# MODEL 9216 USERS MANUAL

# CHAPTER 1

# General Information

## 1.1 Introduction

This User's Manual will:

- Explain the electrical and pneumatic pressure connections for the Model 9216 Intelligent Pressure Scanner.
- Provide computer set-up instructions to make a proper Ethernet connection on most Windows® personal computers.
- Instruct you on using the start-up software to manipulate and acquire data from each module.
- Instruct you on how to program each module with computer software.

Model 9216 is a pneumatic Intelligent Pressure Scanner, with integral pressure transducers and a pneumatic calibration manifold.

The Model 9216 provides engineering unit pressure data with high system accuracy. This is achieved by reading factory-determined pressure and temperature engineering-unit data conversion coefficients from its transducers' nonvolatile memories at power-up. It also allows additional adjustment coefficients to be "fine-tuned" with a multi-point calibration under host control (e.g., possibly utilizing optional 903x Pressure Calibrator modules).

The Model 9216 provides an auto-configuring 10BaseT/100BaseT Ethernet communications port. Half duplex/full duplex operation is also automatically configured. The Model 9216 communicates using the TCP/IP and UDP/IP protocols.

The Model 9216 Intelligent Pressure Scanner is a component of a networked data acquisition concept called the NetScanner System. Multiple NetScanner modules measuring a wide variety of parameters can be networked to form a distributed intelligent data acquisition system.

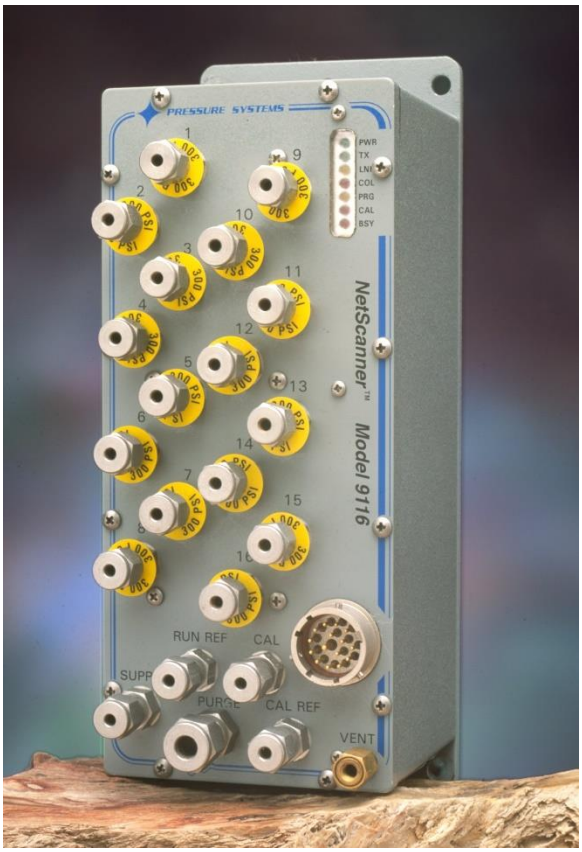



**Figure 1.1**
**Model 9216 Intelligent Pressure Scanner**

## 1.2 Description of the Instrument

The Model 9216 contains 16 measurement channels, each with an individual internal pressure transducer. The most distinctive features are highlighted below:

- Pre-calibrated Transducer - a non-volatile memory chip containing full thermal pressure calibration data is embedded within each internal transducer.
- Individual transducer per measurement input channel - mixed transducer ranges may be installed in a single Model 9216 module.
- Low cost per point - per-channel cost is less than a typical industrial pressure transducer/transmitter.

- High accuracy - Model 9216 pressure scanners are capable of accuracies up to ±0.05% of full scale. Accuracy is maintained through use of built-in re-zero, span, or multi-point calibration capabilities. Accuracies are maintained for six (6) months after calibration.

- Low thermal errors - each internal transducer contains an individual temperature sensor and factory thermal calibration data for use by internal software correction algorithms. Thermal errors are reduced as low as ±0.001%FS/ºC over the calibrated temperature span.

- Re-zero upon demand - an integrated calibration valve allows for automatic re-zero adjustment calibration of dry gas transducers to null offset drift errors.

- Ease of transducer replacement - factory calibrated transducer assemblies may be stocked and rapidly replaced in the field. Storage of thermal coefficients within the transducer allows for 'plug and play' transducer replacement.

- Ease of calibration - each Model 9216 module contains a pneumatic calibration manifold and software commands to automatically perform re-zero, span, and multi-point adjustment calibrations. New offset and gain coefficients that result from the most recent calibration may be stored in non-volatile transducer memory.

- Ease of use - modules have simple command sets and provide engineering units output. They may interface directly to a desktop or laptop computer or they may be interconnected into a large network controlled by many types of host computers.

- Connectivity - use of industry-standard communications network protocols to control and read data from NetScanner System modules allows distribution to the point of measurement and ensures compatibility with third party hardware and software.

### 1.2.1 Differences Between Models 9116 and 9216

The 9216 builds on the proven foundation of the Models 9016 and 9116, incorporating an enhanced microprocessor architecture capable of operating at up to 1GHz clock speeds. The new architecture also includes hardware support for implementation of the IEEE-1588-2008 Precision Time Protocol (PTPv2). The 9216 also includes a new internal operating system, providing a robust platform for future firmware enhancements and features.

The firmware in the Model 9216 implements the standard NetScanner command set, further simplifying use with existing systems. In fact, the Model 9216 can be configured to report its identity as an older model, such as a 9016 or 9116, to ensure compatibility with legacy software that is sensitive to the reported model type. For details regarding the 9216 command set refer to the **Netscanner Programmer's Reference Manual**.

Additional enhancements to the Model 9216 :

**Network Address Assignment**:
DHCP capability in the 9216 has replaced the BootP and RARP dynamic address assignment methods previously used in the 9116.

**IPv6 capability:**
9216 will accept a TCP connection via TCP/IP v6 on port 9000. The link local address is available for this purpose and can be discovered by the IPv6 Neighbor Discovery protocol. NUSS remains an IPv4 only application.

**Timestamping and Clock Synchronization:**
The 9216 will automatically synchronize with a PTPv2 server if one is present on the local subnet. If a PTPv2 master is not available then the user can specify an NTP server for time synchronization. If neither a PTPv2 or NTP server is found, the 9216 contains an internal Real Time Clock (RTC) with battery backup for data and time synchronization of the operating system. Stream data packets are timestamped at trigger time and those timestamps will be transmitted with the stream data packet when requested.

The 9216 provides a very high level of software compatibility with legacy Netscanner products but there are a small number of incompatibilities that users should be sensitive to. Operational incompatibles between the legacy 9016 or 9116 and the 9216 are as follows:

- The 9016 and 9116 both supported the RARP and BOOTP protocols for dynamic IP address assignment. The 9216 uses DHCP only for dynamic address assignment.

- The 9216 supports use of three different data streaming task (configured with the ‘c’ command) to return data automatically at a predefined rate. The 9016, 9116 and 9816 allowed for tasks to be configured to use a mixture of hardware and software triggering to return the data from each configured stream. In the 9216, all streams must be configured to use the same trigger mode, either hardware or software trigger.

- When configuring multiple streams, streams 2 and 3 must be configured at a period that is a multiple of the period of stream 1. Due to this restriction, stream 1 must always be configured first. When stream 1 is configured, streams 2 and 3 are reset and must be configured for proper use.

# 1.3 Options

## 1.3.1 Pressure Ranges

The Model 9216 contains sixteen (16) discrete DH200 transducers. These transducers are available with full scale pressure ranges from 10" $H_2O$ (inches of water column) to 1100 psid. Transducers with different pressure ranges may be combined in a single module.

Please consult the **Netscanner System Model 9216 Data Sheet** for a list of all standard pressure ranges.

### 1.3.2 Manifolds and Pressure Connections

Model 9216 Intelligent Pressure Scanners are available with a true differential or common reference pneumatic manifold and have a standard purge and leak check manifold. They are available with standard 1/8" or optional 1/16", 1/4" or 4mm compression fittings. All fittings utilize an SAE 5/16-24 O-ring boss port which supports a variety of other adapter compression fittings. They are also available with a quick disconnect plate which contains 0.063" bulge tubulation. The common differential version is available with all choices of fittings. The true differential version is available with quick disconnect bulged tubulation fittings only.

Consult the Sales Department at TE Connectivty for availability of other input fittings.

### 1.3.3 Communication Interfaces

All standard NetScanner System Intelligent Pressure Scanners provide temperature compensated and linearized pressure data in engineering units via a digital interface. They have an Ethernet host communications interface using industry standard TCP/IP or UDP/IP protocol. The 9216 supports both the IPv4 and IPv6 standards. This interface provides high data transfer rates and flexible system connectivity. The Model 9216 includes auto-configuring 10BaseT/100BaseT, half duplex/full duplex capabilities for improved network flexibility.

# CHAPTER 2

# Installation and Set Up

## 2.1 Unpacking and Inspection

The NetScanner System product family has many components which may be purchased either as an entire system, or as individual pieces of equipment. Before assembling the system, use the shipping bill as a reference to ensure that all parts have arrived. TE Connectivity takes no responsibility for equipment that is damaged during shipment. If containers are broken, ripped, or damaged, contact the transportation carrier. If the equipment itself appears to be damaged, contact Customer Service at TE Connectivity.

Each Model 9216 Intelligent Pressure Scanner shipment will contain the following minimum components:

- Model 9216 Intelligent Pressure Scanner module
- CD-ROM containing test data and support utilities

## 2.2 Safety Considerations

**WARNING! Always follow your established Environmental, Health and Safety (EHS) procedures and Personal Protective Equipment (PPE) requirements when operating or installing the Model 9216 and its associated electrical and pneumatic equipment.**

Always wear safety glasses when operating this equipment or when working with any pressurized lines. Always ensure that high pressure lines are properly secured and that all pneumatic lines are rated for the proper pressure and temperature environments.

All system power should be **OFF** during installation (or removal) of any components in a NetScanner System module. Failure to turn power **OFF** prior to installation may cause permanent damage to the module. Use caution and check line voltages before applying power to the module.

## 2.3 Preparation for Use

### 2.3.1 Environment

All Model 9216 Intelligent Pressure Scanners are factory calibrated to be meet performance specifications over a wide temperature range but may be operated or stored over a wider temperature range (see **Environmental/Physical** Specifications in the **Netscanner System Model 9216 Data Sheet**). Operating or storing an instrument outside its specified range(s) will result in a loss of measurement accuracy and may cause permanent damage to the instrument.

**WARNING! Exceeding the specified storage or operating temperatures may result in permanent damage to the Model 9216 electronics.**

### 2.3.2 Power

The Model 9216 Intelligent Pressure Scanner needs only a single unregulated power supply. See the **Netscanner System Model 9216 Data Sheet** for specific power requirements.

The Model 9216 has a single round, ruggedized connector through which all power and input/output signals pass as shown in **Figure 2.1**. TE offers the Model 9082 electrical interface cable for use with all Netscanner modules. Details of the 9082 and Netscanner electrical connections are included in **Appendix C**.

**WARNING! Improper connection of power to the Intelligent Pressure Scanner can result in permanent damage to module electronics.**

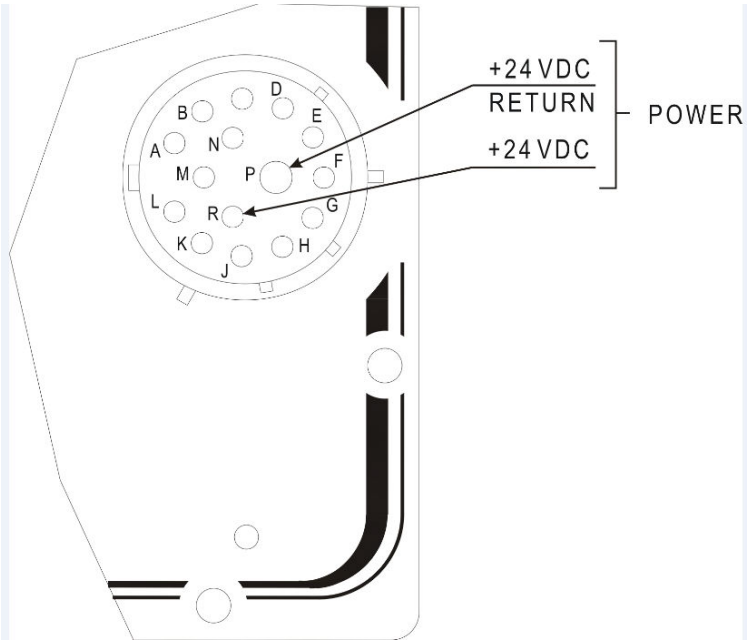



**Figure 2.1**
**9216 Power Pin Assignments**

## 2.3.3 Network Communications Hookup

The Model 9216 has an Ethernet interface using TCP/IP and UDP/IP transmission protocols, allowing it to be interconnected in a network with other modules and a host computer.

### 2.3.3.1 Ethernet Host Port Hookup

The Ethernet Host port of every Model 9216 Intelligent Pressure Scanner module, and its host computer, may be interconnected in a “star” network via a standard 10BaseT or 100BaseT, half or full duplex hub or switch. These standard networking devices will have their own power requirements. Switches may provide or negotiate different speeds and/or different handshaking on its various ports. The Model 9216 will auto-negotiate through the switch, for a half or full duplex connection at 10BaseT or 100BaseT speeds, establishing the best connection available. Ethernet communications pin assignments for the Model 9216 electrical connector are shown in **Figure 2.2.** See **Figure 2.3** for typical network topology.

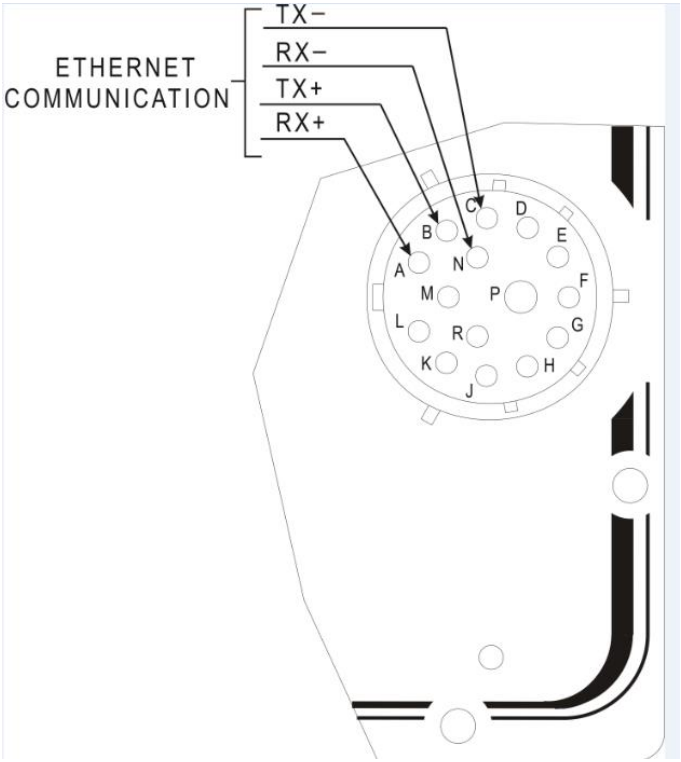



**Figure 2.2**
**Ethernet Host Port Connector Pins**

### 2.3.3.2 Ethernet Address Assignment

The host and each module must have a unique *Ethernet Hardware Address* (*a.k.a. MAC Address)* and a unique *IP Address*. The Ethernet Hardware address is generally fixed (at manufacturing time of the Ethernet microprocessor board inside the module). The Ethernet Hardware address is shown on each module's engraved tag. The Ethernet Intelligent Pressure Scanners are capable of supporting various methods for IP address assignment, using either the factory default (static IP addressing) or user-configured Static IP addressing or Dynamic IP address assignment. Dynamic IP address assignment is through the use of the DHCP protocol and will require a properly configured DHCP server on the network. The 9216 is shipped configured to use static address mode as the factory default. This default method is typically the simplest method for using the Intelligent Pressure Scanner.

In the Static IP addressing mode, the module will use a factory default IP address on power-up. This default address is set to 200.2xx.yyy.zzz where xx is derived from the module type (10 for Model 9216) and yyy.zzz is derived from the module serial number. A similar method is used to calculate each module's Ethernet hardware (MAC) address shown on the module tag. Note that each of these fields (separated by a period, '.') is a decimal representation of a byte value. This means that each field may have a maximum value of 255. For Model 9216 modules, the default IP address will be 200.210.y.zzz where y and zzz are calculated as follows:

y is the integer result of dividing the module serial number by 256.
zzz is the remainder of dividing the serial number by 256 (serial number modulus 256).

These calculations may be verified by checking that y * 256 + zzz equals the original module serial number. Once a module has powered-up and has assigned itself a default IP address, it is capable of communications.

An alternate method for assigning an IP address to an Ethernet module is referred to as a Dynamic IP assignment. This method allows a module to have its IP address dynamically assigned at power-up by an application running on a node of the TCP/IP or UDP/IP network. When configured for Dynamic IP address assignment protocols, the reset module will broadcast its Ethernet hardware (MAC) address on the network in a Dynamic Host Configuration (DHCP) request packet. This broadcast packet identifies the module by its hardware address and requests that a dynamic IP server application return to it an IP address for use. Once this broadcast message is received, the DHCP server will then return an IP address to the module in a dynamic IP reply packet. Most dynamic IP server applications determine this IP address from a user maintained file that lists Ethernet hardware addresses with their desired IP address. If modules are added to the network or module IP addresses are to be changed, the user can simply edit this configuration. If configured for Dynamic IP assignment, a DHCP server must be configured on the network to return an IP address to the module. **If the module fails to receive an IP address from a DHCP server upon reset, it will revert to its static IP address.**

Use of Static or Dynamic IP settings may be selected through the provided NUSS application or by using the ***Set Operating Options*** ('w') command.


**Obtaining the maximum performance of an Ethernet network is a complex process, involving many tradeoffs and is best performed by IT professionals or other personnel familiar with Ethernet parameters, topologies, and equipment capabilities.**

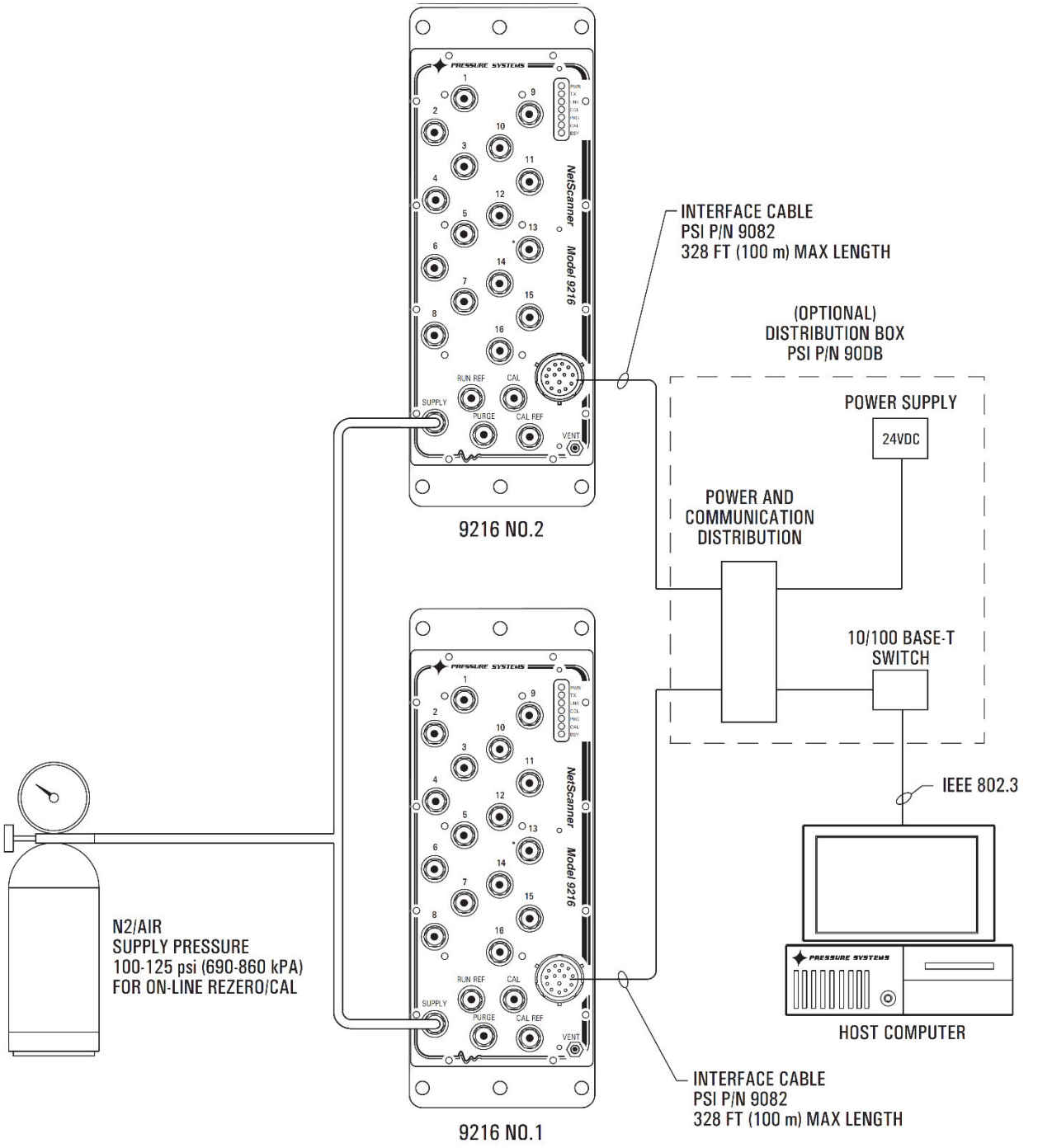



**Figure 2.3**
**Ethernet Network Topology**

### 2.3.4 Case Grounding

The Model 9216 module contains a case bypass capacitor which allows the module case to be mounted on hardware with a small common mode line voltage (less than 50 Volts).

### 2.3.5 Trigger Input Signal

The Model 9216 supports the use of a data acquisition synchronization signal, sometimes called "Hardware Trigger." When configured through the ***Define/Control Host Stream*** **('c')** command, the trigger signal can be used to initiate and synchronize data acquisition and stream outputs to the host.

The trigger signal is intended to be a 2-wire differential signal brought in through the Model 9216 main electrical connector. The signal may be driven by a standard TTL compatible device. The switching threshold for this signal is set at 2.5 VDC. . TE offers the Model 9082 electrical interface cable for use with all Netscanner modules. Details of the 9082 and Netscanner electrical connections, including the trigger input signals, are included in **Appendix C**.

### 2.3.6 Pressure Connections

All pneumatic connections to Model 9216 are found on the instrument top panel. The function of each input port is clearly engraved or printed next to each input. Connections are through bulge tubing, compression fittings, or user-supplied fittings on the tubing plate. All pneumatic inputs to the Model 9216 should contain only dry, non-corrosive gas.

All Model 9216 standard Intelligent Pressure Scanners are supplied with the purge/leak check calibration manifold. Through software commands, this valve may be placed in one of four positions; **RUN**, **CAL**, **PURGE**, or **LEAK-CHARGE**. Pneumatic input requirements for these four operating positions are described in the following sections.

The following guidelines should be used when installing pressure connections to the Model 9216 Intelligent Pressure Scanner modules.

- **Always wear safety glasses when working with pressurized lines.**
- **Ensure that user input pressure will not exceed the proof pressure ratings of the corresponding instrument transducer. Applying excessive pressure to measurement inputs can permanently damage the pressure transducers.**
- **Ensure that all tubing material is rated for the expected pressure and environmental conditions. Failure to use the proper tubing material may result in ruptured lines and possible personal injury.**
- **Ensure all high pressure lines are properly secured.**
- **Place retaining springs over all bulge tube fittings to ensure pneumatic lines remain attached and leak free. Springs should be pushed down on connections so that half of the spring length extends past the tube bulge.**

**WARNING! Introduction of contaminants or corrosive materials to the module pneumatic inputs may damage module transducers, manifolds, and O-ring seals.**

#### 2.3.6.1 RUN Mode Inputs

The standard pneumatic tubing plate for the Model 9216 contains sixteen numbered pneumatic input channels. These numbered inputs are attached to corresponding pressure transducers inside the instrument and should be pneumatically attached to the pressure measurement points under test.

The standard tubing plate also contains an input labeled **RUN REF**. The **RUN REF** input is pneumatically connected to the reference side of all internal DH200 pressure transducers. The **RUN REF** connection is used for situations where all channels have one reference pressure. See the **Model 9216 Data Sheet** for detailed specifications regarding maximum allowed reference pressures. This input may also be left unattached to provide atmospheric reference pressure.

When using instruments with the reference per channel option (true differential), two pneumatic inputs will be provided for every numbered channel. These inputs are labeled '**P**' and '**R**'. The '**P**' connection is the test pressure input. The '**R**' connection is the transducer reference input pressure. Since each channel has its own reference pressure input, the **RUN REF** input is not provided on the true differential tubing plate.

#### 2.3.6.2 CAL Mode Inputs

The Model 9216 tubing plates contain inputs labeled **CAL** and **CAL REF**. When the module's internal calibration valve is placed in the **CAL/RE-ZERO** position, all DH200 transducer pressure inputs are pneumatically connected to the **CAL** input port. All DH200 reference inputs are pneumatically connected to the **CAL REF** input port. The **CAL** input may be used to perform on-line zero adjustment of the transducers. The **CAL** input may also be used for DH200 span adjustment calibrations and accuracy verifications if appropriate pressure calibrators (such as the 903x series) are available. Span calibration of multi-range scanners may also utilize the **CAL** port if the highest applied pressure does not exceed the proof pressure rating of any other installed transducer, otherwise the individual transducers must be calibrated with the valve in the **RUN** position.

When the internal calibration valve is in the **CAL/RE-ZERO** position, the **RUN** inputs (**RUN REF** and numbered input ports) are pneumatically dead-ended to prevent migration of contaminants into the instrument.

#### 2.3.6.3 PURGE Mode Inputs

All standard Model 9216s contain a *purge/leak check option*. The purge option allows users to apply positive pressure to the **PURGE** input which will then be vented out of the user input ports, forcing contaminants (such as moisture) out of the pneumatic input lines. Note that on common reference Model 9216 scanners, only the numbered input ports will be purged (**RUN REF** is not purged)**.** True differential Model 9216 scanners will purge both the run and reference input ports for all channels. **The purge supply provided to the Model 9216 must always be a higher pressure than the highest pressure present on the input ports of the module. The purge supply must also be capable of**

**maintaining proper purge pressure at the high flow rates encountered while the module is in the purge mode.**

**WARNING! Failure to provide sufficient purge supply pressure will result in migration of moisture and contaminants into the Model 9216 module which can result in permanent damage to module components.**

When commanded into the **PURGE** position, the purge input pressure will be connected to the numbered measurement input ports allowing for a flow of air away from the instrument. The purge cycle should be terminated by commanding the Model 9216 into a non-purge mode such as CAL. **Purge cycles should never be terminated by turning off the purge supply air while in the purge position.**

#### 2.3.6.4 LEAK Mode Inputs

The purge/leak charge valve design includes a leak check feature capable of testing the integrity of user pneumatic connections as well as those within the Model 9216 module. For the leak mode to be used, all **RUN** mode pressure inputs must be dead ended (closed) by the user. When the Model 9216 is commanded into the **LEAK-CHARGE** position, the **CAL** input port will be pneumatically connected to module run side inputs. Common reference modules will connect only the numbered run side inputs to **CAL** (**RUN REF** is not charged). True differential (reference per port) modules will connect both the measurement input and reference port to **CAL**. While in the **LEAK-CHARGE** position, a test pressure may be applied through the **CAL** port which will charge the dead ended run side tubulation.


**Note**

**Test pressures applied to the CAL port during the leak check operation must not exceed the full scale pressure of any internal transducers.**

Once the lines are charged, the Model 9216 may be commanded back to the **RUN** position. This will reattach the charged run side lines to their corresponding internal transducer. Consecutive pressure readings from the Model 9216 will now allow user calculation of the line leak rates. Once returned to the **RUN** position, lack of a pressure indicates a gross leak. A slowly declining pressure indicates a slight leak. A leak is more difficult to detect as tubing volume increases. In the case of true differential units where both sides of the sensor are pressurized with the leak test pressure, an initial differential pressure of 0.0 psi should be measured when the unit is placed in the **RUN** position. If the measurement or **RUN** side of the channel leaks at a rate greater than the reference side, a resulting negative differential pressure will be measured. Likewise, if the reference port tubing leaks at a rate greater than the measurement side, a resulting positive differential pressure will be measured.


**Note**

When the Model 9216 internal valve moves from the **LEAK-CHARGE** to **RUN** positions, a small amount of the charged pressure will escape through the dynamic seals**.** Leak rates should be based on the change in line pressure after returning to the **RUN** position and not the variation from the initial applied leak charge presure.

### 2.3.6.5 Supply Air

The Model 9216 modules require an 80 psig minimum dry air (or inert gas) supply which is used to shift the internal calibration valve between its different positions. Each module contains a fitting marked **SUPPLY** for this input. Internal solenoid valves direct this supply pressure to the proper control port on the calibration valve as required by instrument commands. The absence of sufficient supply air to the module will prevent the calibration valve from shifting into requested positions (i.e., **RUN**, **CAL**, **PURGE**, **LEAK-CHARGE**).

To ensure proper long term operation of the internal pneumatic components, the supply air source should comply with ISO 8573.1 quality class 5.2.4. Pressure dew point exception is allowed as long as pressure dew point is 10°C below equipment operating temperature.

**WARNING! Supply air should not exceed 125 psi (875 kPa). Excessive pressure may damage the internal solenoids.**

### 2.3.6.5 Vent Port

The Model 9216 contains a pressure relief valve labeled VENT on the top plate. This unidirectional relief valve will vent any internal pressures within the 9216 case in excess of 1 psi. These pressures can be generated due to venting of internal solenoid valve gases or due to ambient pressure variations around the 9216.

# CHAPTER 3

# Service

## 3.1 Maintenance

This section provides a detailed step-by-step guide for performing repair and maintenance of Model 9216 Intelligent Pressure Scanners. The method for upgrading module firmware is also presented in **Section 3.2**.

**Figure 3.1** is an exploded view of the Model 9216. Please refer to this drawing for an understanding of the construction of Intelligent Pressure Scanner models. **Figure 3.2** depicts the 9216 top plate.

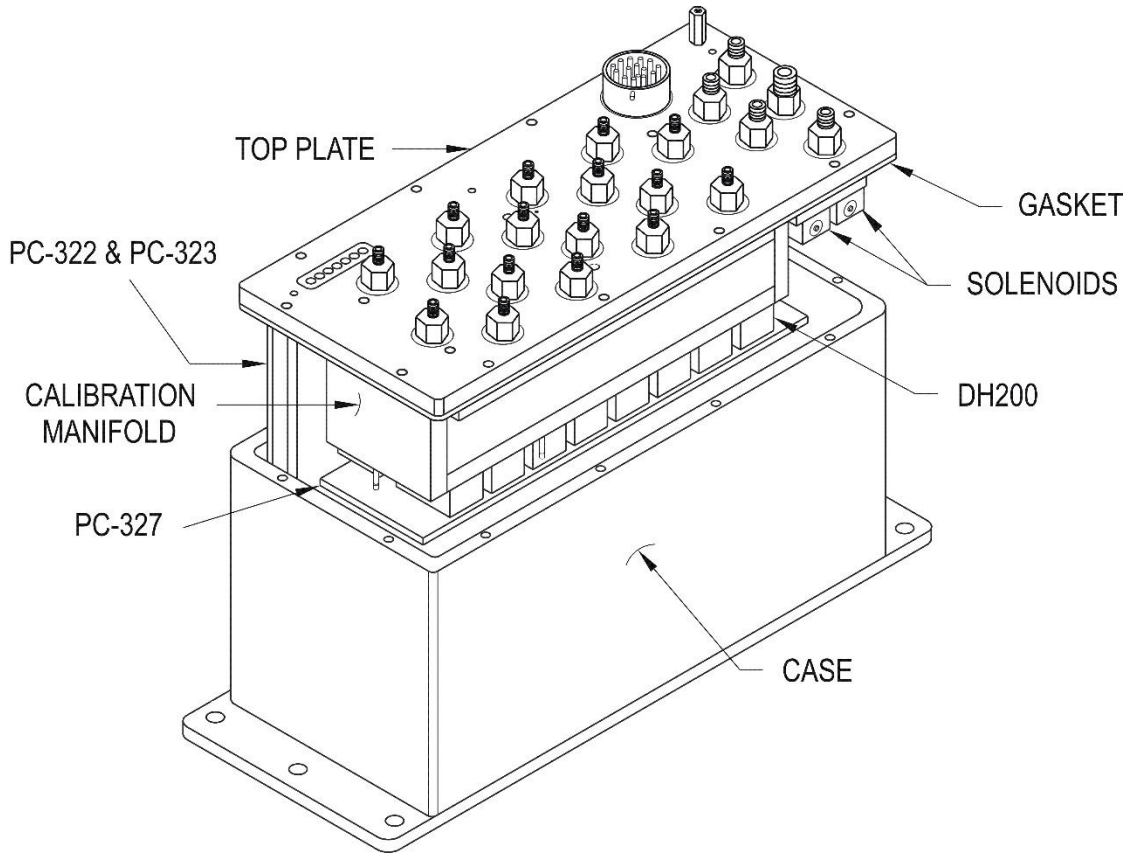



**Figure 3.1**
**Exploded View of Model 9216**

**Note**

The printed circuit boards in Model 9216 module are field *replaceable*, but are NOT intended to be field *repairable*.

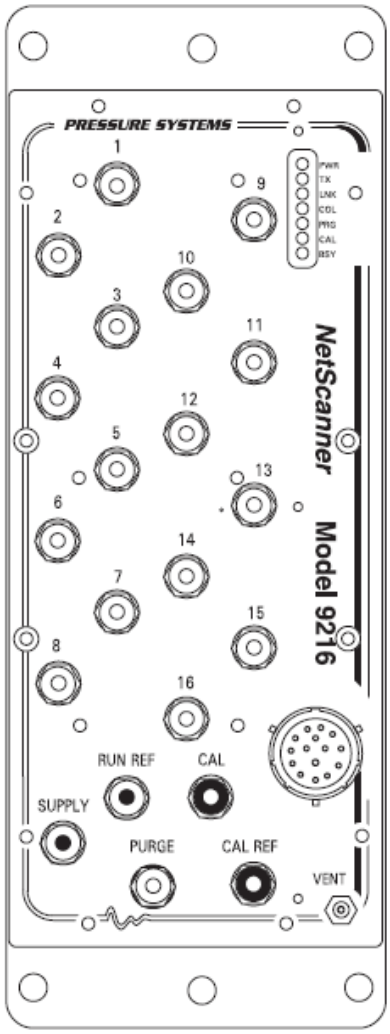



**Figure 3.2**
**Model 9216 Top Plate**

**Table 3.1** provides a convenient cross reference summary of the components found in your Model 9216 Intelligent Pressure Scanner. This may be used as a guide to identify the appropriate component replacement sections in this chapter.

**Table 3.1**
**Component Cross Reference**

| Component | Section |
|---|---|
| PC-327 Analog PCB Assembly | 3.1.3.1 |
| PC-427 ARM daughterboard PCB Assembly | 3.1.3.2 |
| PC-322 Main Board PCB Assembly | 3.1.3.2 |
| DH-200 Transducer | 3.1.4 |
| Solenoid Valves | 3.1.5 |
| Pneumatic Calibration Manifold | 3.1.6 |

## 3.1.1 Common Maintenance

Your Model 9216 Intelligent Pressure Scanner is designed for rugged use. No special preventive maintenance is required, although periodic maintenance may be required to replace worn or damaged components. Upgrades or modifications of module hardware or firmware may also be periodically required. For users who wish to do their own maintenance and repairs, maintenance kits and replacement parts for each model may be purchased from the factory.

**All circuit boards are sensitive to electrostatic discharges. Anti-static protection is required whenever the unit is open.**

**When performing any type of maintenance of Model 9216 components, the following guidelines and precautions should always be followed:**

- **Verify that the work area and technicians are properly grounded to prevent damage to electronic components due to electrostatic discharge.**
- **Ensure that all electrical and pneumatic connections have been removed from the module.**
- **Ensure that the work area is free of dust and other possible contaminants that may affect the high tolerance machined parts (and pneumatic seals, if model has an integral manifold).**
- **Care must be taken to prevent contaminants from reaching O-ring surfaces. If O-ring surfaces require cleaning, use a lint-free applicator with acetone to remove dirt and lightly lubricate the O-ring surface with lubricant provided in the maintenance kit.**
- **Never use sharp objects to cut tubing from the bulged tubes. The tiny scratches left on the tubes could cause leaks.**

In the process of performing general maintenance on a module and in printed-circuit board replacement, the following tools may be required:

- 3/32" and 5/64" Allen-head screwdrivers,
- a 3/16" hex wrench,
- a needle nose tweezers,
- a Phillips-head screwdriver, and
- a small adjustable wrench.

### 3.1.2 Module Disassembly

The following procedure should be used to disassemble any model prior to any maintenance.

(1) Place the scanner with its external connectors facing up. With one hand holding the module housing, remove all screws securing the top plate to the module housing. These are located around the outer edge of the top panel of the module housing. The Model 9216 uses twelve (12) Phillips head screws around the top plate outside perimeter, marked in red in **Figure 3.3** below.

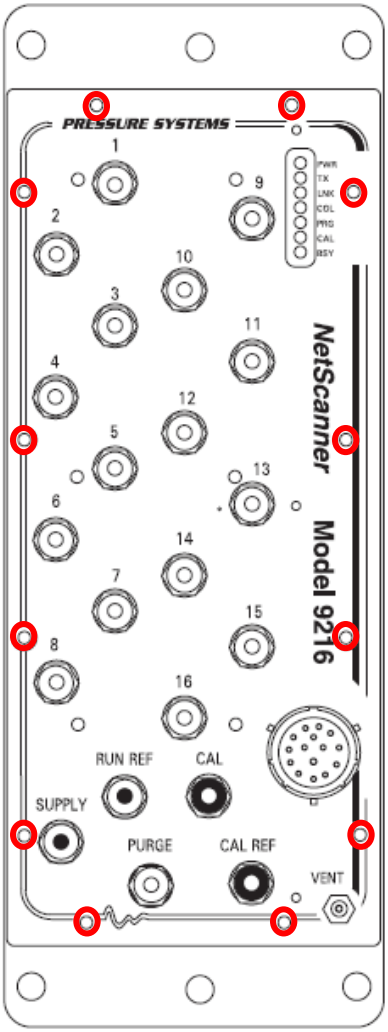



**Figure 3.3**
**Top Plate Securing Screws**

(2) When all screws have been removed, gently lift the top panel and attached electronics up and out of the housing. All components of the pressure scanner are attached to the top plate and will lift out of the module housing when the top plate is removed. See **Figure 3.4**. Carefully remove the gasket with the module top plate. In some cases, it may be easier to hold the top plate and turn the module over, lifting the housing off the top panel.

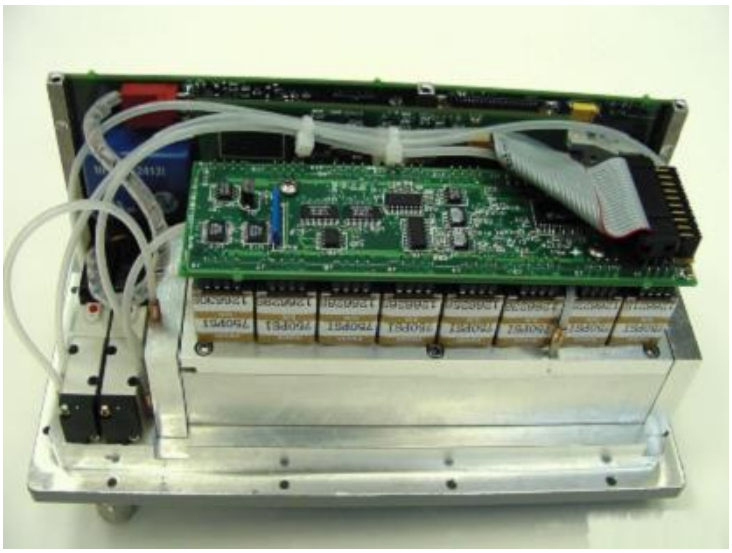


**Figure 3.4**
**Model 9216 Removed From Housing**

## 3.1.3 Electronic Circuit Board Replacement

The Model 9216 contains three (3) printed circuit board assemblies (PCBAs); the PC-322 main board, the PC-427 ARM daughter board, and the PC-327 analog board. The PC-322 and PC427 boards are normally left attached to each other and are treated as a single assembly.

### 3.1.3.1 PC-327 Analog Board

The following procedures should be used for replacement of the PC-327 Analog Board. Use the tools and follow the general precautions described in **Section 3.1.1**.

(1) Disassemble the module as described in **Section 3.1.2**. Carefully remove the ribbon cable harness from connector P1 of the PC-327 board. Note the orientation of the PC-327 relative to the rest of the module to ensure the new PC-327 is installed in the same position.

(2) Remove the two (2) Phillips-head screws securing the PC-327 board to the DH200 transducers. Carefully disconnect the PC-327 board from the DH200s by slowly working the board off; starting at one end and moving down the length of the board. It is important that the gold pins are not bent when removing the board.

(3) Replace the old PC-327 board with a new one by placing it loosely on top of the DH200s. Ensure the board end containing connector P1 is oriented the same as the board just removed (refer to **Figure 3.4**). Inspect and make sure that all the gold pins fit easily into the 8-position sockets on the DH200 transducers. Press the board down evenly until all pins are firmly seated.

(4) Install the two (2) Phillips-head screws to secure the PC-327 to the DH200s. Be careful not to over-tighten. Install the wiring harness to connector P1 of the PC-327, **ensuring proper pin 1 location as shown in Figure 3.4**. **(Pin 1 of the ribbon cable has a red stripe while pin one of P1 will contain a square solder pad on the PC-327.)**

(5) Carefully align the gasket on the top plate, ensuring it is free of contaminants. Re-install the module electronics into the extrusion case. Ensure that the alignment posts in the module's bottom panel align with the PC-322 support brackets when placing the top panel and electronics back into the housing.

(6) Replace the screws that secure the top panel to the scanner housing and tighten. Do not over-tighten; 7-9 inch-pounds torque should be sufficient.

(7) Test your scanner to ensure proper operation.

#### 3.1.3.2 PC-322/427 Main Board/ARM Daughter Board Assembly

The following procedures should be used for replacement of the PC-322/427 Main Board/ARM Daughter board assembly. Use the tools and follow the general warnings already described in **Section 3.1.1**.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the three (3) 2-56 Phillips head screws securing the PC-322/427 assembly mounting brackets to the 9216 top plate. These screws will be in line with the PC-322/427 LEDs that protrude through the top plate (see **Figure 3.5)**. Carefully lift the board out of the top panel.

(3) Carefully remove any attached wiring harnesses from connectors P1, P3 and P6 of the PC-322/427 board assembly. This will require cutting one nylon tie-wrap attached to the center mounting bracket.

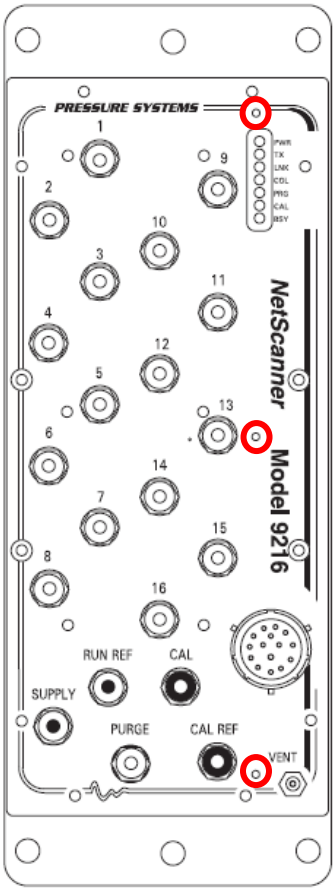



**Figure 3.5**
**PC-322 Bracket Securing Screws**

**Figure 3.6**
**PC-322/427 Assembly**

(4) Install the wiring harness from the circular connector attached to the top plate onto P1 on the new PC-322/427 assembly mating connector.

(5) Place the new PC-322/427 assembly so that its LEDs protrude through the top panel, dressing the wiring harness from P1 so that no more than one layer of the harness will be trapped between the board assembly and the valve assembly. **Loosely** install the three (3) 2-56 screws to secure the PC-322/427 assembly mounting brackets to the top panel. (To ease reassembly, they will be tightened after installing the electronics back into the module case.)

(6) Reinstall the wiring harnesses on connectors P3 and P6 of the PC-322/427 assembly. **Ensure proper pin 1 orientation when installing these connectors**. ***(Pin 1 of the P3 ribbon cable has a red stripe while pin one of P1 will contain a square solder pad on the PC-327.)***

(7) Install the wiring harnesses so they are dressed away from, and will not be pinched or punctured when the alignment posts enter the holes in the assembly mounting brackets. Install the module electronics into the extrusion case, ensuring the alignment posts in the module's bottom panel align with the holes in the PC-322/427 assembly mounting brackets. Ensure that there are no conductors from the P1 harness pinched between the top plate and the extrusion. Ensure that the top plate gasket is properly installed.

(8) Install the 12 screws that secure the top panel to the housing (**Figure 3.3**). Tighten the three (3) screws securing the PC-322/427 assembly mounting brackets (**Figure 3.5**).

(9) Test your scanner to ensure proper operation.

### 3.1.3.3 Remove and Replace PC-427 (Daughter board) on PC-322 (Main PCB)

(1) Remove the two (2) Phillips-head screws that hold the PC-427 onto the PC-322 board. (**Figure 3.7**)

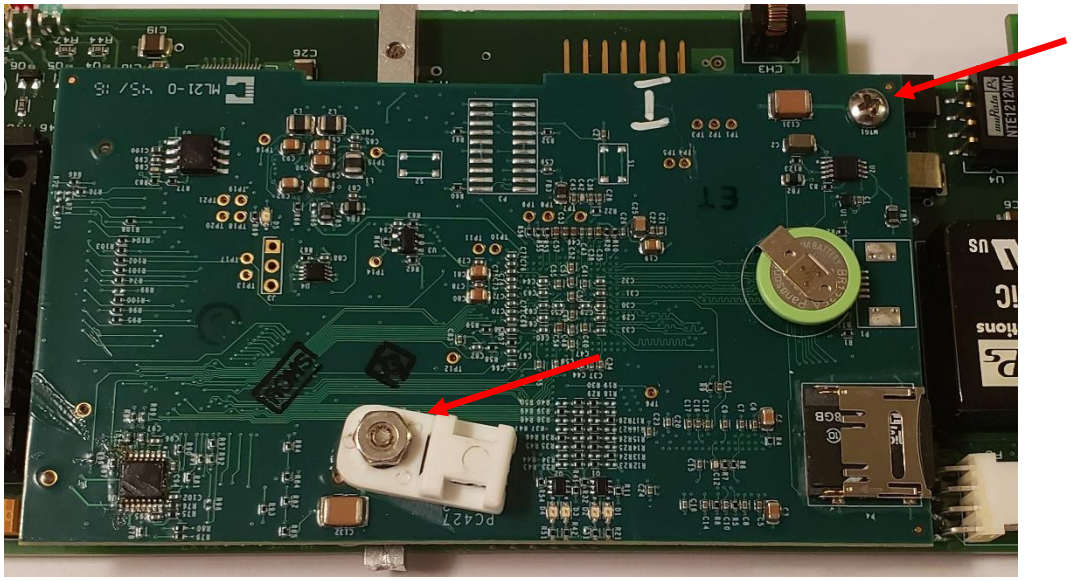


**Figure 3.7**
**Removing PC-427 Daughter Board**

(2) Gently rock the PC-427 board back and forth to loosen it and then lift straight up to remove it. Place the old PC-427 in an electrostatically-protected bag for possible repair at our factory.

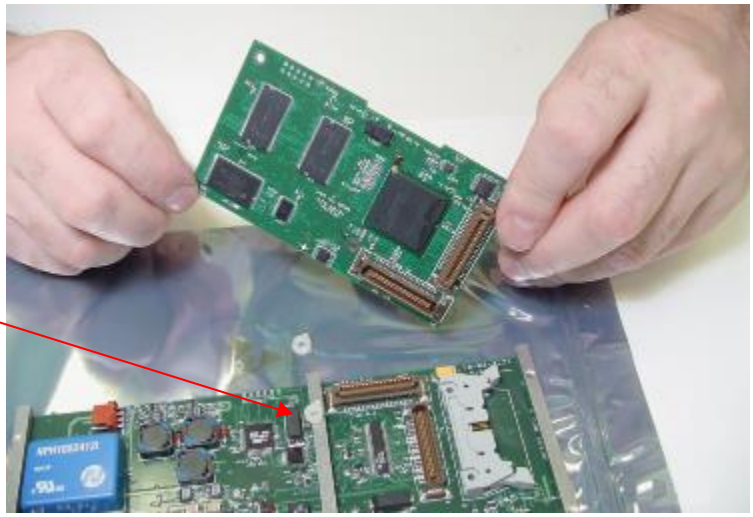



**Figure 3.8**
**PC-427 Daughter Board Removed from PC-322**

(3) Remove the new PC-427 board from its electrostatically-protected container**.** Ensure the nylon spacer is in place on top of the mounting bar and over the threaded hole. (See **Figure 3.8**). Align the two (2) 40-pin connectors and press the board into place. Secure the PC-427 board in place using the long screw through the mounting bar and the short screw into the hex standoff.

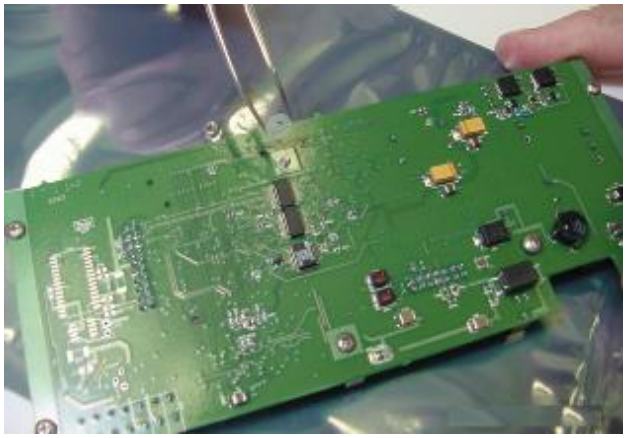


**Figure 3.9**
**PC-322 Board**

(4) Turn the assembly over**.** Replace the nylon washer and secure the nut to the back of the long screw going through the mounting bar as depicted in **Figure 3.9**.

(5) Reassemble the scanner as previously described and test for proper operation.

### 3.1.4 Replacement of Transducers

Your Model 9216 has *internal* DH200 pneumatic transducers, as well as an *internal* calibration manifold with associated valves and O-rings. All these elements occasionally require service or replacement as described in the following sections.

Following is a step-by-step procedure to replace a DH200 transducer in a Model 9216 Intelligent Pressure Scanner. Use the tools and follow the general warnings already described in **Section 3.1.1**.

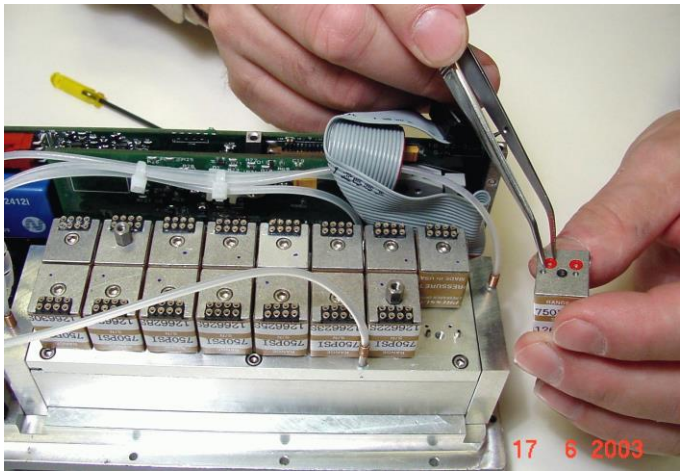



**Figure 3.10**
**Top View of DH200**

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the PC-327 Analog board as described in **Section 3.1.3.1**. Lay the circuit board aside on an anti-static surface.

(3) Remove the retaining screw from the desired DH200 transducer. Lift the transducer straight up to remove it. Make sure that the two (2) O-rings remain with the transducer as it is removed from the adapter plate. Ensure that the adapter plate O-ring sealing surface is clean and free of contaminants. See **Figure 3.10** (above).

(4) Replace the DH200, making sure that the electrical connections are located on the outer edge of the cubic design. Be sure that the two (2) O-rings are in place on the DH200 and that O-ring surfaces are free of contaminants. The DH200 must fit the guiding pins smoothly and be aligned with all other DH200 transducers. Tighten the retaining screw to **40 inch-ounces ±5 inch-ounces** of torque.

**Note**

**The hex-head standoff screws used on DH200 positions 2 and 15 are used to secure the PC-327. These hex-head screws should not be over-tightened or else the screw may break. (Recommended 40 inch-ounces for all DH200 screws)**

(5) Ensure that the two hex-head standoff screws are installed on DH200 positions 2 and 15. Reinstall the PC-327 Analog board as described in **Section 3.1.3.1** so that the hex-head standoffs in positions 2 and 15 align with the two PC-327 mounting holes.

(6) Reassemble the module and test your scanner to ensure proper operation.

### 3.1.5 Calibration Valve Solenoid Replacement

Following is a step-by-step procedure to replace the Calibration Valve Solenoids in a Model 9216 Intelligent Pressure Scanner. All Model 9216 scanners contain the purge and leak check calibration manifold and contain two solenoid valves. Use the tools and follow the general warnings already described at the start of **Section 3.1.1**. Refer to **Section 3.1.6.5** for details concerning solenoid O-ring replacement.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Carefully remove the two (2) Phillips-head screws from the top of the solenoid. Disconnect the solenoid wires from connector P6 of the PC-322 Main Board Assembly.

(3) If the either the new or old solenoid do not have a pluggable wiring harness at the solenoid, the new solenoid wires will require crimp pins to be installed for insertion in the P6 mating housing. The proper crimp pin is Molex part number 08-56-0110. After installing the crimp pins to the solenoid wiring, remove the old crimp pins from the Molex P6 housing and insert the new solenoid's wiring. Ensure that the new wires are installed in the same position as the old wires.

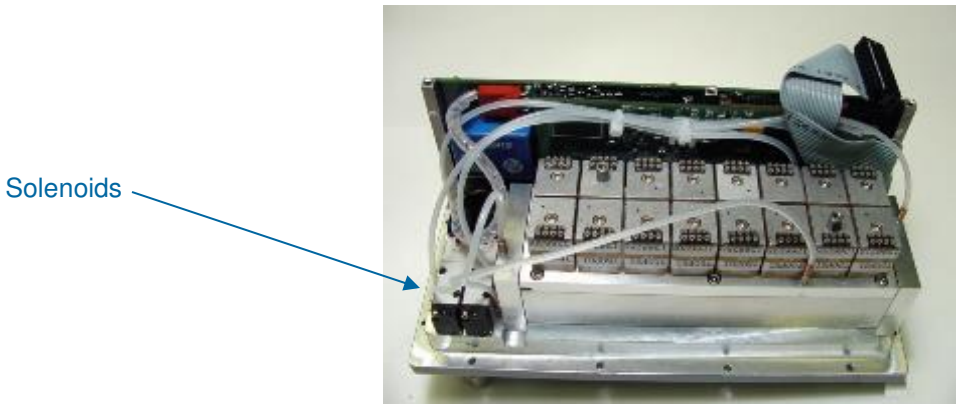



**Figure 3.11**
**Solenoids in Module**

(4) Ensure the three (3) solenoid manifold O-rings are present and free of contaminants. Replace the solenoid with the new one by carefully aligning and gently tightening the screws.

(5) Attach the wiring harness to the solenoid and connector P6 of the PC-322 Main Board Assembly.

(6) Reassemble the module.

(7) Test your scanner to ensure proper operation.

### 3.1.6 Replacement of O-Rings

The 9216 calibration valve includes static and dynamic O-ring seals. When used properly, the rated durability of the dynamic O-rings is in excess of 1,000,000 shifts of the calibration valve.

The procedures described below should be used for replacement of all the O-rings in the Model 9216 Intelligent Pressure Scanner. Use the tools and follow the general warnings already described at the start of **Section 3.1**.

The material needed for the O-ring replacement can be acquired through the proper maintenance kit available from the factory. Specifically needed for these procedures are calibration manifold and piston O-rings, PTFE cup seals, a fast evaporating cleaning fluid ( i.e. acetone, alcohol, Freon®, etc.), 50 psi dry air supply, and Krytox® fluorinated grease **(read product warnings and recommendations thoroughly)**. ***Service of O-ring seals requires a clean working environment.*** Introduction of contaminants to the O-ring or internal calibration manifold surfaces can result in internal pneumatic leaks. *Inspection for contaminates generally requires some type of magnification device, such as a microscope*.

#### 3.1.6.1 DH200 Pressure Transducer O-Ring Replacement

Please note that the DH200 O-rings are used for static seals only. They will typically not require replacement unless exposed to improper liquid media (which will also damage other 9216 components). Following is a step-by-step procedure to replace a DH200 O-Ring should it be required:

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the PC-327 Analog board as described in **Section 3.1.3.1**. Lay the circuit board aside on an anti-static surface.

(3) Remove the DH200 transducer(s) as described in **Section 3.1.4**. If more than one DH200 is removed, it is recommended to record their serial numbers prior to removal to ensure they are reinstalled in the same locations.

(4) Using tweezers, remove the two (2) O-rings from the DH200. Clean the O-ring cup with a lint-free applicator moistened with a cleaning fluid such as acetone, alcohol, Freon®, or any other substance that evaporates quickly and leaves very little residue. Remove any excess cleaner with

the air supply as soon as possible. Do not blow air directly into the holes of the surface since that can drive the fluid into the transducer and/or rupture the silicon pressure transducer.

**Figure 5.12**
**DH200 Transducer O-Ring Replacement**

(5) With clean hands, apply a small amount of Krytox® fluorinated grease to the palm of one hand and rub it out evenly with your index finger. Place one new O-ring onto your greased palm. Work the O-ring around until it is evenly greased. The O-ring should shine when properly lubricated. There should be no white area of excess grease on the O-ring. Make sure there is only a thin film of lubrication on the O-ring. Using your greased finger, place the greased O-rings in the cups on the DH200. Ensure that no grease enters the hole that leads into the transducer.

(6) Reinstall the DH200 as described in **Section 3.1.4**.

(7) Repeat steps 3, 4, 5 and 6 for each set of O-rings in need of replacement.

(8) Replace the PC-327 Analog board as described in **Section 3.1.3.1** and reassemble the module.

(9) Test your scanner to ensure proper operation.

### 3.1.6.2 Tubing Plate O-Ring Replacement

The following is a step-by-step procedure to replace Tubing Plate O-rings in a Model 9216 Intelligent Pressure Scanner.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Place the scanner with the tubing plate on a clean, lint free surface.

(3) Hold the top plate/calibration valve assembly with one hand, supporting the bottom assembly to prevent dropping when all screws are removed. Remove the six (6) Allen- head screws on the top plate that secure the valve assembly to the top plate.

(4) Carefully rotate or slide the tubing plate back and forth, pivoting on the guiding pin about 1/8" several times. This is done to loosen the O-rings from the calibration manifold. Lift the tubing plate straight up. Do not touch the calibration manifold.

(5) Inspect for the presence of shim washers around each of the six (6) screws. If washers are present, retain for use during reassembly.

(6) Remove and replace the O-rings needing maintenance, using the procedure described in **Section 3.1.6.1**. Note that the O-ring seals use an additional PTFE cup seal placed on top of the O-ring. These seals should be replaced as necessary. Note that these PTFE seals *do not* require the use of Krytox® grease.

(7) Examine the tubing plate and calibration manifold to verify that no contaminants are on either surface. This generally requires microscopic examination. Replace the tubing plate by slowly placing the plate on the calibration manifold. Make sure that the O-ring/cup seal side is down toward the pneumatic sliding manifold and the guiding pin on the calibration valve housing fits into the mating hole of the tubing plate. Also, ensure that shim washers, if used, are installed between the tubing plate and the calibration manifold assembly, in all six (6) locations.

(8) Reinstall the six (6) Allen-head screws that pass through the top plate to secure the calibration valve assembly. Tighten evenly, making sure that the screws are only finger tight plus 1/8 turn. It is important not to over tighten the screws since the pneumatic seal is made using dynamic O-rings.

(9) Reassemble the module.

(10) Test your scanner to ensure proper operation.

### 3.1.6.3 Adapter Plate O-Ring Replacement

Following is a step-by-step procedure to replace Adapter plate O-rings in a Model 9216 Intelligent Pressure Scanner. The adapter plate is located opposite of the tubing plate on the calibration manifold. All DH200 transducers are attached to the adapter plate.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the PC-327 Analog board as described in **Section 3.1.3.1**. Lay the circuit board to the side on an anti-static surface.

(3) Remove the six (6) 3/32" Allen-head screws that secure the adapter plate to the calibration valve housing. To remove the two (2) center screws, you must remove the DH200 transducers near the screws. Make sure to note the DH200 serial number and location. The plate should be gently lifted from the calibration housing.

(4) Carefully rotate or slide the adapter plate back and forth, pivoting on the guiding pin about 1/8" several times. This is done to loosen the O-rings from the calibration manifold. Lift the adapter plate straight up. Do not touch the calibration manifold.

(5) Remove and replace the O-rings needing maintenance using the procedure described in **Section 3.1.6.1**. Note that the O-ring seals use an additional PTFE cup seal placed on top of the O-ring. These PTFE seals *do not* require Krytox® grease.

(6) Examine the adapter plate and calibration valve surface to verify that no contaminants are on either surface. This generally requires microscopic examination. Replace the adapter plate by slowly placing the plate on the calibration manifold. Make sure that the O-ring is down towards the pneumatic sliding manifold and the guiding pin on the adapter plate fits into the mating hole of the calibration valve housing. Fasten the adapter plate evenly on all sides.

(7) Install the DH200 transducers that were previously removed. It is suggested to install them back in their original location.

(8) Replace the PC-327 Analog board as described in **Section 3.1.3.1** and reassemble the module.

(9) Test your scanner to ensure proper operation.

### 3.1.6.4 Calibration Manifold Piston O-Ring Replacement

Following is a step-by-step procedure to replace Calibration Manifold O-rings in a Model 9216 Intelligent Pressure Scanner. There are eight (8) pistons, each with an O-ring, inside the calibration valve housing; one (1) on each end of the housing, and three (3) on each side of the calibration valve itself.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the PC-327 Analog board as described in **Section 3.1.3.1**. Lay the circuit board aside on an anti-static surface.

(3) Remove the tubing plate as described in **Section 3.1.6.2**.

(4) Using your index finger, shift the calibration manifold back and forth several times to loosen its connection with the adapter plate O-rings. Carefully lift the calibration valve housing with one hand and turn it over, letting the calibration manifold fall into the free hand. It is imperative that the calibration manifold does not fall on a hard surface since scratches on the manifold can result in pneumatic leaks.

(5) To remove the six (6) pistons from their slots on the manifold valve, hold the valve in one hand and apply air pressure of approximately 30 psi (200 kPa) to the C3/C4 input passages on the valve. The passages (0.043" diameter holes) are located on the side of the valve next to the *tubing plate*, one hole on each side of the valve. Pressure on one side will release three (3) pistons, and pressure on the other side will release the other three (3). If the pistons stick, apply a slightly higher pressure. Place your free hand over the calibration valve housing to prevent the pistons from coming out of the housing. Thoroughly clean the pistons with a fast evaporating cleaning fluid that leaves little or no residue (e.g., acetone, alcohol, Freon®, etc.) and dry with supply air. Replace the piston O-rings after lightly lubricating the rings with Krytox® fluorinated grease. Replace the pistons in their cavity by placing the O-ring side of the piston in first and then pressing the piston completely into its cavity with one finger.

(6) To remove the two (2) C1/C2 pistons from their slots on either end of the manifold valve housing, hold the manifold valve housing in one hand, and apply approximately 30 psi (200 kPa) to the two bulge tubes, one on either end of the housing end-plate. This will result in the pistons being forced out of their cavity. If the pistons stick, apply a higher pressure. Place your free hand over the calibration valve housing to prevent the pistons from coming out of the housing. Clean the pistons, lubricate and replace the O-rings, and replace the pistons into their cavities as described in (5) above.

(7) Thoroughly clean the calibration manifold with a fast-evaporating cleaning fluid that leaves little or no residue (e.g., alcohol, acetone, Freon®, etc.). Replace the calibration manifold into the housing, making sure that the guiding pin fits into the slot of the manifold housing.

(8) Replace the tubing plate as described in **Section 3.1.6.3**.

(9) Replace the PC-327 Analog board as described in **Section 3.1.3.1** and reassemble the module.

(10) Test your scanner to ensure proper operation.

### 3.1.6.5 Solenoid Valve O-Ring Replacement

Following is a step-by-step procedure to replace the internal solenoid valve O-rings in a Model 9216 Intelligent Pressure Scanner. The module contains two internal solenoid valves.

(1) Disassemble the module as described in **Section 3.1.2**.

(2) Remove the solenoid valve by unscrewing the two (2) Phillips-head screws on top of the solenoid. Gently lift it out of the module. Be careful ***not*** to crimp the attached nylon tubing.

(3) Remove and replace the O-rings needing maintenance using the procedure described in **Section 3.1.6.1**.

(4) Replace the solenoid valve and gently tighten the screws.

(5) Reassemble the module.

(6) Test your scanner to ensure proper operation.

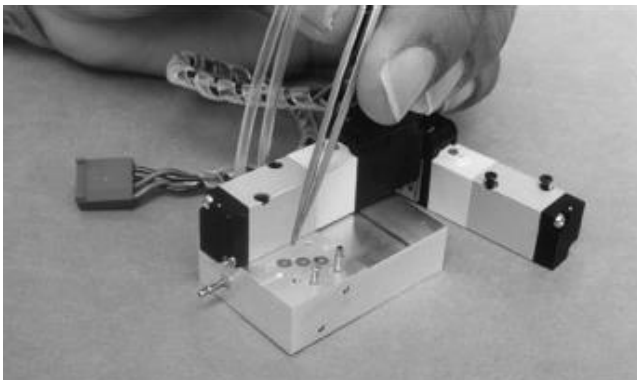


**Figure 5.13**
**Solenoid Valve O-Ring Replacement**

## 3.2 Upgrading Module Firmware

All Model 9216 Intelligent Pressure Scanner modules contain electronically re-programmable Flash memory devices that store the module firmware. TE will periodically provide new releases of module firmware that provide added functionality and/or correct performance errors. All scanner modules may have their firmware downloaded via their Ethernet Host Port. This allows for firmware upgrade while the module is installed in its normal communications network environment. Any new firmware releases may be obtained free of charge by contacting the factory or by downloading from the TE website www.te.com from the respective product pages. Download links can be found on the home page and in the information page for each model (e.g., NetScanner). All firmware is stored as a self-extracting .ZIP file. Once downloaded from the internet, simply execute the download file to extract the archived file(s).

### 3.2.1 Upgrading Firmware Via Host TCP/IP Port

Your Model 9216 Intelligent Pressure Scanner new firmware may be upgraded by the host computer, or any computer on the TCP/IP network directly via the module's host port. The PC application ***NetScanner Unified Software (NUSS)*** is provided free of charge for this purpose. It is recommended that ***NUSS*** (and any new firmware update file) be installed to a suitable subdirectory of your hard disk for better performance. Installation instructions for this support software are provided with the application. Ensure that the TCP/IP communications is properly configured for the PC running the application.

***NUSS*** is provided to all customers who have purchased Model 9216 Intelligent Pressure Scanners. This application has its own User's Manual and may be downloaded from our website, www.te.com.

**Note**

**If the unit loses power during the firmware update, the update may not be successful. When power is reapplied, the unit will return to operation and request that the update be repeated/continued. *If the update is not repeated/continued, the unit, while operational, may be operating with code that predates the most recent code previously in the unit.* Simply repeat the download to install the desired version of the code.**

# CHAPTER 4

# Troubleshooting Guide

## 4.1 Ethernet Module Troubleshooting

### 4.1.1 Checking Module Power-Up Sequence

(1) Proper power to the module should first be verified. If possible, verify that the output of the module power supply is set within the range of 18-36 VDC. This should be nominally set for 24 VDC. Ensure the power supply setting is high enough to compensate for cable voltage drops if long interface cable lengths are used.

(2) Turn module power switch ON and verify the following top panel LED status following initial power-up :

**PWR** LED should remain **ON.** If this LED is not on, all other LED's will likely also be off. Check the 90DB, 9IFC or customer provided power supply to ensure the proper voltage (18-36 VDC) is being provided. Also verify that the power pins in the module interface cable are wired as described in **Section 2.3.2** and **Appendix C**

- **Tx** LED will illuminate briefly upon power-up. This gives a visual indication that the LED is functional. Subsequent activity on the **Tx** LED during the power-up sequence will occur as the module requests a DHCP address (if configured for dynamic address) and as it searches for a PTP clock master.

- **LNK** LED will illuminate briefly upon power-up. This gives a visual indication that the LED is functional. Thereafter, the LED will indicate proper connection to an Ethernet hub or switch, and should remain **ON**.

  If this LED is **OFF**, verify that the module is properly connected to the communications hub or switch. Verify proper power is applied to the switch. Also try connecting the 9216 cable to a different port of the switch. Note that most switches have similar link LEDs to indicate proper connection to the hub itself. If present, verify that the hub link LED for the pressure scanner and the host computer are both active. If the hub is functioning correctly, verify that the communications pins in the module interface cable are wired as described in **Section 2.3.3.1** and **Appendix C**.

- **COL** LED will illuminate briefly upon power-up. This gives a visual indication that the LED is functional. Thereafter, the LED should remain **OFF**.

Any significant variation from this power-up LED sequence is an indication of a possible cabling or PC-322/427 assembly error. If the proper power-up LED sequence is not achieved after following the above suggestions, contact the Repair Department or the Applications Department at TE Connectivity for additional assistance.

## 4.1.2 Checking Module TCP/IP Communications

If the LED indicators of the Model 9216 are correct, the module is normally capable of proper communications. In order for communications to be established with a functional Model 9216 (assuming correct interface cables are used), two user-controlled parameters must be met. First, the module must be configured to obtain a proper (and unique) module IP address. Second, the user's host computer must have its TCP/IP communications interface properly configured.

### 4.1.2.1 Module IP Address Assignment

Before an Ethernet Model 9216 can communicate with a host computer, it must have a valid IP address assignment. As explained in **Section 2.3.3.2**, there are two methods for assigning an IP address to an Ethernet device, static and dynamic. The Static IP addressing protocol is the default method for IP address assignment in the Model 9216**.** This is primarily because it allows the module to assign its own IP address based on a factory default value. The Dynamic IP addressing protocol is slightly more complicated since it requires a Dynamic IP server to be present and properly configured on the network. Before host communications can be established, the user must ensure that the Model 9216 has been assigned a known IP address through either Static IP or using a Dynamic IP server.

If the module does not receive a response to a Dynamic IP addressing request, its **Tx** LED will continue to flash with an increasing delay between **Tx** attempts. If a Dynamic IP reply is not received, verify that a Dynamic IP server (DHCP) is present on the network.

If the user wishes to manually change the factory set IP address in a module, it may be done with the ***NUSS*** application program. To use it for this purpose, select the desired module on the application's *screen map* (left window), then press (click) the right-mouse button to get the module's pop-up *context* menu. From the ***NUSS*** menu, select **Configure, Network Options**. A new screen then appears that will accept a new IP address (and other network parameters). After the new address is sent, the module must be "re-booted" (another choice on the *context* menu) before it will take effect.


**Note**

**Model 9216 modules are factory-configured to use a 200.xxx.xxx.xxx IP address with a 192.0.0.0 subnet mask. These addresses were chosen with the understanding that the modules would run on a totally private network. Addressing errors may occur if modules are connected to a company internal network or if the modules are connected to the Internet. If you are not sure about the configured networking scheme, please consult your network administrator.**

**Note**

**Model 9216 modules are currently designed to use the DHCP protocol for Dynamic IP address assignment. When placed in Dynamic addressing mode, (through the TCP/IP protocol 'w1301' command), the modules will first try to resolve their addresses using DHCP protocol. If no DHCP server can be found, the modules will then revert to the default IP Address stored in system nonvolatile storage. If you are not sure about the DHCP protocol, or if your modules should be using them, please contact your network administrator.**

#### 4.1.2.2 Host IP Address Assignment

In order to communicate with the Ethernet Model 9216, the host computer must also be configured with an appropriate and compatible IP address. If unsure about how to properly configure your host computer's IP address, contact your IT department or network administrator to determine proper host IP address and subnet mask configurations before proceeding.

#### 4.1.2.3 Verifying Host TCP/IP Communications

At this point, the Model 9216 module should be configured to obtain its IP address through either static (default) or dynamic IP addressing. The module's IP address must be assigned and known in order to proceed. The host computer has also been configured for TCP/IP protocol and assigned an IP address compatible with the Model 9216 IP address. A simple method to verify proper operation is through the ***ping*** utility. This is a simple TCP/IP utility that is found on most desktop computers. The ***ping*** utility simply sends a test packet to the specified IP address and waits for reply to be returned. Model 9216 Ethernet modules are programmed to reply to these ***ping*** requests.

To run the ***ping*** utility from most desktop computers, follow these steps. Left click the **START** icon on the bottom left of the screen. Open the **Command Prompt** application, typically found in the **Accessories** folder. At the prompt type '**ping xxx.xxx.xxx.xxx**' where xxx.xxx.xxx.xxx represents the IP address of the device to test. The IP address of an Ethernet Model 9216 module should be used. The ***ping*** program will either report that a reply was received or that it failed to receive a reply. If the ***ping*** application reported receiving a reply, the host computer and the Model 9216 module are both properly configured for TCP/IP communications.

If an error free ***ping*** reply was not received, rerun the ***ping*** application using the IP address of the host computer. This will verify if the TCP/IP protocol was properly configured on the host computer. If a ***ping*** reply was not received, verify the TCP/IP installation steps for your host computer. Also verify that the host computer is configured for the proper IP address and subnet mask.

If the ***ping*** test of the host computer's IP passed, while the ***ping*** of the Model 9216 module failed, check the following possible sources for error:

- Ensure the Model 9216 module's IP has been assigned (as explained in **Section 4.1.2.1**) and that the correct IP was used for the ***ping*** test.

- Ensure the IP address of the host computer and the Model 9216 module are not duplicated on the network.

- Ensure the link LEDs are active on the scanner and the Ethernet hub or switch to which it is attached. Also ensure the link LEDs are active on the host computer's Ethernet adapter and the hub or switch to which it is attached.

- Ensure the Ethernet adapter card installed in the host is properly configured without conflict.

## 4.2 Zero and Gain Calibration Troubleshooting

Incorrect pneumatic setup or incorrect command usage when executing a module's Re-zero or Span calibration command (see **'Z'**, **'h'**, and **'C'** commands in **Chapter 3**) can result in unexpected module operation. A common source of errors during these operations is incorrect control of the module's internal calibration valve and pneumatic inputs.

Pressure connections are described in **Chapter 2** while details of calibration procedures are described throughout **Chapter 4**. Some common errors and problems are listed below. These common problems apply primarily to the Model 9216 with its internal transducers and calibration manifold.

- The module's *supply air* input is either not attached or does not provide enough pressure (less than 65 psig) to shift the calibration valve. This results in the calibration valve remaining in its current position even though module commands have requested movement of the valve.

- The module's calibration valve is not placed in the correct position before executing the Span calibration command (***Calculate & Set Gain***). This command will not automatically shift the valve to the CAL position before taking data (as the Re-zero calibration command does). The user must manually control the calibration valve position using the ***Set Operating Options*** (**'w'**) command if the **CAL** and **CAL REF** inputs are to be used.

- The Re-Zero calibration command (***Calculate & Set Offsets***) will automatically shift the calibration valve unless the option is disabled with the ***Set Operating Options*** ('**w**') command. The valve will be placed in the **CAL** position (with a small delay) before taking Re-zero data. Afterwards, the valve will be placed in the **RUN** position.

- Zero *(offset)* and Span *(gain)* correction terms are not automatically saved in transducer nonvolatile memory. If they are not saved using the ***Set Operating Options ('w')*** command, they will be lost when module power is turned off. Verify that new coefficients produce valid data before saving them.

- When Span calibrating a multi-range unit, attach the calibration pressures to the individual measurement input ports of the range being calibrated and not to the **CAL** input port. Use of the common **CAL** input may result in over-pressuring lower range channels. When sending the ***Calculate and Set Gain*** (**'Z'**) command, ensure that the position field bits are set only for those channels that are attached to the calibration pressure.

- When using the standard ***Calculate and Set Gain*** (**'Z'**) command, the module firmware assumes, by default, that each particular transducer's full-scale pressure is

present at its pneumatic input. All internal calculations of gain correction are based on the exact full scale pressure being applied to the transducers. If it is not possible to provide this exact pressure (as when using a dead weight tester), the alternate form of this command should be used. This allows the host to specify the exact upscale pressure applied to the transducers being calibrated.

- When using the standard ***Calculate and Set Offsets*** (**'h'**) command, the module firmware assumes, by default, that each particular transducer's zero pressure is present at its pneumatic input. All internal calculations of zero correction are based on an input pressure of 0.0 psi. If it is not possible to provide this exact pressure (as when calibrating an absolute pressure transducer), the alternate form of this command should be used. This allows the host to specify the exact minimum pressure applied to the transducers being calibrated.

## 4.3 User Software

For a complete description of all 9216 programming interface, please refer to the **NetScanner Programmer's Reference Manual**, available from the TE.com website.

# CHAPTER 5

# Start-up Software

## 5.1 Introduction

The **NetScanner Unified Startup Software (NUSS)** allows you to operate, from a standard host PC, a diverse network of pressure scanner modules and/or standard/calibrator modules of the **NetScanner System** type.

The **NetScanner System**, for which **NUSS** was designed, is a distributed Ethernet network (using TCP/UDP/IP protocols) that functions as a precision pressure data acquisition system.

**NUSS** recognizes each **Model 9216** module type it finds on the network and automatically provides that module with its appropriate functionality by dynamically adjusting the program's form and menu content. **NUSS** allows you to operate your **Model 9216** modules singly or together in selected groups without having to write any custom software, and without having to learn low-level commands. The software was designed to permit you to test almost every possible module function with a simple interactive point-and-click interface.

**NUSS** is provided to all customers who have purchased a **Model 9216** Intelligent Pressure Scanners. The software as well as the its user's manual may be downloaded from the TE.com website.

# APPENDIX A

## All Commands – Quick Reference

| Type | Command id | Command Function |
|---|---|---|
| TCP/IP Commands | A | Power-Up Clear |
| | B | Reset |
| | C | Configure/Control Multi-Point Calibration (4 sub-commands) |
| | V | Read Transducer Voltages |
| | Z | Calculate and Set Gains (Span Cal) |
| | a | Read Transducer Raw A/D Counts |
| | b | Acquire High Speed Data |
| | c | Define/Control Autonomous Host Streams (6 sub-commands) |
| | h | Calculate and Set Offsets (Re-zero Cal) |
| | m | Read Temperature A/D Counts |
| | n | Read Temperature Voltage |
| | q | Read Module Status |
| | r | Read High Precision Data |
| | t | Read Transducer Temperature |
| | u | Read Internal Coefficients |
| | v | Download Internal Coefficients |
| | w | Set/Do Operating Options/Functions |
| UDP/IP Commands | psi9000 | Query Network |
| | psireboot | Reboot Specified Module |
| | psirarp | Change Specified Module's IP Address Resolution Method (then Reboot) |

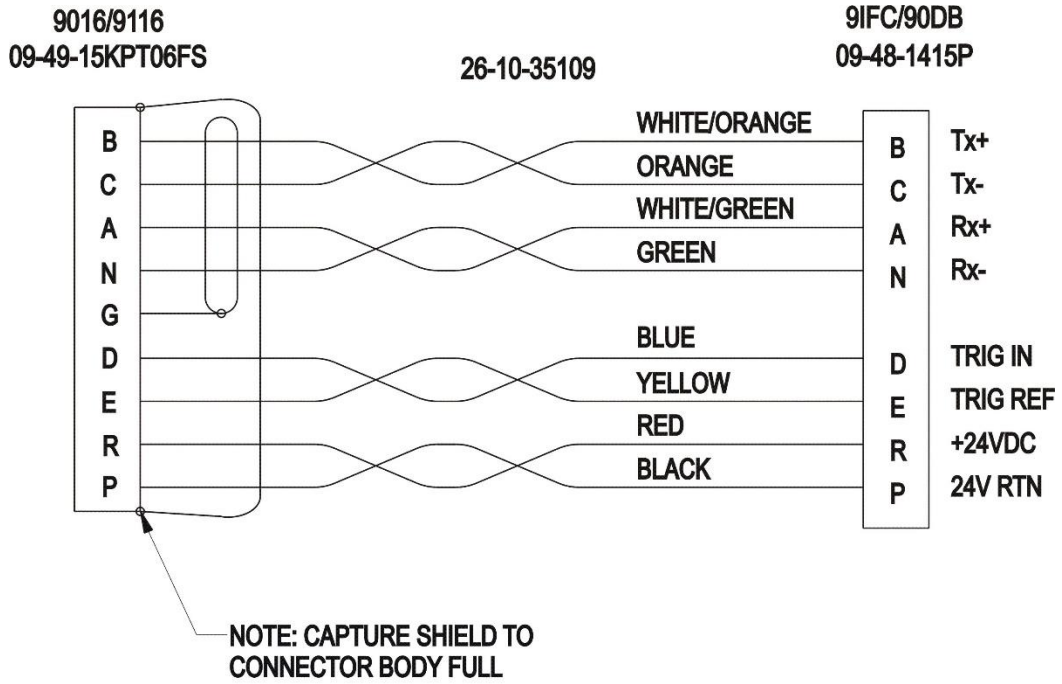
# APPENDIX B

## Model 9216 Response Error Codes

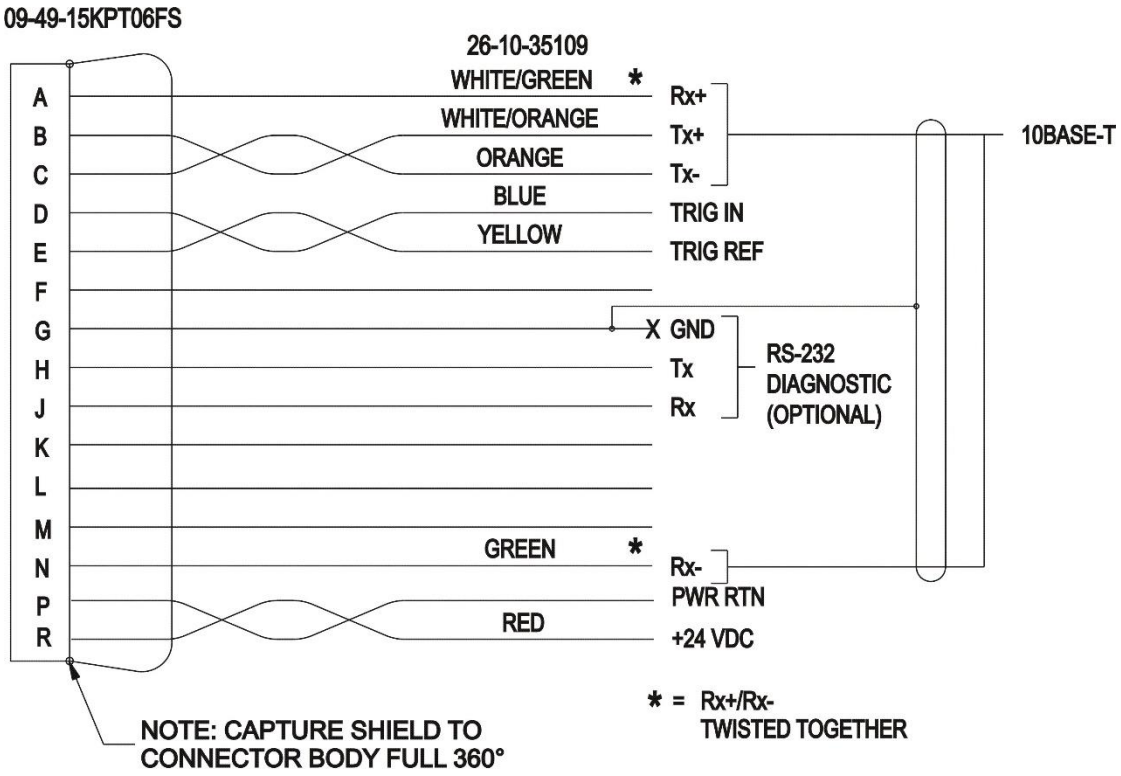
| CODE | MEANING |
|---|---|
| 00 | Reserved |
| 01 | ***Undefined Command Received*** |
| 02 | Reserved |
| 03 | ***Input Buffer Overrun*** |
| 04 | ***Invalid ASCII Character Received*** |
| 05 | ***Data Field Error*** |
| 06 | Reserved |
| 07 | ***Specified Limits Invalid*** |
| 08 | ***NetScanner System error - Invalid Parameter*** |
| 09 | ***Insufficient source air to shift calibration valve*** |
| 0A | ***Calibration valve not in requested position*** |

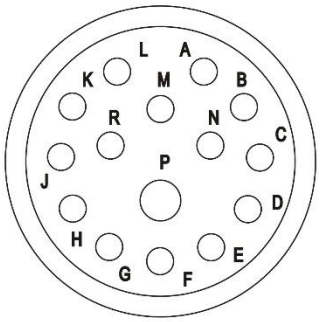
# APPENDIX C

## Cable Diagrams

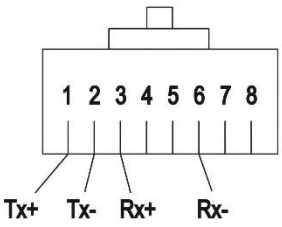



9016/9116 Ethernet Interface cable
9082 Cable



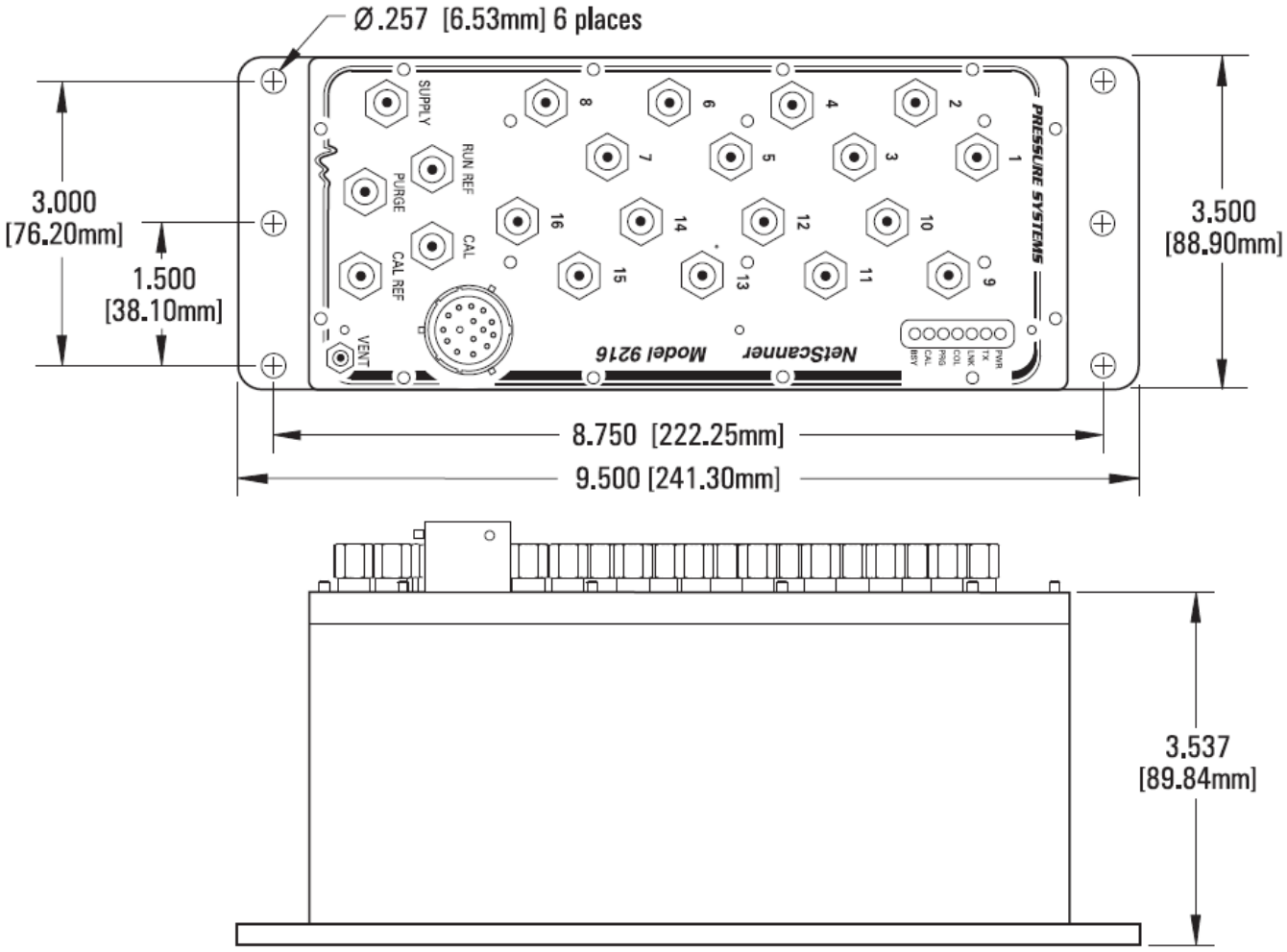

SOLDER CUP SIDE FOR CABLE




Models 9016/916 Ethernet Interface
9082 Cable6

# APPENDIX D

## 9216 Mounting Dimensions



# APPENDIX E

## Model 9216 Range Codes

The following range codes are stored in each DH200 pressure transducer. The range code of each transducer can be read through the Read Internal Coefficient ('u') command. *Standard* Range Codes are shown in ***Bold and Italics*.**

| Range Code | Full Scale Pressure | Minimum Calibration Pressure |
|---|---|---|
| ***1*** | ***0.360 psi (10" Water Column)*** | ***-0.360 psig*** |
| ***2*** | ***0.720 psi (20" Water Column)*** | ***-0.720 psig*** |
| ***3*** | ***1 psid*** | ***-1.0 psig*** |
| ***4*** | ***2.5 psid*** | ***-2.5 psig*** |
| ***5*** | ***5 psid*** | ***-5 psig*** |
| *6* | *10 psid* | *-5 psig* |
| *7* | *15 psid* | *-5 psig* |
| *8* | *30 psid* | *-5 psig* |
| *9* | *45 psia* | *0 psig* |
| ***10*** | ***100 psia*** | ***0 psig*** |
| ***11*** | ***250 psia*** | ***0 psig*** |
| ***12*** | ***500 psia*** | ***0 psig*** |
| ***13*** | ***600 psia*** | ***0 psig*** |
| ***14*** | ***300 psia*** | ***0 psig*** |
| ***15*** | ***750 psia*** | ***0 psig*** |
| ***16*** | ***10 psid*** | ***-10 psig*** |
| ***17*** | ***15 psid*** | ***-12 psig*** |
| ***18*** | ***30 psid*** | ***-12 psig*** |
| ***19*** | ***45 psid*** | ***-12 psig*** |
| 20 | 20 psid | -12 psig |
| 21 | 20 psia | 0 psig |
| 22 | 15 psia | 0 psig |

| Range Code | Full Scale Pressure | Minimum Calibration Pressure |
|---|---|---|
| 23 | 15 psid | -10 psig |
| 24 | 5 psia | 0 psig |
| 25 | 10 psia | 0 psig |
| 26 | 30 psia | 0 psig |
| 27 | 50 psia | 0 psig |
| 28 | 100 psia | 0 psig |
| 29 | 100 psia | 2.5 psia |
| 30 | 250 psia | 25 psia |
| 31 | 50 psia | 2.5 psia |
| 32 | 500 psia | 25 psia |
| 33 | 750 psia | 25 psia |
| 34 | 30 psia | 2.5 psia |
| 35 | 15 psia | 2.5 psia |
| 36 | 125 psia | 0 psig |
| 37 | 35 psid | -12 psig |
| 38 | 150 psia | 0 psig |
| 39 | 200 psia | 0 psig |
| 40 | 22 psid | -12 psig |
| 41 | 60 psid | -12 psig |
| 42 | 375 psia | 0 psig |
| 43 | 150 psia | 0 psig |
| 44 | 75 psia | 0 psig |
| 45 | 150 psia | 0 psig |
| 46 | 650 psia | 0 psig |
| 47 | 850 psia | 0 psig |
| 48 | 150 psia | 25 psig |
| 49 | 750 psia | 50 psig |
| 50 | 75 psia | 2.5 psig |
| 51 | 1.2 psid | -1.2 psig |

# APPENDIX F

## NetScanner System Products

| Model | Purpose |
|---|---|
| 9216 | 16-channel Intelligent Pressure Scanner with Ethernet TCP/IP Host Port. |
| 9022 | 12-channel splash-proof, ruggedized Media-Isolated Intelligent Pressure Scanner with Ethernet Host Port. |
| 9032/33 | Pressure Standard Unit with Ethernet TCP/IP Host Port. |
| 9034/38 | Pressure Calibrator Unit with Ethernet TCP/IP Host Port. |
| 9046 | Intelligent scanner for thermocouple and RTD measurements |
| 98RK | Scanner Interface Rack that holds up to eight (8) Model 9816 Intelligent Pressure Scanners. Rack provides power, pneumatic connections and hub circuitry for up to twelve (12) 10Base-T connections. |
| 9916 | Intelligent Pressure Scanner that requires **98RK-1** Scanner Interface Rack for power, pneumatic connections, and hub circuitry. |
| 90DC | Data Concentrator, containing power and 24 switched Ethernet ports, connections to as many as 24 NetScanner System modules. |
| 9096 | Series 9400 Interface Cable. |
| 9082 | Interface cable for connecting NetScanner System modules to switches and hubs. |
| 9400/9401/9402 | Media-Isolated Pressure Transducers for Models 9021 and 9022 |

# APPENDIX G

## Binary Bit Map

| Bit Value (if Set) | Bit Position | Binary Number | | | |
|---|---|---|---|---|---|
| 1 | 1 | 0000 | 0000 | 0000 | 0001 |
| 2 | 2 | 0000 | 0000 | 0000 | 0010 |
| 4 | 3 | 0000 | 0000 | 0000 | 0100 |
| 8 | 4 | 0000 | 0000 | 0000 | 1000 |
| 16 | 5 | 0000 | 0000 | 0001 | 0000 |
| 32 | 6 | 0000 | 0000 | 0010 | 0000 |
| 64 | 7 | 0000 | 0000 | 0100 | 0000 |
| 128 | 8 | 0000 | 0000 | 1000 | 0000 |
| 256 | 9 | 0000 | 0001 | 0000 | 0000 |
| 512 | 10 | 0000 | 0010 | 0000 | 0000 |
| 1024 | 11 | 0000 | 0100 | 0000 | 0000 |
| 2048 | 12 | 0000 | 1000 | 0000 | 0000 |
| 4096 | 13 | 0001 | 0000 | 0000 | 0000 |
| 8192 | 14 | 0010 | 0000 | 0000 | 0000 |
| 16384 | 15 | 0100 | 0000 | 0000 | 0000 |
| 32768 | 16 | 1000 | 0000 | 0000 | 0000 |

Decimal to Binary Conversion:

892 dec = 512 + 256 + 64 + 32 + 16 + 8 + 4

| | | | | |
|---|---|---|---|---|
| 0000 | 0011 | 0111 | 1100 | binary |
| | 3 | 7 | C | hexadecimal |

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