



## RACKMOUNT INTELLIGENT PRESSURE SCANNERS 9816/98RK-1 NetScanner System

The enhanced Model 98RK-1 rack utilizes a high performance switch enabling the 9816 scanners to communicate with the host computer via an auto-negotiating 10/100/1G Base T Ethernet interface. The rack also provides power and pneumatic connections for up to eight internally-housed 9816 scanners. Additionally, the 98RK-1 can provide power and communication for up to three external NetScanner System components such as Model 9022 for all-media pressure measurements, Model 9032 for high-accuracy barometric or reference pressure measurements or Model 9146-T/R for Thermocouple or RTD measurements.

Model 9816 scanners integrate 16 silicon piezoresistive pressure sensors of any pressure range with a microprocessor. Each field-replaceable pressure sensor incorporates a temperature sensor and an integral EEPROM for storage of personalized calibration data as well as sensor information such as serial number, pressure range, factory calibration date, and user-managed last or next calibration date. Integrating the EEPROM within the sensor enables simplified field replacement of sensors with automatic uploading of sensor data during power up.

The microprocessor uses the sensor data to correct for zero, span, linearity and thermal errors. It also performs digital temperature compensation to reduce sensor thermal errors by a factor of ten or more over conventional compensation. The microprocessor also controls the actuation of an integral manifold to execute on-line zero calibrations upon request. This capability virtually eliminates sensor zero drift error and provides guaranteed system accuracy of up to ±0.05% FS (Full Scale) after rezero.

Each 9816 can sample using up to three concurrent scan lists at continuous rates up to 100 measurements per channel per second in engineering units. Pressure data is output over the Ethernet interface supporting both TCP and UDP protocols. The rack is supplied with comprehensive Visual Basic-based software called NUSS for PC compatible computers. Firmware upgrades are made available at no charge via our website and can be downloaded to the 9816 scanners using NUSS.

The NetScanner System is an array of system components measuring a variety of parameters and sharing the same command set that can be networked to form a comprehensive distributed intelligent data acquisition system.

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## Features

- ±0.05% Accuracy
- 10/100/1G Base T Ethernet TCP & UDP
- Pressure Ranges up to 850 psid

## **Applications**

- Turbine Engine Research
- Turbomachinery Test Cells
- Large Channel Count Pressure Requirements

## **Specifications**

\*After 1 hour warm-up @25°C with atmospheric reference pressure unless otherwise stated / FS= Full Scale

PARAMETER	9816	98RK-1	UNITS	COMMENTS		
PNEUMATICS						
	10 20	N/A	in WC			
	1 100					
	2.5 125					
	5 150		psid			
	10 250					
Pressure Ranges	15 300			ranges < 100 psi are bidirectional ranges ≥ 100 psi are unidirectional		
	30 375	N/A				
	35 500					
	50 600					
	45 750					
	60 850					
Number of Measurement	16	N/A				
Inputs	0.063 bulged tubulation or			variety of compression adapter		
Pneumatic Fittings	SAE 5/16-24, o-ring boss	SAE 7/16-24 o-ring boss		fittings available See page 6 for standard fittings		
		-				
Media	Dry, non-corros	ve gas		9022 datasheet		
Proof Pressure <sup>1</sup>	3.0X 2.0X	NA	FS min	range < 15 psi range 15-100 psi		
	1.5X 5.0X		ES min	range > 100 psi range < 15 psi		
Burst Pressure	3.0X	N/A		range 15-100 psi		
Max Line Pressure 2	2.0X		psi	range ≤ 5 psi		
Max Line Flessure	600	N/A		range > 5 psi Min		
Manifold Control Pressure	100		psi	Max		
Purge Pressure <sup>3</sup>	> max input pressure 850		psi	Min Max		
STATIC PERFORMANCE			,			
Measurement Resolution	±0.003	N/A	% FS			
Static Accuracy <sup>4</sup> After Rezero	±0.05 ±0.15	N/A	% FS	range > 2.5 psi range ≤ 2.5 psi		
Total Thermal Error <sup>5</sup>	±0.001 ±0.0015	N/A	% FS/°C % FS/°C	range > 2.5 psi range ≤ 2.5 psi		
	±0.0003		% FS/psi	range ≤ 100 psi		
Line Pressure Effect	±0.0008 ±0.001	N/A	% FS/psi % FS/psi	range $\leq 5$ psi to $\leq 100$ psi range $\leq 5$ psi		
Measurement Rate	100	N/A	meas/ch/ sec	engineering units		
COMMUNICATION						
Ethernet	10Base T half duplex	10/100/1000 Base T Auto negotiating				
Protocol	TCP and UDP		% FS	static or dynamic IP assignment		

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### **RAKCMOUNT INTELLIGENT PRESSURE SCANNERS 9816/98RK-1**

ELECTRICAL					
Input Voltage	N/A	85 - 264	VAC	47 – 63 Hz	
Operating Power	N/A	65 <sup>6</sup>	Watts		
Hardware Trigger	2.5		VDC	TTL compatible differential input, ±5 VDC common mode voltage	
ENVIRONMENTAL/PHYSICAL					
Compensated Temp Range	0 to 60		°C		
Operating Temp Range	0 to 50		°C	Up to 95% non-condensing humidity	
Storage Temp	-20 to 80	)	°C		
Size	2.06 x 7.00 x 15.25	17.00 X 8.75 X 19.00	inches	L x W x H	
Weight	6.5	26.9	lb.		

Notes:

1. Maximum applied pressure without reducing sensor performance

2. For anticipated Line (Reference) Pressures . . .

#### Above 100 psi on FS pressure ranges of $\leq$ 5 psi or Above 600 psi on 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.

- 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. Maximum power consumption with full complement of 9816 scanners and remotely connected NetScanner modules in highest power draw configurations.

\*Specification subject to change without notice.



## Theory of Operation

The Model 9816 Rackmount Intelligent Pressure Scanner 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 self-contained nature of the Intelligent Pressure Scanner. (This preengineered approach to pressure acquisition offers guaranteed 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 9816 outputs pressure data in engineering units, digitally compensated for zero, span, nonlinearity and temperature effects. The integral pneumatic manifold permits on-line rezero and even span calibration capability under microprocessor control.



Pneumatic Intelligent Pressure Scanner Functional Diagram

### **Digital Sensor Temperature Compensation**

Silicon piezoresistive pressure sensors are low cost, miniature pressure sensing elements ideal 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 recognize the new transducer upon power up and extract the calibration information from the EEPROM.



Digital Sensor Temperature Compensation Functional Diagram



## Theory of Operation

### **Pneumatic Design**

The Model 9816 Rackmount 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.

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 two of four pistons within the manifold. One piston forces the manifold longitudinally into the CAL position; another returns it to the RUN position. The remaining two pistons force the manifold laterally into either the PURGE or the LEAK CHARGE positions. Pressure of 100-125 psig must be present at the Control Pressure Supply Input port on the rear of the 98RK-1 rack 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 respective calibration input ports on the rear of the rack.

The purge function requires pressure in excess of the highest anticipated input pressure to be present at the Purge Input port on the rear of the rack. 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 ensures maximum accuracy.

The leak check function requires the desired test pressure to be applied to the appropriate calibration port on the rear of the rack and the input lines to be deadended at their source. Issuing the LEAK CHARGE command forces the manifold into the LEAK CHARGE position to charge the input lines using pressure from the respective calibration ports. 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.





## Scanner Interface Rack

The Model 98RK-1 Scanner Interface Rack is a 19" rackmountable chassis housing up to eight 9816 scanners. Electrical connections and utility pressures to service the scanners are made via the rear of the chassis. These connections are automatically made to the 9816 scanners once they are inserted into the chassis and secured with the integral locking rod. The 98RK-1 also provides Ethernet connection, hardware trigger and power supply for up to three remote Intelligent Pressure Scanners.

The Model 98RK-1 accepts a universal 85-264 volt 47-63 Hz power input. Measurement pressures can be input via the front of the scanners or the rear of the chassis. The scanners are keyed to receive span calibration pressures from only one of eight calibration ports on the rear of chassis based on the range of their internal transducers. This eliminates the possibility of accidental overpressure while interchanging scanners within the chassis. These calibration ports also serve to provide leak check and accuracy verification pressures to the scanners. TE Connectivity manufactures a line of programmable pressure controllers to support these operations.

Both the 98RK-1 and the 9816 scanners incorporate front panel LED's to indicate the status of Ethernet links, power supply, scanner manifold position and system health.



98RK-1 Scanner Interface Rack Rear Panel Layout

## **Standard Pneumatic Connections**

	9816	98RK-1		
Measurement Inputs	Compression fitting or 0.063" OD bulged tubulation QDC Plate (if front access specified)	0.063" OD bulged tubulation QDC Plate (if rear access specified)		
125 psi SUPPLY, CAL REF, RUN REF and CAL inputs (except CAL7 & CAL8)	N/A	1/4" compression fitting		
CAL7 & CAL8	N/A	1/8" compression fitting		
PURGE input	N/A	3/8" compression fitting		

## **Networking Example**

The NetScanner System allows for a combination of rackmount and stand-alone components to be networked. The illustration on this page shows a configuration for interfacing two 98RK-1 Scanner Interface Racks and three remote NetScanner components to a host computer. Contact TE Connectivity to discuss alternate network solutions.



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## **Ordering Information**

AA - Pr	essure Range						
01,	10" WC	08,	30 psid	24,	50 psid	34,	75 psid
02,	20" WC	09,	45 psid	25,	650 psid	39,	850 psid
03,	1 psid	10,	100 psid	26,	200 psid	99,	Multirange
04,	2.5 psid	11,	250 psid	27,	35 psid		
05,	5 psid	12,	500 psid	30,	150 psid		
06,	10 psid	20,	300 psid	31,	375 psid		
07,	15 psid	23,	125 psd	32,	750 psid		

# PN: 9816-AABBCC0000 9816 Rackmount Intelligent Pressure Scanner

BB = Pneumatic Connection	CC = Manifold Options
01, 0.063", Front Access QDC	06, Common Differential
02, 0.063", Rear Access QDC	07, True Differential, Front Access QDC only ( $BB = 01$ )
03, 1/8" Compression Fitting, Front Access	08, Common Differential, Dual Reference
05, 4mm Compression Fitting, Front Access	

#### PN: 98RK-100000000 Scanner Interface Rack, Universal VAC Input

Example: 9816-0702060000 9816 Rackmount Intelligent Pressure Scanner, 15 psid, Rear Access, Common Differential 98RK-100000000 98RK-1 Scanner Interface Rack, Universal VAC Input

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