

SAPIP Tester V220– Cable TEST Operating Guide Version 5

Troubleshoot SapIP with signal issues while in the Field or the Lab
Troubles shoot cables with basic VOM tests.

Your PC will need to be connected with a USB cable if you wish to take readings with TeraTerm or some other terminal emulator (See Section 1. B.) This test needs to be run with a low voltage cable tester with Excitation supply. (We no longer use the heater supply since 2018. The circuit diagram for the cable tester is in appe4ndix

SECTION 1

The SAPIP Tester checks your SapIP for Faults anywhere in the INPUT section of the SapIP, including the CSB cable. This procedure also checks for any faults on the SPIP-CSB. If the readings are good, then the SAPIP and the umbilical cable (SPIP-CSB) are proven good, and any faults with these parts of the system are eliminated.

In Section 3 one can concentrate on other cables, and look for signal issues. Section 3 uses a VOM meter, to make resistance tests for Shorts, Opens.

A good SapIP is tested with these results, imitating the results of a sensor signal at about +.111 mV with a 100-Ohm Load for the heater resistance. The target voltage should be labelled on the cable tester (some have target of .112 +/- mV.)

First, disconnect CS1 – CS4 cable from SapIP unit. Then connect the 28 pin circular connector of the SAPIP tester to the SPIP-CSB. Then attach the battery leads to a 12 V battery, and then turn on ON/OFF switch, in THAT order. Be sure you have a fully charged 12V battery.

Flip ON/OFF switches on the cable tester to ON position.

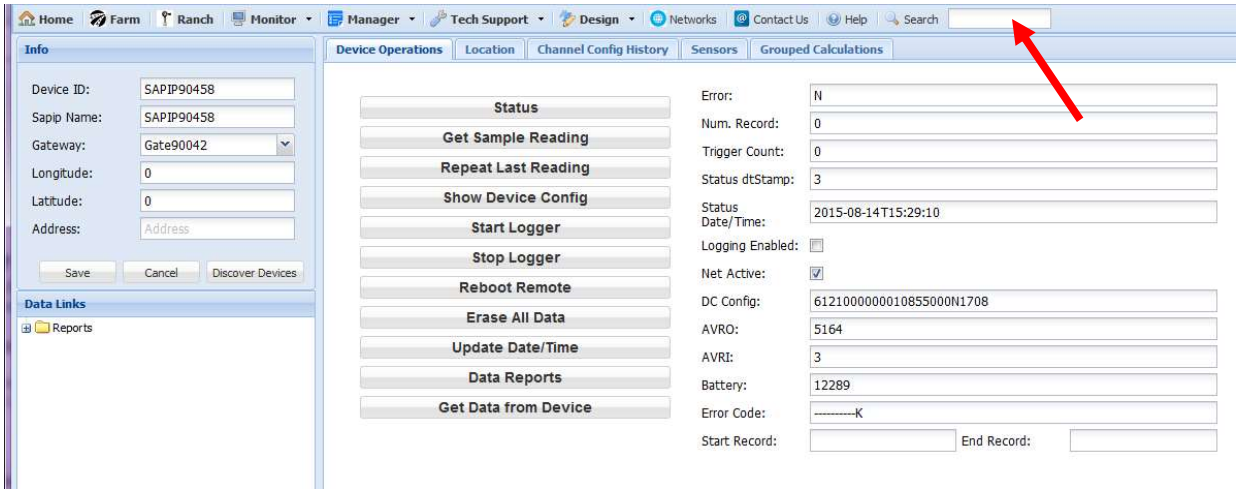
A) Test with Agrisensors.net Website

Log on to http://www.agrisensors.net.

Locate SapIP sensor "Device ID" from enclosure label.

Search for SapIP number and go to 

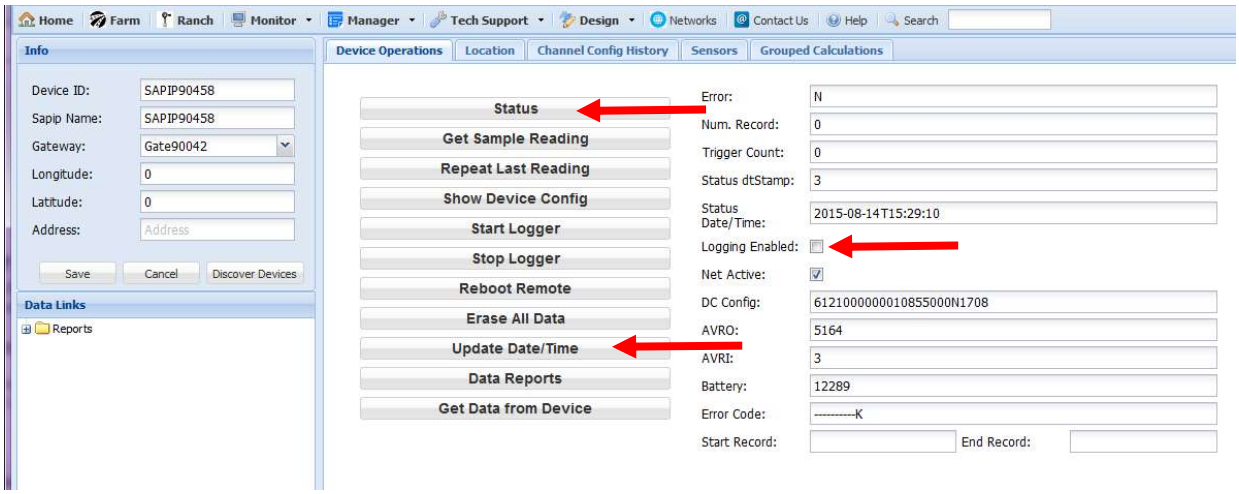
page.



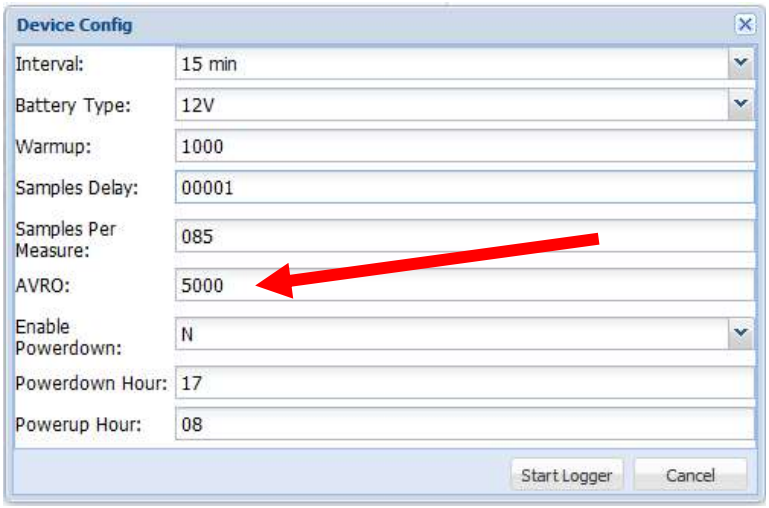
Click on **Status** to check current status of SapIP.

If **Logging Enabled:** box is checked, click on **Stop Logger** to disable logging.

Click **Update Date/Time** to synchronize SapIP with Gateway.



If the AVRO mv is not set to 5000 mV, you need to start the logger with 5000 in the AVRO setting. This will set and hold a steady 5 V to the test circuit within the Cable Tester.



Click **Stop Logger** to proceed.

Go to **Channel Config History** tab and double click on most recent channel configuration to view sensor input range settings.

Change the setting according to the picture below only if needed, click **Save Config** to confirm the setting.

Then CH4=CH8=.111 mV / 21
= 0.005 mV (+/- 1 % usually).

The divide by 21 is the standard resistor divide network on SapIP, but only on channels 4 and 8.

Flip same switch on cable tester from "G" to "+" position, and click on "Get Sample Reading".

Channel 1-3, 5-7 read +00.111mV (with +/- 0.004 tolerance).

Channel 4&8 read (AVRS / 21). For example, AVRS=5.036V, CH4=CH8=.111 / 21 = 0.005 mV. With a +/- 1% tolerance .004 mV to .006 mV

Section Two- Test with TeraTerm (If SPIP-CSU option is available)

Section Two Prerequisite–
Requires a Low Voltage SAPIP Tester - Excitation Supply Configuration to run these test in Section 2.

This configuration has TWO switches for the excitation. The Excitation supply configuration does not test the Vin (generated by the heater AVRS setting) on channel 4 and 8. However, the calibrated voltage generated by the cable tester is very accurate and is checked with a precision NIST certified voltmeter. Then the millivolt (mV) signal generated is recorded on the yellow cable tester tag. There are typically three switches: (Starting from the 28 pin socket)
1) G – SPST – (Single pole) – Sets all inputs to Ground, 0.000 V, or opens to use signal generator switch.
2) Signal generator switch, labeled +/-, is a DPST - Double pole single throw switch, and sets either +.111 mV, or -.111 mV into all channels including the Vin on channel 4 and 8.
3) On-off Switch – interrupts power to the battery, so connection to the SAPIP are made first, and then the power is turned on.

You will need to be familiar with the USB Command list found on the SAPIP ftp support site. See the SAPIP page on http://www.dynamax.com/products/transpiration-sap-flow/sapip-wireless-mesh-network

You will need to be familiar with the USB driver and install the latest FTDI USB driver on your PC. See the USB flash drive to get a certified copy.

STEP ONE: Connect SapIP to laptop computer with SPIP-CSU cable. If needed, install the USB-Com port connection

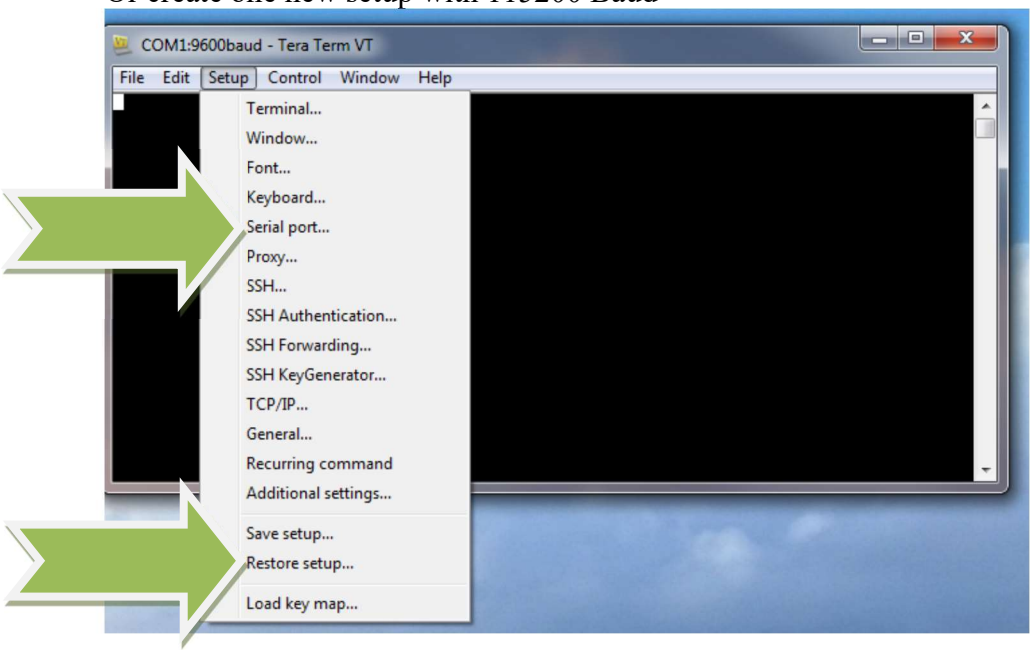
First, disconnect CS1 – CS4 cable from SapIP unit. Then connect the 28 pin circular connector of the SAPIP Tester to the SPIP-CSB. Then attach the battery leads to a 12 V battery, then turn on ON/OFF switch, in THAT order. Be sure you have a fully charged 12V battery.

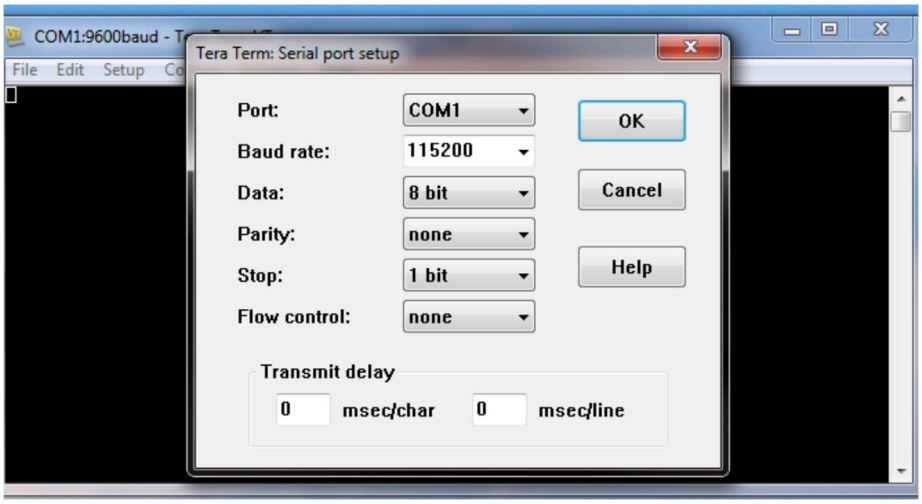
STEP 2

Once virtual COM port is created by Windows OS, open the TeraTerm program.

Go to "TeraTerm" load SapIP COM Port configuration.

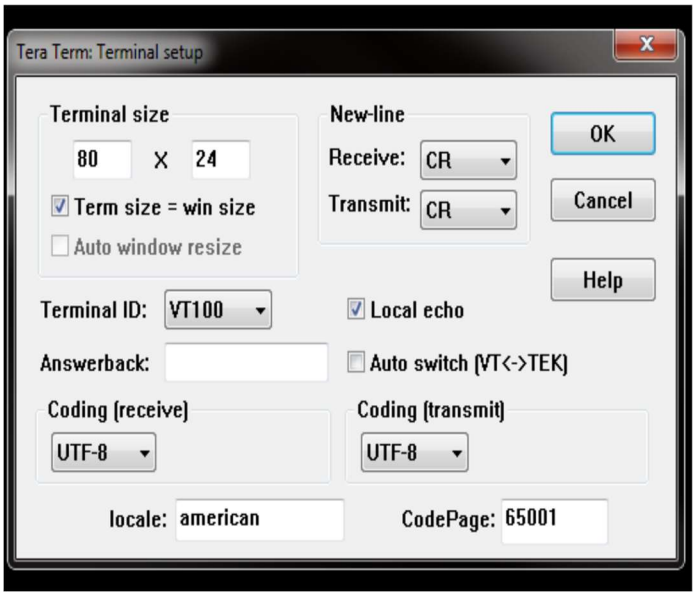
Go to Choose Serial and choose the virtual COM port COM4 – 256 created earlier, click "OK". Either restore the SETUP for SAPIP
Or create one new setup with 115200 Baud

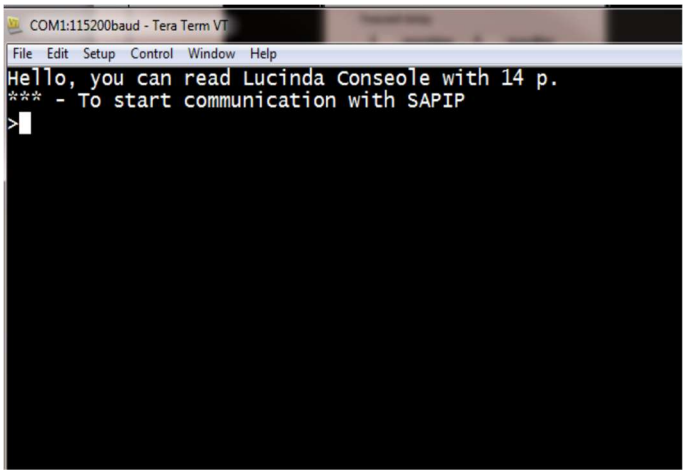




Usually set the Terminal with a Local Echo,

Then set the Font to Lucinda Console 14 pt especially to read on a Laptop.
Save SETUP for this setting to a SAPIP.ini configuration settings, so you can use it again next time.



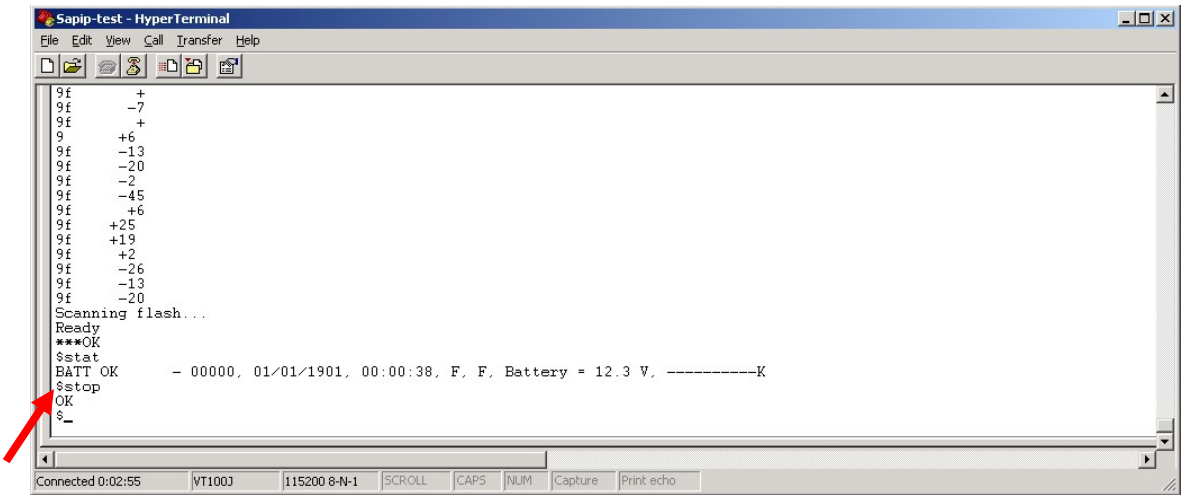


Click "Duplicate Session" to establish communication.

Type " *** " consecutively to enter command mode. Once screen displays "OK" followed by a "$" sign prompt.

$ STAT" and hit "Enter" key.

If SapIP is in logging mode, type "Stop" and hit "Enter" key to stop logging.



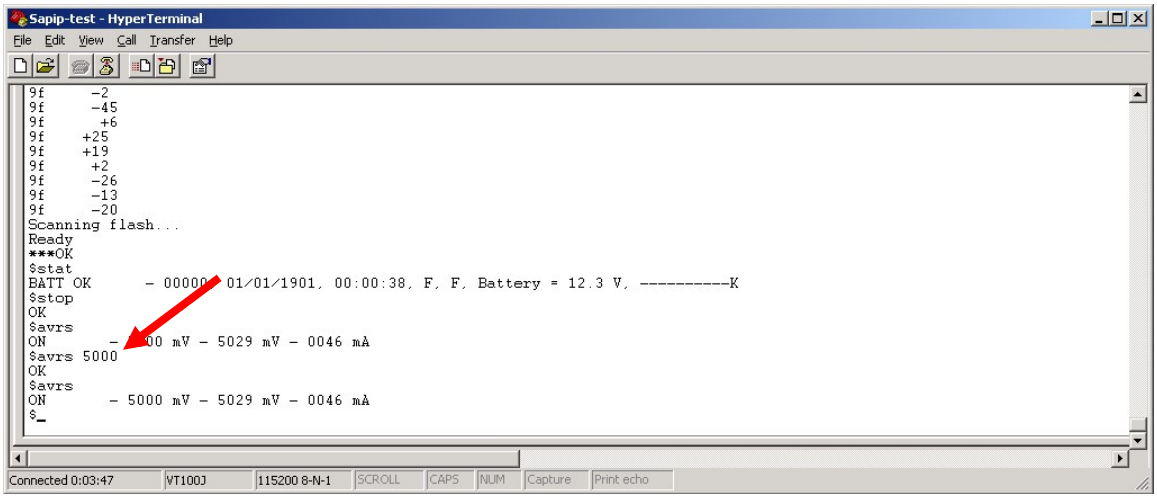
STEP 3

$ AVRS

and hit "Enter" key to check heater voltage level.

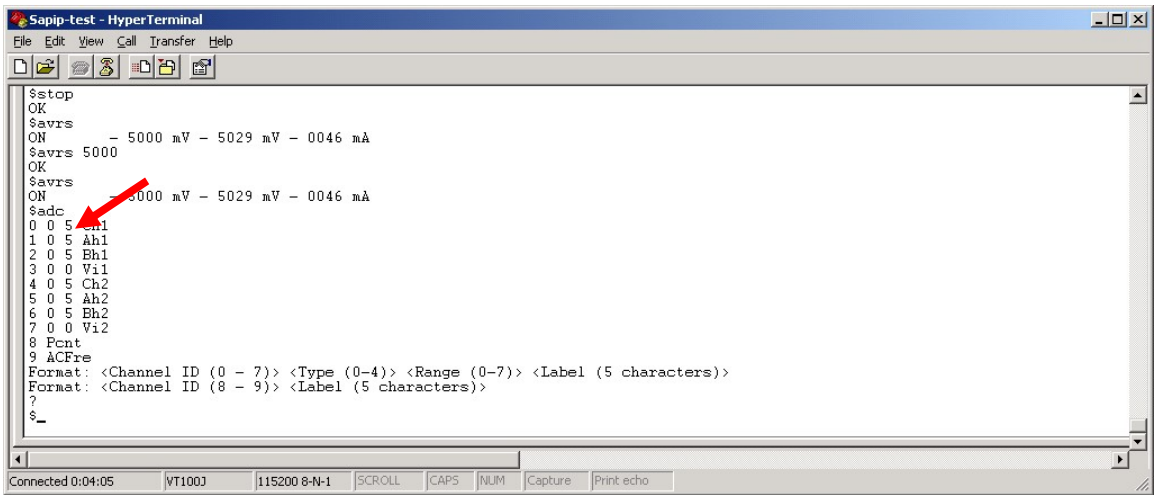
$ AVRS 5000

and hit "Enter" key to set heater voltage level to 5V. Type AVRS, enter, to see the new setting followed by actual heater voltage (5029 mV) and actual heater current (46 Ma). The current is normal for a 100-ohm load, similar to a single 10 mm sensor. Youi have completed the heater testing voltage at 5 volts with 45 to 47ma current output.



STEP 4
Type "ADC" and hit "Enter" key to check channel configuration.

Make sure channel range is set to " 55505550". Use the ADC command to set values.



Set the interval to TN mode, Test Normal with the command
$ INTER tn

Type "START" and hit "Enter" key to start sample data recording (data log every 90 seconds).

Flip second switch on cable tester to "G" position(GROUND VOLTAGE), and enter continue. Set the SPST – toggle to “G” position.

Channel 1-3, 5-7 read +00.000 mV (with +/- 0.003 tolerance).

Read the signal voltages by either method Agrisensors or TeraTerm, and confirm channel 1,2,3,4, 5,6,7,8 read 0.000 mV +/- .003 mV

```
test
OK
00010,01/01/2001,01:57,12.1,+00.000,+00.001,+00.001,+0.0000,+00.000,+00.001,+00.001,-0.0000,00.0400,00000,+24.3,5.05,0000,0000.0,T,F,KKKKKKKKKUK
00010,01/01/2001,01:57,12.1,+00.000,+00.000,+00.000,+0.0000,+00.000,+00.000,+00.001,+0.0000,00.0400,00000,+24.3,5.05,0000,0000.0,T,F,KKKKKKKKKUK
00010,01/01/2001,01:57,12.1,-00.000,+00.000,+00.000,-0.0000,+00.000,+00.000,+00.001,-0.0000,00.0400,00000,+24.3,5.05,0000,0000.0,T,F,KKKKKKKKKUK
00010,01/01/2001,01:58,12.1,-00.000,+00.000,+00.000,-0.0000,+00.000,+00.000,+00.000,+0.0000,00.0400,00000,+24.3,5.05,0000,0000.0,T,F,KKKKKKKKKUK
00010,01/01/2001,01:58,12.1,-00.000,-00.000,+00.000,-0.0000,-00.000,+00.000,+00.000,+0.0000,00.0400,00000,+24.3,5.05,0000,0000.0,T,F,KKKKKKKKKUK
***OK
```

(Readings on G)

STEP 5

Set the SPST toggle switch away from “G”.
Set the DPST toggle to “+” position, and rerun the test about five minute.

The values for channel 1,2,3, 5,6,7 should read the calibration mV, for example 0.111 mV, +/- .004 mV. Channels 4 and 8 will read 00.000, which is normal. Channel 4 and 8 inputs are divided by 21, and are usually configured to read in Volts, thus are insignificant at range “0”.

```
test
OK
00010,01/01/2001,02:08,12.1,+00.111,+00.111,+00.111,+0.0000,+00.111,+00.111,+00.112,+0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:08,12.1,+00.111,+00.111,+00.111,+0.0000,+00.111,+00.111,+00.112,+0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:09,12.1,+00.111,+00.111,+00.111,+0.0000,+00.111,+00.111,+00.112,+0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:09,12.1,+00.111,+00.111,+00.111,+0.0000,+00.111,+00.111,+00.112,+0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:09,12.1,+00.111,+00.111,+00.111,+0.0000,+00.111,+00.111,+00.112,+0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
***OK
```

(Readings on +)

STEP 6

Set the DPST toggle to the “-“ position, and continue running the test five minute.

```
test
OK
00010,01/01/2001,02:18,12.1,-00.111,-00.111,-00.111,-0.0000,-00.111,-00.111,-00.110,-0.0000,00.0400,00000,+25.0,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:18,12.1,-00.111,-00.111,-00.111,-0.0000,-00.111,-00.111,-00.110,-0.0000,00.0400,00000,+24.6,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:19,12.1,-00.111,-00.111,-00.111,-0.0000,-00.111,-00.111,-00.110,-0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:19,12.1,-00.112,-00.111,-00.111,-0.0000,-00.111,-00.111,-00.110,-0.0000,00.0400,00000,+25.0,5.05,0000,0000.0,T,F,KKKKKKKKUK
00010,01/01/2001,02:19,12.1,-00.111,-00.111,-00.111,-0.0000,-00.111,-00.111,-00.110,-0.0000,00.0400,00000,+24.8,5.05,0000,0000.0,T,F,KKKKKKKKUK
***OK
```

(Readings on -)

In all step 4 , 5 , and 6 above, the heater may be turned off, or on.

DIAGNOSTICS for AGRISENSOR or TERATERM READINGS:

1)
If a channel is disconnected, it will read +99.999, and the X or O status character will appear in the status list. For Example KXKKKKKKUK indicates that there is a break or loose connection on channel 2 after the power –up open circuit test (which also runs at Midnight).

If the open circuit is corrected, you will need to reboot, and thus reset the open circuit test.
If the reading of the status is KOKKKKKKUK, then the Over range is reported, (as +9.9999 mV.). By simply correcting the loose connection the O- overrange status byte will change to "K", or an okay result.

2)
If a channel wire or connector is loose, the readings will range up and down, out of the specification. Ex: +00.111 mV, and then may drift down to 0.100 mV.

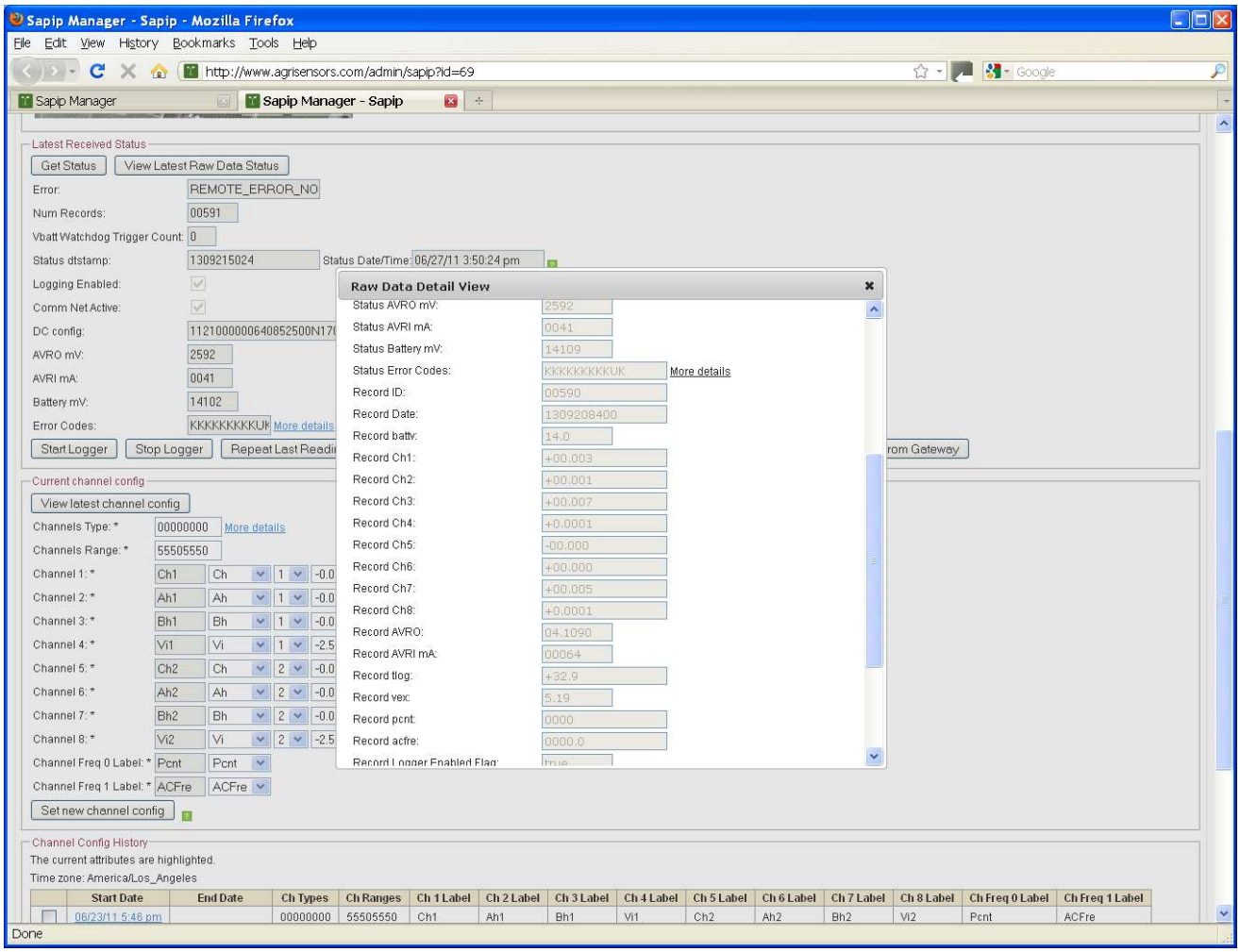
For reading heater voltages with Section 2, or with reading Sensors:

3)
If channel 4 or 8 are disconnected or open, then those readings may be 00.000, or may be out of range. (The low voltage tester in Section Two will normally read 0.)

4)
If channel 4 or 8 are missing a (-) reference signal, then all reading may be corrupted by the signal going out of range of the circuit Analog converter device. You may read all 00.001 or a similarly low voltage on all channels if this is the case. In this instance, the status string may still read KKKKKKKKUK.

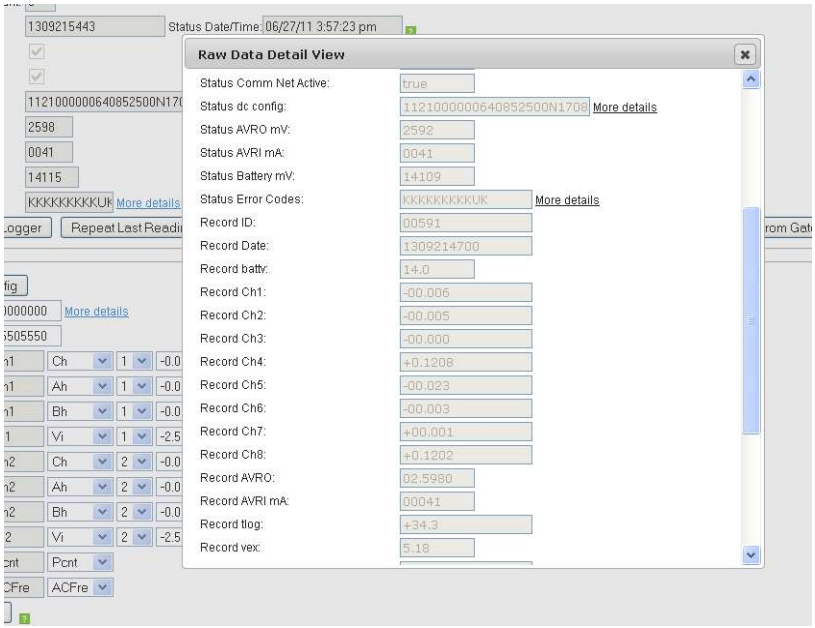
Also if the 28 pin connector has contamination or water inside, you may also get zero reading on channels 1,2,3 and 5,6,7.

IF this fault is suspected readings will look like this:



The data above shows values of 0 on most channels, not the proper millivolt readings with a typical sensor or the Cable Tester. Most importantly, the channel 4 and 8 does not agree with the setting of AVRO (4.1 V / 21 = .195 V). The current of 64 MA is consistent with a good sensor heater, and a good connection to the AVRO heater output.

Now we reduce the voltage on the heater to the common mode limit of 2.5 Volts, by starting the logger with the lower voltage, then STOP, and take another sample reading.



After setting the AVRO = 2.50 V, notice the current is OK (41 ma).
The readings of the CH1 and CH5 are indicating some small transfer of heat inward.
(This data shown above is with two good sensors)….
AND CH 4 and CH 8 indicate the power to the sensors are OK, (2.5 V / 21 = .12 V).

This example indicates that the (-) reference of the SAPIP or the circuit is broken. Since this is an internal fault, the SAPIP should be returned for repair or replacement.

While one may attach an extension cable having a similar problem, or the SPIP-CS1 may have a similar problem, it is important to run this test with the cable tester to eliminate an issue with the SAPIP-CSB.

If you suspect a SPIPCS1 or CS4 cable, it may be resolved by unplugging the cable SPIP-CS4 / EXQC, cleaning and reinsertion. Please be sure that all connection have the O-ring seated, there is no corrosion, and the inside of the connector is filled with G4 silicone grease.

You can also diagnose by substitution of a known good cable – SPIP-CS4 or CS1, and then checking directly with known good sensors. If this resolves the problem, then check the EXQC extension cables with a known good SPIP-CS4. This test must be performed with a heater voltage set to the target of 4 V or more.

If there are two sensors attached, and one break in the wiring, you may run only one sensor cable at a time, and see which is causing the over-range signals. For instance, if cable one is good, when cable two is removed, then switch cable ONE to input TWO. If the readings are good, then cable ONE (and sensor ONE) are validated. Now repeat the test using only cable TWO, on input TWO, and then move to input ONE. One of the results will isolate that either Cable TWO is GOOD, or that one SapIP input is loose or bad.

Section 3. Cable test readings with a VOM – Volt Ohm Meter.

Clearly the results of the SapIP logger are preferred for very accurate cable testing. However there are routine maintenance needs, and basic cable testing, which can be done with a resistance test using a Digital VOM.

Here are the types of test, which are performed with a cable TEST JIG. The cable test jig has a socket for the male connector, which can also be used to test a SGEX sensor continuity. The EXO-sensor test jig, continuity test, (See picture at the right) has all the leads necessary to connect to the Male end of the 9-pin circular connector. The Pin Assignment diagram in the appendix show the position of the male pins on a SGEX sensor, which are the same assignments for all connecting cables EXQC extensions.

There is a version of a Cable Jig which has the connector for the Female side as well. See Page 16.

Signal names for each Sensor / cable tester are labeled, and wiring is brought out to a terminal screw. The procedure is to touch one VOM lead to the screw terminal (Male Side) and read the resistance to the opposite side (Female) of the cable.

First Inspect for corrosion from water or condensation inside the connector. Any non-gold color such as green, brown, or black (all indications of copper oxidations) should be addressed first.

Corrosion needs to be addressed by using circuit cleaner according to the manufacturer instructions. If you use a spray cleaner, use caution and eye protection. A soft toothbrush, nylon cleaning brush or Q-tip will assist in removing corrosion, old grease and dirt. Be careful not to bend any leads. After cleaning, air spray dry the connector and remove excess moisture.

Next check each wire for open circuit:

1) Check the VOM is set to read a low resistance (<= 200 Ohms) set on the VOM dial.
2) Touch the leads Black to Red on the meter probes before you start.
3) The lead of the meter should read zero to .2 Ohms (if the meter is calibrated well and working.)
4) Start reading resistance for each cable wire, Pin 1 Male to Pin 1 Female side
5) The readings will be acceptable from .2 Ohms to 3 Ohms Maximum.
6) Longer cables read higher than shorter cables.
7) If the Meter reads INF, or infinite (Over Range), then the wire is broken.

8) If the meter reads higher than 3 ohms, then there is corrosion or a weak connection present at the connector interfaces.
9) Move the leads of the VOM to the next signal wire / connection, and repeat for all leads.

Section 4 - Cable test using CS-1/CS-4 and the 9-pinCable test jigs

See section D before proceeding, to set VOM and make observations.

Attach jigs:
28 pin- CS1 cable tester, and 9-Pin Cable tester to corresponding sides taking of CS1/ CS4 and either cable (1 or 2) on the 9-pin side.

All terminals on the appropriate side of the 28-pin jig should correspond with the matching wire color on the 9-pin side. Read the results in Ohms going from the 28-pin side to the opposite jig.

Note: the white wire on the 9-pin side should read continuity with all three white wires on the corresponding side (cable 1 or 2 side) of the 28-pin jig.

The best method would be to hold one lead to a single terminal on the 9-pin jig, and probe all terminals on the 28-pin jig to make sure only the correct wire reads within acceptable ranges.

If there is a problem, note which pin number (on side of 9-pin jig) and which CS1 / CS4 28 pin Number has a problem. The pin numbers are written on the side of the Jigs in black ink. Report the findings on a tag with any defective readings, attaching the tag to the cable itself.

The 9-pin cable tester (male pins) may be used in conjunction with a sensor test jig (female pins), then used to easily make readings on an extension cable, such as EXQC-25

Section 5 - Cable test and Inspection SPIP-CSB on the SapIP, and SPIP-CS4 28 pin connector s to the sensors.

The purpose of this test is to see if the cables and the connection to the wiring are sealed from water. If the glues have shrunk, or have gaps, then water may be allowed to get into the connection and cause shorting or cross talk. Both of these can cause high voltage to leak into the low voltage where sensitive signals are disturbed. The signals can cause multiple problems, including zero voltage on otherwise normal signals or very erratic – high signals.

1) The inspection requires you remove 2 Phillip's head screws the cable clamp with a very good screwdriver. The glue may have shrunken and allow water inside.

2) Look inside the gap from the cable and the head of the terminal housing. If there is a gap, then this cable should be marked and then returned for a new glue to address and fill the gap. The gap will require the head to be unscrewed, using acetone to unloosen, and then upgraded by Dynamax.

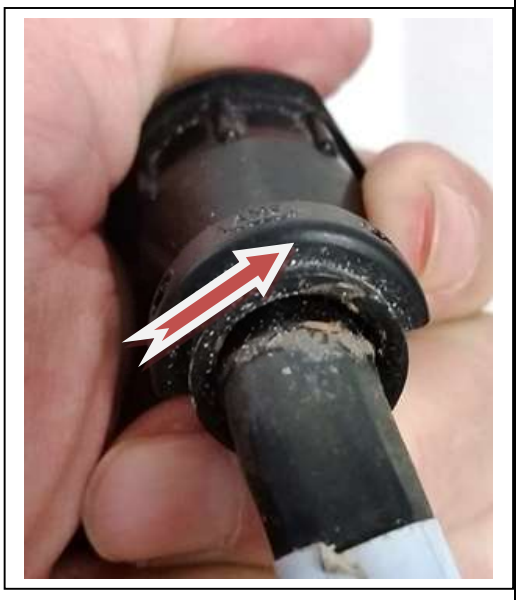
3) The gaps are filled with three parts stages of synthetic rubber to fill all the air space.

4) Do not put the cable clamp back on, but mark the sensor for upgrade.

5) If the cable does pass, and it is filled with glue, turn over the cable housing, and move the cable down. If there is a gap there, the cables will again need to have additional sealing.

6) If either gaps have occurred, there is a FAIL to be remedied.

7) If the sensor shell has no gaps, fill the surrounding area with RTV sealer, and then place the terminal screw clamp back, and reseal with 2 screws. Then place RTV around the top of the cable / housing and allow sitting in a vertical position for 1 hour to cure. Full cure is 24 hours before going to the field.



Section 6 – Antenna, Surge Protector, Cable Testing:

The procedure is the same except as in Section 3 for cables, except that the results must be tighter, and much lower resistance.

1) Touch the leads to the inner wire of the coaxial connector on both opposite sides of the cable. Reading should be 1 Ohm or less.
2) Touch the leads to the outer part of the coaxial connector on opposite sides of the cable. Readings should be 1 Ohm or less.
3) Touch the leads to the inner wire on one side and the outer (shield) part of the connector. The resistance should be infinite which indicates there is no short in the connector or wiring (Open).

All three results must pass, and then the cable is deemed good. There are other requirements; however this is the basic field test.

Please label any failure mode found in cable tests on a service tag, and attach it to the cable. This will speed up repairs or diagnostics.

Section 7 – SAPIP- 0 Voltage ERRORS / and Sensor Testing for SAPIP are contained in a Fruition presentation and should be attached as part of this test procedure.

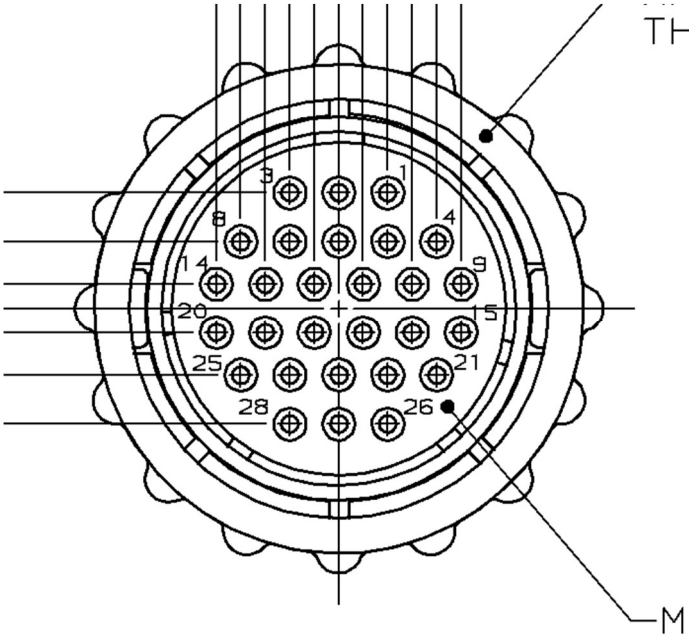
The procedure is an expansion of the low voltage test, and requires that two sensors of known good quality are reserved for each test procedure.

Section 9 – Heater and wiring issues that caused 0 voltages are explained with the assistance of the Heater wiring in the appendix.

In essence any voltage that is caused by the heater (5 Volts) excitation for example, can be cross-talked to another wiring that is designed to read millionths of a Volt (millivolts). That can be caused by your finger oil, water, copper corrosion, old solder between the wires, or pin holes in the heater. It is stopped by very clean leads, and stopped by separation of G4 grease or by a silicone sealer around all the leads. Please check the lead wiring chart to understand where any of these short or cross talk can come from.

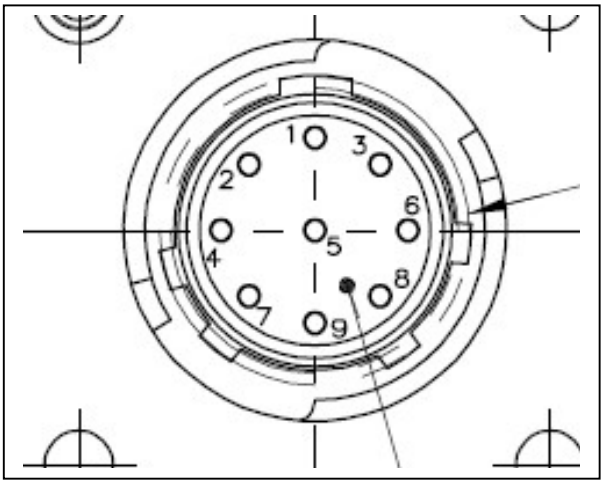
APPENDIX

SPIP-CSB
Cable Set – Board –
28 Pin Circular
Connector umbilical
Cable pin outs and
assignments.



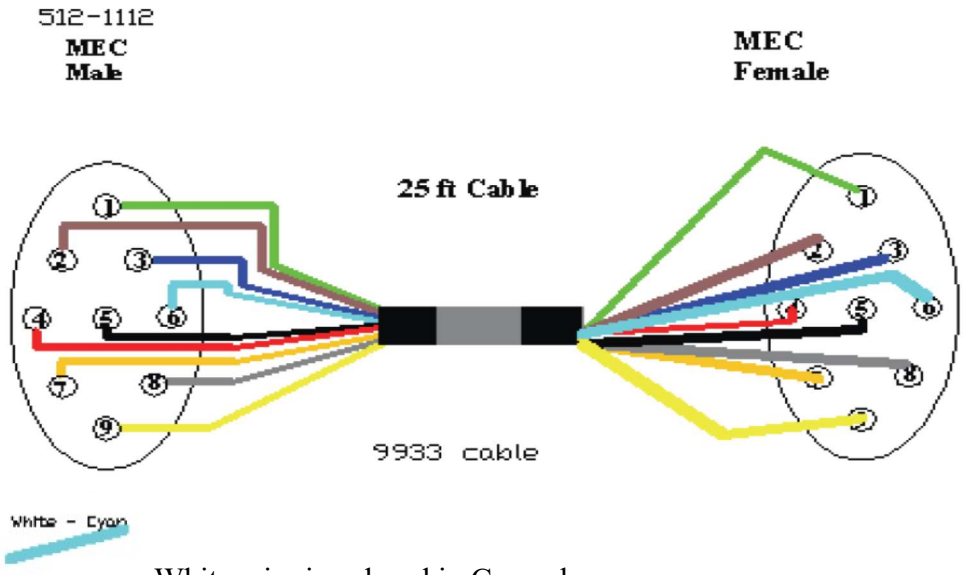
28 PIN PLUG - FEMALE	PIN NO	Wire color
ADC_RAWCHAN0+ (CH1+)	1	BLUE
ADC_RAWCHAN0- CH1-)	2	GREEN
ADC_RAWCHAN1+ (CH2+)	3	BLUE; Blk ring
ADC_RAWCHAN1- (CH2-)	4	GREEN; Blk ring
ADC_RAWCHAN2+ (CH3+)	5	BLUE; Red ring
ADC_RAWCHAN2- (CH3-)	6	GREEN; White ring
ADC_RAWCHAN3+ (CH4+)	7	BLUE; White ring
ADC_RAWCHAN3_ (CH4-)	8	GREEN; Blk and white ring
ADC_RAWCHAN4+ (CH5+)	9	ORANGE
ADC_RAWCHAN4- (CH5-)	10	WHITE
ADC_RAWCHAN5+ (CH6-)	11	ORANGE; Blk ring
ADC_RAWCHAN5- (CH6-)	12	WHITE; blk ring
ADC_RAWCHAN6+ (CH7+)	13	ORANGE; Red ring
ADC_RAWCHAN6- (CH7-)	14	WHITE; Red ring
ADC_RAWCHAN7+ (CH8+)	15	ORANGE; Green ring
ADC_RAWCHAN7-_ (CH8-)	16	WHITE; Blk and red ring
OPEN	17	
OPEN	18	
CONTACT_INPUT_RAW+	19	RED; Green ring
CONTACT_INPUT_RAW-	20	RED; Black and white ring
OPEN	21	
SHLD to GND	22	BLACK; Red and white ring
EXCITATION_VOLTAGE	23	RED; Black ring
GND	24	BLACK; Red ring
HEATER_VOLTAGE	25	RED; White ring
GND	26	BLACK; White ring
+VIN_UNPROTECTED	27	RED
GND	28	BLACK

Sensor Pin assignments EXO sensors:



Sensor Connection for SGEX sensors:
9 pin circular connector.
Pin No/Color / Signal
1. Green A
2. Brown B
3. Blue C
4.Red D - Heater Supply +
5. Black E - Heater Supply (-)
6.White H Ref (-)
7. Orange (D+) - Heater reading +
8. Drain Wire – shield
(not connected on Sensor)
9. Yellow (E-) - Heater Reading (-)

Pin assignments – Optional extension cables. EXQC-25, -50, -75



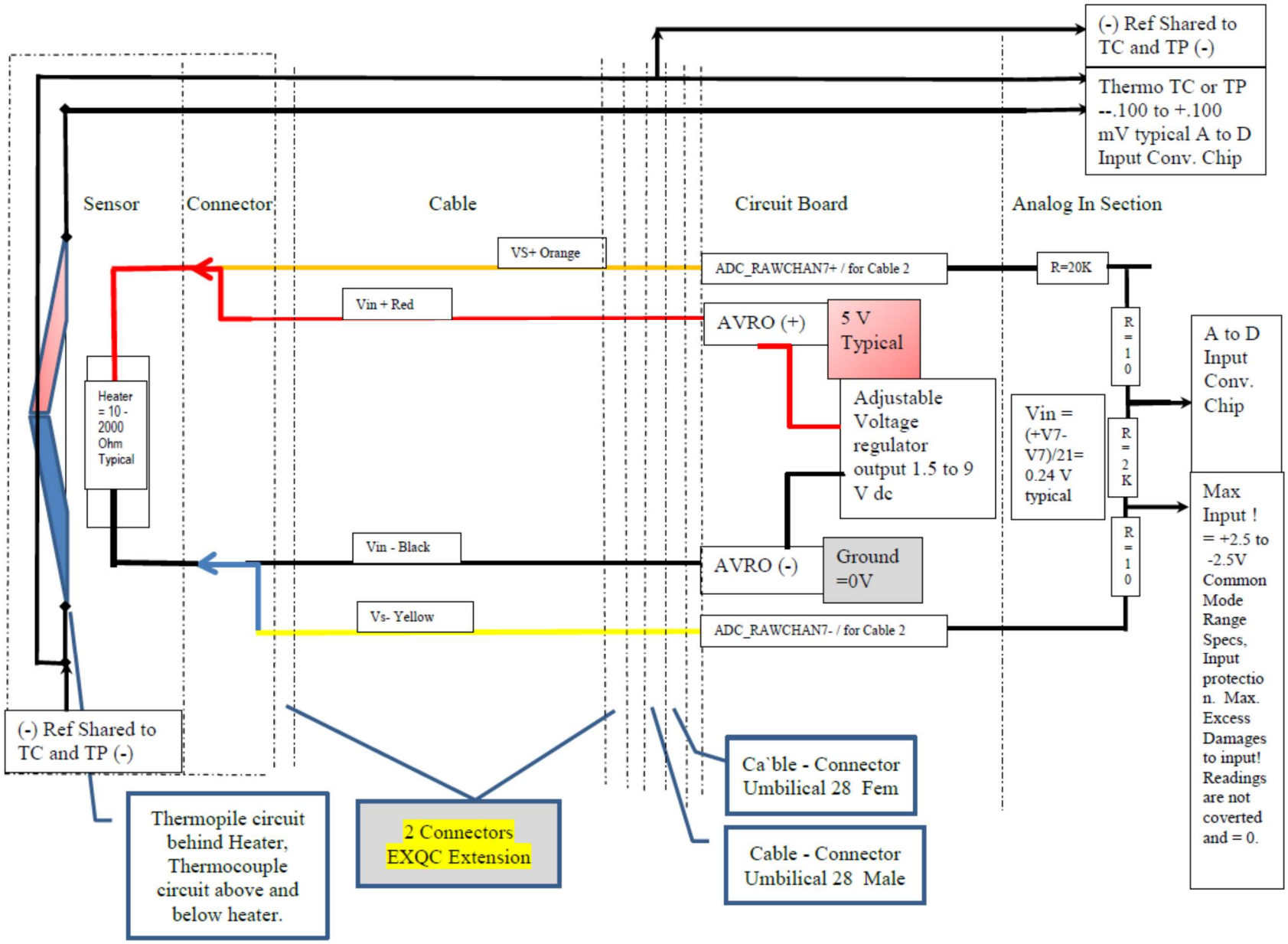
White wire is colored in Cyan above.

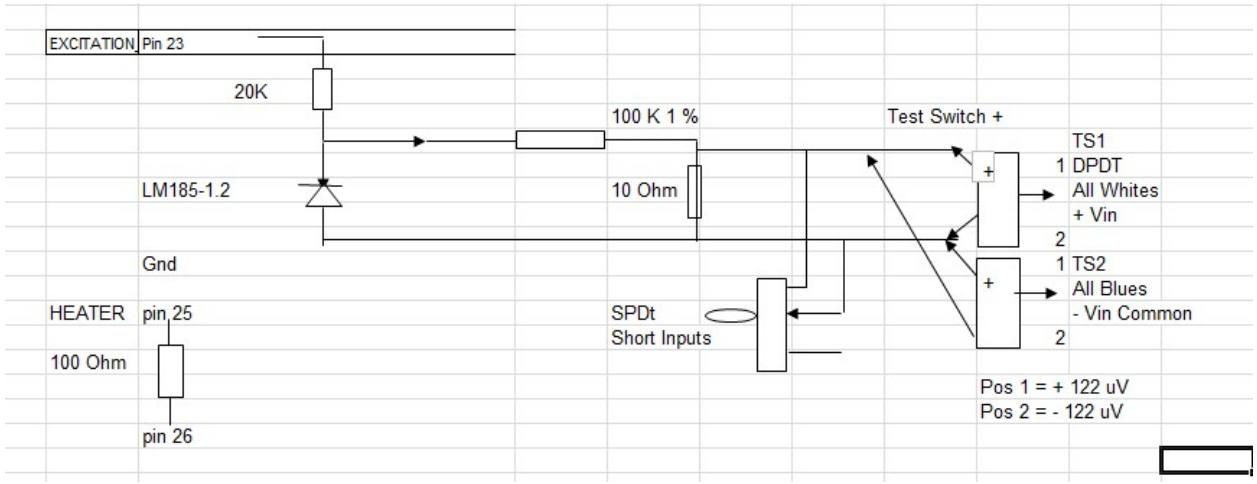
SPIP – CS1 Cable Set 1, for Two SGEX sensors, SGDC sensors. Cable 1 and Cable 2 15 ft / 8 wire /shielded

28 Pin Socket - Male Pin	Pin	**Connection - Cable - Definition**		**9 Wire = 8+ Shield**			Cable Type	
ADC_RAWCHAN0+	1	Cable1 - SGEX	Ch	Blue				
ADC_RAWCHAN0-	2	Cable1 - SGEX	Ch-	White - Jumpers	Blue Jumper		2461	9 wire
ADC_RAWCHAN1+	3	Cable1 - SGEX	Ah	Green				8+sld
ADC_RAWCHAN1-	4	Cable1 - SGEX	Ah-	Jumper to Ch-	Blue Jumper			
ADC_RAWCHAN2+	5	Cable1 - SGEX	Bh	Brown				
ADC_RAWCHAN2-	6	Cable1 - SGEX	Bh-	Jumper to Ch-	Blue Jumper			
ADC_RAWCHAN3+	7	Cable1 - SGEX	Vs+	Orange				
ADC_RAWCHAN3_	8	Cable1 - SGEX	Vs-	Yellow				
ADC_RAWCHAN4+	9	Cable2- SGEX	Ch	Blue				
ADC_RAWCHAN4-	10	Cable2- SGEX	Ch-	White - Jumpers	Blue Jumper		2461	9 wire
ADC_RAWCHAN5+	11	Cable2- SGEX	Ah	Green				8+sld
ADC_RAWCHAN5-	12	Cable2- SGEX	Ah-	Jumper to Ch-	Blue Jumper			
ADC_RAWCHAN6+	13	Cable2- SGEX	Bh	Brown				
ADC_RAWCHAN6-	14	Cable2- SGEX	Bh-	Jumper to Ch-	Blue Jumper			
ADC_RAWCHAN7+	15	Cable2- SGEX	Vs+	Orange				
ADC_RAWCHAN7-_	16	Cable2- SGEX	Vs-	Yellow				
OPEN	17							
OPEN	18							
CONTACT_INPUT_RAW+	19							
CONTACT_INPUT_RAW-	20							
OPEN	21							
SHLD to GND	22	Common connect Shield		Shields, Connect Cables -1 Cable-2				
EXCITATION_VOLTAGE	23							
GND	24							
HEATER_VOLTAGE	25	Cable 1-2 SGEX		Red to Cable 1	Red to Cable2	Y-connect - heat shrink		
GND	26	Cable 1-2 SGEX		Black - Cable 1	Blk to Cable2	Y-connect - heat shrink		
+VIN_UNPROTECTED	27	Cable 4 - Batt+		RED	20 AWG	Alpha1895c sl005	3/8"Ring	
GND	28	Cable 4 - Batt-		BLACK		No shielding needed	3/8 Ring	

Dynamax Inc
SAPIP –Cable Tester - Version 5

SENSOR – HEATER WIRING





Depending on the resistance values from ideal, the target voltage may vay from .111 mV to .122 mV
Each should be recorded on the tester tag.