Dynamax

SapIP

Wireless Network

Quick Start Guide

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Section 1. Introduction

The new SapIP wireless data logging system from Dynamax, Inc., with EXO or Dynagage sap flow sensors, can be used to measure plant water use in “real-time” with no calibration. The SapIP gateway can monitor up to (20) SapIP nodes with (2) sap flow sensors each. The nodes can be located up to 5,000 feet away from the gateway module. Data is collected and analyzed through the Dynamax website for easy monitoring and data download.

The Sap-IP sap flow system solves many field data collection issues with a state-of-the-art wireless data collection platform. This new system was developed so field monitoring would not require wiring sensors to a central data logger and data could be collected remotely. Cables can be expensive, hard to maintain, and difficult to move around in the field, and existing RF data loggers and low cost motes typically do not have the range, power management, accuracy or resolution required for scientific grade sensors. The Sap-IP system solves all these problems and is a breakthrough for most field monitoring applications.

Remote data collection from widely distributed sensor networks has many environmental, commercial, and agronomic applications, and this highly efficient and low power RF solution is integrated into a single module, making an excellent, low cost, easy to install solution for field research. The system can be used with EXO sensors, Dynagage sensors, TDP sap velocity probes, or soil moisture sensors. Plans for compatibility and use with a variety of environmental sensors is in process.

Features

- Sensor Mote with Eight Channel Differential Signal Logger
- Self-Healing Sleeping Network. Real-time data collection
- Wide range input signals: micro Volts to ±2.5 Volts
- High accuracy and high resolution
- 30,000 records saved to flash memory
- Radio Transmission at low power 50 mW, programmable to 1 mW
- Two versions available – 2.4 Ghz, and 900 Mhz spread spectrum, FCC licensed
- Compact Size 7 cm x 30 cm, easily mounted with straps provided

Why Do We Want SapIP?

- Data on the spot– wireless mesh radio network
- Remote access from anywhere with internet
- Remote Control and Monitoring Status
- Real Time Data-updated within minutes.
- Reduce cable cost and travel cost
- Improve data storage capacity and multi point access
- Logger Storage and Automatic network Storage
- NO user programming required-all preconfigured

SapIP Product Ranges

Self Contained Nodes

2.4 Ghz High Gain-500 m Range
900 Mhz –1Km Range

Internet Gateway – Base Station

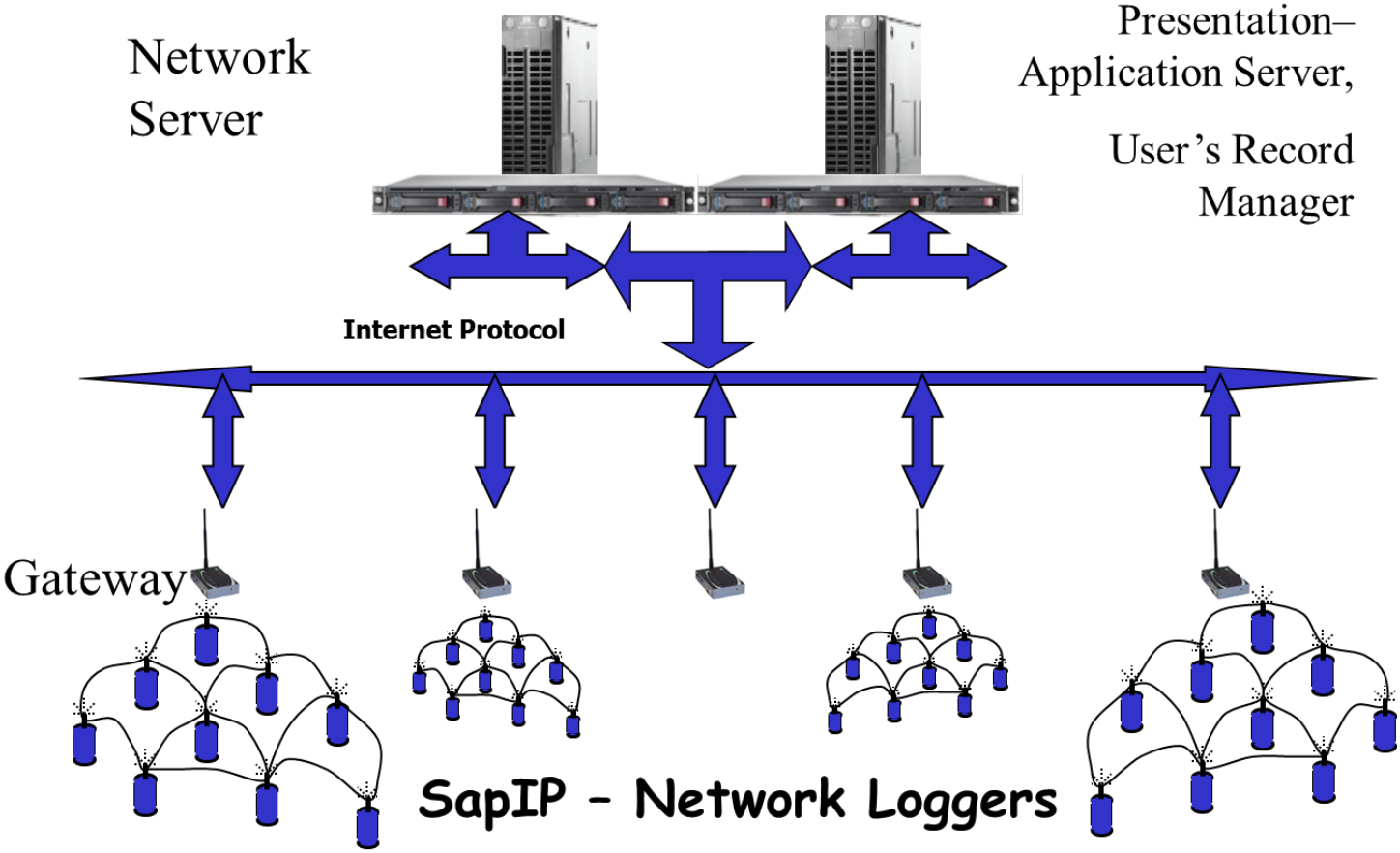
LAN and power connections.
High gain outdoor antenna

The Benefits of Being Wireless

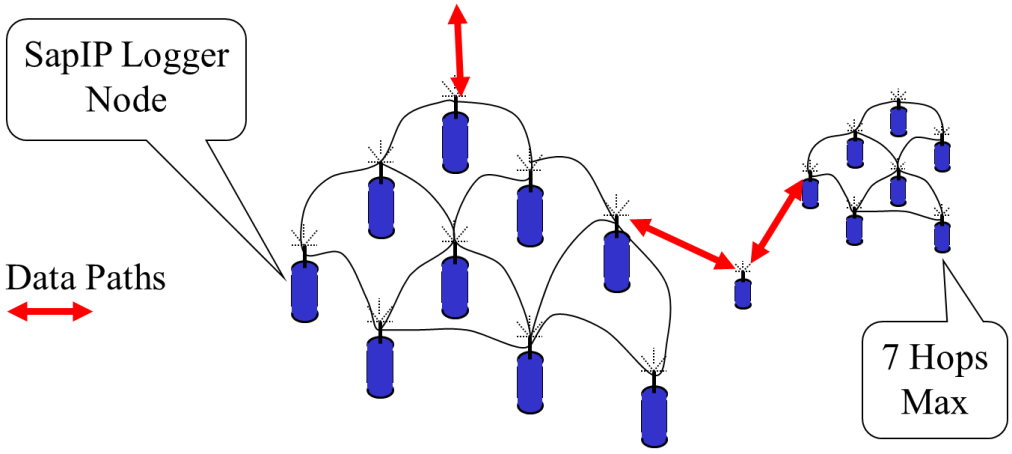
- Distributed wide-area data represents real situations
- Data from any internet connected computer browser
- On-line automatic data presentation graphs and analysis
- On-line support from Dyanamax expertise
- On-line diagnostic for problems and data questions

Agrisensors.NET

Remote Logging Network



Dynamax Solution – Mesh Network What is a mesh network?



Mesh is like a Fish net,
many points interconnect.

What is a Mesh Network?

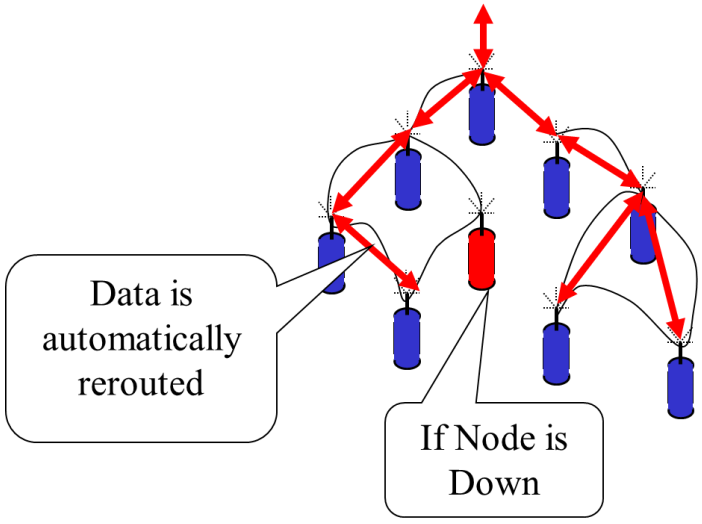
- **Hopping Data and Control:**
  Any SapIP node can talk to another node in range.

- **Range:**
  2.4 Ghz Model ~ 500m with ISM band (International)
  900 Mhz Range – 1. Km (USA version)

- **Automatic network discovery:**
  Nodes decide the best route, least hops to the gateway.

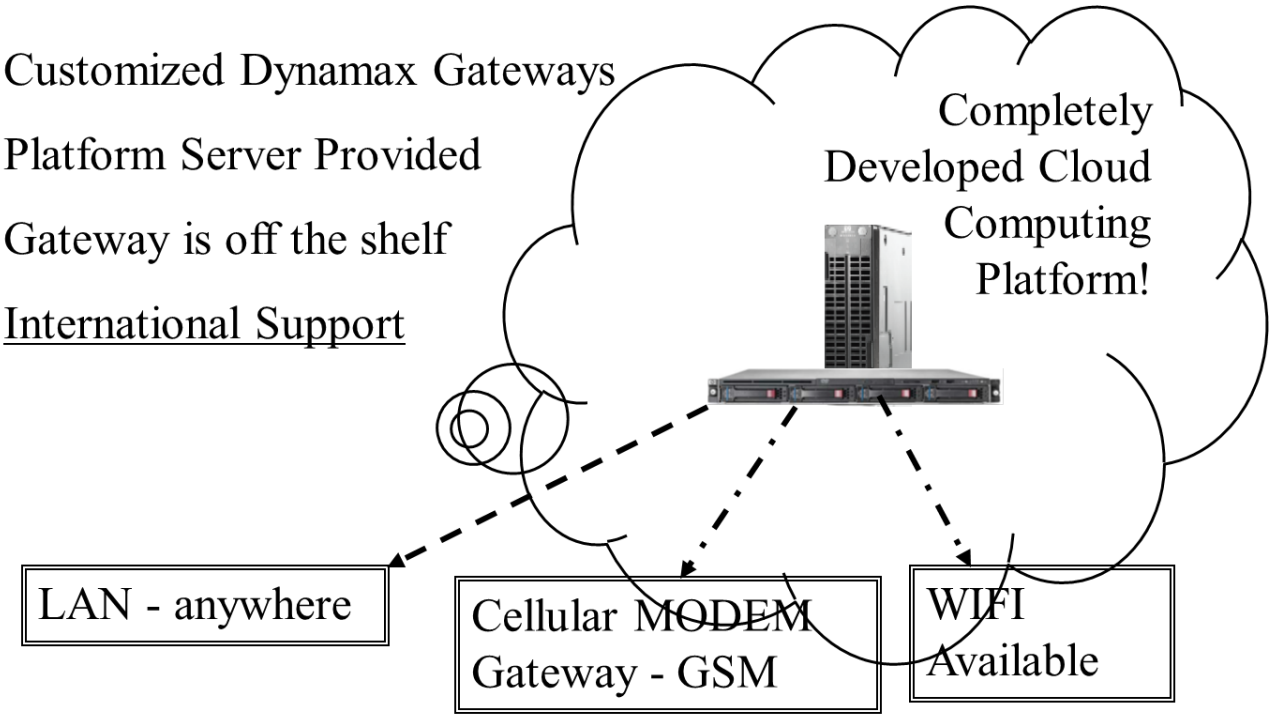
If node goes down, the network find the next best route to send data. No user intervention. Automatic data recovery included. Data storage in logger in Flash memory.

What is Self Healing?



Platform Included

- Customized Dynamax Gateways
- Platform Server Provided
- Gateway is off the shelf
- International Support



Web Access Data – Agrisensors.NET

Dynamax Server – Access Controlled

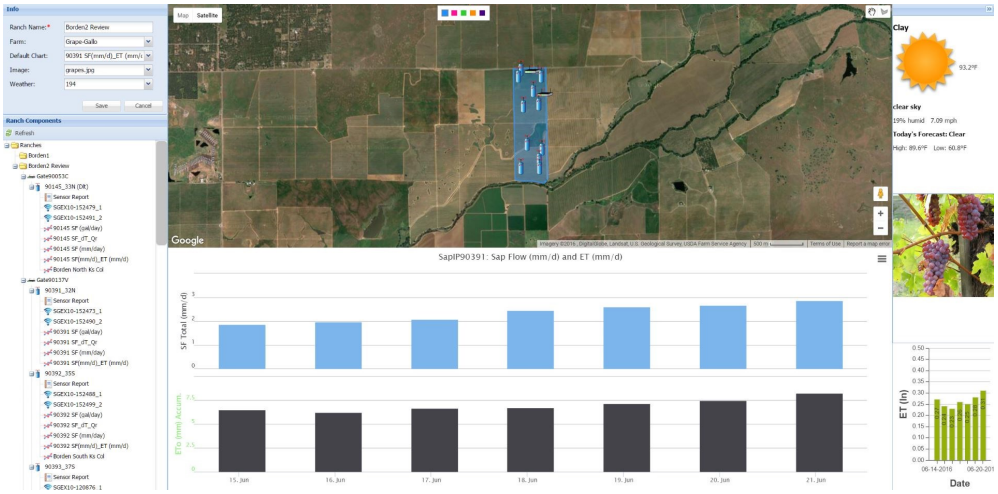
Locate Devices

Start and Stop Devices

Collect Data

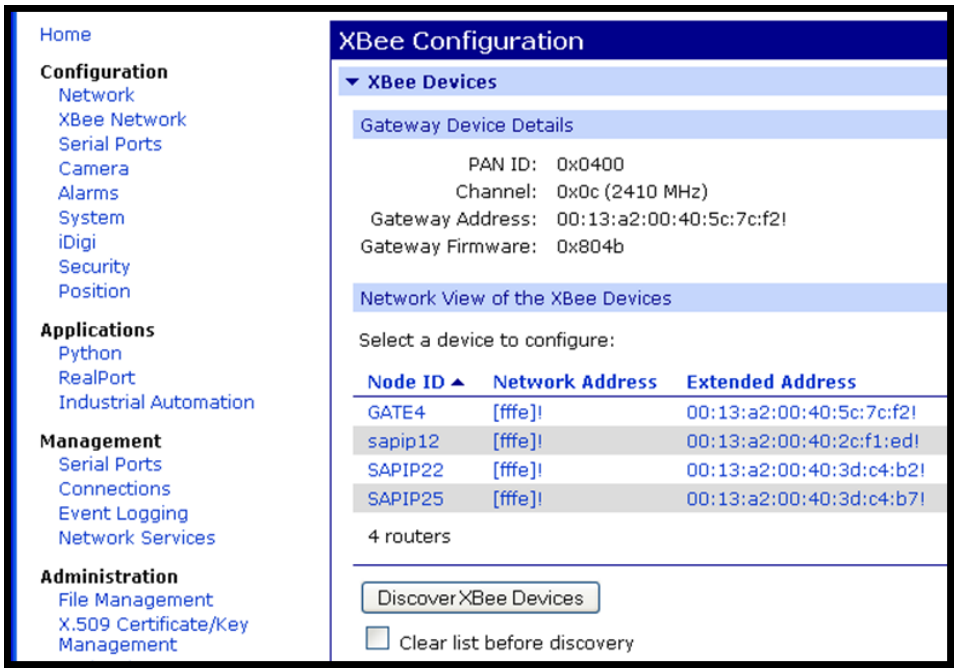
Report Data Integrity

Satellite Map example >



Gateway Management

- Move SapIP node to a network
- Check the RF Signals
- Reboot a gateway
- Update Software
- Modify Time Zone
- Change Network configuration
- Supported on-site or remotely



SapIP Specifications

- Data Memory 30,000 Records– 3mB (300 days @15 min
- 8 Inputs-Differential +/- 2.5 V to +/- 100uV in 7 ranges
- Analog/ Digital Conv. 22 Bit accuracy (+/- 4uV
- Pulse Inputs 1 Switched 150 Hz max, 1– Magnetic Low voltage
- Heater Power 1.5 A-from 1.5V to 9.0– Remote Setting
- Excitation Voltage 150mAat 5.0 Volts (Micro climate and soil sensors)
- Interval-Logging/ Transmit 10 minute to 1 hour (6 ranges), typical 15 minutes
- Wireless Transmission Range 350m urban, 500 m Rural (50mW power
- Antenna 7dB Provided– out door, with surge protection
- Size/ weight 7x30cm/ 600g
- Batteries 12v Marine Not Provided-Solar Panel 20W typical
- Current 35 Ma while transmitting (without sensors)
- Environmental Sealed IP 67, waterproof, rain proof, -20 to 50 C
- Ports 28 pin circular connector for all I/O and power , USB OPTION
- LED Red - RF status, Yellow– SapIP feedback

Choose Sensor Attachment

CS1– Cables set 1– SapFlow
2 Dynagage or Exo –skin

CS2-Cable set 2 –Research with:
3 Dynacense– Commercial grade sensors/cable
2 Moisture + 1 Rain Cage

CS3– Cable Set 3– Commercial Dynacense
3 DynaCense– New 2 Channel commercial SF

CS4– Cable set 4: Short version of CS1– 1 ft.

CS5– Microclimate humidity, temp, WS, WD, Solar

CS6– TDP sensor– Sap Velocity

Deployment Strategy

Sap Flow Network with Microclimate and soil monitoring high reliability with fail safe features

Research team –Enterprise management

Large Scale Farming– Production monitoring

Newest Technology

Only High resolution logger with integrated Radio to Internet Data

Platform is scalable to cover large areas

Stand alone option– USB data device

Scientific Grade Input performance ppm resolution (.1 uV)

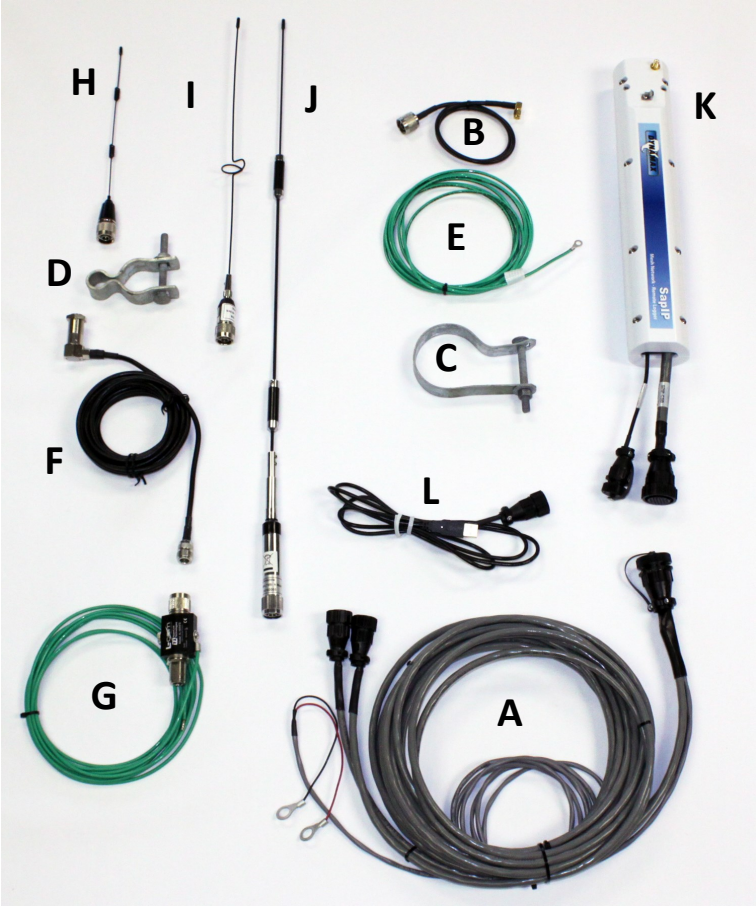
Very flexible sensor configuration

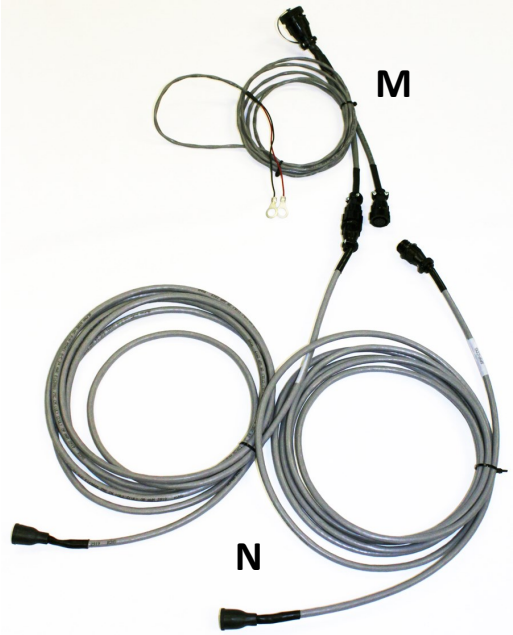
Price is 1/2 of comparable 10 channel loggers

Package is self contained and durable, without the high price

Section 2. Bill of Materials– System Components

SapIP– Contents– Exo-Skin (SGEX) Sensor Option





A) **SPIP-CS1** - 15 ft. SapIP cable with protective cap. (*for use with SGEX sensors only*)
1 ft. cable option is available part number **SPIP-CS4**

B) **SPIP-ANT2** - 2 ft. antenna cable

C) SapIP mounting clamp

D) Antenna mounting clamp

E) 10 ft. ground wire

F) **MM-SMN** - 10 ft. antenna mount

G) **AL-NMNFB** - 12 ft. ground wire with surge protector

H) **MA24-7N** - 2.4 Ghz antenna (7 dBi) - International

I) **MA9-5N** - 900 Mhz antenna (5 dBi) - US

J) **MA9-7N** - 900 Mhz antenna (7 dBi) - US

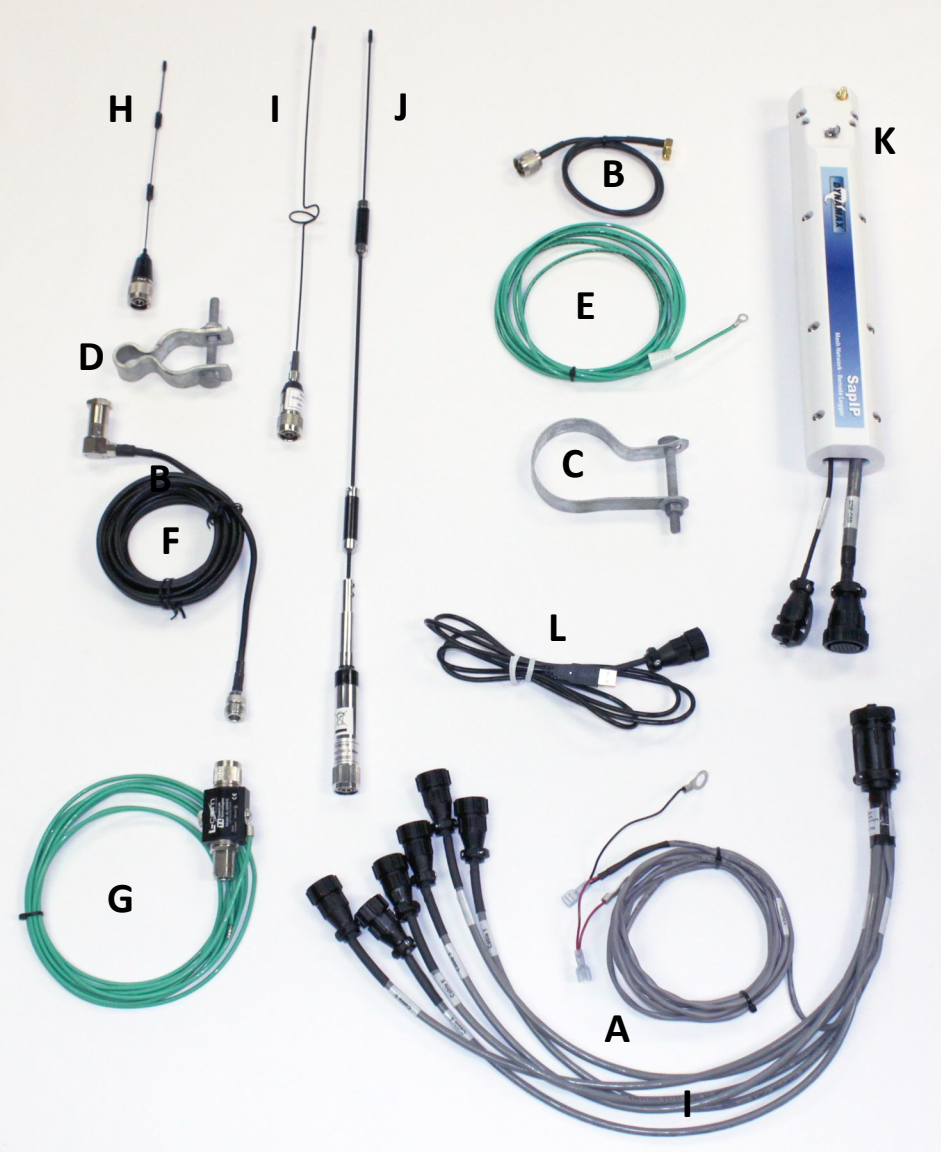
K) SapIP Node

L) **SPIP-CSU USB** option cable - **one per ORDER**

M) 1 ft. SPIP-CS4 cable

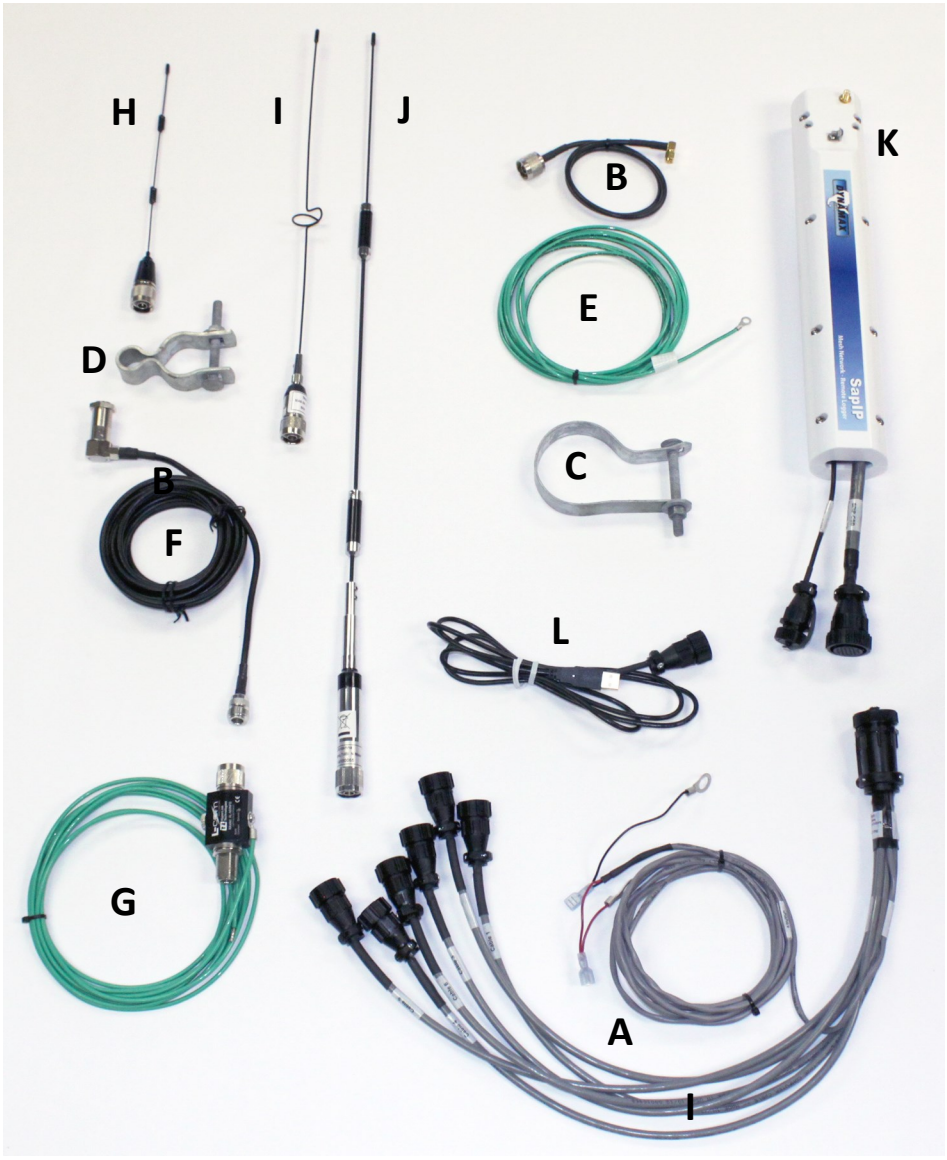
N) (2) SPIP-CDG cables for Dynagage Option

SapIP Contents – TDP Sensor Option



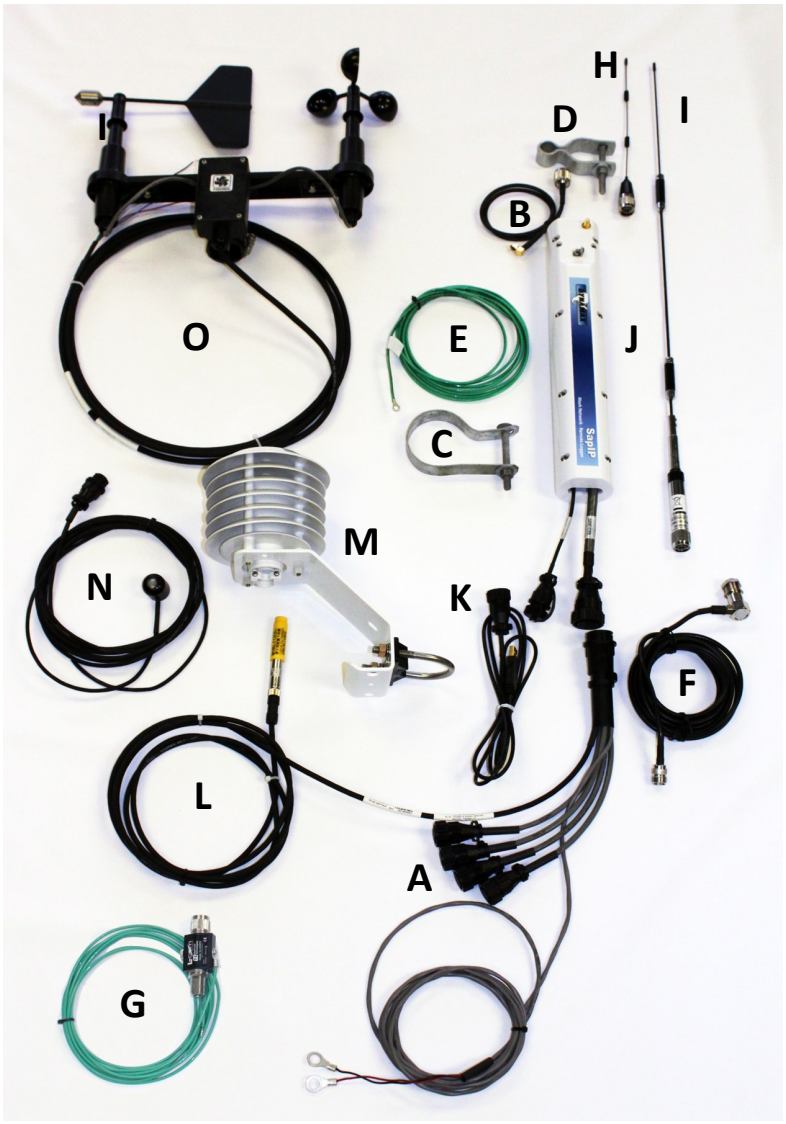
A) **CS6** - 2 ft. TDP cable option for 6 sensors
B) **SPIP-ANT2** - 2 ft. antenna cable
C) SapIP mounting clamp
D) Antenna mounting clamp
E) 10 ft. ground wire
F) **MM-SMN** - 10 ft. antenna mount
G) **AL-NMNFB** - 12 ft. ground wire with surge protector
H) **MA24-7N** - 2.4 Ghz antenna (7 dBi) - International
I) **MA9-5N** - 900 Mhz antenna (5 dBi) - US
J) **MA9-7N** - 900 Mhz antenna (7 dBi) - US
K) SapIP Node
L) SPIP-CSU USB option cable - one per ORDER

SapIP Contents – Soil Moisture Sensor Option



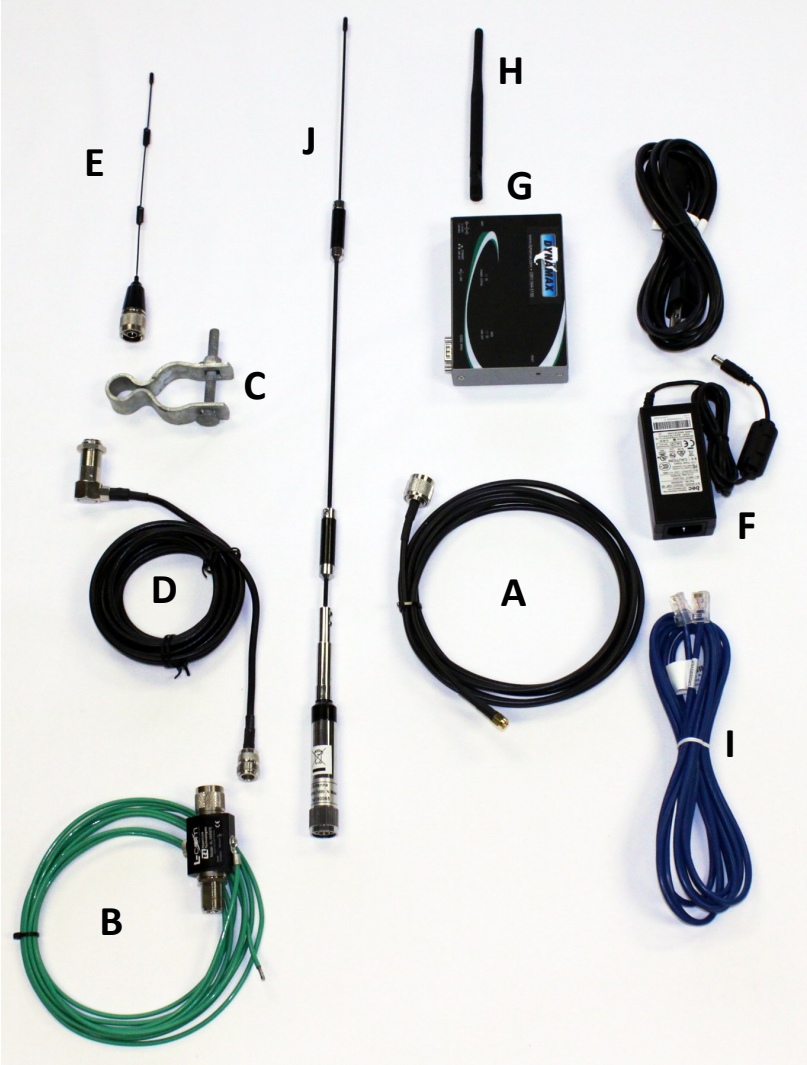
A) **CS7** - 2 ft. soil moisture cable option for 4 or 6 sensors (SM4 or SM6)
B) **SPIP-ANT2** - 2 ft. antenna cable
C) SapIP mounting clamp
D) Antenna mounting clamp
E) 10 ft. ground wire
F) **MM-SMN** - 10 ft. antenna mount
G) **AL-NMNFB** - 12 ft. ground wire with surge protector
H) **MA24-7N** - 2.4 Ghz antenna (7 dBi) - International
I) **MA9-5N** - 900 Mhz antenna (5 dBi) - US
J) **MA9-7N** - 900 Mhz antenna (7 dBi) - US
K) SapIP Node
L) SPIP-CSU USB option cable - one per ORDER

SapIP Contents – MICRO Climate Option



A) **CS5** Micro climate sensor and power cable
B) **SPIP-ANT2** - 2 ft. antenna cable
C) SapIP mounting clamp
D) Antenna mounting clamp
E) 10 ft. ground wire
F) **MM-SMN** - 10 ft. antenna mount
G) **AL-NMNFB** - 12 ft. ground wire with surge protector
H) **MA24-7N** - 2.4 Ghz antenna (7 dBi) - International
I) **MA9-5N** - 900 Mhz antenna (5 dBi) - US
J) SapIP Node
K) **SPIP-CSU** USB option cable - one per ORDER
L) Relative humidity and temp probe
M) 6 plate radiation shield
N) Solar radiation pyrometer - Only supplied with the MICRO2 System
O) Wind speed and direction sensor - Only supplied with the MICRO2 System

Gateway Kit - LAN Option



A.) **SPIP-ANT10** - 10ft. Antenna cable3

B.) **AL-NMNFB** - 12ft. Ground wire with surge protector

C.) Antenna mounting Clamp

D.) **MM-SMN** - 10ft. antenna mount

E.)**MA24-7N** - 2.4 Ghz antenna (7dBi) - International

F.) Power Supply & Cord

G.) **SAPIP-GATE9-L**- Gateway

H.) Gateway Antenna– Short range

I.) Crossover cable

J.) **MA9-7N** - 900Mhz antenna (7dBi) - US

Gateway Kit - Cellular Option

A.) (2) **SPIP-ANT10** -10ft. Antenna cable3

B.) (2) **AL-NMNFB** - 21ft. Ground wire with surge protector

C.) (2) Antenna mounting Clamp

D.) (2) **MM-SMN -** 10ft. antenna mount

E.) Power Supply & Cord

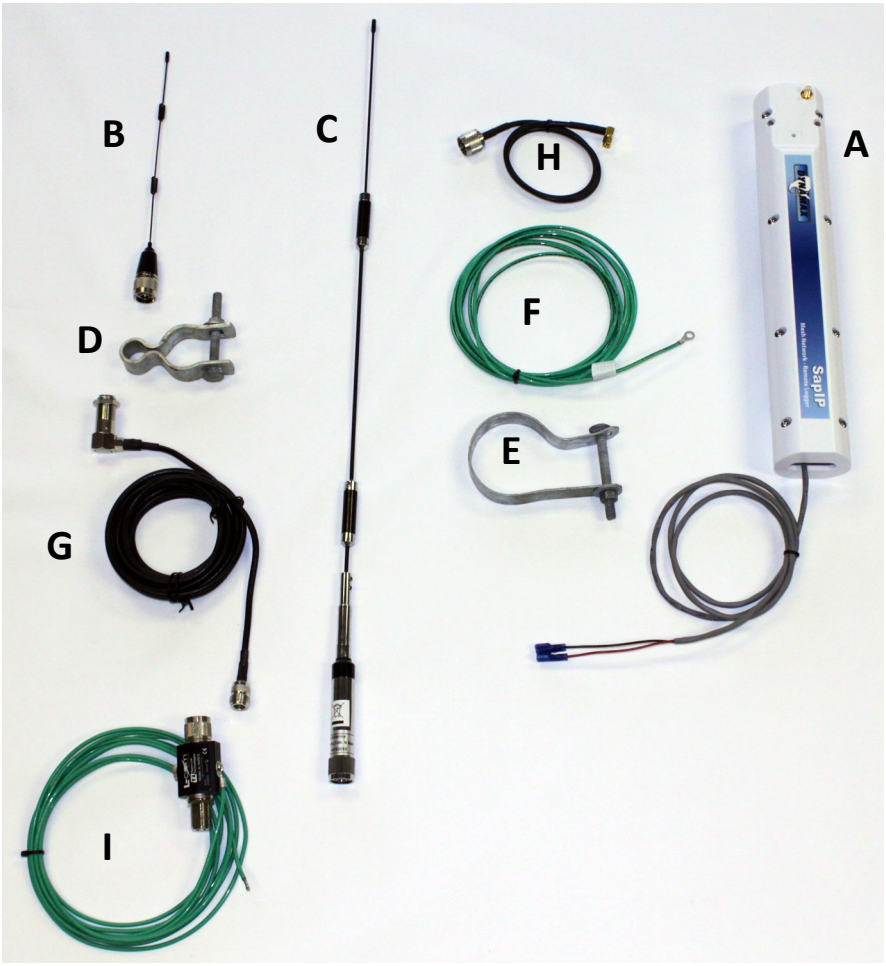
F.) **SAPIP-GATE9-L** Gateway

G.) (2) Gateway Antenna – Short range

H.) Crossover cable

I.) **MA9-7N**-900Mhz antenna (7dBi) - US

SapIP Contents - SapIP Repeater



A) SapIP Repeater Relay Module with power cable

B) **MA24-7N -** 2.4 Ghz antenna (7 dBi) - International

C) **MA9-5N** 900 Mhz 7dBi Omni Dir. Antenna - US

D) Antenna mounting clamp

E) SapIP mounting clamp

F) 10 ft. ground wire

G) **MM-SMN** - 10 ft. antenna mount

H) **SPIP-ANT2** 2 ft. antenna cable

I) **AL-NMNFB** - 12 ft. ground wire with surge protector

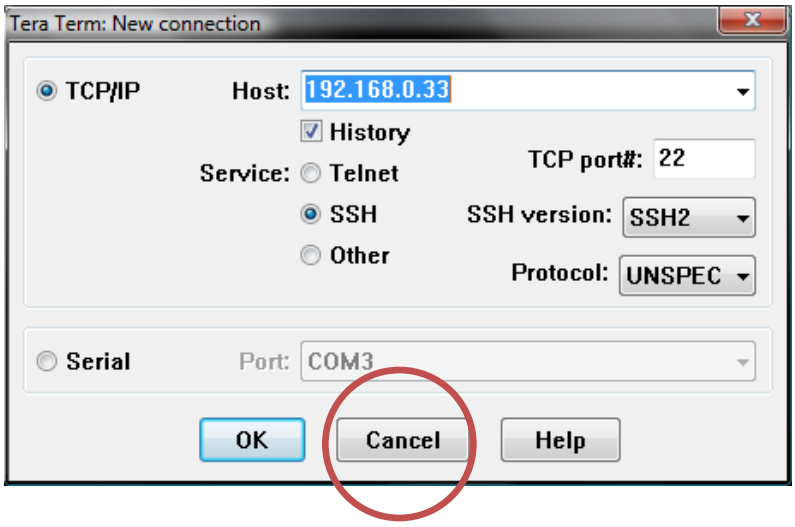
Section 3. Testing the SapIP Node

Take the SapIP node and attach the cable SPIP-CSU and plug the other USB end into your PC.
Attach cable SPIP-CSB to your sensor cable (SPIP-CS4, SPIP-CS1… etc.)
Make sure your power source is connected.

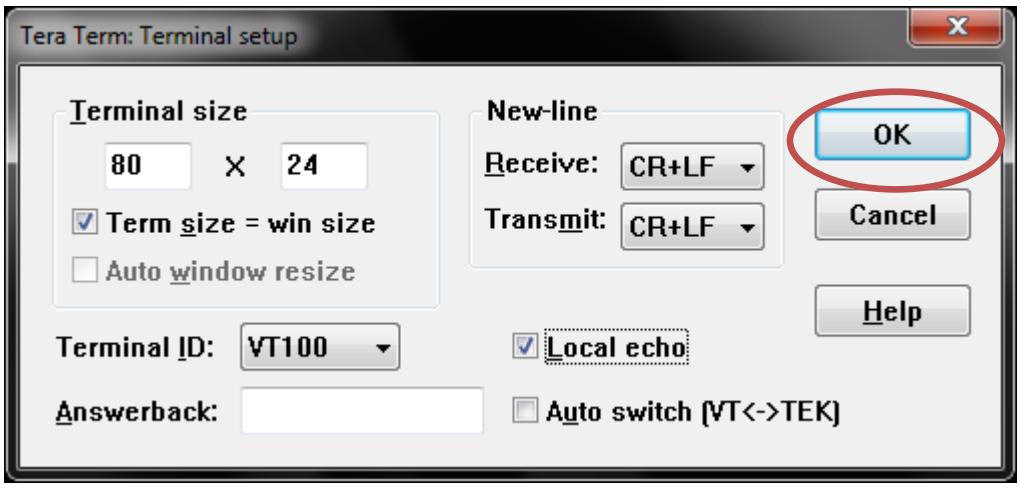
Teraterm is an open-source, free, software implemented, terminal emulator (communications) program. It emulates different types of computer terminals, from DEC VT100 to DEC VT382. It supports telnet, SSH 1 & 2 and serial port connections. It also has a built-in macro scripting language.

The following steps are for the first time using TeraTerm on a computer or if the setup file cannot be found. For second time users, see "**Using TeraTerm**"

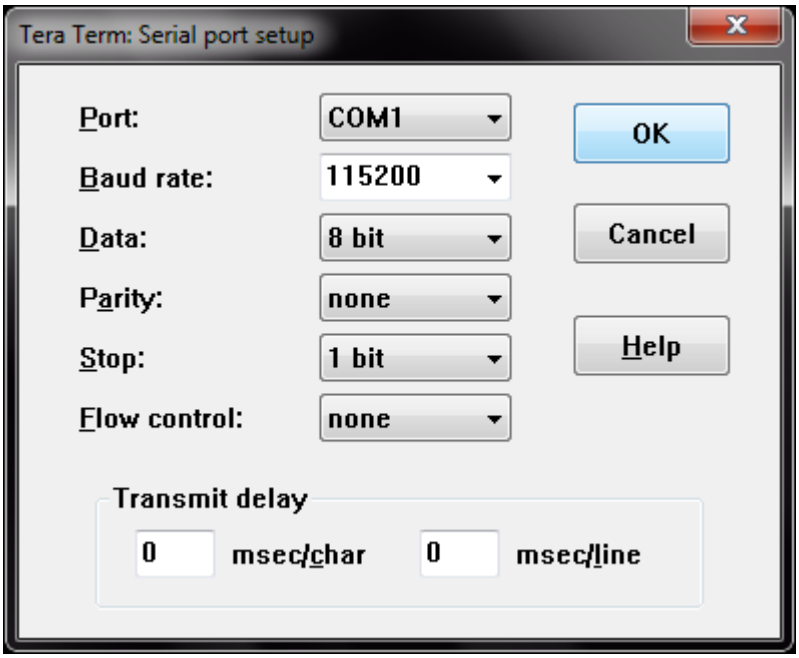
After loading TeraTerm, click "**Cancel**" on the following window :



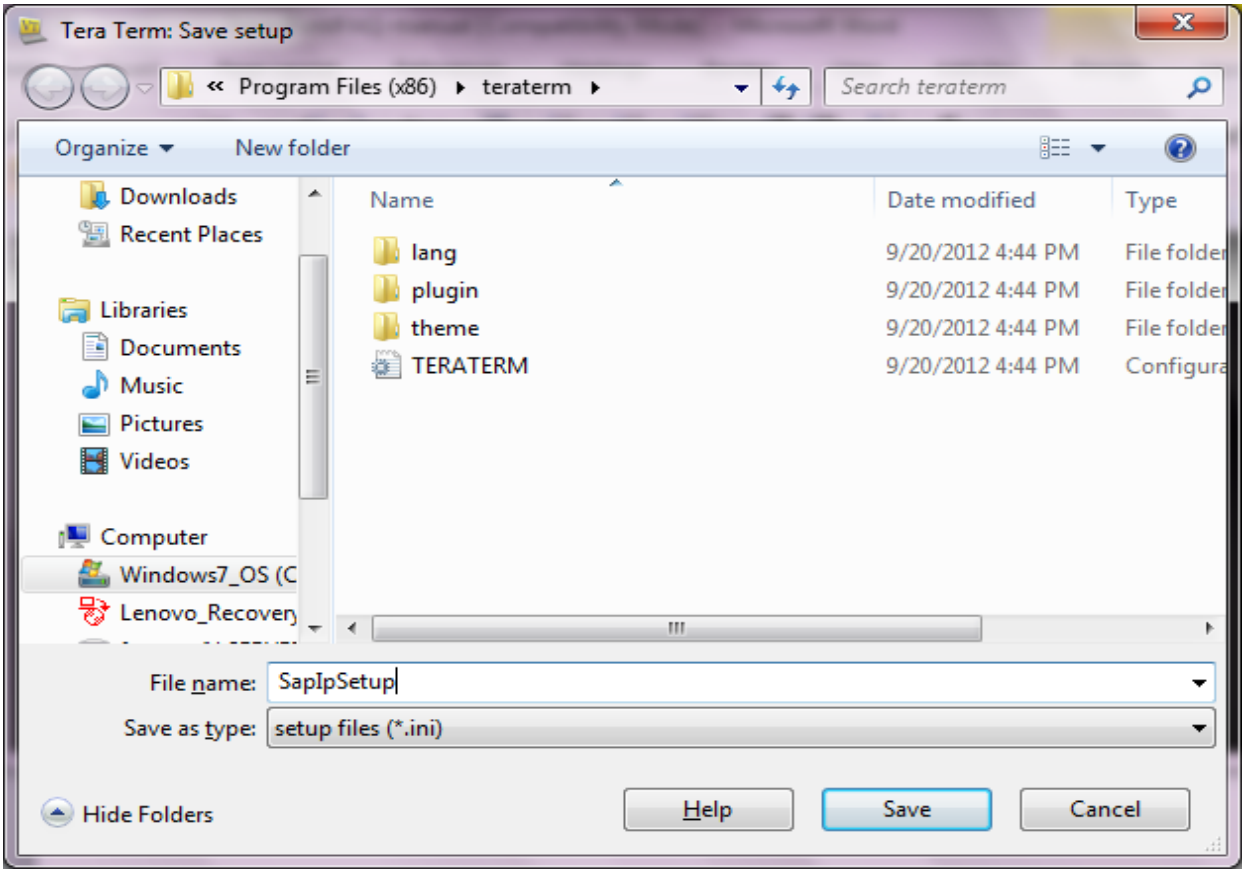
Go to **Setup** -> Terminal, and change all values to match the following and select **OK**:



Now go to **Setup -> Serial Port** and change all values to match the following.

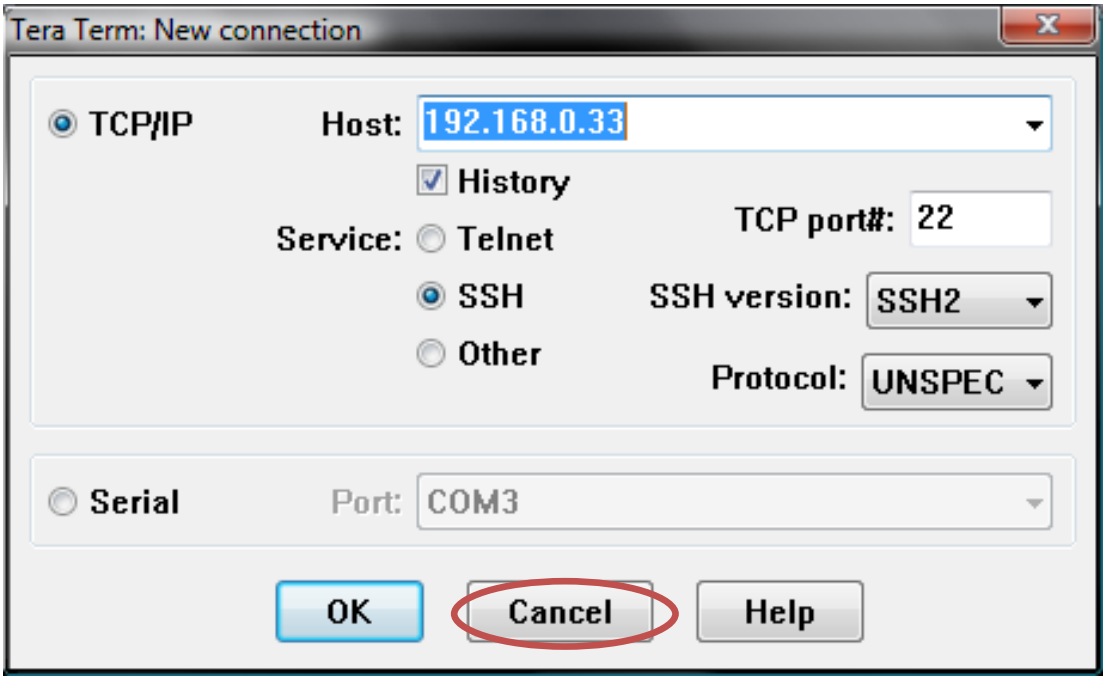


Click "**Ok**"
Go to **Setup -> Save Setup** and save this file using a name and location that will be easy to recall.

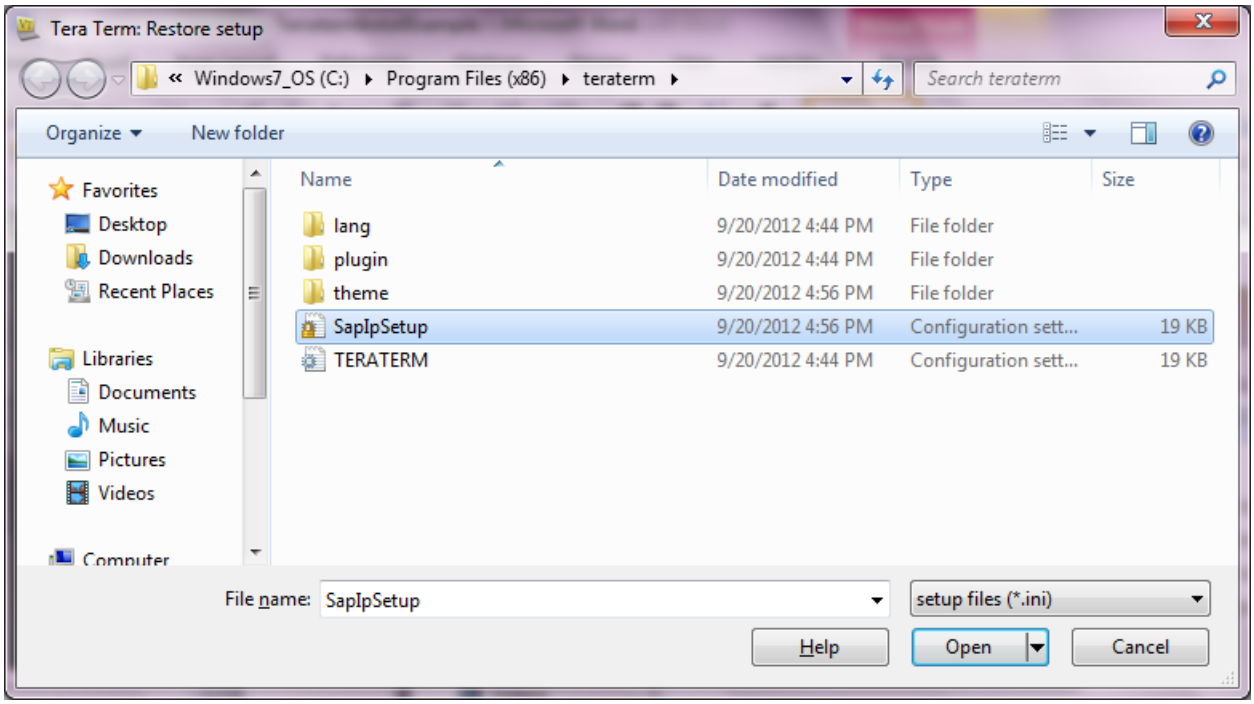


Using TeraTerm

After opening TeraTerm, click "**Cancel**" on the following window:

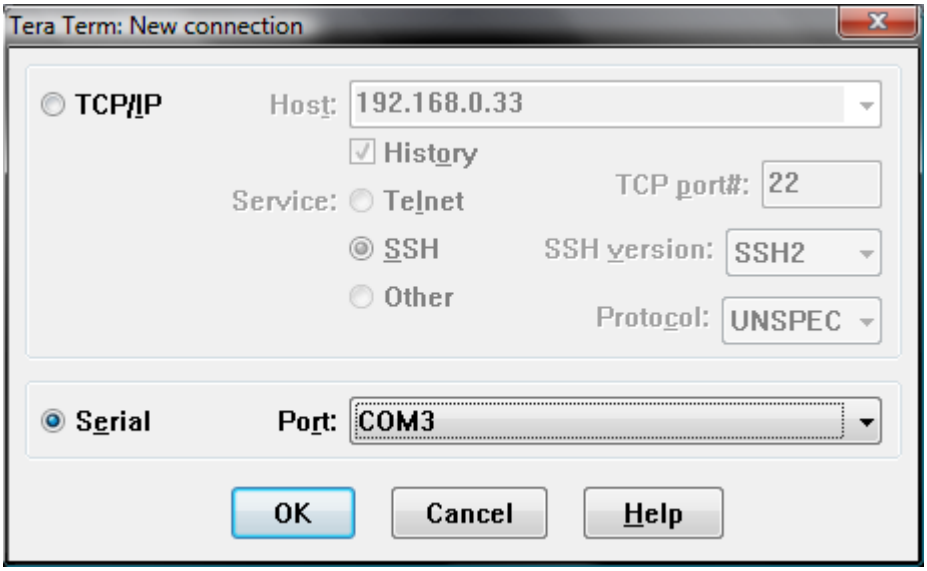


Go to **Setup -> Restore Setup** and load the file created when you first set up TeraTerm.



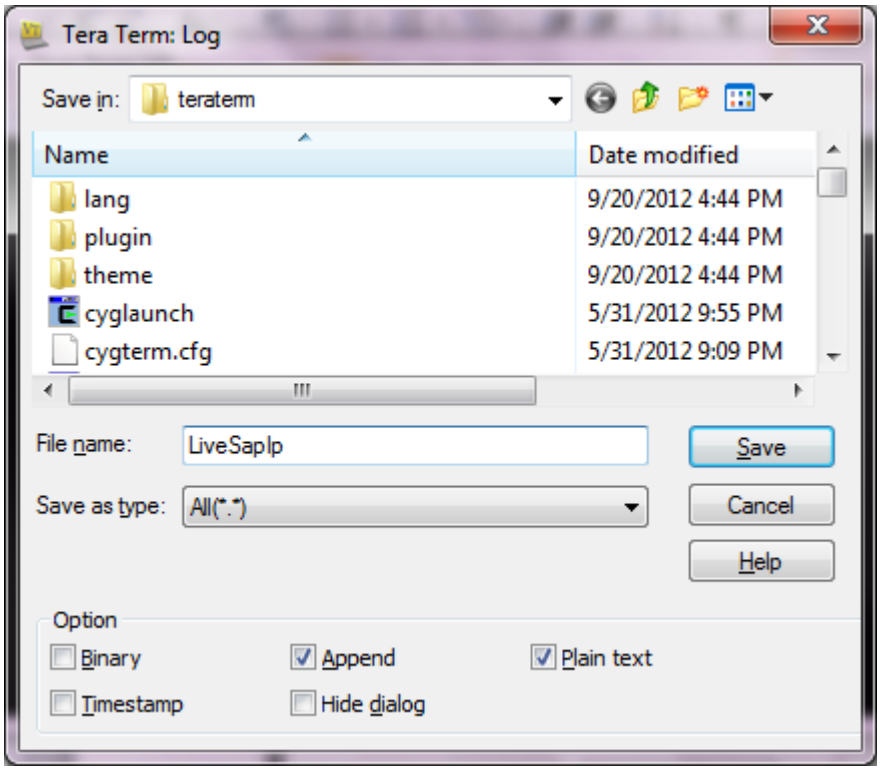
Click "**Open**"

Go to **File -> New Connection** and select "**Serial**"
On the drop down menu for **Port**, your SapIP will typically be the last entry on this list. There will be a different port number depending on various factors. The setting should **NEVER** be COM3.



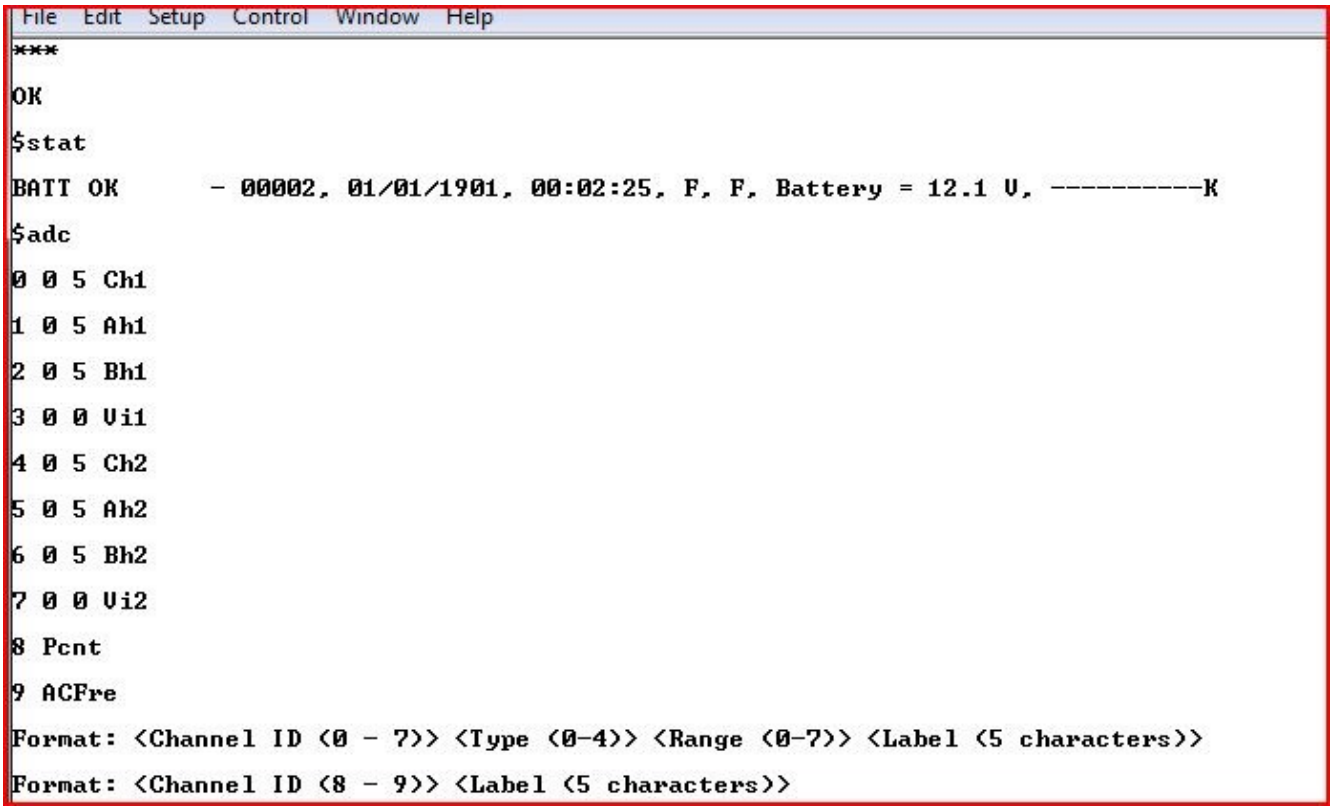
Command Line Mode

If you want to keep a log and capture raw data before you move forward with any other commands, go to **File -> Log** and name the file and save.



At this point you will begin testing by typing the command "*******" to enter the command line mode. Command line mode is characterized by the **$** symbol followed by your cursor. From here you can enter

(Lists of TeraTerm commands are at the end of this procedure.)



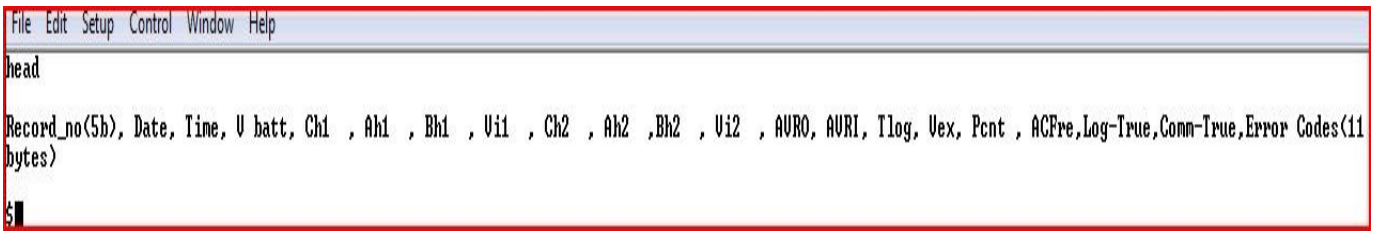
(Preliminary status and value check using "stat" and "adc" commands)

If values for adc command do not match this, change them by typing "**adc**" followed by the values above for each channel. EXAMPLE: "**adc 0 0 5 Ch1**"

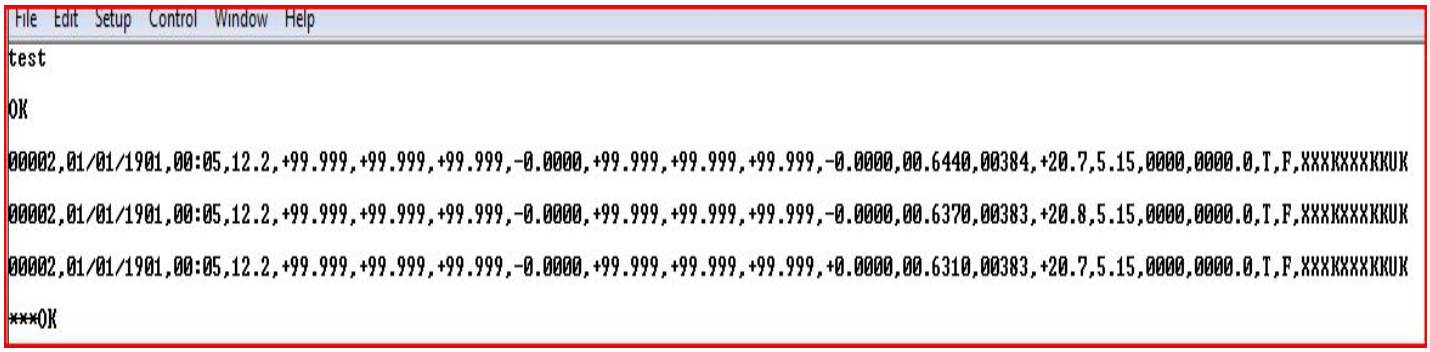
Test Data

Typing "**test**" in the command line enters test mode. If prompted "**No, stop logger first**", type "**stop**" and type "**test**" again.

Values are separated by commas. The fields to watch are 4 through 13 for this purpose. They are: Battery Voltage, Ch1, Ah1, Bh1, Vi1, Ch2, Ah2, Bh2, Vi2, and Heater Voltage.
To see these values, type "**head**".

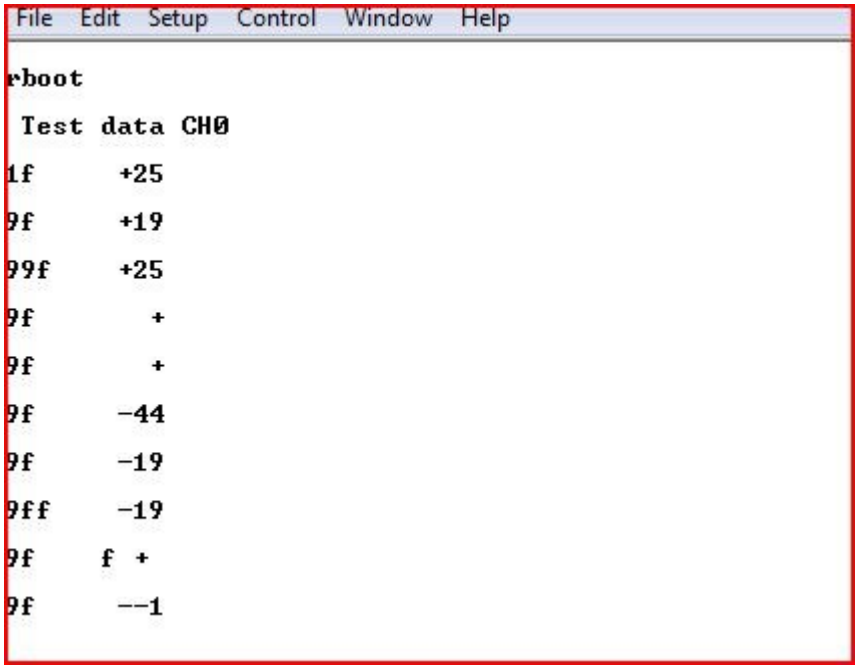


If SapIP was tested with no sensors enter command "***, **stop"** and connect sensors.



(Test without sensors being detected)

After connecting sensors (if none were connected before SapIP was turned on), type "**rboot**" to reboot the SapIP. This resets the "open circuit" detections values of **+99.999**. Attach the sensor with the dowel in place.



(Reboot command)

Once you see the "**Ready**" prompted on the screen, you can return to command mode using "***".

```
Scanning flash...
DEF ATSM=0
DEF ATOS=50
DEF ATOW=4000
READ_MODULE_CONFIG 1 CT=4120
nConfigRead=5
ATSL=79
ATOS=500
ATOW=20000
ATSM=8
Ready
```

(SapIP is ready to begin functioning)

Before beginning the test, type "**avrs**" to see the heater voltage. Heater should be on and at 3Volts when SapIP first received.

Now we will want to run a test with heater OFF. To turn heater off, type "**avrs 0000**".

```
File  Edit  Setup  Control  Window  Help
avrs
ON        - 3000 mV - 3048 mV - 0023 mA
$avrs 0000
OK
```

Once heater is off, we can begin first test. Type "**test**"

Test data without heater on

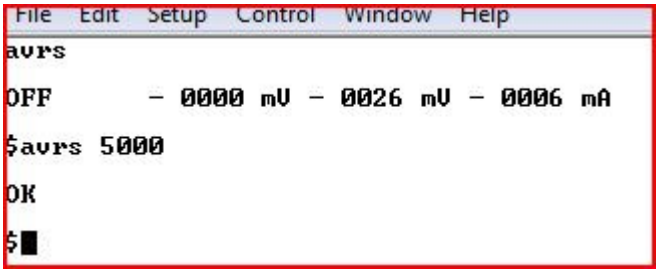
```
File  Edit  Setup  Control  Window  Help
***
OK
$test
OK
00002,01/01/1901,00:02,12.2,+00.006,-00.009,-00.008,+0.0000,+00.006,-00.005,-00.004,+0.0000,00.0330,00006,+21.7,5.15,0000,0000.0,T,F,KKKKKKKKKUK
00002,01/01/1901,00:02,12.2,+00.006,-00.010,-00.008,+0.0000,+00.006,-00.005,-00.004,+0.0000,00.0330,00006,+21.5,5.15,0000,0000.0,T,F,KKKKKKKKKUK
00002,01/01/1901,00:02,12.2,+00.006,-00.010,-00.008,+0.0000,+00.006,-00.005,-00.004,+0.0000,00.0330,00006,+21.7,5.15,0000,0000.0,T,F,KKKKKKKKKUK
```

(Approximate normal readings with sensors detected and heater voltage at 0)

Heater Voltage Testing

The next test will be with the heater voltage (entered in millivolts, min=1500(1.5V), max=9000(9V) valid values), turned on to the appropriate level depending on the type of sensor being used. (See sensor User's Manual for this value)

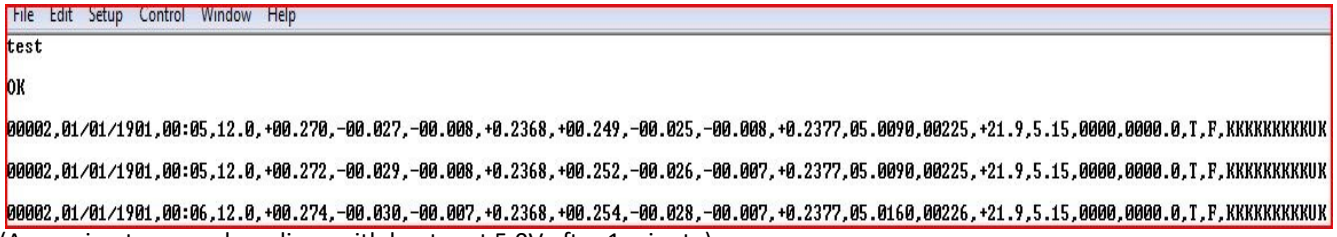
To turn heater on, type "*******", "**stop**", "**avrs 5000**".
(If your sensor is smaller than 6mm, do not exceed the max voltage in the table below)



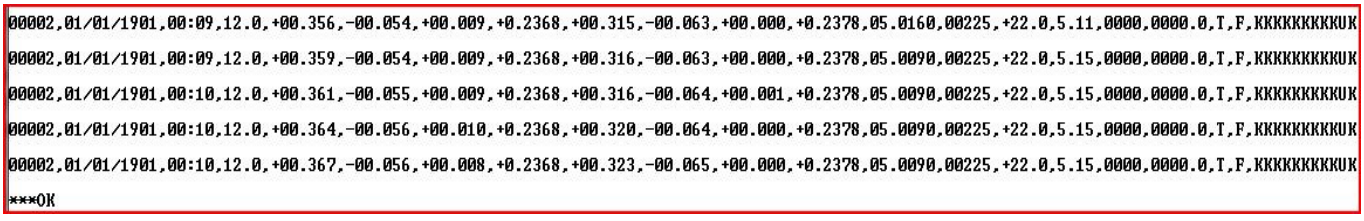
(Heater voltage changed to 5.0V)

Sensor Size	MAX Voltage
2-3mm sensors	2.5 Volts
5 mm sensors	4.5 Volts
9-25 mm sensors	5 Volts

Type, "**test**" to begin test with heater on.



(Approximate normal readings with heater at 5.0V after 1 minute)



(Approximate reading with heater at 5.0V after 10 minutes)

Approximate values between 2-10 min of testing.

CH	AH	BH	Vi
.100 to.400 mv	-.010 -to-.050mv	+.010-to+.050mv	Avrs/21

If no values are reading erratic (i.e +99.999) then everything is working properly and the SapIP is ready to be install in the field.

Section 4. Mounting

This the a list of all items needed to mount / install a SapIP and Gateway System:
For an example of mounting one Gateway and 4 SapIP.

For mounting on top of a rail Fence Poles pole **5 ea** 10 ft (1.25") , or suitable alternative mounting for field Installation of antennas.

For mounting to a wooden posts (10 ea 1.in pipe hanger clamps) Mounting 4 ea SapIP to Trellises / or to poles.

For mounting to metal poles (10 clamps for 1.25 " top rail) Mounting 5 ea to 10 ft poles (1.25 fence rail), 4 SapIP and 1 Gateway Antenna.

Or 4 on poles, and one on building for Gateway. (with in 1 Km LOS)

For Gateway:

One Battery backup UPS for Gateway. (250 watt)

Gateway:
Install indoors with A/C power with a small UPS (Office supply) - location within 5 ft of exterior wall / window, near antenna location. Plugs into LAN with regular Lan cable (not supplied)

For grounding / Solar:

(4) 20w solar panels & regulator / chargers

- (For Solar Panel Option) 12 V marine or deep cycle battery(s) (4) 40A/hr deep cycle 12v batteries
- Plastic battery box(es) to keep battery dry. May be purchased from battery supplier or Dynamax Model: ENC-PL. The Battery boxes are usually heavy-duty plastic construction able to keep out moisture and to prevent contamination. Shade the battery boxes to keep the temperature from going too high inside on hot days.
- 5 ea Grounding Rod – 4 - 6 ft copper stake and ground wire clamp.

  Copper rods approximately 1/2 in diameter (Home Depot / Lowes), with grounding wire clamp nut

- Post driver / slide hammer, sledge hammer

For SapIP and Sensors:

(4 ea) 1.25 dia.top rail fence poles x 6-8ft poles suitable for mounting the SapIP modules antennas & solar panels

The Hardware to mount the antennas and the SapIP are provided in the accessory kit.

- Tools and supplies usually necessary: to install sensors
  - o Volt - Ohm meter (VOM)
  - o caliper or flexible measuring tape 1/2" or 13 mm
  - o open end wrench, closed end 1/2 in and 3/8 "

  Ratcheted Box wrench for 7/16 and 1/2” bolts and nuts. / or deep socket ratchet wrench
  - o small flat blade screwdriver (large and small)
  - o sharp knife
  - o electrical tape
  - o aluminum foil (2 packages)
  - o 2 medium sandpaper, 2 course sandpaper (heavy duty) / a small rasp.
  - o paper or cloth towels
  - o water
  - o -nylon tie wraps,1 ft long/ 20 tie wraps 6 in
  - o clear packing tape, or white vinyl tape to secure weather shields

    You may prefer the long tie wraps for securing shielding.
  - o Electrical insulation compound - G4 (provided) and
  - o canola oil releasing compound (provided with sensors)