



## ETHERNET INTELLIGENT PRESSURE SCANNER

### NetScanner System Model 9216

The Model 9216 pneumatic intelligent pressure scanner is a completely self-contained high performance pressure acquisition module for multiple measurements of dry, non-corrosive gases. The scanner integrates 16 silicon piezoresistive pressure sensors of any pressure range with the latest microprocessor technology in a compact, ruggedized package. Each field-replaceable pressure sensor incorporates a temperature sensor and EEPROM for storage of calibration data along with sensor identification information such as pressure range, factory calibration date and user-managed last or next calibration date.

The microprocessor uses the data from the EEPROM to correct for sensor offset, span, linearity and thermal errors. The microprocessor's digital temperature compensation algorithm reduces sensor thermal errors by a factor of ten or more over conventional sensor compensation. The microprocessor also controls the actuation of an integral manifold to execute on-line zero or span calibrations upon request. This capability virtually eliminates sensor offset drift error and provides system accuracy errors less than  $\pm 0.05\%$  FS (Full Scale).

The 9216 can sample using up to three concurrent scan lists at continuous rates up to 500 measurements per channel per second in engineering units with timestamps. Pressure data in engineering units is output through an auto-negotiating 10 or 100 Mbit Ethernet interface supporting both TCP and UDP protocols. The 9216 data output optionally includes data time stamps derived from either the 9216 internal real time clock, NTP clock or an IEEE 1588-2008 Precision Time Protocol (PTPv2) grand master clock. The scanner is supplied with comprehensive software called NUSS for PC compatible computers. Firmware upgrades are available at no charge via our website and can be downloaded to the scanner over the 9216 Ethernet interface using NUSS.

The Model 9216 intelligent pressure scanner is one component of the NetScanner system. Multiple NetScanner components measuring a wide variety of parameters and sharing the same command set can be networked to form a distributed intelligent data acquisition system.

### Features

- $\pm 0.05\%$  FS System Accuracy
- EU Throughput Rates of 500 Hz
- IP66 Rated Enclosure
- IEEE 1588-2008 PTPv2 & NTP disciplined clock
- Auto start capability

### Applications

- Turbomachinery Test Stands
- Wind Tunnel Wall Pressure Measurements

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## Specifications

\*After 1 hour warmup at 25°C with atmospheric reference pressure unless otherwise stated / FS = Full Scale

PARAMETER	9216	UNITS	COMMENTS
<b>PNEUMATICS</b>			
	±10		
	±20	In WC	
Pressure Range	±1	+50	+375
	±2.5	+60	+500
	±5	+100	+650
	±10	+125	+750
	±15	+150	+850
	+30	+200	+1100
	+35	+250	
	+45	+300	
		psi	Ranges ≤ 10 psi are calibrated over the range of -FS to +FS pressure Ranges > 10 psi and < 100 psi are calibrated over the range of -12 psi to +FS pressure ranges ≥ 100 psi are unidirectional only
Number of Pressure Inputs	16		available in combined ranges
Pneumatic Fittings	1/16", 1/8", 1/4", 4mm 5/16" -24 SAE .063" bulge tube		Compression fittings O-ring boss QDC tubing plate
Media	Dry		non-corrosive gas
Proof Pressure <sup>1</sup>	3.0X		range <15 psi
	2.0X	FS min	range 15-100 psi
	1.5X		range >100 psi
Burst Pressure	5.0X		range <15 psi
	3.0X	FS min	range 15-100 psi
	2.0X		range >100 psi
	1.5X		range = 1100 psi
Max Line Pressure <sup>2</sup>	100	psi	range ≤5 psi
	600		range >5 psi
Manifold Control Pressure	100	psi	min
	125		max
Purge Pressure <sup>3</sup>	> max input pressure	psi	min
	1100		max
<b>STATIC PERFORMANCE</b>			
Measurement Resolution	±0.003	% FS	
Static Accuracy <sup>4</sup> After Rezero	±0.05	% FS	range > 2.5 psi
	±0.15	% FS	range ≤ 2.5 psi
Total Thermal Error <sup>5</sup>	±0.001	% FS/°C	range > 2.5 psi
	±0.0015	% FS/°C	range ≤ 2.5 psi
Line Pressure Effect	±0.0003	% FS/psi %	range ≥100 psi
	±0.0008	FS/psi %	range >5 psi to <100 psi
	±0.001	FS/psi	range ≤ 5 psi
Measurement Rate	500	meas/ch/sec	engineering units
<b>ELECTRICAL</b>			
Input Voltage	18 - 36	VDC	unregulated
Input Current	225	mA	maximum @ 24VDC
Hardware Trigger Threshold	2.5	VDC	TTL compatible differential input, ±5 VDC common mode voltage

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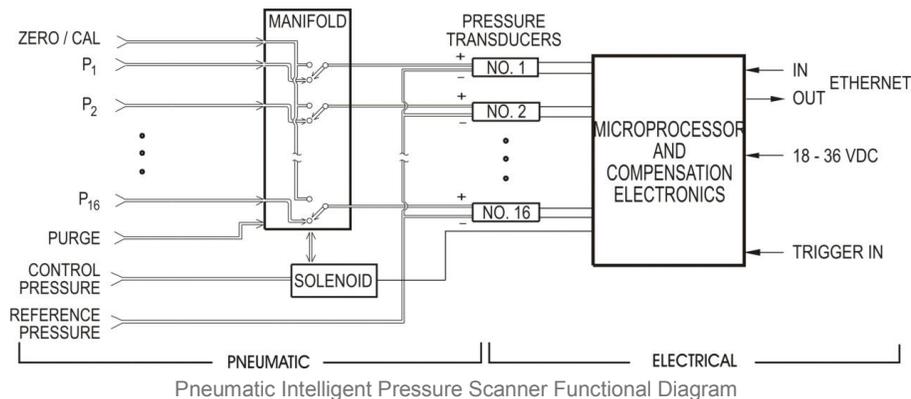
COMMUNICATION			
Communication	10/100 Base-T	auto negotiating, half duplex/full duplex	
Protocol	TCP and UDP	static or dynamic IP assignment	
Time Protocol	PTPv2 (IEEE 1588-2008) or NTP	external master clock or server required	
ENVIRONMENTAL/PHYSICAL			
Calibrated Temp Range			
Standard	0 to 60	°C	
Optional	-30 to 60	°C	
Operating Temp Range			
Standard	-20 to 70	°C	up to 95% non-condensing humidity
Optional	-30 to 80	°C	
Storage Temp	-30 to 80	°C	
Size	9.50 x 3.50 x 3.54	inches	L x W x H
Weight	6.5	lb	
Splashproof Rating	IP66		
Acoustic Noise Rating	160 dB		

Notes:

1. Maximum applied pressure without reducing sensor performance
2. For anticipated Line (Reference) Pressures . . .  
 above 100 psi for FS Pressure Ranges of  $\leq 5$  psi or  
 above 600 psi for FS Pressure Ranges of  $> 5$  psi
  - calibration manifold should not be shifted at line pressure
  - rate of line pressure change should be no more than 10 psi/sec
3. Purge pressure must be greater than maximum input pressure and should not exceed transducer burst pressure
4. Static accuracy includes the combined errors due to non-linearity, hysteresis and non-repeatability
5. Includes thermal effects of zero & span relative to 25°C
6. Consult factory for special temperature range calibrations

## Theory of Operation

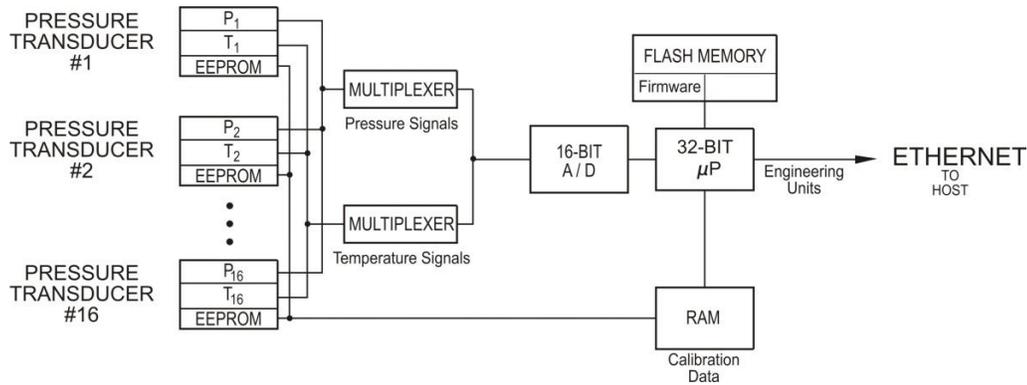
The 9216 combines integral pressure transducers with a miniature data acquisition system to provide a multichannel pressure scanner. The integration of the microprocessor with the pressure transducers provides several benefits in addition to the compact nature of the intelligent pressure scanner. This pre-engineered approach to pressure acquisition offers higher system accuracy, unlike individual pressure transducers where stated accuracy is met only if the many user-considerations are addressed, especially with respect to temperature effects and zero drift. The Model 9216 Ethernet intelligent pressure scanners output pressure data in engineering units, digitally compensated for offset, span, non-linearity and temperature effects. The integral pneumatic manifold permits on-line rezero and even span calibration capability under microprocessor control.



## Digital Sensor Temperature Compensation

Silicon piezoresistive pressure sensors are low cost, miniature pressure sensing elements suited for packaging individually for each pressure port. However, like most sensors, they are affected by temperature. Since these effects are repeatable, sensor calibration over temperature and pressure can be used to characterize and correct these errors.

Each silicon pressure sensor is packaged along with a nonvolatile memory device (EEPROM) and a temperature sensor in its own miniature field-replaceable housing. The transducers are factory-calibrated over the specified pressure and temperature spans. The resultant calibration data, along with the pressure range and serial number of the sensor, are stored in the integral EEPROM. The microprocessor utilizes this information to compensate transducer outputs for offset, sensitivity, nonlinearity, and thermal effects before transferring pressure data to the host computer. Should a transducer be replaced, the microprocessor will automatically recognize the new transducer upon power up and extract the calibration information from the EEPROM.



## Internal Clocks and Time Keeping

The 9216 contains an internal real time clock (RTC) for keeping system date and time. This clock is factory initialized to UTC-0 time. The 9216 also has the ability to continually synchronize its internal RTC to either an NTP server or IEEE 1588-2008 Precision Time Protocol (PTPv2) grandmaster clock if they are present and accessible on the 9216's network. As part of the 9216 data stream configuration, data samples may optionally include an absolute time stamp indicating when the data sample was acquired. It is also possible to configure 9216 data streams to start autonomously at a set absolute time. This is useful for initiating data streaming synchronously through a large 9216 configuration without the use of the hardware trigger signal.

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## Pneumatic Design

Model 9216 intelligent pressure scanners incorporate a unique manifold enabling on-line pneumatic rezero and span calibrations to maximize transducer accuracy. The manifold can be specified with either a common pressure reference or an individual pressure reference (true differential) per channel. Both configurations feature built-in purge and leak check capability of the pneumatic input lines as standard. The manifold utilizes a proprietary "O" ring seal providing years of leak free operation. If required, "O" rings can be replaced in the field using common tools.

Figures 1-4 illustrate the pneumatic function of the manifold for a single channel. Figures 1-3 depict the three manifold positions (RUN, CAL and PURGE). Figure 4 illustrates the LEAK CHARGE position for charging the input lines to execute a leak check. LEAK CHARGE position is not available for pressures above 850 PSI.

To initiate these operations, the user simply issues the appropriate command via the host computer. Operating under control of the onboard microprocessor, integral solenoids are energized to apply control pressure to one of four sets of pistons within the manifold. One piston forces the manifold longitudinally into the CAL position; another returns it to the RUN position. The remaining two sets of pistons force the manifold laterally into either the PURGE or the LEAK CHARGE positions. Pressure of 100-125 psig must be present at the Supply Input port on the 9216 when the command is issued.

Rezero or span calibration functions place the manifold in the CAL position. Once there, data is acquired to update zero and/or span terms and the manifold is then returned to the RUN position. Span calibrations require the appropriate full scale pressure to be present at the calibration port.

The purge function requires pressure in excess of the highest anticipated input pressure to be present at the purge input port. Issuing the purge command places the manifold into the PURGE position allowing purge pressure to exit the scanner through the input lines. Purging can require 1-3 scfm of flow depending on applied purge pressure.

**NOTE: On-line rezero or purge is not required to operate the scanner but provides maximum accuracy.**

The leak check function requires the desired test pressure to be applied to the appropriate Calibration port and the input lines to be dead-ended at their source. Issuing the Leak command forces the manifold into the LEAK CHARGE position to charge the input lines using pressure from the Calibration port. Once charged, the manifold is commanded to the RUN position where periodic readings from the transducers can be obtained to analyze pressure decay in each input line.

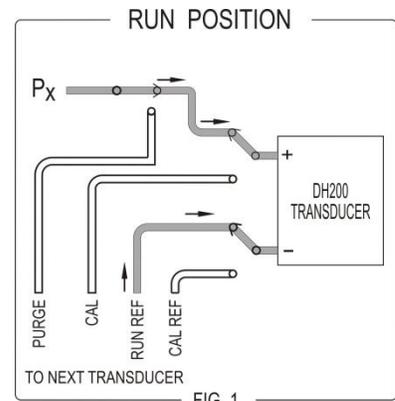


FIG. 1

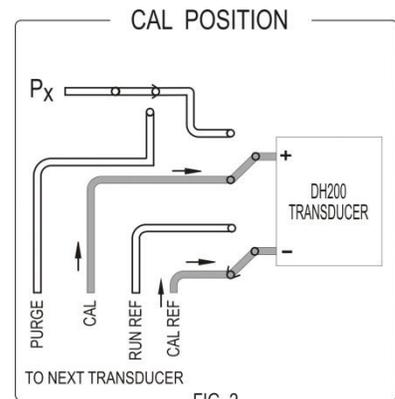


FIG. 2

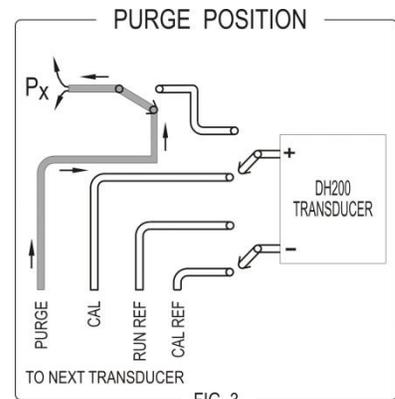


FIG. 3

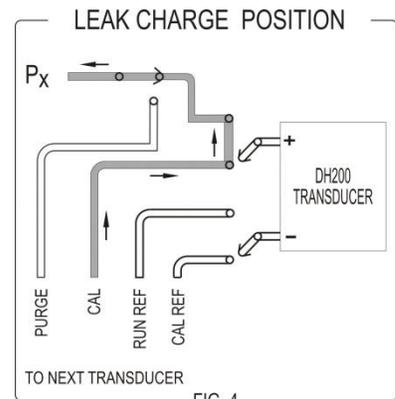


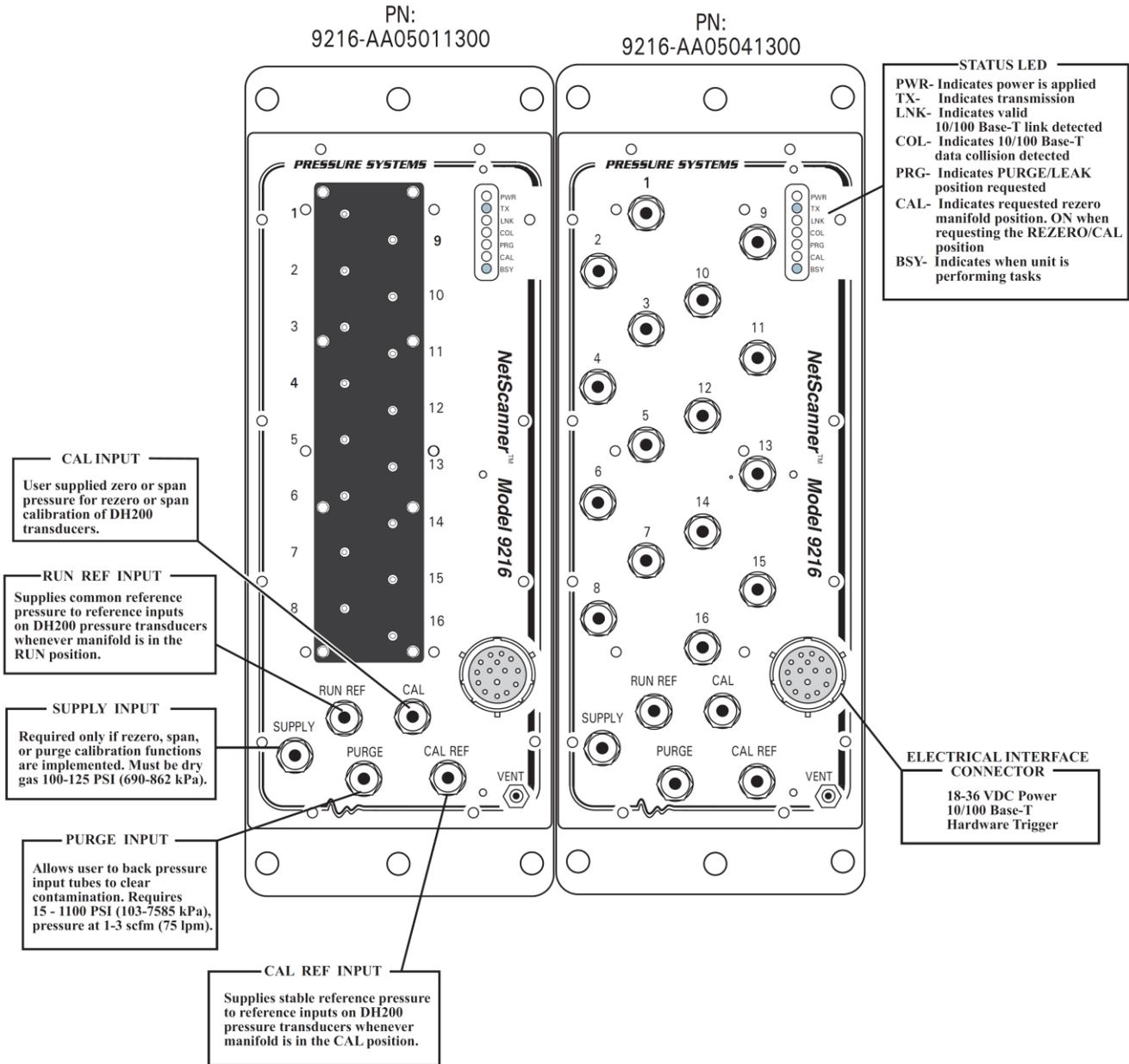
FIG. 4

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## Front Panel Layout

The 9216 front panels contain all pneumatic and electrical connections required to operate the device.

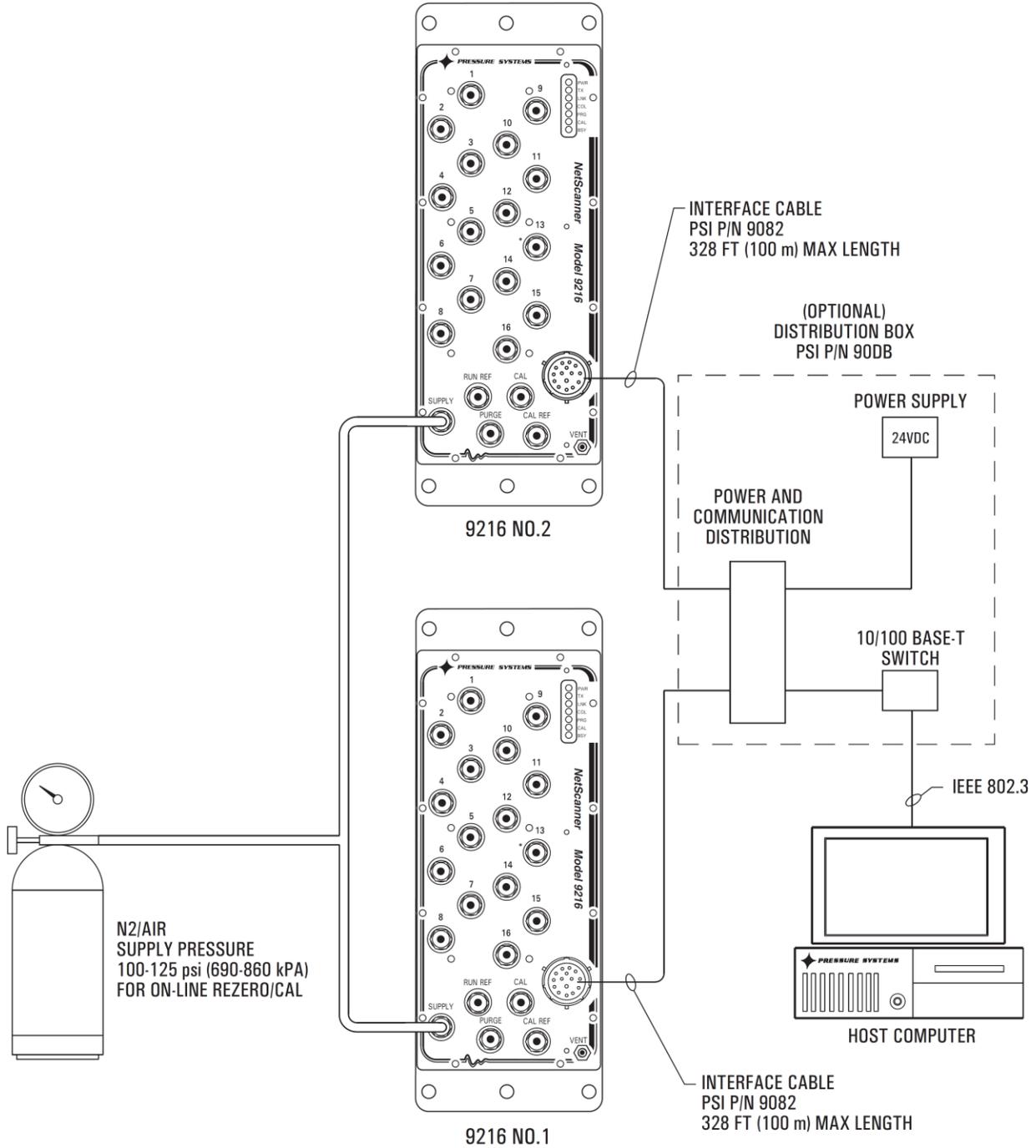


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## Networking Example

Multiple NetScanner or compatible third party devices may be networked together. The illustration shown on this page shows the required cables and accessories necessary to integrate two Ethernet intelligent pressure scanners to a desktop computer.



**Ordering Information**

PN: **9216-AABBCC13FF** 9216 Ethernet intelligent pressure scanner, 16 Channels

**AA = Pressure Range (Consult Factory for multiple pressure range configurations and other ranges not listed)**

01, 10" WC	08, 30 psid	23, 125 psid	31, 375 psid
02, 20" WC	09, 45 psid	24, 50 psid	32, 750 psid
03, 1 psid	10, 100 psid	25, 650 psid	34, 75 psid
04, 2.5 psid	11, 250 psid	26, 200 psid	39, 850 psid
05, 5 psid	12, 500 psid	27, 35 psid	75, 1100 psid *limited options available in this range
06, 10 psid	19, 600 psid	29, 60 psid	99, Multirange
07, 15 psid	20, 300 psid	30, 150 psid	

**BB = Manifold Options**

- 05, Common Differential, Purge, Leak Check
- 06, True Differential, Purge, Leak Check

**CC = Measurement Pressure Fittings**

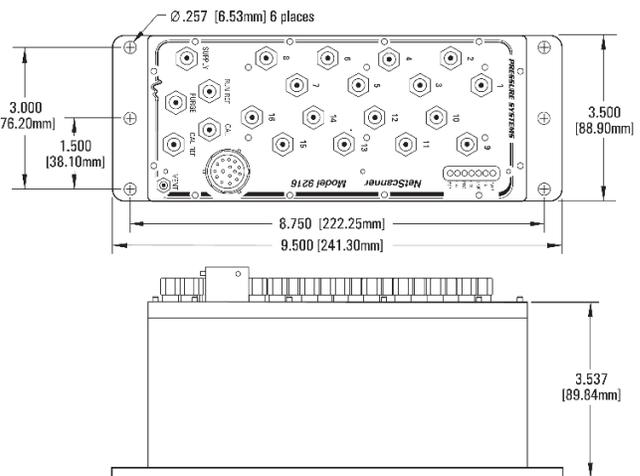
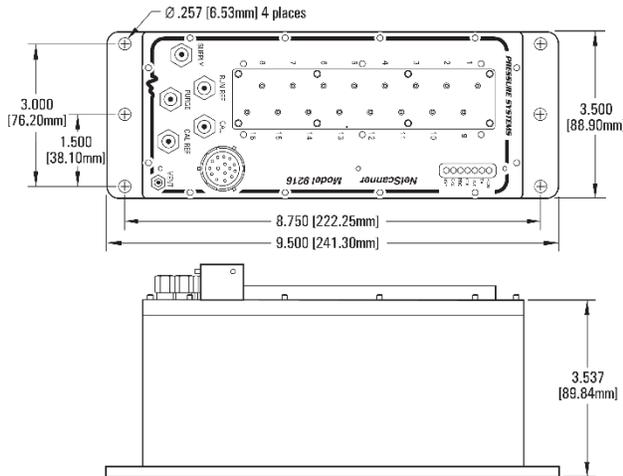
- 01, 0.063" Bulged Tubulation, QDC
- 02, 1/8" Swagelok Style Compression
- 03, 1/4" Compression
- 04, 1/8" Compression
- 05, 1/16" Compression
- 07, 5/16" - 24 SAE O-ring Boss
- 10, 5/16 SAE to M10 Adapter
- 11, 4mm Compression

**FF = Calibrated Temperature**

- 00, 0 to 60°C
- 06, -30 to 60°C

**Example: 9216-0105041300**

9216 Ethernet intelligent pressure scanner, 16 channels, 10"WC, Common Differential with Purge and Leak Check, 1/8" Compression Fitting, Ethernet, 0-60°C



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