

RAD 4000 SERIES SOFTWARE REQUIREMENTS SPECIFICATION

RAD4000 V1.04

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RAD4000 CONTROL AND CONFIGURATION

The operation of each RAD4000 is controlled by sending commands to selected units via the network. The RAD4000 returns data or information over the same network to the requesting client/host.

RAD4000 COMMANDS

This section describes the commands used to control the RAD4000. The RAD4000 software performs the following general tasks:

- 1) Read and filter the raw A/D counts that represent pressure and temperature.
- 2) Convert the pressure A/D counts to user chosen pressure units.
- 3) Receive and execute commands via the Ethernet or Serial.
- 4) Output converted data, status, setup and calibration data over the Ethernet or Serial outputs.

NOTES: When an RAD4000 module is in a "not ready" mode, all commands are disabled except STATUS and STOP.
When a communications variable is modified, the RAD4000 system computer must be restarted, in order for the changes to take effect.

COMMAND FORMAT

Each of the commands are explained with the following sections: command, syntax, arguments, description, and returns.

COMMAND lists the name of the command.

SYNTAX lists the format of the command. The following conventions are used:

- BP** Boldface letters indicate command keywords and operators. Within the discussion of syntax, bold type indicates that the text must be entered exactly as shown.
- expression* Words in italics indicate place holders for information you must supply, or information returned by the calibrator, such as a coefficient name or pressure data.
- [/H] Items in square brackets are optional.
- ,
- <CR> Items in angle brackets are used for names of keys on a typical keyboard. The carriage-return key, sometimes marked as a bent arrow, Enter, or Return on the key board, is called <CR>.

Spaces, as used in the syntax, are entered as spaces.

DESCRIPTION describes the function of the command.

RETURNS lists the format of the information that the unit returns to the host.

A **PROMPT (>)** will be output when the RAD4000 is ready to accept a command.

TCP/IP does not guarantee that packet boundaries will be maintained between a Host and a RAD4000 module. **ALL** commands from a Host **MUST** be terminated properly with CR-LF (ASCII 13 - ASCII 10).

Scanivalve DSP Boot Loader

The Scanivalve DSP Boot Loader loads the RAD4000.hex file from PROM to RAM at bootup. The boot loader also allows a user to easily update the RAD4000 application. The boot loader runs an FTP server. It has been tested with Fire Fox FTP, Windows Explorer, Windows Command Line FTP client, and Linux FTP client.

Any additional file transfer protocols or additional FTP client support modification will be made solely to the application.

FTP Server

The FTP server supports the following FTP commands prior to login:

USER	Allows the user to enter a user name. Anonymous is allowed.
PASS	Allows the user to enter a password.
QUIT	Disconnects from the FTP server.

The FTP server supports the following FTP commands prior to login after login:

RETR	Initiates a file transfer from the RAD4000 to the host.
STOR	Initiates a file transfer from the host to the RAD4000.
PASV	Sets up data port so a client can connect to server port.
LIST	Returns a directory listing of the files stored on the enclosure
SIZE	Returns the size of the file in bytes.
DELE	Deletes the file.
NOOP	No operation. Mostly used by the client as an "are you still there" command.
TYPE	[A, B or I] accepts the command, but only TYPE A is supported
PORT	Set active FTP data port
NLST	Same as LIST
PWD	Returns the current working directory
XPWD	Same as PWD
CWD	Changes working directory
	NOTE: This command changes the directory that is returned in PWD, but no actual directory is changed. Sub directories are not supported.
XCWD	Same as CWD

Only ASCII type of transfer is supported. Passive and Active data connections are supported. This allows data to be transferred without the server initiating a connection to the client. This will minimize problems from firewalls.

Boot Loader and Application File System

Filenames are limited to the 8.3 format with no spaces allowed. Only one drive is supported. Because the Enclosure does not have a time and date clock, all files created by the enclosure will have a date of Aug 8, 2008, unless NTP is enabled. No subdirectories are supported, however, if a file path is included in the file specification only the file name portion is used. The file will be written in the root directory of the drive. The disk drive will hold a maximum of 1024 files, or 2GB of data.

Boot Loader Commands and Configuration Variables

When a command is complete, the prompt character, the greater than character ">", is output preceded by a carriage return and line feed.

The commands listed below are supported by the boot loader and the executable program. Unless otherwise noted, they may be viewed and modified in the RAD40004000 executable program. Commands and variables noted as boot loader only will not be documented in this manual.

NOTE: Under normal operation, a user will not have access to the Boot Loader Program

VER	Returns the version of the Boot Loader NOTE: This command is available in the boot loader only. It should not be confused with the VER command in the application.
FORMAT	Formats the SD Flash to all 0's NOTE: This command is available in the boot loader only.
LIST IP	Returns the settings of the IP group. This command and the configuration variables in this group are described in detail in another section of this manual.
SET <parameter>	Sets the indicated parameter
IPADD <IP address>	Sets the IP address of the enclosure. If the IPADD is changed, the power must be cycled to take effect.
SUBNET <mask>	Sets the subnet address of the enclosure. If the SUBNET is changed, the power must be cycled to take effect.
MAC <MAC address>	Sets the MAC address for the enclosure. If the MAC is changed, the power must be cycled to take effect. NOTE: This command MUST NOT be modified
LOGIN <user name>	Sets the user name for FTP login.
PASSWORD <password>	Sets the password associated for LOGIN
LOGIN1 <user name>	Sets the user name 1 for FTP login.
PASSWORD1 <password>	Sets the password associated for LOGIN name1
APP <application file name>	Sets the file name of the application to run. This is the file name that is used when automatically running the application from the boot loader. It is also the file name used when using the RUN command. If this file is not found an error is returned.
GW <IP Address>	This IP address will be used to access the NTP Server if the IPNTP address setting is an IP address outside the RAD Subnet.
SAVE [<file name>]	Saves the configuration variables to the working directory. When an optional file name is entered, it saves the IP group settings to that file name.
TYPE <file name>	Lists the contents of the named file.
LOAD <file name>	Loads the named file into the LIST IP configuration variables.
DIR	Lists the files on the Micro SD card.
DEL<file name>	Deletes the named name from the Micro SD card
DIP	Reads and shows the settings of the DIP switch. The following is returned: DIPsettings Auto Run Application 0 Debug 0 No Serial Host 0 Spare 0 1 indicates on. 0 indicates off
RUN	NOTE: This command is available in the boot loader only. Runs the application named in the APP variable. NOTE: This command is available in the boot loader only.

RAD4000 COMMAND LIST

COMMAND SYNTAX	BANK A MODE BANKA <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to switch the DOUTs set in the configuration variable: BANKA. This command is intended for use with ZOC22, 23, and 33 modules but could be used in any situation where DOUT settings must be changed quickly.
RETURNS	<n/> nl - end of line
EXAMPLE	To switch the valves in a ZOC 22, 23, or 33 to measure the pressures applied to the Bank A inputs: Enter the command: BANKA The RAD4000 will switch the outputs based on the setting of the configuration variable: BANKA. This command assumes that the configuration variable is set correctly.

COMMAND SYNTAX	BANK B MODE BANKB <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to switch the DOUTs set in the configuration variable: BANKB. This command is intended for use with ZOC22, 23, and 33 modules but could be used in any situation where DOUT settings must be changed quickly.
RETURNS	<n/> nl - end of line
EXAMPLE	To switch the valves in a ZOC 22, 23, or 33 to measure the pressures applied to the Bank B inputs: Enter the command: BANKB The RAD4000 will switch the outputs based on the setting of the configuration variable: BANKB. This command assumes that the configuration variable is set correctly.

COMMAND SYNTAX	BANK USER MODE BANKUSR <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to switch the DOUTs set in the configuration variable: BANKUSR. This command is intended for use with ZOC22, 23, and 33 modules but could be used in any situation where DOUT settings must be changed quickly.
RETURNS	<n/> nl - end of line
EXAMPLE	To switch the valves in a ZOC 22, 23, or 33 to a special mode of operation as defined in the configuration variable BANKUSR: Enter the command: BANKUSR The RAD4000 will switch the outputs based on the setting of the configuration variable: BANKUSR. This command assumes that the configuration variable is set correctly.

COMMAND
SYNTAX

CALIBRATE INSERT
CALINS <press> <channels><CR>

ARGUMENTS

<press> - a real number that represents the calibration pressure for this point.
<channels> - a combination of:
module-port for one channel; or:
module-port,module-port for multiple modules; or
module-port...module-port for a range of modules.
Module is the physical location of the module in the system.
Port is a single pressure sample point within a module.

DESCRIPTION

This command reads one averaged frame of pressure and temperature counts and stores the information in memory in the INSERT format shown in the CALIBRATE Command. **NOTE:** The RAD4000 does not control the calibration. It will only read the information when commanded.

RETURNS

<n/ > - end of line

When this command returns the prompt, a SAVE command must be issued. The RAD4000 will insert the stored data in the Module Profile Files.

EXAMPLE

If a user wanted to calibrate a module connected to A/D position 3 at 15 psi:

Apply CTL1 and CTL2 Control pressures
Connect a pressure standard to the CAL input.
Enter the command:

CALINS 15 3-1..3-32<CR>

The RAD4000 will measure the counts for each channel and write the new master plane information into memory.

COMMAND SYNTAX	CALIBRATE ZERO CALZ <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to perform a zero calibration. This operation produces A/D count values for each pressure channel that is subtracted from the raw pressure counts before conversion to the engineering units. The data are stored in a Zero Array and a Delta Array. These values may be read by executing a ZERO or DELTA command. This command places the RAD4000 in the CALZ Mode until the command is completed or a STOP command is issued. CALZ requires approximately 15 seconds to complete.
RETURNS	<n/> nl - end of line
EXAMPLE	To update the current ZERO file and correct for any zero drift of the transducers: Enter the command: CALZ The RAD4000 will measure the zero counts for each channel and update the Zero and Delta Arrays. The RAD4000 will write the information into the file, ZERO.CFG when a SAVE Command is executed.
NOTE	It is very important that a user execute a CALZ after the RAD4000 and ZOC modules have been allowed to stabilize after power up. Also a CALZ should be executed if power is cycled, or if a RESTART or RELOAD command is executed.

COMMAND SYNTAX **CHANNEL**
CHAN <*scan group*> <CR>

ARGUMENTS <*scan group*> - the number 1, the only active scan group number.

DESCRIPTION This command outputs the channel configuration for the scan group entered in the argument.

RETURNS CHAN: <group><sequence><mod><port><lpress> <hpress><numchan><eu><nl>
group - the scan group, 1
sequence - the scan port number
mod - the module number
port - the port number in the module
lpress - the minimum pressure value
hpress - the maximum pressure value
numchan - the number of channels in the module
eu - the eu conversion setting, 0 = raw counts, 1 = EU
nl - end of line

EXAMPLE To verify the which channels have been assigned to SCAN GROUP 1:

Type:
CHAN 1 <CR>

The RAD4000 will return:

```

CHAN: 1 1 1 1 -6.100000 6.100000 32 1
CHAN: 1 2 1 2 -6.100000 6.100000 32 1
CHAN: 1 3 1 3 -6.100000 6.100000 32 1
CHAN: 1 4 1 4 -6.100000 6.100000 32 1
CHAN: 1 5 1 5 -6.100000 6.100000 32 1
CHAN: 1 6 1 6 -6.100000 6.100000 32 1
CHAN: 1 7 1 7 -6.100000 6.100000 32 1
CHAN: 1 8 1 8 -6.100000 6.100000 32 1
CHAN: 1 9 1 9 -6.100000 6.100000 32 1
CHAN: 1 10 1 10 -6.100000 6.100000 32 1
:: :: : : : : : : :: :: :: : :
CHAN: 1 31 1 31 -6.100000 6.100000 32 1
CHAN: 1 32 1 32 -6.100000 6.100000 32 1
>

```

This shows that all 32 ports of a 32 channel module have been assigned in sequence to Scan Group 1. The module is connected to input one. The minimum full scale pressure value is -6.1 engineering units. The maximum pressure value is 6.1 engineering units. The output data will be in engineering units

COMMAND SYNTAX	CLEAR CLEAR<CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to clear any errors that have occurred. The errors are sent to the client in response to a ERROR command.
RETURNS	<i><n/</i> nl - end of line.
EXAMPLE	To clear any errors listed in the ERROR Buffer, the following command would be issued: CLEAR <CR> The ERROR buffer will be cleared
NOTE	Errors are not stored in Versions 1.00 through 1.03

COMMAND	CONTROL PRESSURE RESET
SYNTAX	DOUTPU<CR>
ARGUMENTS	<i>none.</i>
DESCRIPTION	Resets the control pressures to the power up condition. This will reset control pressures if the BANKA, BANKB, and BANKUSR commands are used to modify control pressure settings from the power up condition. This also will reset DOUTS that have manually set. Scanivalve Corp recommends that all ZOC22, ZOC23, and ZOC33 modules have all control pressures removed if the modules will be powered on for a long time.
RETURNS	<n/> nl - end of line.
EXAMPLE	To reset the control pressures to the power up mode after several operations of the BANK(x) commands, Type: DOUTPU<Enter>

COMMAND SYNTAX	DELETE DELETE <start temp><end temp>[<channels>]<CR>
ARGUMENTS	<p><start temp> - an integer from 0 to 69 that represents the low point of the temperature planes to be deleted.</p> <p><end temp> - an integer from 0 to 69 that represents the high point of the temperature planes to be deleted.</p> <p>[<channels>] - optional, a channel to be deleted. This may be in the format: <i>module-port</i> or <i>serial number-port</i> for a single module. <i>module-port..module-port</i> or <i>serial number-port..serial number-port</i> for a range of channels</p>
DESCRIPTION	<p>Converts all pressure points within temperature planes between the low and high temperature range, inclusive, to "calculated". This allows new MASTER points to be entered via the INSERT command.</p> <p>NOTE: Refer to the description of the FILL command for more information.</p>
RETURNS	<p><n/>
 nl - end of line.</p>
EXAMPLE	<p>To delete the master points for all modules in a system using eight 32 channel modules, the following command would be issued:</p> <p style="padding-left: 40px;">DELETE 0 69 1-1..8-32<CR></p> <p>To delete the master points for channels 49 through 56 in a ZOC33 connected to input six, the following command would be issued:</p> <p style="padding-left: 40px;">DELETE 0 69 6-49..6-56<CR></p> <p>To delete the master points for channel 3 in a ZOC17 connected to input four, the following command would be issued:</p> <p style="padding-left: 40px;">DELETE 0 69 4-3<CR></p>

COMMAND SYNTAX **DELTA**
DELTA <module><CR>

ARGUMENTS <module> - the module position 1 through 8.

DESCRIPTION Lists the active delta zero correction values that resulted from a CALIBRATE ZERO. These values are used in the conversion of raw counts to Engineering Units (EU). These variables can only be set by executing a CALIBRATE ZERO command. If a module number is not entered, the DELTA values for all active modules are listed.

RETURNS DELTA: <channel> <value> <nl>
DELTA: <channel> <value> <nl>
: : : :
DELTA: <channel> <value> <nl>

channel - the channel in module-port format
value - the zero correction values
nl - end of line.

EXAMPLE To view the DELTA values for the module connected to input one:
Type: DELTA 1<CR>
The RAD4000 will return the current delta values
DELTA: 1-1 40
DELTA: 1-2 38
DELTA: 1-3 29
DELTA: 1-4 31
:: :: :: ::
DELTA: 1-10 34
DELTA: 1-11 35
DELTA: 1-12 27
:: :: :: ::
DELTA: 1-29 30
DELTA: 1-30 29
DELTA: 1-31 20
DELTA: 1-32 29
>

NOTES Delta values are the difference between the current CALZ zero value and the zero value stored in the calibration coefficients. The values tend to be low when a module has been recently calibrated and increase slowly over time as the sensors drift.

It is very important that a user execute a CALZ after the RAD4000 and ZOC modules have been allowed to stabilize after power up. Also a CALZ should be executed if power is cycled, or if a RESTART or RELOAD command is executed.

The Zero and Delta Arrays are cleared when the RAD4000 is powered down or when a RESTART or RELOAD command is executed. The data in the ZERO.cfg file is intended to be historical data. The Zero and Delta values are not reloaded at power up or restart because it is impossible to determine how long the power has been off. This also is designed to insure that a new set of zeros is acquired if modules have been switched.

COMMAND
SYNTAX

DOUT
DOUT <discrete channel><status><CR>

ARGUMENTS

<discrete channel> - a Digital Output channel 1 through 64.
<status> - 1 = On
0 = Off

DESCRIPTION

Commands the Discrete Output channel on or off.

RETURNS

<n/>

nl - end of line.

NOTE

The DOUT channels correspond to a channel in an RDS3200 module. If the corresponding RDS module is not installed, an error will be reported. For more information on the operation of the RDS module, please refer to the hardware manual.

EXAMPLE

In this example, digital output channel 1(RDS number 1, channel 1 in address location 9) will be energized:

DOUT 1 1 <CR>

In this example, digital output channel 11 (RDS number 2 channel 3 in address location 10)will be de-energized.

DOUT 11 0 <CR>

DOUT Channel Assignments

Position	Channels
9	1 - 8
10	9 - 16
11	17 - 24
12	25 - 32
13	33 - 40
14	41 - 48
15	49 - 56
16	57 - 64

COMMAND SYNTAX	ERROR ERROR <CR>
ARGUMENTS	None
DESCRIPTION	Lists the errors that have occurred since the last CLEAR. Only the first 30 errors will be listed. If more than 30 errors have occurred, the message: ERROR: Greater than 30 errors occurred" will appear at the end of the list.
RETURNS	ERROR: <error message><n/> ERROR: <error message><n/> : : : : ERROR: <error message><n/> error message - an error message shown in the error list. nl - end of line.
EXAMPLE	To read the contents of the Error Buffer: Type: ERROR The RAD4000 will return the last 30 errors in the format:: ERROR: Module or Port not found ERROR: List MI no group number ERROR: Group not between 1 and 8 If no errors have been logged, the RAD4000 will return: ERROR: No errors
NOTE	The Error Buffer is only updated if the configuration variable: IFUSER , is set to 0. When IFUSER is set to 1, errors will be displayed as they occur.
NOTE2	This is not supported in Versions 1.00 through 1.03

COMMAND
SYNTAX

INSERT
INSERT <temp><channel><press><press counts> M<CR>

ARGUMENTS

<temp> - an integer from 0 to 69 that represents the temperature in degrees Celsius.
<channel> a combination of *module* and *port*. Syntax is:
module-port or *serial number-port* for one channel.
<press> a real number that represents the calibration pressure point.
<press counts> a signed integer from 32767 to -32768 that represents the current pressure counts from the sensor.

DESCRIPTION

Inserts one pressure-pressure counts entry into the Correction Table. Only master points are accepted.
The LIST MASTER and LIST ALL commands download the contents of the conversion table in the format required by this INSERT command.
If a MASTER plane is overwritten, an error will be generated.

RETURNS

<n/>
nl - End of line.

EXAMPLE

Although INSERT commands are most often entered from a Module Profile File, they may be entered from a keyboard.

The following command will insert a master point at 30.5°C for channel 1 of the module installed in position 3. The applied pressure is 11.9998 psi, the measured counts are 26376.

```
INSERT 30.50 3-1 11.9998 26376 M
```

The following command will insert a master point at 48.75°C for channel 59 of the module installed in position 3. The applied pressure is 10.9998 psi, the measured counts are 20254.

```
INSERT 48.75 3-59 10.9998 20254 M
```

The following command will insert a master point at 43.75°C for channel 26 of module serial number 209. The applied pressure is -2.4864 psi, the measured counts are -6651.

```
INSERT 43.75 209-26 -2.4864 -6651 M
```


COMMAND **LIST ALL CONVERSION COEFFICIENTS**
SYNTAX **LIST A <start temp><end temp> <channels><CR>**

ARGUMENTS <start temp> - The lowest temp plane to be returned.
 <end temp> - The highest temp plane to be returned.
 <channels> - a combination of *module* and a *port*. Syntax is:
 module-port or *Serial number-port* for one channel

DESCRIPTION Lists all of the master and calculated points in the temperature-pressure correction matrix. This command places the RAD4000 in the LIST mode until the command is completed or a STOP command is issued.

RETURNS INSERT <temp><channel><press><press counts><M or C><nl>
 INSERT <temp><channel><press><press counts><M or C><nl>
 : : : :
 INSERT <temp><channel><press><press counts><M or C><nl>

temp - the temperature plane
channel - the channel in module-port notation
press - the pressure in EU
press counts - the A/D counts of pressure
M - a Master Plane generated from a calibration
C - a Calculated Plane generated by the software
nl - end of line.

NOTE **The LIST A and LIST M commands are identical in RAD4000 firmware**

EXAMPLE To list all of the coefficients from 16°C to 20°C for channel 1 in a module calibrated from 17°C to 40°C
 Type: LIST a 16 20 1-1<CR>
 The RAD4000 will return a list of INSERT commands showing the temperature, channel, applied pressure, and counts

```

INSERT 16.00 1-1 0.000000 0 C
INSERT 16.00 1-1 19.000000 0 C
INSERT 16.00 1-1 25.000000 0 C
:: :: :: :: :: :: ::
INSERT 17.00 1-1 -45.949100 -26184 M
INSERT 17.00 1-1 -31.250000 -17763 C
INSERT 17.00 1-1 -19.969601 -11302 M
INSERT 17.00 1-1 -6.250000 -3425 C
INSERT 17.00 1-1 0.000000 162 M
INSERT 17.00 1-1 19.984600 11636 M
INSERT 17.00 1-1 25.000000 14523 C
INSERT 17.00 1-1 35.000000 20281 C
INSERT 17.00 1-1 45.949100 26586 M
:: :: :: :: :: :: ::
INSERT 20.00 1-1 -45.949100 -26166 C
INSERT 20.00 1-1 -31.250000 -17750 C
INSERT 20.00 1-1 -19.969601 -11292 C
INSERT 20.00 1-1 -6.250000 -3424 C
INSERT 20.00 1-1 0.000000 160 C
INSERT 20.00 1-1 19.984600 11629 C
INSERT 20.00 1-1 25.000000 14514 C
INSERT 20.00 1-1 35.000000 20267 C

```

COMMAND
SYNTAX

LIST BOOT LOADER GROUP VARIABLES
LIST IP <CR>

ARGUMENTS

None

DESCRIPTION

Lists the Identification configuration variables from Group IP.

RETURNS

```
SET <variable> <value> <nl>
SET <variable> <value> <nl>
  : : : :
SET <variable> <value> <nl>
variable      the configuration variable name
value         the current setting
nl            end of line.
```

EXAMPLE

To view the current Boot Loader Group Variables settings:

Type: LIST IP<CR>

The RAD4000 will return the current boot loader variable settings. They could appear as follows.

```
SET IPADD 191.30.140.104
SET SUBNET 255.255.0.0
SET MAC 000.096.093.400.000.103
SET LOGIN Scanivalve
SET PASSWORD Scanner
SET LOGIN1 Scanivalve1
SET PASSWORD1 Scanner1
SET ALLOWANON 1
SET APP Rad4000.hex
SET GW 10.0.0.1
```

NOTE1:

Modifications to the variables in this group may result in one or more of the following conditions:

1. Unstable network operation.
2. Problems completing FTP file transfers.
3. Enclosure operational problems

NOTE2:

The variables in this group are not saved when a SAVE command is issued. They may only be saved by using the SAVEIP command.

COMMAND SYNTAX	LIST CALIBRATION VARIABLES LIST C <CR>
ARGUMENTS	None
DESCRIPTION	Lists the Conversion configuration variables from Group C.
RETURNS	<pre>SET <variable> <value> <nl> : : : : SET <variable> <value> <nl></pre> <p>variable - the configuration variable name value - the current setting nl> - end of line.</p>

EXAMPLE To view the current conversion variable settings:

Type: LIST C<CR>

The RAD4000 will return the current conversion settings. They could appear as follows.

```
SET ZC 1
SET UNITSCAN psi
SET CVTUNIT 1.000000
SET BIN 0
SET EU 1
SET CALZDLY 5
SET MPBS 0
SET CALPER 500
SET CALAVG 32
SET MAXEU 9999.00
SET MINEU -9999.00
SET STARTCALZ 0
SET FILLONE 0
SET A2DCOR 1
>
```

For more information, refer to the Conversion Variable information in this manual.

COMMAND	LIST DIGITAL VARIABLES
SYNTAX	LIST D <CR>
ARGUMENTS	None
DESCRIPTION	Lists the Digital Configuration variables from Group D.
RETURNS	<pre> SET <variable> <value> <nl> SET <variable> <value> <nl> : : : : SET <variable> <value> <nl> </pre> <p> variable - the configuration variable name value - the current setting nl - end of line. </p>

EXAMPLE To view the current digital variable settings:

Type: LIST D<CR>

The RAD4000 will return the current digital settings. They could appear as follows.

```

SET DOUTPU 5
SET DOUTCALZ e
SET DOUTPGSEQ 0
SET DOUTPG 0
SET DOUTSCAN 20
SET DLYPGSEQ 1
SET DLYPG 10
SET DOUTREADY 40
SET BANKA 0
SET BANKB 0
SET BANKUSR 0

```

COMMAND **LIST FILES**
SYNTAX **DIRFILE <CR>**

ARGUMENTS None

DESCRIPTION Lists the data files stored In the RAD4000 folder on the RAD4000 system computer hard disk drive.

RETURNS *<filename>* *<n>*
 : : ::
 <filename> *<n>*
 <n>

filename - The data file name
nl - end of line.

EXAMPLE To list all data files stored on the RAD4000 system computer hard disk drive:

Type: DIRFILE<CR>

The RAD4000 will return a file list

Ip.cfg	221
Rad4000.hex	525008
M351.MPF	177912
Sn.gpf	105
CV.GPF	870
Zero.cfg	2022
Nas.cfg	172
SSN.CFG	3

COMMAND SYNTAX	LIST GAIN VARIABLES LIST G <module> <CR>
ARGUMENTS	None
DESCRIPTION	Lists the active temperature gain set for the module from the Temperature Gain Group, Group G. Module may be the position or the serial number. These data are used to convert temperature counts to degrees Celsius. This is the "M" term in the temperature characterization equation. The value of this term will vary based on the module type. Refer to the section on Temperature Gain Values in the Configuration Variable Section of this manual for more information on the values for the "M" terms.
RETURNS	SET TEMPMn <value><n/> n - The module position or the serial number value - The temperature gain value for module n nl - end of line.
EXAMPLE	<p>To verify the temperature gain setting for the module serial number 253,</p> <p style="padding-left: 40px;">Type: LIST g 253<CR></p> <p>The RAD4000 will return:</p> <p style="padding-left: 40px;">SET TEMPM253 0.0228</p> <p>The gain settings may also be verified by module location. To verify the temperature gain setting of the module connected to input 6,</p> <p style="padding-left: 40px;">Type: LIST g 6<CR></p> <p>The RAD4000 will return:</p> <p style="padding-left: 40px;">SET TEMPM6 0.0228</p> <p>The temperature gain settings may be verified for all modules connected to the RAD4000.</p> <p style="padding-left: 40px;">Type: LIST g<CR></p> <p>The RAD4000 may return:</p> <p style="padding-left: 40px;">SET TEMPM1 0.037058 SET TEMPM2 0.037058 SET TEMPM3 0.037058 SET TEMPM4 0.037058 SET TEMPM5 0.037058 SET TEMPM6 0.037058 SET TEMPM7 0.037058 SET TEMPM8 0.037058 ></p>

COMMAND	LIST IDENTIFICATION VARIABLES
SYNTAX	LIST I <CR>
ARGUMENTS	None
DESCRIPTION	Lists the Identification configuration variables from Group I.
RETURNS	<pre> SET <variable> <value> <nl> SET <variable> <value> <nl> : : : : SET <variable> <value> <nl> variable - the configuration variable name value - the current setting nl - end of line. </pre>

EXAMPLE To verify the general module configuration settings:

Type: LIST i<CR>

The RAD4000 may return:

```

SET NL 0
SET DISPIN 0*
SET HAVENET 1*
SET HAVEARINC 0*
SET CONOUT 2*
SET NETOUT 2*
SET FORMAT 0
SET NETIN 1*
SET IFUSER 1*
SET ECHO 0
SET CAL 0 9600*
SET CALSCHED 0 rp 0*
SET AUX 0 9600 1*
SET AUXSCHED 0 rp 0*
SET RESCAN 0 0*
SET TWOAD 1*

```

NOTE **Variables marked with an asterisk are not used in RAD4000 firmware. They have been left in the software as place holders. They cannot be modified, but setup software that attempts to modify these parameters will not be affected.**

COMMAND
SYNTAX

LIST MODULE INFORMATION VARIABLES
LIST MI <module><CR>

ARGUMENTS

<module> - module group 1 through 8 or module serial number.

DESCRIPTION

Lists the configuration variables from Groups M1 through M8. If the module is not identified, all modules are listed. Each Module Information Group has provisions for up to four comment lines. These lines may be used to aid in the identification of the module group.

RETURNS

```
REM<module> 1 <comment> <nl>
REM<module> 2 <comment> <nl>
REM<module> 3 <comment> <nl>
REM<module> 4 <comment> <nl>
SET <variable> <value> <nl>
SET <variable> <value> <nl>
  : : : :
SET <variable> <value> <nl>
variable      - the configuration variable name
value         - the current setting
nl            - end of line.
```

EXAMPLE 1

```
To view the configuration of the module connected to RAD4000 A/D 1,
Type: LIST mi 1<CR>
The RAD4000 may return:
  REM1 1 Comment line 1
  REM1 2 Comment line 2
  REM1 3 Comment line 3
  REM1 4 Comment line 4
  SET TYPE1 0
  SET ENABLE1 1
  SET NUMPORTS1 32
  SET NPR1 5
  SET LPRESS1 1..32 -6.100000
  SET HPRESS1 1..32 6.100000
  SET NEGPTS1 1..32 4
  SET MODTEMP1 0 1.000000
>
```

COMMAND **LIST NETWORK ATTACHED STORAGE VARIABLES**
SYNTAX **LIST NAS <CR>**

ARGUMENTS None

DESCRIPTION Lists the Network Attached Storage Variables from Group NAS.

RETURNS SET <variable> <value> <nl>
 SET <variable> <value> <nl>
 : : : :
 SET <variable> <value> <nl>

 variable - the configuration variable name
 value - the current setting
 nl - end of line.

EXAMPLE To view the current digital variable settings:

 Type: LIST NAS<CR>

The RAD4000 will return the current digital settings. They could appear as follows.

```

SET USERNAS scanconas
SET PASSNAS scanco
SET ENNAS 0
SET PATHNAS /c:rad4000
SET IPNAS 191.30.130.105
SET FILENAS Scan
SET ENNTP scanco
SET ITPNTP 10.0.0.1
SET UTCCOFFSET -6
>

```

COMMAND
SYNTAX

LIST OFFSET VARIABLES
LIST O <module><CR>

ARGUMENTS

None

DESCRIPTION

Lists the active temperature offsets set for the module from the Temperature Offset Group, Group O. These data are used to convert temperature counts to degrees Celsius. This is the "B" term in the temperature characterization equation. The value of this term will vary based on the module type. Refer to the section on Temperature Gain Values in the Configuration Variable Section of this manual for more information on the values for the "B" terms.

RETURNS

SET TEMPBn <value> <n/>

n - the module position or serial number
value - the current setting
nl - end of line.

EXAMPLE

To verify the the temperature offset setting for the module serial number 253,

Type: LIST o 253<CR>

The RAD4000 will return:

SET TEMPB253 -259.7403

The offset settings may also be verified by module location. To verify the temperature offset setting of the module connected to input 6,

Type: LIST o 6<CR>

The RAD4000 will return:

SET TEMPB6 -259.7403

The temperature offset settings may be verified for all modules connected to the RAD4000.

Type: LIST o<CR>

The RAD4000 may return:

SET TEMPB1 -259.740234
SET TEMPB2 -259.7403
SET TEMPB3 -259.7403
SET TEMPB4 -259.7403
SET TEMPB5 -259.7403
SET TEMPB6 -259.7403
SET TEMPB7 -259.7403
SET TEMPB8 -259.7403
>

COMMAND SYNTAX	LIST PROFILE LIST SETTINGS LIST P <CR>
ARGUMENTS	None
DESCRIPTION	Lists the Installed module serial numbers from the Serial Number Profile Group, Group P. These data are used to create Module Profile Files that will hold module specific configuration variables.
RETURNS	<pre>SET RAD4000SN <value> <n/ > SET SN1 <value> <n/ > SET SN2 <value> <n/ > : : : : SET SN8 <value> <n/ ></pre> <p>value - the serial number of the module installed at that location nl - end of line.</p>
EXAMPLE	<p>To Verify the module input configuration</p> <p style="padding-left: 40px;">Type: LIST p<CR></p> <p>The RAD4000 may return:</p> <pre style="padding-left: 40px;">SET RADSN 104 SET SN1 253 SET SN2 0 SET SN3 0 SET SN4 0 SET SN5 0 SET SN6 0 SET SN7 0 SET SN8 0 ></pre>
NOTE:	If a module is not detected at boot up, during a RESTART, or after a LIST SYS U command, the software will use the last known configuration.

COMMAND	LIST SCAN VARIABLES
SYNTAX	LIST S <CR>
ARGUMENTS	None
DESCRIPTION	Lists the General Scan configuration variables from Group S.
RETURNS	<pre> SET <variable> <value> <nl> SET <variable> <value> <nl> : : : : SET <variable> <value> <nl> variable - the configuration variable name value - the current setting nl - end of line. </pre>
EXAMPLE	<p>This command is used to verify the general scan settings of the RAD4000</p> <p style="padding-left: 40px;">Type: LIST s<CR></p> <p>The RAD4000 will return:</p> <pre> SET PERIOD 500 SET ADTRIG 0 SET SCANTRIG 0 SET PAGE 0 SET QPKTS 0 SET BINADDR 0 0.0.0.0 SET IFC 62 0 SET TIMESTAMP 1 SET FM 1 SET TEMPPOLL 1 > </pre>

COMMAND
SYNTAX

LIST SCAN GROUP VARIABLES
LIST SG <group><CR>

ARGUMENTS

<group> - The number 1 for the only active scan group

DESCRIPTION

Lists the Scan Group configuration variables from Group G1.

RETURNS

```
SET <variable> <value> <nl>
SET <variable> <value> <nl>
  : : : :
SET <variable> <value> <nl>
variable      - the configuration variable name
value         - the current setting
nl            - end of line.
```

If no channels are assigned to a scan group, the following will be returned for a channel variable:

```
SET CHAN< scan group >0<nl>
```

For more information, refer to the CHAN Scan Variable in the SG Group

EXAMPLE

To verify or modify the configuration settings of Scan Group 1,

```
Type: LIST SG 1<CR>
```

A typical RAD4000 with a 32 channel module will return:

```
SET AVG1 100
SET FPS1 0
SET SGENABLE1 1
SET CHAN1 1-1..1-32
>
```

NOTE

When the SET CHANn parameter is modified, it must be set to 0 before the new channel configuration is entered. If not, the new configuration will be appended to the existing configuration.

For example: if a 64 channel module is assigned to Scan Group 1, the SET CHAN variable will be:1-1..1-64, If the module is changed to a 32 channel module and the channel assignment is not set to 0 before the new assignment: 1-1..1-32 is added, the channel assignment will appear as follows:

```
SET CHAN1 1-1..1-64
SET CHAN1 1-1..1-32
```

This also applies in cases where a user has software to configure the scan groups prior to a test. If a scan group has channels defined and the channels are defined again without setting the channels to 0 first, the channel assignment will appear twice. If Scan Group 1 has a 32 channel module assigned and it is re-assigned by an initialization program, the channel assignments will appear as follows:

```
SET CHAN1 1-1..1-32
SET CHAN1 1-1..1-32
```

COMMAND
SYNTAX

LIST SYSTEM COMPONENTS
LIST SYS [<U>] <CR>

ARGUMENTS

blank - the existing system information, as determined at power up, will be displayed. No data will be updated.
<U> - the system information will be updated and displayed.

DESCRIPTION

Lists the system information. This is the same information displayed at power up. This command must be run when system changes are made after power up.

RETURNS

RAD4000 Serial Number N
LOC A2DSN -MODEL- -SN- CHAN VALVE -NPR1- -NPR2- XDUCER -CAL-DATE-
1
2
3
4
5
6
7
8
LOC -MODEL- -SN- CHAN DESCRIPTION
9
10
11
12
13
14
15
16

NOTE

Positions 1 through 8 are reserved for A/D modules. Positions 9 through 16 are reserved for RDS modules. All positions do not have to be filled. The positions are identified by the setting of the dip switches on the A/D and RDS modules. The first RDS module must always be identified as position 9. If the first RDS is installed in a position other than 9, the DOUT commands will not function. Also, an error will be returned at bootup and after a LIST SYS command.

EXAMPLE 1 To view the current System Information as determined at power up:

Type: LIST SYS<CR>

The RAD4000 will return:

RAD4000 Serial Number 103

LOC	A2DSN	-MODEL-	-SN-	CHAN	VALVE	-NPR1-	-NPR2-	XDUCER	-CAL-DATE-
1	111	ZOC33	300	64	X1	15.00	15.00	DIF	8/16/2009

2 110

3

4

5

6

7

8

LOC	-MODEL-	-SN-	CHAN	DESCRIPTION
9	RDS	103	8	REMOTE DIGITAL SWITCH [DOUT 1-8]

10

11

12

13

14

15

16

The RADBASE4000 is Serial number 103. It has two RAD A/D 3200 modules connected.

RAD A/D3200 Sn 111 is installed in Location 1, ZOC33 Sn 300 is connected to this A/D module. The ZOC33 has 64 channels. It is not duplexed. The Full Scale pressure range of the module is 15.00 psi. The module is set up as a normal Differential Pressure Module. It was last calibrated August 16, 2009.

RAD A/D3200 Sn 110 is installed in location 2. If a ZOC module is connected to this A/D, it does not have an ID Chip installed, or the ID Chip is not responding.

RDS3200 Sn 103 is installed in location 9. The DOUT commands will function correctly.

EXAMPLE 2 If the first RDS module is not installed in position 9, the data return will appear as follows:

RAD4000 Serial Number 103

LOC A2DSN -MODEL- -SN- CHAN VALVE -NPR1- -NPR2- XDUCER -CAL-DATE-

1 111 ZOC33 300 64 X1 15.00 15.00 DIF 8/16/2009

2 110

3

4

5

6

7

8

LOC -MODEL- -SN- CHAN DESCRIPTION

9

10 RDS 103 8 REMOTE DIGITAL SWITCH [DOUT 9-16]

11

12

13

14

15

16

WARNING: No RDS present at location 9

COMMAND SYNTAX	PURGE PURGE <CR>
ARGUMENTS	None
DESCRIPTION	<p>Commands the RAD4000 to initiate a purge sequence. This command may be initiated by entering the command from the local system computer or a host computer. The RAD4000 must be in the READY mode. The purge sequence is:</p> <ol style="list-style-type: none"> 1. The digital output are set according to the DOUTPGSEQ variable. 2. The output remain set for a delay time set by the DLYPGSEQ variable. 3. When DLYPGSEQ times out, the digital output are set according to the DOUTPG variable. 4. The digital output will remain set until the DLYPG variable is met or until a STOP command is issued. 5. When DLYPG times out or when a STOP command is received the digital output are set according to the DOUTPGSEQ variable. 6. The output remain set for a delay time set by the DLYPGSEQ variable. 7. When DLYPGSEQ times out, the RAD4000 returns to the READY mode. <p>When a purge is initiated by a digital input, the RAD4000 may be in the READY mode or in the SCAN mode. The purge sequence is the same as above unless the RAD4000 is in the SCAN mode. If the RAD4000 is in the SCAN mode, the scanning will be suspended until the purge sequence is completed. At that time scanning will be resumed.</p>
RETURNS	<p><n/>
nl - End of line.</p>
EXAMPLE	<p>To initiate a PURGE sequence: Type: PURGE<CR></p>

COMMAND	REBOOT
SYNTAX	REBOOT <CR>
ARGUMENTS	None
DESCRIPTION	Commands the software to restart the RAD4000.hex program.
RETURNS	<n/> nl End of line.
EXAMPLE	To initiate a Reboot sequence, Type: REBOOT<CR>

COMMAND	RESET SEQUENCE NUMBER
SYNTAX	RSTSEQ [<Sequence Start>] <CR>
ARGUMENTS	blank - the sequence number will be reset to 0000. <Sequence Start> - the sequence number will be reset to the number entered.
DESCRIPTION	Resets the sequence number used to complete the file name when network Attached Storage (NAS) is enabled.
RETURNS	<n/> nl - End of line.
EXAMPLE	To reset the Sequence Number to 0000, Enter: RSTSEQ <CR>
	To reset the Sequence Number to 0100, Enter RSTSEQ 100 <CR>
NOTE	This command is only active when NAS is enabled

COMMAND	RESTART
SYNTAX	RESTART <CR>
ARGUMENTS	None
DESCRIPTION	Commands the software to restart the RAD4000.exe program.
RETURNS	<n/> nl - End of line.
EXAMPLE	To initiate a Restart sequence, Type: RESTART<CR>

COMMAND	SAVE
SYNTAX	SAVE [<file name>]<CR>
ARGUMENTS	file name - Optional - All configuration parameters will be saved to this file.
DESCRIPTION	<p>Commands the RAD4000 to save the configuration variables, and correction tables to disk.</p> <p>If the optional file is not specified, data are saved to a file named cv.gpf on the RAD4000 Hard Disk Drive.</p> <p>If the optional file is specified, data are saved to that file in the current RAD4000 folder unless a different path is specified.</p>
RETURNS	<p><n/></p> <p>nl - End of line.</p>
EXAMPLES	<p>To save the current configuration variable settings and conversion coefficients without specifying a file,</p> <p style="padding-left: 40px;">Type: SAVE<CR></p> <p>To save the current configuration variable settings and conversion coefficients to a specific file,</p> <p style="padding-left: 40px;">Type: SAVE config.txt<CR></p>
NOTE	A SAVE command requires approximately 20 seconds to complete its execution

COMMAND SYNTAX	SAVE BOOT LOADER VARIABLES SAVEIP<CR>
ARGUMENTS	None
DESCRIPTION	<p>Commands the RAD4000 to save the boot loader configuration variables to the Micro SD Card. Boot loader configuration variables are saved to the ip.cfg file.</p> <p>The SAVEIP write process requires two commands to complete.</p> <ol style="list-style-type: none"> 1, The SAVEIP command stages the IP configuration variables and prepares the software to write to the Micro SD Card. This command does not actually perform the write. 2. The write process does not occur until a SAVEIPCONFIRM command is issued. The SAVEIPCONFIRM command is considered to be part of the SAVEIP command.
EXAMPLE	<p>To save the current bootloader configuration variable settings</p> <p style="padding-left: 40px;">Type: SAVEIP<CR></p> <p>The software will return the following message:</p> <p style="padding-left: 40px;">WARNING: This action could cause network communication problems. Type SAVEIPCONFIRM confirm SAVEIP or STOP to cancel the operation.</p> <p>Type SAVEIPCONFIRM to complete the SAVE.</p>
NOTE 1	Changes to the bootloader configuration variables will not take effect until power is cycled, or a REBOOT command is issued.
NOTE 2	The SAVEIP command requires approximately 60 seconds to complete. Normally, commands entered during this time would be ignored, but it is possible on rare occasions to cause the enclosure firmware to freeze..

COMMAND	SAVE NETWORK ATTACHED STORAGE VARIABLES
SYNTAX	SAVENAS<CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to save the Network Attached Storage (NAS) configuration variables to the Micro SD Card. NAS configuration variables are saved to the nas.cfg file.
EXAMPLE	To save the current NAS configuration variable settings Type: SAVENAS<CR>
NOTE	Changes to the NAS configuration variables are not saved during a execution SAVE or SAVEIP command.

COMMAND SYNTAX	SCAN SCAN <CR>
ARGUMENTS	None
DESCRIPTION	<p>Commands the RAD4000 to scan the pressure sensors and output scan data. The SCAN function operation depends on the setting of ADTRIG and SCANTRIG.</p> <p>The SCAN function is only active in the Network mode.</p> <p>ADTRIG = 0 SCANTRIG = 0</p> <p>The SCAN function will be initiated immediately when the SCAN command is received. Data will be acquired at the rate determined by the settings of PERIOD, AVGN and the Number of Channels in the modules being scanned. Data will be output in Averaged Frames as the Frames are ready until FPS is satisfied or a STOP Command is received.</p> <p>ADTRIG = 0 SCANTRIG = 1</p> <p>In this case, a hardware trigger will initiate the SCAN function. The Software trigger will not initiate the SCAN function. Data will be acquired at the rate determined by the settings of PERIOD, AVGN and the Number of Channels in the modules being scanned. Scanning will continue until FPS is satisfied or a STOP command is received. Multiple trigger pulses received during a scan will be ignored.</p> <p>ADTRIG = 1 SCANTRIG = 0</p> <p>In this case, the SCAN command only enables the scan function. The RAD4000 will enter the WTRIG mode and wait for a hardware or software trigger. When a trigger is received, the RAD4000 will acquire and output one averaged frame of data and re-enter the WTRIG mode. Data will be acquired at the rate determined by the settings of PERIOD, AVGN and the Number of Channels in the modules being scanned. Multiple trigger pulses received during a scan will be ignored. When a Frame has been output, the next trigger will repeat the process. This will continue until the Frames per Scan Variable has been satisfied or a STOP command is received.</p>
RETURNS	<p>The format of the returned data is based on the setting of the BIN configuration variable. If BIN is set to 1 the Scan Packets are returned in Binary Format(Refer to the section on Binary Data Packets for more information). If BIN is set to 0, the scan packets are returned in ASCII Format as follows:</p> <pre> <group> <frame> <channel> <pressure> <nl> <group> <frame> <channel> <pressure> <nl> :: :: :: :: :: <group> <frame> <channel> <pressure> <nl> </pre> <p>group - the scan group number from 1 to 8 frame - the current frame number channel - the channel in module-port format pressure - the pressure in either counts or real number format based on the setting of the EU configuration variable. nl - end of line.</p>

EXAMPLE

A scan group is set up to display 16 channels of module 1 with fps set to 1

Type: SCAN<CR>

The RAD4000 returns:

Group=1 Frame=0000001

101= 0.0052	102= .0086	103= -0.0015	104= 0.0017	105= -0.0162	106= 0.0035
107= 0.0036	108= 0.0114	109= 0.0031	110= 0.0073	111= 0.0111	112= -0.0035
113= 0.0057	114= 0.0097	115= 0.0049	116= 0.0086		

NOTES

1. Only channels that are listed with the LIST SGn command are returned.
The field length is not fixed. Scan Groups are returned as they are ready.
2. All frames are separate parsable frames.
3. The RAD4000.exe console window will display up to 512 channels from a Scan Group.
4. If ADTRIG is set to 1, SCANTRIG must be set to 0. If SCANTRIG is set to 1, ADTRIG must be set to 0.

COMMAND	SET
SYNTAX	SET <name> <value><CR>
ARGUMENTS	<name> - the Configuration Variable to be set or modified. <value> - the value to be assigned to that Configuration Variable.
DESCRIPTION	Commands the RAD4000 to set one of the Configuration Variables. When Configuration Variables are listed with the LIST command, the variables are output in the format required by the SET command. This enables the user to upload the data from a file that has been created by a LIST download.
RETURNS	<n/> nl - end of line.
EXAMPLE	This command will change configuration variable settings. To set zero correction on Type: SET ZC 1<CR> To change the pressure units to Pascals Type: SET UNITSCAN PA<CR> To change the scan channels in Scan Group 2 from module 2, channels 1 through 64, to module 1, channels 1 through 16: Type: SET CHAN2 0<CR> SET CHAN2 1-1..1-16<CR>

COMMAND SYNTAX	SLOTS SLOTS <channel><CR>
ARGUMENTS	<channel> - The channel in module-port format
DESCRIPTION	Queries the RAD4000 to return the 10 boundary pressures for the 9 pressure slots defined for a given channel.
RETURNS	Press 9 <pressure> <nl> Press 8 <pressure> <nl> Press 7 <pressure> <nl> Press 6 <pressure> <nl> Press 5 <pressure> <nl> Press 4 <pressure> <nl> Press 3 <pressure> <nl> Press 2 <pressure> <nl> Press 1 <pressure> <nl> Press 0 <pressure> <nl>
EXAMPLE	<p>To determine the boundary pressures for channel 1 of the 5 psi module s/n 253</p> <p style="padding-left: 40px;">Type: SLOTS 253-1<CR></p> <p>The RAD4000 will return:</p> <p style="padding-left: 40px;">Press 9 6.10000 Press 8 4.88000 Press 7 3.66000 Press 6 2.44000 Press 5 1.22000 Press 4 0.00000 Press 3 -1.52500 Press 2 -3.05000 Press 1 -4.57500 Press 0 -6.10000</p> <p>The pressures applied during a calibration must be selected so that there are not two or more applied pressures in any slot. The module in the example above has been set up with 4 negative points. By default, it will have 4 positive points as a calibration must always include a zero point.</p> <p>In this example, the slots for channel 1 of a 15 psi module in input 2 is configured for 2 negative points</p> <p style="padding-left: 40px;">Type SLOTS 2-1<CR></p> <p>The RAD4000 will return:</p> <p style="padding-left: 40px;">Press 9 15.00000 Press 8 12.85714 Press 7 10.71429 Press 6 8.57143 Press 5 6.42857 Press 4 4.28572 Press 3 2.14286 Press 2 0.00000 Press 1 -7.50000 Press 0 -15.00000</p>

COMMAND SYNTAX	STATUS STATUS <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to return the current status.
RETURNS	<p>STATUS: <current status><nl></p> <p>Current status: one of the following:</p> <p>READY The RAD4000 is ready to accept any command.</p> <p>SCAN The RAD4000 is in the SCAN mode. The only commands that will be accepted are STATUS or STOP.</p> <p>CALZ The RAD4000 is executing a CALIBRATE ZERO command. The only commands that will be accepted are STATUS or STOP.</p> <p>IDPWRITE The RAD4000 is writing to the ID chip. The only commands that will be accepted are IDPCONFIRM and STOP. No other commands will be accepted.</p> <p>INVALID The command entered is not a valid command for the current mode of operation.</p> <p>FDISK The RAD4000 is re-formatting the Micro SD Card.</p> <p>SAVE The RAD4000 is saving the application configuration variables and MPF files.</p> <p>SAVEIP The RAD4000 is saving the Boot Loader IP configuration variables.</p> <p>PURGE The RAD4000 is in the PURGE mode</p> <p>CAL The RAD4000 is acquiring data for calibration</p> <p>nl end of line.</p>

EXAMPLE The STATUS command may be entered at any time. This is one of the commands that will not generate an error if entered while the RAD4000 is not READY.

If the STATUS command is entered while the RAD4000 is on, but inactive, the RAD4000 will return:

 STATUS: READY

If the STATUS command is entered while the RAD4000 is executing a Calibrate Zero command, the RAD4000 will return:

 STATUS: CALZ

COMMAND SYNTAX	STOP STOP <CR>
ARGUMENTS	None
DESCRIPTION	Commands the RAD4000 to abort the current operation and return to the READY mode.
RETURNS	<i><n/</i> nl - end of line.
EXAMPLE	To abort any function or operation: Type: STOP<CR>

COMMAND SYNTAX **TEMPERATURE**
TEMP <units><CR>

ARGUMENTS *units* - May be one of the following:
RAW - Returns the temperature in raw counts.
EU - Returns the temperature in Engineering Units

DESCRIPTION Lists the current temperatures of all 8 modules. If a module is not connected, the returned temperature will be 0

RETURNS TEMP: 1 <temp> <n|>
TEMP: 2 <temp> <n|>
: : :
TEMP: 8 <temp> <n|>
temp - The module temperature in raw counts or engineering units
n|> - End of line.

EXAMPLE To view the current temperatures of the modules connected to the RAD4000
Type: TEMP EU<CR>

The RAD4000 will return:
TEMP: 1 28.00
TEMP: 2 105.75
TEMP: 3 00.00
TEMP: 4 00.00
TEMP: 5 00.00
TEMP: 6 00.00
TEMP: 7 00.00
TEMP: 8 00.00

To view the A/D counts of the temperature inputs
Type: TEMP RAW<CR>

The RAD4000 will return:
TEMP: 1 12551
TEMP: 2 32767
TEMP: 3 0
TEMP: 4 0
TEMP: 5 0
TEMP: 6 0
TEMP: 7 0
TEMP: 8 0

NOTE A counts reading of 32767 indicates an open input. A counts reading of 0 with an engineering unit reading of 0 indicates that the module is not enabled.

COMMAND
SYNTAX

TEMPERATURE GRAD4000IENT COMPENSATION
TGRAD<CR>

ARGUMENTS

none

DESCRIPTION

This command reads the temperature of the A/D modules and stores this information in a table. This table is then used to estimate the A/D module temperatures during a scan based on the temperature of the RAD4000BASE.

RETURNS

<Location> <RAD4000Base Temp> <A/D Temp> <Delta Temp> <n/>
Location - A/D Location, 1 through 8
RAD4000Base Temp - Measured Temperature of the RAD4000Base in degrees C
A/D Temp - Measured Temperature of the RAD4000 A/D Module in this location.
Delta Temp - The calculated Temperature differential for the A/D Module in this location.
nl - End of line.

NOTE

The RAD4000 software can only read the temperature of the RAD4000BASE when in the scan mode. The temperature of the A/D modules connected to the RAD4000BASE can be estimated based on the gRAD4000ient calculation derived from the table generated by this command.

EXAMPLE

A RAD4000Base has two A/D modules connected. To calculate and store the temperature differential for these modules, Type:

TGRAD4000<enter>

The RAD4000 software will calculate the differential temperatures and return:

```
Loc 1 Base 33.187500 Temp 28.562500 Delta -4.625000  
Loc 2 Base 33.187500 Temp 27.750000 Delta -5.437500  
Loc 3 Base 33.187500 Temp 0.000000 Delta -33.187500  
Loc 4 Base 33.187500 Temp 0.000000 Delta -33.187500  
Loc 5 Base 33.187500 Temp 0.000000 Delta -33.187500  
Loc 6 Base 33.187500 Temp 0.000000 Delta -33.187500  
Loc 7 Base 33.187500 Temp 0.000000 Delta -33.187500  
Loc 8 Base 33.187500 Temp 0.000000 Delta -33.187500
```


COMMAND	TIME AVAILABILITY TEST
SYNTAX	TIME <CR>
ARGUMENTS	None
DESCRIPTION	This command tests the Network Time Protocol (NTP) Server specified in the IPNTP configuration variable. If a Time can be retrieved, it will be returned.. If the Time Server cannot be found, an error is returned
RETURNS	The Time, if The Time Server can be found,or an Error, if the Time Server cannot be found Time in the format: YYYYMMDD HHMMSS Where: YYYY is the year MM is the month (1 to 12) DD is the day (1 to 7) HH is the hour in 24 hour format MM is the minute SS is the seconds Error The message: ERROR: Time Server cannot be found <n/>> nl - End of line.
NOTE	This command is only active if NTP is enabled

COMMAND	VERSION
SYNTAX	VER <CR>
ARGUMENTS	none
DESCRIPTION	Requests the version number of the Rad4000.hex file.
RETURNS	VERSION: <i><version string></i> <i><nl></i>
EXAMPLE	To determine the version of Rad4000.hex software in use: Type: VER<CR> The RAD4000 will return: VERSION: 1.04

COMMAND **ZERO**
SYNTAX **ZERO <module><CR>**

ARGUMENTS <module> -the module position 1 through 8 or the serial number.

DESCRIPTION Lists the active zero correction values obtained from a CALIBRATE ZERO command. These data are used in the conversion of raw counts to Engineering Units (EU). These values may only be set by executing a CALIBRATE ZERO. If a module number is not entered, the ZERO values for all modules are listed.

RETURNS ZERO: <channel> <value> <n/>

ZERO: <channel> <value> <n/>

 : : : :

ZERO: <channel> <value> <n/>

channel - the channel in module-port or serial number-port format

value - the zero correction values

nl - end of line.

EXAMPLE To view the current zeros for module 1

 Type: ZERO 1<CR>

 The RAD4000 will return:

 ZERO: 1-1 160

 ZERO: 1-2 165

 ZERO: 1-3 68

 ZERO: 1-4 131

 ZERO: 1-5 41

 ZERO: 1-6 162

 ZERO: 1-7 145

 ZERO: 1-8 233

 ZERO: 1-9 158

 :: :: :: ::

 :: :: :: ::

 ZERO: 1-28 96

 ZERO: 1-29 19

 ZERO: 1-30 134

 ZERO: 1-31 132

 ZERO: 1-32 238

NOTE If a module number is not entered, the zero values for all enabled modules will be returned.

RAD4000 CONFIGURATION VARIABLES

GENERAL SCAN VARIABLES (Group S)

VARIABLE	ADTRIG <code>
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	This variable determines the method for a Frame Trigger. 0 - Frame timing is controlled by an internal timer set by PERIOD. 1 - Frame timing is controlled by an external hardware or a software trigger. When ADTRIG is enabled, a frame will be triggered whenever a hardware or software trigger input is received. The hardware trigger is a hard wired input to the power input connector. The Software trigger is a TAB, or Ctrl I, character. When a SCAN command is received, the RAD4000 enters a WAIT state until a trigger pulse is received. At that time, the RAD4000 will acquire and output one averaged frame of data then re-enter the WAIT state. This will continue until a STOP command is received or the FPS variable is satisfied. Multiple trigger pulses received during a scan will be ignored.
NOTE	If ADTRIG is set to 1, SCANTRIG must be set to 0.

VARIABLE	BINADDR <port> <IP address>
VALID VALUES	port - 0 to 65535 IP address - any valid IP address
DEFAULT VALUE	port - 0 IP address - 0.0.0.0
DATA TYPE	integer
DESCRIPTION	When port is set to 0, data are NOT sent out over the binary address port, Data are sent over the standard TCP port. If port is 0 to 65535, data are sent over that port to the IP address identified in a UDP format.

VARIABLE	IFC <char 1> <char 2>
VALID VALUES	char 1 - Any valid ASCII character char 2 - Any valid ASCII character
DEFAULT VALUE	char 1 - 62 char 2 - 0
DATA TYPE	integer
DESCRIPTION	This variable sets the interframe characters to be used when transmitting ASCII unformatted output. If only one character is desired, char 2 must be set to 0. If both characters are set to 0, no interframe characters will be transmitted.
EXAMPLE	If a Carriage Return is desired between frames, the following command would be used: SET IFC 13 0

VARIABLE **PERIOD <period>**
VALID VALUES 20 to 65535
DEFAULT VALUE 500
DATA TYPE integer
DESCRIPTION This master period variable sets the sample rate, in microseconds, of the pressure A/D converters and the one temperature A/D converter. Period is the dwell time between channels. Period is only one of the terms required to determine data rate. Data rate is determined by the equation:

$$DataRate = \frac{1}{Period \times Channels \times AVG}$$

Data Rate is expressed in Hertz per channel
Period is in microseconds
Channels is the number of channels in the largest module enabled
AVG is the average term for that scan group

VARIABLE **SCANTRIG <code>**
VALID VALUES 0, or 1
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Controls scan initiation.
0 - Scanning is initiated by the SCAN command.
1 - Scanning is initiated by an external hardware trigger. When SCANTRIG is enabled, a scan will be initiated whenever a hardware trigger input is received. The hardware trigger is a hard wired input to the power cable. The scan function will continue until the Frames per Scan variable is satisfied or a STOP command is received. Multiple trigger pulses received during a scan will be ignored.

NOTES If SCANTRIG is set to 1, ADTRIG must be set to 0.
A Software Trigger will not initiate the SCAN function.

VARIABLE **FM <code>**
DEFAULT VALUE 1
DATA TYPE integer
NOTE **This variable is not used in RAD4000 firmware. It is a place holder only.**

VARIABLE **PAGE <code>**
DEFAULT VALUE 1
DATA TYPE integer
NOTE **This variable is not used in RAD4000 firmware. It is a place holder only.**

VARIABLE **QPKTS <code>**
DEFAULT VALUE 1
DATA TYPE integer
NOTE **This variable is not used in RAD4000 firmware. It is a place holder only.**

VARIABLE **TEMPPOLL <code>**
DEFAULT VALUE 1
DATA TYPE integer
NOTE **This variable is not used in RAD4000 firmware. It is a place holder only.**

VARIABLE	TIMESTAMP <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.

CONVERSION VARIABLES (Group C)

VARIABLE **BIN <code>**
VALID VALUES 0 or 1
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Sets the format of the output data: (Refer to the packet definitions for more information)
 0 - Output is in ASCII
 1 - Output is in binary format

VARIABLE **CALAVG <sample average>**
VALID VALUES 2 to 256
DEFAULT VALUE 64
DATA TYPE integer
DESCRIPTION Sets the calibration sample average. This value should be set to insure that a sufficient number of samples will be acquired to insure a stable, noise free calibration.

VARIABLE **CALPER <period>**
VALID VALUES 50 to 5000
DEFAULT VALUE 500
DATA TYPE integer
DESCRIPTION Sets the period, in microseconds, of the RAD4000 calibration data acquisition. This is the same as PERIOD in the SCAN Group. This value should be set to insure that a sufficient settling time exists so that the channel samples are stable.

NOTE: **For versions 1.00 through 1.03**
 This variable is fixed at 500 microseconds
 For all versions 1.04 and higher
 CALPER will be set automatically to the value set in PERIOD, if PERIOD is 500 microseconds or less. If PERIOD is set to a value greater than 500 microseconds, the value of CALPER will be fixed at 500 microseconds.
 Users will not be able to modify this variable.

VARIABLE **CALZDLY <delay>**
VALID VALUES 5 to 128
DEFAULT VALUE 15
DATA TYPE integer
DESCRIPTION Sets the delay time, in seconds, before the RAD4000 executes a CALZ Command. This value should be set to insure that a sufficient delay exists so that the Zero Offset data are not biased by residual pressure in the module calibration valves.

VARIABLE **CVTUNIT <value>**
VALID VALUES any real number
DEFAULT VALUE 1.0
DATA TYPE float
DESCRIPTION This is the conversion factor to convert from PSI units to the desired scanning units. This value may be set directly or by setting the UNITSCAN variable.

VARIABLE	EU <code>
VALID VALUES	0, 1
DEFAULT VALUE	1
DATA TYPE	integer
DESCRIPTION	Sets the units of the output data: 0 - Output is in raw counts 1 - Output is in selected engineering units

When the A/D counts reach 32767 or -32768, and EU is set to 1, the RAD4000 will output the values set in **MAXEU** and **MINEU** to indicate that a conversion error may exist. The RAD4000 will also output these values when the maximum or minimum master conversion planes are exceeded.

VARIABLE	FILLONE <code>
VALID VALUES	0, 1
DEFAULT VALUE	0
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.

VARIABLE	MAXEU <value>
VALID VALUES	Any valid floating point number
DEFAULT VALUE	9999
DATA TYPE	Floating point
DESCRIPTION	Sets the maximum Engineering Unit Value. This is the number that will be displayed when an overflow condition occurs When the A/D counts reach 32767, and EU is set to 1, the RAD4000 will output 9999 or whatever has been entered as the MAXEU value to indicate that a conversion error may exist. The RAD4000 will also output these values when the maximum or minimum master conversion planes are exceeded.

VARIABLE	MINEU <value>
VALID VALUES	Any valid floating point number
DEFAULT VALUE	-9999
DATA TYPE	Floating point
DESCRIPTION	Sets the minimum Engineering Unit Value. This is the number that will be displayed when an overflow condition occurs When the A/D counts reach -32768, and EU is set to 1, the RAD4000 will output -9999 or whatever has been entered as the MINEU value to indicate that a conversion error may exist. The RAD4000 will also output these values when the maximum or minimum master conversion planes are exceeded.

VARIABLE **MPBS <number of planes>**
 VALID VALUES 0 to 140
 DEFAULT VALUE 0
 DATA TYPE integer
 DESCRIPTION When an INSERT command is issued and a master point is overwritten, a configurable number of temperature planes on either side of the new MASTER plane are converted to calculated. These points will be recalculated when a FILL command is executed. The number of planes to be entered in this variable may be calculated by the formula:

Planes = TEMP * 4 where TEMP is the number of degrees to be changed. For example, if it is desired to have points $\pm 4^\circ$ of the new master plane modified, then MPBS would be set to 16.

VARIABLE **STARTCALZ <code>**
 VALID VALUES 0, 1
 DEFAULT VALUE 0
 DATA TYPE integer
 DESCRIPTION When set to 1, causes the RAD4000 to execute a CALZ at startup. The RAD4000 does not save zeros at power down. If the RAD4000 is set to start scanning immediately or if it is difficult to input commands to the RAD4000 once it is powered up, then this variable should be set to 1. The RAD4000 will then execute a CALZ at the end of the initialization sequence.

VARIABLE **UNITSCAN <units>**
 VALID VALUES see list below
 DEFAULT VALUE PSI
 DATA TYPE string
 DESCRIPTION This sets the output engineering units for the RAD4000. Setting this value will also set CVTUNITS. CVTUNITS may be set to a different value, however UNITSCAN must be set first. The following are the list of units supported:

ATM	FTH2O	KGM2	MH2O	OZFT2
BAR	GCM2	KIPIN2	MMHG	OZIN2
CMHG	INHG	KNM2	MPA	PA
CMH2O	INH2O	KPA	NCM2	PSF
DECIBAR	KGCM2	MBAR	NM2	PSI
				TORR

NOTE If a value other than those listed is entered, The RAD4000 will default to PSI.

VARIABLE **ZC <code>**
 VALID VALUES 0, 1
 DEFAULT VALUE 1
 DATA TYPE integer
 DESCRIPTION Enables or disables zero correction of the pressure data
 0 - No zero correction is performed.
 1 - Zero correction is performed.

DIGITAL OUTPUT CONFIGURATION VARIABLES (Group D)

VARIABLE **DLYPG <value>**
VALID VALUES 0 to 3600
DEFAULT VALUE 10
DATA TYPE integer
DESCRIPTION Sets the time, in seconds, that the module inputs will be purged. This is only a part of the total purge sequence time. This timer can be interrupted by a STOP command. When set to 0, the time is infinite and the PURGE sequence can only be terminated by a STOP command.
When a STOP command interrupts the PURGE sequence, only the DLYPG timer will be interrupted. The software will exit the PURGE sequence by stepping through the DLYPGSEQ settings and timing to prevent possible overpressure of the sensors

VARIABLE **DLYPGSEQ <value>**
VALID VALUES 0 to 60
DEFAULT VALUE 1
DATA TYPE integer
DESCRIPTION Sets the time delay, in seconds, before purge air is applied to the modules. If 0 is entered, no delay will occur.

VARIABLE **DOUTCALZ <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables digital outputs for a **CALZ** operation. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered as 2 hexadecimal digits.

VARIABLE **DOUTPG <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables digital outputs for a **PURGE** sequence. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **DOUTPGSEQ <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables digital outputs to transition from normal operation to **PURGE** operation. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **DOUTPU <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables the digital outputs for normal power up configuration. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **DOUTSCAN <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUES value - 40
DATA TYPE integer
DESCRIPTION value - Enables the digital outputs to indicate that the RAD4000 is in the **SCAN** mode. This variable **ONLY** affects the **DOUT** bit that is enabled. All other outputs are masked.
Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **DOUTREADY <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 80
DATA TYPE integer
DESCRIPTION Enables the digital outputs to indicate that the RAD4000 is in the **READY** mode. This variable **ONLY** affects the **DOUT** bit that is enabled. All other outputs are masked.
Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **BANKA <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables the digital outputs to switch the control pressures in a ZOC22, 23, or 33 to measure the pressures in the Bank A inputs. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE **BANKB <value>**
VALID VALUES 0 to FF Hexadecimal
DEFAULT VALUE 0
DATA TYPE integer
DESCRIPTION Enables the digital outputs to switch the control pressures in a ZOC22, 23, or 33 to measure the pressures in the Bank B inputs in a duplex module. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

VARIABLE	BANKUSR <value>
VALID VALUES	0 to FF Hexadecimal
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Enables the digital outputs to switch the control pressures in a ZOC22, 23, or 33 to a user defined mode. Output 1 is the least significant binary bit. Output 8 is the most significant binary bit. The variable is entered in hexadecimal digits.

SCAN GROUP CONFIGURATION VARIABLES (Group G1 through G8)

VARIABLE	AVG1 <sample average>	Where n = the scan group number
VALID VALUES	1 - 256	
DEFAULT VALUE	16	
DATA TYPE	integer	
DESCRIPTION	Sets the minimum number of samples to average for Scan Group 1. Refer to the CHANn variable for information on averaging of modules with a dissimilar number of channels.	

VARIABLE	CHAN1 <channels>	
VALID VALUES	<channels> - <i>channels</i> is a combination of a <i>module</i> and a <i>port</i> . Syntax is: <i>module-port</i> for one channel <i>module-port,module-port</i> for many channels <i>module-port..module-port</i> for a range of channels <i>Module</i> is the physical location of the module in the rack or the connector supporting the module. <i>Port</i> is a single pressure sample point within a module.	
DEFAULT VALUE	When 0 is entered, no channels are assigned to a scan group. 0	
DATA TYPE	string	
DESCRIPTION	Sets the channel assignments in scan group 1. Duplicate <i>module-port</i> entries are not permitted in the same module group. For example: the notation: CHAN 1-1,1-1 is not valid.	

If a scan group contains ports from dissimilar modules, for example: a 64 port module and a 16 port module, the smaller module will be sampled more often in order to keep the larger module synchronized with the smaller module. The additional samples from the smaller module are averaged. In the previous example the 16 port module will be sampled 4 times for every one sample of the 64 port module.

The order of the channels in the output frame is determined by the order of entry. Use the LIST SG1 command to verify the output frame order.

Setting the channel variable does not automatically erase old channels. The user is responsible to insure that unwanted channels are cleared before new channels are set.

The command :
SET CHAN1 0<enter>
will clear the scan group.

VARIABLE	FPSn <frames>	Where n = the scan group number
VALID VALUES	0 - 2147483648	
DEFAULT VALUE	0	
DATA TYPE	long integer	
DESCRIPTION	Frames per Scan. Sets the number of averaged frames for Scan Group n to be output after a SCAN command is issued. Data will be output at a rate set by the formula below. Averaged frames will be output until the setting of FPS is met. Each Scan group may have a different value of FPS. When set to 0, the scan will continue until a stop command is received.	

$$DataRate = \frac{1}{Period \times Channels \times AVG}$$

Data Rate is expressed in Hertz per channel
 Period is in microseconds
 Channels is the number of channels in the largest module enabled
 AVG is the average term for that scan group

VARIABLE	SGENABLE1 <code>
VALID VALUES	0 or 1
DEFAULT VALUE	1
DATA TYPE	integer
DESCRIPTION	Enables the Scan Group output: 0 - Disabled 1 - Normal Scan Mode Enabled

VARIABLE	SGENABLEn <code>	Where n = 2- 8
VALID VALUES	0 or 1	
DEFAULT VALUE	0	
DATA TYPE	integer	
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.	

VARIABLE	NPRn <pressure>	Where n = the module position number
VALID VALUES	any valid integer up to 4 digits	
DEFAULT VALUE	15	
DATA TYPE	integer	
DESCRIPTION	Defines the nominal pressure range for the module installed in position n.	

VARIABLE	NUMPORTSn <ports>	Where n = the module position number
VALID VALUES	16,32, or 64	
DEFAULT VALUE	64	
DATA TYPE	integer	
DESCRIPTION	Defines the number of ports for the module n.	

VARIABLE	TYPEn <code>	Where n = the module position number
VALID VALUES	0, 1, 2, 3, or 4	
DEFAULT VALUE	0	
DATA TYPE	integer	
DESCRIPTION	This variable defines the module n type:	
	0 - Standard	
	1 - Absolute	
	2 - Gauge	
	3 - True Differential	
	4 - Electrical Input Module	

MODULE PROFILE VARIABLES (Group P)

VARIABLE	RAD4000SN <serial number>
VALID VALUES	Any valid integer up to 4 digits
DEFAULT VALUE	0000
DATA TYPE	Integer
DESCRIPTION	The serial number of the RAD4000.
NOTE	This is a read only variable

VARIABLE	SNn <serial number>	Where n = the module position number
VALID VALUES	Any valid integer up to 4 digits	
DEFAULT VALUE	0000	
DATA TYPE	Integer	
DESCRIPTION	The serial number of the module installed in slot n.	
NOTE	This is a read only variable	

IDENTIFICATION CONFIGURATION VARIABLES (Group I)

VARIABLE	AUX <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	AUXSCHED <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	CAL <code>
DEFAULT VALUE	0
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	CALSCHED <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	CONOUT <code>
DEFAULT VALUE	2
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	DISPIN <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	ECHO <enable>
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	Determines if characters received from the network or the serial host will be echoed back to the host. 0 - Echo is disabled 1 - Echo is enabled
VARIABLE	FORMAT <code>
VALID VALUES	0, or 1
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	Determines if data are to be scrolled on the display. 0 - data are scrolled 1 - data are displayed in place, formatted for a VT100 terminal.

VARIABLE	HAVEARINC <code>
DEFAULT VALUE	0
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	HAVENET <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	IFUSER <code>
VALID VALUES	0 or 1
DEFAULT VALUE	1
DATA TYPE	integer
DESCRIPTION	Determines the method of logging errors. 0 - All errors will be logged. Errors may only be accessed by issuing an ERROR command and cleared by issuing a CLEAR command. 1 - All errors will be displayed as they occur.
VARIABLE	NETIN <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	NETOUT <code>
DEFAULT VALUE	2
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	NL <code>
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Determines the new line character(s) for all output. 0 - <CR><LF> 1 - <CR>
VARIABLE	RESCAN <code>
DEFAULT VALUE	1
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.
VARIABLE	TWOAD <code>
DEFAULT VALUE	0
DATA TYPE	integer
NOTE	This variable is not used in RAD4000 firmware. It is a place holder only.

TEMPERATURE OFFSET VARIABLES (Group O)

VARIABLE	TEMPBn <value> Where n = the module position number
VALID VALUES	any real number
DEFAULT VALUE	-259.7403
DATA TYPE	float
DESCRIPTION	The "B" term in the conversion equation used to convert temperature counts to degrees Celsius. If a module number is not specified, all modules will be displayed. This value is for a Platinum RTD(500Ω at 0°). The conversion formula is:

$$^{\circ}\text{C} = \text{TempM} \times (\text{Counts}) - \text{TempB}$$

TEMPERATURE GAIN VARIABLES (Group G)

VARIABLE	TEMPMn <value> Where n = the module position number
VALID VALUES	any real number
DEFAULT VALUE	0.037058
DATA TYPE	float
DESCRIPTION	The "M" term in the conversion equation used to convert temperature counts to degrees Celsius. If a module number is not specified, all modules will be displayed. This value is for a Platinum RTD(500Ω at 0°). The conversion formula is:

$$^{\circ}\text{C} = \text{TempM} \times (\text{Counts}) - \text{TempB}$$

Some ZOC modules use different RTD's for temperature measurement. The values of TEMPBx and TEMPMx may have to be modified by the user when a different RTD is used. The following table lists the other RTD's that could be installed and the values of TEMPB and TEMPM for each one.

RTD	TEMPB	TEMPM	MODULES
Nickel- Iron 604 Ω at 0°C	-198.514371	0.023559	ZOC16TC (Std.) ZOC22B (Standard) ZOC23B (Standard) DSA3016 (Std.) DSA3216 (Std.)
Platinum 100 Ω at 0°C	-259.740234	0.185290	ZOC22B (Special) ZOC23B (Special) ZOC33 (Special)
Platinum 500 Ω at 0°C	-259.740234	0.037058	ZOC33 (Standard)
Platinum 1000 Ω at 0°C	-259.740234	0.018529	ZOC22B (Special) ZOC23B (Special) ZOC33 (Special)

BOOT LOADER IP CONFIGURATION VARIABLES (Group IP)

This group contains all of the network setup variables. All of these variables may be modified using the boot loader program, the serial connection, or the ethernet connection. Changes to the variables in this group do not take effect until the AC power has been cycled.

Modifications to the variables in this group may result in one or more of the following conditions:

1. Unstable network operation.
2. Problems completing FTP file transfers.
3. Enclosure operational problems

The variables in this group are not saved when a SAVE command is issued. They may only be saved by using the SAVEIP command.

VARIABLE	IPADDR <IP address>
VALID VALUES	IP address any valid IP address
DEFAULT VALUE	191.30.40.xxx Where xxx is the serial number of the RAD4000
DATA TYPE	integer
DESCRIPTION	The IP Address of the module

VARIABLE	SUBNET <Subnet Mask>
VALID VALUES	Subnet Mask any valid Subnet Mask
DEFAULT VALUE	255.255.0.0
DATA TYPE	integer
DESCRIPTION	The Subnet mask for the module. The subnet mask must be configured for the network where the enclosure will be connected.

VARIABLE	MAC <MAC Address>
VALID VALUES	MAC 000.096.093.xxx.yyy.zzz
DEFAULT VALUE	000.096.093.040.000.xxx Where xxx is the serial number of the enclosure
DATA TYPE	integer
DESCRIPTION	The MAC address of the module. The last three octets may be modified by a user, but it is recommended that they not be modified. The first three octets MUST NOT be modified. These octets represent a setting registered to Scanivalve Corp.

VARIABLE	LOGIN <User Name>
VALID VALUES	User Name any valid character string
DEFAULT VALUE	Scanivalve
DATA TYPE	string
DESCRIPTION	The User name for the FTP login

VARIABLE	PASSWORD <Password>
VALID VALUES	Password any valid character string
DEFAULT VALUE	Scanner
DATA TYPE	string
DESCRIPTION	The password associated with the user name for the FTP login

VARIABLE **LOGIN1 <User Name>**
VALID VALUES User Name any valid character string
DEFAULT VALUE Scanivalve1
DATA TYPE string
DESCRIPTION The User name for a second FTP login. The RAD4000 will support two FTP logins.

VARIABLE **PASSWORD1 <Password>**
VALID VALUES Password any valid character string
DEFAULT VALUE Scanner1
DATA TYPE string
DESCRIPTION The password associated with the user name for the second FTP login

VARIABLE **ALLOWANON <code>**
VALID VALUES 0 or 1
DEFAULT VALUE 1
DATA TYPE integer
DESCRIPTION Determines the new line character(s) for all output.
0 Do not allow anonymous FTP logins
1 Allow anonymous FTP logins

VARIABLE **APP <Application>**
VALID VALUES Application any valid Application Name
DEFAULT VALUE Rad4000.hex
DATA TYPE string
DESCRIPTION The file name of the application to run. This is the file name that is used when automatically running the application from the boot loader. It is also the file name used when using the RUN command. If this file is not found, an error is returned.

VARIABLE **GW <IP address>**
VALID VALUES any valid IP address
DEFAULT VALUE 0.0.0.0
DATA TYPE integer
DESCRIPTION This IP address will be used to access the NTP Server if the IPNTP address setting is an IP address outside the RAD Subnet.

NETWORK ATTACHED STORAGE CONFIGURATION VARIABLES (Group NAS)

This group contains the network attached storage configuration variables. All of these variables may be modified using the boot loader program, the serial connection, or the ethernet connection.

Modifications to the variables in this group may result in one or more of the following conditions:

1. Unstable network storage operation.
2. RAD4000 operational problems

The variables in this group are not saved when a SAVE , or SAVEIP command is issued. They may only be saved by using the SAVENAS command.

VARIABLE	ENNAS <Code>
VALID VALUES	0, 1, or 2
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Enables data to the NAS. 0 - Data are not sent to the NAS 1. - Data are sent to the NAS. A sequence number will be used to construct the file name. 2 - Data are sent to the NAS. The time, gathered from Network Time Protocol (NTP), will be used to construct the file name.

VARIABLE	ENNTP <Code>
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	Enables the Network Time Protocol (NTP). 0 - Network Time Protocol is disabled. 1. - Network Time Protocol is enabled.

VARIABLE	FILENAS <Filename>
VALID VALUES	any valid character string
DEFAULT VALUE	Scan
DATA TYPE	string
DESCRIPTION	Sets the data file prefix name.

VARIABLE	IPNAS <IP Address>
VALID VALUES	any valid IP address
DEFAULT VALUE	0.0.0.0
DATA TYPE	integer
DESCRIPTION	The IP Address of the NAS.

VARIABLE	IPNTP <IP Address>
VALID VALUES	Any valid IP address
DEFAULT VALUE	0.0.0.0
DATA TYPE	integer
DESCRIPTION	The IP Address of the NTP Server.

VARIABLE **PASSNAS <Password>**
VALID VALUES Password - any valid character string
DEFAULT VALUE ScannerNas
DATA TYPE string
DESCRIPTION The password associated with the user name for the login to the NAS.

VARIABLE **PATHNAS </Disk/Share>**
VALID VALUES Any valid path to the NAS disk
DEFAULT VALUE /disk1/share
DATA TYPE string
DESCRIPTION Sets the path on the NAS for the data file.

VARIABLE **USERNAS <User Name>**
VALID VALUES User Name any valid character string
DEFAULT VALUE ScanivalveNas
DATA TYPE string
DESCRIPTION The User name for login to the NAS.

VARIABLE **UTCCOFFSET<Offset>**
VALID VALUES any valid number
DEFAULT VALUE 0
DATA TYPE signed integer
DESCRIPTION The time offset from Coordinated Universal Time (UTC).

Network Attached Storage (NAS) Operation

When the variable: ENNAS is set to 1 or 2, all ASCII or BINARY data are directed to the NAS via FTP. Binary files will have the extension: .BIN. ASCII files will have the extension: .TXT.

The setting of ENNAS will determine the construction of the file name.

When ENNAS is set to 1, a sequence number is used to construct the file name.

For Binary (BIN = 1), the file name will be the file name prefix as set by the variable: FILENAS and a sequence number set by the software. The format is:

<file name prefix>_SSSS.BIN

For ASCII (BIN = 0), the file name will be the file name prefix as set by the variable: FILENAS and a sequence number set by the software. The format is:

<file name prefix>_SSSS.TXT

The sequence number is maintained in the RAD4000 and saved to a file named: SSN.CFG. The save to SSN.CFG is automatic and not part of the SAVE command group. This file is maintained on the Micro SD. If this file is not found the sequence will start at 0000.

NAS Setup for use with a RAD4000

When a NAS is used with a RAD4000, it must be set up as a FTP Server. A user must consult the documentation for the NAS being used to insure proper operation.

Local Host Computer Setup as a NAS

A Local/Host computer, such as a Laptop, may be used as a NAS for high speed data storage. In order for the data to be transferred, the computer must be set up as a FTP Server. FTP Server software must be set up and running before a SCAN command is issued. A procedure to install and set up a typical FTP Server software is included in the Special Procedures Section of the Hardware manual.

Scanivalve DSP Boot Loader

The Scanivalve DSP Boot Loader's main function is to allow the user to easily upload the Enclosure 4000 application via FTP. The boot loader runs the FTP server. It has been tested on Fire Fox FTP and Internet Explorer drag and drop.

Any additional file transfer protocols or additional FTP client support modification will be made solely to the application.

FTP

The FTP server supports the following FTP commands prior to login:

USER Allows the user to enter the user's name. Anonymous is allowed.
PASS Allows the user to enter the password.
QUIT Disconnects from the FTP server.

The FTP server supports the following FTP commands prior to login after login:

RETR Initiates a file transfer from the enclosure to the host.
STOR Initiates a file transfer from the host to the enclosure.
PASV Sets up data port so client can connect to server's port.
LIST Returns a directory listing of the files stored on the enclosure
SIZE Returns the size in bytes of the file.
DELE Deletes the file.
NOOP No operation. Mostly used by the client as an "are you still there" command.

Only ASCII type of transfer is supported. Only passive data connection is supported. This allows data to be transferred without the server initiating a connection to the client. This could cause firewall problems.

Boot Loader and Application File System

Filenames are limited to the 8.3 format with no spaces allowed. Only one drive is supported.

Because the Enclosure does not have a time and date clock all files created by the enclosure will have a date of Aug 8, 2008

No subdirectories are supported, however, if a file path is included in the file specification only the file name portion is used. The file is written in the root directory of the drive.

Up to 1024 files are allowed or 2GB of data.

DIP Switch Settings

The processor board has 4 DIP switches that affect the operation of the software. These switches are only read at power up. Changes to the dip switches are not effective until the power is cycled.

- SW 1 When this switch is on automatically boots the application on power up.
- SW 2 When this switch is on the boot loader will run in the debug mode. Debug output is directed to the COM2 serial port.
- SW 3 When this switch is on the boot loader and application uses the COM2 serial port for communication to other devices. When this switch is off the COM2 serial port is used as host communication. COM1 is only used for device communication. COM1 is the top serial connection.
- SW 4 Spare

Host Communication

Commands are issued to the enclosure and response is returned from the enclosure via either the COM1 serial port or the Ethernet connector. The boot loader returns the command information to the host that it received its command. That is, when the command is received from the network it is returned to the network. When it is received from the COM1 serial port it is returned to COM1 serial port.

The network supports TCP/IP connection using Telnet or HyperTerminal

Commands

When a command is completed, the prompt character, the greater than character ">", is output preceded by a carriage return and line feed.

The commands listed below are supported by the boot loader and the executable program, unless otherwise noted. They may be viewed and modified in the ENCL4000 executable program.

- VER Returns the version of the Boot Loader
NOTE: This command is available in the boot loader only. It must not be confused with the VER command in the application
- FORMAT Formats the SD Flash to all 0's
NOTE: This command is available in the boot loader only.
- LIST IP Returns the configuration variable settings of the IP group
- SET <parameter> Sets the indicated parameter
- IPADD <IP address> Sets the IP address of the enclosure. If IPADD is changed, the power must be cycled to take effect.
- SUBNET <mask> Sets the subnet address of the enclosure. If SUBNET is changed, the power must be cycled to take effect.
- MAC <MAC address> Sets the MAC address for the enclosure. If MAC is changed, the power must be cycled to take effect.
NOTE : This variable should not be modified

LOGIN <user name> Sets the user name for FTP login.

PASSWORD <password> Sets the password associated for LOGIN

LOGIN1 <user name> Sets the user name 1 for FTP login.

PASSWORD1 <password> Sets the password associated for LOGIN name1

LOGINNAS <name> Sets the name for login to the NAS. The boot loader does not access the NAS (Network Attached Storage) device. This is place in this group for compatibility with the IP group in the application.

PASSWORDNAS <password> Sets the password associated with LOGINNAS name

IPADDNAS <IP address> Sets the IP address of the NAS

APP <application file name> Sets the file name of the application to run. This is the file name that is used when automatically running the application from the boot loader. It is also the file name used when using the RUN command. When this file is not found the application does not run and an error is returned.

SAVE [<file name>] Saves the configuration variables to the working directory. When an optional file name is entered, it saves the IP group settings to that file name.

TYPE <file name> Lists the contents of the named file.

LOAD <file name> Loads the named file into the LIST IP configuration variables.
NOTE: This command is a debug command.

DIR Lists the files on the SD card.

DEL<file name> Deletes the file name

DIP Reads and shows the settings of the DIP switch. The following is returned:
DIP settings Auto Run Application 0 Debug 0 No Serial Host 0 Spare 0
1 indicates on, 0 indicates off
NOTE: This command is available in the boot loader only.

RUN Runs the application named in the SET APP setting.
NOTE: This command is available in the boot loader only.

RAD4000 Scan Function

When a SCAN function is initiated, the RAD4000 will scan all of the channels in the modules enabled in the software. All modules are scanned in parallel. Each channel in a module will be accessed at the rate set in the configuration variable, PERIOD. Data from each channel are accumulated in a buffer until the AVG term is met. The data from each channel are averaged and then output as a FRAME. This process will continue until the number of frames set in the variable, FPS, have been output, or a STOP command is received. When FPS has been met, or a STOP command received, the Scan function will stop and the RAD4000 will return to the READY mode. If FPS is set to 0(zero), the SCAN function will continue indefinitely until a STOP command is received. A STOP Command may be entered by typing STOP from the Local or remote keyboard, or by pressing the Escape Key on either input.

Two configuration variables, ADTRIG and SCANTRIG, determine how the SCAN function will be implemented.

Internal Trigger

When these variables are set to 0 (disabled), the SCAN function will be controlled by an internal clock trigger. The SCAN function will be initiated by a SCAN command issued from the RAD4000 computer or an external Host computer. Scanning will commence approximately 5 milliseconds after the SCAN command is received. Each Frame will be acquired as soon as the previous Frame acquisition is complete. The SCAN function will remain active until FPS is met or a STOP Command is received.

External Trigger

The RAD4000 SCAN function may be controlled with external triggers. The settings of SCANTRIG and ADTRIG determine how the SCAN function will be initiated and how each Frame will be acquired. ADTRIG and SCANTRIG cannot be enabled at the same time.

When ADTRIG is set to 1(enabled), the SCAN function will be initiated by the SCAN command. The RAD4000 will enter the SCAN mode and wait for a hardware or software trigger. When a trigger is received, the RAD4000 will acquire and output one averaged Frame of data and re-enter the WTRIG mode. Multiple trigger pulses received during a Frame Scan will be ignored. When a frame has been output, the next trigger will repeat the process. This will continue until the Frames per Scan Variable has been satisfied or a STOP command is received. If ADTRIG is set to 1, SCANTRIG must be set to 0.

When SCANTRIG is set to 1(enabled), the SCAN function will be initiated by the DINSCAN digital input. When a hardware trigger is received, the RAD4000 will enter the SCAN mode, acquire and output averaged Frames of data until the Frames per Scan Variable has been satisfied or a STOP command is received. Multiple trigger pulses received after the first trigger will be ignored. When Frames per Scan has been satisfied, the RAD4000 will exit the SCAN mode and return to the READY mode. Another hardware trigger will repeat the process. A software trigger will not initiate this process. If SCANTRIG is set to 1, ADTRIG must be set to 0.

Hardware Trigger

The Hardware Trigger input is optically isolated to prevent grounding problems. It is a TTL level, edge sensing device. It requires a minimum signal of 9 Vdc @ 6.5 mA. It may accept voltages as high as 15 Vdc. The external trigger input is on pins 8 and 9 of the RAD4000 Power input connector.

Software Trigger

The Software Trigger is a <TAB> character, or Ctrl I, or the TRIG command.

RAD4000 Profile File

When the RAD4000.EXE program is started, including a RELOAD or RESTART, a RAD4000 Profile file will be generated. This file is named RAD4000nnn.DPF, where nnn is the serial number of the RAD4000. This file is an ASCII text file and contains the following information:

```
RAD4000 Serial Number: <serial number><CR><LF>
Module Serial Number in Position 1: <module serial number><CR><LF>
Module Serial Number in Position 2: <module serial number><CR><LF>
Module Serial Number in Position 3: <module serial number><CR><LF>
Module Serial Number in Position 4: <module serial number><CR><LF>
Module Serial Number in Position 5: <module serial number><CR><LF>
Module Serial Number in Position 6: <module serial number><CR><LF>
Module Serial Number in Position 7: <module serial number><CR><LF>
Module Serial Number in Position 8: <module serial number><CR><LF>
```

If a RAD4000nnn.DPF file exists when the RAD4000.EXE program starts up, it will be overwritten by the information obtained from the polling of the ID chips.

Module Profile File

Each module has a unique Module Profile File which is created during the initial calibration of the module. This file is updated each time a SAVE command is executed by the RAD4000. These files are read when the RAD4000.EXE program is started, including RELOAD and RESTART.

The information contained in the Module Profile File is:

```
REMN 1 <comment><CR><LF>
REMN 2 <comment><CR><LF>
REMN 3 <comment><CR><LF>
REMN 4 <comment><CR><LF>
SET TYPEn <module type><CR><LF>
SET NUMPORTSn <number of ports><CR><LF>
SET NPRn <Nominal Full Scale Pressure Value><CR><LF>
SET TEMPMn <temperature gain factor><CR><LF>
SET TEMPBn <temperature offset factor><CR><LF>
SET LPRESSn <channels> <pressure><CR><LF>
SET HPRESSn <channels> <pressure><CR><LF>
SET NEGPTSn <channels> <number of negative points><CR><LF>
INSERT <temperature> <channels> <pressure> <pressure counts> M<CR><LF>
INSERT <temperature> <channels> <pressure> <pressure counts> M<CR><LF>
::      ::::      ::      ::      ::::      :  ::  ::
INSERT <temperature> <channels> <pressure> <pressure counts> M<CR><LF>
```

Binary Scan Packets

Packets without Module-Port Information

Byte	Name	Value
0	Binary ID	1 = EU (EU =1) 2 = Raw (EU = 0)
1	Group ID	1 to 8 If Tag Bit is set, 80 Hex will be merged with the Scan Group Number. (81 to 88)
2 and 3	Number of Channels	0 to 512
4 through 7	Frame Number	1 to 2^{32}
8 through 11	Time in milliseconds	0 to 2^{32}
12 through 15	Channel 1 Data	4 bytes per channel
16 through 19	Channel 2 Data *	4 bytes per channel
: : : : :	: : : :	: : : :
(4n + 8) through (4n + 11)	Channel n Data *	4 bytes per channel

* Optional based on Number of Channels setting.

Packets with Module-Port Information

NOTE This packet is not supported in Version 1.00 through 1.04

Byte	Name	Value
0	Binary ID	3 = EU with channels (EU = 1) 4 = Raw with channels (EU = 0)
1	Group ID	1 to 8 If Tag Bit is set, 80 Hex will be merged with the Scan Group Number. (81 to 88)
2 and 3	Number of Channels	0 to 512 (Byte 2 is LSB)
4 through 7	Frame Number	1 to 2^{32}
8 through 11	Time in milliseconds	0 to 2^{32}
12 through 19	Channel 1 Data	Data (4 bytes), Module (2 bytes), Port (2 bytes)
20 through 27	Channel 2 Data *	Data (4 bytes), Module (2 bytes), Port (2 bytes)
: : : : :	: : : :	: : : :
(8n + 4) through (8n + 11)	Channel n Data *	Data (4 bytes), Module (2 bytes), Port (2 bytes)

* Optional based on Number of Channels setting.

When BIN is set to 1 and the BINADDR is set to a value other than zero, the data from the AUX or CAL commands are converted to a BINARY format and output over the UDP binary port specified in the BINADDR variable. The data format is:

- <ID byte> - 1 byte, the value will be 1 if the data are from a calibrator or 2 if the data are from an auxiliary unit.
- <pressure> - 4 bytes of floating point binary pressure data

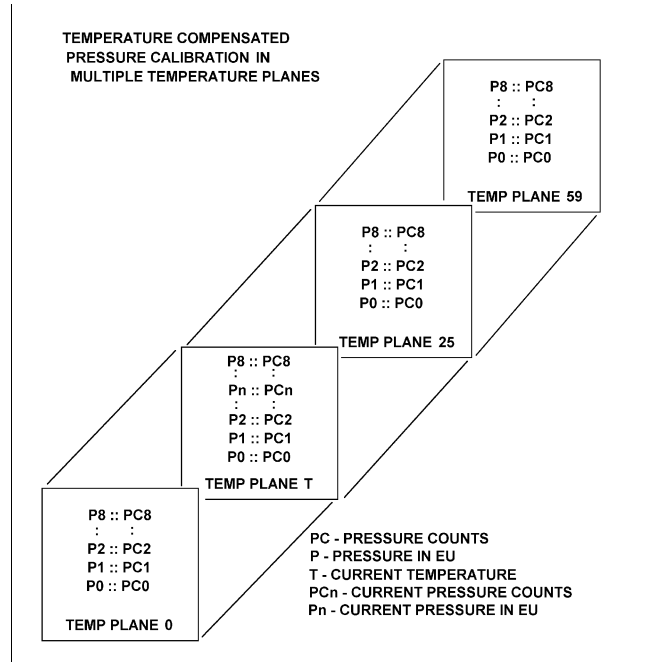
Packets with RAD4000 Serial Number Information

NOTE This packet is not supported in Versions 1.00 through 1.04

Byte	Name	Value
0	Binary ID	8 = EU with channels (EU =1) 9 = Raw with channels (EU = 0)
1	Group ID	1 to 8 If Tag Bit is set, 80 Hex will be merged with the Scan Group Number. (81 to 88)
2 and 3	Number of Channels	0 to 512 (Byte 2 is LSB)
4 and 5	RAD4000 Serial Number	1 to 2 ¹⁶
6 through 9	Frame Number	1 to 2 ³²
10 through 13	Time in milliseconds	0 to 2 ³²
14 through 21	Channel 1 Data	Data (4 bytes), Module (2 bytes), Port (2 bytes)
22 through 29	Channel 2 Data *	Data (4 bytes), Module (2 bytes), Port (2 bytes)
: : : : : :	: : : :	: : : :
(8n + 4) through (8n + 13)	Channel n Data *	Data (4 bytes), Module (2 bytes), Port (2 bytes)

* Optional based on Number of Channels setting.

APPENDIX A - TEMPERATURE COMPENSATED PRESSURE CONVERSION



FORMULAS:

Pressure interpolation within current temperature plane:

$$P_{n_t} = \frac{1}{PC_{1_t} - PC_{0_t}} ((PC_{1_t} - PC_{n_t})P_{0_t} - (PC_{0_t} - PC_{n_t})P_{1_t})$$

Calculation of entries in current temperature plane:

$$P_t = \frac{1}{T_{25} - T_0} ((T_{25} - T)P_{0_0} - (T_0 - T)P_{0_{25}})$$

APPENDIX B - ENGINEERING UNIT CONVERSION CONSTANTS

UNITSCAN Setting	Engineering Unit	PSI to EU 1 psi =	EU to PSI 1 EU =
ATM	Atmospheres	0.068046 A	14.6960 psi
BAR	Bars	0.068947 b	14.5039 psi
CMHG	Centimeter of Mercury	5.17149 cmHg	0.193368 psi
CMH2O	Centimeter of Water	70.308 cmH ₂ O	0.014223 psi
DECIBAR	Decibar	0.68947 db	1.4504 psi
FTH2O	Foot of Water	2.3067 ftH ₂ O	0.43352 psi
GCM2	Gram per square Centimeter	70.306 g/cm ²	0.014224 psi
INHG	Inch of Mercury @ 0°C	2.0360 inHg	0.491159 psi
INH2O	Inch of Water @ 4°C	27.680 inH ₂ O	0.036127 psi
KGCM2	Kilogram per square Centimeter	0.0703070 kg/cm ²	14.2235 psi
KGM2	Kilogram per square Meter	703.069 kg/m ²	0.0014223 psi
KIPIN2	kips per square inch(ksi)	0.001 kip/in ²	1000.0 psi
KNM2	Kilonewton per square Meter	6.89476 kN/m ²	0.145038 psi
KPA	Kilopascal	6.89476 kPa	0.145038 psi
MBAR	Millibar	68.947 mb	0.014504 psi
MH2O	Meter of Water	0.70309 mH ₂ O	1.42229 psi
MMHG	Millimeter of Mercury	51.7149 mmHg	0.0193368 psi
MPA	Megapascal	0.00689476 Mpa	145.038 psi
NCM2	Newton per square Centimeter	0.689476 N/cm ²	1.45038 psi
NM2	Newton per square Meter	6894.76 N/m ²	0.000145038 psi
OZFT2	Ounce per square Foot	2304.00 oz/ft ²	0.000434028 psi
OZIN2	Ounce per square Inch	16.00 in/ft ²	0.062500 psi
PA	Pascal	6894.76 Pa	0.000145038 psi
PSF	Pound per square Foot	144.00 lb/ft ²	0.00694444 psi
TORR	Torr	51.7149 T	0.0193368 psi

APPENDIX C - CHANGE LIST

This section contains change information to assist a user in determining the differences between different versions of software.

Version 1.00 - February 2010

First release.

Version 1.01 - March 2010

Corrected minor bugs in

TGRAD

A2DCALC

IDPWRITE

Version 1.02 - Not Released

Version 1.03 - April 2010

Corrected bugs in the following variables to improve reliability and accuracy.

TGRAD

CALZ

Corrected a bug in the conversion calculation that caused errors near zero

Version 1.04 - June 2010

Corrected a bug in the external frame trigger

Corrected timing issues to insure 625 samples/channel/second

Corrected an error in the data for all channel ones in Frame 1

Added support of MODTEMP

Added support of the ERROR buffer

Added support of IFUSER

Added support of the CLEAR command

Modified the method of setting the value of CALPER