QUAESTA INSTRUMENTS, LLC

Operation Manual and Specifications

NPM3000E

Version: OM_10-2014_v4

Figure 1. NPM3000 with proportional tube

The NPM3000 represents a line of products with a range of features and options. The NPM3000, in general, is a neutron pulse monitor with integrated high voltage supply, neutron pulse counter and multichannel analyzer (MCA) designed to interface directly with He3, BF3 and Borlon-lined proportional tube neutron detectors. It is capable of autonomously counting and analyzing proportional tube signals and producing neutron pulse height spectra. The NPM3000E communicates via an Ethernet interface, is optimized for low power consumption and comes with specialty GUI, PC command-line executables, and file management commands. Optionally, the NPM3000E can count and log an external pulse input as well as produce a TTL output.

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Section 1. Overview and Hardware

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MANUAL REVISION INFORMATION:
The document and version number is listed on the front page. Please make note of these numbers when contacting Quaesta Instruments for customer support.
11-2012, First Release
01-2013,
-Minor typographical errors fixed.
-Added Input Pulse Counter Description and accompanying Specifications.
-Added photograph of device in Section 1.
-Added microSD card description and Specifications.
-Added example output to Info and Status Description.
-Moved comprehensive list of commands to Appendix A.
-Updated Type Command description.
-Added description of how to use Windows Hyperterminal as a terminal interface
-Added Appendix D describing Firmware upgrade procedures.
-Modified Electrical Specifications table to show HV Supply range as 250V to 2000V range. Previous manuals indicated 0V to 2000V.
-Added troubleshooting section, Appendix E.
10-2013,v1
-Added TTL Output Section (A.4)
-Added more details to XPort Device configuration section, Section 6.
-Added Section 7, notes on Configuration of the NPM3000E device.
-Added Section 8, the value of the integrated MCA
-Added Appendix F, NPM3000E 'menu' command output
-Added Appendix G, GUI Application screen captures and descriptions.
10-2013,v2
-Misc format fixes

10-2013,v3
-Fixed List of Tables and List of Figures live links.
10-2014 v4
-Added Extended Gain jumper block information (Appendix H).

General Safety Information

Do not operate the hardware in a manner not specified in this document and in the user documentation. Misuse of the hardware can result in a hazard. You can compromise the safety protection if the hardware is damaged in any way. If the hardware is damaged, return it to Quaesta Instruments for repair or replacement.

Clean the hardware with a soft, nonmetallic brush or cloth. Make sure that the hardware is completely dry and free from contamination before returning it to service.

Input pins (6-pin connector) are protected against electrical power surges, however, the user should never apply voltage outside of the designed input range (see Electrical specifications in Table 2).

HV Warnings

-The hardware has a high voltage output (HN connector) that operates up to 2000V. Never touch the HN Connector's center pin with your hand or other probing device. Never operate the hardware with the high voltage (HV) connector exposed. It is generally understood that HV levels of 70V DC and higher can pose a shock hazard.

-Use an approved connector plug or cap or attach to an approved high voltage proportional tube before turning on or applying power to the device.

-Care should be taken to not short the HN connector center pin (HV) to the HN connector metal housing (GND). This may damage the NPM circuitry.

-The HV level cannot be measured with a standard voltmeter. Contact Quaesta Instruments if there is a need to make direct measurements of the High Voltage. The voltage levels can be queried via NPM firmware commands.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) as stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in its intended operational electromagnetic environment. This product is intended for use in commercial and industrial locations. There is no guarantee that harmful interference will not occur in a particular installation or when the product is connected to a test object. To minimize the potential for the product to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

NPM3000E Device Overview

Features

- Low-noise charge sensitive amplifier
- Internal Pulse Counter counts up to 4 billion counts
- Programmable neutron detection parameters:
  - High voltage output (250V to 2000V†).
  - Gain
  - Lower Discriminator (pulse count trigger level)
  - Upper Discriminator
  - Deadtime (165µsec and longer) – for reduction of multiple-coincidence counting
  - TTL pulse output
- Programmable multichannel analyzer
  - Number of Bins (64, 128, 256, 512, 1024, or 2048 bins) – each bin contains up to 4 billion counts
- Optional Input Pulse Counter (Optional: -C option):
  - Counts up to 4 billion counts.
  - Threshold (Pulse Level Discriminator) – settable from 0 to 4V
- Data logging capability: real-time clock, 2 microSD cards (1 internal, 1 external) for storage
- All programmable parameters are stored in EEPROM
- Signal pulse waveform capture capability
- Bright red LED indicator to indicate pulses counted
- Optional Analog signal monitor pin output (test point). Pulse waveforms can be captured and displayed via a Terminal interface or via the provided GUI application.
- Integrated temperature and relative humidity sensor (optional)
- Programmable and retrievable High Voltage, Gain, and Discriminator settings.
- Ethernet interface. (RS-232, SDI-12 and USB versions available).

- A PC based GUI application is available for product configuration and/or routine use. Simple firmware update procedure allows further customization.

† A 3000V range version of the device is available. Contact the factory to order and discuss application requirements.

Hardware Components (General)

The NPM3000E comprises an anodized aluminum enclosure with input and output connectors on front and rear panels. The device is externally powered and contains the following components:

External

- High voltage output cable (HN connector)
- 6-pin connector (NPM and ethernet power inputs, monitor differential signal input)
- Ethernet connector
- microSD card slot (push-push)
- LED (pulse indicator)
- Optional Pulse Counter Input (LEMO Connector)

Internal

- High voltage source
- Charge sensitive amplifier
- Adjustable gain stage
- Discriminator (upper/lower)
- Pulse counter
- Multichannel analyzer (MCA)
- Real-time clock
- microSD card

Rear Panel

Rear Panel Components

1. microSD push-push device (push to engage/disengage)

2. 6-pin connector (Brand: **Phoenix Contact**):

    a. Header (PCB mount): Model PTSM 0,5/ 6-HH-2, 5-SMD R44. Order No.: 1778803

    b. Plug (external): Model PTSM 0,5/ 6-P-2, 5. Order No.: 1778874

    c. Pin Assignments (see **Error! Reference source not found.**)

6-pin Connector Pin Assignments	
Pin 1	Ethernet power (6 to 18 VDC)
Pin 2	Ethernet power ground
Pin 3	NPM Power (6 to 18 VDC)
Pin 4	NPM power ground
Pin 5	Signal +
Pin 6	Signal -

Table 1. 6-pin connector pin assignments

3. Red LED Pulse indicator (pulse indication can be turned On/Off via mode settings available in the firmware)

4. RJ-45 Ethernet connector

5. Optional External Pulse Counter Input, LEMO Connector HGP.00.250.CTLP

Rear Panel Layout

Figure 2 shows a layout of the rear panel (not to scale).

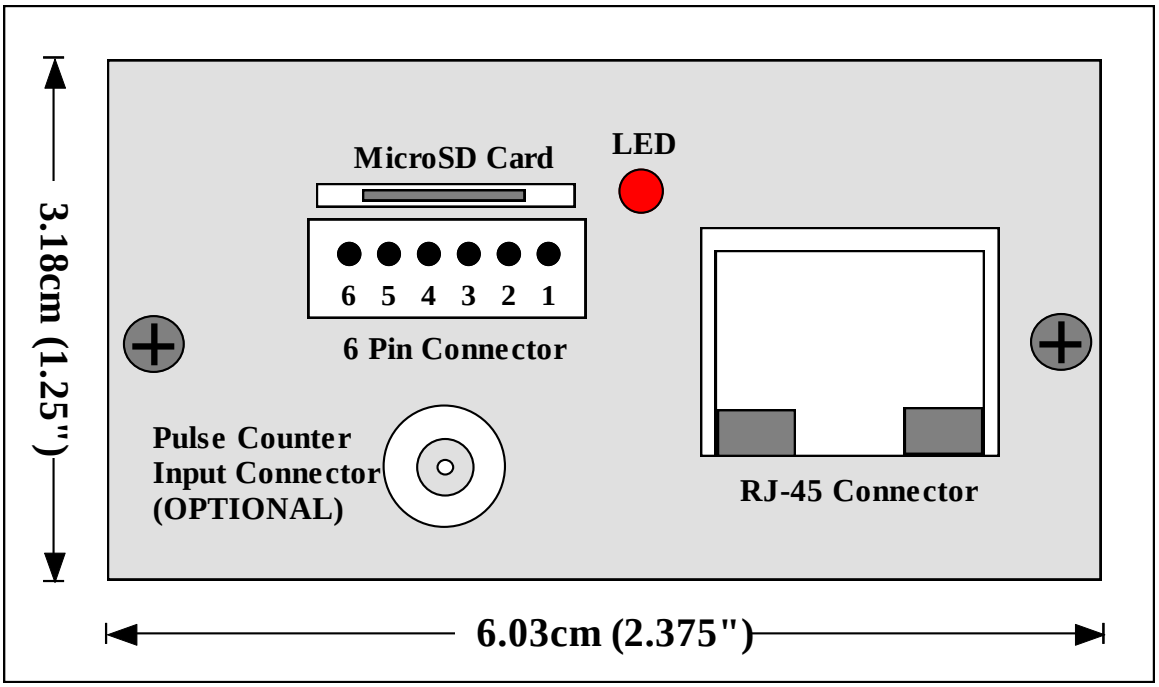


Figure 2. Enclosure rear panel layout

Front Panel

Front Panel Components

1. High voltage cable feedthrough. A pigtail configuration may be terminated with an HV connector as desired. An HN connector is standard.

Front Panel Layout

Figure 3 shows a layout of the front panel (not to scale). This is an end view of the front panel HV cable feedthrough and pigtail end view.

See **Figure 4** for a side view of the NPM3000E device showing the enclosure, HV cable and HN connector pigtail.

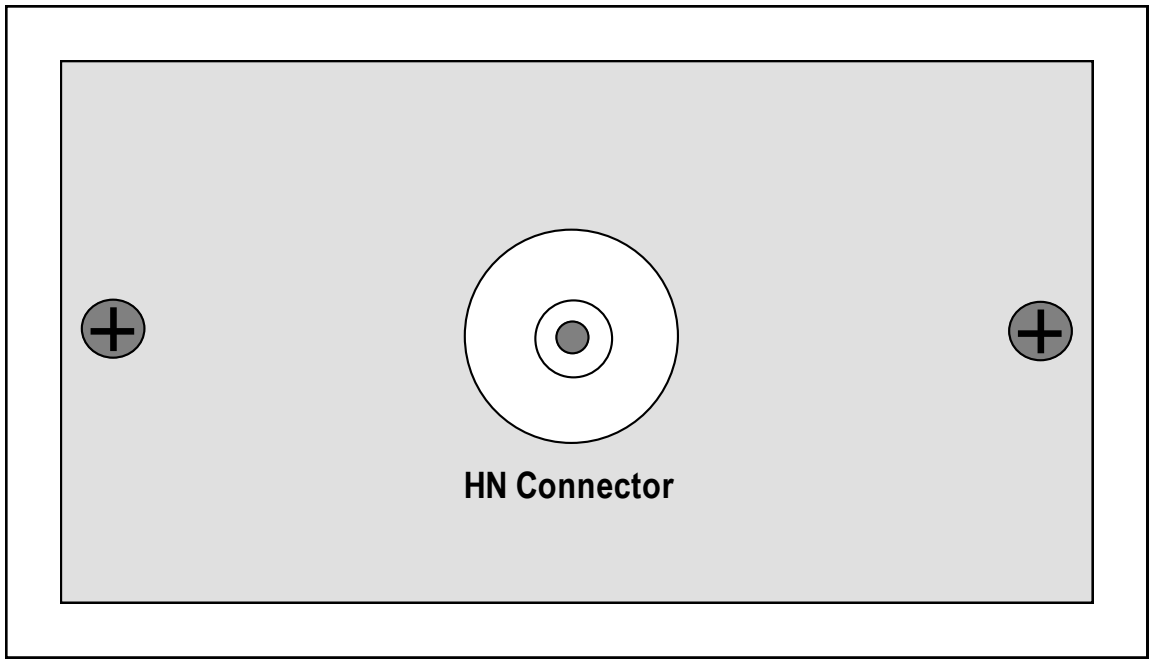


Figure 3. Enclosure front panel layout.

Figure 4. Photograph of NPM3000E with HN Pigtail.

Figure 4 shows a photograph of an NPM3000E device with a male HN connector (the HN connector is shown with a cap). Cable length is 15 cm.

Internal Components

Electrical diagram

Figure 5 depicts a functional diagram of major internal components of the device. This is not a schematic and not to scale.

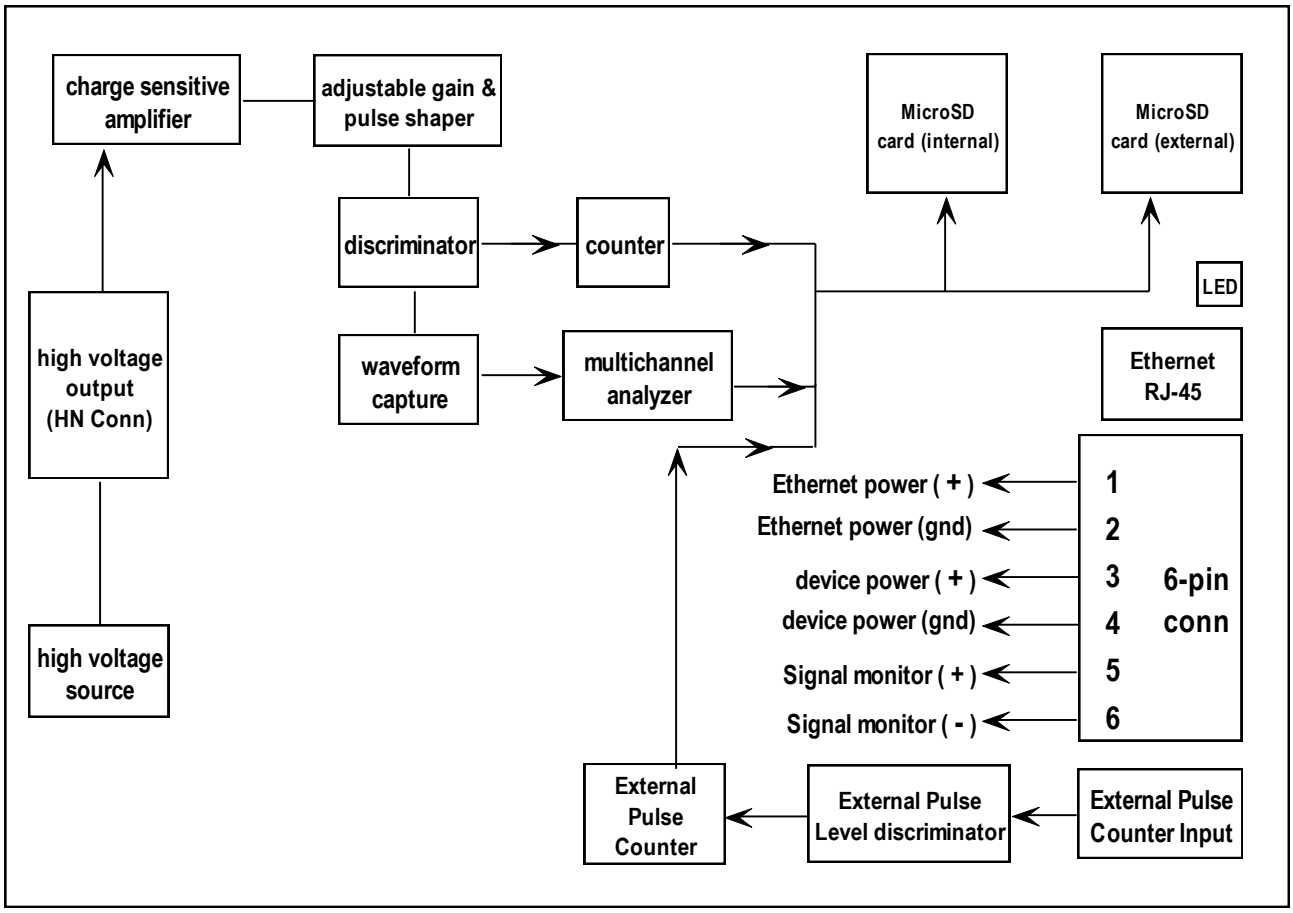


Figure 5. Internal Components Functional Block Diagram

Device Version (Options) Designation

The version of the device is indicated on the device label.
Configuration Options are separated by dashes.
i.e. NPM3000E-DL-TH-C-HN16

The version of the device may be found by typing “version” in a terminal program (see Teraterm interface appendix directions) or by connecting to the device via the Quaesta Instruments provided GUI application.

Integrated High Voltage Supply Designation
-HV2K - 2000 V (300 V to 2000V) supply range
-HV3K - 3000 V (300 V to 3000V) supply range

Integrated Datalogging (internal and External SD cards, and Real Time Clock)
-DL

Integrated Temperature and Humidity Sensor
-TH

External Counter Input (with Threshold setting)
-C

TTL Output
-TTL

Extended Gain Range
-EG Adds Components and a Jumper Block to the NPM3000E Circuit Board to provide Extended Gain Selection range over the Standard 1:20 range.

HV Connector Options
-HN -HN connector panel mounted
-SHV -SHV connector panel mounted
-SHV -SHV connector panel mounted

Pigtail Options
HV connectors can optionally be pigtailed.
In such a case the cable length is indicated as appended to the HV connector type, i.e. a 16cm pigtail with an HN connector termination is indicated by –HN16

Example:
An NPM3000E device with integrated 2000V supply, datalogging, internal temperature and humidity sensor, external counter input, and a 16cm pigtail with HV output would be indicated as:
NPM3000E-HV2K-DL-TH-C-HN16.

Section 2. Electrical Specifications

Electrical Specifications	
External Elements	
Front Panel	
High Voltage Output	HN Connector Pigtail Standard (other connectors can be provided)
Rear Panel	
Ethernet Connector	RJ-45 (class 10/100)
LED	Red, flashes with counting pulses (functionality can be turned ON/OFF via modes available in firmware)
microSD card (external)	storage: push-push style (engage/disengage)
6-pin connector (PCB Mount)	Brand: Phoenix Contact, Model PTSM 0,5/ 6-HH-2, 5-SMD R44. Order No.: 1778803
pin 1	Ethernet power input (6 - 18VDC)
pin 2	Ethernet power ground input
pin 3	NPM power input (6 - 18VDC)
pin 4	NPM power ground input
pin 5	Differential input Signal, Positive (+)
pin 6	Differential input Signal, Negative (-)
Differential input specs (pins 5,6)	Range: 0 – 40V,lower input thresh< 1.1V, upper input thresh > 1.5V
6-pin connector (Plug)	Brand: Phoenix Contact, Model PTSM 0,5/ 6-P-2, 5. Order No.: 1778874
Optional Input Pulse Connector	Brand: LEMO HGP.00.250.CTLP
Input Pulse, Input Impedance	50 ohms, series termination, 0.25W rated
Input Pulse Allowed Voltage Range	w/ Source Impedance of 50 ohms, 0 to 10V
	w/Source Impdedance <<50 ohms, 0 to 5V
	The limitiing element is a 0.25W rated 50 ohm series termination resistor. Short lived higher voltage pulse levels can be tolerated. The duty cycle of the pulse train and average power dissipated in the 50 ohm series termination resistor should then be considered.
Internal Components	
PCB Elements	
High voltage supply	250V - 2000V, step size: 1V, stability 0.5V
Adjustable gain	1.0 – 20.0, step size: 0.1
Discriminator (lower)	3% to 100% of full scale range
Discriminator (upper)	Lower discriminator setting to 100% of full analog scale range
Deadtime (pulse lockout time)	165µsec to 16,000µsec
Maximum pulse rate	6000Hz
Pulse Input Counter Threshold (“PulseLevel” parameter)	0 to 4V, step size 0.01V
Environmental	
Temperature	-40C to +80C
Humidity	80%, non-condensing

Table 2. Electrical Specifications

Power Requirements		
Ethernet Power Consumption	80mA at 12VDC, 25C, Typical. If the ethernet interface is used, add this to current consumption specified below.	
NPM3000E Consumption, with Ethernet and Input Pulse Counter Off (i.e., parameter PulseCounterOn=0)	Specifications at 12VDC, 25C, Typical	**Max Input Pulse Counter Count Rate (Pulse Counter Optional)**
HV = 0 Volts	5.9 mA (70 mW). Idle Mode, no counting active.	N/A
HV = 500 Volts	19.2 mA	N/A
HV = 1000 Volts	23.1 mA	N/A
HV = 1500 Volts	29.5 mA	N/A
HV = 2000 Volts	38.3 mA	N/A
		N/A
Neutron Pulse Module Power Consumption, with Input Pulse Counter On (i.e., parameter PulseCounterOn=1)	Specifications at 12VDC, 25C, Typical	**Max Input Pulse Counter Count Rate (Pulse Counter Optional)**
HV = 0 Volts	8.5 mA (100 mW nominal)	1.9 MHz
HV = 500 Volts	21.9 mA	10 MHz
HV = 1000 Volts	25.8 mA	10 MHz
HV = 1500 Volts	32.2 mA	10 MHz
HV = 2000 Volts	41.0 mA	10 MHz
Neutron Pulse Module Power Consumption, with Input Pulse Counter On (i.e., parameter PulseCounterOn=2)	Specifications at 12VDC, 25C, Typical	**Max Input Pulse Counter Count Rate (Pulse Counter Optional)**
HV = 0 Volts	13.8 mA (165 mW nominal)	10 MHz
HV = 500 Volts	21.9 mA	10 MHz
HV = 1000 Volts	25.8 mA	10 MHz
HV = 1500 Volts	32.2 mA	10 MHz
HV = 2000 Volts	41.0 mA	10 MHz

Table 3. Power Consumption

Section 3. SD Card (Data Storage) Information

The NPM3000E devices are equipped with both internal and external microSD card slots. Use of both standard microSD and microSDHC cards are supported.

When the NPM3000E *SaveDAT* parameter is set to one (i.e., *SaveDAT=1*), data will be recorded every *Recordperiod* to both internal and external microSD cards if they are both present. See Section **Error! Reference source not found..**

Formatting the microSD cards

Each microSD card used in a NPM3000E device should be formatted with a FAT32 filesystems. A 4096 byte (4K) cluster size is recommended.

***Note that the NPM3000E devices will still read and write from cards formatted with the standard FAT filesyste. The use of the standard FAT filesystem will limit the number of files which can be stored in each directory of the SD card.*

See the description of the Format command in Section **A8. Filesystem Commands and Parameters** for information and directions on formatting the microSD cards.

Use of the FAT32 filesystem (rather than the FAT16 filesystem) allows for many more files to be created on the SD card before the filesystem stops creating new files.

Industrial Grade vs Commercial Grade microSD cards

For maximum microSD card reliability, It is recommended that Industrial Grade microSD cards be used. Standard off the shelf commercial grade microSD cards available at consumer electronics stores will also function, but may have lower reliability.

Industrial Grade microSD cards employ “Single Level Cell” technology and advanced error correcting algorithms to obtain higher degrees of reliability than commercial SD cards.

Industrial Grade microSD cards will typically draw higher current than commercial grade SD cards when active. This does not add a significant current draw to the NPM3000E device operation since the writing to the microSD cards during normal operation is momentary.

Two manufacturers of Industrial grade microSD cards are: ATP Electronics (www.atpinc.com) and Delkin Devices (www.delkin.com). These cards are readily available in the United States through distributors. Distributors and manufacturers may supply other Industrial Grade microSD cards in the European Union.

To date (Jan 2013) ATP Industrial Grade 1GB or 2GB microSD cards have been shipped by Quaesta Instruments in the NPM3000E devices, and these have been tested thoroughly in the laboratory. Other industrial grade microSD cards should also

function but have not been tested. Commercial Grade microSD cards such as made by Sandisk have also been tested successfully in the devices.

As of January 2013, the ATP web site provides the following discussion of Industrial Grade microSD cards:

"ATP Industrial Grade microSD Cards are optimized for demanding enterprise mobility applications such as **Point of Sales**, **bar coding**, **data collection**, where mission-critical data requires the highest level of reliability, durability, and data integrity.

ATP's SIP (System-In-Packaging) manufacturing process encapsulates all exposed components and points of failure to ensure the products are fully waterproof, shockproof, and ESD (Electro-Static Discharge) proof. ATP Industrial Grade microSD Cards can withstand at least a storage temperature range of -40 to 85 degrees Celsius and an operating temperature range of -40 to 85 degrees Celsius.

In addition to this temperature range, the cards are completely waterproof, dustproof, and ESD (Electro-Static Discharge) proof. All ATP Industrial Grade microSD cards are produced under a stringent RoHs and Green Package compliant manufacturing process to guarantee a consistent high level of build quality and performance."

Industrial Grade microSD Specifications

Specifications of the ATP Industrial Grade microSD cards are as follows. Provided by ATP as of Jan 2012:

Product Name	Industrial Grade microSD
Capacities	512MB to 8GB
Connector Pin	8 Pins
Environmental	Operating Temp: -40°C to 85°C
Characteristics	Storage Temp: -40°C to 85°C
	MTBF (mean time between failures, @25°C): min. 2,000,000 hours
Reliability	Number of Insertions: 10,000 minimum
	TBW 6.1 TeraBytes to 48 TeraBytes Random Write
Dimension: LxWxH (mm)	11*15(+/- 0.1)*1.0(+/- 0.1)
Weight	0.4 gram max
StaticDataRefresh	YES
Life Monitor	YES

Other Industrial Grade microSD card manufacturers have similar specifications. Cards from these other manufacturers have not been thoroughly tested in Quaesta Instruments laboratories but are also expected to function well.

SD Card Data Organization

The NPM3000E device has provisions for using both an internal and external MicroSD card.

If the datalogging option is selected at the time of purchase, an industrial grade internal MicroSD card and a Real-Time Clock battery will be included internally to the NPM at the factory. Likewise, an industrial grade external MicroSD card will be included.

DAT, BIN, and HGM directories are automatically created on the internal and external SD cards if they do not already exist.

The internal SD card is designated by 0: and the external SD card is designated by 1:

Access to the filesystem has been provided through commands which mimic the PC 'DOS' commands. i.e., 'dir','cd','0:','1:','getcwd', etc
Doing a directory of the internal SD card will show something similar to:

```
0:
0:/  Internal SD Card
dir
dir
D---- 2013/05/11 20:41         0 DAT
D---- 2013/05/11 20:41         0 HGM
D---- 2013/05/30 12:19         0 BIN   0 File(s),
   0 File(s),         0 bytes total,    3 Dir(s)
0:/ External SD Card
```

The DAT directory will house files which contain time series of recorded data, in plain Text format. The DAT files are only created if SaveDAT=1. See Section XX for further details on DAT files.

The BIN directory contains binary data files which contain time series of recorded data, in a binary format. The BIN files are only created if the SaveBIN=1. See Section XX for further details on BIN files.

The HGM directory contains text data files which contain periodic recordings of histogram (pulse height amplitude distributions) as obtained through use of the NPM3000E's integrated MCA.

DAT File Contents

The DAT directory contains files which contain time series of recorded data, in plain Text format. A text header with NPM parameter information is written at the top of each file, with data columns labeled. The data records are appended to the text file.

Example:
On July 1, 2013 an NPM3000E device with the datalogging option is powered on at 12:18. Parameters are automatically retrieved from its EEPROM.
The retrieved Logging parameters for this example are as below.

```
//LOGGER PARAMETERS//
PrintDAT              1       ->prints text records to the terminal "real-time"
SaveDAT               1       -> text data record files are created every
                              newFilePeriod. Header information is written to the
                              data file when it is created. The header contains the
                              current Neutron Pulse Module operating parameters
                              as well as the current LOGGER parameters. Data is
                              appended to the current DAT file every Recordperiod.
SaveBIN               0       ->binary data not being saved in BIN directory
PrintHGM              0       ->Histogram data not being printted to terminal
SaveHGM               1       ->Histogram data being saved to HGM directory
PulseCounterON        0       ->External Counter Input not being recorded.
TemperatureON         1       ->NPM temperature being recorded
HumidityON            1       ->NPM humidity being recorded
BatteryON             1       ->Power Supply voltage being recorded
SignalON              1       ->State of 'Signal' input being recorded
RecordPeriod(Sec)     30      ->Cadence of data sampling and recording
RecordsPerHGM         120     ->Determines cadence of NPM histogram (pulse
                              height spectrum recording. Here it is (30 seconds/
                              record)*(120 Records per HGM) = 3600 seconds,
                              i.e. Histograms are being recorded every 1 hour.
NewFilePeriod         Day     ->New DAT,BIN, and HGM files will be created at the
                               top of each day per the SaveDAT,SaveHGM, and
                              SaveBIN parameter settings.
Current Time          2013/07/01,12:18:18   ->File Creation time.
YYYY/MM/DD,HH:MM:SS, Index,  NPM_Cnts,Pulse_Cnts, DegC,RHum, Batt,Sig
```

A column header is the last line of the generic data header.

We can use the directory command, i.e. 'dir' to query the internal card's DAT directory contents a few minutes later.

```
0:/
getcwd
0:/DAT
dir
D---- 2013/05/11 20:41         0 .
D---- 2013/05/11 20:41         0 ..
----A 2013/05/31 23:59     58911 NPM1_130531.DAT
----A 2013/06/01 23:59     91609 NPM1_130601.DAT
----A 2013/06/02 23:59     91609 NPM1_130602.DAT
----A 2013/06/03 23:59    707119 NPM1_130603.DAT
----A 2013/06/04 01:20     97467 NPM1_130604.DAT
----A 2013/07/01 12:20      1253 NPM1_130701.DAT
   6 File(s),   1047968 bytes total,    2 Dir(s)
0:/DAT External SD Card
```

The data is being stored in the file NPM1_130701.DAT (the NPM1 name prefix is a parameter configurable by the user).
We can view the contents of the NPM1_130701.DAT by using the 'type' command.

```
Type 0:/DAT/ NPM1_130701.DAT
```

```
type ip122_130701.dat
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.3.7
Model              NPM3000E
Model Version      HVDLS
Serial Number      12040018
Name               NPM1
//NPM3KE PARAMETERS//
Voltage            1325
MaxVoltage         2000
Gain               20.0
LowerDisc          11
UpperDisc          120
nBins              128
DeadTime           160
VibeMode           0
PeakMode           0
HgmMode            2
TTLMode            2
LEDMode            1
PulseLevel         0.50
//LOGGER PARAMETERS//
PrintDAT           1
SaveDAT            1
SaveBIN            0
PrintHGM           0
SaveHGM            1
PulseCounterON     0
TemperatureON      1
HumidityON         1
BatteryON          1
```

```
SignalON           1
RecordPeriod(Sec)  30
RecordsPerHGM      120
NewFilePeriod      Day
Current Time       2013/07/01,12:18:04
YYYY/MM/DD,HH:MM:SS, Index,  NPM_Cnts, DegC,RHum, Batt,Sig

2013/07/01,12:18:34,    73,       404, 29.9,24.3,12.01,0,A4C5
2013/07/01,12:19:04,    74,       437, 29.9,24.3,12.01,0,6E5F
2013/07/01,12:19:34,    75,       404, 29.9,24.3,12.02,0,1A52
2013/07/01,12:20:04,    76,       408, 29.9,24.3,12.02,0,30DD
2013/07/01,12:20:34,    77,       428, 29.9,24.2,12.01,0,3689
```

In the example above, no external pulses are being counted.
If the user had set `PulseCounterON=1` (low rate, low power consumption, counter) or `PulseCounterON`=2 (higher rate, higher power consumption counter) been selected, a 'Pulse_Cts' column would have been added as below:

```
YYYY/MM/DD,HH:MM:SS, Index,  NPM_Cnts,Pulse_Cnts, DegC,RHum, Batt,Sig
```

i.e. Pulse_Cts, DegC, RHum, Batt, and Sig columns will only be present in the Text DAT files if the corresponding PulseCounterOn, TemperatureON, HumidityON, BatteryON, or SignalON parameters are set to 1.

The last column shown is a checksum CRC-16 value, which can be used to verify each record's data content. The checksum is performed on all bytes in the text record, starting with the first byte in the text record.

After the CRC-16 value is calculated, a comma is written followed by the 4 character Hex representation of the CRC-16 checksum value.

CRC-16 Algorithm details:

Polynomial: x^16 + x^15 + x^2 + 1 (0xa001)
Initial value: 0xffff

BIN File Contents

The BIN directory contains binary data files which contain time series of recorded data, in a binary format. The BIN files are only created if `SaveBIN=1`.

No Headers are written to the file.
i.e., the first data record begins at the first byte of the file.

Each binary data record is a fixed 22 bytes in size, and contains the following data.

Byte Number	Data Type	Data
0-3	Unsigned Long**	# of Seconds Since Jan 1, 1970
4-7	Unsigned Long**	# of Data Records Recorded since Device Boot
8-11	Unsigned Long**	# of Neutron Pulse Counts
12-15	Unsigned Long**	# of External Pulse Input Counts
16	Signed Byte	Temperature Sensor (rounded to nearest Deg C)
17	Signed Byte	Relative Hum % (rounded to nearest %)
18	Unsigned Byte**	Power Supply Voltage in Tenths of Volts, i.e. a value of 132 corresponds to 13.2 Volts
19	Unsigned Byte**	Signal Value (either 0 or 1)
20-21	Unisgned Integer**	CRC-16 Checksum

**All data is in Little Endian byte order.
i.e. Least Significant Byte is first.

Note:
The binary record format <u>cannot</u> be changed by the user. i.e., the number of bytes in the record will always be 22 bytes, irrespective of the values of the PulseCounterOn, TemperatureOn, HumidityOn, SignalOn, BatteryOn parameters.

Contact Quaesta Instruments if a custom data record format is desired.

HGM File Contents

The HGM directory contains text data files which contain periodic recordings of histogram (pulse height amplitude distributions) as obtained through use of the NPM3000E's integrated MCA. The HGM files are only created if `SaveHGM=1`.

Each .HGM file contains time series of recorded data, in plain Text format. A text header with NPM parameter information is written at the top of each file, with data columns labeled. The data records are appended to the text file.

An example of an HGM file are shown below.
A data file header is written when the HGM file is created.
The header is of the same format as that written to DAT files.

Note the `Current Time` line in the header information, indicating the time of HGM file creation.

A column header is written at the end of the file header, and indicates what data is being sampled every `recordperiod`.
For the example HGM file below, recordperiod = 60 and recordsperhgm = 60, meaning basic data is sampled (and stored to a DAT file if SaveDAT=1) every 60 seconds and histograms are recorded every 60 recordperiods, or once every hour.

i.e., 60 secs/recordperiod x 60 recordperiods/histogram = 3600 seconds/histogram = 1hr/ histogram.

Histograms are sampled and written in a format selected by the HgmMode parameter (see Section *A2.10*) and the `nBins` parameter. Before each HGM in the data file, a data record containing the total number of counts since last histogram sampling is written.
Since `HgmMode=2` as found in the file header, the histograms are displayed in two columns. Column 1 is the Histogram Bin# and Column 2 is the total counts accumulated in that Bin# since the histogram was last zeroed. The Bin# represents the Relative Pulse Height of the recorded pulse.

At the end of the

```
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.3.7
Model              NPM3000E
Model Version      HV2K
Serial Number      0123456789ABCDEF
Name               IP181
//NPM3KE PARAMETERS//
Voltage            1275
MaxVoltage         2000
```

```
Gain                1.9
LowerDisc           30
UpperDisc           120
nBins               128
DeadTime            200
VibeMode            0
PeakMode            0
HgmMode             2
TTLMode             0
LEDMode             1
//LOGGER PARAMETERS//
PrintDAT            0
SaveDAT             1
SaveBIN             1
PrintHGM            0
SaveHGM             1
TemperatureON       1
HumidityON          1
BatteryON           1
SignalON            1
RecordPeriod(Sec)   60
RecordsPerHGM       60
NewFilePeriod       Day
Current Time        2013/06/02,00:00:36
YYYY/MM/DD,HH:MM:SS, Index,  NPM_Cnts, DegC,RHum, Batt,Sig

2013/06/02,00:30:33,  1860,      5939, 35.8,20.1, 8.67,0,4400
0,0
1,0
2,0
3,0
4,0
5,0
6,0
7,0
8,0
9,0
10,0
11,0
12,0
13,0
14,0
15,0
16,0
17,0
18,0
19,0
20,0
21,0
22,0
23,0
24,0
25,0
26,0
27,0
```

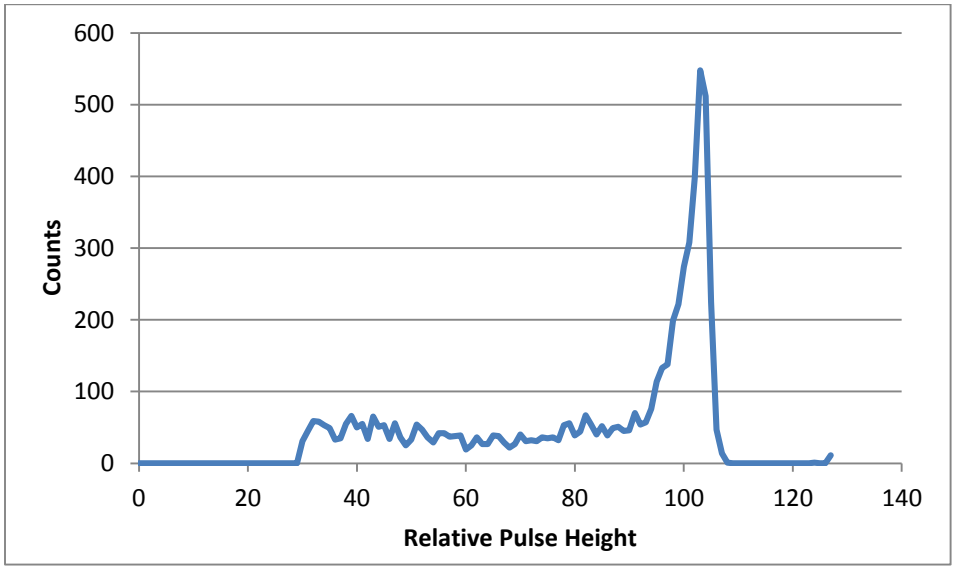
```
28,0
29,0
30,31
31,45
32,59
33,58
34,53
35,49
36,33
37,35
38,55
39,66
40,50
41,55
42,34
43,65
44,51
45,53
46,34
47,56
48,36
49,25
50,33
51,54
52,47
53,36
54,29
55,42
56,42
57,37
58,38
59,39
60,19
61,25
62,36
63,27
64,27
65,39
66,38
67,29
68,22
69,27
70,40
71,31
72,32
73,31
74,36
75,35
76,36
77,32
78,53
79,56
80,39
81,44
82,67
```

```
83,54
84,40
85,52
86,39
87,49
88,51
89,45
90,46
91,70
92,54
93,57
94,76
95,114
96,133
97,138
98,199
99,222
100,274
101,308
102,398
103,548
104,512
105,225
106,47
107,14
108,1
109,0
110,0
111,0
112,0
113,0
114,0
115,0
116,0
117,0
118,0
119,0
120,0
121,0
122,0
123,0
124,1
125,0
126,0
127,11
Elapsed Time=3600

2013/06/02,01:30:33,  1920,      5812, 35.7,19.6, 8.67,0,7D7E
0,0
1,0
2,0
..
..
88,53
89,49
```

```
90,60
91,81
92,56
93,81
94,80
95,98
96,120
97,137
98,193
99,218
100,236
101,334
102,401
103,563
104,453
105,220
106,55
107,13
108,0
109,0
110,0
..
..
..
121,0
122,1
123,0
124,0
125,0
126,0
127,15
Elapsed Time=3600
```

The first recorded histogram can be plotted. The shape is that of a textbook He3 spectrum and indicates that the detector tube and electronics are working well. See Section



Section 4. NPM3000E Command Quick Reference Tables

A quick reference list of available commands and parameters are included in the tables below.
Commands are to be sent as text commands via the Ethernet interface. Commands should be terminated with a Carriage Return and Linefeed character sequence (i.e. CR+LF). Terminal emulators such as Teraterm Pro or Windows Hyperterminal can be configured to communicate with NPM3000E devices via TCPIP. Configuration of these terminal emulators is covered in appendices at the end of this manual.

A provided set of Command Prompt commands (executables) allows the user to communicate via a PC at the Windows Command prompt level.

Alternatively a GUI application provided by Quaesta Instruments can be utilized to communicate with the NPM3000E devices.

Both the command prompt based command set and the GUI application make use of the basic NPM3000E firmware commands identified in the quick reference below.

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

- C – Control Commands
- R – Read Commands
- R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

The quick reference tables below are organized below by command functionality and "subsystem."

Miscellaneous Device Commands and Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A1.1	Name	R/W	Name of the NPM3000E device
A1.2	Menu	R	Report all available commands
A1.3	Info	R	Report device identification and parameters
A1.4	Status	R	Report various status information
A1.5	Reboot	C	Reset the system

Table 4. Miscellaneous Device Commands

NPM Subystem Commands and Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A2.1	Voltage	R/W	High Voltage Supply value in Volts (250 to 2000)
A2.2	MaxVoltage	R/W	Maximum allowed High Voltage (0 to 2000)
A2.3	Gain	R/W	Amplifier Gain (1.0 to 20.0)
A2.4	LowerDisc	R/W	Lower Discriminator (Neutron Pulse Threshold)
A2.5	UpperDisc	R/W	Upper Discriminator
A2.6	Nbins	R/W	Number of Bins used in the integrated Multi-Channel Analyzer histograms
A2.7	DeadTime	R/W	Neutron pulse detection dead-time or “lockout” time
A2.8	VibeMode	R/W	Vibration cancellation mode - not typically used (0 or 1)
A2.9	PeakMode	R/W	Pulse shape display mode - not typically used (0 or 1)
A2.10	HgmMode	R/W	Histogram format mode (1,2, or 3)
A2.11	LEDMode	R/W	LED activation mode (0 or1)
A2.12	Counts	R	Report and zero the neutron pulse counter
A2.13	Query	R	Report the neutron pulse counter without zeroing
A2.14	Hgm	R	Report the histogram according to HgmMode
A2.15	MaxHgm	R	Report histogram maximum information
A2.16	ZeroCounts	C	Zero the neutron pulse counter
A2.17	ZeroHgm	C	Zero the histogram
A2.18	Adev	R	Report analog noise average deviation – diagnostic

Table 5. NPM Subsystem Commands and Parameters

Input Pulse Counter Commands and Parameters, Quick Reference (with Input Pulse Counter Option)

Sec	Command Name	Cmd Type	Operation
A3.1	PulseCounterOn	R/W	Input Pulse Counter mode (0,1, or 2)
A3.2	PulseLevel	R/W	Input Pulse Counter Threshold Voltage (0.00 to 4.00)
A3.3	PulseCounts	R	Report and Zero the Input Pulse Counter
A3.4	PulseQuery	R	Report the Input Pulse Counter without Zeroing
A3.5	ZeroPulseCounts	C	Zero the Input Pulse Counter

Table 6. Input Pulse Counter Subsystem Commands and Parameters

TTL Output Commands (with TTL Output Option), Quick Reference

Sec	Command Name	Cmd Type	Operation
A4.1	TTLMode	R/W	TTL Output Mode

Table 7. TTL Output Commands

Sensor Commands (with Sensors Option), Quick Reference

Sec	Command Name	Cmd Type	Operation
A5.1	Temperature	R	Temperature and Relative Humidity
A5.2	Humidity	R	Temperature and Relative Humidity
A5.3	Battery	R	Battery Voltage (Power Supply Voltage)
A5.4	Signal	R	External Signal State

Table 8. Sensor Subsystem Commands

Ethernet to Serial Communication Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A6.1	`ComEcho`	R/W	Turns Off/On echoing of input characters (0,1)
A6.2	`ComFlowControl`	R/W	0 – No Flow Control 1 – XON/XOFF Software Flow Control 2 – Hardware Flow Control (for NPM3000E Devices manufactured after Sept 2013). NPM3000E Serial Numbers begin with YYMM where YY is year and MM is month of manufacture.
A6.3	`ComTimeout`	R	Sets a Timeout parameter. Particularly useful when using XON/XOFF software flow control.
A6.4	`ComBaudRate`	R	Baud Rate

Table 9. Ethernet to Serial Communication Parameters

Datalogger Commands and Parameters, Quick Reference (with Datalogging Option)

Sec	Command Name	Cmd Type	Operation
A7.1	PrintDAT	R/W	Print text data each RecordPeriod (0 or 1)
A7.2	SaveDAT	R/W	Save text data each RecordPeriod (0 or 1)
A7.3	SaveBIN	R/W	Save binary data each RecordPeriod(0 or 1)
A7.4	PrintHGM	R/W	Print histogram periodically (0 or 1)
A7.5	SaveHGM	R/W	Save histogram periodically (0 or 1)
A7.6	TemperatureON	R/W	Include Temperature in Records (0 or 1)
A7.7	BatteryON	R/W	Include Supply Voltage in Records (0 or 1)
A7.8	SignalON	R/W	Include Signal in Records (0 or 1)
A7.9	RecordPeriod	R/W	Data recording interval in seconds
A7.10	RecordsPerHGM	R/W	Number of data records between Histograms
A7.11	NewFilePeriod	R/W	Interval for New File Creation. (Day, Month, Year)
A7.12	Time	R/W	Date and Time (i.e. 2012/05/08 14:35:22)
A7.13	ShowFilenames	R	Report current DAT and HGM filenames
A7.14	LogMode	R	Report current datalogger settings
A7.15	ShowData	R	Sample and report a data record (does not Zero Counts)
A7.16	CreateNewFiles	C	Create new files with time-based names

Table 10. Datalogger Subsystem Commands and Parameters

FIle System Commands and Parameters, Quick Reference (with Datalogging Option)

Sec	Command Name	Cmd Type	Operation
A8.1	Dir	R	List of files in the active file directory
A8.2	GetCWD	R	Current working directory
A8.3	DiskInfo	R	Bytes free and Size of Internal and External SD cards
A8.4	FileInfo	R	Specific File information (as output in 'Dir' command)
A8.5	Type	R	List contents of a file
A8.6	Cd	C	Change to a different directory
A8.7	0: or 1:	C	Select Internal (0:) or External (1:) SD cards
A8.8	Copy	C	Copy a file
A8.9	Rename	C	Rename a file
A8.10	Attrib	C	Set attributes of a file

A8.11	Del	C	Delete a file or files
A8.12	Mkdir	C	Create a new directory
A8.13	Transfer	C	Transfer a file to a PC (with handshaking)
A8.14	Format	C	Format the Internal SD card (use with caution)
A8.15	SdReset	C	Power cycle the SD cards

Table 11. File System Commands and Parameters

PC Based Command Prompt Environment Commands

Sec	Command Name	Operation
A9.2	`qiinfo`	Retrieve NPM3000E device parameter information
A9.3	`qistatus`	Retreive NPM3000E device status
A9.4	`qisynctime`	Syncs the NPM3000E device time to the PC system time
A9.5	`qidir`	Retrieve directory listing
A9.6	`qicopy`	Copy a file
A9.7	`qixcopy`	Copy an entire directory
A9.8	`qisendcmd`	Send a command or text string to the NPMs

Table 12. PC Based Command Line Commands

Section 5. Configuring the NPM3000E Device IP Address

At the factory, the IP Address of NPM3000E devices are set with a default IP Address in the range 192.168.15.XXX .

The NPM3000E utilizes an Xport embedded Ethernet to Serial device manufactured by Lantronix to provide Ethernet connectivity to the NPM3000E microcontroller. An NPM3000E IP address can be changed via a GUI application provided by Lantronix or via an HTML Web interface embedded in the XPORT device.

**Note that the user can configure Xport device security options if desired. Quaesta Instruments can assist the user in understanding and configuring these options.*

Setting IP Address, Option 1

Lantronix provides an easy to use GUI application for setting the Device IP address of the XPORT device.

- Step 1
  Download and install on a PC the Device Installer application from Lantronix. The application can be retrieved from www.lantronix.com/support/downloads . The link for the Device Installer application will be under the Utilities/Software heading.

- Step 2
  Attach the NPM3000E device to the same physical subnet as the PC. Turn on the Ethernet power to the NPM3000E device. LED's on the NPM3000E's RJ45 connector will momentarily flash when power is first applied, indicating the XPort is active and receiving power.

  When connected to an Ethernet network via an Ethernet switch or directly to the PC via an Ethernet crossover cable, an LED on the NPM3000E's RJ45 connector will turn green and stay on. An additional LED will blink when Ethernet traffic is detected.

- Step 3
  Start the Lantronix ***Device Installer*** application. A screen similar to that in **Figure 6. Lantronix Device Installer Application**will be appear. The application automatically searches for Lantronix XPORT hardware at startup and displays the current IP address and Hardware Address of devices found in the right panel. Note that the entry in the right panel in **Figure 6** is displayed in Red and the Status is listed as Unreachable. This indicates that the device's IP address is located on a different subnet from the PC. Notice that the IP address of the Local Area Connection (the PC) is shown as 192.168.14.1 in the left panel of **Figure 6Error! Reference source not found.** while the IP address of the Xport device as seen in the right panel is 192.168.15.110. The Subnet mask of the PC was set to 255.255.255.0, and, thus, the PC will not be able to connect to the XPort device via Ethernet. See a network administrator if necessary.

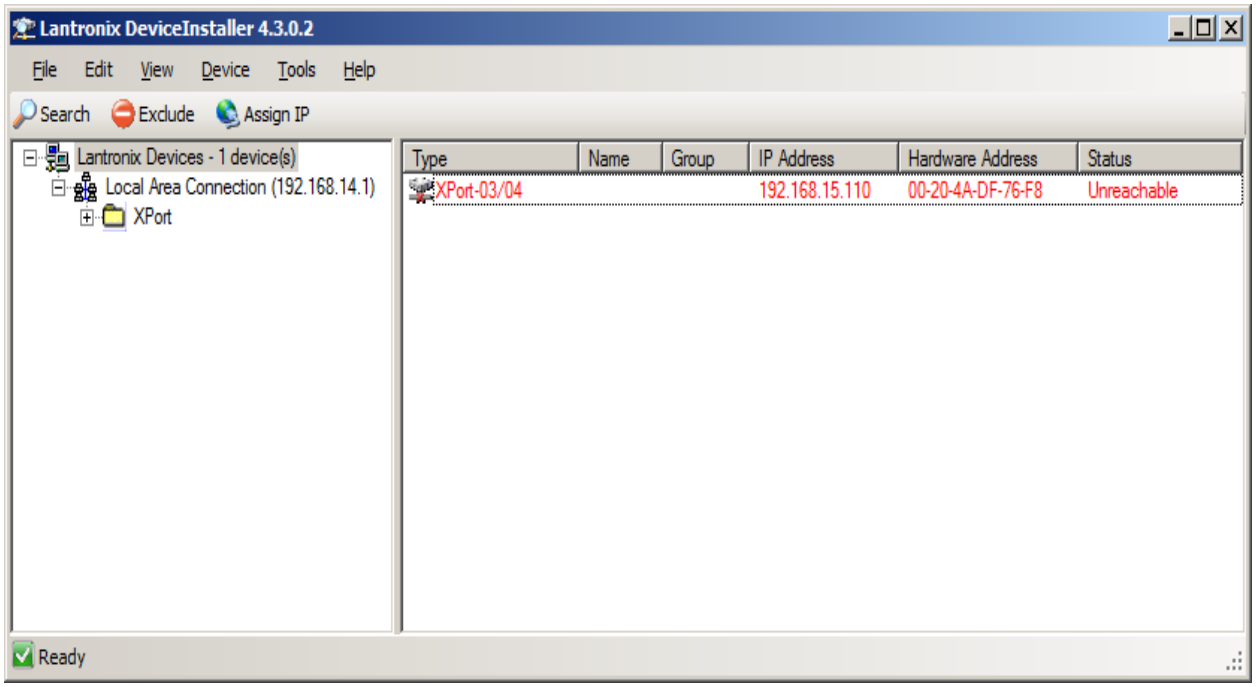


Figure 6. Lantronix Device Installer Application

If a device is disconnected or reconnected after the application is running, then selecting the "Search" option from the application toolbar will search for and refresh the list of devices.

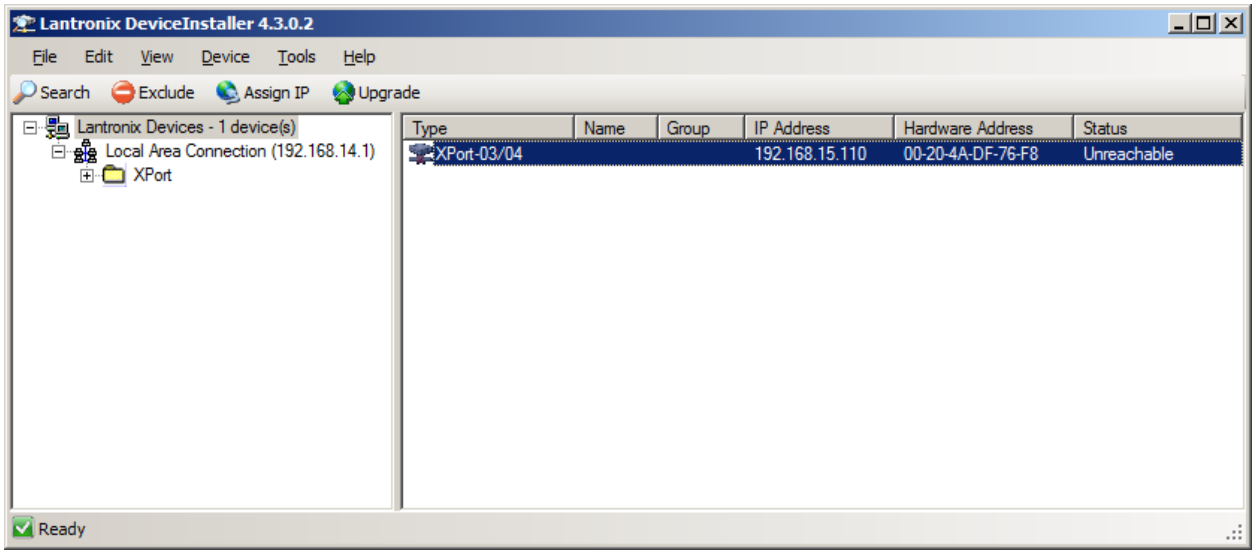


Figure 7. Device Selection in Lantronix Device Installer Application

Note that the Hardware Address (also known as a MAC address) is a physical address of the Xport hardware and cannot be changed. The user may desire to record this hardware address for future use and/or reference.
Note that the entry in the right panel will be shown in Red if the device is on a subnet different than the PC application.

- Step 4

  Select the appropriate device, and the entry will highlight in blue. See **Figure 7**.

- Step 5

  Select ***Assign IP address*** from the application toolbar. A form as shown in **Figure 8** will appear. Choose the ***Assign a specific IP address*** radial button option, and then select the command button labeled ***Next>***. A form similar to that of **Figure 9** will appear.

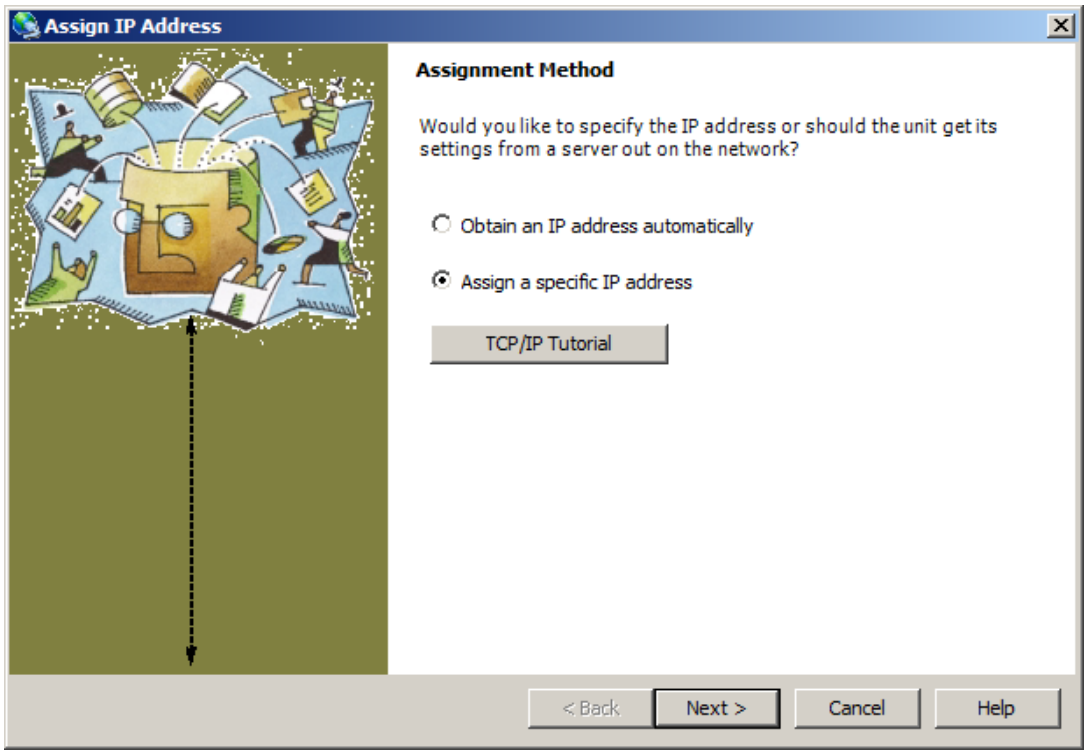


Figure 8. IP Assignment Method

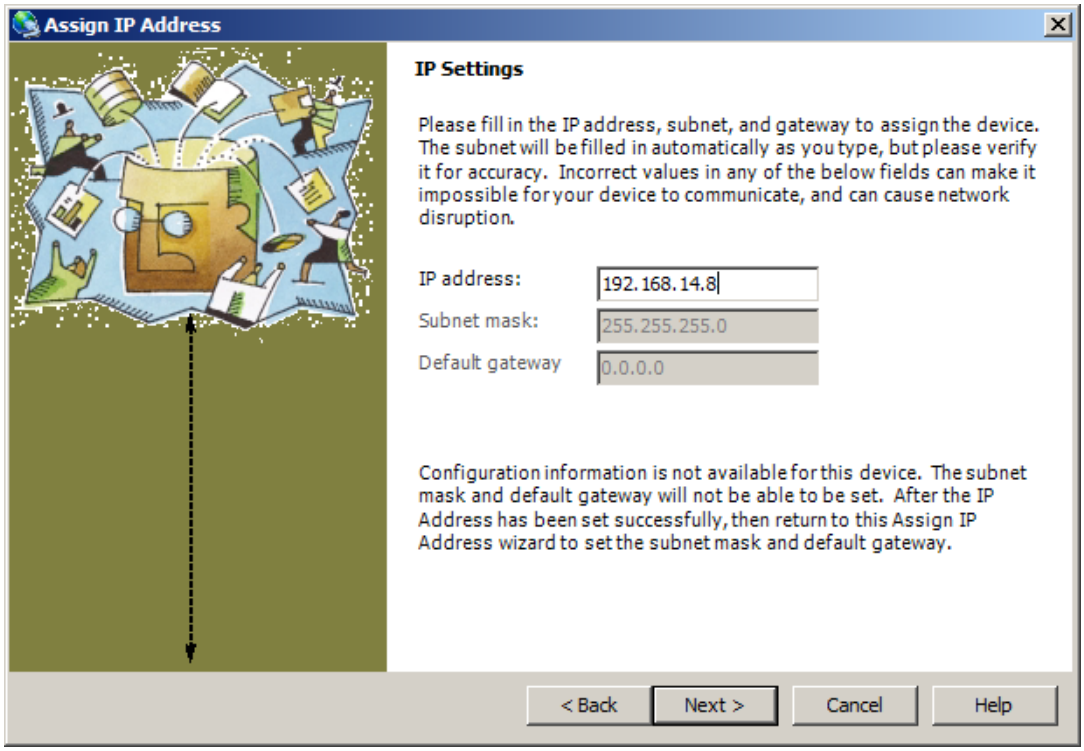


Figure 9. Edit IP Address

- Step 6
  Edit the IP address (**Figure 9**) as desired (In the figure it set to 192.168.14.8), and select the command button labeled ***Next>***.

- Step 7
  Follow the remaining instructions to complete the IP address assignment. After IP address assignment, the application will query the device and display the new setting as in **Figure 10**. Notice that the **status** of the device is now listed as ***Online***.

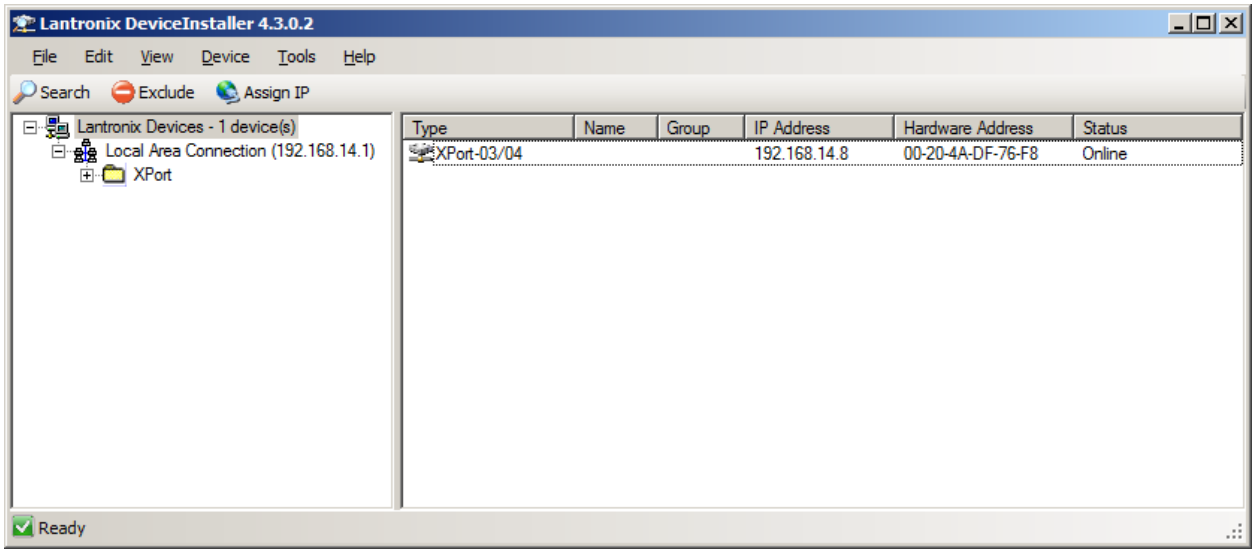


Figure 10. New IP Address display

Setting IP Address, Option 2

If the device's IP address needs to be changed, it is recommended that the user utililze the Lantronix Device Installer application, described earlier in this section.

Configuration of the NPM3000E IP address can also be completed from a PC via a Web browser if the IP address of the NPM3000E device is known and the PC and the NPM3000E device are on the same subnet. i.e. the device's current IP address must be an IP address reachable by the PC's Ethernet connection.

To access the web manager page for the ethernet interface, enter the IP address in the web browser. A username and password screen may appear at first connection. By default at the factory the username and passwords are left as null fields.

If the user desires to add a password to secure the Web management screen, a 4 character password may be entered on the Server page (selectable from the left side of the Xport screen).

The main web manager page for the embedded XPort ethernet controller will have the appearance similar to **Figure 11**. Select Network and the Network configuration page will appear. See **Figure 12**.

In addition to configuration of the IP address, the Web browser interface also allows for setting of other TCPIP and Xport parameters. Improperly entered settings can cause the NPM3000E device to stop functioning properly. It is recommended that the user only change the IP address with this interface. All other settings should remain unaltered.

***Setting the IP address via the Web browser interface should be completed carefully and with caution!*

Figure 11. Ethernet server Web manager access

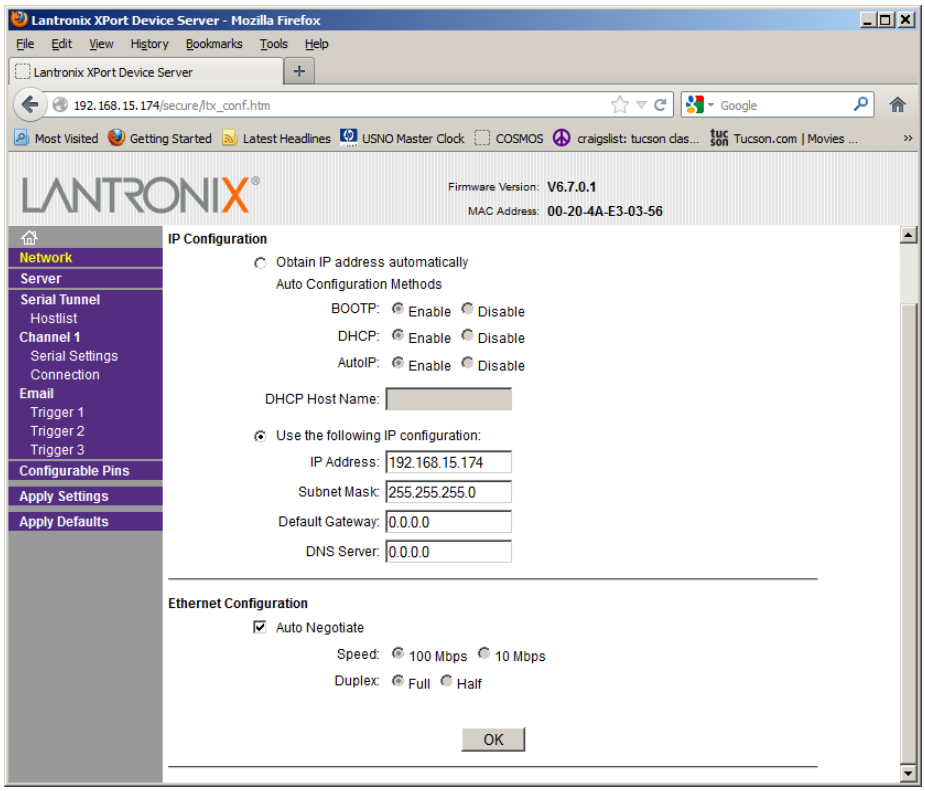


Figure 12. Web manager Network Configuration Page

Section 6. Configuring the Lantronix XPort Ethernet to Serial Adapter parameters

Xport Serial Communication Parameter Config

The XPort device communicates with the NPM3000E microcontroller through a serial communication (UART link).

The XPort serial communication Flow Control and Baud rate parameters must be set to match the ComFlowControl and ComBaudRate parameters as set in the firmware of the NPM3000E device (see Sec A6.2 ComFlow Control and Sec A6.4 ComBaudRate for details on settng these NPM3000E parameters).

Note: All NPM3000E devices manufactured before Sept 2013 do not support Hardware CTS/RTS flow control. The date of manufacturer is embedded in the 8 character serial number of the NPM3000E device: YYMMXXXX.

Figure 13. XPort Serial Settings, Xon/Xoff Software Flow Control shows the XPort serial settings configuration page, with the XPort configured for Software Flow Control. If use of Xon/Xoff software flow control is desired, then the user should select the Xon/Xoff Pass Chars to Host setting, which will allow binary data to be transmitted properly using a PPP type protocol supported by the NPM3000E device.

If available in the hardware (NPM3000E devices manufactured after Sept 2013), the preferred method of Serial Flow Control is Hardware Flow Control using CTS/RTS hardware lines. **Figure 14** shows the XPort serial settings configured to use CTS/RTS flow control.

Note on the Serial to Ethernet Baud Rate:

The NPM3000E device supports `ComBaudRate` parameter settings of 115200, 230400, 460800, and 921600 baud for the internal serial interface between the NPM3000E microcontroller and the XPort device.

Xport CPU Performance Mode

Baud Rates of 460800 and 921600 require placing the XPort device in High CPU Performanc e mode. Use of *High CPU performance Mode* will result in significantly higher power consumption. Power consumption conscious users should consider operating the XPort device in *Regular CPU Performance Mode* and using the corresponding availale Baud Rate settings of 115200 or 230400 for the Serial to Ethernet device internal Baud Rate.

Figure 15 displays the XPort Server settings parameter page, which contains the CPU Performance Mode option parameter.

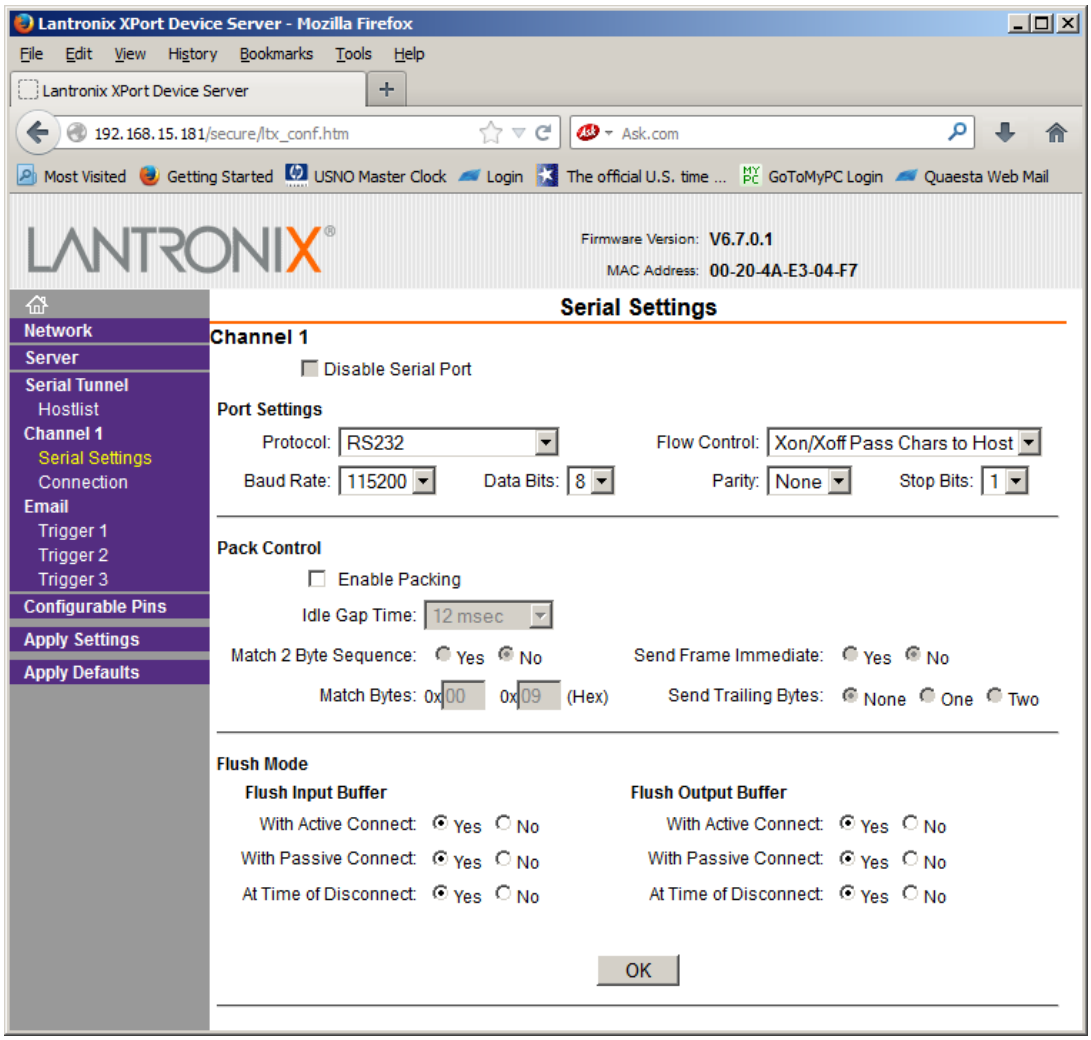


Figure 13. XPort Serial Settings, Xon/Xoff Software Flow Control.

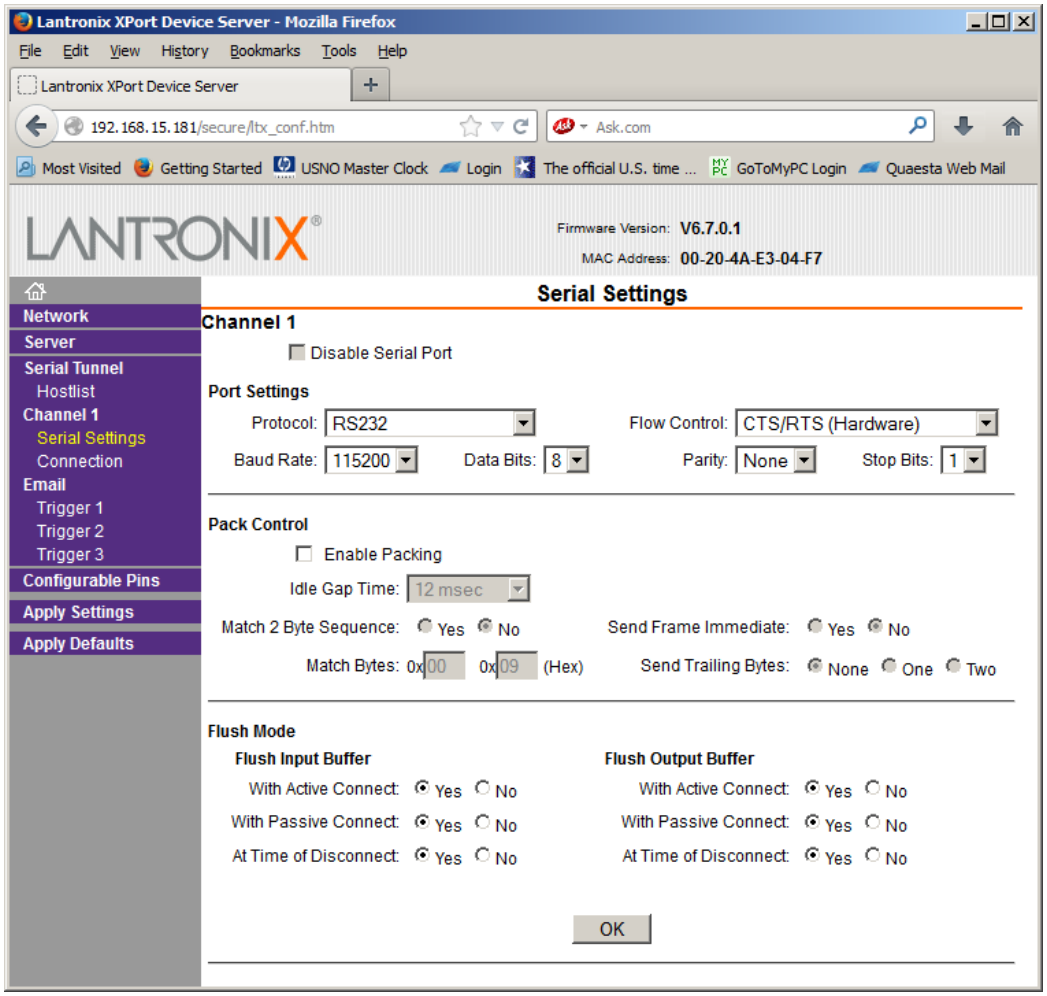


Figure 14. Serial Settings, CTS/RTS Hardware Flow Control.

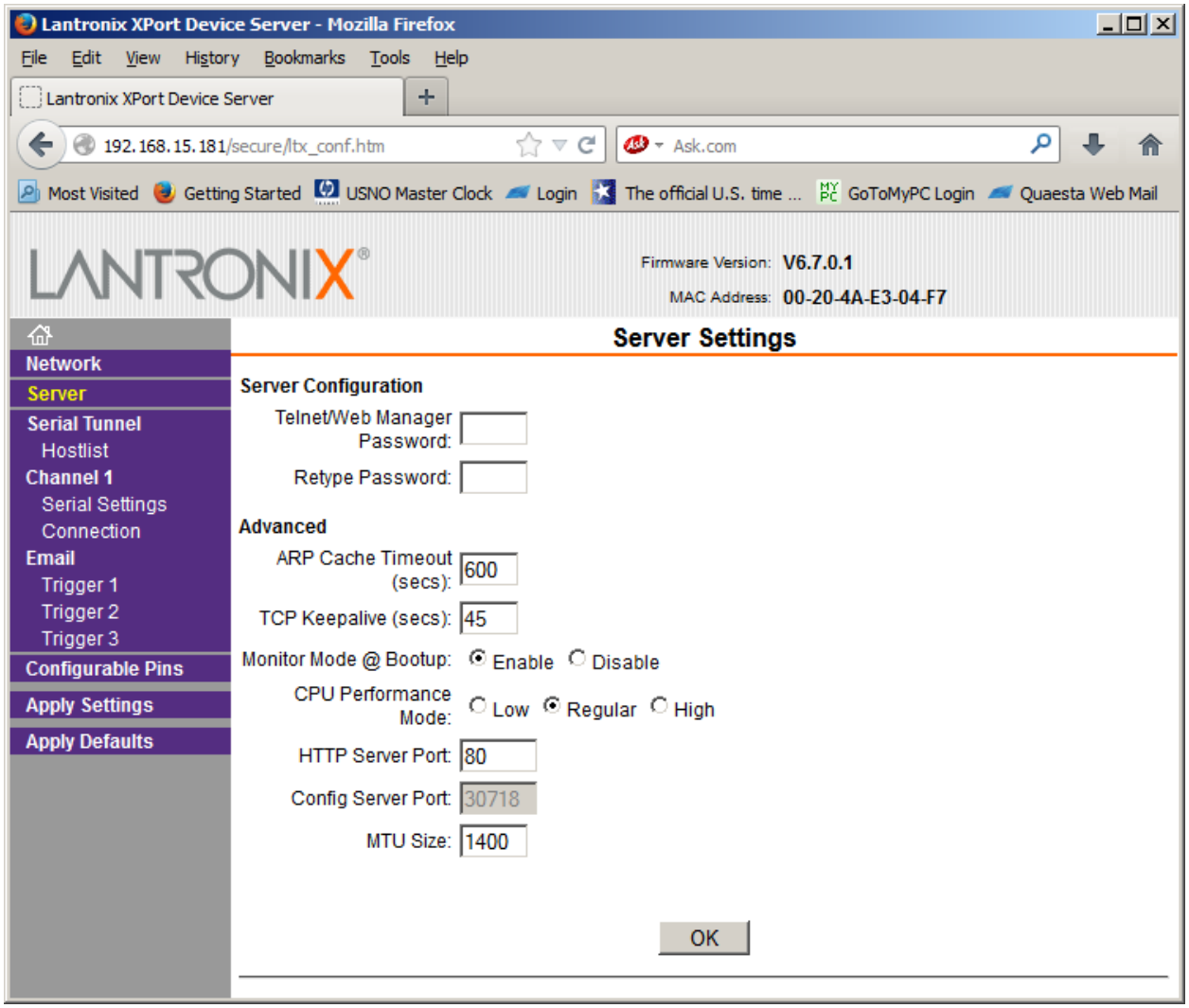


Figure 15. XPort CPU Performance Mode Settings

Xport Device TCP Connection Settings

The TCP connection settings for the XPort should be configured as shown in **Figure 16**.

Notes:
-The 'Connect Response' parameter should be set to Char Response, as shown. The NPM3000E microcontroller firmware expects this setting.

-The TCP Local Port setting should be set to 10001 if the user will be utilizing the Quaesta provided GUI application, but can otherwise be configured as desired.

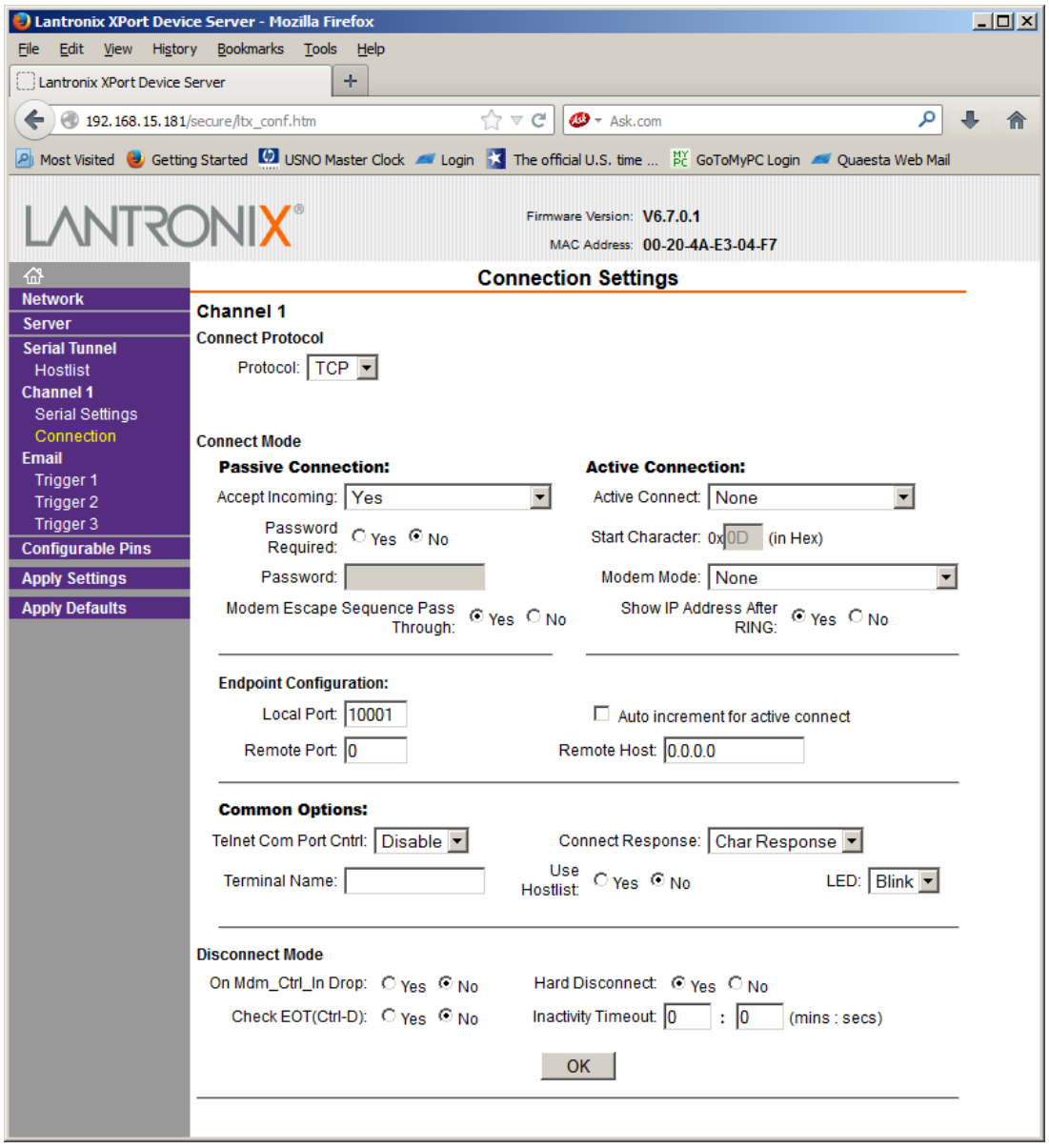


Figure 16. XPort TCP Connection Settings

Xport Configuration via Telnet

The XPort operating parameters can be configured via Telnet if the device has been so enabled.

This is considered an advanced user mode and the user should attempt this with caution.

The user should consult Quaesta Instruments and/or the appropriate Lantronix XPort documentation if assistance is needed on this topic. The NPM3000E device can become unreachable if certain settings are applied inappropriately.

The user is encouraged to study the Lantronix XPort manufacturer information if XPort Configuration via Telnet is desired.

Section 7. Configuration and Use of the NPM3000E Device

Parameter Configuration through a Terminal Interface

The NPM3000E microcontroller can be reached via a Terminal program such as Teraterm Pro or PuTTY, and Windows Hyperterminal. Terminal interface programs such as Teraterm Pro or PuTTY are highly recommended due to their ease of use and degree of configurability.

See ***Appendix B. Configuring Teraterm Pro*** for directions on setting up a terminal interface to the NPM3000E device.

Once the terminal interface is configured, one can interactively set parameters, look at file contents, etc.

Note that all commands and entries must be terminated with the CR + LF sequence.

Type the command `'menu + CR+LF'` and output similar to the following will be displayed to the terminal, listing the available commands and parameters. See **Appendix F** for an example of the menu command output.

Parameters are categorized as 'R','W' for write, or 'R/W' for both. See **Section 4. NPM3000E Command Quick Reference Tables** for quick reference or ***Appendix A. Command and Parameter Description*** for a detailed description of each command and parameter.

As an example, to change the electronic Gain of the device the user can do so at the terminal interface:

```
Gain=4.2    (terminal program should be configured to transmit CR+LF)
4.2             (if comand accepted, the parameter value is returned)
```

The user may also separate the parameter name from the desired setting by a space or tabs (whitespace)., i.e.

```
Gain    4.2    (terminal program should be configured to transmit CR+LF)
4.2             if comand accepted, the parameter value is returned)
```

Quaesta Instruments GUI Application

The Quaesta Instruments provided GUI can be used to set NPM3000E parameters, monitor device status, examine SD card contents, retrieve stored data, plot data, etc.

The Main GUI Window is shown in **Figure 17**. The Neutron Pulse Module operational parameters can be configured in the left frame of the Main GUI window, and the datalogging operational parameters can be configured in the middle pane of the Main GUI window. The Right most pane shows the current status of the NPM3000E device as retrieved by the NPM3000E device 'status' command.

The GUI is shown as it first appears after starting the application. The application is not connected to an NPM yet.

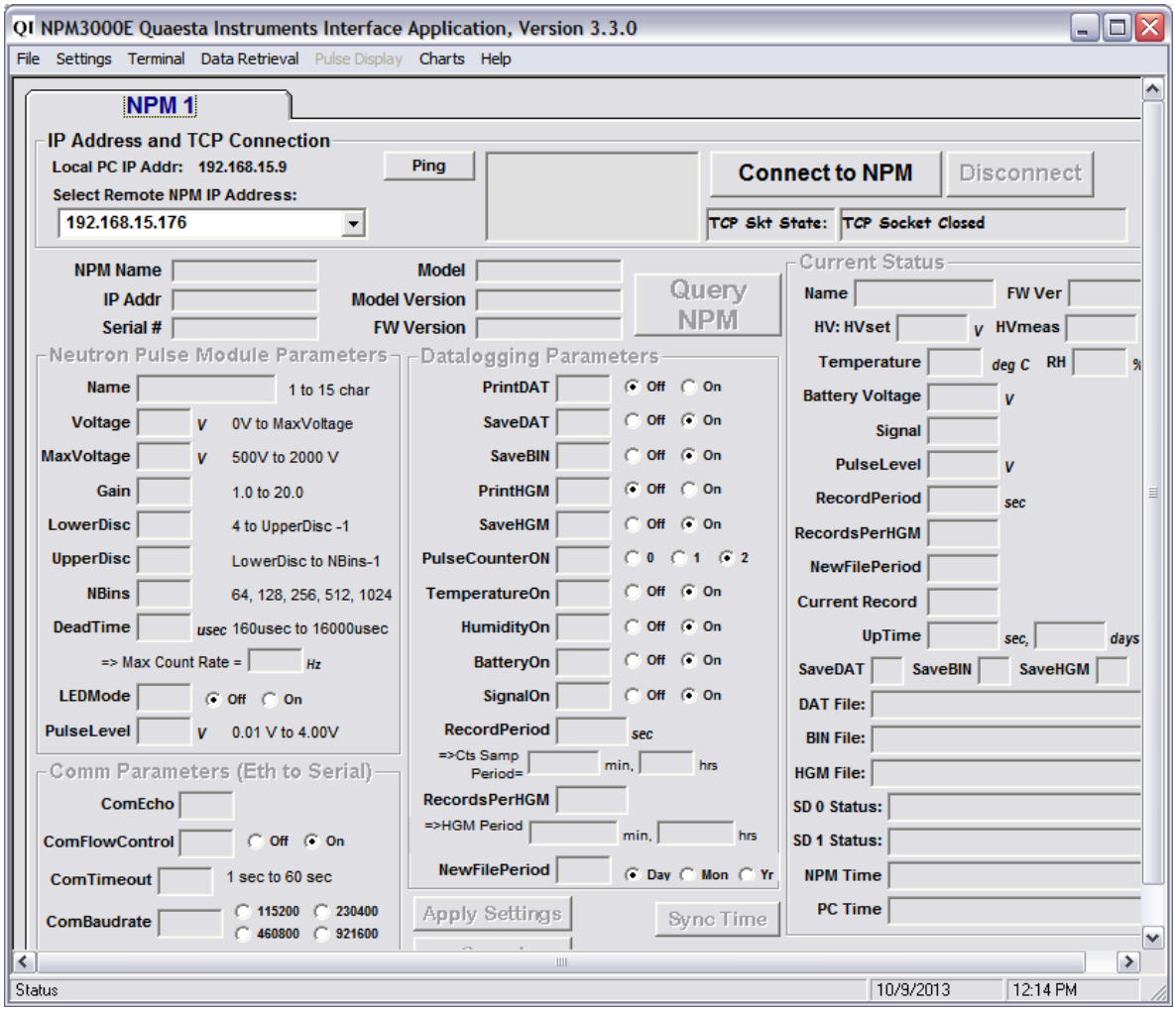


Figure 17 . NPM3000E GUI Main Window

To test if an NPM3000E device with a particular IP address is on the currently accessible network, you can select the NPM with the proper IP address and issue a Ping command with the Ping command button.
If the connection is OK, the user can connect to the desired NPM.
If an IP address of an NPM needs to be added, first do so via the "*IP Address List* " management form accessible via the ***Settings*** menu selection.

Once connected, parameters can be entered directly in the appropriate fields. Click the *"Appy Settings"* command button to load the parameters on the NPM.

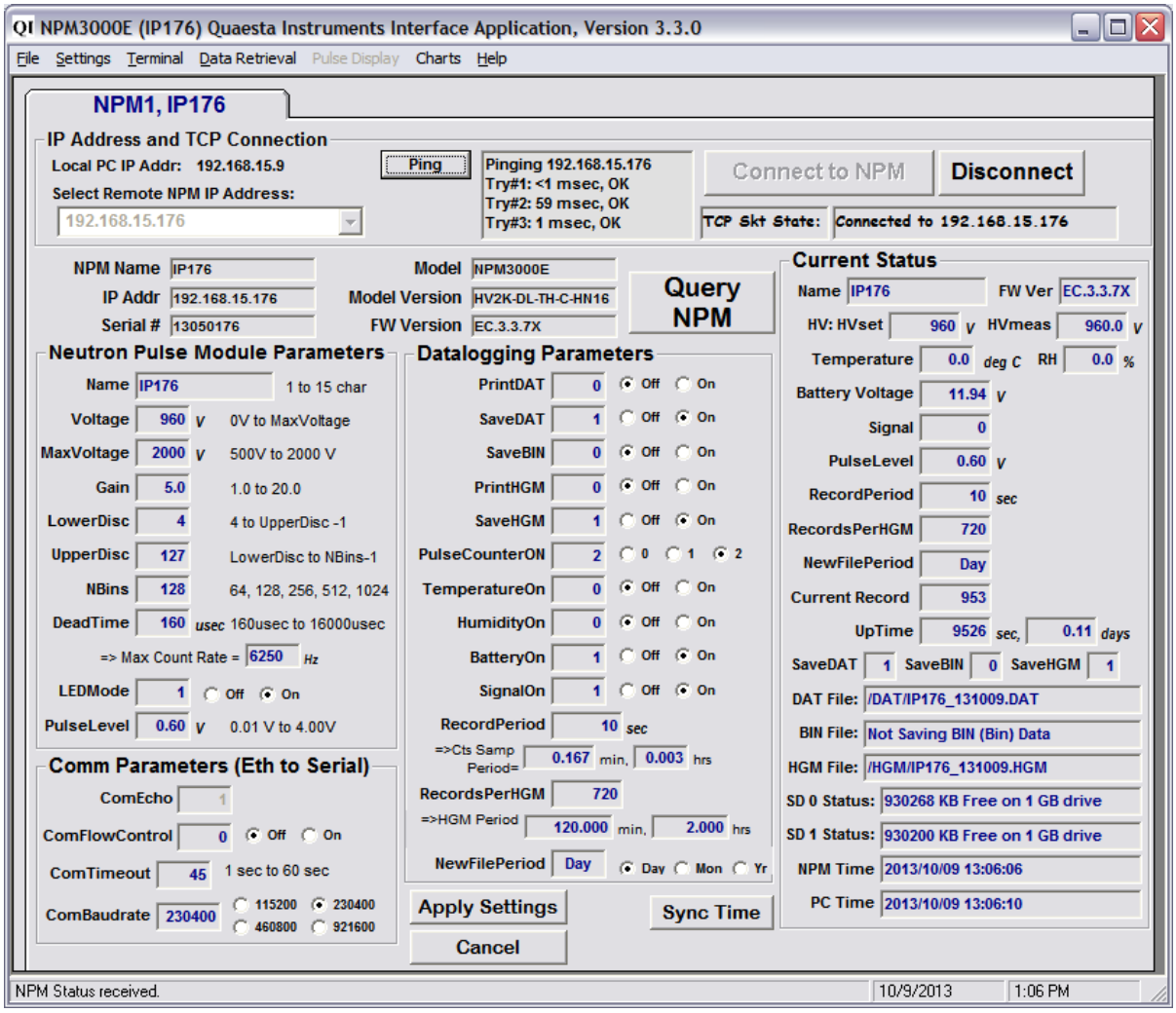


Figure 18. GUI Main Window with NPM Connection

In addition to setting NPM3000E operational parameters, the GUI can be used to issue commands via the command-line, and also retrieve and plot data. Menu selections from the main form provide access to these additional GUI capabilities.

Further description of the Quaesta Instruments GUI Application can be found in ***Appendix G***.

Section 8. The Value of the integrated MCA Histograms (Pulse Height Spectrums)

The NPM3000E integrated MCA can be used to quickly and reliably configure a detector systems with gas filled proportional tubes using only cosmic background generated neutrons. *i.e., without the need for a radiation source*.

Helium-3 (He3) , Boron Trifluoride (BF3, and Boron-lined proportional gas tubes are often used in the recording of thermal neutrons. Histograms of neutron-generated pulse heights for each of these tube types have well characterized distributions. As an NPM3000E device histogram fills in, the feature locations can be quickly identified, allowing the device high voltage, gain, and electronic discriminator settings to be quickly tuned. The task is made even easier if a tube manufacturer's recommended operating voltage range is known.

The use of the spectrums allows the user to avoid the often tedious task of High-Voltage plateauing traditionally used in setting up and using gas-filled proportional tubes.

The NPM3000E integrated MCA further provides the ability to monitor "real-time" the system health of the neutron detector system by monitoring the device generated histograms (pulse height spectrums). If the neutron detector system is working properly, the pulse height spectrum distribution will be consistent and stable over time. If the distribution changes, adjustments can be made as needed to the neutron pulse module operating parameters (i.e., HV,Gain, Discriminator setttings, etc). Changes in the pulse height spectrum distributions may also give clues to the nature of the problems present. i.e., the user may be able to identify whether there is a problem with the Tube, Electronics, instrument humidity level, etc.

The sections immediately following present for reference classic pulse height spectrums obtained using He3, BF3, and Boron-lined gas proportional tubes. For completeness and reference, a brief discussion of High Voltage plateauing is also included.

The user of Quaesta Instruments Neutron Pulse Modules may find references such as Glenn F. Knoll's book **Radiation Detection and Measurement** useful in understanding the NPM3000E reported histograms and gas proportional tube operation in general.

He3 Tube Spectrums

A typical spectrum for a He3 tube acquired in the laboratory is shown in **Figure 19**. Different gas pressures and tube designs will alter the appearance somewhat but thebasic features will remain.

The location of the Peak relative to the Lower Edge of the "Wall Effect Continuum" is a property of the gas used in the detector. For ^{3}He gas an alpha particle and a triton are produced when a neutron reacts with a ^{3}He nucleus, i.e.

$^{3}_{2}He + ^{1}_{0}n \rightarrow ^{3}_{1}He + ^{1}_{1}p$, Q-value= $0.764Mev$. In this case the ratio:

$$\frac{E_{^{3}H}}{E_{^{3}H} + E_{p}} = \frac{0.191Mev}{0.191Mev + 0.573Mev} = 0.25$$

This ratio can also be found from the histogram (for ^{3}He gas detectors) as

$$\frac{Bin\#of\ Lower\ Edge of\ Continuum}{Bin\#of\ Peak\ Location}$$ = 24/97 ~ 0.25 ; see **Figure 19**

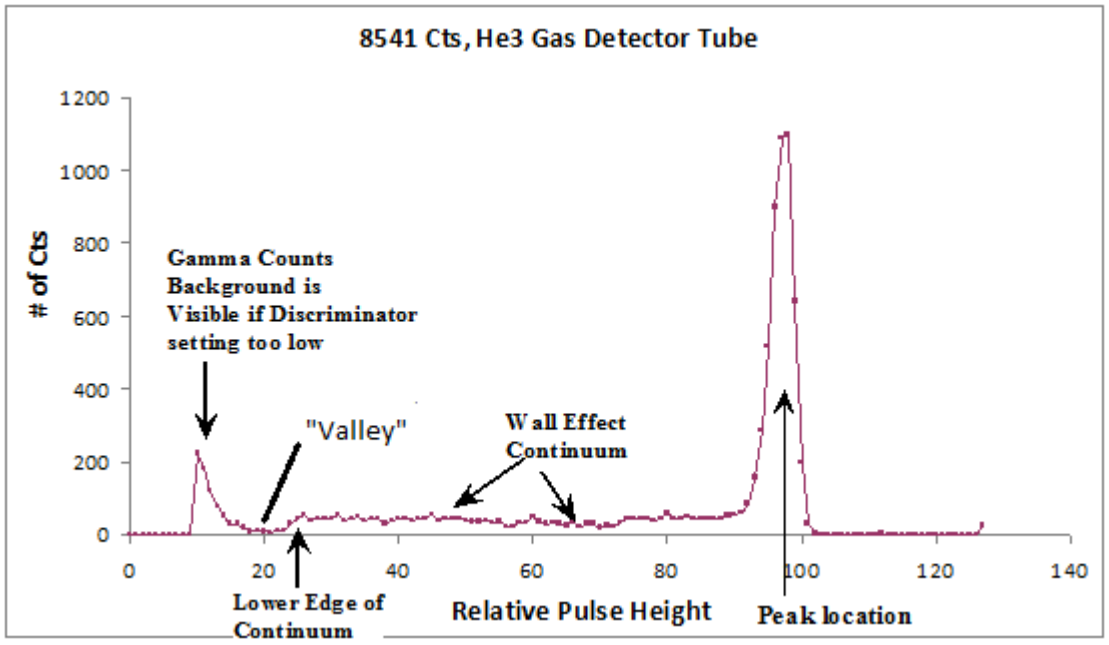


Figure 19. Typical He3 Histogram (Pulse Ht Spectrum)

A "valley" is located to the left of the wall effect continuum and separates the neutron generated pulses from lower amplitude pulses created through Gamma ray background and electronic noise.

Note:

A user interested in counting all measured neutrons with maximum insensitivity to changes in operating voltage, electronic gain, and tube performance may set the lower discriminator in the "valley" region.

Other users may desire to set the lower discriminator value in the wall effect continuum region to ensure further immunity to noise and gamma induced background.

An advantage of the use of the histogram information is the ability to consistently, reliably, and repeatedly set the voltage, gain, and lower and upper discriminators.

An addditional advantage of the use of the histogram information is in monitoring the system health of the neutron detector configuration.

BF3 (Boron-10 enriched) GasTube Spectrums

For BF_3 (B-10 enriched) gas detectors the neutron counting spectrum looks a bit different. A spectrum will have the general characteristics as shown in **Figure 20** and has been well characterized in the literature. Different gas pressures and tube designs will alter the appearance somewhat. The dual peaks in the pulse height spectrum are a result of the branching of the reaction between the excited state and ground state of the ^{7}Li product nucleus. The reader is invited to consult references such as Glenn F. Knoll's book **Radiation Detection and Measurement** for more information.

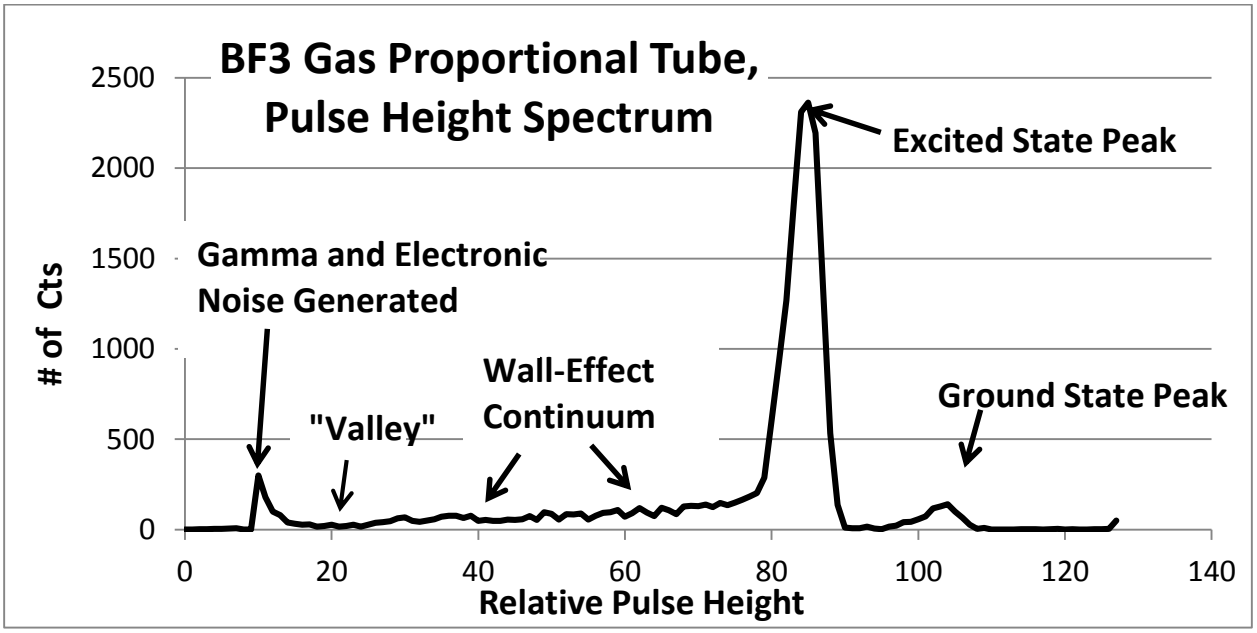


Figure 20. Typical BF3 Histogram (Pulse Height Spectrum)

A “valley” is located to the left of the wall effect continuum and separates the neutron generated pulses from lower amplitude pulses created through Gamma ray background and electronic noise.

Note:
A user interested in counting all measured neutrons with maximum insensitivity to changes in operating voltage, electronic gain, and tube performance may set the lower discriminator in the “valley” region.

Other users may desire to set the lower discriminator value in the wall effect continuum region to ensure further immunity to noise and gamma induced background.

An advantage of the use of the histogram information is the ability to consistently, reliably, and repeatedly set the voltage, gain, and lower discriminator.

An addditional advantage of the use of the histogram information is in monitoring the system health of the neutron detector configuration.

Boron-10 Lined Tube Spectrums

Boron-10 lined tubes introduce boron as a solid coating on the interior walls of a proportional counter tube.

The interactions with incoming neutrons now occur in the wall of the tube. Since the reaction products are oppositely directed, only one of the reaction products can be detected. This leads to a pulse height spectrum without a main peak and without a “valley” .

When a neutron interacts with a B-10 nucleus, two reaction products are produced: a Lithium-7 nucleus and an alpha particle. Due to conservation of momentum, these reaction products travel in opposite directions.

Since the reaction products are generated in the wall of the tubing, only one of these reaction products makes it into the proportional gas medium and is converted to signal. The result is a spectrum similar to that shown for a GE Reuter-Stokes Boron-10 lined tube in **Figure 21**.

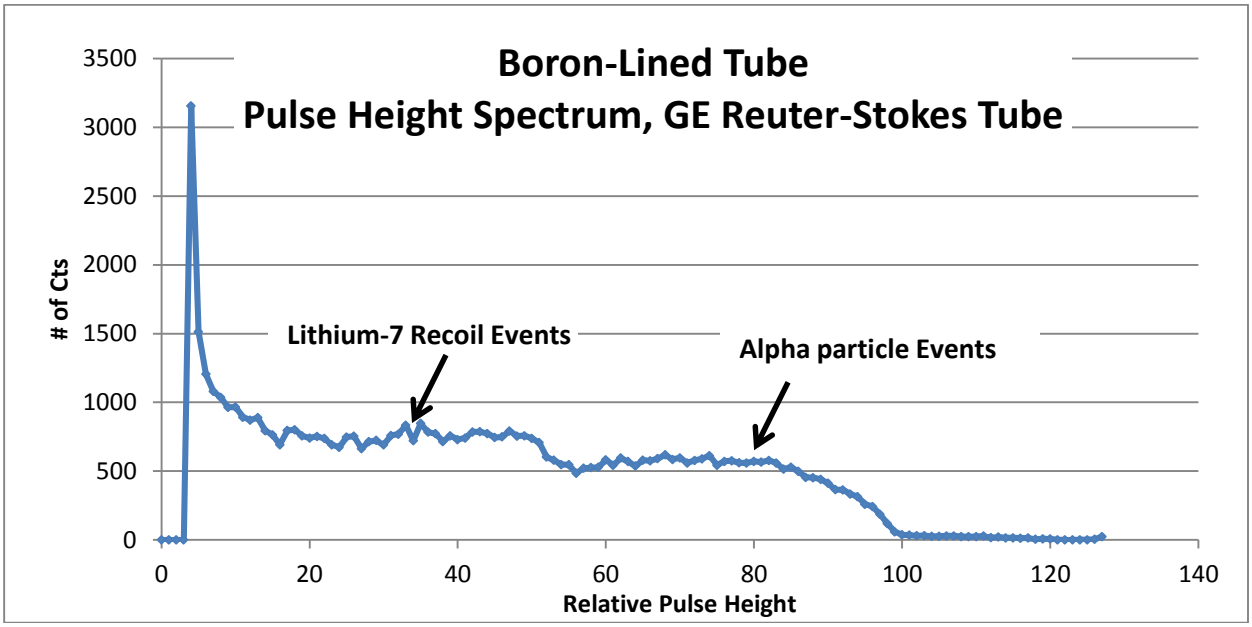


Figure 21. Typical Boron-10 lined Tube Histogram (Pulse Height Spectrum)

Although Boron-10 lined gas proportional tubes lack a "valley" they can be used to produce stable and reliable neutron count measurements over time if the proper electronics such as the NPM3000E module are used and system monitoring is routinely performed.

Using the Histograms toTune the NPM Operating Parameters

Lower Discriminator:

A Lower Discriminator setting acts as a low threshold for pulse counting and pulse height recording. If pulse heights are lower than the Lower Discriminator level, then they are not counted or recorded by the NPM3000E unit. The NPM Lower Discriminator level is set as a Histogram Bin location. Bin 20 - 23 is for example a typical setting for He3 tubes if the Peak in the Pulse Height Spectrum is between 95 and 100, inclusive. See ***He3 Tube Spectrums*** for further discussion.

Note that if the Lower Discriminator is set too low, the NPM3000E can also be sensitive to Gamma Background and low level electronic Noise.

A typical user setting is in the "valley" between the Gamma Background and the Wall Effect continuum, although some users prefer to set the Lower Discriminator up on the continuum "shelf", ensuring further immunity to gamma pile up and low amplitude electronic noise.

Gain: By increasing the amplifier gain one increases the measured pulse heights which have the effect of sliding the peak in the spectrum to the right. Changing the gain in essence "expands" and "compresses" the spectrum laterally. Increasing the gain will amplify the pulse heights but will also amplify gamma background and electronic noise.

High Voltage: Increasing/decreasing the high voltage applied to the tube will also amplify/reduce the detector generated pulse heights. Increasing the pulse heights via the high voltage, rather than changing the electronic gain, has the benefit of amplifying the detector generated pulse heights while not amplifying the electronic noise. However, neutron detector tube manufacturers generally provide a recommended operating voltage. The detector tube manufacturer has typically designed the tube for maximum performance near the recommended operating voltage. In addition, increased operating voltage can lead to a greater incidence of spurious counts due to high voltage breakdown. If the tube operation is sensitive to higher humidities, then increased operating voltages can sometimes exacerbate such sensitivity.

Upper Discriminator: The Upper Discriminator allows one to filter out pulse heights which are higher than a chosen value. The NPM3000E counts pulse heights greater than the Lower Discriminator bin number and lower than or equal to the Upper Discriminator bin number.

Note: Histogram Bins are numbered from 0 to nBins-1. A 128 bin histogram will have bins numbered from 0 to 127. Setting the Upper Discriminator setting to 127 or higher results in effectively no Upper Discriminator at all, and all pulse heights greater than the Lower Discriminator setting will be counted.

Spurious counts in the form of high voltage breakdown events are often full scale (high pulse amplitude events).

Note: On Quaesta Instruments NPM devices, the Upper Discriminator setting **does not affect the recorded histogram** but **does affect the counted pulse tally**.
i.e., **pulses with pulse heights greater than the Upper Threshold setting will still show up in the recorded and reported histograms but will NOT be "counted" or "tallied" as neutron counts.**

******This is done to allow the user to continue to monitor the relative number of higher amplitude pulses while not officially counting these pulses…***

HV Counting Plateaus, Reference

A traditional HV counting plateau for a neutron detector with neutron pulse module is as shown in **Figure 22**.
Proper setting of the Q-NPM-Parameters will result in operation in a "Counting Plateau" region. In such a configuration the Neutron Pulse Module and Detector Tube System is maximally insensitive to changes in Gain, High Voltage, and even the Discriminator Level itself. A maximally stable HV counting plateau will result when the Lower Discriminator is placed in the "valley" of He3 or BF3 tube pulse height spectrums indicated in **Figure 19** and **Figure 20**, respectively.

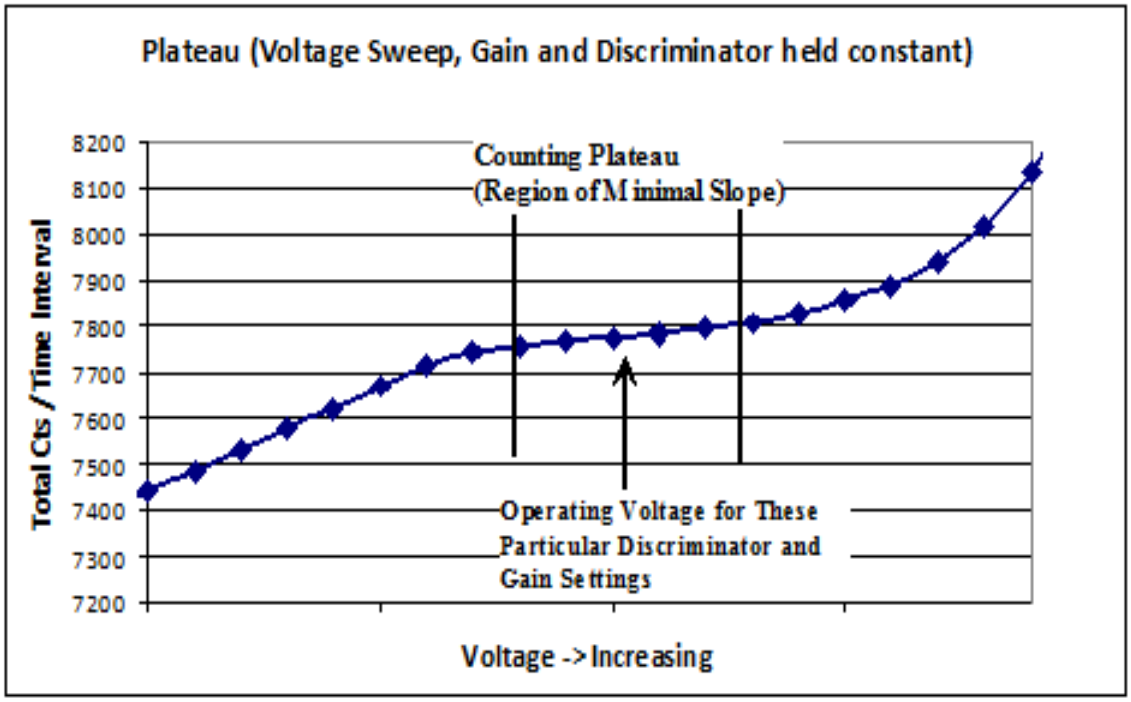


Figure 22. Traditional HV Counting Plateau

Generation of this plateau can be cumbersome to complete without a neutron source, and is often not a viable option in the field when only cosmic background generated thermal neutrons are available. In such a case, use of histograms such as those in **Figure 19** and **Figure 20** for He3, BF3 and B-10 lined gas proportional tubes, respectively, can be used to set the NPM parameters and monitor the detector performance.

Furthermore, Boron-10 lined proportional gas tube pulse height spectrums do not have a "valley" and therefore will not have an HV plateau. As such, the use of the

NPM3000E integrated MCA can be invaluable as a setup tool as well as a system monitor tool.

***Use of the NPM3000E histograms enables the user to easily, reliably, consistently and systematically configure their neutron detection system.*

Detector Configuration Examples

Some Quaesta Instruments NPM users have found the following detector cofiguration guidelines useful for quickly optimizing and configuring their neutron detector systems. It is recognized that system operators have their own preferred settings and configurations, derived from years of industry experience. The following settings will result in maximal counting of detector neutron events and will place the Lower Discriminator value in the "valley" on He3 and BF3 gas proportional tubes. Some operators prefer to set the Lower Discriminator more conservatively, up "on" the Wall Effect Continuum shelf, providing greater immunity to low amplitude noise, such as that generated by gamma ray pileup and electronic noise. The use of the histograms gives the operator confidence and peace of mind in their detector configuration.

Example Configurations:

If using He tubes:

1. Set the number of Bins to 128. This is the Quaesta Instruments NPM factory default.
2. Set the operating voltage to a voltage near the Tube manufacturer's recommended operating voltage.
3. Set the gain so that the location (in Bin #'s) of the Peak in the Pulse Height spectrum is between 95 and 100.
4. Set the Lower Discriminator level to near bin 20-23 (the low edge of the continuum should be at approximately bin 24). If the gamma background and other low amplitude noise are well behaved then one will be setting the discriminator in the "valley" (See ***He3 Tube Spectrums*).**
5. The user may instead desire to set the Lower Discriminator up on the continuum shelf for greater immunity to gamma pile up and/or electronic noise generated low pulse amplitude events. (See ***He3 Tube Spectrums*).**
6. Set the Upper Discriminator value as desired to filter high pulse amplitude events. Remember that the Bin numbers range from Bins 0 to (nBins -1). i.e., a settng of UpperDisc=127 for an NPM with nBins=128 will turn off the discriminator. Setting UpperDisc=126 will filter those events with Pulse Height 127 or higher (i.e., will filter all full analog scale pulse events).

It using BF tubes:

1. Set the number of Bins to 128. This is the Quaesta Instruments NPM factory default.
2. Set the operating voltage to a voltage near the Tube manufacturer's recommended operating voltage.
3. For tubes set the gain so that the location (in Bin #'s) of the Peak in the Pulse Height spectrum is around 85.
4. Set the discriminator level to Bin 27-30 (the low edge of the continuum should be somewhere near bin 30). If the gamma background and other low amplitude noise are well behaved then one will be setting the discriminator in the "valley". See the heading entitled ***BF3 (Boron-10 enriched) GasTube Spectrums***
5. The user may instead desire to set the Lower Discriminator up on the continuum shelf for greater immunity to gamma pile up and/or electronic noise generated low pulse amplitude events. See the heading entitled ***BF3 (Boron-10 enriched) GasTube Spectrums*.**
6. Set the Upper Discriminator value as desired to filter high pulse amplitude events. Remember that the Bin numbers range from Bins 0 to (nBins -1). i.e., a settng of UpperDisc=127 for an NPM with nBins=128 will turn off the discriminator. Setting UpperDisc=126 will filter those events with Pulse Height 127 or higher (i.e., will filter all full analog scale pulse events).

Should the user desire to generate HV counting plateaus with the NPM3000E device, the plateau may be generated by interactively or programmatically sweeping the NPM3000E voltage and recording the counts in fixed time intervals. The details are left to the user.

Appendix A. Command and Parameter Description

A thorough description of NPN3000-E commands and parameters are included in this appendix.

Commands are to be sent as text commands via the Ethernet interface using the TCPIP protocol. Commands should be terminated with a Carriage Return and Linefeed character sequence (i.e. CR+LF). NPM3000E output issued as a result of these commands are also transmitted as text via the Ethernet interface using the TCPIP protocol.

Terminal emulators such as Teraterm Pro or Windows Hyperterminal can be configured to communicate with NPM3000E devices via TCPIP. Configuration of these terminal emulators is covered in appendices at the end of this manual. Quaesta Instruments personnel generally prefer the Teraterm Pro terminal program.

A provided set of PC executables allows the user to communicate through a PC command prompt window.

Alternatively a GUI application provided by Quaesta Instruments can be utilized to communicate with the NPM3000E devices.

Both the command prompt command line executables and the GUI application make use of the basic NPM3000E firmware commands identified in the quick reference below.

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

- C – Control Commands
- R – Read Commands
- R/W -- Read/Write Parameter Commands (i.e., the parameter is both readable and writeable)

Read parameters and commands can be queried by simply typing the name (i.e., ‘Gain’)

Write parameters can be written or set by using an equal sign (i.e. ‘Gain=3.8’).

Control commands can be activated by simply typing the name with any required arguments, i.e. ‘reboot’.

These commands are organized below by functionality and “subsystem” in the appendix Subsections below.

A1. Miscellaneous Device Commands and Parameters

Miscellaneous Device Commands and Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A1.1	`Name`	R/W	Name of the NPM3000E device
A1.2	`Menu`	R	Report all available commands
A1.3	`Info`	R	Report device identification and parameters
A1.4	`Status`	R	Report various status information
A1.5	`Reboot`	C	Reset the system

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A1.1 `Name` *R/W. The assigned name of the NPM3000E device*

Each NPM can have a unique Name determined by the user. The Name can consist of a string of alphanumeric characters and is limited to 16 characters maximum length. Entering "Name" without an argument will display the current Name.

Example:

```
Name= NPM_Unit#1
NPM_Unit#1
```

A1.2 `Menu` *R. Display a list of all user availabe commands*

Displays brief descriptions and where appropriate, examples of use for each command.

A1.3 `Info` *R. Display all system user parameters*

Provides the Firmware Version, Model, Model Version, and Serial Number, followed by a list of the user settable parameters. An example of the output is shown below.

Example:

```
info
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.2.4
```

```
Model                NPM3000E
Model Version        HV2K-DL-TH-C-HN16
Serial Number        12090161
Name                 IP161
//NPM3KE PARAMETERS//
Voltage              1500
MaxVoltage           2000
Gain                 3.0
LowerDisc            30
UpperDisc            127
nBins                128
DeadTime             160
VibeMode             0
PeakMode             0
HgmMode              2
TTLMode              0
LEDMode              1
PulseLevel           0.40  (with Input Pulse Counter option)
//LOGGER PARAMETERS//
PrintDAT             1
SaveDAT              1
PrintHGM             0
SaveHGM              1
PulseCounterON       1     (with Input Pulse Counter option)
TemperatureON        1
HumidityON           1
BatteryON            1
SignalON             0
RecordPeriod(Sec)    60
RecordsPerHGM        60
NewFilePeriod        Day
Current Time         2012/09/04,15:29:38
```

A1.4 Status *R. Display current system status*

Displays a summary of the device condition, as shown below.

```
status
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.2.4
Model                NPM3000E
Model Version        HV2K-DL-TH-C-HN16
Serial Number        12090161
Name                 IP161
Set Voltage          1500
Measured Voltage     1500.1
Temperature          27.9
```

```
Humidity            12.4
Battery             12.11
Signal              0
PulseLevel          0.01   (with Input Pulse Counter option)
RecordPeriod(Sec)   60
RecordsPerHGM       60
NewFilePeriod       Day
Current Record      9822
UpTime              584895
SaveDAT             1
SaveHGM             1
DAT FileName        /DAT/IP161_1211010000.DAT
HGM FileName        /HGM/IP161_1211010000.HGM
Current Time        2012/11/01,16:21:40
```

A1.5 `Reboot` *C. Reboot the system firmware.*

Reboot the NPM3000E system firmware. The NPM3000E device firmware will Reset. The NPM3000E device will then start up as after a Power Cycle sequence. The NPM3000E device will reset both the Internal and External SD cards whenever the system starts up. The reset sequence takes approximately 6 seconds before the bootloader sequence starts.
Six question marks will then be output as the bootloader runs, after which time the main firmware code program will start.
If desired, loading of new firmware code must be initiated within the 6 question mark sequence. **See Appendix D: Firmware Upload Procedures.**

A2. NPM Commands and Parameters

The NPM commands and parameters described below are parameters specific to the Neutron Pulse Module electronics operation.

NPM Commands and Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A2.1	`Voltage`	R/W	High Voltage Supply value in Volts (250 to 2000)
A2.2	`MaxVoltage`	R/W	Maximum allowed High Voltage (0 to 2000)
A2.3	`Gain`	R/W	Amplifier Gain (1.0 to 20.0)
A2.4	`LowerDisc`	R/W	Lower Discriminator (Neutron Pulse Detection Threshold)
A2.5	`UpperDisc`	R/W	Upper Discriminator
A2.6	`Nbins`	R/W	Number of Bins used in the integrated Multi-Channel Analyzer histograms
A2.7	`DeadTime`	R/W	Neutron pulse detection dead-time or “lockout” time
A2.8	`VibeMode`	R/W	Vibration cancellation mode -not typically used (0 or 1)
A2.9	`PeakMode`	R/W	Pulse shape display mode - not typically used (0 or 1)
A2.10	`HgmMode`	R/W	Histogram format mode (1,2, or 3)
A2.11	`LEDMode`	R/W	LED activation mode (0 or1)
A2.12	`Counts`	R	Report and zero the neutron pulse counter
A2.13	`Query`	R	Report the neutron pulse counter without zeroing
A2.14	`Hgm`	R	Report the histogram according to HgmMode
A2.15	`MaxHgm`	R	Report histogram maximum information
A2.16	`ZeroCounts`	C	Zero the neutron pulse counter
A2.17	`ZeroHgm`	C	Zero the neutron pulse height histogram
A2.18	`Adev`	R	Reports Analog Noise Average Deviation (diagnostic)

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., ‘Gain’) and can be written or set by using an equal sign after the parameter (i.e. ‘Gain=3.8’).

A2.1 `Voltage` *R/W.* *High Voltage Supply value (Volts).*

Each NPM has an internal high voltage power supply which can be set to any Voltage between 250 Volts and 2000 Volts. The Voltage is set with an integer value and is regulated to a precision of 0.1 Volt. Entering a Voltage greater than

the *MaxVoltage* parameter is not allowed and will result in the Voltage being set to MaxVoltage. Entering "Voltage" without an argument will display the currently measured Voltage and the desired Voltage.
Example:

```
voltage=1300
1300
```

The voltage will ramp slowly to the new voltage (will take approximately 20 seconds for voltage to ramp from 0 to 1000V and stabilize):

```
voltage
Measured/Set: 1300.1/1300
```

A2.2 `MaxVoltage` *R/W.* *Maximum Allowed High Voltage*

The MaxVoltage parameter is a safeguard which helps prevent accidentally setting the Voltage to a level higher than would be considered safe for the neutron detector tubes being used with the NPM. For example, perhaps the user desires to experiment with a variety of voltages when using a particular tube, but wishes never to exceed a maximum voltage. MaxVoltage can be set to the maximum allowable voltage that is recommended for the tube. Entering "MaxVoltage" without an argument will display the current MaxVoltage value.

Example:

```
MaxVoltage= 1800
1800
```

A2.3 `Gain` *R/W.* *Amplifier Gain.*

The neutron pulse module amplifier Gain can be set to any value between 1.0 and 20.0 with a resolution of 0.1. Typically, the Gain will be set according to the requirement for a particular detector tube. A Gain producing pulse heights of roughly 75-80% of the full scale range of the amplifier is ideal. For example, if the Nbins parameter is set to 128, the user may desire to select a Gain that causes the majority of pulses to produce peak heights of approximately 100. The pulse heights can easily be observed in real-time by setting *PeakMode=1*. Alternately, the pulse height histogram can be viewed to determine the height of the majority of the pulses. Entering "Gain" without an argument will display the current Gain value.

Example:

```
Gain= 5.7
5.7
```

A2.4 `LowerDisc` *R/W.* *Neutron Pulse Detection Lower Threshold*

The LowerDisc discriminator value determines the pulse height (in histogram Bin numbers) below which a pulse is not counted. This is typically used to filter out gamma ray pulses or low level electronic noise. The units of LowerDisc are in

bin numbers. So for example, if Nbins=128 then a LowerDisc value of 32 would prevent pulses that have a height of less than 25% (32/128) of full scale from being counted. Entering "LowerDisc" without an argument will display the current LowerDisc value.

Example:

```
LowerDisc= 30
30
```

A2.5 `UpperDisc` *R/W.* *Neutron Pulse Detection Upper Threshold*

The UpperDisc parameter prevents pulses with heights above a threshold level (in histogram Bin numbers) from being counted. The units of UpperDisc are in bin numbers. For example, if Nbins=128, then an UpperDisc value of 120 would prevent pulses that have a height greater than 93% (120/128) of full scale from being counted. This can be used to eliminate coincident events or spurious noise pulses which can have exceedingly large pulse heights.

The Maximum value of the UpperDisc parameter is (Nbins-1). If set to the maximum value, the Upper Discriminator is disabled and full scale (saturated ADC) pulses will be registered.

Entering "UpperDisc" without an argument will display the current UpperDisc value.

Note on Histogram reporting:
The UpperDisc parameter filters pulses with amplitudes greater than the UpperDisc value from being recorded in the total counts parameter. However, the UpperDisc parameter does not affect the recorded histograms. i..e, when an UpperDisc value is set, the recorded histogram will still tally counts in bins higher than this value. This is done so that users can still observe and monitor the overall pulse height distribution and monitor high amplitude pulses even when they do not want to count them. High amplitude pulses can be an indicator of spurious counts or high voltage breakdown in the detector tube, connector, or NPM electronics.

Example:

```
UpperDisc= 125
125
```

A2.6 `Nbins` *R/W.* *Number of MCA Histogram Bins*

Specifies the number of bins, or resolution, of the pulse-height histogram recorded by the NPM3000E integrated Multichannel Analyzer (MCA). Allowed values for Nbins are: 64, 128, 256, 512, and 1024. Any other value will be rejected. Entering "Nbins" with no argument displays the current value.

Example:
```
Nbins= 128
128
```

A2.7 `DeadTime` *R/W.* *Neutron pulse detection "lockout" time*

The DeadTime parameter specifies the minimum time interval, in microseconds, during which two consecutive pulses can be detected. DeadTime can sometimes be useful for screening out semi-coincident pulses wherein two briefly spaced pulses occur due to a single common event. For example, if an event is known to cause multiple counts to be generated within a specific time period, the DeadTIme parameter can be adjusted to a value equal to or greater than this time period as a way to eliminate the secondary pulses. The smallest allowable DeadTime is 160us and the longest DeadTime is 65536us (range = 0.16 msec to 65.5 msec). Entering "DeadTime" with no argument displays the current value.

Note: DeadTime in neutron counting devices is sometimes referred to as a "Lockout Time."

Example:
```
DeadTime= 2000
2000
```

A2.8 `VibeMode` *R/W.* *Vibration cancellation mode*

The VibeMode parameter turns OFF or ON (0 or 1) a mechanical vibration cancellation algorithm. This algorithm examines the shape of the pulse and can eliminate many pulses that are sometimes generated when there are large mechanical vibrations of the neutron detector tube. Entering "*VibeMode*" without an argument will display the current VibeMode value. For the "*VibeMode*" feature to operate properly, the *Gain* parameter should be set to produce maximum pulse heights approximately 80% of full scale or less. If *VibeMode = 1* and full scale real neutron pulses are present (as might occur if the *Gain* is high) these full scale neutron pulses may be rejected and not counted.
Entering "VibeMode" with no argument displays the current value.

Contact Quaesta Instruments for more guidance on using this mode.
Example:
```
VibeMode=0
0
```

A2.9 `PeakMode` *R/W.* *Pulse shape display mode.*

PeakMode provides a method for observing pulse shape and peak pulse height information about individual detected neutron pulses as they occur in real-time. If PeakMode is set to a value of 1, only the pulse height (peak of the pulse) information is displayed. Entering " PeakMode" without an argument will display the current PeakMode value.

Note: This value is not stored in EEPROM, and thus will not be remembered at startup or reboot.

Example:
PeakMode= 1

A typical pulse peak-height summary, with a 128 bin histogram, might look similar to the following:

P=1628,B= 101,C=1092

where:

- P is the Pulse maximum height (peak height) in ADC bits. Full scale analog measurements are 2048 bits.
- B is the corresponding Bin location in histogram bin numbers.
- C is the current neutron count number since the last zeroing of the neutron counter

The "P" value is the pulse peak-height and has a maximum value of 2047. The "B" value is the bin number within which the pulse peak value falls. The magnitude of this value will depend on the number of bins in the histogram (Section 3.7). The "C" value is the number of counts that have been measured since the last time the "Counts" or "ZeroCounts" commands were issued.

If PeakMode is set to a value from 2 to 256, the peak-height information is followed with data representing the pulse shape. The analog pulses are bi-polar and the pulse-shape data are integers ranging from -2047 to +2047, with a value of 0 representing the quiescent state of the amplifier output.

Note that the PeakMode parameter is not retained in non-volatile memory and the PeakMode command must be re-issued at startup.

Example:
A typical displayed pulse shape output might look similar to the following:

```
PeakMode= 32
P=1628,B= 101,C=1092
 764
 966
1162
```

```
1293
1405
1495
1567
1612
1628
1623
1597
1572
1528
1463
1384
1299
1219
1124
1023
 914
 810
 686
 574
 455
 345
 236
 114
 12
-83
-170
-251
-331
```

A2.10 `HgmMode` *R/W.* *Reported Histogram format mode*

The *HgmMode* parameter specifies the format in which the histogram is displayed following an *Hgm* command.

HgmMode= 1 , the histogram consists of a single column with *Nbins* number of rows. Each row contains the number of pulse counts that have been placed in the corresponding bin number.

HgmMode= 2 , the histogram is displayed in a similar manner to *HgmMode=1* except that a prefixed column is added which specifies the bin number for each histogram value.

HgmMode= 3 , the histogram is displayed in a similar manner to *HgmMode=1* except that the histogram values are scaled such that the histogram peak has a value of 255. This is useful for normalized graphical representations of the histogram.

In all cases, the histogram is followed by the total number of counts represented in the histogram and the total number of seconds that have elapsed, since the histogram was last zeroed with the *ZeroHgm* command. Entering *HgmMode* without an argument will display the current *HgmMode* value.

Example:
```
HgmMode=2
2
```

A2.11 LEDMode *R/W.* *LED Activaton Mode*

LEDMode= 1 , the LED on the back of the NPM3000E will momentarily flash whenever a pulse is detected.
LEDMode= 0 , the LED flash is suppressed.

Note that when the Ethernet communications port is powered, the LED flash is always activated regardless of LEDMode. Entering *LEDMode* without an argument will display the current LEDMode value.

Example:
```
LEDMode=0
0
```

A2.12 Counts *R.* *Display and Zero the Neutron Pulse Counter*

Displays the number of pulses counted since the last *"Counts"* command was issued or since the last *"ZeroCounts"* command was issued. The neutron counts value is set to zero following the display of the current value.

A2.13 Query *R.* *Display the Neutron Counter Without Zeroing*

Displays the number of pulses counted since the last "*Counts"* command was issued or since the last "ZeroCounts" command was issued. The *"Query"* command does not zero the neutron counts value.

A2.14 Hgm *R.* *Displays the MCA histogram*

Displays the currently accumulated histogram according to the format specified by the *HgmMode* parameter.

A2.15 `MaxHgm` *R.* *Display histogram maximum information*

Displays the position of histogram maximum in Bin numbers, maximum value of the histogram (in number of counts), and the total number of counts in the histogram.

A2.16 `ZeroCounts` *C.* *Zero the neutron pulse counter*

Zeroes the neutron pulse counter.

A2.17 `ZeroHgm` *C* *Clears the NPM pulse height histogram*

Zeroes or Clears the neutron pulse module histogram recorded by the integrated Multichannel Analyzer.

A2.18 `Adev` *R.* *Analog Noise Average Deviation (diagnostic)*

Calculates the "Analog noise Average Deviation", a parameter generally only used for diagnostic purposes. The NPM3000E unit will sample a burst of analog measurements on the neutron pulse ADC channel and report the Average deviation (similar to the standard deviation) and also report the MAX and MEAN ADC values of the burst. The user may enter a parameter to indicate the number of *`Adev`* measurements to average.

Example:

```
adev= 10
NoiseADEV=  17.000  NoiseMAX=  83  NoiseMEAN=  -1
```

This will report the average of 10 *Adev* measurements. The values returned are In ADC values. 1 ADC bit is approximately 0.00073, or 0.73 mVolts.
The Adev reported values should be converted to an effective histogram bin number since the *`LowerDisc`* and *`UpperDisc`* parameters are entered as Bin numbers (see **Section A2.4** and **Error! Reference source not found.** for *`LowerDisc`* and *`UpperDisc`* description).
The electronics have been designed such that 1.5V corresponds to 2048 ADC bits. To convert to Bin# use, for example, the following:

*Bin# = NoiseMax * Nbins / 2048*

If NoiseMax=83, as above, the corresponding Bin# of such noise is 5.2. This means that at least one "noise" pulse would have been detected during the *`Adev`* interval if *`LowerDisc`* had been set to the value 5.

Contact Quaesta Instruments for further information.

A3. Input Pulse Counter Commands and Parameters

Input Pulse Counter Commands and Parameters, Quick Reference (Requires Input Pulse Counter Option)

Sec	Command Name	Cmd Type	Operation
A3.1	`PulseCounterOn`	R/W	Input Pulse Counter mode (0,1, or 2)
A3.2	`PulseLevel`	R/W	Input Pulse Counter Threshold Voltage (0.00 to 4.00)
A3.3	`PulseCounts`	R	Display and Zero the Input Pulse Counter
A3.4	`PulseQuery`	R	Display the Input Pulse Counter without Zeroing
A3.5	`ZeroPulseCounts`	C	Zero the Input Pulse Counter

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A3.1 `PulseCounterON` *R/W.* *Input Pulse Counter Mode*

The Input Pulse Counter can be set in one of three modes: OFF, Low Power Consumption Mode, or High Count Rate mode.

"**Table 3. Power Consumption**" in **"Section 2. Electrical Specifications"** summarizes the system Power consumption and corresponding maximum counting rates for the three *PulseCounterON* modes.

PulseCounterON=0 , The Input Pulse Counter is OFF and Input Pulse Counts will not be recorded in data records.

PulseCounterON=1 , The Input Pulse Counter is ON in Low Power consumption mode. Input Pulse Counts will be recorded in data records.

Voltage=0 (Neutron Pulse Module counting is disabled) then the NPM3000E device is itself in low power mode and the microcontroller clock frequency is running at a minimum value in order to minimize power consumption and minimize the system battery drain. The maximum count rate of the Input Pulse Counter in this case is nominally 1.9 MHz.

.

If *Voltage* is non-zero (i.e., > 250V) the Neutron Pulse Module subsystem is fully active. The Input Pulse Counter will operate with a maximum count rate of nominally 10 MHz.

PulseCounterON=2 , The Input Pulse Counter is ON in Maximum Counting Rate mode. Input Pulse Counts will be recorded in data records.

The Input Pulse Counter will operate with a maximum count rate of nominally 10 MHz.

This is irrespective of the High Voltage supply value of the Neutron Pulse Module. The microcontroller clock frequency will be run at its highest rate to maximize the counting rate. This comes at the expense of greater power consumption when *Voltage=0*.

A3.2 `PulseLevel` *R/W.* *Input Pulse Counter Lower Threshold Voltage*

The Input Pulse Counter threshold voltage level will count Input Pulses with pulse heights above this level and will ignore pulses with pulse heights below this threshold value. This units are Volts.

A3.3 `PulseCounts` *R.* *Display and Zero the Input Pulse Counter*

Display and Zero the Input Pulse Counter.

A3.4 `PulseQuery` *R.* *Display the Input Pulse Counter without Zeroing*

Display the Input Pulse Counter without Zeroing the Input Pulse Counter.

A3.5 `ZeroPulseCounts` *C.* *Zero the Input Pulse Counter*

Zero the Input Pulse Counter.

A4. TTL Output Commands

The NPM3000E may be configured with an optional TTL output.
This is indicated in the model version by the inclusion of a –TTL.

TTL Output Commands (with TTL Output Option), Quick Reference

Sec	Command Name	Cmd Type	Operation
A4.1	TTLMode	R/W	TTL Output Mode, 0 or 1

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A4.1 `TTLMode` *R/W.* *TTL Output Mode.*

The TTL Output mode may optionally provided at the time the product is ordered. Contact Quaesta Instruments to discuss configuration options.

Mode options include options of the form:

`TTLMode=0`, TTL Output off.
`TTLMode=1`, TTL output pulse width 1 = 63 nsec

Additional *`TTLMode`* pulse width options can be provided. Contact Quaesta Instruments with such requests.

The TTL output is a logical OR of the NPM neutron pulse output and the external Pulse Counter input. This allows devices to be "daisy-chained" allowing for high count rates in banks of detectors.

In addition, the TTL output can be configured to have low impedance (50 ohms) or high impedance per customer request.

A5. Sensor Commands

Sensor Commands (with Sensors Option), Quick Reference

Sec	Command Name	Cmd Type	Operation
A5.1	`Temperature`	R	Temperature and Relative Humidity
A5.2	`Humidity`	R	Temperature and Relative Humidity
A5.3	`Battery`	R	Battery Voltage (Power Supply Voltage)
A5.4	`Signal`	R	External Signal State

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A5.1 `Temperature` *R. Report Temperature and Relative Humidity*

Report Temperature and Relative Humidity, Comma Separated, i.e.
T, RH

Example:

```
temperature
 28.7,35.5
```

The temperature is 28.7 C and the Relative Humidity is 35.5%

A5.2 `Humidity` *R. Report Temperature and Relative Humidity*

Report Temperature and Relative Humidity, Comma Separated, i.e.
T, RH

Example:

```
humidity
 28.7,35.5
```

The temperature is 28.7 C and the Relative Humidity is 35.5%

A5.3 `Battery` *R. Report Battery Voltage (Power Supply Voltage)*

Report NPM3000E Power Supply voltage in Volts.

Example:

```
Battery
12.03
```

A5.4 `Signal` *R. Report External Signal State*

External Input Signal Level (Phoenix 6-pin connector Pins 5 and 6).
Returns:
0 if Differential Input < 1.1 V.
1 if Differential Input > 1.5V.

A6. Ethernet to Microcontroller Serial Communication Parameters

The NPM3000E devices utilizes an Ethernet to Serial device for the purposes of interfacing TCPIP communication to a serial UART on the NPM3000E microcontroller.

Ethernet to Serial Communication Parameters, Quick Reference

Sec	Command Name	Cmd Type	Operation
A6.1	`ComEcho`	R/W	Turns Off/On echoing of input characters (0,1)
A6.2	`ComFlowControl`	R/W	0 – No Flow Control 1 – XON/XOFF Software Flow Control 2 – Hardware Flow Control (for NPM3000E Devices manufactured after Sept 2013). NPM3000E Serial Numbers begin with YYMM where YY is year and MM is month of manufacture.
A6.3	`ComTimeout`	R	Sets a Timeout parameter. Particularly useful when using XON/XOFF software flow control.
A6.4	`ComBaudRate`	R	Baud Rate

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A6.1 `ComEcho` *R/W. Echoing of TCPIP incoming characters*

Turns Off/On echoing of incoming TCPIP characters to the sender.
0 – Echo Off
1 – Echo On

A6.2 `ComFlowControl` *R/W. Flow Control for Ethernet to Serial Comm*

A Lantronix Xport Ethernet to seial adapter is employed in the NPM3000E devices.
Flow control is available to make sure outgoing TCPIP communication from the NPM3000E device is robust.
This is particularly important when retrieving files of data from the NPM3000E device or when using high Ethernet to Serial Comm baud rates.

Values allowed:

0 – No Flow Control
1 – XON/XOFF Flow Control
2 – Hardware Flow Control (CTS/RTS)

Note that the Lantronix XPort device must be configured to utilize the same Ethernet to Serial baud rate and Flow Control configuration as the NPM3000E device.
i.e., after setting the ComFlowControl parameter on the NPM3000E device, the Lantronix Xport Flow Control must be set to match the NPM3000E flow control setting.
If using the Quaesta Instruments provided GUI, the Quaesta Instruments GUI application will automatically attempt to connect to the Xport and make the appropriate Flow Control setting. The XPort can also be configured directly through an http interface (i.e. web browser) or via Telnet. See **Section 6. *Configuring the Lantronix XPort Ethernet to Serial Adapter*** parameters for more details and examples of configuration of the XPort device.

Option 2, Hardware Flow Control, is preferred, but is only available on devices manufactured after Sept 2013.

If Xon/XOff flow control is used, sending of binary data requires encoding Xon/XOff characters which may be found in the binary stream.
See Appendix XX for a description of binary data records and PPP type encoding implemented when `ComFlowControl=1`

The Quaesta Instruments provided GUI application and PC command line executables supports XON/XOFF flow control when retrieving binary files of data.

Note that when using the NPM3000E devices with hardware flow control, the devices behave as if the user was directly connected via TCPIP to the microcontroller. The Xport and NPM3000E microcontroller robustly manage the flow of data internally, which is transparent to the user.
Thus, CTS/RTS hardware flow control (`ComFlowControl=2`) is preferred if implemented on the NPM3000E device hardware. All devices with manufactturing dates after Aug 2013 will have CTS/RTS flow control capability implemented in hardware. The manufacturing year and month can be found in the device Serial number. The serial number has the format YYMMXXXX.

A6.3 `ComTimeout` *R/W. Ethernet to Serial Timeout parameter, Secs.*

Sets the NPM3000E Ethernet to Serial Timeout parameter, in Seconds. The NPM3000E device will abort the current transmission of serial data if a period of `ComTimeout` seconds elapses when waiting for character input.

A6.4 `ComBaudRate` *R/W. Baudrate of Ethernet to Serial Comm Link*

Allowed Baudrates are 115200, 230400, 460800, and 921600.

Higher baud rates are desirable when transferring larger files of data. Higher baud rates will typically require use of ComFlowControl (see A6.2 in this section). ***Note that the Lantronix XPort device must be configured to utilize the same Ethernet to Serial baud rate and Flow Control configuration as the NPM3000E device.***
After setting the Baud Rate on the NPM3000E device, the Lantronix Xport serial baud rate must be set to the same baud rate. NOTE THAT THE NPM3000E COMBAUDRATE PARAMETER MUST BE SET FIRST AS COMMUNICATION WILL BE GARBLED IF THE XPORT Serial Baud rate setting does not match the NPM3000E microcontroller ComBaudRate setting.

If using the Quaesta Instruments provided GUI to change the `ComBaudRate` setting, the Quaesta Instruments GUI application will first change the `ComBaudRate` parameter on the NPM3000E device, and then automatically attempt to connect to the Xport and make the appropriate Serial baud rate setting. The XPort can also be configured directly through an http interface (i.e. web browser) or via Telnet. See Appendix XX for more details and examples of configuration of the Xport device.

A7. Datalogger Commands

Datalogger Commands and Parameters, Quick Reference (with Datalogging Option)

Sec	Command Name	Cmd Type	Operation
A7.1	`PrintDAT`	R/W	Print text data each RecordPeriod (0 or 1)
A7.2	`SaveDAT`	R/W	Save text data each RecordPeriod (0 or 1)
A7.3	`SaveBIN`	R/W	Save binary data each Recordperiod (0 or 1)
A7.4	`PrintHGM`	R/W	Print histogram periodically (0 or 1)
A7.5	`SaveHGM`	R/W	Save histogram periodically (0 or 1)
A7.6	`TemperatureON`	R/W	Include Temperature in Records (0 or 1)
A7.7	`BatteryON`	R/W	Include Battery in Records (0 or 1)
A7.8	`SignalON`	R/W	Include Signal in Records (0 or 1)
A7.9	`RecordPeriod`	R/W	Data recording interval in seconds
A7.10	`RecordsPerHGM`	R/W	Number of data records between Histograms
A7.11	`NewFilePeriod`	R/W	Interval for New File Creation. (Day, Month, Year)
A7.12	`Time`	R/W	Date and Time (i.e. 2012/05/08 14:35:22)
A7.13	`ShowFilenames`	R	Report current DAT and HGM filenames
A7.14	`LogMode`	R	Report current datalogger settings
A7.15	`ShowData`	R	Sample and report a data record (does not Zero Counts)
A7.16	`CreateNewFiles`	C	Create new files with time-based names

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A7.1 `PrintDAT` *R/W Print data each RecordPeriod (0 or 1)*

Turns OFF/ON the reporting of data to the terminal each RecordPeriod
0 = OFF
1= ON

Example:

```
PrintDAT=1
1
```

A7.2 `SaveDAT` *R/W Save data to SD cards each RecordPeriod (0 or 1)*

Turns OFF/ON the saving of text formatted data to the SD cards each RecordPeriod
0 = OFF
1= ON

Example:
```
SaveDAT=1
1
```

A7.3 `SaveBIN` *R/W Save binary data to SD cards each RecordPeriod*
Turns OFF/ON the saving of data to the SD cards each RecordPeriod
0 = OFF
1= ON

Example:
```
SaveBIN=1
1
```

The use of binary data greatly reduces the amount of data stored. When SaveBIN=1 each binary record contains 22 bytes:
2 bytes –
2 b

A7.4 `PrintHGM` *R/W Print histogram data periodically (0 or 1)*

Turns OFF/ON the periodic reporting of the Multichannel Analyzer Histogram data to the terminal.
0= OFF
1= ON

When *PrintHGM=1* histograms will be sampled and reported to the terminal every (*RecordPeriod * RecordsPerHGM*) minutes.

Example:
```
PrintHGM=0
0
```

A7.5 `SaveHGM` *R/W Save histograms to SD cards periodically*

Turns OFF/ON the periodic recording of the Multichannel Analyzer Histogram data to the SD cards.
0= OFF
1= ON

When *SaveHGM=1* histograms will be sampled and recorded to the SD cards every ((*RecordPeriod* * *RecordsPerHGM*) minutes.

Example:
SaveHGM=1
1

A7.6 `TemperatureON` *R/W* *Include Temperature in Data Records*

Turns OFF/ON the inclusion of Temperature in the data sampled each RecordPeriod.
0=OFF
1=ON

Example:
TemperatureON=1
1

A7.7 `BatteryON` *R/W* *Include Power Supply Voltage in Data Records*

Turns OFF/ON the inclusion of the Power Supply voltage in the data sampled each RecordPeriod.
0=OFF
1=ON

Example:
BatteryON=1
1

A7.8 `SignalON` *R/W* *Include External Signal in Data Records*

Turns OFF/ON the inclusion of the External Signal (as input on pins 5 and 6 of the Phoenix 6-pin connector on the rear panel) each RecordPeriod.
0=OFF
1=ON

Example:
SignalON=1
1

A7.9 `RecordPeriod` *R/W* *Data recording interval in seconds*

Specifies the number of seconds between the sampling of data records. Minimum allowed value is 3 seconds.

Example:
```
RecordPeriod= 60
60
```

A7.10 `RecordsPerHGM` *R/W* *Number of data recording intervals between sampled histograms*

The *`RecordsPerHGM`* parameter specifies the number of records that must occur for each histogram. *`RecordsPerHGM`* can have a minimum value of 1 record per histogram. Entering *`RecordsPerHGM`* without an argument will display the current RecordsPerHGM value.

Example:
```
RecordsPerHGM = 60
60
```

Note: If RecordPeriod = 60 and RecordsPerHGM=60, then Histograms would be sampled every 60 minutes, or once per hour.

A7.11 `NewFilePeriod` *R/W Interval for New File Creation*

Specifies the period of time between which new files will automatically be created. Allowable periods are the words: Day, Month, and Year.

Example:
```
NewFilePeriod = Day
Day
```

A7.12 `Time` *R/W Date and Time (i.e. 2012/05/08 14:35:22)*

Date and Time in YYYY/MM/DD HH:MM:SS format.

Example:
```
Time=2012/07/09 15:24:00
2012/07/09,15:24:00
```

Waiting 20 seconds and then querying:
```
Time
2012/07/09,15:24:20
```

A7.13 `ShowFilenames` *R Report active DAT and HGM filenames*

Report the currently active DAT and HGM filenames.

Example:

```
SaveDAT=1
SaveHGM=0
showfilenames
DAT FileName = /DAT/IP173_1301180000.DAT
HGM FileName : Not Saving Histogram
```

A7.14 `LogMode` *R Reports the current Logger parameters*

Reports the current Datalogger parameters.

Example:
```
logmode
PrintDAT      = 0
SaveDAT       = 1
PrintHGM      = 0
SaveHGM       = 1
PulseCounterON= 1
TemperatureON = 1
HumidityON    = 1
```

```
BatteryON     = 1
SignalON      = 0
RecordPeriod  = 60
RecordsPerHGM = 60
NewFilePeriod = Day
```

A7.15 `ShowData` *R* *Sample and report a data record immediately*

Sample and report a data record immediately. Does not zero the counters.
Example:
TemperatureON=1
HumidityON=1
BatteryON=1

Showdata
2013/01/19,00:01:00, 2091, 459, 25.1,23.4,12.03

The current Record number is 2091, the neutron counter value is 459, Temperature is 25.1C, Relative Humidity is 23.4% , Supply Voltage is 12.03 Volts

A7.16 `CreateNewFiles` *C* *Create new files with time-based names*

Creates New Files with a filename of the form YYYYMMDDHHMM.DAT and YYYYMMDDHHMM.HGM for data record files and histogram files respectively. The current date and time are used.

Example:

```
CreateNewFiles
File Created: 0:/DAT/IP173_1301190008.DAT
File Created: 1:/DAT/IP173_1301190008.DAT
File Created: 0:/HGM/IP173_1301190008.HGM
File Created: 1:/HGM/IP173_1301190008.HGM
```

A8. Filesystem Commands and Parameters

Filesystem Overview

The NPM3000E file collection of commands for handling and working with files has been implemented to match closely the analogous Microsoft DOS operating system commands. There are two Secure Digital memory cards, one internal (0:/) and one removable external (1:/) and both memory cards are formatted with the FAT32 file system. There are two specific directories located in the root of both memory cards. The "DAT" directory is intended for data files and the "HGM" directory is intended for histogram files.

Upon startup, the NPM3000E system creates these two directories if they don't already exist. It also conditionally creates new files based on the unit's name and the date and time.

As in DOS, one can change to a file's directory in order to access the file or one can enter the file's entire path in order to access the file from any other directory. For instruction purposes, this manual assumes that the file of interest is located in the current working directory.

FIle System Commands and Parameters, Quick Reference (with Datalogging Option)

Sec	Command Name	Cmd Type	Operation
A8.1	`Dir`	R	List of files in the active file directory
A8.2	`GetCWD`	R	Current working directory
A8.3	`DiskInfo`	R	Bytes free and Size of Internal and External SD cards
A8.4	`FileInfo`	R	Specific File information (as output in 'Dir' command)
A8.5	`Type`	R	List contents of a file
A8.6	`Cd`	C	Change to a different directory
A8.7	`0: or 1:`	C	Select Internal (0:) or External (1:) SD cards
A8.8	`Copy`	C	Copy a file
A8.9	`Rename`	C	Rename a file
A8.10	`Attrib`	C	Set attributes of a file
A8.11	`Del`	C	Delete a file or files
A8.12	`Mkdir`	C	Create a new directory
A8.13	`Transfer`	C	Transfer a file to a PC (with handshaking)
A8.14	`Format`	C	Format the Internal SD card (use with caution)
A8.15	`SdReset`	C	Power cycle the SD cards

Commands are not case-sensitive (i.e. they are case-insensitive).
Commands are of three types:

C – Control Commands
R – Read Commands
R/W -- Read/Write Parameter Commands

Read/Write parameters can be queried or read by simply typing the name (i.e., 'Gain') and can be written or set by using an equal sign after the parameter (i.e. 'Gain=3.8').

A8.1 `Dir` *R* *List of files in the active file directory*

Entering '*Dir*' without an argument will display the contents of the current working directory. Entering "*Dir*" with a pathname will display the contents of the directory specified by the path.

A8.2 `GetCWD` *R* *Report the current working directory*

Retrieve the current working directory location.

A8.3 `DiskInfo` *R* *Report size and bytes free of the SD Cards*

Report the size and free bytes for both the Internal and External SD cards.

Example:
```
diskinfo
0:/   971144 KB Free on 1 GB drive
1:/   970216 KB Free on 1 GB drive
```

A8.4 `FileInfo` *R* *Report file information (as output in 'Dir' command)*

Reports file information for a single file as reported by the 'Dir' command.

Example:
```
fileinfo ip173_1205210000.dat
----A 2013/01/20 11:13     38669 ip173_1205210000.dat
```

A8.5 `Type` *R* *List the contents of a file*

List the contents of a file.
Entering "*type*" without an argument will list the entire contents of a file.
One may also list a specified portion of the file, either a the beginning (Head) of the file or at its end (Tail). The number of blocks (512 bytes each) to be listed is specified with an integer.

Example 1:

To retrieve the entire contents of a file:
```
Type File1.xyz
```

To retrieve the first 1024 bytes of a file:
```
Type File1.xyz Head 2
```

To retrieve the last 4096 bytes of a file:
```
Type File1.xyz Tail 8
```

A8.6 `Cd` *C* *Change the active directory*

This command will behave like the PC based DOS 'cd' command.
Entering '*cd*' without an argument will behave as the '*getcwd*' return the current working directory location.
Entering '*cd*' followed by a directory name or a path to a directory on the active drive will change the current active working directory to the specified location
Example:
```
cd 0:/HGM
0:/HGM
```

Entering 'cd' followed by a directory name or a path to a directory on a different drive will change the default active directory on the different drive. i.e., if the active directory is 0:/HGM and the user enters '*cd 1:\HGM*' the active working directory will remain 0:/DAT, but when the user subsequently enters '*1:*' the active working directory will become *1:\HGM*.
Example:

```
getcwd
0:/DAT
cd 1:/HGM
0:/DAT
1:
1:/HGM  External SD Card
cd
1:/HGM
```

A8.7 `0: or 1:` *C* *Select internal (0:) or External (1:) SD Cards*

'0:' will make the active SD card the internal SDcard.
'1: ' will make the active SD card the external SDcard.

A8.8 `Copy` *C* *Copy a file*

Copy a file to another filename and/or location.

Example 1:
Copying a file from the current directory to the external SD card DAT directory.

```
Copy  File1.xyz  1:/DAT/File1.xyz
```

Copying a file from the internal card HGM directory to the external card HGM directory and giving the copied file a different name:

```
Copy  0:/HGM/File1.xyz  1:/HGM/Name1.abc
```

A8.9 `Rename` *C* *Rename a file*

Changes the name of a file.

Example:

```
Rename  File1.xyz  Name1.abc
```

A8.10 `Attrib` *C* *Set attributes of a file*

The 'Attrib' command can be used to change the Read-only and Archive attributes of a file.

Example1:

```
Attrib  +R File1.xyz
```

(Make the file be Read-Only)

Example2:
`Attrib -R File1.xyz` (Remove the Read-Only flag)

Example3:
`Attrib +A File1.xyz` (Set the Archive flag)

Example4:
`Attrib -A File1.xyz` (Remove the Archive flag)

A8.11 `Del` *C* *Delete a file or files*

The 'Del' command can be used to delete a file from the current or other directory.

Example:
```
Del 1:/HGM/File1.xyz
```

Wildcard deletes are also allowed. For example, all files ending with .xyz can be deleted from a directory with:
```
Del *.xyz
```

All of the files in a directory can be deleted with:
```
Del *.* or Del *.
```

Example:
```
Del 1:/HGM/*.hgm
```

A8.12 `Mkdir` *C* *Create a new directory*

Creates a daughter directory.

Example:
```
mkdir temp
OK
```

A8.13 `Transfer` *C* *Transfer a file to a PC (with handshaking)*

Used by a PC (typically an application or program) to transfer a file from the NPM3000E to the PC. The protocol to be followed by the PC based retrieval code is as follows:

1. Send to the NPM3000E: Transfer File1.xyz

2. Wait for Response from NPM3000E instructing to initiate transfer with 'C'
3. Send a 'C'
4. Receive a SOH (0x01)
5. Receive 512 bytes of data
6. Send an ACK (0x06)
7. Repeat - go to step 4, until receive an EOT (0x04)
8. Send an ACK (0x06)

By default the NPM will clear the archive bit on the NPM3000E directory listing following a successful file transfer. An optional “noarchive” switch is available which will not clear the archive bit.

Example:

i.e., `Transfer  File1.xyz  /noarchive`

will initiate a file transfer. The archive bit will not be cleared.

Note: Quaesta Instruments provides PC based command executables which allow one to transfer files from the NPM3000E unit to a PC. See Section **A9. NPM3000E .**

A8.14 `Format` *C* *Format the Internal SD card (use with Caution)*

Allows complete erasure and formatting of the internal SDcard. this command should be used with care because all data on the card will be lost. Note that in order to format the external SDcard, one must remove the card from the NPM3000E and format it in a PC.

Note: When formatting the external microSD card, FAT32 should be selected as the filesystem. It is suggested that the user also select a cluster size of 4K or 4096 bytes.

Example Internal SD card format:

```
0:
0:/DAT  Internal SD Card
format
You are requesting to Format, 0: Internal SD Card
If you are sure you want to do this enter: Y.  Otherwise
just hit return.
Y
Please wait....

Done formatting, 0: Internal SD Card
0:
0:/  Internal SD Card
getcwd
0:/
```

See **Figure 23** for an example of External SD Card formatting witn a Windows PC (screen capture from a captured on a Windows 7 machine).

A8.15 `SdReset` *C* *Power cycle the SD cards*

Will power cycle the SD cards without resetting the system. This can be tried if the SD cards become nonresponsive. SD cards have internal microcontrollers and the *`SdReset`* command will return them to their power up state.

This command will take several seconds to complete.

If the *`SaveDAT`* and/or *`SaveHGM`* parameter is set, new files will be created as described by the "*`CreateNewFiles`*" command in **Section A7.16**

Example:

```
sdreset
Resetting SD cards
```

```
OK SD cards are Reset
File Created: 0:/DAT/IP173_1301220821.DAT
File Created: 1:/DAT/IP173_1301220821.DAT
File Created: 0:/HGM/IP173_1301220821.HGM
File Created: 1:/HGM/IP173_1301220821.HGM
```

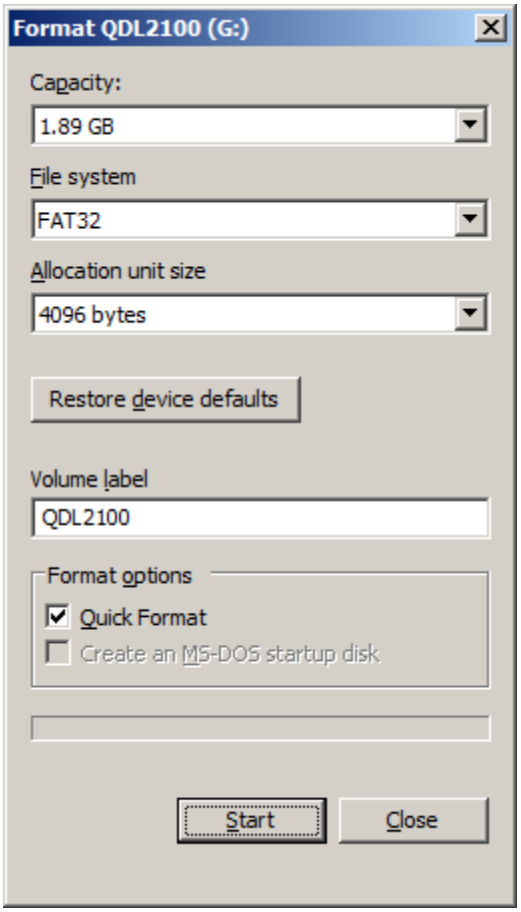


Figure 23. Format of External SD card on Windows PC.

A9. NPM3000E PC Command-Line Executables

A9.1 PC Based Command Line Executables Overview

Quaesta Instruments provides a set of PC based command-line executables that have been developed for use on a Microosoft Windows PC. The executables have been tested using Windows XP and Windows 7 operating systems. The executable files can be located in the directory from which the commands are called or can be located in a chosen PC directory and an appropriate DOS Path environment variable modified.

These commands can be operated from within a scripting environment and thus can be run from batch files. Output from these commands can be redirected to a file via use of the ">" character.

Each command requires an IPAddress argument as the first argument following the command. This IP Address must be entered in IPV4 Dotted Decimal notation.

After the command is entered, the command line arguments are parsed and checked for validity. Informational error messages are displayed if necessary.

If the command is of the proper syntax and structure, then communication with the NPM3000E device at the IPAddress is initiated. If successful, appropriate information will be displayed. If a TCPIP communication error occurs, this message will be displayed.

**Note that the NPM3000E device can only support a single TCPIP connection. The commands will return TCPIP connection errors if the NPM3000E device is already serving another TCPIP connection (this might occur, for example, if the user is utilizing the Quaesta Instruments LLC provided PC GUI interface application to interface to the NPM3000E).*

***During execution of the PC Based command-line commands the NPM3000E parameters PrintDAT, PrintHGM, and PeakMode will all be set to 0. This is to supress any automatic printing of data from the NPM hat may cause interference with the operation of the command-line based retrieval.*

PC Based Command Prompt Commands

Sec	Command Name	Operation
A9.2	`qiinfo`	Retrieve NPM3000E device parameter information
A9.3	`qistatus`	Retreive NPM3000E device status
A9.4	`qisynctime`	Syncs the NPM3000E device time to the PC system time
A9.5	`qidir`	Retrieve directory listing
A9.6	`qicopy`	Copy a file
A9.7	`qixcopy`	Copy an entire directory
A9.8	`qisendcmd`	Send a command or text string to the NPMs

A9.2 `qiinfo` *Retrieve NPM3000E device parameter information*

The PC command prompt environment command "`qiinfo`" operates identically to the "`Info`" command described in Section 4.1. Firmware Version, Model, Model Version, and Serial Number, followed by the following list of user settable parameters are displayed.

Usage:
`qiinfo IPAddr`
`IPAddr` *IP Address in Dotted Decimal Notation, i.e. 192.168.1.34*

Example:
`qiinfo 192.168.1.34`

A9.3 `qistatus` *Retreive NPM3000E device status*

The PC command prompt environment command "`qistatus`" operates identically to the "`Status`" command described in Section 4.6.

Usage:
`qistatus IPAddr`
`IPAddr`: IP Address in Dotted Decimal Notation, i.e. 192.168.1.34

Example:
`qistatus 192.168.1.34`

A9.4 `qisynctime` *Syncs the NPM3000E device time to the PC system time*

The PC command prompt environment command "`qisynctime`" syncs the NPM3000E device time to the local PC. Note that there may be some time delay associtated with the TCPIP communication.

Usage:
`qisynctime IPAddr`
`IPAddr`: IP Address in Dotted Decimal Notation, i.e. 192.168.1.34
Example:
`qistatus 192.168.1.34`

A9.5 `qidir` *Retrieve directory listing*

The PC command prompt environment command "`qidir`" retrieves a directory listing and operates similarly to the "`dir`" command described in Section 6.2.

Usage:
`qidir IPAddr [NPMdirname]`

`IPAddr`	IP Address in Dotted Decimal Notation, i.e. 192.168.1.34
`NPMDirname`	Name of Directory on NPM3000E to be listed. ***If omitted, contents of the internal card 0:/DAT directory will be listed.*

Example:
`qidir 192.168.1.34 1:/DAT`
will display the contents of the external SD card's /DAT directory.

A9.6 `qicopy` *Copy a file.*

The PC command prompt environment command "`qicopy`" copies a file from the NPM3000E device to the local PC. A file of the same filename will be created on the PC.

***An NPM3000E file which is currently being used for storage can be copied but the phrase "_Partial" will be appended to the filename before the file extension . i.e., A currently active DAT file's transferred filename (filename on the PC) would have the form "NPMName_YYMMDDHHMM.DAT" would have the form "NPMName_YYMMDDHHMM_Partial.Dat". Similarly for active HGM files.*

Usage:
`qicopy IPAddr NPMFullPathFilename [PCDirName] [/M]`

`IPAddr`	IP Address in Dotted Decimal Notation, i.e. 192.168.1.34
`NPMFullPathFilename`	Full Directory Path Filename of file on the NPM3000E to be copied. i.e. 0:/DAT/Unit1
`PCDirName`	PC Directory to which the file will be copied. Can be a sub-directory of the current operating PC directory or can be an absolute Full Path Directory name. The directory must exist or an error will be returned. *** If omitted the file will be copied to the current PC directory.*
`/M`	Turns off the archive attribute of the file after copying.

Example:

`qicopy 192.168.1.34 0:/DAT/Unit1_1201132316.dat`
will copy the NPM3000E file to the current PC operating directory.

`qicopy 192.168.1.34 0:/DAT/Unit1_1201132316.dat Unit1Data`
will copy the NPM3000E file to the sub-directory "Unit1Data".

`qicopy 192.168.1.34 0:/DAT/Unit1_1201132316.dat D:/Unit1Data`
will copy the NPM3000E file to the absolute directory "D:/Unit1Data" on the PC's "D" drive.

A9.7 `qixcopy` *Copy an entire directory.*

The PC command prompt environment command "`qixcopy`" copies the entire contents of an NPM3000E device to the local PC. NPM3000E filenames will be duplicated on the PC. Some functionality similar to the DOS command xcopy is provided.
Informational messages will be displayed as the files are copied.

***An NPM3000E file which is currently being used for storage cannot be copied. i.e., if the SaveDAT parameter is set to SaveDAT=1 then a current " .DAT" file used for data storage cannot be copied. Likewise, if the SaveHGM parameter is set to SaveHGM=1 then the current ".HGM" file used for data storage cannot be copied. To copy such a file first set SaveDAT=0 or SaveHGM=0 as appropriate. After copying of the file the SaveDAT and SaveHGM parameters should be returned to SaveDAT=1 and SaveHGM=1 as appropriate.*

Usage:
`qixcopy IPAddr NPMFullPathDirName [PCDirName] [/A] [/M]`

`IPAddr` IP Address in Dotted Decimal Notation, i.e. 192.168.1.34

`NPMFullPathDirName`
Full Path Directory Name of a directory on the NPM3000E to be copied. i.e. 0:/DAT/, 1:/HGM, etc

`PCDirName` PC Directory to which the file will be copied. Can be a sub-directory of the current operating PC directory or can be an absolute Full Path Directory name. The directory must exist or an error will be returned.
*** If omitted the file will be copied to the current PC directory.*

`/A` Copies only files with the archive attribute set, doesn't change the attribute.

`/M` Copies only files with the archive attribute set, and turns off the archive attribute if copy is successful.

Example:
`qixcopy 192.168.1.34 0:/DAT /M`
will copy non-archived files from the NPM3000E internal card's DAT directory to the current PC operating directory. The Archive attribute will be turned off for each file successfully transferred.

`qixcopy 192.168.1.34 1:/DAT C:/Unit1Data`
will copy all files from the NPM3000E external card's DAT directory to the PC absolute directory "C:/Unit1Data". The Archive attribute ***will not*** be turned off on the NPM3000E files transferred.

`qixcopy 192.168.1.34 0:/HGM D:/Unit1Data /A`
will copy non-archived files from the NPM3000E internal card's HGM directory to the PC absolute directory "D:/Unit1Data" on the PC's "D" drive. The Archive attribute ***will not*** be turned off on the NPM3000E files transferred.

A9.8 `qisendcmd` Send a command to the NPM3000E

Usage:
`qisendcmd IPAddr NPMCommand`

`IPAddr`	IP Address in Dotted Decimal Notation, i.e. 192.168.1.34
`NPMCommand`	Must be a valid NPM3000E command and be less than 64 characters long. i.e. `SaveDat=1`. " " surrounding the `NPMCommand` argument will send the argument literally. i.e., to send an NPMCommand with a space in the command enclose the command with " ".

The NPM3000E will attempt to connect to the device and if successful will send the command.
The unit will return OK, with the first line of the NPM output returned.

Example:

```
qisendcmd 192.168.1.34 time

Attempting Connection to Quaesta Inst NPM at 192.168.1.34
...
Connected.
Sending NPMCommand=time
OK, 2012/12/22,07:57:20
```

Appendix B. Configuring Teraterm Pro

This appendix describes NPM3000E Communication via Teraterm Pro. Any computer with an Ethernet 10/100 type Ethernet interface and Windows XP or Windows 7 operating system can be used. Directions below are for Windows XP and Windows 7 and utilize Teraterm Pro version 2.3 as the terminal interface program.

First, you will need to download and Install Teraterm Pro version 2.3 or later. Directions and screen captures herein are for Teraterm Pro v 2.3. Teraterm Pro v2.3 is readily available as freeware via the internet. Alternatively, one can use PuTTY, Windows Hyperterminal, or another third party Terminal interface program which supports TCP connectivity… The directions below are specific to Teraterm Pro.

Note that the NPM3000E device can be "pinged" when connected either directly to a PC with a crossover Ethernet cable or connected to an Ethernet switch, i.e., if the IP address of the NPM3000E is 192.168.15.111, then type ***ping 192.168.15.111* at the PC command prompt, and the NPM3000E device should respond. Note that the device's IP address must be reachable via the PC.

The user should read all directions below before proceeding as one may desire one mode of connection over another.

Communicating via TeraTerm and WINDOWS XP

Windows XP, Connection to NPM3000E Through Ethernet Switch

Windows XP: Connecting to the NPM3000E when connected through an Ethernet Switch (i.e. not connected directly to the PC).

1. Connect the NPM3000E to an Ethernet switch which will allow the PC and the NPM3000E to communicate on the same subnet, i.e., they can both be connected to the same Ethernet switch. A standard Ethernet cable (non-crossover) should be used.
2. Run the Lantronix Device Installer application if necessary and configure the IP address of the NPM3000E unit with an IP address on the same subnet as the PC, i.e., if the PC IP address is 192.168.8.XXX and the PC subnet mask is 255.255.255.0, then the NPM3000E address should be set to 192.168.15.YYY. One should make sure that the NPM3000E IP address does not conflict with another IP address on the Network.
3. Provide power to the NPM3000E using the power adapter. Also make sure the Ethernet enable switch is plugged in.

4. Start TeraTerm

Go to the Menu: File → New Connection
- Select TCP/IP
Set the following: Host: 192.168.15.111 TCP port#: 10001

- Uncheck telnet box

The Host should be set to the IP address of the NPM3000E.
It is important to use the TCP port#: 10001 since the NPMs are configured at the factory to communicate on this port. This will allow Teraterm to communicate to the NPM with IP address 192.168.15.111.

Change the Host IP address as necessary to communicate with other NPM3000E devices.

The IP address listed here must be on the same subnet as the PC. See Step 3, above.

5. See Configuring TeraTerm section below to further configure Teraterm for communication.

Windows XP, Direct Connection to NPM3000E with Crossover Cable

1. Disconnect any Ethernet cable connected to computer. We will be connecting the NPM3000E directly to the computer bypassing any networks.
2. Connect the NPM3000E to the computer with a crossover type network cable, (red cable was included with the prototype unit).
3. Start Control Panel
   →Network Connections → Local Area Connection → Properties
   → Internet Protocol (TCP/IP) Properties

   Set the computer to the following IP address
   - IP address: 192.168.15.100
   - Subnet Mask: 255.255.255.0
4. Provide power to the NPM3000E using the power adapter.
5. Connect the NPM3000E using an Ethernet crossover cable.
6. Start TeraTerm
   Go to the Menu: File → New Connection
   - Select TCP/IP
   Set the following: Host: 192.168.15.111 TCP port#: 10001

   - Uncheck telnet box
   The Host should be set to the IP address of the NPM3000E.
   It is important to use the TCP port#: 10001 as the NPMs are configured at the factory to communicate on this port.This will allow Teraterm to communicate to the NPM with IP address 192.168.15.111.

Change the Host IP address as necessary to communicate with other NPM3000E devices.

The IP address listed here must be on the same subnet as the PC.
See Step 3, above.

7. See Configuring TeraTerm section below (page 4) to further configure Teraterm for communication.

   One should now be able to type at the Command prompt and the NPM3000E will echo characters back. Type “menu” for example and the NPM3000E will respond with a menu of commands and the command descriptions.

Windows XP, Switching Back to LAN after Crossover Cable Use

1. Disconnect crossover cable between NPM3000E and the computer

2. Start Control Panel
   - Network Connections
   - Local Area Connection
   - Properties
   - Internet Protocol (TCP/IP) Properties
   - X Obtain IP address automatically

3. Connect LAN cable. Wait for DHCP to assign IP address.

Communicating via Teraterm and WINDOWS 7

Windows 7, Connection to NPM3000E Through Ethernet Switch

1. Connect the NPM3000E to an Ethernet switch. This will allow the PC and the NPM3000E to communicate on the same subnet, i.e., they can both be connected to the same Ethernet switch. A standard Ethernet cable (non-crossover) should be used.
2. Run the Lantronix Device Installer application if necessary and configure the IP address of the NPM3000E unit with an IP address on the same subnet as the PC, i.e., if the PC IP address is 192.168.8.XXX and the PC subnet mask is 255.255.255.0, then the NPM3000E address should be set to 192.168.15.YYY. One should make sure that the NPM3000E IP address does not conflict with another IP address on the Network.
3. Provide power to the NPM3000E using the power adapter. Also make sure the Ethernet enable switch is plugged in.
4. Start TeraTerm

   Go to the Menu: File-> New Connection
   - Select TCP/IP
   Set the following: Host: 192.168.15.111 TCP port#: 10001

- Uncheck telnet box

The Host should be set to the IP address of the NPM3000E.
It is important to use the TCP port#: 10001 as the NPMs are configured at the factory to communicate on this port. The settings above will allow Teraterm to communicate to the NPM3000E device having IP address 192.168.15.111. Change the Host IP address as necessary to communicate with other NPM3000E devices.

The IP address listed here must be on the same subnet as the PC.
See Step 3, above.

5. See Configuring TeraTerm section below to further configure Teraterm for communication.

Windows 7, Direct Connection to NPM3000E with Crossover Cable

1. Plug in the NPM3000E using the power adapter.
2. Connect the computer to the NPM3000E using the red crossover cable.
3. Open "Network and Sharing Center" from taskbar button or from Control Panel.
   - click on "Local Area Connection"
   - Properties
   - Internet Protocol Version 4 (TCP/IPv4) Properties
   - x Use the following IP address
   - IP address: 192.168.15.100
   - Subnet Mask: 255.255.255.0
4. Start TeraTerm
   Go to the Menu: File → New Connection
   - Select TCP/IP
   Set the following: Host: 192.168.15.111 TCP port#: 10001

   - Uncheck telnet box
   The Host should be set to the IP address of the NPM3000E.
   It is important to use the TCP port#: 10001 since the NPMs are configured at the factory to communicate on this port.
   The settings above will allow Teraterm to communicate to the NPM3000E device having IP address 192.168.15.111.
   Change the Host IP address as necessary to communicate with other NPM3000E devices.

   The IP address listed here must be on the same subnet as the PC.
   See Step 3, above.

6. See Configuring TeraTerm section below to further configure Teraterm for communication.

Windows 7, Switching Back to LAN after Crossover Cable Use

1. Disconnect the crossover cable.
2. Connect an Ethernet cable.
3. Open “Network and Sharing Center” from taskbar button or from Control Panel.

   - click on "Local Area Connection"
   - Properties
   - Internet Protocol Version 4 (TCP/IPv4) Properties
   - x Obtain IP address automatically.
   - Wait for DHCP to assign IP address.

Configuring TeraTerm

File → New Connection.

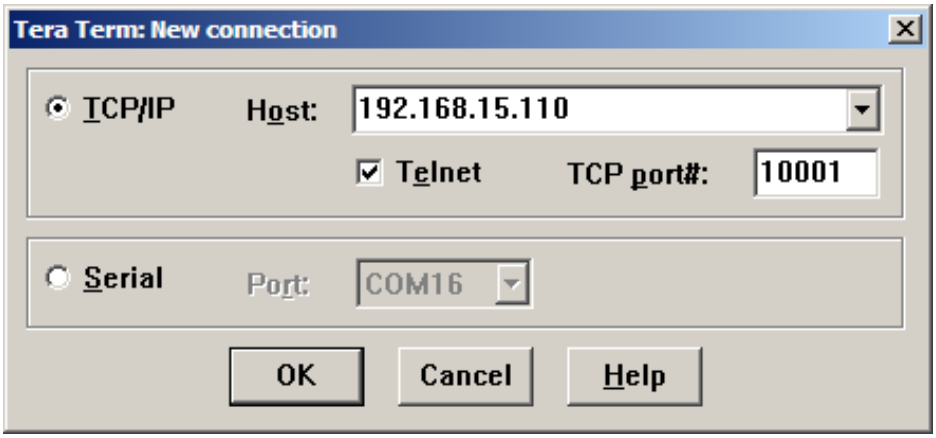


Figure 24. Configuring TeraTerm

Setup-> Window. You can set the title and the number of lines in the Scroll Buffer.

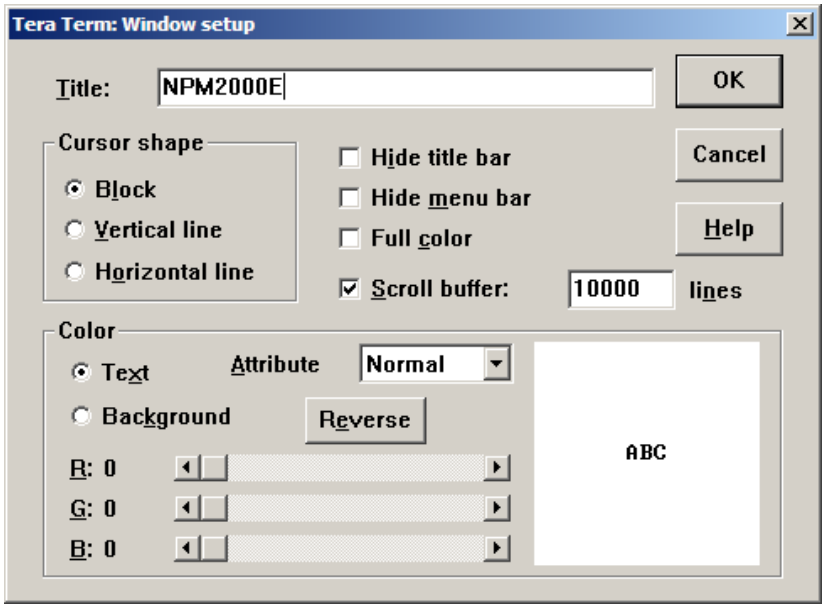


Figure 25. Tera Term Window Setup

Setup → Terminal.

It is usually most convenient to allow the TeraTerm window to be resized(i.e. Term Size=win size).
Set the New-line conditions as in the GUI window below.
Terminal ID is VT100.

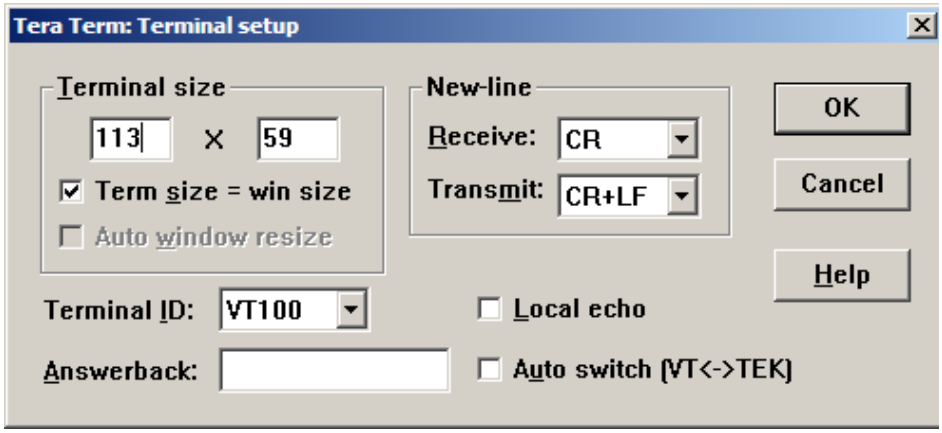


Figure 26. Terminal Setup

Appendix C. Configuring Windows Hyperterminal

While Quaesta Instruments personnel generally prefer TeraTerm Pro as a terminal interface program, Windows Hyperterminal or other TCPIP terminal capable applications will allow communication as well.

Windows Hyperterminal is available as a free utility on Windows XP machines and can be used to communicate with the NPM3000E device.
Windows Hyperterminal can also be purchased for use on Windows 7 machines.

The description which follows assumes that an ethernet connection to the NPM3000E device is available. See the first part of Appendix B. Configuring Teraterm Pro for basic Windows TCPIP settings if necessary.

Figure 27 shows the TCPIP selection form available by selecting File-> Properties. Select the IP address of the desired NPM3000E device and select the appropriate port number for communication to the NPM3000E device. At the factory, the port number is set to 10001. This port number may be changed by the NPM3000E user if desired. Contact Quaesta Instruments for assistance if this is desired.

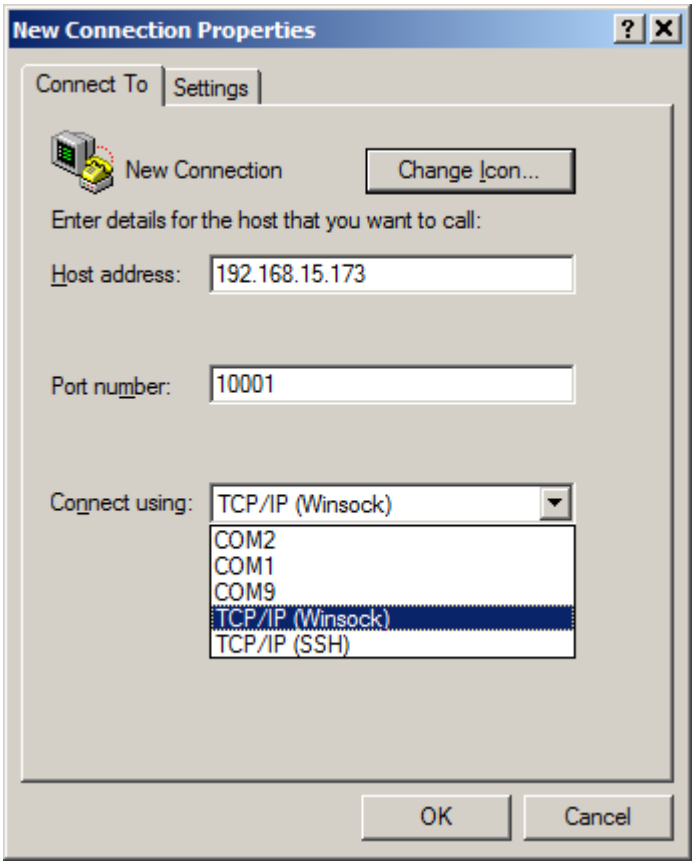


Figure 27. Windows Hyperterminal TCPIP connection

Figure 28 shows options available via the Settings Tab of **Figure 27**. Select VT100 and a Backscroll buffer size of 500 lines. 500 is the largest number allowed.

Next, select the "ASCII Setup" button and a form as in **Figure 29** will appear. Select the "Send line ends with line feeds" checkbox. This is necessary as all commands sent to the NPM3000E device must terminate with a Carriage Return + Line Feed character sequence (these are Hex characters 0x0D and 0x0A).

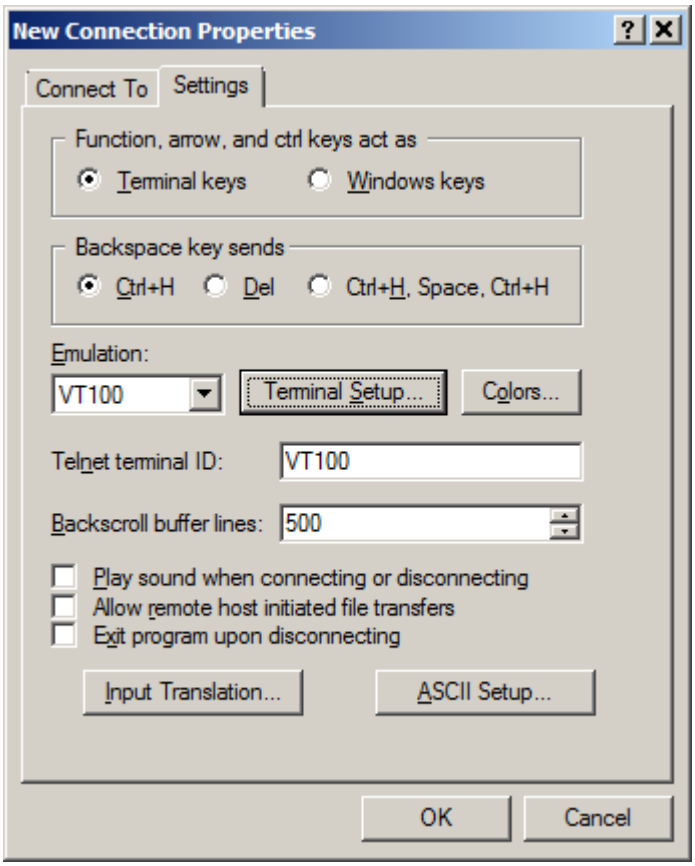


Figure 28. Windows Hyperterminal Terminal Emulation Setup.

The user may desire to change the font size of the text shown in the terminal window as the default Windows Hyperterminal font size is quite large.

From the main Hyperterminal window select View->Font and a form as shown in **Figure 30** will appear.

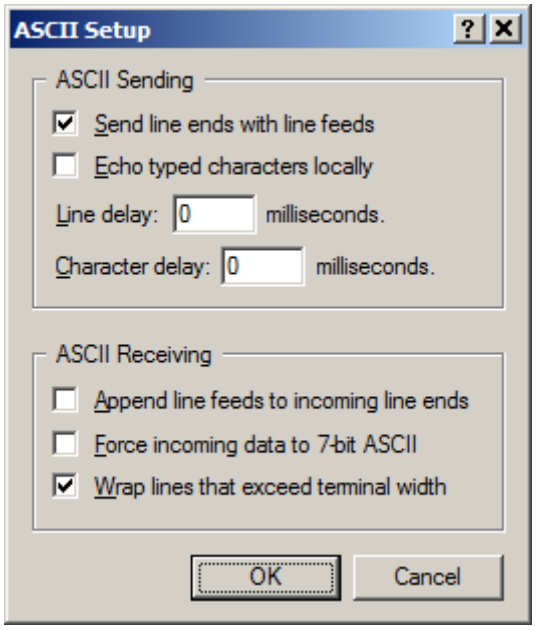


Figure 29. Windows Hyperterminal Line Ending Setup.

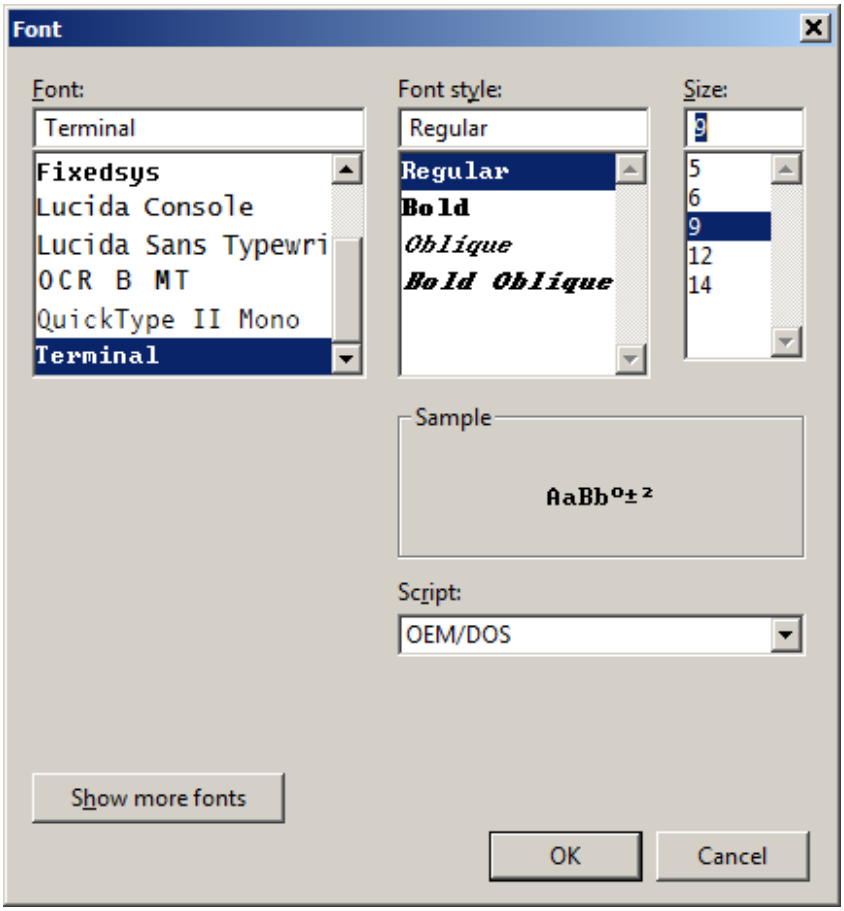


Figure 30. Windows Hyperterminal Font Setup.

Appendix D: Firmware Upload Procedures

When should Firmware be uploaded to the NPM3000E device?

Firmware may be uploaded if desired but it is recommended that new firmware be uploaded only if one or more of the following conditions is met:

1. A Firmware upgrade is desired for new functionality or if a relevant bug has been addressed and fixed in a firmware update.
2. The NPM3000E device Firmware is corrupted. This should be a very rare occurrence as the microcontroller and firmware used in the NPM3000E device has been designed to operate many years without failure. However, certain environments and/ or conditions such as severe raditation exposure may result in such corruption.

There are several firmware upload procedure options available to the NPM3000E user.

Each one of these firmware upload procedures relies upon the presence of a small bootloader firmware program resident in the NPM3000E device. The bootloader is the first microcontroller code which runs upon system reset. A reset occurs when power is cycled, a brown-out reset occurs, the watchdog timer expires, or a user issues the reboot command .

New Firmware can be uploaded easily if existing device firmware is intact and the NPM3000E device is functional. One of three firmware upload procedures can be used:

1. Use of the Quaesta Instruments GUI application (preferred).
   This can be done remotely via the Ethernet interface.

2. Use of the External SD card on the NPM3000E device. Requires local access to the device's external SD card and the ability to cycle the NPM power (do not need to cycle the Ethernet interface power). This procedure can also be used if the main firmware code is corrupted.

3. Via Teraterm Pro, a Windows based terminal emulation program. Xmodem file transfer is utilized. The sequence of steps is time critical, and therefore the user is encouraged to practice in the laboratory first before using this procedure on a field unit. Use of Teraterm Pro may also require the cycling of the power on the NPM electronics (do not need to cycle the Ethernet interface power). This procedure can be used if the firmware code is corrupted, but power cycling of the NPM electronics portion of the NPM3000E device will be required to gain access to the bootloader program.

Note: If the NPM3000E device Firmware is believed corrupted, then new Firmware can still be uploaded as long as the NPM3000E device bootloader program is still resident and functioning. ***Appendix E*** *addresses recovery of the NPM3000E device if its main firmware program is corrupted and the device appears non-responsive.*

D.1 Firmware Upload using the Quaesta Instruments GUI

Firmware can be uploaded to an NPM 3000E device using the Quaesta Instruments Interface Application Software (**Figure 31**) running on a Microsoft Windows PC. A binary file containing the new firmware must be accessible from the PC. This binary file will be selected from the GUI by the user during the firmware upgrade process.

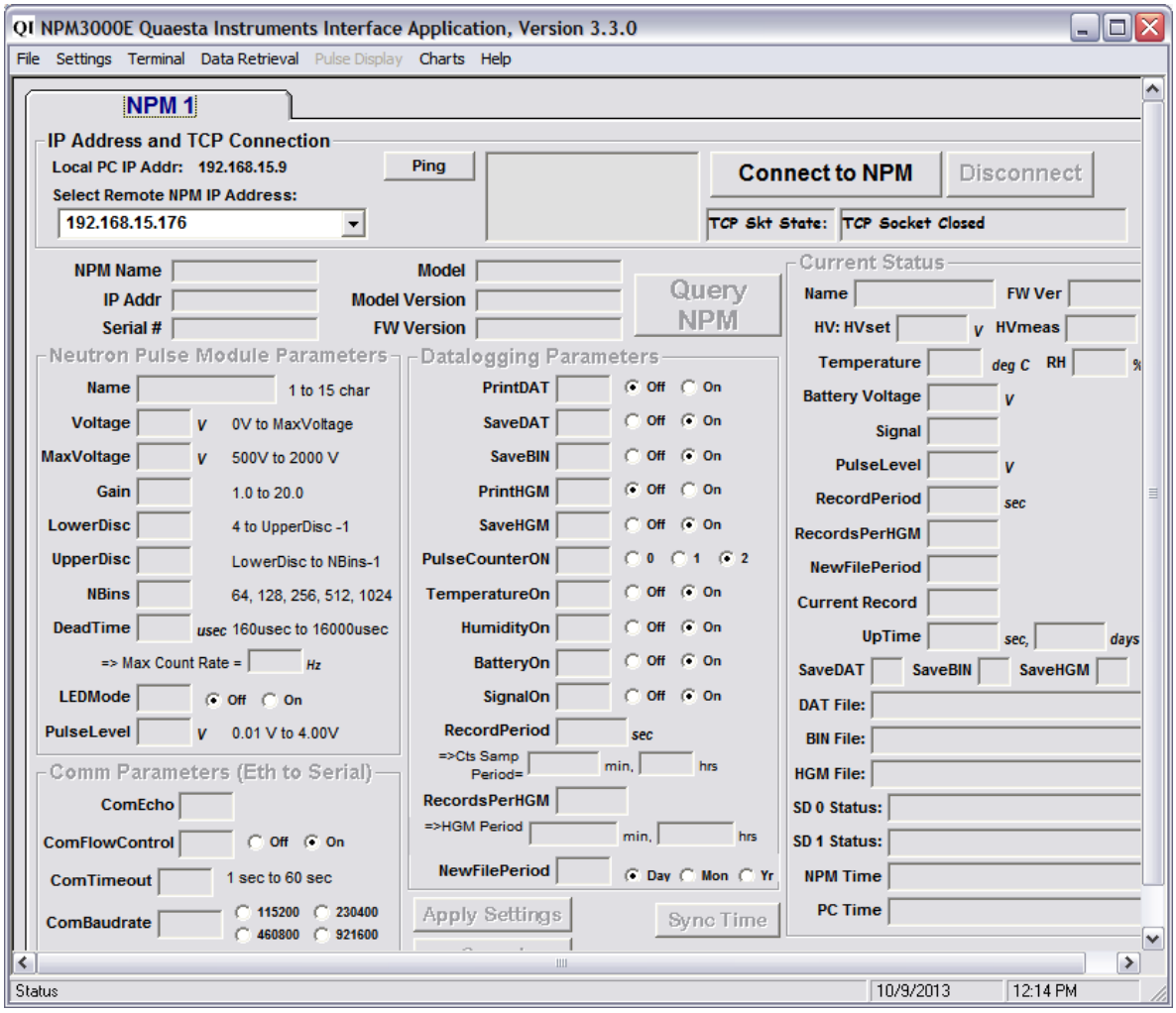


Figure 31. GUI Application Main Window.

To Upgrade the Firmware, execute the following steps.

1. Select the IP address of the device undergoing firmware uploading in the Local IP Address input cell.
2. Select the ***Ping*** button to ensure that the device is active and its ethernet server is on and functioning. An **OK** message will be displayed below the ***Ping*** button if the device's ethernet server is active and a connection was made.
3. Select the ***Connect to NPM*** button and the software will attempt to initiate a TCPIP session with the NPM3000E device. If a TCPIP session is successfully

started, the software will attempt to retrieve current configuration information from the device. Data will be populated in the GUI. See **Figure 32 Error! Reference source not found.**.

4. **Important:** before performing a firmware upgrade with the GUI make sure the ComBaudrate parameter is set to a value of 115200. This is the baudrate active between the NPM3000E device and the Lantronix XPort ethernet to serial converter. If a change to the ComBaudRate parameter is needed then the Lantronix XPort baudrate setting will also have to be appropriately changed. The bootloader of the NPM3000E device expects 115200 baud as the baudrate. After firmware upgrade the NPM3000E device and Lantronix XPort baudrate can be restored to a higher baud rate if desired.
5.

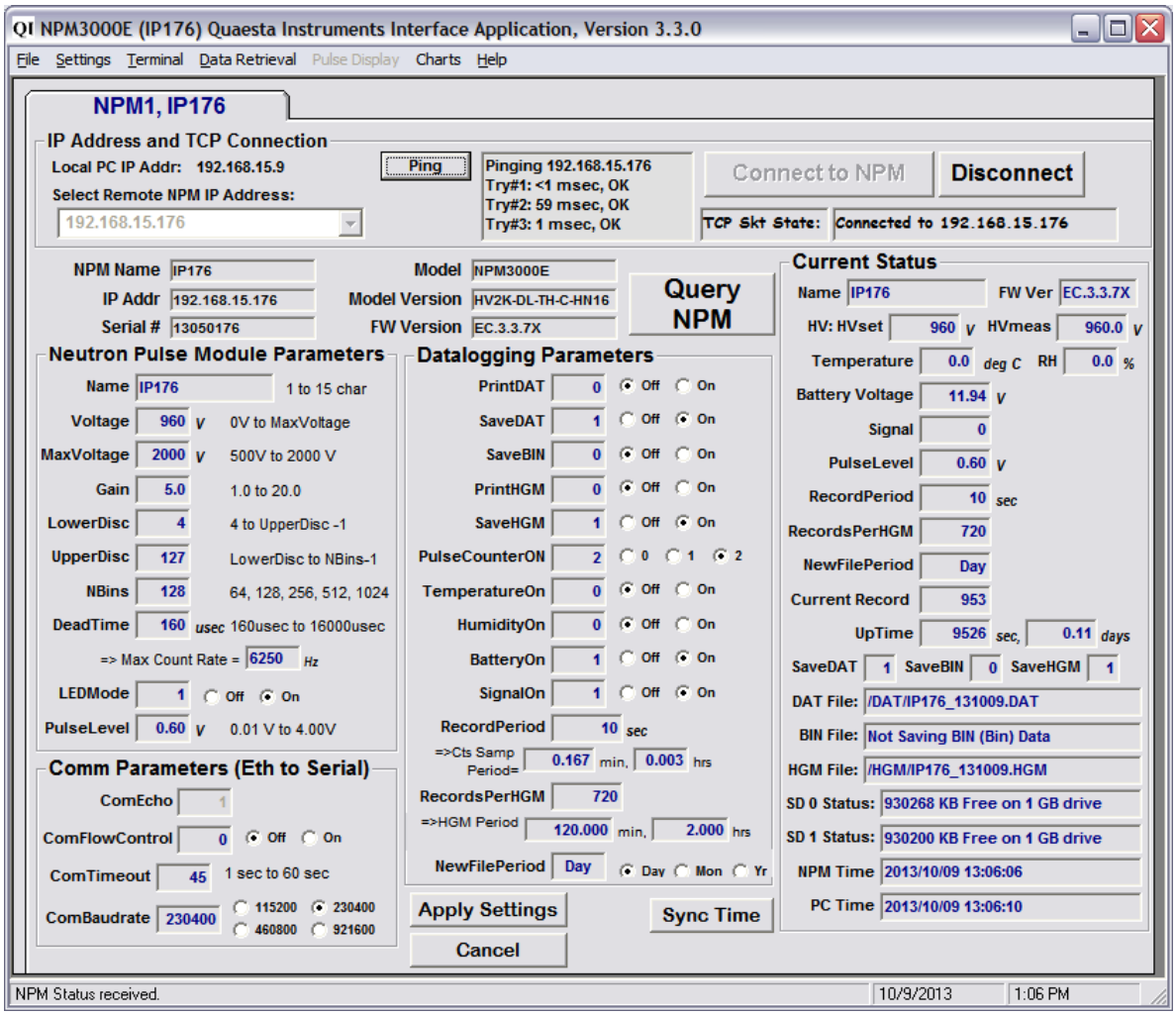


Figure 32. GUI Application Window, with retrieved NPM3000E parameters.

Under the ***Help*** menu, select the ***Firmware Upgrade*** option. This will open an additional GUI, the ***NPM3000E Firmware Upgrade Tool*** (**Figure 33**).

6. Select the ***Query NPM*** button, and this window will fill in with information about the device including IP address, serial number, and the current firmware version in a display labeled ***Current FW Version***.
7. Select the button labeled ***Select FW Upgrade Binary File*****.** This opens a browser window that allows the user to navigate to the binary file with the new firmware that is to be uploaded to the device. Once this binary file is found, select it and press the ***Open*** button in the browser window. This file's path is now loaded into the ***NPM3000E Firmware Upgrade Tool*** and this path will be indicated in the ***Filename*** display.
8. Select the FW Upload button and the firmware will begin upload. As the firmware uploads, the status of bytes of data transferred will be displayed. When the firmware upload is complete, the version of this new firmware will automatically be indicated in the "Current FW Version" field in the ***NPM3000E Firmware Upgrade Tool*** window . The new firmware version will also be displayed in the main window of the ***NPM 3000E Quaesta Instruments Interface Application*****.** This confirms firmware upload is successful.

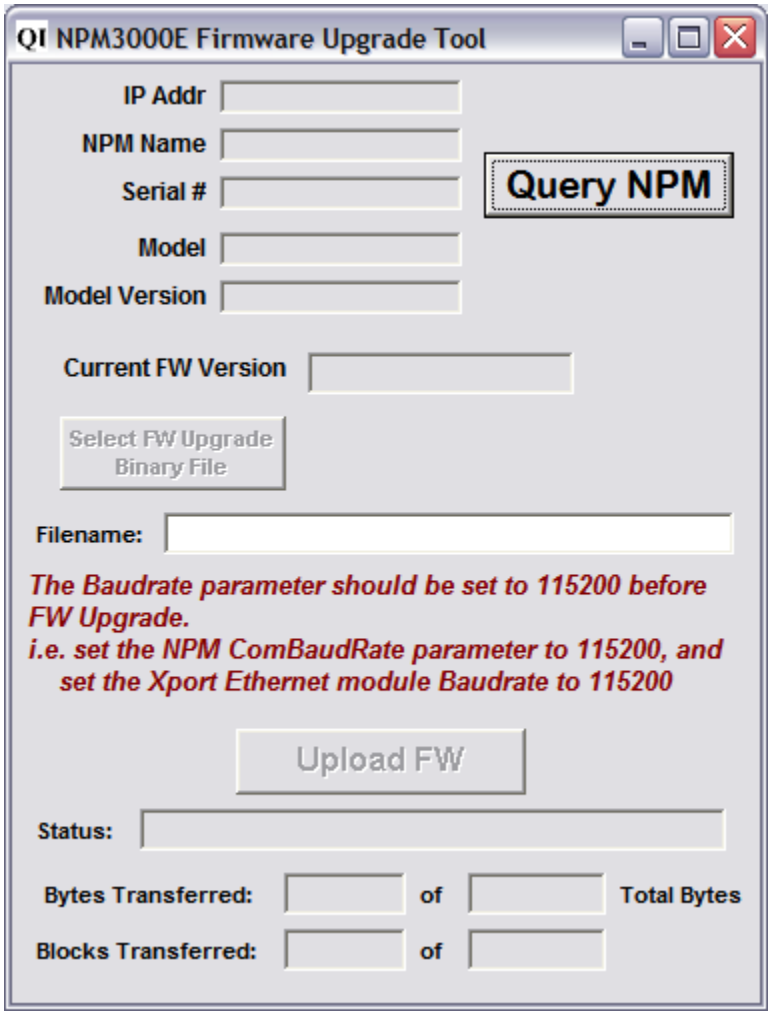


Figure 33. GUI FW Upgrade Tool.

D.2 FW Upload Using the NPM3000E External SD card

FW upgrade of the NPM3000E device can be accomplished via the External SD card if physical access to the device is available.

The following procedure should be followed:

1. Obtain an appropriate NPM3000E firmware upgrade file from Quaesta Instruments. This file wil have a ".bin" extension. i.e., filename will have form of "NPM3000EXXX.bin"
2. Remove the External microSD card and copy the obtained bin file to the top level directory of the microSD card, renaming the file if necessary to "NPM3000E.bin". ***Important: The filename on the microSD card must have the filename "NPM3000E.bin".***
3. Power cycle the NPM3000E device and the device bootloader will search for the NPM3000E.bin file. If found, the new firmware will be uploaded. Once successful, the unit will begin running the new firmware.

The user may find it useful to monitor the FW upload process by connecting to the device first with a terminal emulation program such as TeraTerm Pro or Windows Hyperterminal.

Upon power cycle terminal output from the unit will pause while the SD cards are power cycled. During FW upload from an NPM3000E.bin a series of dots will be printed as the bootloader loads blocks of data from the SD card firmware file.
When new firmware is successfully loaded the firmware will run, displaying the informational header and list of parameter values as shown in the example output on the next page.

Note: It is recommended that the user remove, rename, or delete the NPM3000E.bin file from the External microSD card after successful firmware upgrade. If the NPM300-E.bin file is left on the external microSD card, the NPM3000E bootloader will attempt to reload the new firmware each time the unit is power cycled or rebooted. This will likely not cause any problems, but if a power glitch or other anomaly occurs during a firmware upload from the external microSD card, the loaded Firmware may be corrupted. In such a case the unit may need to be power cycled again for the firmware to be read from the SD card and loaded properly.

Example:

Retrieve an appropriate FW binary file from Quaesta Instruments LLC. Copy the firmware file to the NPM3000E device external SD card, making sure it is named NPM3000E.bin. Upon reboot the NPM3000E bootloader will

```
dir
1:/ External SD Card
----A 2013/01/21 22:15    106236 NPM3000E.bin
   1 File(s),    106236 bytes total,    0 Dir(s)
1:/ External SD Card

reboot
.............................................................
.............................................................
.............................................................
..............

Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.3.0
Model              NPM3000E
Model Version      HV2K-DL-TH-C-HN16
Serial Number      12090173
Name               IP173
//NPM3KE PARAMETERS//
Voltage            0
MaxVoltage         2000
Gain               20.0
LowerDisc          10
UpperDisc          127
nBins              128
DeadTime           160
VibeMode           0
PeakMode           0
HgmMode            2
TTLMode            0
LEDMode            1
PulseLevel         0.40
//LOGGER PARAMETERS//
PrintDAT           0
SaveDAT            1
PrintHGM           0
SaveHGM            1
PulseCounterON     0
TemperatureON      1
HumidityON         1
BatteryON          1
```

```
SignalON            0
RecordPeriod(Sec)   60
RecordsPerHGM       60
NewFilePeriod       Day
Current Time        2013/01/21,22:23:00
File Created: 0:/DAT/IP173_1301212223.DAT
File Created: 1:/DAT/IP173_1301212223.DAT
File Created: 0:/HGM/IP173_1301212223.HGM
File Created: 1:/HGM/IP173_1301212223.HGM
```

D.3 FW Upload Using Teraterm's Xmodem File Transfer

The presence of a working bootloader is necessary in order to upload new firmware to the NPM3000E device.

The recommended method of FW uploading to the NPM3000E devices is via the GUI application FW Upgrade tool provided in the Quaesta Instruments GUI NPM3000E GUI interface application (see **Appendix D.1 Firmware Upload using the Quaesta Instruments GUI)**. One may also reliably upload the Firmware utilizing the external microSD card as in **D.1 Firmware Upload using the Quaesta Instruments GUI**.

For completeness, a technique of uploading new firmware to the NPM3000E devices via Teraterm Pro is presented. In this case the Xmodem file transfer option available in Teraterm may also be used to upload Firmware via the Xmodem file transfer protocol.

***Important*:** before performing a firmware upgrade via Teraterm's Xmodem feature, make sure the ComBaudrate parameter is set to a value of 115200. This is the baudrate active between the NPM3000E device and the Lantronix XPort ethernet to serial converter. If a change to the ComBaudRate parameter is needed then the Lantronix XPort baudrate setting will also have to be appropriately changed. The bootloader of the NPM3000E device expects 115200 baud as the baudrate. After firmware upgrade the NPM3000E device and Lantronix XPort baudrate can be restored to a higher baud rate if desired.
This FW upgrade process may require several repeated FW upgrade attempts.

If a working bootloader is present, a series of 6 question marks will be transmitted to the terminal output, beginning about 6 seconds after power on or reboot.

A summary of steps for uploading new Firmware is listed here for reference. See below for more detailed instructions.

Step 1. Either power cycle the unit or type reboot
Step 2. Enter <CTRL-Q> at the question marks. Wait for "C" response.
Step 3. Select XMODEM file transfer and select the file (**make sure to select the CRC radio button in the file dialog**)
Step 4. If FW uploads properly a progress box will indicate 100% complete and the new firmware will run displaying the current NPM3000E operating parameters.

Note that if the new firmware does not load the user may have to power cycle the device and repeat the firmware upgrade attempt. If main code firmware is not present on the NPM3000E device or the firmware main code is corrupted or incompletely loaded, then the unit will display 6 question marks (??????) and will appear to "hang", becoming unresponsive. The unit will need to be power cycled if this occurs. After power cycle the series of question marks should begin again, allowing for another opportunity for firmware upload.

If the user is not successful with firmware upload via the TeraTerm Pro Xmodem method, the user may try firmware upload through the use of the External microSD card in the previous manual section**, Section D.2 FW Upload Using the NPM3000E External SD card.**

Note: If power is applied simultaneously to both the XPort Ethernet adapter and the NPM3000E device, then it may be difficult to to connect and see the question marks appear. In that case, a reboot command can be issued after connection to the device is made, which should then display the question marks.

Example of NPM3000E device output at reboot or power up of the NPM3000E device:

```
reboot
??????
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.3.0
Model              NPM3000E
Model Version      HV2K-DL-TH-C-HN16
Serial Number      12090173
Name               IP173
//NPM3KE PARAMETERS//
Voltage            0
MaxVoltage         2000
…
…
…
RecordPeriod(Sec)  60
RecordsPerHGM      60
NewFilePeriod      Day
Current Time       2013/01/21,22:24:34
```

If the user types a “CTRL Q” when the question marks are displayed the NPM3000E device will allow a firmware upgrade via the Xmodem protocol to be performed. The user should wait for a “C” to be transmitted indicating it is time to transfer the upgrade file via Teraterm. i.e., when a “C” is received the user can begin the upgrade

```
reboot
??
Wait for "C"
Then use XMODEM-CRC
```

Select File->Transfer->XMODEM->Send…
A File Selection Box of the form shown in **Figure 34** will appear.
Make sure the **CRC** radio button is selected at the bottom of the window.
Navigate to the folder which contains the desired NPM3000E firmware *.bin file and select the file. Select the **Open** command button and the firmware will be uploaded. A progress box of the form shown in **Figure 35** will be displayed.

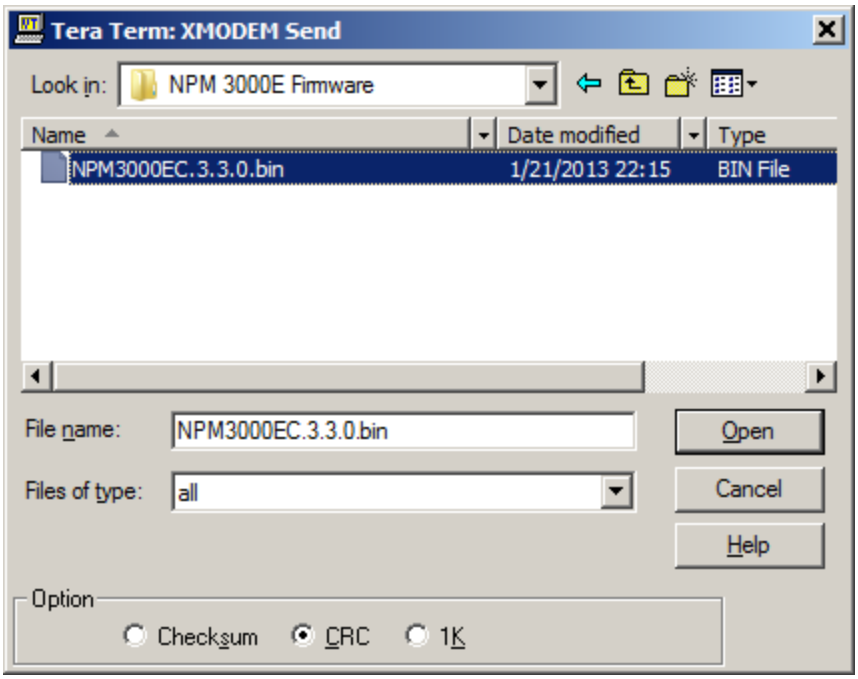


Figure 34. TeraTerm XMODEM Firmware Upgrade File Selection

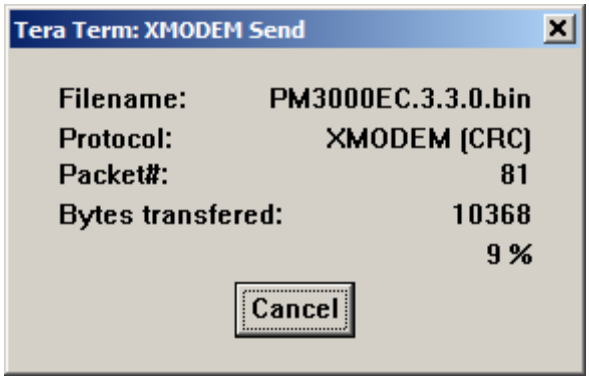


Figure 35. Teraterm XMODEM Firmware Upgrade Progress

```
reboot
??                    (User entered <CTRL-Q) here)
Wait for "C"
Then use XMODEM-CRC
C                     (User selected File as in Figure 34)
Quaesta Instruments, LLC
www.QuaestaInstruments.com
Firmware Version  EC.3.3.0
Model              NPM3000E
Model Version      HV2K-DL-TH-C-HN16
Serial Number      12090173
Name               IP173
//NPM3KE PARAMETERS//
Voltage            0
MaxVoltage         2000
Gain               10.0
LowerDisc          10
UpperDisc          127
nBins              128
DeadTime           160
VibeMode           0
PeakMode           0
HgmMode            2
TTLMode            0
LEDMode            1
PulseLevel         0.40
//LOGGER PARAMETERS//
PrintDAT           0
```

```
SaveDAT             1
PrintHGM            0
SaveHGM             1
PulseCounterON      0
TemperatureON       1
HumidityON          1
BatteryON           1
SignalON            0
RecordPeriod(Sec)   60
RecordsPerHGM       60
NewFilePeriod       Day
Current Time        2013/01/22,09:38:44
File Created: 0:/DAT/IP173_1301220938.DAT
File Created: 1:/DAT/IP173_1301220938.DAT
File Created: 0:/HGM/IP173_1301220938.HGM
File Created: 1:/HGM/IP173_1301220938.HGM
```

Appendix E

Troubleshooting: Non-responsive NPM3000E device.

If the NPM3000E device becomes non-responsive via the Ethernet interface, then TCPIP connectivity to the device should first be thoroughly checked:

Note that only one TCPIP connection to the NPM3000E firmware may be active at one time. Check to make sure another direct connection to the device is not active. i.e. if using the GUI verify that a connection via TeraTerm or other terminal program is not active.

1. A "PING" command from a PC command prompt terminal or the Quaesta Instruments GUI application can be issued and will verify that the PC being used for communication has its TCPIP settings configured properly. If a response to the PING command is obtained from the NPM3000E device then the device's ethernet server is properly functioning. A "PING" command to the device will return a response even if a connection to the NPM3000E is active. i.e., if a Quaesta Instruments GUI application is connected to an NPM3000E device a command prompt "ping" command will show a response.
2. If the PING fails, verify that the ethernet server on the NPM3000E device is properly powered.
3. Verifty that ethernet cabling between the device and PC is intact.
4. Make sure the correct IP address is being used. If the device is powered, LED lights on the device's ethernet connector will illuminate.
5. Verify that the correct IP address is being used. Use of the Lantronix device installer application may be useful here if a local TCPIP connection is available. See ***Setting IP Address, Option 1*** in ***Section 5. Configuring the NPM3000E Device IP Address*** for guidance with the Lantronix Device installer application.
6. TCPIP Communication to the device should utilize port 10001. See ***Appendix B. Configuring Teraterm Pro*** **i**f attempting communication via a Terminal based program.
7. Use of a web browser may allow one to quickly verify the functionality of the Lantronix ethernet interface. The web page will be accessible even if a direct TCPIP connection is active elsewhere to the NPM3000E device. The user can enter the IP address directly in a Web browser and an http page displayed by the Lantronix device will be displayed. If a web page is returned then the ethernet server is functioning. See ***Setting IP Address, Option 2*** in ***Section 5. Configuring the NPM3000E Device IP Address***. Caution is warranted when making use of the web interface to the NPM3000E device as parameters such as the working TCPIP port number, etc., can be changed.

If TCPIP connectivity is verified and the NPM3000E device is still non-responsive, then the user should verify proper cabling and that power is being delivered to the Neutron Pulse Module portion of the NPM3000E device.

If the NPM3000E device still appears nonresponsive, then the NPM3000E main Firmware code may have been corrupted. A working bootloader on the NPM3000E device is necessary in order to upload new firmware.
To check for the presence of working bootloader, Teraterm Pro or other suitable TCPIP terminal program can be utilized.

Step 1. Turn On the Device's ethernet interface.
Step 2. Make sure the PC being used has the correct TCPIP configuration to contact the device.
Step 3. If necessary, determine the device's IP address as described in ***Section 5. Configuring the NPM3000E Device IP Address***.
Step 4. Connect to the TCPIP server on the device using the directions in ***Appendix B or Appendix C.***
Step 5. Power cycle the NPM portion of the NPM3000E device and a series of question marks will appear if the NPM3000E bootloader program is present and functioning.

If a working bootloader is present, new firmware may be uploaded. See ***Appendix D: Firmware Upload Procedures***

Appendix F

NPM3000E, Menu Command Output.

As of NPM3000E FW Version 3.3.7, the following output is issued by the NPM3000E device in response to the 'menu' command.

```
menu

*** List of available Commands (Not Case Sensitive)***

*** Cntrl-R to repeat previous command***

*** - C -  Control commands***
*** - R -  Read commands   ***
*** -R/W-  Read/Write parameters. Enter the parameter name to see the current value            ***
***        To change the value enter the parameter name followed by the new value             ***
***        Separate the parameter name from the new value with an Equal, Space, Comma, or Colon***

***Miscellaneous Commands and Parameters***

Name            -R/W- Identifier: e.g. 'Name=Detector #1', maximum 16 characters
Menu            - R - List of all commands
Help            - R - List of all commands
Info            - R - Identification and Parameters
Status          - R - Various status information
Adev            - R - Noise Mean Deviation:     e.g. 'ADEV=100' is 2048 sample Adev, averaged 100 times)
Sdev            - R - Noise Standard Deviation: e.g. 'SDEV=100' is 2048 sample Sdev, averaged 100 times)
ComEcho         -R/W- Com Echo:         1 for Yes, 0 for No
ComFlowControl  -R/W- Com Flow Control: 0 for none, 1 for Software, 2 for Hardware
ComTimeOut      -R/W- Com Flow Control ComTimeOut: e.g. 'ComTimeOut=10', {1 <= Seconds <= 60}
ComFlowLED      -R/W- Light LED during XOFF: 1 for Yes, 0 for No
ComBaudRate     -R/W- Com Baud Rate: e.g. 'ComBaudRate=115200', 115200, 230400, 460800, 921600
SendProbe       - R - Send diagnostic data block: e.g. 'SendProbe=100'
Reboot          - C - System reset
```

```
***NPM Commands and Parameters***

Voltage         -R/W- High Voltage: e.g. 'Voltage=1000', maximum is MaxVoltage
MaxVoltage      -R/W- Maximum Allowable Voltage: e.g. 'MaxVoltage=1500', maximum is 2000
Gain            -R/W- Gain: e.g. 'Gain=5.3', from 1 to 20
LowerDisc       -R/W- Lower Discriminator: e.g. 'LowerDisc=25', maximum is nBins-1
UpperDisc       -R/W- Upper Discriminator: e.g. 'UpperDisc=127', maximum is nBins-1
nBins           -R/W- Number of Histogram Bins: e.g. 'NBINS=128', 64,128,256,512,1024
DeadTime        -R/W- DeadTime: e.g. 'DeadTime=1000', in microseconds from 160 to 65000
VibeMode        -R/W- Vibration Sensitivity Reduction Mode: 0 or 1, e.g. 'VibeMode=1'
PeakMode        -R/W- Peak Mode: e.g. 'PeakMode=1' -> peak info, 'PeakMode=n' -> n point pulse shape
HgmMode         -R/W- Histogram Mode: e.g. 'HgmMode=1', mode is 1,2, or 3
TTLMode         -R/W- TTL Output Mode: 1 for ON, 0 for OFF, see manual for output pulse width
LEDMode         -R/W- LED Mode: 1 for ON, 0 for OFF, LEDMode is always ON when Ethernet is ON
Counts          - R - Report and Zero the Counts and the Timer
Query           - R - Report the Counts Without Zeroing
Hgm             - R - Report Histogram, format according to HgmMode
MaxHgm          - R - Report position of histogram maximum, maximum value, and total histogram counts
ZeroCounts      - C - Zero the Count value
ZeroHgm         - C - Zero the Histogram

***Pulse Counter Commands and Parameters (With Pulse Counter Option)***

PulseCounterON  -R/W- Pulse Counter Control: 0 for OFF, 1 for ON, 2 for ON,High Speed
PulseLevel      -R/W- Pulse Counter Threshold Level in Volts: e.g. 'PulseLevel= 1.75',0 to 4 Volts
PulseCounts     - R - Report and Zero the Pulse Counts
PulseQuery      - R - Report the Pulse Counts Without Zeroing
ZeroPulseCounts - C - Zero the Pulse Counts

***Sensor Commands***

Temperature     - R - Temperature(Celsius) and Humidity(%Relative)(Optional)
Humidity        - R - Temperature(Celsius) and Humidity(%Relative)(Optional)
Battery         - R - Battery Voltage
Signal          - R - External Signal: ON or OFF

***Data Logger Commands and Parameters (With Data Logger Option)***

PrintDAT        -R/W- Print Data Records:  1 for Yes, 0 for No
SaveDAT         -R/W- Save  Data Records:  1 for Yes, 0 for No
SaveBIN         -R/W- Save  Binary Records:1 for Yes, 0 for No
```

```
PrintHGM        -R/W- Print Histograms:    1 for Yes, 0 for No
SaveHGM         -R/W- Save  Histograms:    1 for Yes, 0 for No
TemperatureON   -R/W- Include Temperature: 1 for Yes, 0 for No
HumidityON      -R/W- Include Humidity:    1 for Yes, 0 for No
BatteryON       -R/W- Include Battery:     1 for Yes, 0 for No
SignalON        -R/W- Include Signal:      1 for Yes, 0 for No
RecordPeriod    -R/W- Record Period in seconds{ >= 3 }: e.g. 'RecordPeriod= 3600'
RecordsPerHGM   -R/W- Number of records per Histogram: e.g. 'RecordsPerHisto= 100'
NewFilePeriod   -R/W- NewFile Period: e.g. 'NewFilePeriod= Day', Day,Month,Year
Time            -R/W- Time and date: e.g. 'Time= 2011/05/18 16:34:00'
ShowFileNames   - R - Report current DAT and HGM filenames
LogMode         - R - Report current LogMode settings
ShowData        - R - Report data according to output selections

***File System Commands (With Data Logger Option)***

Dir             - R - Report files in directory
GetCwd          - R - Report current working directory
DiskInfo        - R - Report bytes free and size of SD cards
FileInfo A.B    - R - Report file information: e.g. 'FileInfo Qwerty.dat'
Type A.B        - R - Display a file (see manual for Switches): e.g. 'Type 1105191456.DAT'
Cd A            - C - Change to a different directory : e.g. 'Cd HGM' or 'Cd..' or 'Cd /'
0: or 1:        - C - Change to the Internal drive '0:', or to the External drive '1:'
Copy A.B X.Y    - C - Copy a file: e.g. 'Copy 1105191456.DAT 1:/BackupData.TXT'
Rename A.B X.Y  - C - Rename or move a file: e.g. 'Rename 1105191456.DAT 1:/ARC/DAT/BackupData.TXT'
Attrib ?? A.B   - C - Change Attributes of a file: e.g. 'Attrib +R-A 1105191456.DAT'
Del A.B         - C - Delete a file: e.g. 'Del 1105191456.DAT' or 'Del *.DAT'
MkDir A         - C - Make a new directory: e.g. 'MkDir Locker'
Transfer A.B    - C - Transfer a file to a PC (see manual): e.g. 'Transfer 1105191456.DAT'
Format          - C - Format the internal SD card. Use with Caution!
SdReset         - C - Power cycle the SD cards
```

Appendix G

Quaesta Instruments GUI Application, Reference

The Quaesta Instruments provided GUI can be used to set NPM3000E parameters, monitor device status, examine SD card contents, retrieve stored data, plot data, etc.

The Main GUI Window is shown in **Figure XX Main GUI Application Window**. The Neutron Pulse Module operational parameters can be configured in the left frame of the Main GUI window, and the datalogging operational parameters can be configured in the middle pane of the Main GUI window. The Right most pane shows the current status of the NPM3000E device as retrieved by the NPM3000E device 'status' command.

The GUI is shown as it first appears after starting the application. The application is not connected to an NPM yet.

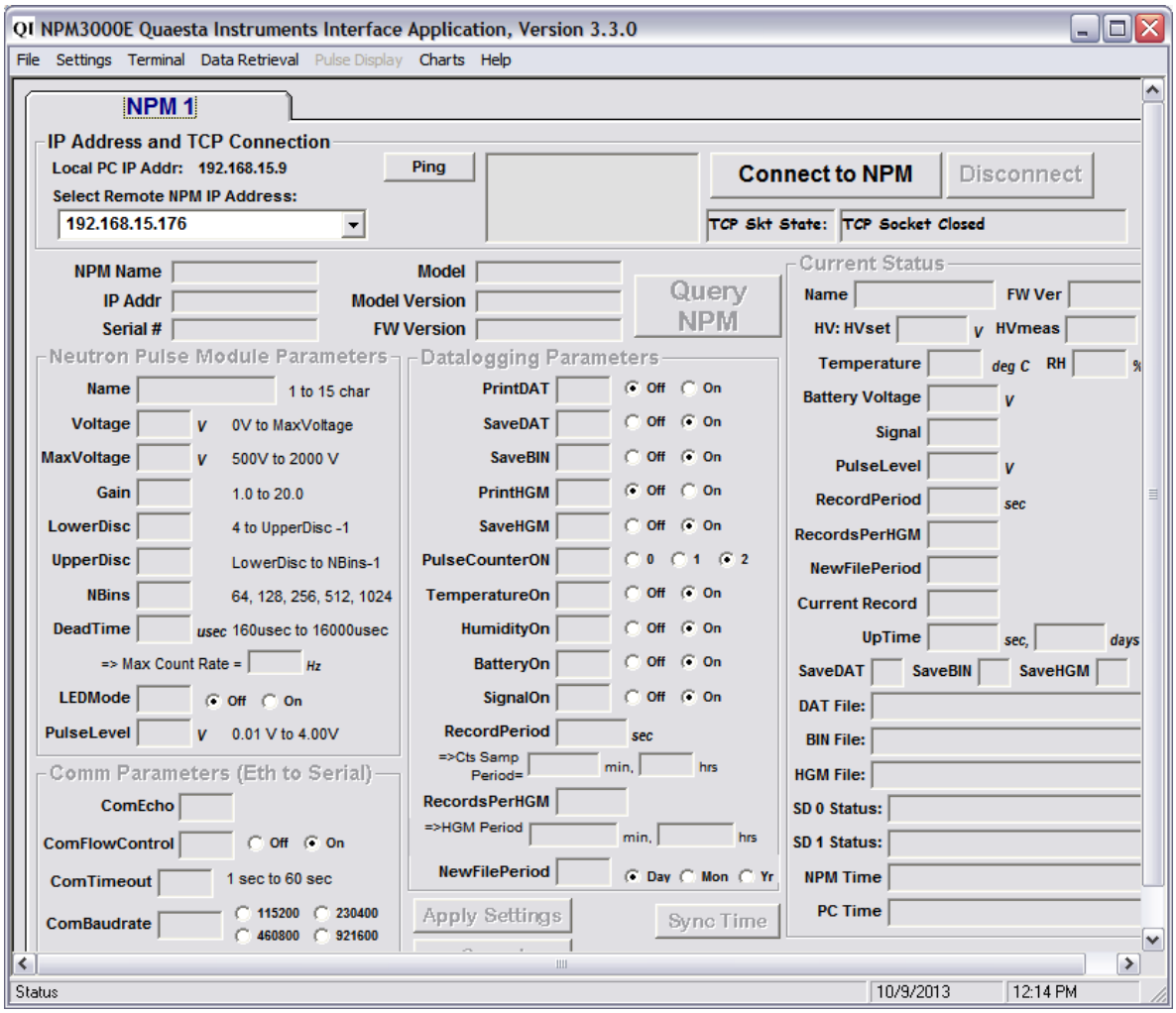


Figure 36. GUI Application Main Window

To test if an NPM3000E device with a particular IP address is on the currently accessible network, you can select the NPM with the proper IP address and issue a Ping command with the Ping command button.
If the connection is OK, the user can connect to the desired NPM.
If an IP address of an NPM needs to be added, first do so via the "*IP Address List* " management form accessible via the ***Settings*** menu selection.

Once connected, parameters can be entered directly in the appropriate fields. Click the *"Appy Settings"* command button to load the parameters on the NPM.

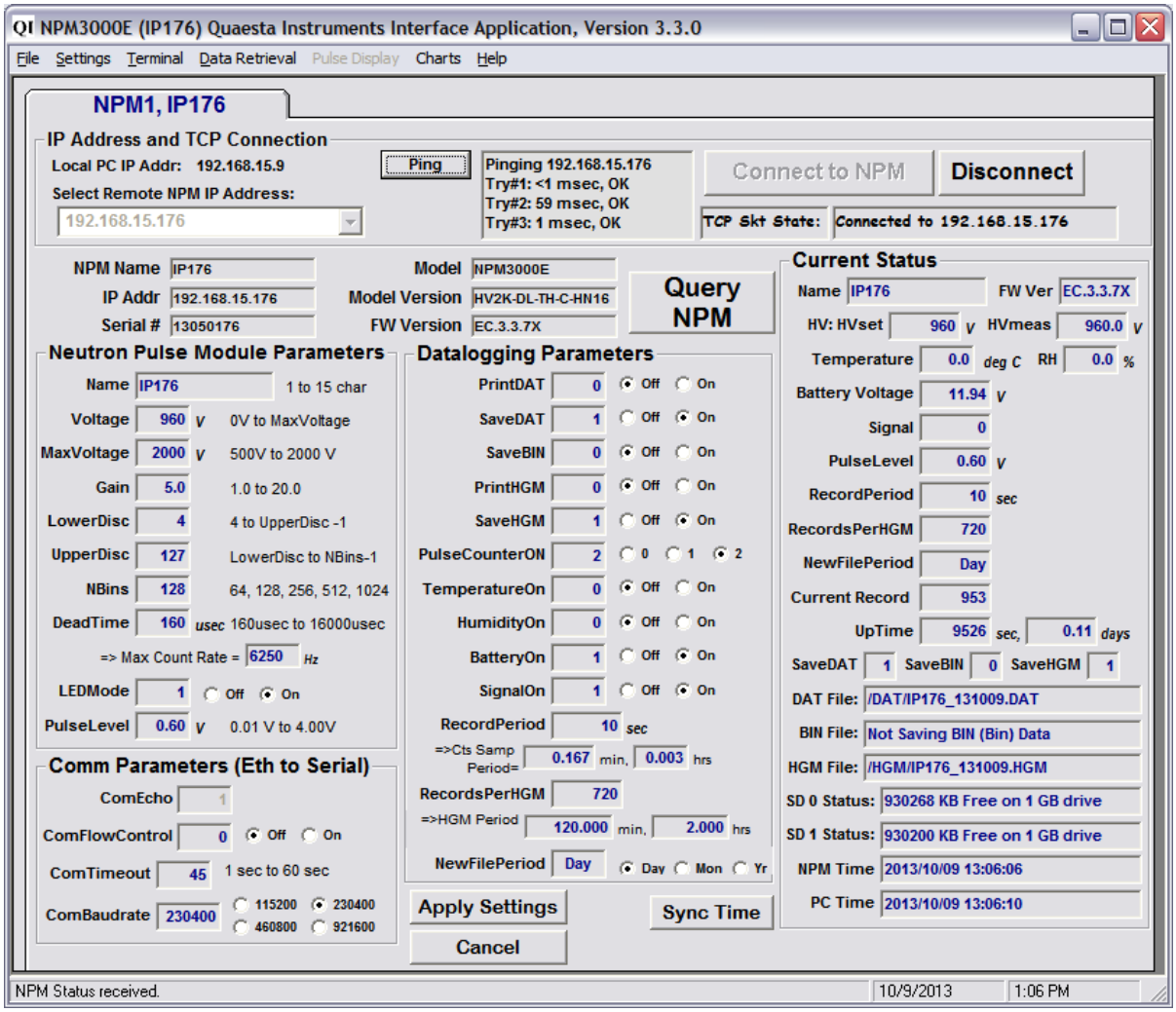


Figure 37. GUI Main Window with Connected NPM

In addition to setting NPM3000E operational parameters, the GUI can be used to issue commands via the command-line, and also retrieve and plot data. Menu selections from the main form provide access to these additional GUI capabilities.

GUI Menu Selections Available, Quick Reference

Menu Item	Description
File	
Preferences	*(in Development)*
Exit	*(closes the application cleanly)*
Settings	
IP Address List	*(allows user to add and delete NPM3000E IP addresses)*
Working Directories and Files	*(view and set current application working directories)*
Advanced Modes	*(describes several advanced parameter settings in which some users might be interested.)*
XPort Settings	*(Allows the user to set XPort parameters via the GUI application. The user may also set the Xport operating parameters directly via a Web Browser)*
Terminal	
Display	*(opens a Text terminal which can be used to directly issue commands to a connected NPM. Also can monitor "real-time" text traffic rom the NPM)*
Data Retrieval	*(opens a Form which displays files located on the Internal and External SD cards. Also allows for File transfer of DAT, HGM, and BIN files).*
Charts	
Offline-Data Series	*(plot retrieved DAT time series files)*
Offline-Histograms	*(plot retrieved HGM record files)*
Real-Time Data Series	*(retrieve and plot currently active DAT and BIN data)*
Real-Time Histograms	*(query and display current MCA recorded HGM data)*
Help	
Support	*(GUI Version and Quaesta Instruments Contact Info)*
Firmware Upgrade	*(upgrade NPM3000E firmware. Requires proper firmware file. Contact Quaesta Instruments if necessary.)*

Screen captures for many of these menu selections are presented in the immediate following pages.

Settings → *IP Address List*

Mulitple NPM3000E devices can be connected on an Ethernet subnet, as long as they all have different IP addresses. A particular NPM3000E XPort ethernet interface module IP address can be set using the procedure described in ***Section 5. Configuring the NPM3000E Device IP Address***.

After an NPM3000E device has been properly assigned and IP address, the device's IP Address can be added to the GUI application's IP address list.

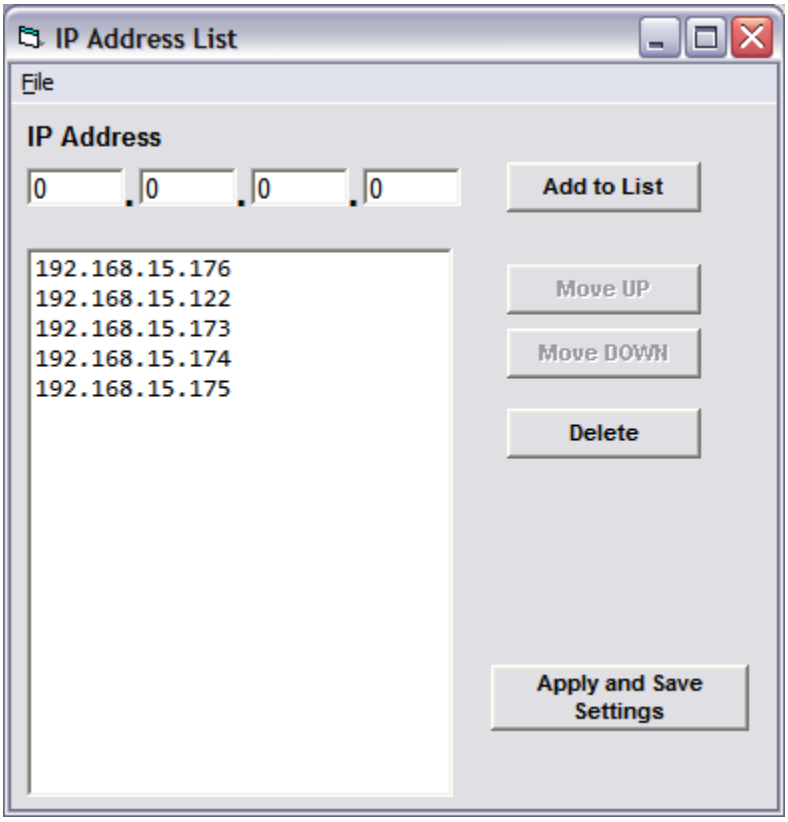


Figure 38. GUI NPM3000E IP Address List

The NPM3000E GUI application stores this data in an IPAddressConfig.txt file. The IPAddressConfig.txt file location is listed when the menu item ***Settings-> Working Directories and Files*** is selected. The user may edit this file directly but should be careful not to alter the file structure.

Settings → *Working Directories and Files*

This menu selection opens a window of the format shown in **Figure 39**. The user can select the directories where Transferred data will be stored. The location of the IPAddressConfig.txt file is also displayed, and the list may be accessed for editing by selecting the "Edit IP Address List" button.

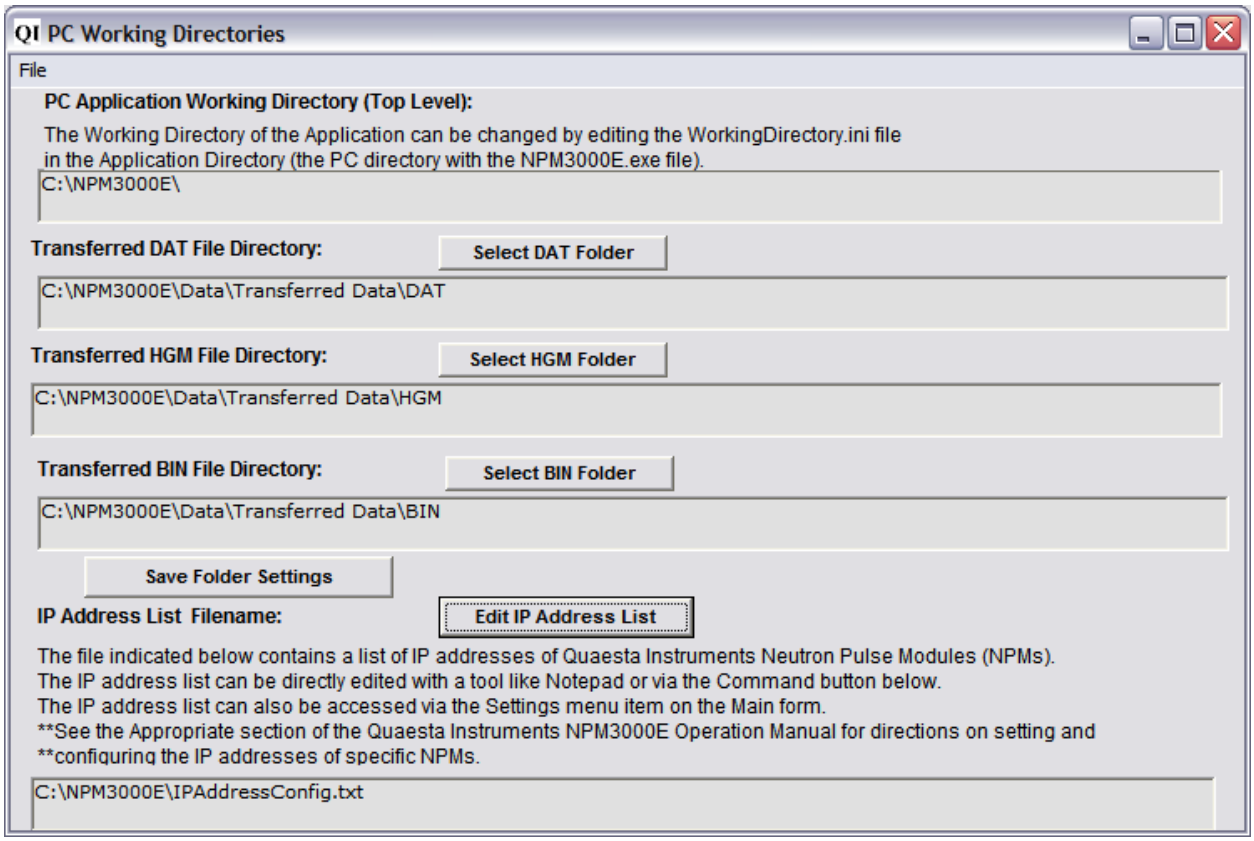


Figure 39. GUI Working Directories window.

Settings → *Advanced Modes*

Advanced operating modes are presented and discussed in this form.

Settings → *XPort Settings*

XPort Operating parameters can be changed via this form. *The user should make these changes carefully and with caution as improper XPort settings can make the NPM3000E device unreachable.*

Terminal → *Display*

A text based user interface terminal screen will be opened. See **Figure 40** and **Figure 41**. Commands can be typed in the Input text box and sent to the NPM. Selecting the "Show Traffic Real Time" checkbox will result in all TCP text traffic from the NPM being displayed in the terminal. Selecting the "Show Traffic Real Time" checkbox will slow the response of the GUI somewhat. Output be copied via the Edit menu. The "List of Commands" menu item will show a menu of available NPM3000E commmands with a brief description of each.

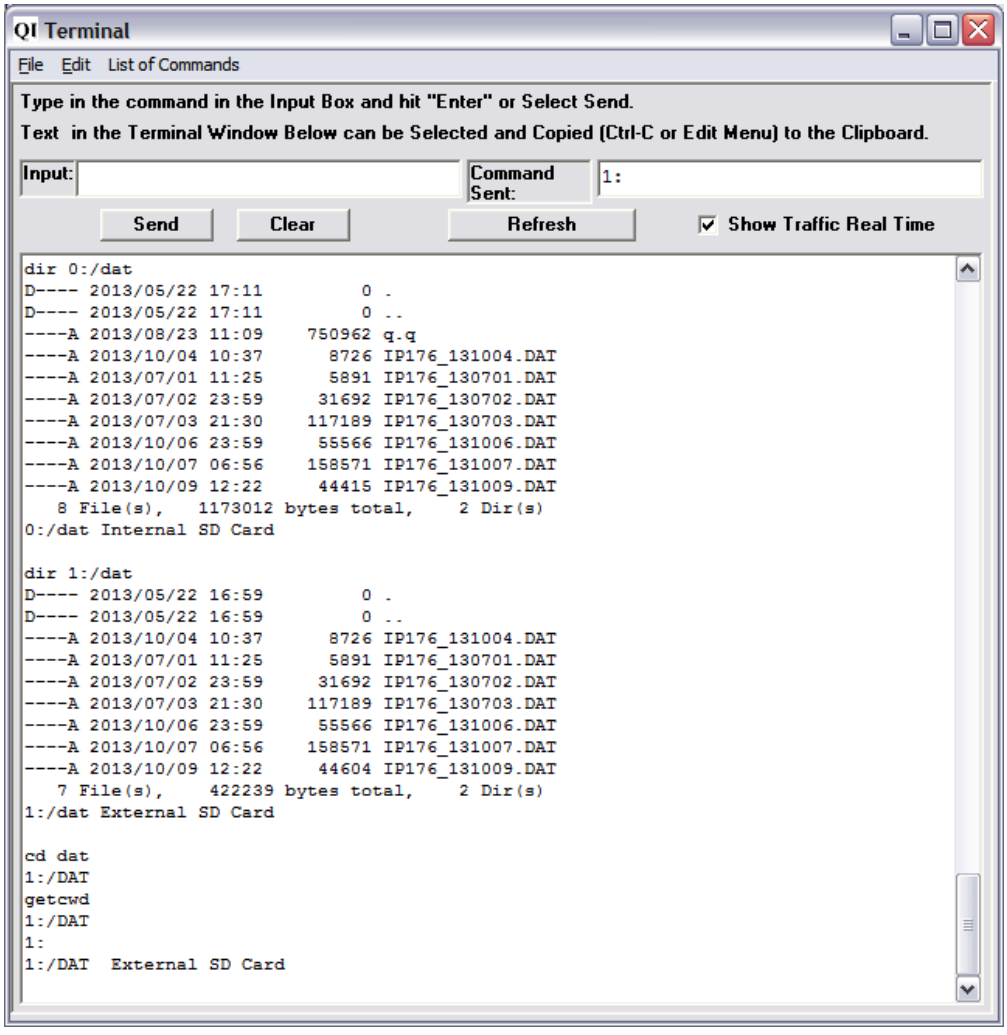


Figure 40. GUI Terminal Interface, SD Card Dir Example

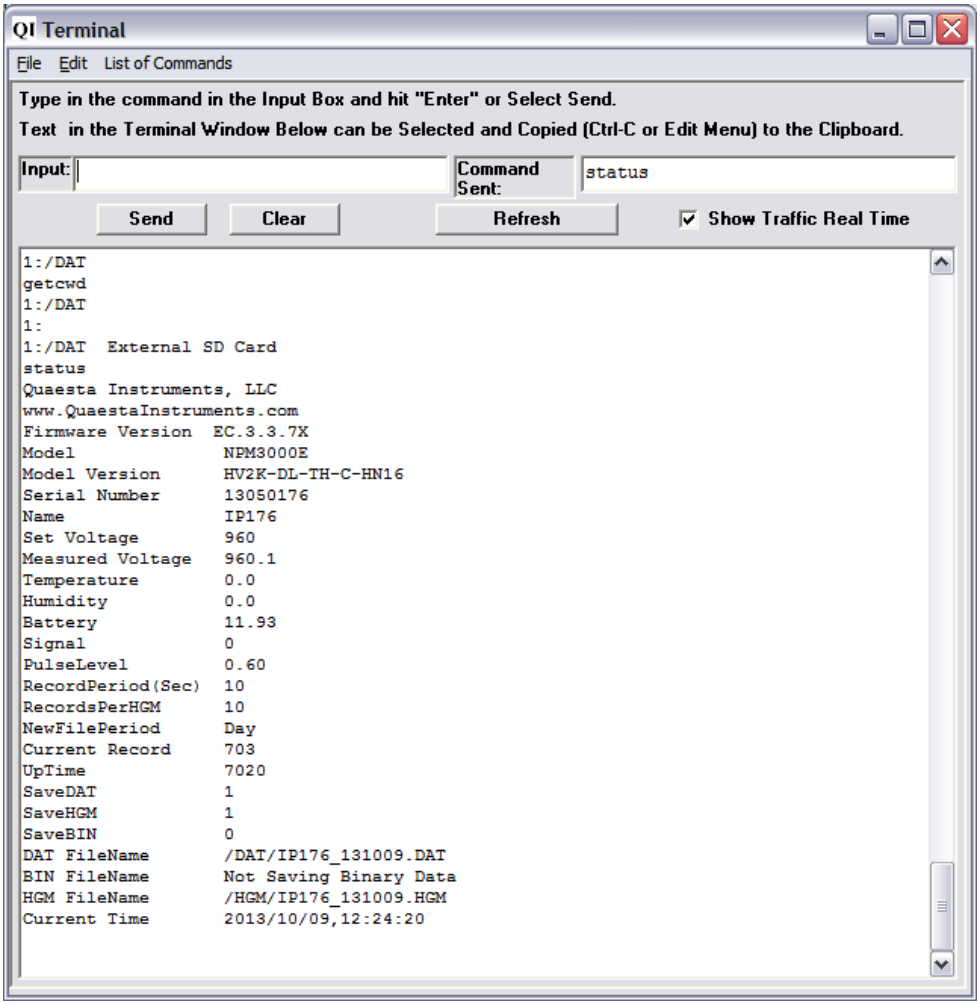


Figure 41. GUI Terminal Interface Window, Status Example

Data Retrieval

This menu selection will open a window displaying SD card contents of the connected NPM. Reference **Figure 42**.

DAT, HGM, and BIN folder contents on both Internal and External SD cards can be displayed.

Files can be selected and retrieved.

The "DOS" archive bit on the SD card files can be used as an indicator of whether the file has been transferred. Select the "Clear Archive Bit upon Transfer" checkbox and the archive bit will be cleared for the SD card data file after the file is successfully transferred.

Selecting the "Retrieve" command button after files are selected will open a dialog window allowing the user to select the destination folder for the files. File transfer progress is displayed in the same dialog window.

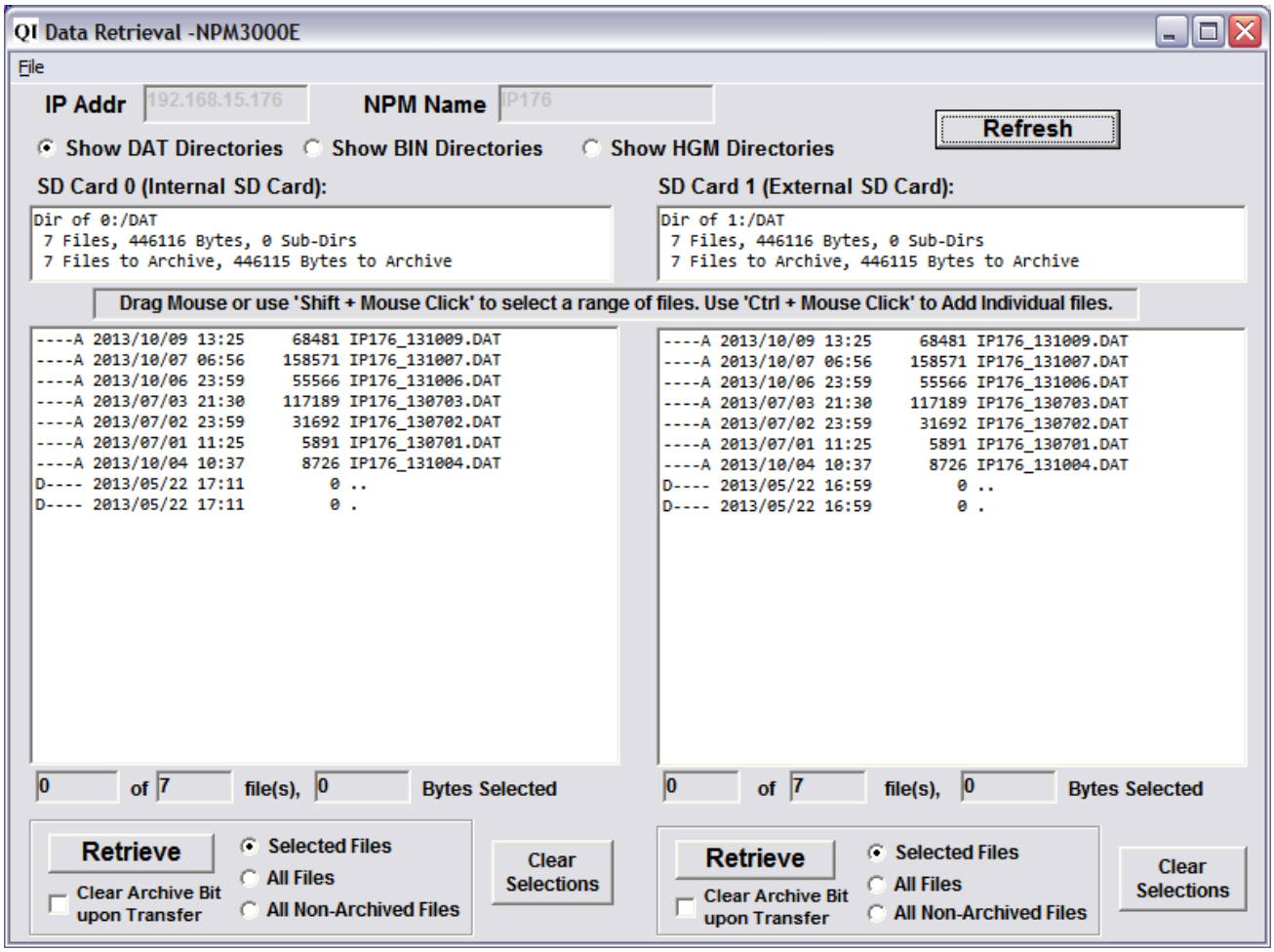


Figure 42. GUI SD Card Data Display and Retrieval

Charts → *Offline-Data Series*

DAT and BIN files retrieved from the NPM3000E device can be plotted. See **Figure 43**. The DAT or BIN file can be selected via the *File* menu option.

The top pane can be used to display neutron counts and/or external input pulse counts.

The bottom pane can display device temperature and humidity (if –TH option is selected), supply voltage, and Signal Input, selectable via the radio buttons.

Data series can be plotted vs Record #, Day of Month, or Day of Year.

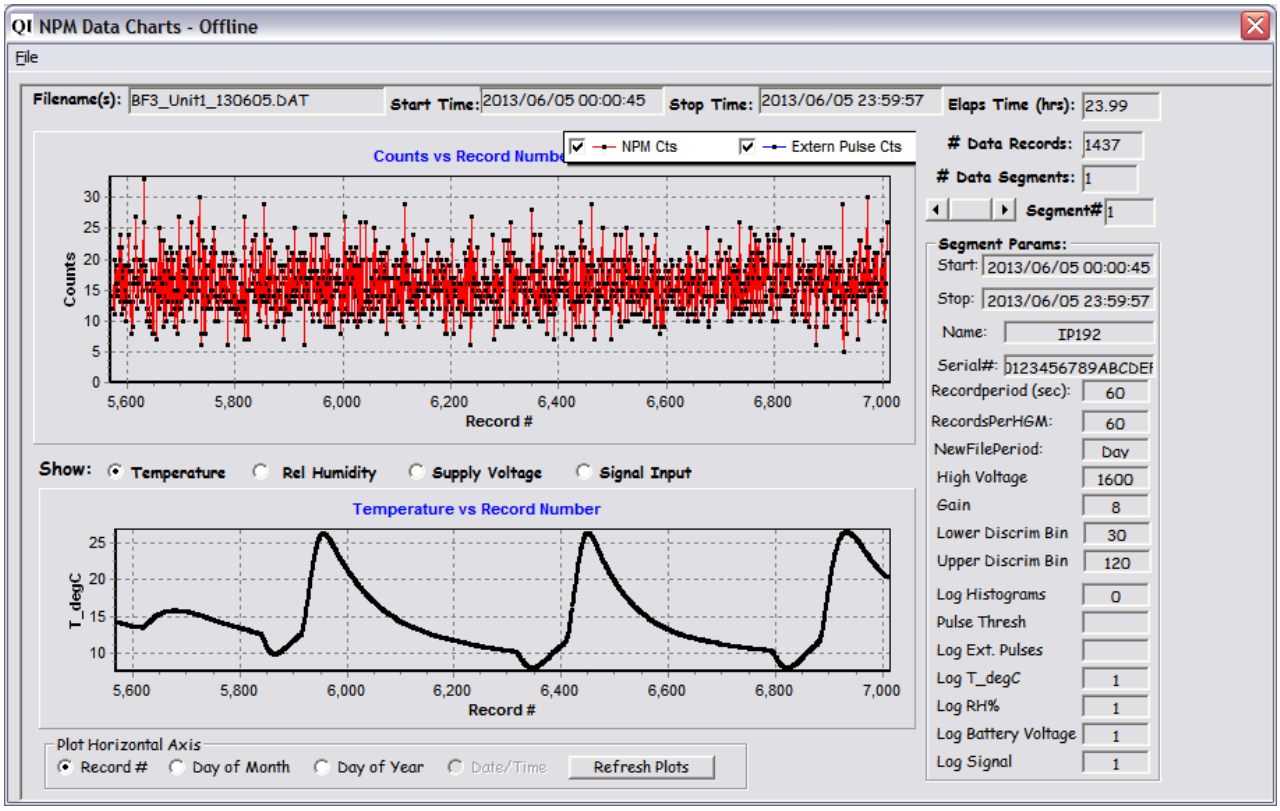


Figure 43. GUI Offline DAT and BIN Time Series Plots

Charts → *Offline-Histograms*

The HGM series allows one to scroll through the histograms recorded by the NPM3000E device during detector operation, as a system monitoring tool.
The chart below shows a typical spectrum from a BF3 detector for a one hour histogram recording interval and indicates the system is working fine during that period. See ***Section 8. The Value of the integrated MCA Histograms (Pulse Height Spectrums)*** for more discussion on the integrated MCA recorded histograms.

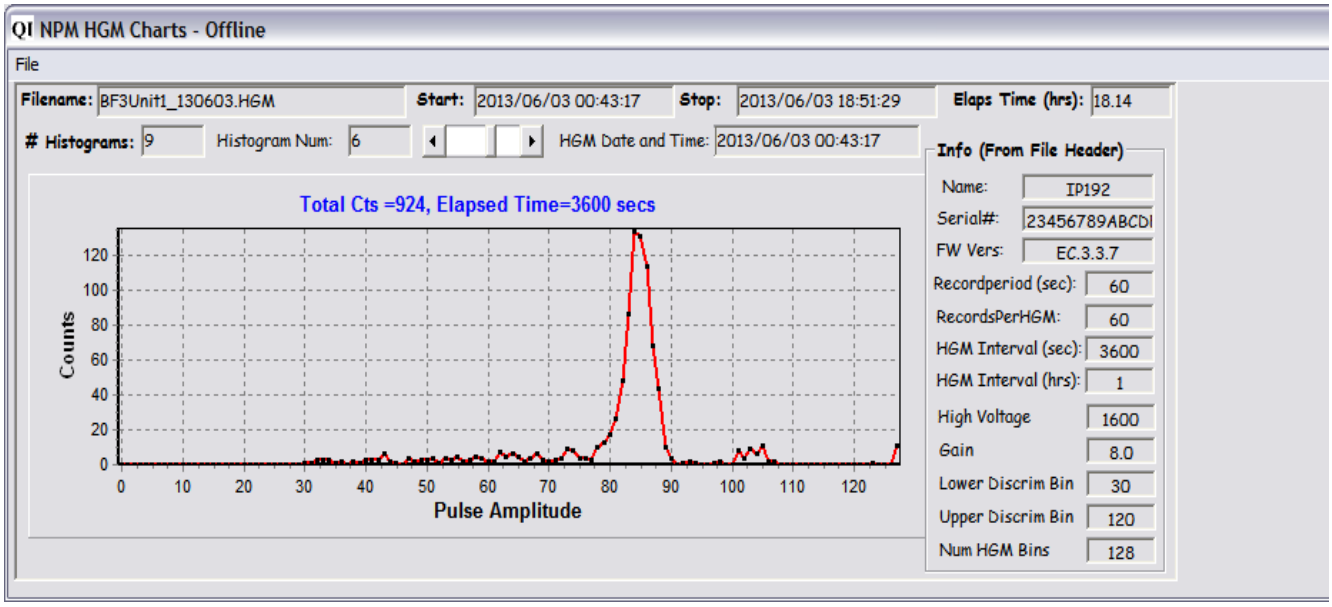


Figure 44 . Real-Time Histogram (Pulse Height Spectrum) Query

Charts → *Real-Time Data Series*

Opens a Window in which active DAT and/or BIN file data can be displayed and updated "real-time".

Charts → *Real-Time Histograms*

The following image shows a histogram retrieved from an NPM3000E device.
A relatively low sensitivity He3 tube is connected to the NPM3000E and no source is being used. The spectrum is generated only through then relatively low flux of Cosmic background generated neutrons. After just 25 minutes the spectrum is filling in nicely and has the textbook He3 shape.

The Lower Discriminator is set to a value of 10 here for demonstration purposes. In practice it would be set higher to avoid counting of pulses caused by Gamma pileup and electronic noise.

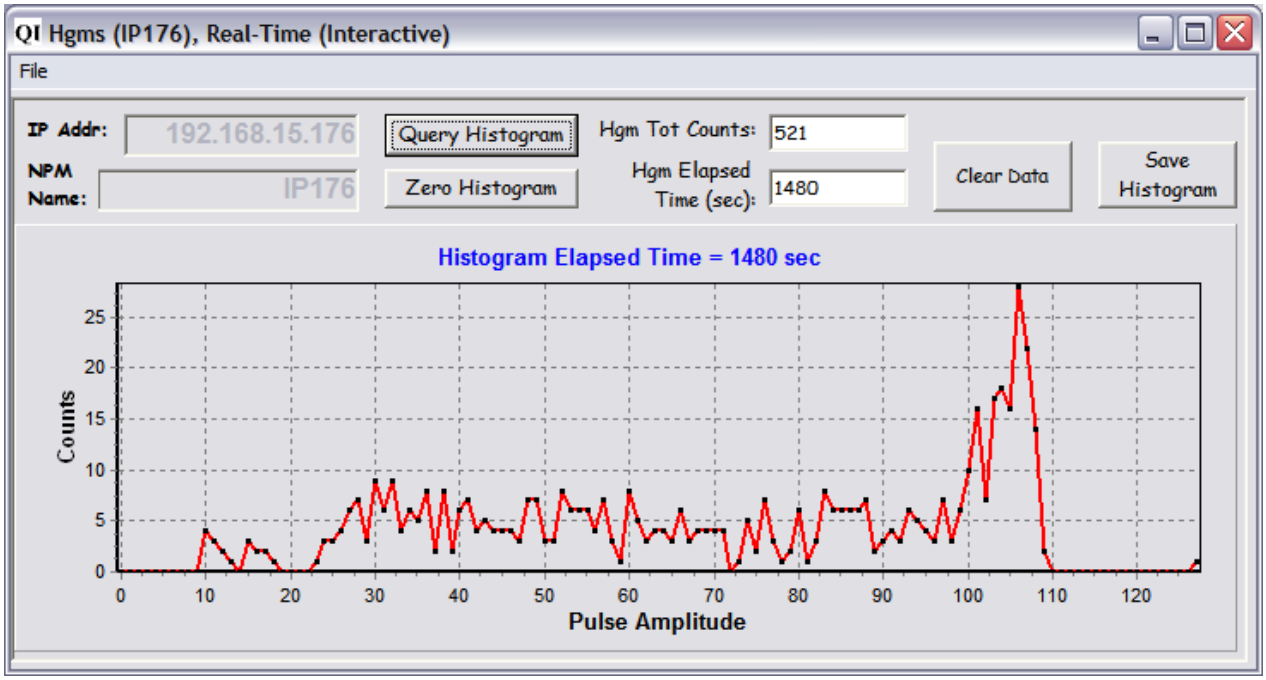


Figure 45. GUI Real-Time (Interactive) HGM Retrieval and Display

Help → *Support*

Displays a form containing GUI version information and contact information for technical support, should it be needed.

Help → *Firmware Upgrade*

Display a FW Upgrade tool form. Use of the tool is described in ***Appendix D: Firmware Upload Procedures.***

Appendix H

Extended Gain Range Jumper Settings

When ordered wth the –EG version option, the NPM3000E device will have an Extended Gain Range Jumper Block located on the device circuit board.

This Extended Gain range jumper block provides additional reduced gain settings for the Charge Sensitive amplifier stage of the NPM3000E device.

Devices with the –EG option manufactured after June 2014 (Serial #'s begin with Year and Month of manufacture, i.e. 1406XXX) provide for reduced nominal gain settings. Available settings are: Divide by: 30, 60, 90, 120, 150, 180, and 210.

The Device Serial # can be identified in the following ways:

1. Located on the device enclosure label.
2. Via the Ethernet interface and use of a Terminal program or the Quaesta Instruments GUI application.
3. If datalogging is being employed, informational headers located at the beginning of SD card .DAT and .HGM data files will contain the device Serial #.

CAUTION

Accessing the Extended Gain Range jumper block requires opening the NPM3000E device enclosure.
Caution should be taken as High Voltage is generated on the NPM3000E board.
The user should fully remove the Power connector from the NPM3000E circuit board and wait 60 seconds minimum before accessing the Extended Gain range jumpers. This will allow the High Voltage to dissipate to a safe level. Continued care should be taken when handling the circuit board and applying the jumpers.

Figure 46 provides guidance for accessing the Extended Gain range jumper block.

A jumper value of 1 indicates the Jumper is present. The jumper settings can be represented as a Binary sequence with Jumper 2 being the Most Signifcant Bit (MSB). See **Table 13. Extended Gain Range Jumper**, below.

Gain Adjustment	*Jumper 2 (MSB)*	*Jumper 1*	*Jumper 0 (LSB)*
Divide by 30	**0**	**0**	**1**
Divide by 60	**0**	**1**	**0**
Divide by 90	**0**	**1**	**1**
Divide by 120	**1**	**0**	**0**
Divide by 150	**1**	**0**	**1**
Divide by 180	**1**	**1**	**0**
Divide by 210	**1**	**1**	**1**

Table 13. Extended Gain Range Jumper Settings

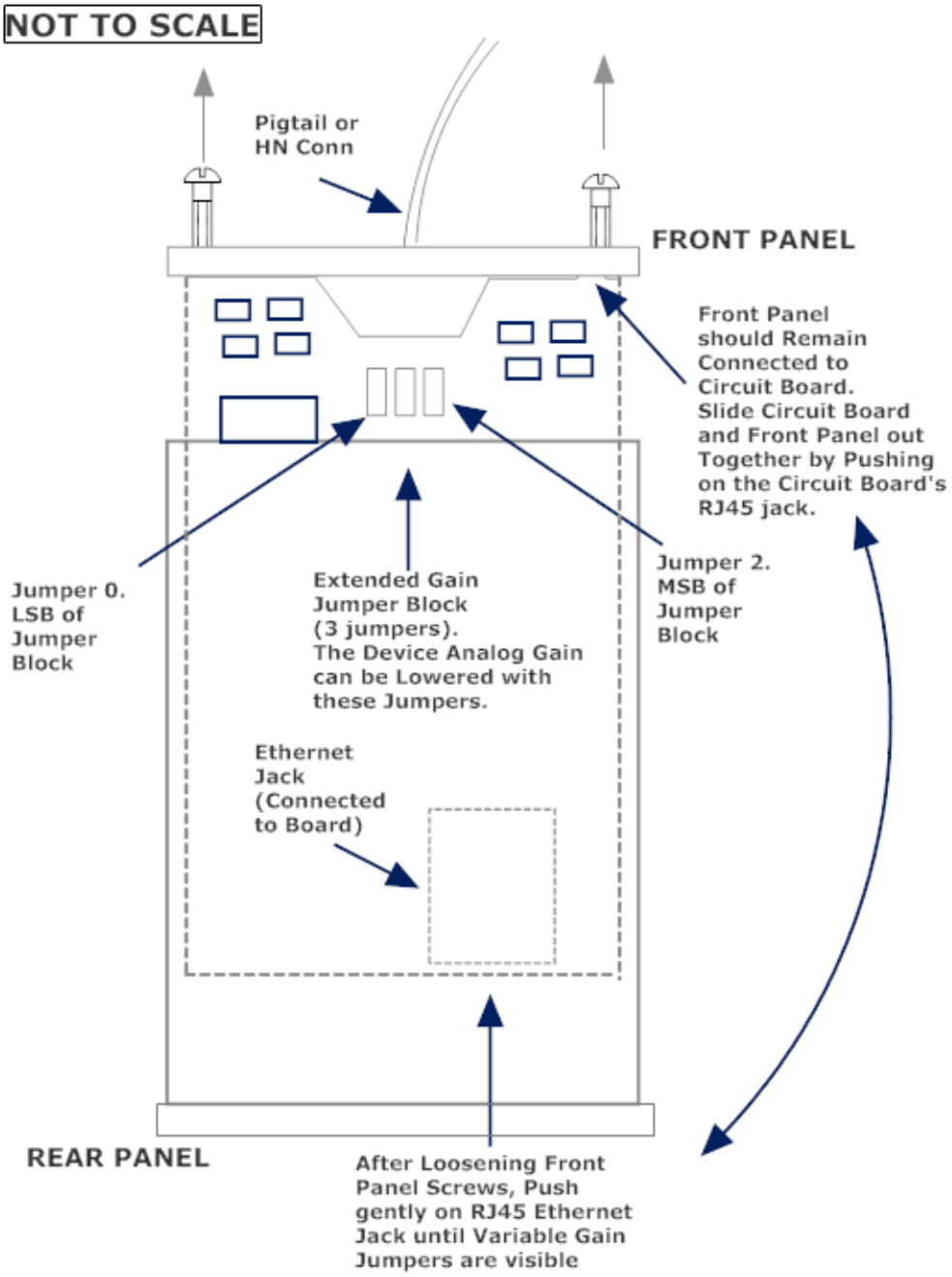


Figure 46. Extended Gain Range Jumper Block Access.