measurement
SPECIALTIES
PRESSURE SYSTEMS

NetScanner™ Unified Startup Software
(NUSS) User's Manual
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Preface

This User's Manual helps you:

- Install the **NetScanner™ Unified Startup Software (NUSS)** software on your Windows® XP-based host personal computer.
- Configure Windows® XP to utilize the layered TCP/UDP/IP protocols required to communicate reliably between NUSS and all NetScanner modules located on your Ethernet network.
- Use **NUSS** to query and view all the NetScanner modules on your Ethernet network. Multiple TCP connections may be obtained and maintained.
- Use **NUSS** to quickly configure, test, and operate a NetScanner *Scanner* module, *Standard* module, or *Calibrator* module, and perform *calibration adjustments* of all *scanner* modules, singly or in groups
- Use **NUSS** to fully control all the functionality of a single module — or several modules running concurrently (independently or in a coordinated fashion) — using a simple point-and-click interface, and without having to know any low-level module commands.

This **User's Manual** is intended for "normal" users who have purchased a complete NetScanner system from Pressure Systems. Special addenda for "advanced" and "factory" users are also available from PSI's website.

Our Company

Pressure Systems, Inc. (PSI), a Measurement Specialties Company, develops, manufactures, and services pressure measuring instruments with the highest level of traceable accuracy as required for aerospace and industrial applications. Our products have become the world standard for electronic pressure scanning. We strive to provide quality products and services which exceed customer's needs and expectations. Feel free to contact us directly for additional applications assistance. (Toll free within North America: 1-800-678-7226. E-mail: Applications@pressuresystems.com.) Also see our website at www.PressureSystems.com.

Publication Disclaimer

This document is thoroughly edited and is believed to be entirely reliable. PSI assumes no liability for inaccuracies. All computer programs supplied with our products are written and tested on available systems at the factory. PSI assumes no responsibility for other computers, languages, or operating systems. PSI reserves the right to change the specifications without notice.

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APPENDIXES

Revision Tracking Sheet

Release Number	Release Date	Summary of Significant Changes
#1	12/01/2001	See NUSS Version 1.0.0 Release Notes
#2	04/01/2002	See NUSS Version 1.1.0 Release Notes
#3	01/01/2003	See NUSS Version 1.2.0 Release Notes
#4	01/31/2007	See NUSS Version 2.0.0 Release Notes
#5	10/30/2010	See NUSS Version 2.3.0 Release Notes

See **Appendix A** for a summary of all changes since Release #4.

See **Appendix F** for a description of all File Formats – plus examples of all Report files

Chapter 1

1.0   Introduction For Normal Users

The **NetScanner Unified Startup Software** (abbreviated **NUSS**) allows you to operate, from a Windows-based host PC, a diverse network of *pressure scanner* and *temperature scanner* modules, plus *standard* or *calibrator* modules of the **NetScanner** type (i.e., those System 9000 modules (and racks) with Ethernet host interfaces). Whether you need it to setup a new module for the first time, or to operate a full network of existing modules, NUSS does the job.

> If you wish to install NUSS first (or download latest version), proceed to **Chapter 2**. While there, you may also need to configure your Windows operating system so it can effectively communicate with your modules, via the Ethernet, by utilizing the TCP/UDP/IP network protocols. For Troubleshooting advice also see **In Case of Difficulty** in **Section 2.7**.

NUSS integrates a diverse set of "startup", "query", "calibration", and "test" programs – thus the "U" for "unified" in its name. The "query" software recognizes all NetScanner modules (of various types) it finds on the network, and displays them all on a "map". Left-clicking any one module on the map selects (and highlights) it. Right-clicking pops-up a "context" menu, that offers all the current functionality available to that module alone. Additionally, NUSS includes "Group" facilities (on other conventional Windows menus) to coordinate operating multiple modules on the network *concurrently*, when this is desired. NUSS also *learns* how a particular module is currently being used, so as to minimize *setup* operations the next time the program is used with the same module (or group of modules). Such persistent memories can also be erased with a "forget" function. NUSS can also be configured to match the needs of a particular class of user (normal, advanced, or factory), providing only the facilities that user needs — without overwhelming him/her with too much unneeded functionality or detail.

This particular manual describes the "main" facilities available to *normal* users and to *all* users. There are two additional user-specific manual *addenda* available at the PSI website for *advanced* and *factory* users:

Each addendum is in the form of like-numbered chapters describing successively more information for the particular type of user. These additional features are already built into the your existing installed copy of NUSS and can be engaged by simply adding appropriate *command line switches* to your NUSS "startup" shortcut (see Chapter 2 of each addendum). The introduction in Chapter 1 of each addendum summarize all the new features for that user type.

The Normal user version supports NetScanner (903x) calibrators only (used to calibrate pressure scanner modules). The *Advanced* addendum is recommended for the class of customers who needs additional support for System 8400 calibrator (PCU/PSU) modules. This version also adds the *Execute Commands* and *Execute Script* programs useful to customers who are not afraid of learning and using the "low level commands" of NetScanner modules.

The *Factory* addendum is recommended only for users at the PSI factory (and field) who have additional specific test equipment (e.g., Thermotron temperature controlled oven (TCO), Ruska DPC calibrator (DPC), Keithley digital voltmeter (KDV), and Programmable voltage reference (PVR)) available to help in automating most of the module tests. Customers are not prohibited from using this highest level of functionality, but are not likely to benefit from it without an investment in the special equipment required.

The **NetScanner™ System**, for which NUSS was designed, is a distributed Ethernet network (using layered TCP/UDP/IP protocols) that functions as a precision pressure (and temperature) data acquisition system. It is based on PSI's proven Intelligent Pressure Scanner technology. A *typical* system may be comprised of one or more **Model 98RK-1** Scanner Interface Racks, each housing up to eight (8) **Model 9816** Intelligent Pressure Scanner modules — each scanning up to 18 pressure channels — and networked together with one or more host computers via the Ethernet interface. Each rack provides scanner power supply and pneumatic connections, as well as hub circuitry for up to twelve (12) 10Base-T Ethernet connections. The four extra connections provide for a *host computer* and up to three *standalone* modules (that may be plugged into three rear connectors of the rack). These *standalone* modules can obtain their power from the rack and may include:

• Intelligent Pressure Scanners (**Model 9116** with 16 internal *pneumatic* transducers or **Models 9022** with 1-12 configurable external transducers), or
• Intelligent Pressure Standards (**Model 9032** *absolute* (*barometer*) type or Model **9033** *differential* type), each with one (1) pressure *input* channel, or
• Intelligent Pressure Calibrators (the **Model 9034** *absolute* type or **Model 9038** *differential* type), each with one (1) pressure *input* and *output* channel.
• Intelligent Temperature Scanners (**Model 9046 and 9146** with 16 externally configurable *temperature* or *resistance* transducers.

A *more distributed* system may also be constructed without racks — comprising one or more *standalone* NetScanner modules (of the types listed above) — using special PSI distributed power supply modules — and user-supplied Ethernet hubs or switches connecting this network to the host computer(s).

You should refer to the various user's manuals for each specific NetScanner module type and/or rack — for additional hardware details — and for descriptions of the low-level command sets used for programming each module. However, you may ignore low-level commands entirely if you learn how to use NUSS effectively.

NUSS allows you to operate NetScanner modules, singly or together in selected groups, without having to write any custom software, and without having to learn low-level commands. In fact, PSI has designed this software to permit you to test and use just about every possible module function with a simple interactive point-and-click user interface. PSI even uses NUSS at the factory for many of the production, calibration, and testing functions required to deliver NetScanner modules to you.

NUSS is also easy to use. Its more complicated and detailed test functions are "hidden" from your view — until you need them. Even in this simpler state, NUSS is capable of configuring, operating, and maintaining your entire network of modules concurrently.

Most functions of NUSS are operated interactively with *mouse* operations (i.e., clicks, drags, and drops). The verb "click", used alone, means "press the left (or primary) mouse button" unless otherwise explicitly stated as "right-click" (press the secondary mouse button). Left-handed users who have *reconfigured their mouse* to use primary=right and secondary=left, needs to reverse this manual's instructions. NUSS also provides alternate *keyboard* selection methods (per standard Windows conventions). See **Appendix K** (Keyboard Shortcuts) for more information.

1.1   Description of Supported Modules

The **NetScanner Unified Startup Software (NUSS)** is capable of configuring and operating all **NetScanner** Intelligent *Pressure* and *Temperature* **Scanners, Standards**, and **Calibrators**.

The various models of **NetScanner** Intelligent **Pressure Scanners** are functionally similar, differing mostly in the number of pressure *channels* each can scan (12-18 channels) and the type of pressure *medium* (pneumatic-only or all-media) used. In such modules, each pressure sensor is normally packaged with an integral temperature sensor and an EEPROM for storage of calibration and setup data unique to the sensor. Temperature data, as well as pressure data, are acquired continuously so that pressure measurements are dynamically compensated for sensor temperature changes. Some *pneumatic pressure* scanners (Models 9116, and 9816) also have internal solenoid valves, to allow a precise *calibration* pressure to be substituted for the normally measured *run* pressures, and to perform other pneumatic test or maintenance functions (e.g., leak check or purge). Some scanner models have only externally configurable transducers (like the 9022 shown below), and thus do not have any internal calibration valves – though external plumbing may be added by the user to facilitate calibration.
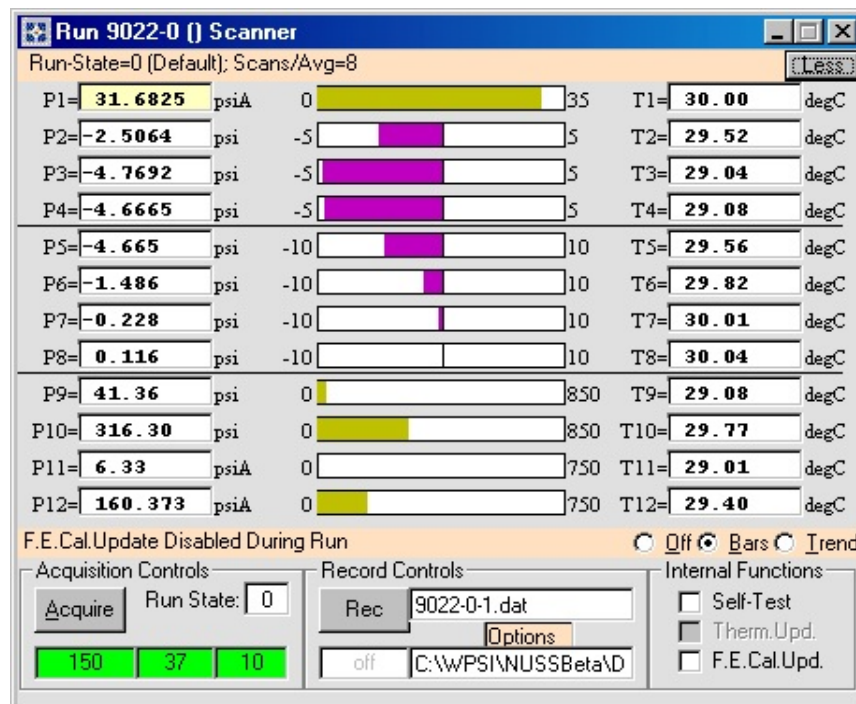
Typical NUSS *Run* form for Model 9022 Pressure Scanner

A **9046 Temperature Scanner** module is similar in form to a PSI Model **9116** pressure scanner. The following types of transducers can be utilized: Thermocouple types (B, E, J, K, N, R, S, T), Thermistors (3K, 5K, 10K), and RTD's (385 and 7990). In addition, channels may be configured to measure simple resistance (in *ohms*) in four ranges or voltage (in *volts*). Each channel configured as a thermocouple channel also reads its Uniform Temperature Reference *(UTR) junction temperature* as secondary (other) E.U. Data. EEPROM's, located within each transducer interface "cube", store local offset and span adjustment coefficients which the user may adjust as necessary. Some *configuration options* are also stored as *calibration coefficients* and must be set manually – to set the transducer type for each channel – to configure per-channel *filter* characteristics – and to configure the desired units (˚C or ˚F) for all channels. The *'Calibrate | View/Edit Coefficients'* function of NUSS supports such configuration tasks, and Normal users can edit certain *coefficients*.
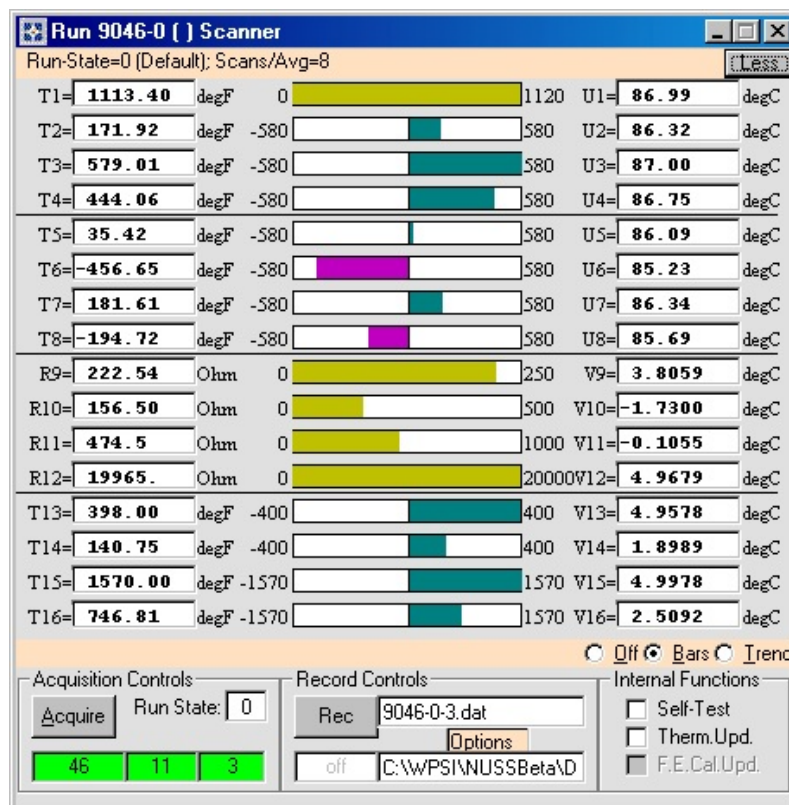
Typical NUSS *Run* form for Model 9x46 Temperature Scanner

The various models of Intelligent Pressure **Standards** and **Calibrators** have some functionality (like temperature compensation) in common with the pressure **Scanners**, but are generally only 1-channel pressure measuring devices. However, they are capable of higher precision and accuracy than **Scanners**. Their internal solenoid valves, option sets,

and command sets are different in various ways. **Calibrator** modules differ from **Standard** modules (and **Scanner** modules), in that they not only *acquire* (read) pressure data — but can also *generate* (write) an accurate pressure externally (used for calibrating other **Scanner** modules).   See Chapter 4 for detailed *calibration* functions that may utilize one or more **Calibrator** modules to "adjust" the accuracy of the other associated **Scanner** (and Standard) modules. Like a **Calibrator** module, an "absolute" type of **Standard** (also known as a *barometer*) module may be associated with a **Scanner** module, so as to provide various individual channels of the latter with special calculations (e.g., that show *absolute* pressure data readings instead of the module's native *differential* readings).

Typical NUSS *Run* form for 9032 Barometer Standard

Typical NUSS *Run* form for 9034 Pressure Calibrator

Regardless of which type of NetScanner module **NUSS** controls, its *screen windows* (generally called *forms*) and *function menus* adjust automatically to provide the appropriate functionality of the module type recognized. **Run** forms (combining Data Acquisition, Display, Recording, Playback, and Module Control) automatically adjust their size to display the number of channels currently being scanned by the module (as defined in its currently assigned and changeable *Run State)*. Since modules have many *configurable* options, these are functionally grouped for convenience under submenus of both the **Configure** and **Calibrate** menu functions. The corresponding display forms that pop-up, when selected, automatically adjust to show the particular options of the module type selected.

These many ***Configure*** and ***Calibrate*** options, although a few are *configurable*, are mostly only *viewable (read-only)* for Normal users. Advanced and Factory users are allowed to modify additional selected options and calibration coefficients. Some modules have a few *write-only* options (i.e., ones that can be changed but not examined).

1.2   Overview of Normal NUSS Functionality

Although Chapter 3 covers the "how to" for this material in detail, it may be useful for you to take a *quick-tour* of the *normal* functionality of NUSS first. **We purposely use more "words" than "pictures", at this point, to introduce you to basic NUSS terminology.**

The **NetScanner Unified Startup Software (NUSS),** when started, opens a small "status strip" *form*, with menu, at the top of your screen. Think of this simple form as ***home base*** for group-oriented NUSS functions that affect *coordinated groups of modules* on the network, or which affect *NUSS as a whole* (e.g., View Files, Archive Files, Exit). You learn more about this menu later (Section 1.2.5) since it is easier to learn the single-module functions before learning the group functions

The NUSS "home base" form's menu

Upon starting, NUSS also opens a second **Network Status** form immediately (just below the home base strip by default), and broadcasts a "query" command to all NetScanner modules that are *powered-up* on your network. This two-pane form displays a ***Nodes Map*** (in the left pane), showing a *hierarchical* view of all responding NetScanner modules. These displayed "nodes" are sorted first by *module type* (model number), then by *module serial number* (within each type). Thus, the map shows all the functioning NetScanner modules currently recognized on your Ethernet network. An *icon,* for each module displayed, also summarizes its state (i.e., connected or not, operable or not, etc.) The meaning of these icons are described more fully below and in Chapter 3. The **Network Status** window (or *form*) operates in a manner similar to an older standalone utility program, called UDP Query, which it replaces and extends. Its principal advantage (over UDP Query) is that it can connect to and operate multiple modules concurrently.

The NUSS Network Status form

The **Network Status** form also has its own *menu* and other *controls*, that allows you to do other *network- specific* functions, when necessary, such as:
• 	*query* the network manually (to update the **Nodes Map**);
• 	define new *groups* of modules (or edit existing groups);
• 	assign a *current module group* as the target for all "group" functions;
• 	select modules (individually or in groups) to *connect*, *disconnect, reset,* and *forget.*

When a *module type icon* (or *model # icon)* in the **Nodes Map** (left pane) is *highlighted* the **Description** (right pane) shows a *status report* of the selected module (or all modules of a selected model #). Depending upon the amount of information displayed, you may need to use scroll bars in the window pane to see all of it. You can also resize the form by dragging its boundaries, and it remembers its new size when NUSS is next started.

To perform most NUSS functions, on one single module at a time, you use a module's *context menu* (obtained by *right-clicking* anywhere in the **Nodes Map** when a particular module has its serial # *highlighted*). The resulting "pop-up" menu has three sections (*top*, middle, and *bottom*) with a line separating them.
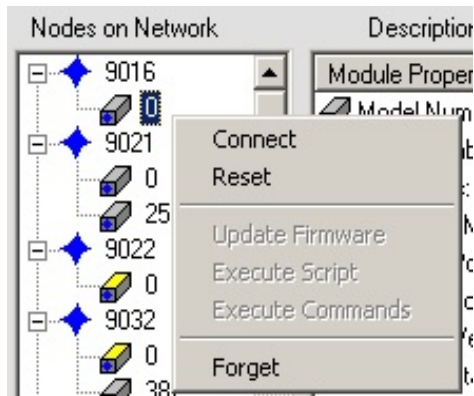
 Unconnected module *Context* menu

Initially, only the *top* and *bottom section*s contain usable functions — since the module and host are not yet *connected* (see example inset left). To be *connected* means that *this* host (i.e., the client currently running NUSS) and the selected module have successfully negotiated opening a *socket* connection — to allow reliable two way communication using the high-level TCP/IP protocol.
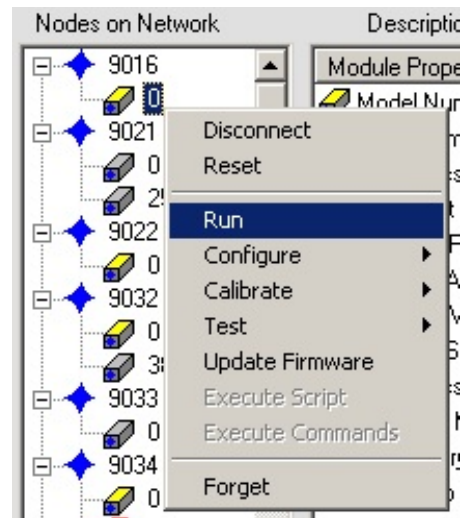
Connected module *Context* menu

Once a connection is achieved, the *middle section* of the *context menu* enables other module-specific functions. In the example (inset right) some of the middle functions are visible but *dim*. In this case, the *dim* functions are reserved for Advanced users only. During the process of *connecting* to each module, NUSS also reads numerous status

values from the module. It stores these data internally and uses them to determine the module's operational state and its class, and to adjust the functionality of its forms accordingly. This additional information available, after connection, is not immediately visible in the **Description** pane of the **Network** form (which only shows module information returned by the UDP query). However, other *Configure* functions (that can be started from the context menu) can display it all.

1.2.1   Module Functions in Context Menu's *Top Section*

A single module only has to be *powered-up* to respond to the query function and execute most of these *top-section* context menu functions.

The context menu's *first* "top" function *opens* a *TCP/IP connection* (if one is possible) or *closes* the *connection* (if one already exists) for the specified module. To use this function your host computer and each module on your network all require a valid and unique IP address (more about this later). The function's label changes between **Connect** and **Disconnect,** to indicate the function it can currently perform. Please note that the *TCP/IP* protocol imposes a minimum time (about 10 seconds) after module **Disconnect**, before a **Connect** is possible again for that module. If you attempt reconnect too soon, a pop-up is displayed to indicated the necessary wait.

You can only successfully *open* a connection to a module from your host computer if no other host computer has a connection open to that module. You can only *close* a connection if your host already has a valid connection. The icons of all modules on the Nodes Map are *bright* (top colored *yellow*) if they are *connected*, and *plain* (top colored *grey*) if they are *not connected* (but are available to be connected). Other red symbols, superimposed on the icon, indicate *connection unavailability* or various inoperable status.

The context menu's *second* "top" function, labeled **Reset**, allows a module to be reset overtly (i.e., the hardware is reset and its firmware is "rebooted" and restarted) when you perceive that it is not working correctly. After **Reset**, a module is essentially in the same "default" state it would be in at power-up — but if it were *previously connected to any host* it is no longer so. A **Reset** also does an implied immediate **Disconnect**. Please note that there is a minimum time (module-dependent, but typically 10 seconds) after module **Reset**, before a **Connect** is possible again for that module. After using **Reset**, you may also have to *query* the network in order to connect-to and use that module again with NUSS.

> **WARNING:** The **Reset** function should be used carefully — as it also closes any good *connection* with *this* or *another host*. Though using NUSS on multiple hosts is not encouraged, it may be accomplished if each host's user only operates its own unique groups of modules — cooperatively with other host users.

1.2.2   Module Functions in Context Menu's *Middle Section*

As indicated above, the functions in the *middle section* of the module's context menu become usable (bright) after a successful *TCP/IP connection* with the module and *this* host is made. The module must have a unique *IP address* and be available (i.e., not be connected to another host) before this is possible. **Most of these new functions provide you with the principal NUSS operations for a single selected module**. Each selected function generally opens an independent *form* (or *pop-up dialog box*) allowing multiple features and operating parameters to be dynamically specified with simple controls (i.e., buttons, check-boxes, etc.). Clicking the **[Cancel]** or **[Exit]** or **[X]** button in that *form* closes any open files and erases the independent form.

The *first* "middle" function in the *context menu*, labeled ***Run,*** is the most useful. It opens a **Single-Module Run** form, which acquires and displays (by default) all the *primary* E. U. Data (e.g., pressure and or temperature) of that module, and updates these displays periodically – as autonomous streams arrived from the module are processed.   A **[More]** button, if clicked, reveals additional functionality, including secondary ("other") data displays (e.g., compensation temperature or UTR junction temperature) for each channel. Also added to the form are ***Acquire*** and ***Run-State*** controls and status displays. Additionally, a ***Record*** feature is revealed that can record all acquired data streams (to disk files) in their raw binary format. A complementary ***Playback*** feature (available only when live acquisition is stopped) can later process and edit these files, sending *reports* to secondary files (to both readable "text" files and to "spreadsheet" (comma separated variable) files). These secondary files may be viewed directly on the screen, loaded into a spreadsheet application (like Excel) for further post-processing (e.g., plotting), printed, or moved to another "archive" folder for safe-keeping. Click the **[X]** button to exit the Run form. Multiple ***Run*** forms for several different modules can operate concurrently. You may also move and resize each form, appropriately, to improve visibility.

Using a ***Configure*** function (described below) you may predefine, for each module, any of several custom ***Run States*** — that specify the particular channels to be acquired, and other live acquisition and data stream delivery options (like triggering or clocking periods). Since every module starts its ***Run*** function using a permanent default ***Run State 0***, you do not have to define any other *custom* ***Run States*** unless you dislike the default one – which scans pressures and compensation temperatures of each pressure scanner module channel – at medium to slow clocked (not triggered) rates. Temperature scanner modules have a similar default ***Run State 0,*** and may have custom ***Run States*** prepared for them if needed.

Every unique ***Run State*** also has a single unique ***Display Set***. From an active ***Run*** form, you may interactively alter its ***Display Set*** to change the overall display formats (name, units, precision, optional calculations, etc.) for each channel displayed.

A separate "group" **Run** function, available on the *home-base* menu, has all the features of the single-module **Run** function. Additionally, it is capable of *coordinating* acquire, display, record, and playback operation for *all connected modules in the current module group*. It can record the data streams from each contributing module into a single data file. It can also select a particular *Run State (presumably common to all the modules in the selected group)* to define a particular *acquire* and *record* capability for *all* the modules it coordinates, or the modules can run with *mixed **Run States***.

Primary numerical (tabular) and graphic (bar-graph or trend graph) forms of data are displayed for each EU pressure channel acquired (or played-back) for a module on the *Left* side and Middle of a **Run** form. *Secondary ("other") data* (by default, EU compensation temperature (in °C) for pressures scanners – or UTR junction temperature for temperature scanners (in °C or °F)) are optionally displayed on the *Right* side of a **Run** form. However, these secondary data may be changed to other formats (e.g., raw pressure or raw temperature in volts or A/D counts, or EU pressure to some alternate units (e.g., kPa if the native units are psi)).

Special calculated data may be optioned, for display, on either the Primary or Secondary side of the **Run** form. Pressure scanner modules may have the latest acquired datum from a particular *absolute standard* module (*barometer*) *added* to (or *subtracted* from) a specified individual transducer (channel), and the resulting calculation displayed instead of the underlying acquired datum. This is accomplished by associating a particular Logical Barometer Number (LBN) with any transducer. Separately, a *'Configure | Barometers'* function associates a barometer (or absolute calibrator acting as a barometer) with each LBN. Most pressure scanner transducers deliver native *differential* data (e.g., in psi, kPa). You may choose to *add* the *absolute* barometer datum to it, yielding an *absolute* calculated result (e.g., in psiA, kPaA). Some 940x external transducers (plugged into a Model 9022 module) deliver native absolute data (e.g., in psiA, kPaA). You may choose to *subtract* an absolute barometer datum from it, yielding a *differential* calculated result (e.g., psi, kPa).

Of course, all the barometers and associated scanner channels with calculations specified, must all be running as separate instances of the **Run** form in order for these calculations to be successfully performed.   If the barometer datum needed for the calculation is not available for some reason (e.g., its **Run** form not active), the underlying channel's datum value is displayed with an *orange* (caution) background color – indicating that the calculation was not performed. If the calculation is successful, its datum is displayed against a *light-yellow* (absolute data) or *light-blue* (differential data) background. See examples (inset right).

P1δ= 3.4402 psiA

P1δ= 48.3008 psiA

P12= 539.320 psi
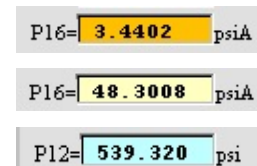
A normal native datum value (with no barometer calculations specified) is displayed against a *white* background. However, it also changes to an *orange* background (with its numerical value replaced with ***** characters) if the datum is over-scale (e.g., above full-scale transducer range). For scanners with Temperature alarms (e.g., Model 9x16), any temperature channel (in *right* column of **Run** form) may display its datum against a *bright-red* background if datum is above or below specified *alarm limits*.
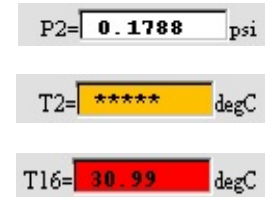
All these *per-channel* display and calculation options are saved persistently in an interactively-configured **Display Set** (which is an integral part of the current **Run State**). Changing the **Run State** also changes the **Display Set**. A **Forget** function (in bottom section of context menu) can restore all channels to their default **Run State** and default **Display Set** (see sections below for more detail).

Scanner modules, depending on the model number, my also have Calibration valves that may be controlled manually by clicking buttons on the **Run** form. Clicking the *frame label* (of this frame of controls) reveals other hidden **Module** functions that may also be invoked live from the **Run** form.

Using this **Run** function of *standard* or *calibrator* modules provides a similar periodically-updated form, but with only a single channel data display (but with the same Primary EU pressure and Secondary Compensation Temperature). The same *Acquire*, *Run-State*, *Record*, and *Playback* controls are also available via the **[More]** button. These modules also have **Digital Inputs** and **Digital Outputs** that may be controlled manually by clicking buttons in the **Run** form (should the user have external sensors or external solenoid valves connected to them). A *calibrator* module's **Run** form also has **Set Pressure** *controls* — that allow you to manually change its generated (output) pressure in native units (e.g., psi, kPa, psiA, kPaA), and operate the module's specialized valves and modes.

The "middle" **Configure** context menu function provides a submenu of choices — whose content varies with module type. Via this submenu you may create selectable module *Run States* or choose to view and modify various module *option groups,* which *functionally partition* the many options available in a module. Your choice opens a suitable **Configure** form for the chosen function. The first selection activates a **Run State Editor** which allows you to define one or more custom **Run States** *(numbered 1-9)*. These assignable *configuration scripts* may each specify up to three (3) *autonomous data streams*, each containing module status and one or more data groups of scanned input channels — that the assigned module delivers to the host for use by the display and record features of the **Run** function. Other acquisition options (e.g., # A/D scans averaged, hardware trigger use or clocked acquisition period), and one **Display Set**, may be associated with each **Run State** you define. Such options are saved persistently in files, and are only "registered" in

the module when a particular *Run State* is selected by module **Run** functions. You may also associate a more verbose *functional label* with each numbered **Run State**. Finally, you may associate a verbose *functional label* with the *module* itself (in addition to its universal *<model #>-<serial #>* designation that NUSS uses by default to identify it uniquely).

A separate "group" ***Configure*** function, available on the *home-base* menu, is useful for "broadcasting" a particular option setting to *all connected modules of the same type (in a currently-defined group)*, in one coordinated operation. It also allows **Run States** to be created/edited for the entire group. It also provides configuration functions for various NUSS-wide features as a whole, and for special calibration and barometer functions.

The "middle" ***Calibrate*** context menu function also provides a submenu of choices. Your choice opens a particular **Calibrate** form, which displays various calibration data (i.e., coefficients) for that module and its various transducers. For **Scanner** module types, you may also invoke one or more *calibration adjustment procedures* that automatically *adjust* certain key coefficients of selected transducers. You may perform a *Zero-only* adjustment procedure, with or without the assistance of an associated *calibrator* module. This procedure results in new *offset* coefficients being calculated and stored for the affected transducer channels. If a suitable *calibrator* module is available, with a pressure generation range near that of the full-scale range of the *scanner* module's transducers being calibrated, you may also perform a *Span-only* or *Multi-Point* calibration adjustment procedure. The *Span-only* procedure results in new *gain* coefficients being calculated and stored. The *Multi-Point* adjustment procedure results in new *gain* **and** *offset* coefficients being calculated and stored, but also allows *more than two* calibration points to be specified for a better "least-squares" fit of the calibration data. In either case, you may then inspect the new coefficients and optionally save them in non-volatile storage inside the associated transducer(s). Other submenu functions of ***Calibrate*** may *configure* other characteristics of a scanner's calibration process (i.e., the associations between its transducer channels and a suitable calibrator module and its assigned intermediary Logical Range Number (LRN), and all the calibration set points to be used during Span-only or Multi-Point adjustments). Chapter 4 is devoted to the detailed "how to" of calibration adjustment functions – and the ways LRNs are defined and used.

A separate "group" ***Calibrate*** function, available on the *home-base* menu, is best for coordinated calibration adjustments to *all connected scanner modules* (or some specified group) concurrently, using one or more pre-associated *calibrator* modules sequentially.

For *calibrator* or *standard* module types no calibration adjustment functions appear on the **Calibration** submenu. You may return these modules to PSI for re-calibration when necessary. However, you may view the coefficients stored in these modules.

The "middle" **Test** context menu function opens a submenu listing test programs available for that module. This submenu varies considerably in content according to the particular module type selected. For example, you might choose a *leak test, pressure accuracy test,* or *noise test* on a *scanner* module, using the pressure setting capabilities of a *calibrator* module (assigned to the scanner module via an intermediary LRN on a per-channel basis). We detail most of these tests in Chapter 5. However, some tests are *Advanced* or *Factory* user functions only (some requiring special test equipment be attached to the host PC).

A separate "group" **Test** function, available on the *home-base* menu, allows coordinated testing of *multiple scanner modules (defined in a group)* concurrently. Not every test that is available to a single-module is also available as a "group" test, however.

The "middle" **Update Firmware** context menu function opens a **Download to Module** form. You may need to perform this procedure occasionally, as PSI tries to keep all users updated with the latest capabilities of each module. Filling in the various fields of this form allows you to select the firmware image file, and download it to a module.

If you prefer to use a "group" function that can update the firmware in *all connected modules of the same module type* concurrently, see the ***Update Firmware (Group)*** submenu function on the *home-base* **File** menu instead.

Interestingly, each of the above context menu functions, though designed to allow you to concentrate on *one single module* at a time, may actually have *multiple "concurrent instances"* of its form open for more than one module at a time. NUSS allows such multiple instances to operate independently. However, such operation may become clumsy and inefficient as additional modules are added. Alternately, the equivalent "group" functions, on the *home-base* menu, are better suited for *coordinated* multiple module use, and easier to use for that purpose. However, because it simplifies your learning, we defer complete descriptions of these "coordinated group" functions until after we know how to fully operate the single-module equivalent functions. Details usage of all available functions, both in their single-module and group flavors, is covered in Chapter 3. There, you find numerous pictures of the pertinent screen forms, illustrating how to operate their many controls and functions.

1.2.3   Module Functions in Context Menu's *Bottom Section*

Finally, the "bottom" section of the context menu has only one function called '***Forget***'. When executed, it pops-up a dialog box to see if you want to *delete* (or not) the "historical" ***Run*** form configuration files of the selected module. These files remember various things about the last time you executed the ***Run*** form for that module – including the size and position of that form and how each of the displayed data items on that form (per channel) are configured as to their *name*, *units*, or *precision* (sometimes called the **Display Set** of each module's assigned ***Run State***). This function is particularly useful and necessary for scanner modules that can have their *individual transducers changed* frequently. Such modules (Models 9022, and 9x46) require the '***Forget***' function to be executed each time any of their channels (or module-wide options) are reconfigured by ***Configure*** and ***Calibrate*** functions. For example, the temperature units of the Model 9x46 are changed on a module-wide basis, by changing a particular *calibration coefficient* common to all channels of that module.

1.2.4   Other Network Status Form Menu Functions and Controls

The **Network Status** form's own menu (below its Title Bar) provides several basic *network-related* functions. There are also other useful indicators and "*hidden"* mouse controls that are located below the menu in a Status Bar of this form.
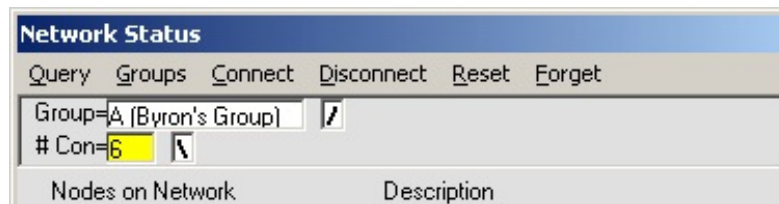
Menu functions on **Network Status** form

The ***Query*** menu function allows you to manually query the network — whenever you believe that new (or previously non-functioning) NetScanner modules would respond and appear on the **Nodes Map** — since NUSS initially started (and did its initial automatic query). This may be necessary when modules have had a power failure/restore cycle (or were ungraciously *rebooted* by other host computer(s) — running NUSS or another network application). To minimize the need to use this function, you can also configure all your modules so that they automatically respond (and update the NUSS **Nodes Map**) after they are *reset* (i.e., when power is restored or the module is rebooted). Such automatic action is NOT the default setting of modules. See Section 2.5.1 (in Chapter 2) for a procedure that reconfigures modules so that they respond (and appear on the map) automatically several seconds after *reset*.

The *Groups* menu function opens a form (called the **Group Editor**) that allows you to *define, edit,* and *select* labeled groups of modules — that belong to this host for various usage. Up to 26 groups may be defined. Groups are conveniently referred to with short labels A-Z, though you may also assign a more verbose (16-character) functional label to each as well. Three groups (X, Y, and Z) are reserved for "system use", and are **automatically configured** (though they may be manually edited after NUSS starts). Group X (also named "Calibrators") is created to define all Calibrator modules in your system. Group Y (also named "Barometers") is also created to define all Barometer modules in your system. These two special groups are configured *automatically* (at NUSS restart) before any other **Configure** functions (that assign Calibrator or Barometer modules) can be used. Group Z (also named "Reserved") is used behind-the-scenes by a **Playback-0nly** function. All other groups (A-W) may be *user-defined*. A final *special group* labeled "*" (star) is used to refer to a *continuously-variable dynamic* group known as "All Connected NetScanner Modules". It is often useful when you have manually connected (via context menu) a particular series of modules (not otherwise defined in a formal group definition) and you want to issue certain commands to that "group". Group "*" (star) is often the most useful group for many ad hoc applications. It can only be viewed (but never modified) by the **Group Editor**. Since it is dynamic, it is never stored in a file like the other groups.

Once named groups are defined, there are *other menu items* and *"hidden" controls* in this form to utilize them. You may choose a single *Current Group* (from the Group Editor form while defining or editing a group) which is then displayed in its own **"Group="** field. Clicking this field on the form also brings up a choice menu showing all *currently defined* groups, allowing you to change the *Current Group* quickly when necessary. This "displayed" group is the *assumed target* for various other "group" functions on this menu (discussed below) and on the "home-base" menu.

The *remaining* menu functions, labeled **Connect, Disconnect, Reset**, and **Forget** each attempt to act collectively on all the modules in the *Current Group*. However, if the special "*" (star) group is assigned as the *Current Group*, the **Connect** function is normally meaningless, and a pop-up notifies you of that fact. However, if you have elected to use simulated (serial # 0) module, you can choose to use this otherwise meaningless function to Connect *All* simulated modules. The "*" group is, however, very useful for all other "group" functions.

The **Connect** and **Disconnect** functions, when applied to the *Current Group,* operate sequentially on each defined module in that group. Since this takes a finite amount of time for each module, the user may *examine* the count in the **# Con=** (i.e., number of modules currently connected) field in order to determine when the selected function is done. It is unwise to execute any other NUSS function while these group functions are in progress.

The *Reset* function, when applied to the *Current Group*, manually broadcasts a ***reboot*** command to *every* module defined in that *group*. This function is particularly useful after a host (or module) power loss, but should otherwise be used cautiously and considerately — should other hosts control modules on the network. Since it takes a module several seconds to respond after *Reset* (depending on its particular firmware startup procedures), you may need to manually *Query* all modules on the network *several times* to see *all* changes in the affected modules (if any are configured not to respond automatically upon reset).

The ***Forget*** function, when applied to the *Current Group*, manually causes the same single-module '***Forget***' function available from the context menu to be executed for each module in the *Current Group*. However, instead of being asked whether the historical *Run* files of a single module are to be deleted (or not), that dialog pops-up for each module in the group.

Hidden controls are revealed by *hovering the mouse pointer over* each of four (4) fields (white text boxes). These are located within the rectangular status bar located between the **Network Status** form's menu and its **Nodes Map**. Actually, these are only *hidden* if you have not yet discovered that NUSS has *ToolTips* (small pop-up "info" rectangles that appear when you hover the mouse cursor for a few seconds over various items in each form). The *ToolTip* for each of these fields shows the function that is performed if you click it with the mouse.

The first useful "hidden" control is obtained by *clicking* the *group name field* to the right of the "**Group**=" label. This field displays the current assignment to the *Current Group*. When clicked, it causes a dialog form to appear. This form allows you to select another *defined* group. You must click the **Groups** menu item, instead, to define any new groups.

The most useful of these "hidden" controls is obtained by *clicking* the *number field* to the right of the "**# Con**=" label (i.e., the current number of connected modules).   If the field contains zero, then nothing happens. However, if there are any connected modules, clicking it executes a single-module *Run* function, for *each module* that is "currently connected"**.** This operation proceeds sequentially, just as if *Run* had been manually executed via the context menu for each module separately. Clicking the field again causes each *Run* form to stop, as if its *Exit* button were pressed manually.   Please note that this function does **not** necessarily apply to the *Current Group* currently assigned (unless that group's modules just happen to be the only ones currently connected).

The last two "hidden" controls are obtained by *clicking* either of the *tiny unlabeled fields*, at the extreme right of the labeled fields. The top field shows UDP "receive" activity. The bottom field shows TCP "receive" activity. Normally these tiny fields indicate (by displaying a moving "baton" character) when a "receive" event is processed for its

particular protocol type (UDP or TCP). If the tiny field is clicked with a mouse it causes additional status fields to appear to its right — across the width of the form. You may have to widen the form (by dragging its right boundary) to see all of these fields. The extra fields show 2 or 3 counters (total # receives, and total # transmits) and a "latest error message" field for its protocol type. The TCP line has an extra "error" counter field. Clicking the tiny field again makes all its extra status fields disappear. Also, clicking each of extra status fields, while they are visible, "resets" their internal counters. *ToolTips* show the exact meaning of each field.

1.2.5   Home-Base Menu (Group) Functions

The principal NUSS **home-base** menu, on the top-of-screen "status strip" form provides useful functions that target the entire application program (NUSS) or that use the *connected* modules in the *Current Group*. When you use any of these *coordinated-group* functions, it is *required* that any *single-module* functions be *inactive* for the same modules. Each *such* function, when selected, opens its own special form. The program that operates in that form expects that all the modules in the *Current Group* to be **pre-connected** by commands from the Network Status form. If not, then you are notified. You may then abort the function or use just the particular modules that may be connected in the group.

When you finish using a coordinated-group function, clicking the **[Exit]** or **[X]** button for its particular controlling form terminates its underlying program, closes any open files, and erases the form from the screen.

Home Base Menu (Group) functions

The *first* "home base" menu function, labeled *File*, leads to a submenu containing two distinct sections of other sub-functions, separated by a line. The first section contains "group" functions. Currently, it contains only one such function: ***Update Firmware (Group),*** though other functions may appear in this section for Advanced users. The second section contains functions related to the overall NUSS program. These include *View Files* **(NUSS)**, *Archive Files* **(NUSS)**, *Forget Orphans,* and *Exit (NUSS)*.
The *'File | Exit (NUSS)'* function is the normal way to terminate the NUSS program (though clicking the **[X]** button in the top right corner of the **home-base** strip form works just as well). Upon exiting NUSS, it normally *disconnects* any *connected* modules. This makes these modules available to the next invocation of NUSS (or to other NUSS programs (or other applications) running on this and other hosts connected to the network). Likewise, *Exit* also "signals" any other active forms of NUSS to exit if they are still active

(including the ***Network Status*** Form which has no independent **[Exit]** or **[X]** button). It also *terminates any tests in progress* (and *closes any open files)*.

The *'File | Forget Orphans'* function operates somewhat like the **'Forget'** function for individual modules and groups of modules – except that it offers to delete the ***Run*** form's historical files ONLY for modules who are currently NOT visible on the **Network Map**. It is mostly useful to Factory-like users that must process many modules arriving and then leaving the system, never to return (except for repair). This function allows one to delete files belonging to modules not expected to return to the particular NUSS system.

The *'File | Archive Files (NUSS)'* function causes a special ***Archive*** form to appear when selected. If no *Archive Base Path* has yet been specified by the *'Configure | General Option (NUSS)'* form, then the ***Archive*** form has only the ability to *Delete* selected files in NUSS subfolders of the *Main Base Path* (i.e., the path were the NUSS executable is installed). However, if an *Archive Base Path* has been specified, then the ***Archive*** form can additionally Delete selected files in subfolders of the *Archive Base Path* — and can also *Move* or *Copy* files in either direction — between like-named subfolders of the two distinct base paths. This ***Archive*** function is particularly useful when the modules on your system change frequently, and there is a need to get rid of NUSS internal files that were generated when old modules were present on the system and are just taking up space. It is also useful when record/playback data files need to be moved to archive storage, and their name space must be reclaimed (i.e., Test Run Number files are deleted in the Main Base Path's **Dat** subfolder so that automatic record/playback data file naming is restarts at 1).

The *'File | View Files (NUSS)'* function causes a common Windows dialog box form to appear when selected. It initially reveals all the files in the Main Base Path ("installation" folder) of NUSS, whose path is recorded (as *CurDir="path"*) in the Status Bar just below the "home-base" menu. You may use the dialog box to explore all the files in subfolders of this path. These contain all the many *initialization*, *data*, *report*, *command*, *log,* and *firmware download* files used by or generated by NUSS. This dialog box also has other convenient filters that may be selected to "narrow" or "widen" your view of the selected folder's file types. This dialog box may also be used to *open, copy, move, rename,* or *delete* any "single" file you select (via the dialog's right-click *context* menu). If you need to operate on "multiple" files simultaneously, you should use the ***Archive*** form described above, or use the standard Windows ***My Computer*** or ***Explorer*** applications instead. After you "drill down" to view other subfolders the latest path appears in the *CurDir="path"* label — and may be the starting path if you reselect this function later. However, other functions of NUSS may also change this current path.. If you restart NUSS, the Main Base Path ("installation" folder) is always restored as the current path. This ***View Files*** subfunction may also be executed by simply *clicking* the "home-base" Status Bar with your mouse.

The *'File | Update Firmware (Group)'* function leads you to a "group" *firmware update* program, executing in its own form, that can update the firmware of *a group of connected modules of a particular module type*. This coordinated version may be more useful than the single-module ***Update Firmware*** function available from a module's *context menu*. If you have many modules to update at once, it definitely saves you time and effort. You must define a group of "like" modules (same model #) to use it however.

The *second* "home base" menu function, labeled ***Run***, leads to a submenu containing two sub-functions (***Run (Group)*** and ***Playback Only***).

The *'Run | Run (Group)'* function executes a "group" data acquisition program, that reveals a unique **Group Run** form — supported by other ***Display*** forms. It can *acquire, display, record*, and *playback* data from all the modules of the *Current Group* in a coordinated fashion. It is also easier to use (and operates more efficiently) than running *multiple-instances* of the single-module version of ***Run***. For example, its *Record* feature writes the "time-stamped" data streams acquired from all the group's modules to a *common single data file*. Acquired data are displayed in other separate forms (similar to those used by the *single-module **Run*** function), one for each module of the group. Pre-defined ***Run States*** may also be changed dynamically during "live" operation — for all the modules collectively (i.e., all modules running the same **Run State**) — or singly by module (i.e., modules running with "mixed" **Run States**). For example, when you select Run State 4, every defined Run State 4 "script" for every affected module is sent to its module to initialize it, before acquisition restarts. Such changes can quickly switch the channels being acquired in each stream and displayed. Data recording may also be started, stopped, or left unchanged, by simply changing **Run States**.

When acquisition is stopped, the *Playback* feature of the **Group Run** function operates just as it does for single-module ***Run***. Any pre-recorded data files (created by the ***Run Group*** function — or even *the single-module **Run** function*) may be played back directly to the displays, or edited and reduced to other "secondary" text or spreadsheet data files.

The other function of the home-base menu item ***Run*** is called *'Run | Playback Only'*. It activates the same **Group Run** form described above. However, it places it immediately into the *Playback* mode, permanently inhibits its ability to acquire live data, and ignores the *Current Group* of modules entirely. This mode has the advantage of allowing you to *Playback* **any previously recorded file** for any single module or module group — even if that module *is no longer currently available (visible on Network Map) and functioning*. You start it by selecting an existing data file for playback, by clicking the unlabeled *File* and/or *Path* text boxes in the **Playback Controls** frame. After the header of the selected data file is examined (to find out how many modules' data are recorded in it) the necessary ***Display*** form(s) are revealed to show the module(s) data. Click the **Options** label to specify how that data is to be processed, then press the **[Play]** button to start processing the

data in the selected file. Otherwise, it operates just like **Playback** for single modules and groups of modules.

The **Configure**, **Calibrate**, and **Test** "home base" menu "group" functions have already been described briefly above, so further details of their operation are deferred to Chapters 3, 4, and 5. These functions generally provide a more useful "value-added" feature set than their single-module equivalents — though not every "single-module" function has a "group" equivalent on these submenus – particularly the **Test** menu..

The **Configure** menu item has an additional block of three (3) "*(NUSS)*" submenu functions — that do not appear on the single-module context menus. These include *'Configure|Calibrators'*, *'Configure|Barometers'*, and *'Configure|General Options'*. These configure several important *global* (overall NUSS) options. The last of these (*'Configure|General Options'*) has a text box used to configure a "favorite text editor" program that is used by NUSS for *viewing*, *printing*, or *saving* all *Report* files generated by it. It also has a text box to configure where the NUSS User's Manuals are located (e.g., hard disk or network drive path or CD drive). Finally, it has a text box to configure an *Archive Base Path*, which is used by the *'File | Archive (NUSS)'* function to archive (save) the contents of like-named subfolders of the *Main Base Path*.

The *last* "home base" menu function, labeled **Help**, provides a submenu leading to the highest level Help features of the NUSS program.

Submenu item *'Help|Tips'* provides access to **general information** about the Help features of NUSS, including an abbreviated summary of all these menu functions.

Submenu item *'Help|About'* has information **about** your current NUSS version (and its currently configured user-level).

The Help menu may be also be configured (see*'Configure|General Options'* described above) to link directly to where all User's **Manuals** of NUSS are installed. Then, by simply selecting submenu item *'Help|Manuals'* you can browse all the NUSS documentation via your default "Internet browser". This begins with a HTML root file (called *nussindx.htm*) that has links to all the PDF copies of the various *chapters* and *appendixes* of NUSS manuals.   NOTE: this feature requires you to install Adobe's Acrobat Reader (Version 4 or above). This free program, available from Adobe's website (www.adobe.com/support/downloads), displays all NUSS manual text and illustrations in full color.

Finally, you may also access PSI's **website** directly via selecting submenu item *'Help|Website'*. This is particularly useful for fetching (downloading) the latest version of NUSS, its latest User's Manual, and the latest versions of NetScanner module firmware.

The latter may be placed in the **Firmware** subfolder (just below the NUSS installation path) for easy access by either the single-module and group *Update Firmware* menu functions.

In addition to this ***Help*** *menu*, there are many other *help features* built into NUSS. For example, pop-up ***ToolTips*** (described briefly earlier) open tiny rectangular windows to describe the purpose of all *controls, labels, fields,* and *forms* when the mouse cursor is allowed to rest on them.   These ***ToolTips*** provide the primary descriptions of every feature of NUSS. They are always there to help you when you need help. However, should they become invasive, just relocate your mouse pointer to the *Title-Bar* or *Menu-Bar* of any form or window, and they disappear. Since *menu items* do not have their own ***ToolTips*** available to describe them, select the ***'Help|Tips'*** menu item for a summary list of all three types of menu functions.

1.3   Where Are The Details?

If you have not yet installed NUSS, Chapter 2 awaits you.

You now have a quick tour of NUSS under your belt, and are probably asking: "Is that all there is?" Well, no! Up to now, you may have only learned the "what" for *Normal* users. Starting with Chapter 3 you are able to explore the "how-to" in detail. The remaining chapters divide up the detailed material into more *functional* groups such as Configuration & Operation, Calibration, Testing, etc. However, emphasis is still on using the various *single-module* and *coordinated multi-module* (*group)* functions — to effectively operate a complete network system of NetScanner modules — without having to write programs using low-level module commands.

Advanced users of NUSS have additional detailed documentation available to them in a *special addendum* to this manual. The addenda are available on the PSI website:

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http://www.pressuresystems.com

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or look for the AdvAdden subfolder on the NetScanner Product CD. Then read Chapter 2 *of that addendum* for instructions on making NUSS operate for Advanced users, and for extending your copy of the manual to include the Advanced Addendum chapters in its index. The additional features that are available for Advanced users are:
•   New forms and menu functions that can send *low-level commands* to modules (**Execute Command** and **Execute Script** functions).
•   Methods for utilizing System 8400 *calibrator* (PCU) and *standard* (PSU) modules as substitutes for their equivalent (Model 903x) NetScanner *calibrator* modules.
•   Features that support Dynamic IP Address Assignment to NetScanner modules from a server located on a central host.
•   Options that allow internal NUSS operations to be extensively logged to a NUSS.log file (in **Cmd-Log** subfolder) so that failures can be easily analyzed. Every command to and response and stream from a module are logged as well as many other error conditions and operator actions.

See **Appendix A** for a summary of all changes since Release #4 (2.0.0).

See **Appendix F** for a description of all File Formats – plus examples of all Report files. Any Report files that were previously found in other Chapters (in Release #4 or Version 2.0.0) have now been moved to this appendix.