psi
GCM2	Gram per square Centimeter	70.306 g/cm2	0.014224 psi
INHG	Inch of Mercury @ 0C	2.0360 inHg	0.491159 psi
INH2O	Inch of Water @ 4C	27.680 inH2O	0.036127 psi
KGCM2	Kilogram per square Centimeter	0.0703070 kg/cm2	14.2235 psi
KGM2	Kilogram per square Meter	703.069 kg/m2	0.0014223 psi
KIPIN2	kips per square inch(ksi)	0.001 kip/in2	1000.0 psi
KNM2	Kilonewton per square Meter	6.89476 kN/m2	0.145038 psi
KPA	Kilopascal	6.89476 kPa	0.145038 psi
MBAR	Millibar	68.947 mb	0.014504 psi
MH2O	Meter of Water	0.70309 mH2O	1.42229 psi
MMHG	Millimeter of Mercury	51.7149 mmHg	0.0193368 psi
MPA	Megapascal	0.00689476 Mpa	145.038 psi
NCM2	Newton per square Centimeter	0.689476 N/cm2	1.45038 psi
NM2	Newton per square Meter	6894.759766 N/m2	0.000145038 psi
OZFT2	Ounce per square Foot	2304.00 oz/ft2	0.000434028 psi
OZIN2	Ounce per square Inch	16.00 in/ft2	0.062500 psi
PA	Pascal	6894.759766 Pa	0.000145038 psi
PSF	Pound per square Foot	144.00 lb/ft2	0.00694444 psi
TORR	Torr	51.714901 T	0.0193368 psi

APPENDIX B: DATA MATRIX

Data Destination	Data Format	Data Type	Sample Rate	UNITS	TRIG	ENUDP	ENFTP	Binary Server Connected	FORMAT	SSEP	Max Scan Rate (Hz)	Notes
TCP Telnet	ASCII Only	ADC Counts	INT	RAW	0, 2, 3	0	0	No	A, F, C	No	1000	
			EXT	RAW	1	0	0	No	A, F, C		1000	
		EU Pressure	INT	PSI	0, 2, 3	0	0	No	A, F, C		1000	
			EXT	PSI	1	0	0	No	A, F, C		1000	
TCP Binary Server (port 503)	Binary Only	ADC Counts	INT	RAW	0, 2, 3	0	0	Yes		Yes*	5000	
											5000	
			EXT	RAW	1	0	0	Yes			5000	
											5000	
		EU Pressure	INT	PSI	0, 2, 3	0	0	Yes			5000	
											5000	
			EXT	PSI	1	0	0	Yes			5000	
											5000	
FTP	ASCII	ADC Counts	INT	RAW	0, 2, 3	0	1	No	A, C	No	1000	
			EXT	RAW	1	0	1	No	A, C		1000	
		EU Pressure	INT	PSI	0, 2, 3	0	1	No	A, C		1000	
			EXT	PSI	1	0	1	No	A, C		1000	
	Binary	ADC Counts	INT	RAW	0, 2, 3	0	1	No	B	Yes*	5000	
											5000	
			EXT	RAW	1	0	1	No	B		5000	
											5000	
		EU Pressure	INT	PSI	0, 2, 3	0	1	No	B		5000	
											5000	
			EXT	PSI	1	0	1	No	B		5000	
											5000	
UDP	ASCII	ADC Counts	INT	RAW	0, 2, 3	1	0	No	A, C	No	NA	*Not Supported*
			EXT	RAW	1	1	0	No	A, C		NA	
		EU Pressure	INT	PSI	0, 2, 3	1	0	No	A, C		NA	
			EXT	PSI	1	1	0	No	A, C		NA	
	Binary	ADC Counts	INT	RAW	0, 2, 3	1	0	No	B	Yes*	5000	
											5000	
			EXT	RAW	1	1	0	No	B		5000	
											5000	
		EU Pressure	INT	PSI	0, 2, 3	1	0	No	B		5000	
											5000	
			EXT	PSI	1	1	0	No	B		5000	
											5000	

* The maximum rate when using SSEP is 1000Hz in any data transfer method

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APPENDIX C: DSA VALVE LOGIC

This section provided valve logic drawings for each configuration of the DSA5000 Gas Pressure Scanners - standard differential, true differential, individual reference, and absolute - and the common valve states such as measurement mode, calibrate mode, and purge mode.

All "modes" are only valid if 90-120PSI pressure is active at the CTL Supply port, the module is powered on, and software commands are used to control the solenoids.

CTL1 is a normally closed valve.
CTL2 is a normally open valve.
PRGCTL is a normally closed valve.

Solenoids can be normally closed (standard) or normally open. When no control pressure is supplied, all modules will default to Px mode.
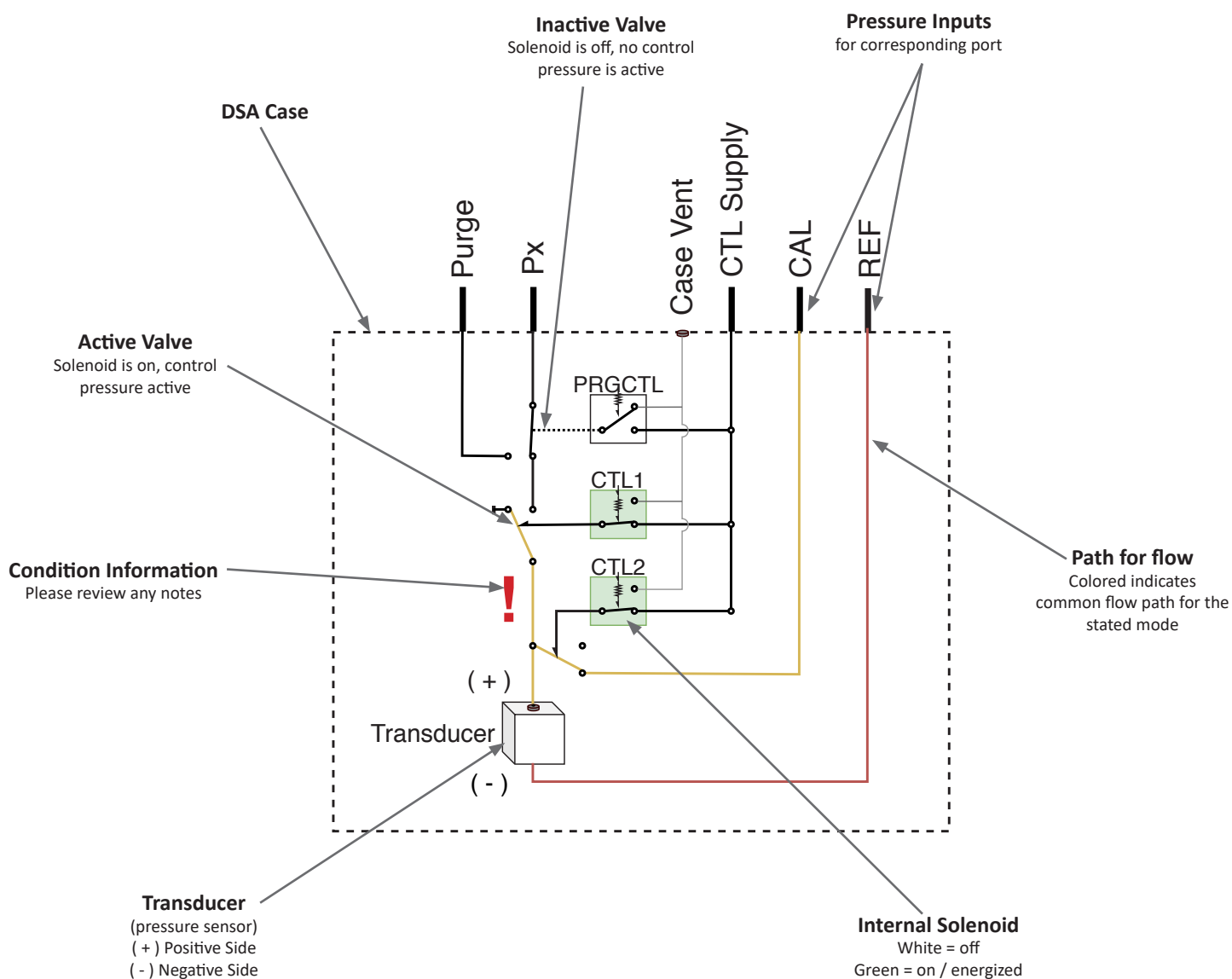
STANDARD DIFFERENTIAL VALVE LOGIC

Standard or common differential builds with normally closed solenoids. This includes single (Px) and standard differential dual range (DR) units.

Dual range units will have two CAL and REF ports, one for each group of pressure ranges (L for channels 1-8, H for channels 9-16). The valve operates the same, however the CAL/REF ports are only common to the label group of channels.
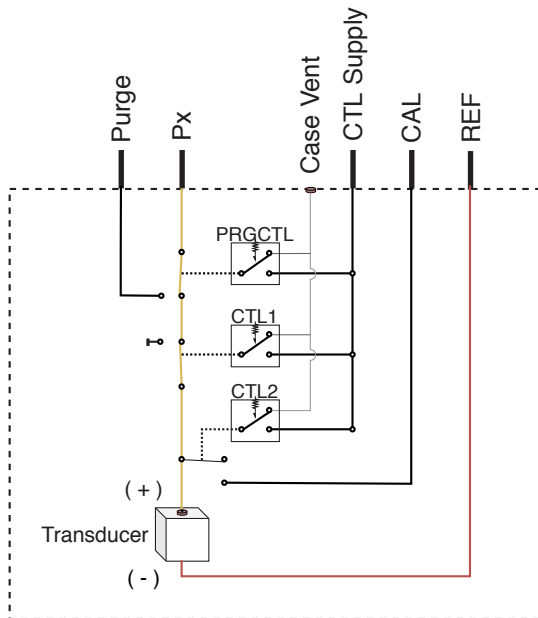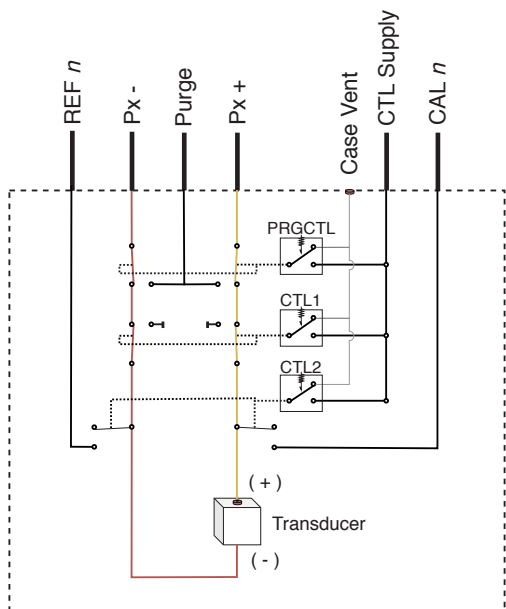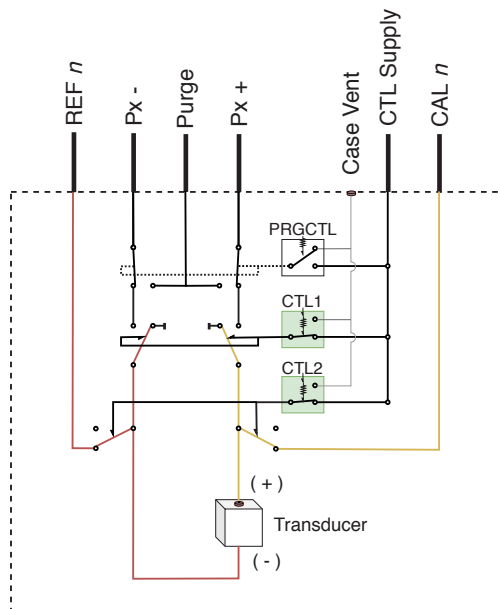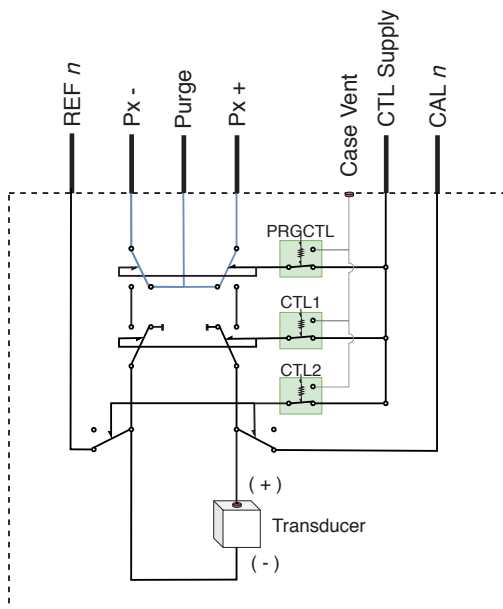

FIGURE C.1 - MEASUREMENT (PX) MODE
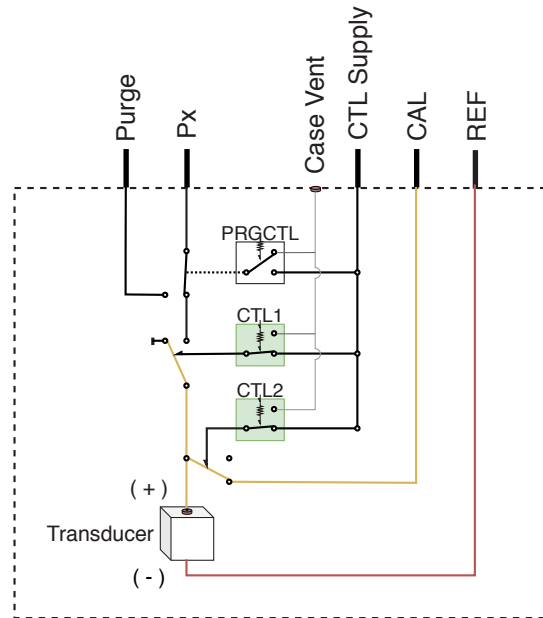
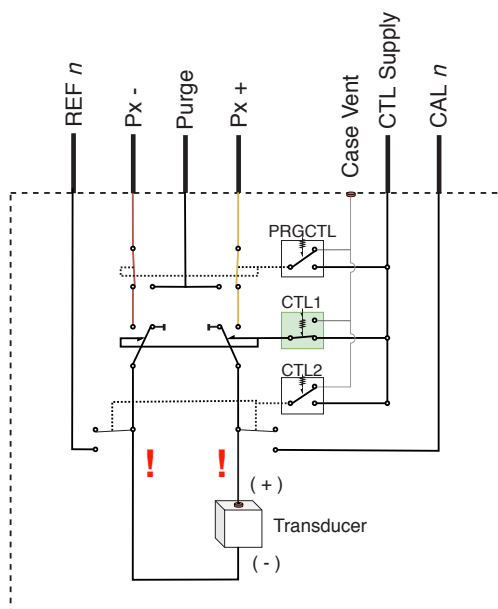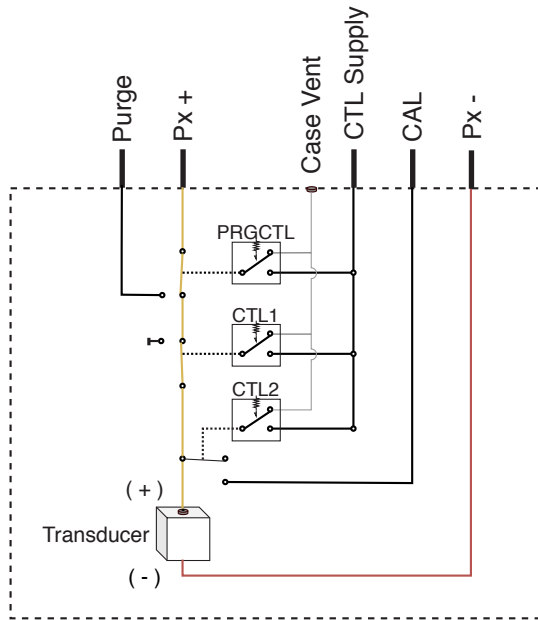**FIGURE C.2 - CALIBRATE (CAL) MODE**
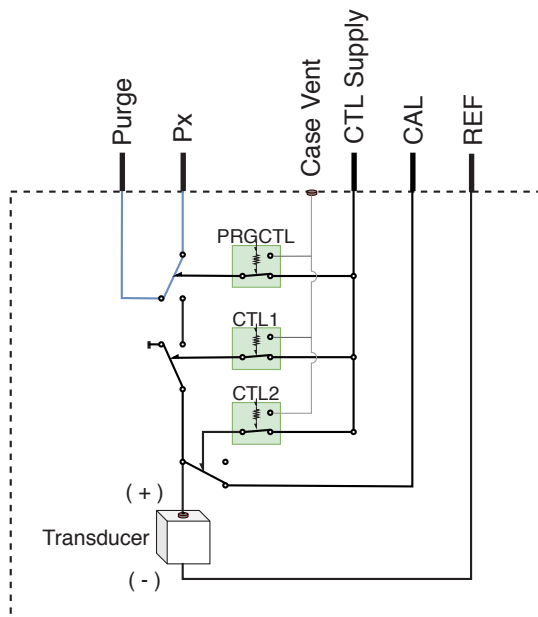
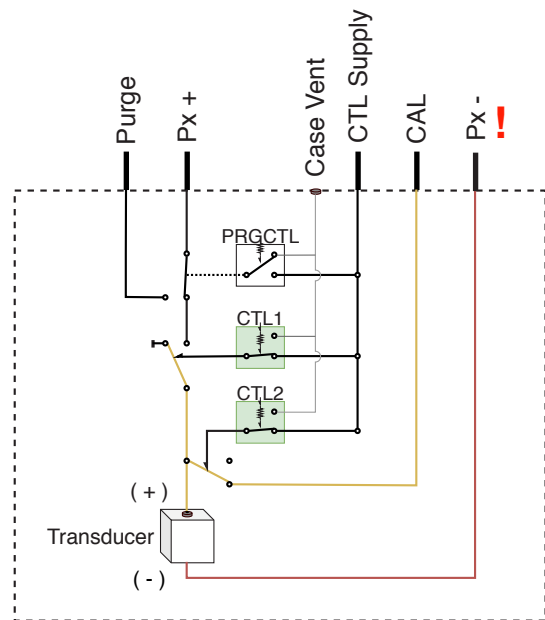**FIGURE C.3 - PURGE (PRG) MODE**
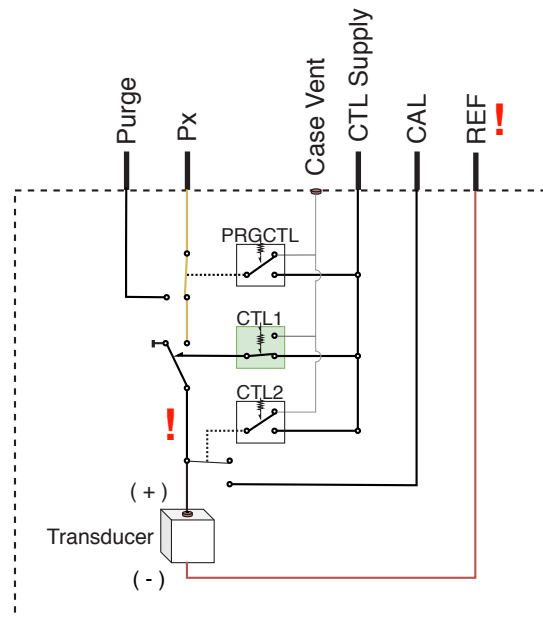
FIGURE C.4 - ISOLATE (ISO) MODE

Note: In isolate only mode, the current pressure between the CTL1 valve and the Transducer (+) will be trapped. Changes in temperature or elevation can increase or decrease this pressure which may cause overpressure.
Note: While the input is blocked, the REF is still open to the negative side of the transducer. This could result in a differential overpressure.

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TRUE DIFFERENTIAL VALVE LOGIC

True differential builds with normally closed solenoids. This includes single (DPx) and standard differential dual range (DDR) units. Dual range units will have two CAL and REF ports, one for each group of pressure ranges (L for channels 1-8, H for channels 9-16). The valve operates the same, however the CAL/REF ports are only common to the label group of channels.

FIGURE C.5 - MEASUREMENT (PX) MODE

FIGURE C.6 - CALIBRATE (CAL) MODE

FIGURE C.7 - PURGE (PRG) MODE

FIGURE C.8 - ISOLATE (ISO) MODE

Note: In isolate only mode, the current pressure between the CTL1 valve and the Transducer (+) and (-) will be trapped. Changes in temperature or elevation can increase or decrease this pressure which may cause overpressure.

INDIVIDUAL REFERENCE VALVE LOGIC

Individual Reference builds with normally closed solenoids. While used for true differential measurements, valve limitations apply. While gaining more available channels over a true differential build, correct Calibration mode and Purge mode are not possible. All Px - (negative) inputs are unaffected by the valve and common ports.
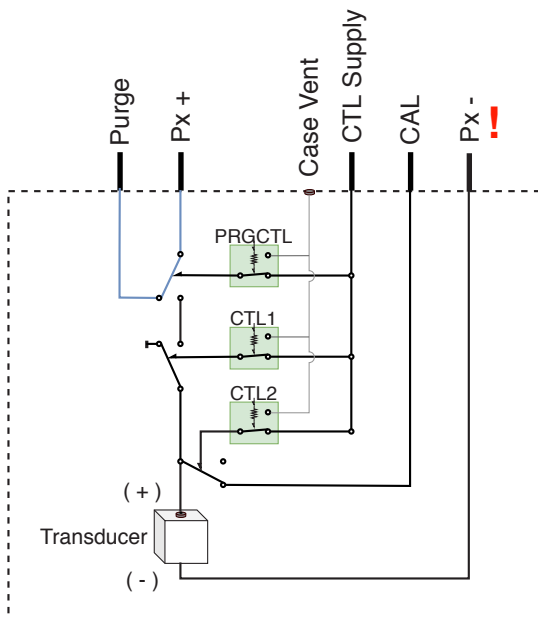

FIGURE C.9 - MEASUREMENT (PX) MODE

FIGURE C.10 - CALIBRATE (CAL) MODE

Note: In calibrate mode, all Px - (negative) inputs are still discrete to each individual transducer. For calibrations, all Px - (negative) ports must be manifolded together externally.

FIGURE C.11 - PURGE (PRG) MODE

Note: In purge mode, purge pressure will flow through all Px + (positive) inputs, but will not flow to the Px - (negative) inputs. The Px - inputs cannot be purged through the module.
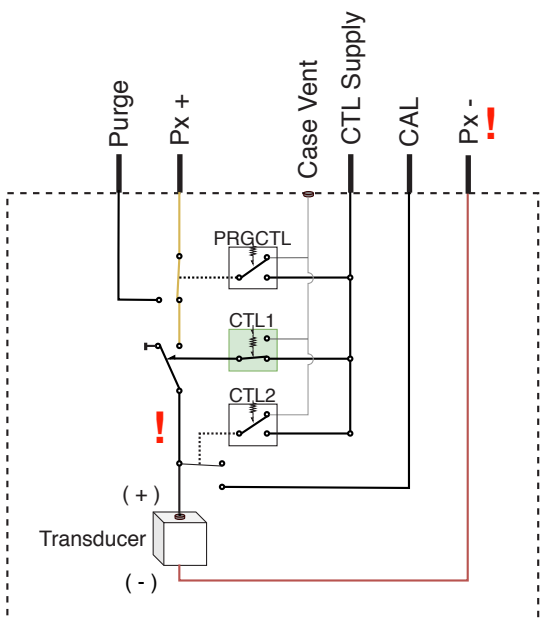
FIGURE C.12 - ISOLATE (ISO) MODE

Note: In isolate only mode, the current pressure between the CTL1 valve and the Transducer (+) will be trapped. Changes in temperature or elevation can increase or decrease this pressure which may cause overpressure.
Note: While the input is blocked, the Px - (negative) ports are still open to the negative side of the transducer. This could result in a differential overpressure.

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Absolute Valve Logic

Absolute builds with normally closed solenoids. This includes single (APx) and absolute dual range (ADR) units. Absolute transducers only have one input. The negative side of the transducer is vacuum sealed.

Dual range units will have two CAL ports, one for each group of pressure ranges (L for channels 1-8, H for channels 9-16). The valve operates the same, however the CAL ports are only common to the label group of channels.
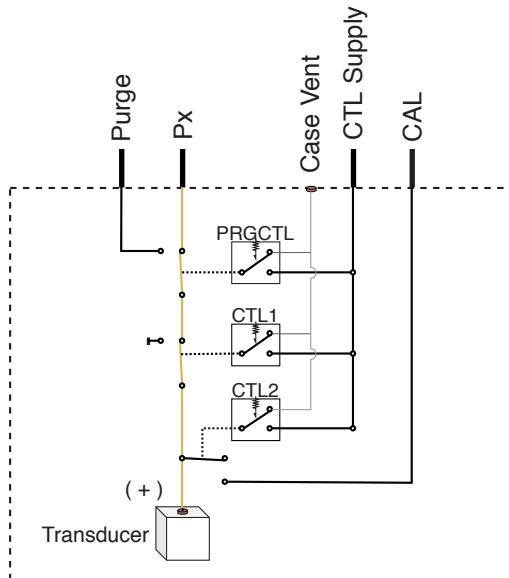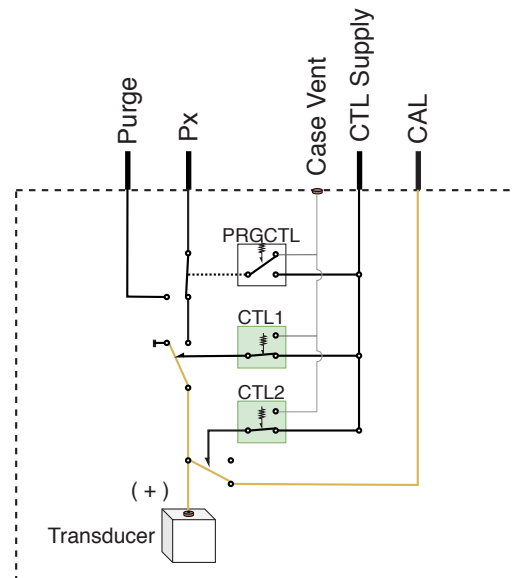

FIGURE C.13 - MEASUREMENT (PX) MODE

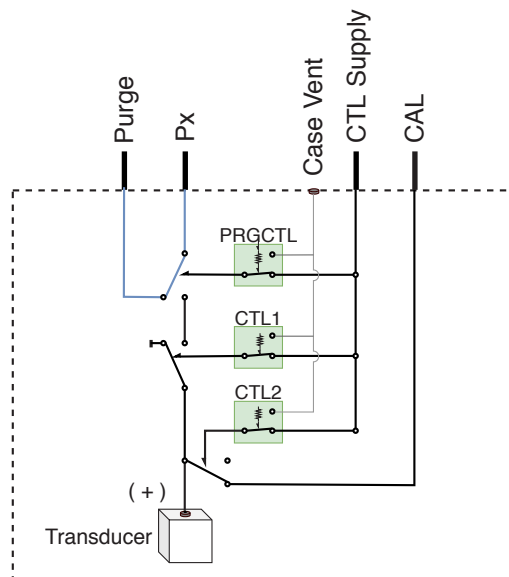

FIGURE C.14 - CALIBRATE (CAL) MODE
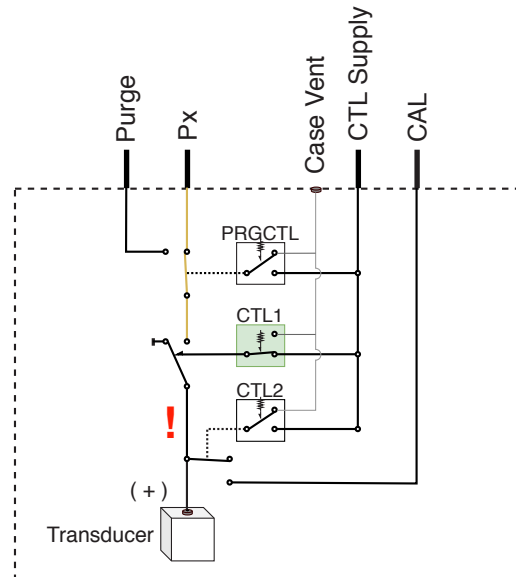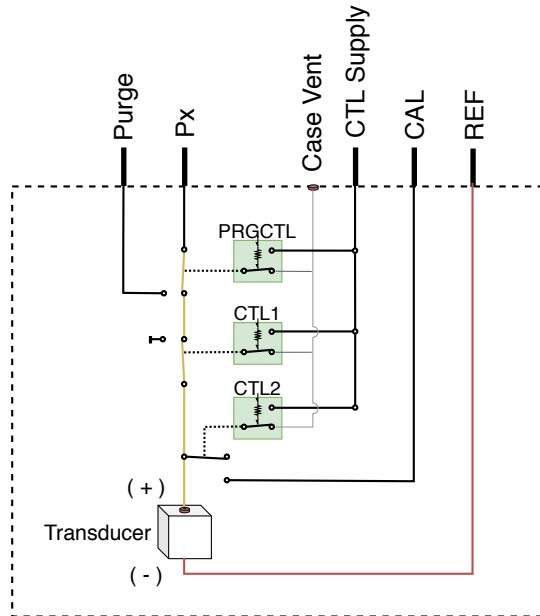

FIGURE C.15 - PURGE (PRG) MODE

FIGURE C.16 - ISOLATE (ISO) MODE

Note: In isolate only mode, the current pressure between the CTL1 valve and the Transducer (+) will be trapped. Changes in temperature or elevation can increase or decrease this pressure which may cause overpressure.

DIFFERENTIAL W/ N.O. SOLENOID VALVE LOGIC

Standard differential builds with normally open solenoids. These valve states require that control pressure be supplied at all times. Solenoid logic is opposite that of the standard, normally closed modules.
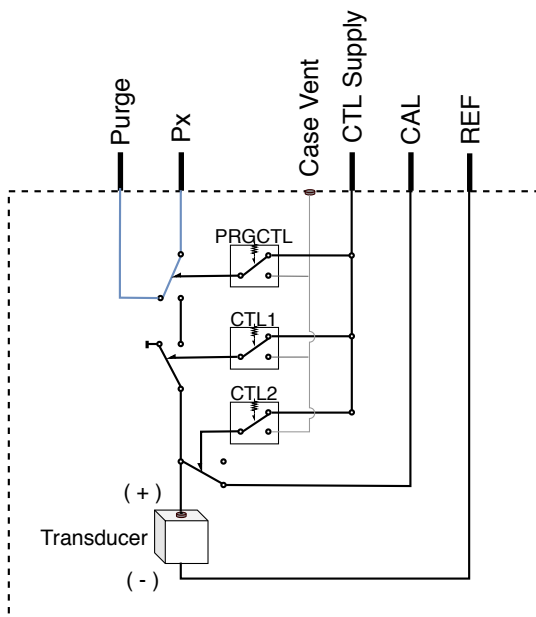
If control pressure is not present, modules will always default to measurement (Px) mode, regardless of solenoid state.
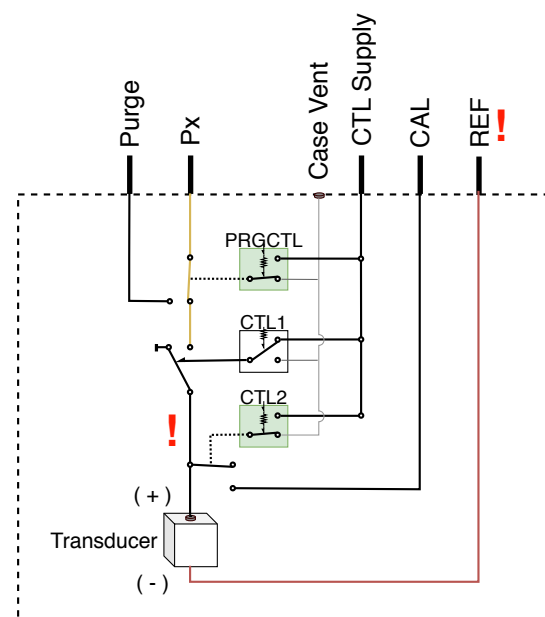

FIGURE C.17 - MEASUREMENT (PX) MODE
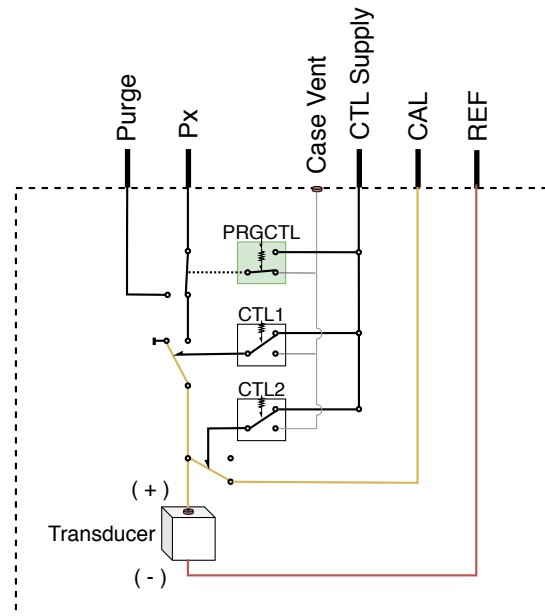
FIGURE C.18 - CALIBRATE (CAL) MODE

FIGURE C.19 - PURGE (PRG) MODE

FIGURE C.20 - ISOLATE (ISO) MODE

Note: In isolate only mode, the current pressure between the CTL1 valve and the Transducer (+) will be trapped. Changes in temperature or elevation can increase or decrease this pressure which may cause overpressure.

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APPENDIX D: DSA5000 MODEL NUMBER IDENTIFIER

The following information explains the DSA5000 part number.

DSA5000 / 063T - 100 PSID +SM

Add Shock Mount

Model

Series

Build / Type
0 - TCPIP/SSEP - Gas (≤500PSI)
1 - TCPIP/SSEP - Gas (>500PSI)
2 - TCPIP/SSEP - All-Media
3 - iDDS - Gas (≤500PSI)
4 - iDDS - Gas (>500PSI)
5 - iDDS - All-Media

Pneumatic Input Fitting Kit
NA - No Fitting Kit
QC - Quick-Connector (063)
042T - 0.042" OD Tubulations
063T - 0.063" OD Tubulations
125T - 0.125" OD Tubulations
063C - 1/16" Compression
125C - 1/8" Compression, Stainless Steel
125B - 1/8" Compression, Brass

Pressure Range(s)
Specify **PSID, PSIG, or PSIA**
Multi-Ranges separated by "/"

Configuration (Dash Number)
01 through **28** - See Table D-1 Below

Table D-1

PRESSURE TYPE	HEATER	QUICK-DISCONNECT (QD) HEADER	CONFIGURATION	AVAILABLE BUILD			
				0	3	1, 4	2, 5
Standard (Px)	No	No	01	X	X	X	X
		Yes	02	X	X	X	
	Yes	No	03	X	X	X	X
		Yes	04	X	X	X	
Dual Range (DR)	No	No	05	X	X	X	
		Yes	06	X	X	X	
	Yes	No	07	X	X	X	
		Yes	08	X	X	X	
Individual Reference (IR)	No	No	09	X	X	X	
	Yes	No	10	X	X	X	
True Differential (DPx)	No	No	11	X	X	X	
		Yes	12	X	X	X	
	Yes	No	13	X	X	X	
		Yes	14	X	X	X	
Dual Range, True Differential (DDR)	No	No	15	X	X	X	
	Yes	No	16	X	X	X	
Absolute (APx)	No	No	17	X	X		X
		Yes	18	X	X		
	Yes	No	19	X	X		X
		Yes	20	X	X		
Dual Range, Absolute (ADR)	No	No	21	X	X		
		Yes	22	X	X		
	Yes	No	23	X	X		
		Yes	24	X	X		
Standard w/ N.O. Solenoids (NOPx)	No	No	25	X			
		Yes	26	X			
	Yes	No	27	X			
		Yes	28	X			

APPENDIX E: SOFTWARE CHANGE LOG

Version 1.00 - Initial Release (October 2022)

Version 1.01 - Changed binary packet structure. Resolved an issue with PRU binary files. Added checking to firmware update process. (December 2022)

Version 1.02 - Added LIST arguments. Resolved an issue with the A/D synchronization. Support for Absolute modules. Corrected issue with valve change during CALZ. Minor web server fixes. Minor response fixes. Added RESET command. Resolved an issue when setting TRIG. (February 2023)

Version 1.03 - Added Heater support. (March 2023)

Version 1.04 - Added Field Calibration and True Differential support. Fixed a memory leak related to UDP scanning. Minor cleanup in LIST PTP, FTP, and S variables. (April 2023)

Version 1.05 - Added SSEP functionality and associated commands - see the SSEP section for details. Resolved an issue when loading field calibration coefficients. Fix a bug when external triggers are detected during boot sequence. Changed the boot process to ignore time requests or updates until ready. Resolved an issue with PTP resetting after power up. Disable the Scan page of the web server when a module is not in standalone mode. Changed internal data output methodology. Updated first 4 bytes of the module data in the binary packet. Added ERRORLOG 2 option. Miscellaneous small cleanup and fixes. (October 2023)

Version 1.06 - Resolved an issue with timestamps in CSV format. Fix a temperature update routine when scanning above 50Hz. Resolved an intermittent issue when external scan triggering after a CALZ. (November 2023)

Version 1.07 - Resolved an issue with CALZ when binary server was active. Added LIST V and associated variables. Added purge control functionality. Added control over the CALZ dwell time. Added option to boot in a certain valve state. Resolved issues with NPR bounds in specific models. Improved SSEP scanning reliability. Added Freon Dormant state as accepted VALVE argument. Added support for additional model build 2 through 5. Allow heater set point to be set. (April 2024)

Version 1.08 - Added Emulator functionality. Added support for DSA3200/DSAPTP Emulator. Improved PTP timestamp accuracy. Resolved speed negotiation issue when 4-wire Ethernet cables are used. Added support for LF only termination on received commands. (July 2024)

Version 1.09 - Added support for Normally Open solenoids and models 25 through 28. (January 2025)

Version 1.10 - Add support for future firmware updates. Add PTP Domain variable. (April 2025)

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