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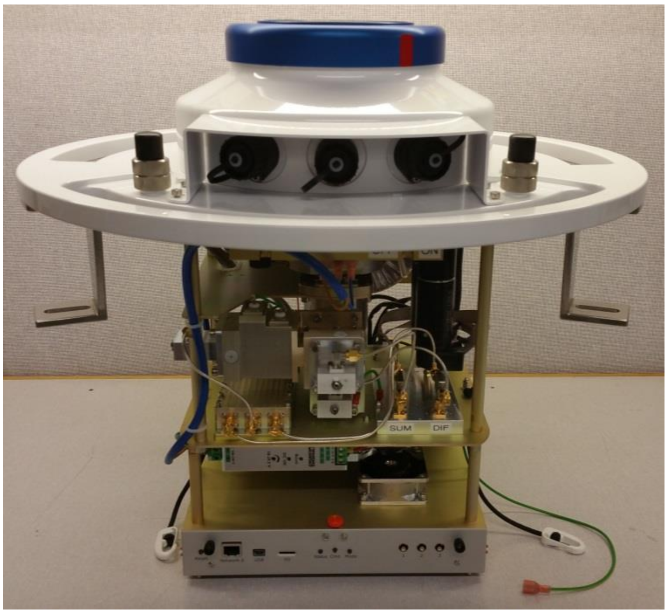
Artemis Mk6 FAT Initial Setup



PREPARED ON BEHALF OF GUIDANCE MARINE BY

Paul Woods
Name of author

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ii References

WI G2 ESD Equipment Testing and Recording
Refer to production works order for latest revision of parts.

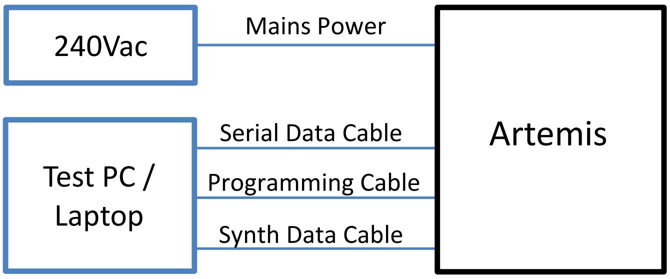
iii Term Definitions & Acronyms

Term	Definition
ASI	Artemis Service Interface (software)

Test setup block diagrams – Black boxes are part of the Artemis build, Blue boxes are attached test equipment.

1. Artemis Software Versions

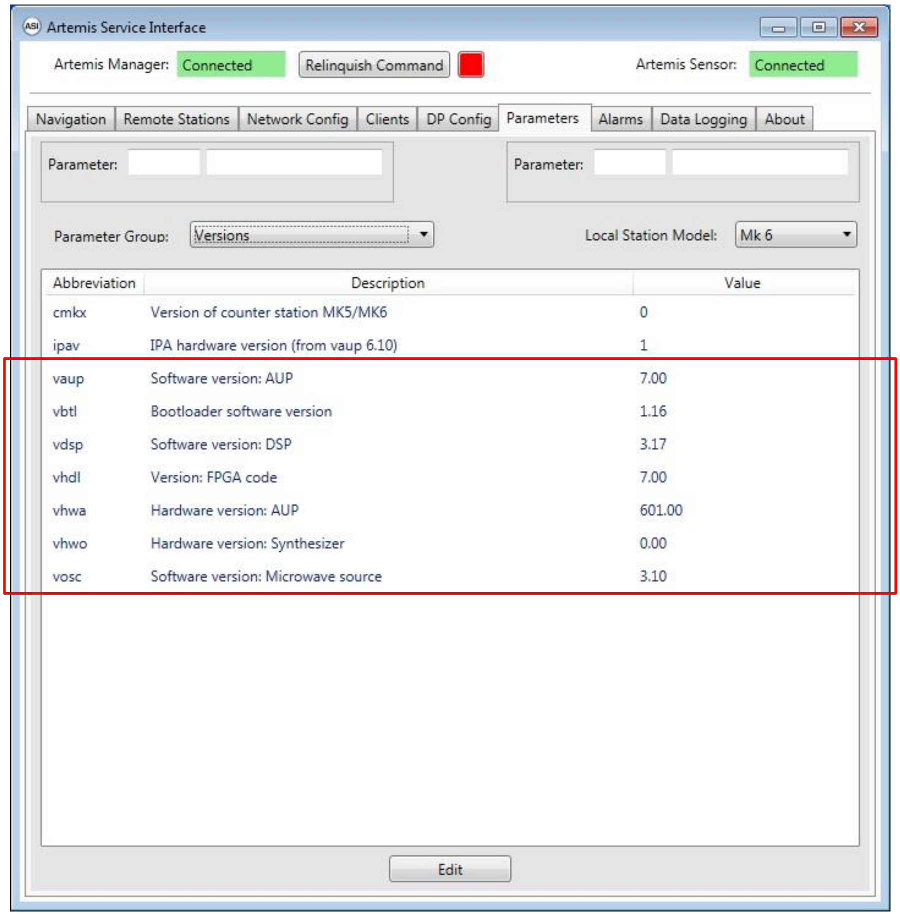
Connect up the Artemis as shown:



If the AUP is not programmed, use the programming document 93-0465-4 to program the Artemis with the latest production release of software.

Open the ASI software and connect to the Artemis.

The installed version of software is found under the parameter settings – Versions.

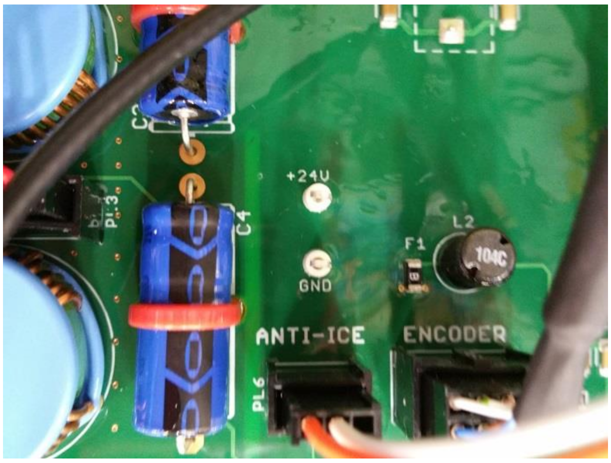


Record the Versions in section 2 of the build record.

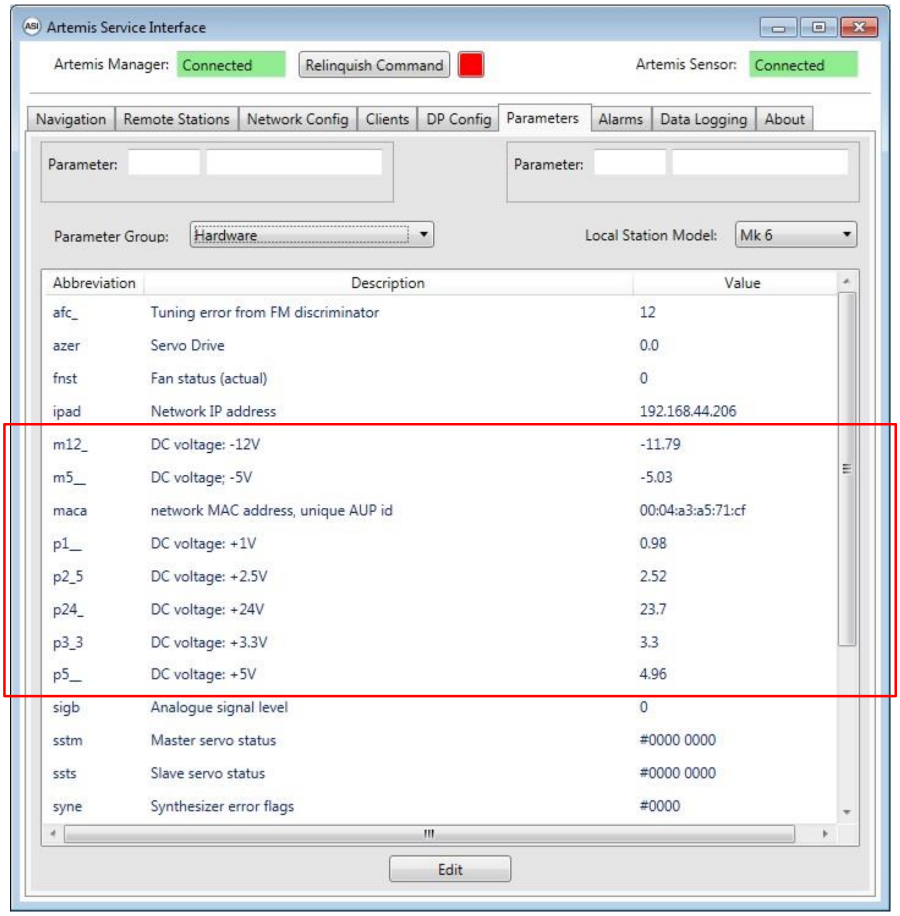
Note: vhwa and vhwo are not recorded.

2. Voltage Measurements

Connect a calibrated DVM across the GND and +24V test points on the Interconnect board. Record the reading in section 4.1 of the build record.



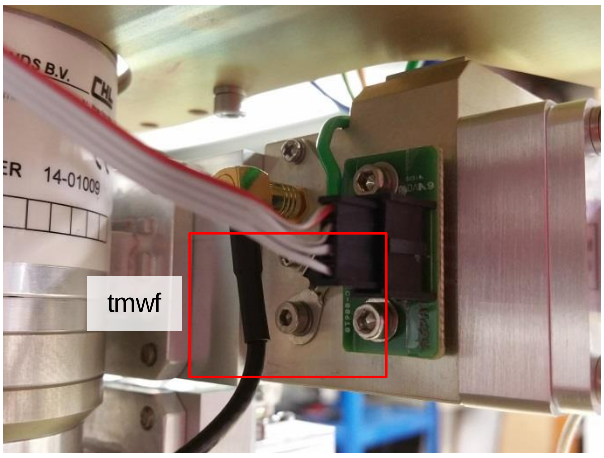
The AUP voltage measurements are in the parameter settings – hardware in the ASI software.

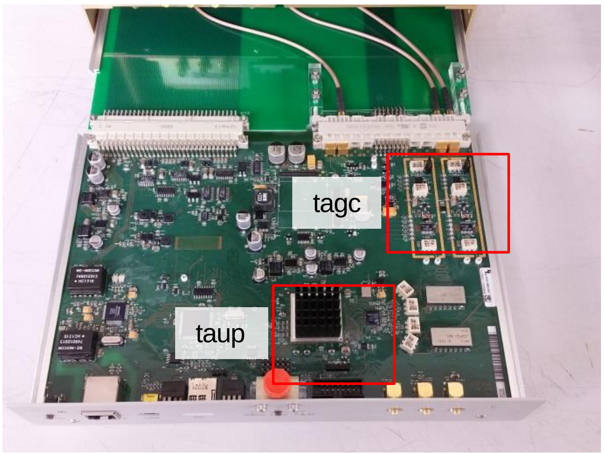


Record the values in section 4.1 of the build record.

3. Temperature Sensors

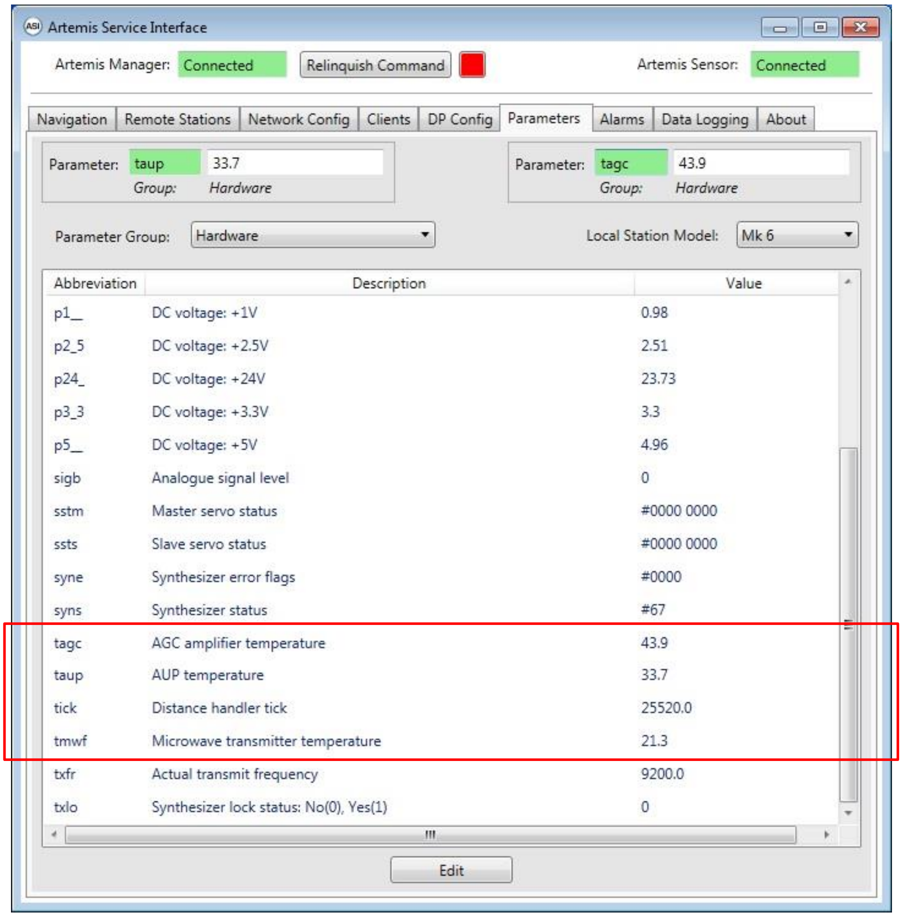
There are 3 temperature sensors on the Artemis to check. The microwave front end sensor that is mounted to the PIN module, this is the tmwf temperature reading.





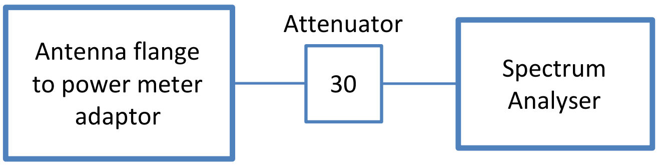
The taup and the tagc temperature sensors are on board the AUP. Remove the AUP and slot in the AUP breakout board. To test these you don't need to remove the top cover of the AUP enclosure (Picture shows areas to spray) and spray each of the sensor areas with freezer spray for a fraction of a second (prolonged spraying can cause thermal damage) watch the temperature on the ASI drop and recover by a few degrees.

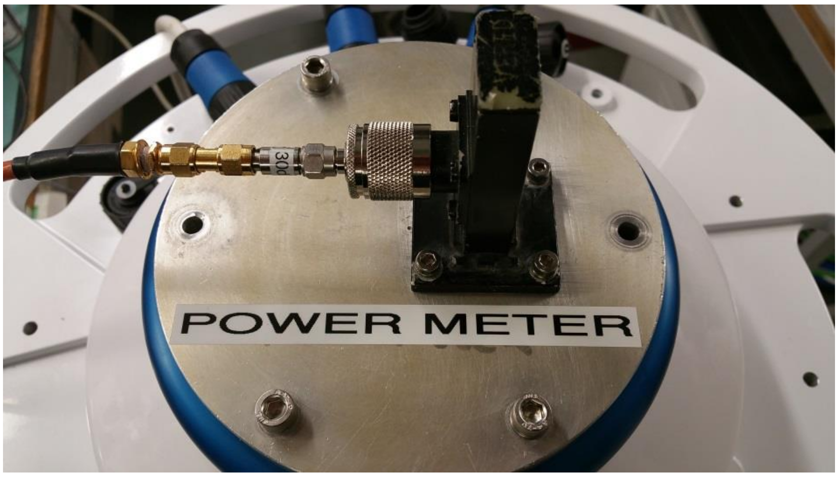
The ambient temperature measurements are in the parameter settings – hardware in the ASI software. Record the values in section 4.2 of the build record.



4. Microwave Output Characteristics

Mount the power meter adaptor plate to the Artemis antenna flange. Connect the spectrum analyser to the Artemis with a 30 dB in line attenuator.

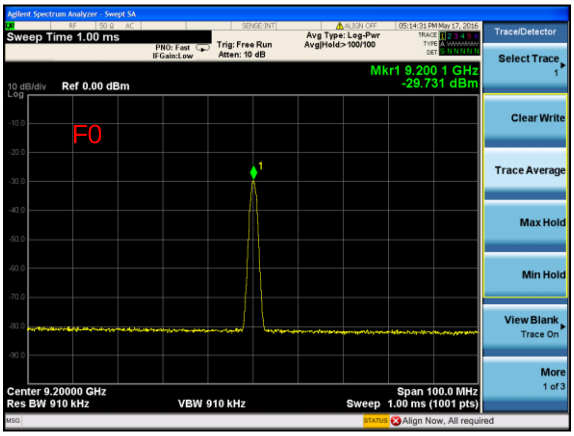


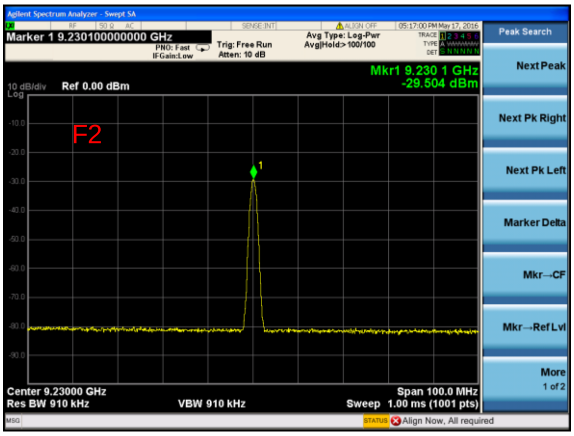


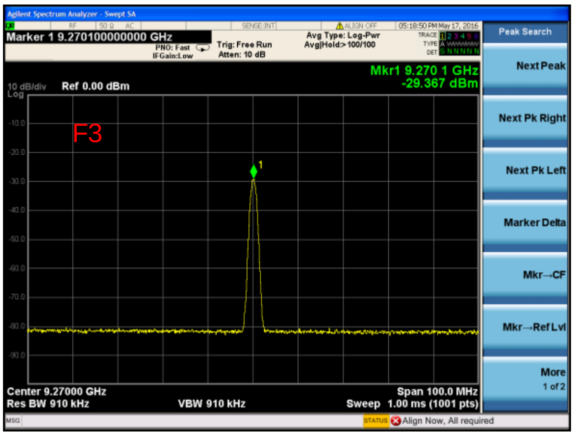
Set the spectrum analyser to following settings:

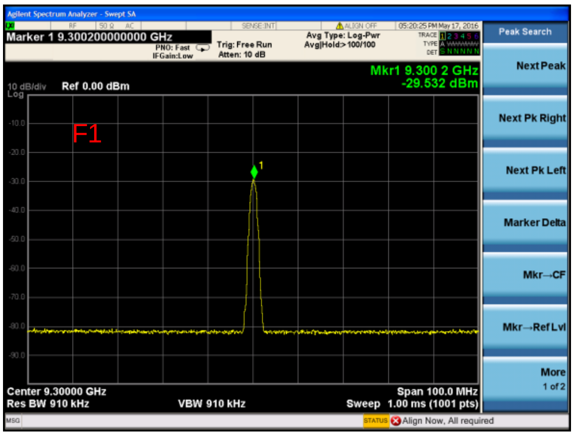
Centre Frequency: 9250MHz
Span: 150MHz
Amplitude: Ref level 0dBm
Bandwidth: Auto (This is usually 910KHz)
Trace Detector: Trace Average (100/100)

Set the Artemis as a Mobile unit using the ASI software, select F0 frequency pair. Set the unit into operating mode.



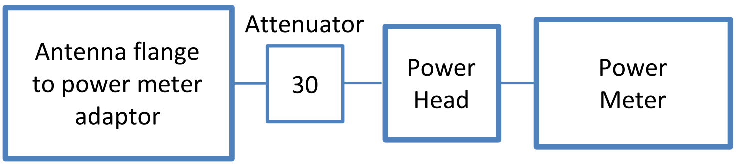


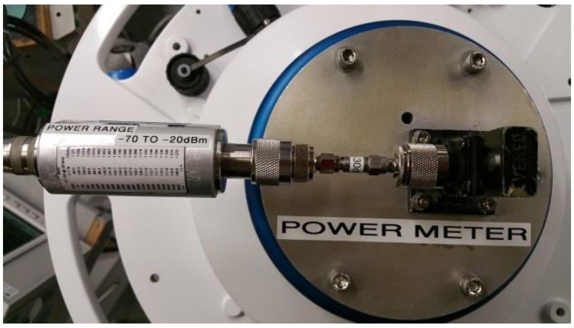




Select the remote stations in the ASI for F2, F3 and F1 and move the centre frequency on the spectrum analyser to suit. You will see the above output power peaks at each frequency setting, use peak search on the spectrum analyser to measure each frequency.
Record the frequency values in section 4.3 of the build record.

Connect the power head to the 30dB attenuator on the Artemis.





Set the power meter up (If using TE500, power head 6920):

LIN FACTOR: 6.7
CAL FACTOR: 107
dB REL -46.8dB Note: this is the loss of the waveguide adaptor + the attenuator

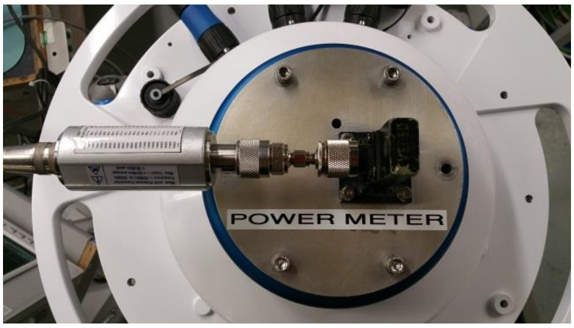
then AUTO ZERO. Check the power head for any changes to values to the LIN or CAL factor.

In the ASI software – set txpm to Manual transmit power, then set txpw to high power.

Run through the remote stations for F0 to F3 and log results in section 4.3 of the build record.

Set txpw to low power adjust iatt (default value is 0.5) to get the suppression between high and low power to 20dB on F0, then check across F1 to F3 and adjust again if needed to get the best match across all frequencies.
Suppression is calculated by 'high power – low power'

Log the results in section 4.3 of the build record. Allowed tolerance is ± 1dB.



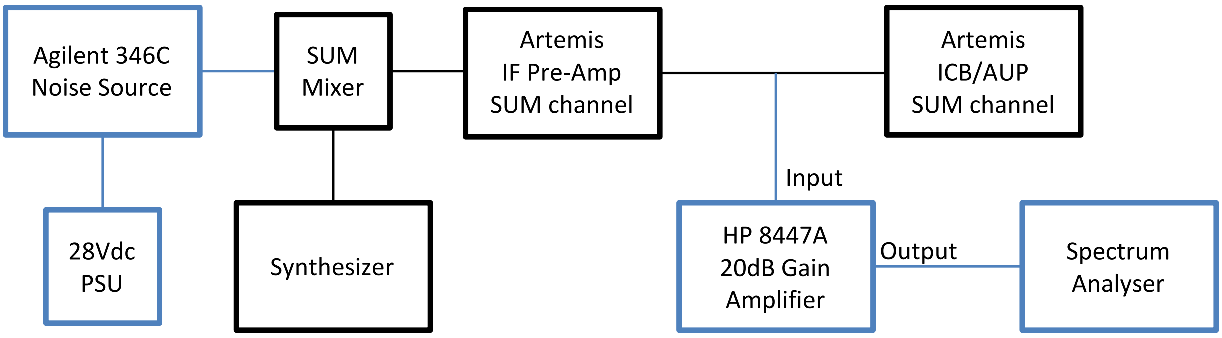
Place in Standby, remove 30dB attenuator and connect the power meter directly to the power meter adaptor plate. Set dB REL to -16.8dB on the power meter, this is the loss of the waveguide adaptor only.

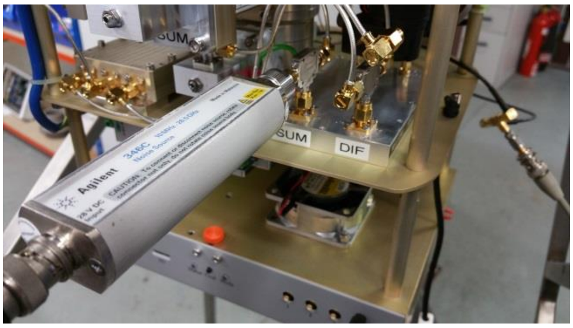
Run through the remote stations for F0 to F3 in the ASI and log the standby results in section 4.3 of the build record.

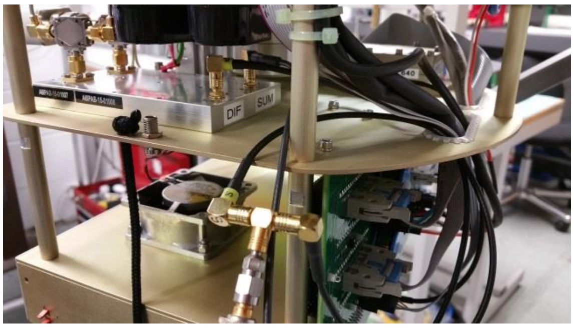
The suppression is the difference between the high power output and standby. For example +20dB high power output and -25dB standby power would be a suppression of 45dB. This is the final calculation for section 4.3 of the build record.

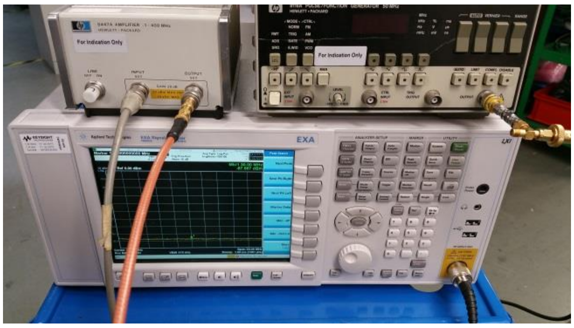
5. IF Pre-Amp Gain and Noise Measurement

Connect up the Artemis as shown below:







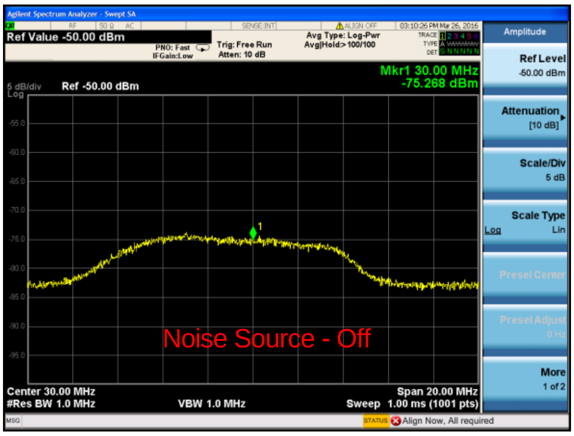


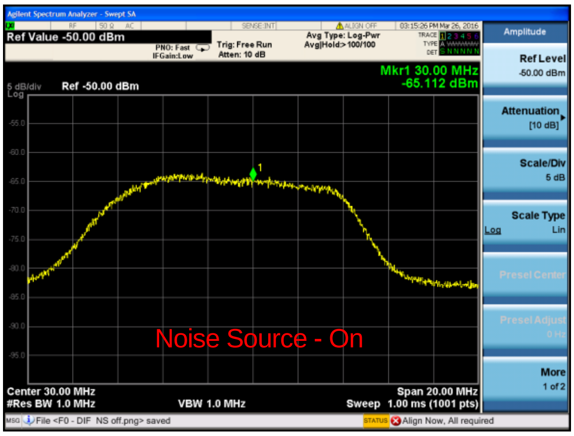
Disconnect the SMA cable from the SUM mixer and attach the Noise Source and lock-off with a SMA spanner. Disconnect the SMB SUM channel output to ICB cable and attach to one side of the 'T' piece adaptor. Place the SMB to SMB test lead from the 'T' piece adaptor to the SUM channel output. Connect the 'T' piece adaptor to the input of the HP 8447A, connect the output into the spectrum analyzer.

Set the spectrum analyser to following settings:

Centre Frequency: 30MHz
Span: 20MHz
Amplitude: Ref level -50dBm / Amplitude 5dB per division
Bandwidth: 1MHz
Trace Detector: Trace Average (100/100)
Marker: 30MHz

Power up the Artemis unit and put into operating mode, Selecting F0 remote station.





With the noise source powered off, you will get a flat filter response shown above. If the filter response is not flat then there is something wrong in the build.
Note down the signal level (-75.268dB). Power up the noise source and note down the signal level (-65.112dB)

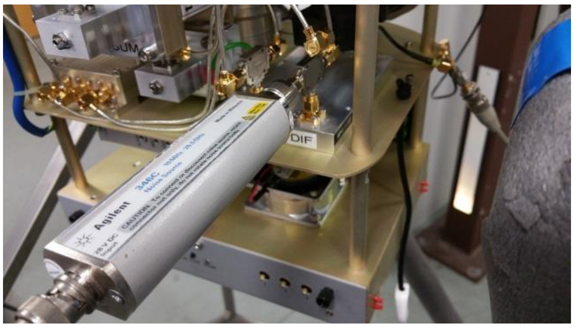
	A	B	C	D	E	F	G
1	Y Factor						
2							
3	Resolution Bandwidth (MHz)	1					
4	ENR (dB)	17.8	(Add 3 for mixer double sideband)				
5	Noise Source Off (dBm)	-75.268					
6	Noise Source On (dBm)	-65.112					
7	Y Factor (dB)	10.156					
8	Noise Figure (dB)	8.08					
9	Gain	30.65					
10							

$$\text{Noise Figure (NF)} = 10 * \log_{10} \left(\frac{10^{(ENR/10)}}{10^{(Y/10)} - 1} \right)$$

Open the IPA gain and noise configuration spreadsheet and enter the noise source signal values and it will work out the noise figure and gain for you. Enter this into section 4.4 of the build record.

Repeat again for remote station F1.

Power down the unit and swap the noise source over to the DIF side, reconnecting the SUM into the system.

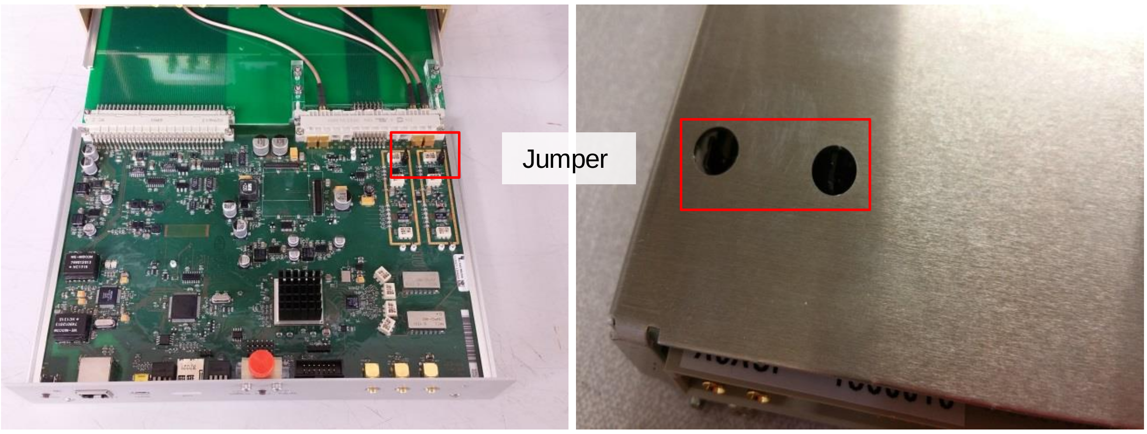


Power up the Artemis unit and put into operating mode. Repeat the test that was carried out on the SUM channel and enter the results into section 4.4 of the build record.

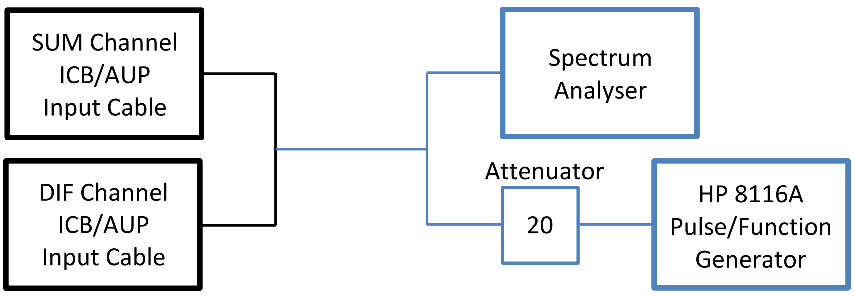
Power down the Artemis and remove the noise source from the system.

6. AGC Amplifier

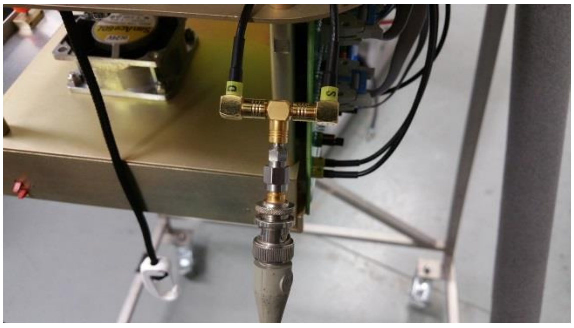
Power down the Artemis and remove the AUP, then remove the two jumper links on the AUP and then fit back into the Artemis.

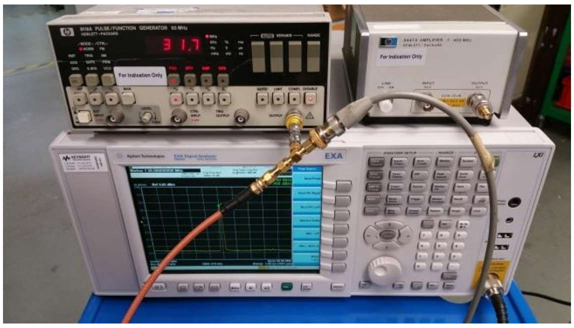


Connect up the Artemis as shown below:



Disconnect the SMB SUM channel output to ICB cable and attach to one side of the 'T' piece adaptor
Disconnect the SMB DIF channel output to ICB cable and attach to one side of the 'T' piece adaptor.
Connect a 20dB attenuator onto the output of the HP 8116A Pulse / Function generator. Connect a 'T' piece adaptor to the 20dB attenuator. Connect the spectrum analyzer to the Function generator 'T' piece. Connect the SUM / DIFF 'T' piece to the Function generator 'T' piece.

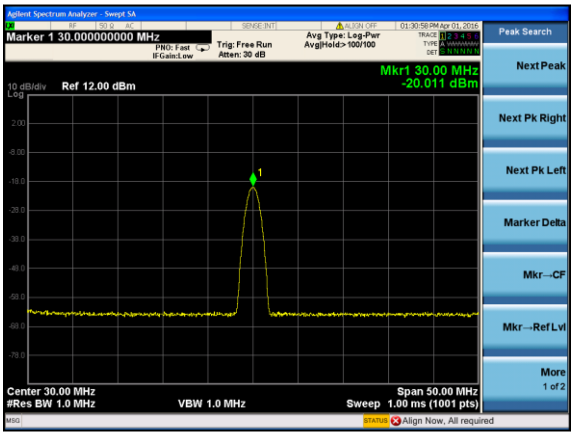




Set the spectrum analyser to following settings:

Centre Frequency: 30MHz
Span: 50MHz
Amplitude: Ref level 0dBm / Amplitude 10dB per division
Bandwidth: 1MHz
Trace Detector: Trace Average (100/100)
Marker: 30MHz

Use the spectrum analyzer to set-up the function generator (the spectrum analyzer will most likely be the only calibrated piece of test equipment)



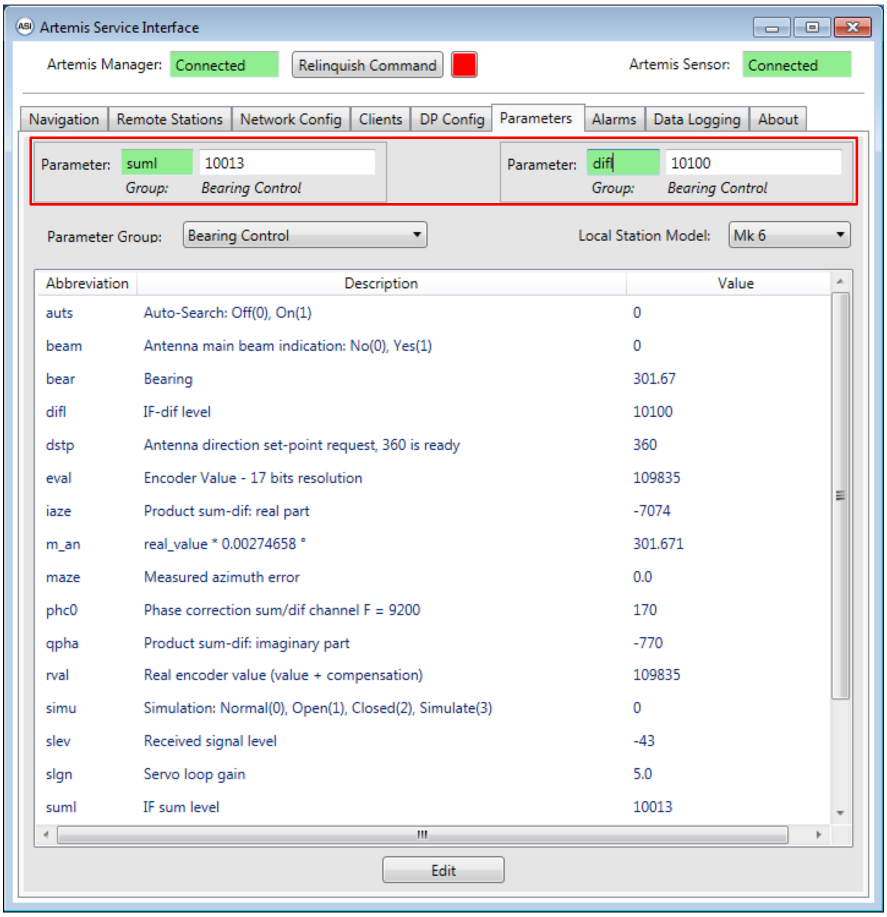
Set the function generator to sine wave, change the frequency till the peak of the output is at 30MHz. As you can see in the picture the function generator is set to 31.7MHz to get the 30MHz output, the numbers and output don't quite tie up which is why the calibrated spectrum analyzer is used to check / setup the output. Once the frequency is set adjust the AMP setting to adjust the output power to -20dBm.

Power up the Artemis, then using the ASI software set to operating mode.

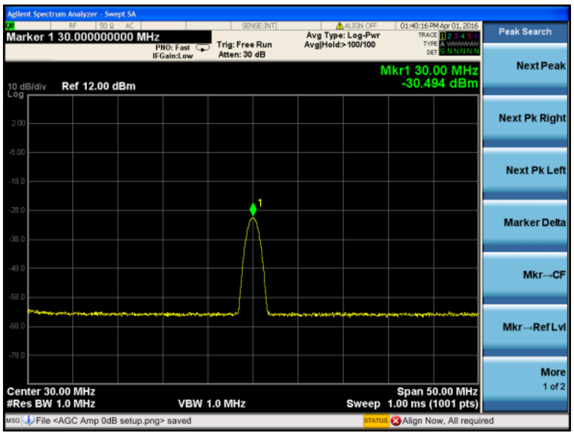
Open the parameters tab and in the two parameter boxes type 'suml' and 'difl'

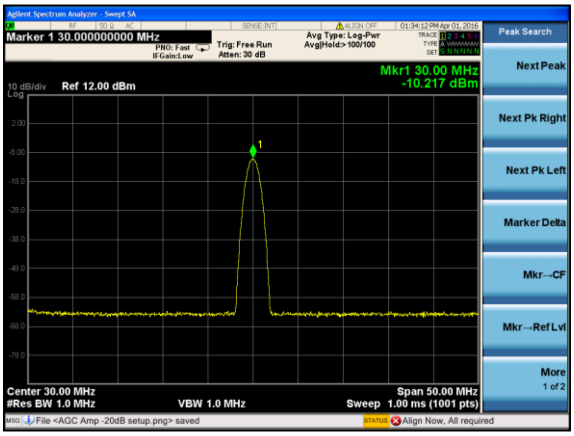
These should be approximately the same value but the limits for both are slightly different.

The SUM channel is 10,000 ± 1% (9900 to 10100)
The DIF channel is 10,000 ± 5% (9500 to 10500)
Note down the SUM and DIF levels in section 4.5 of the build record.



Change the attenuator from 20dB to 30dB and repeat. Do the same with 40dB, 10dB and no attenuator.



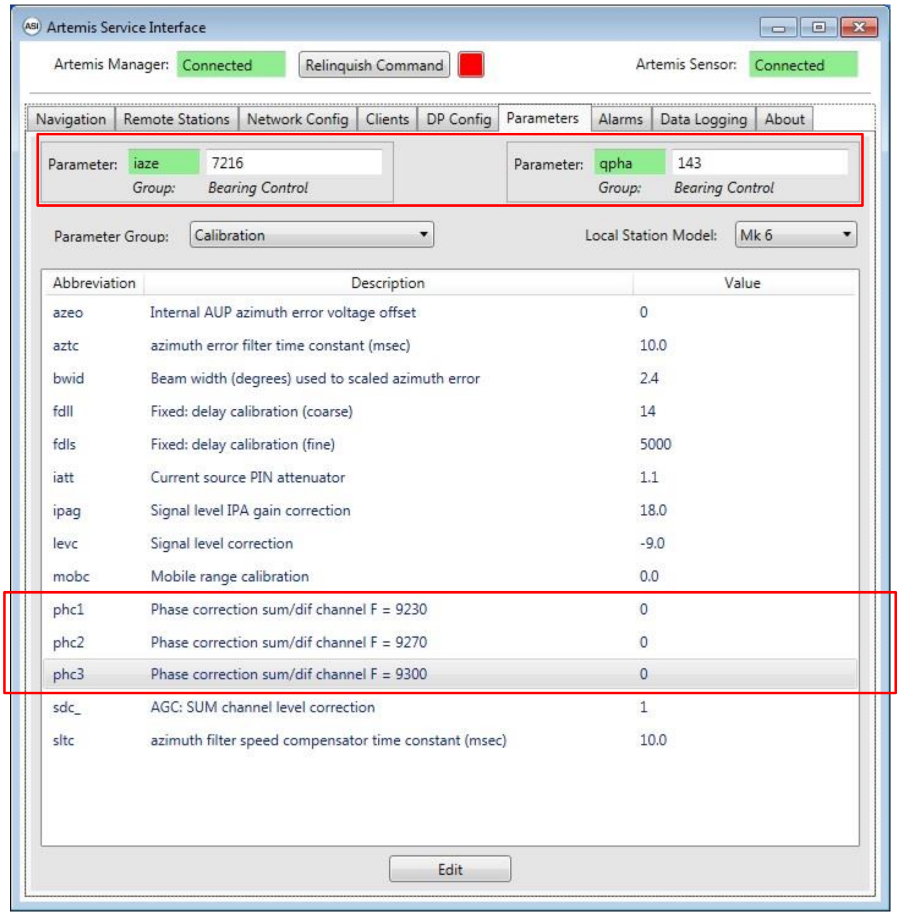


Each time you change the attenuator check on the spectrum analyzer that the signal is correct. As you change the attenuators the signal strength will follow suit, the frequency will always be at 30MHz. When all attenuator values have been done, return to the original -20dB attenuator.

Note down the suml and difl output values in section 4.5 of the build record.

In the ASI software under the parameters tab, change the phc0, phc1, phc2 and phc3 values to ‘0’

Then in the parameter boxes type ‘iaze’ and ‘qpha’



This is used to work out the SUM DIF Phase difference.

$$Phase\ difference = \frac{qpha}{iaze}$$

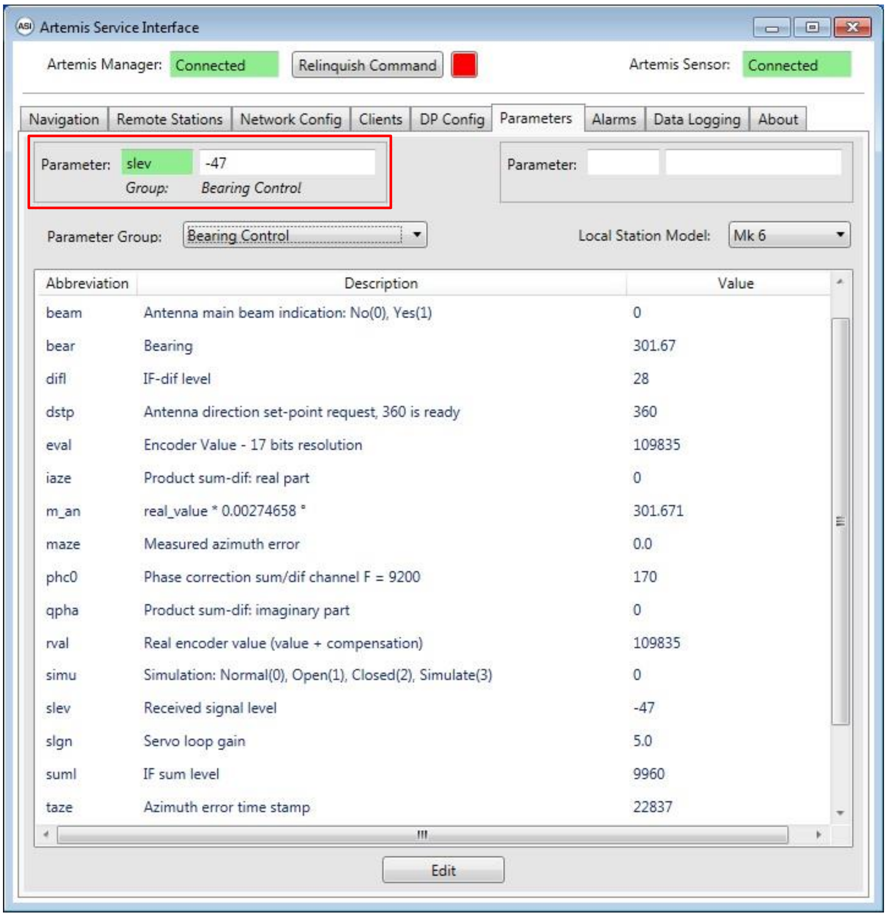
So the above values give 143 / 7216 = 0.0198°

Note this down in section 4.5 of the build record.

Return phc0, phc1, phc2 and phc3 to the value of 170.

Remove the DIF cable from the ‘T’ piece adaptor and leave it floating.

Type ‘slev’ into the parameter box of the ASI software.



Note down the signal level with the 20dB attenuator inline. Change the attenuator from 20dB to 30dB and repeat. Then 30dB to 40dB, 40dB to 10dB, 10dB to no attenuator, checking on the spectrum analyzer that the signal level is correct. Then the signal level correction is ready to be worked out.

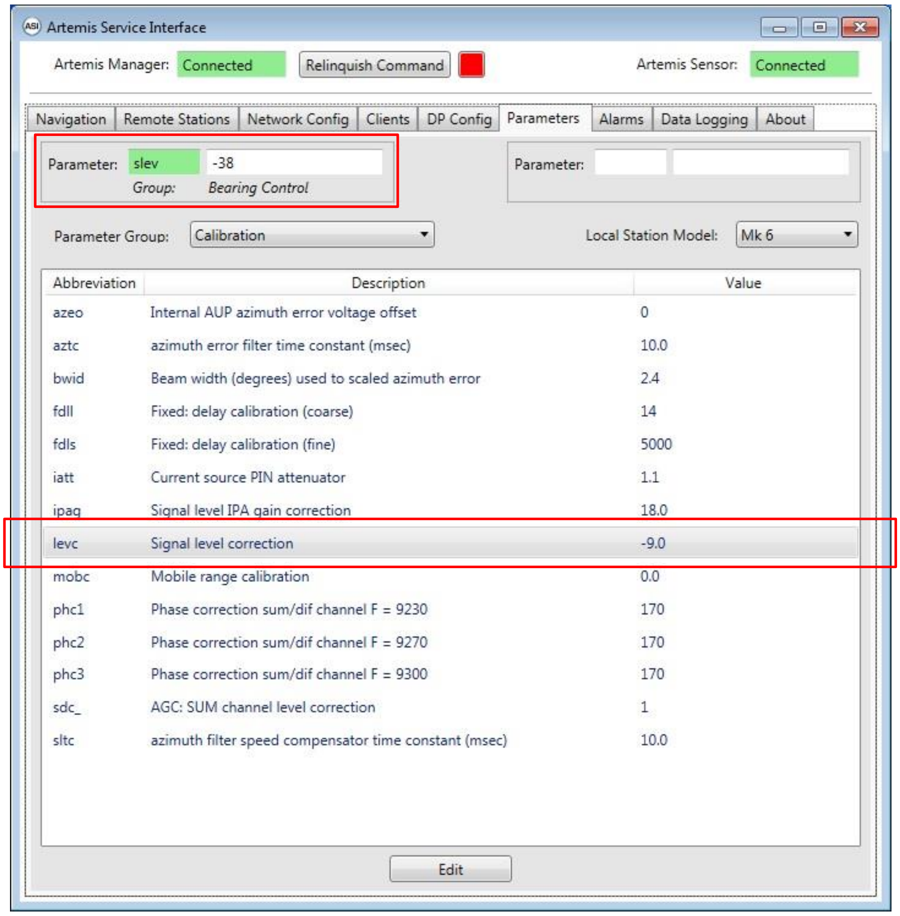
The target signal level is:

Attenuator Value	Target Signal level
40dB	-58
30dB	-48
20dB	-38
10dB	-28
0dB	-18

Adjust the value of ‘levc’ and check each of the attenuator values to make sure that the target signal level has been gained.

If the overall difference in signal level is +9dB across all the target signal levels, then type -9.0 into the ‘levc’ parameter.

Note this down in section 4.5 of the build record.



Power down the unit and remove the AUP from the Artemis and place the two jumper links back onto the AUP, refit the AUP. Remove the ‘T’ piece adaptor and place the SUM and DIF cables back onto the IF Pre-amp.

7. Fixed Delay Adjustment

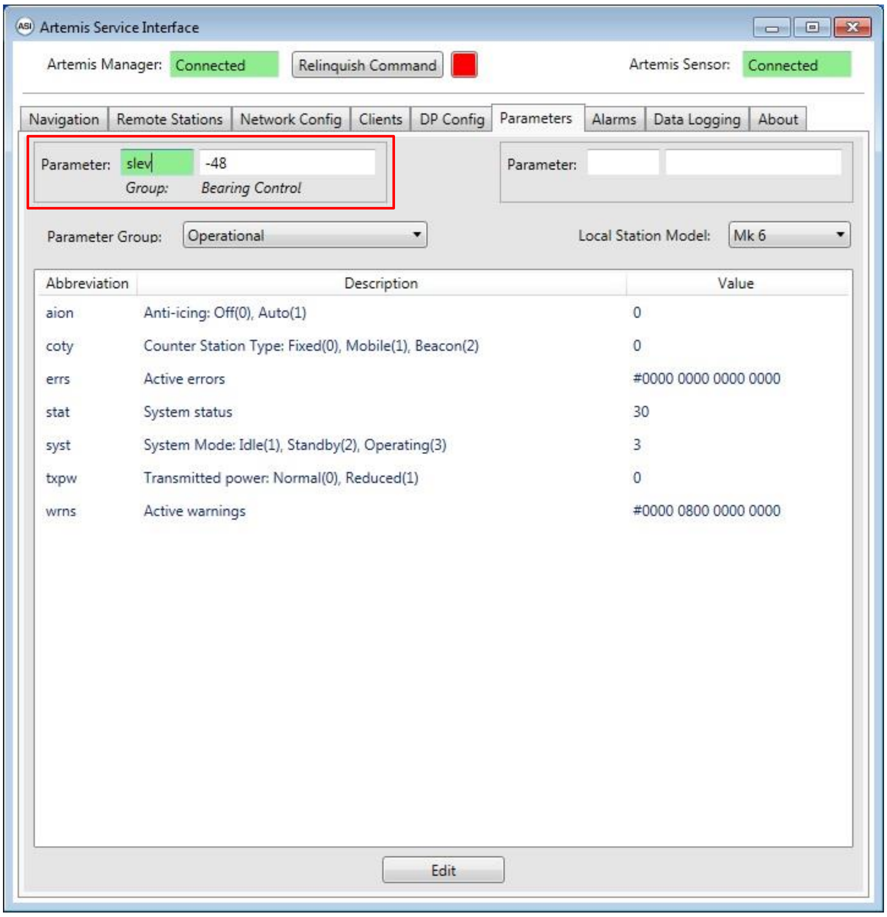
Remove the power meter adaptor plate from the antenna flange and fit the TDC fixed delay meter, making sure it is securely bolted down.

Power up the Artemis and using the ASI software set the following parameters.

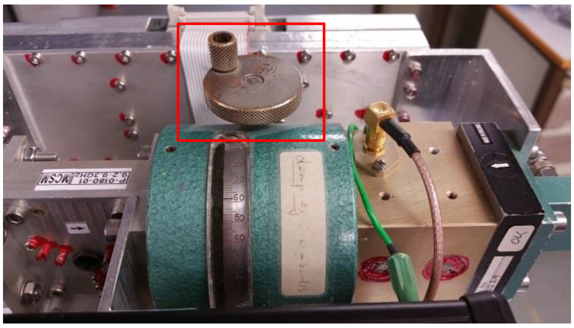
stty: Fixed Station
txpm: Manual
simu: Open Loop
txpw: Normal (high power)

Then select remote station F0

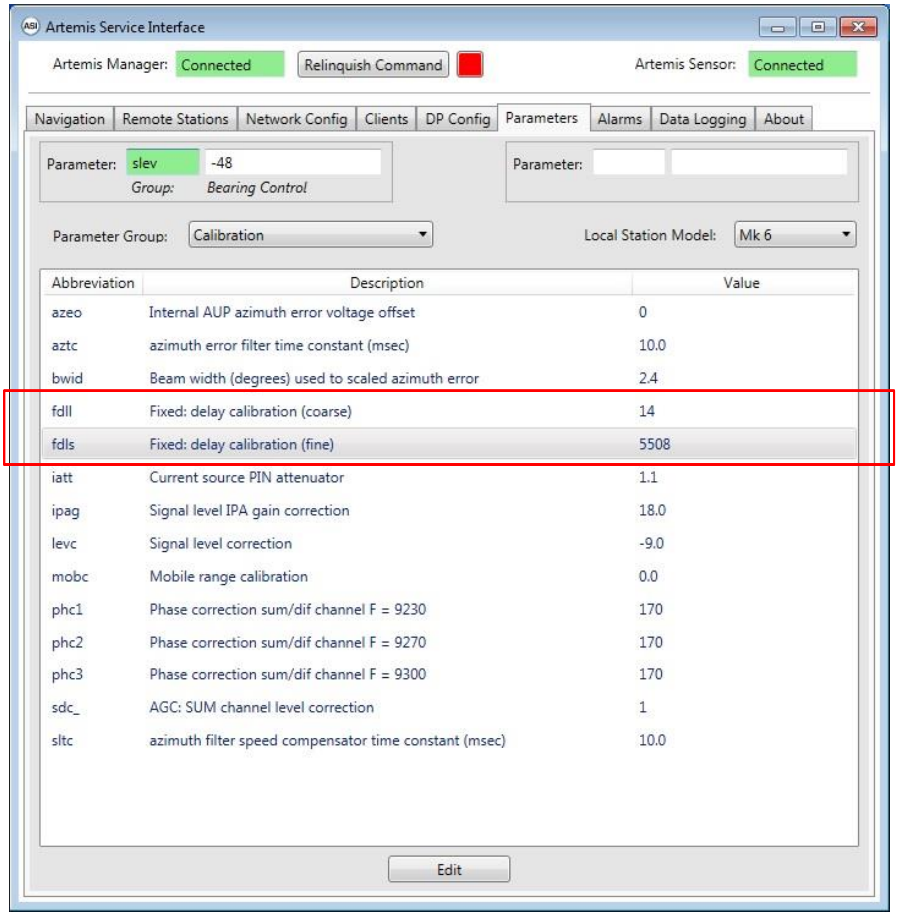
Connect the power to the TDC fixed delay meter, +12V, 0V and -12V and power up. The fixed delay meter should already be on F0, if not, use the ▲ and ▼ arrow keys till the display states 0: 9200 MHz
There will be fixed delay value written on the display of approx. 489nS (this is the target value across F0, F1, F2 and F3)

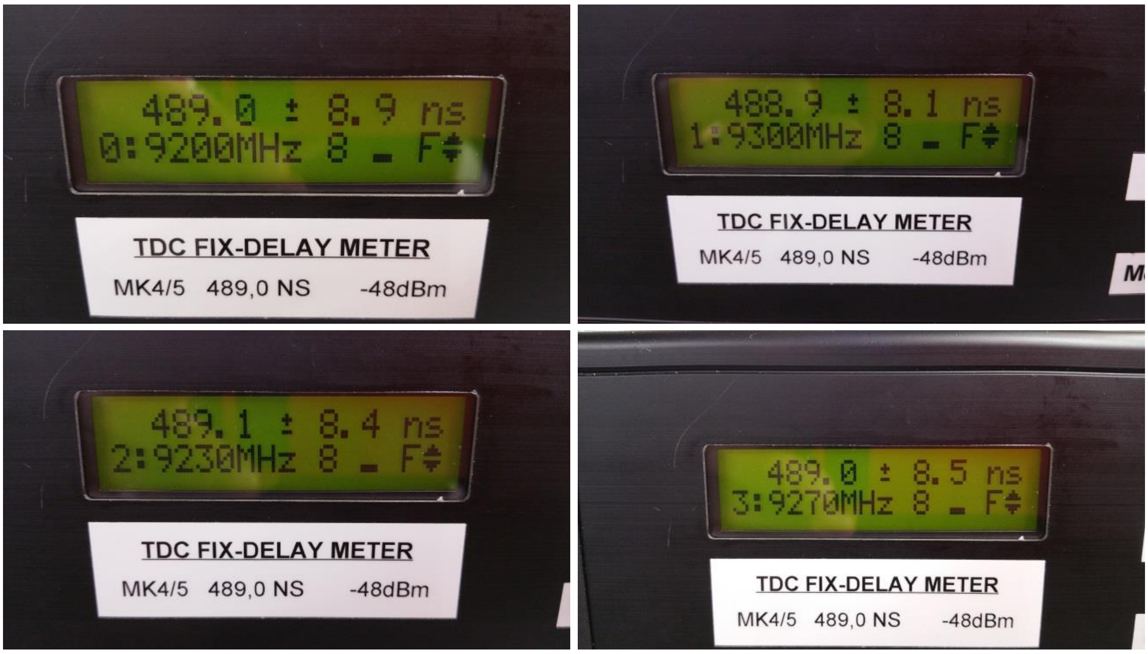


Make sure that the returned signal level across all frequencies is set at -48dB. To do this select the remote station F0, check the signal level, Select F1 remote station and press the arrow keys on the TDC Fixed delay meter till you see 1: 9300MHz. Then you get a timing written on screen (that's when you know it is connected) Check the signal level… Do this for all four frequencies. Any adjustment required to be carried out can be done by turning the adjustable attenuator pot on the TDC Fixed delay meter.



Once you have -48dB across all frequencies look at the time delay on the TDC Fixed delay meter. There are two adjustment parameters in the ASI software to set-up the delay time, 'fdll' and 'fdls'. 'fdll' is a course adjustment and 'fdls' is a fine adjustment. The likelihood is that only the 'fdls' will require adjustment to get the correct time delay.



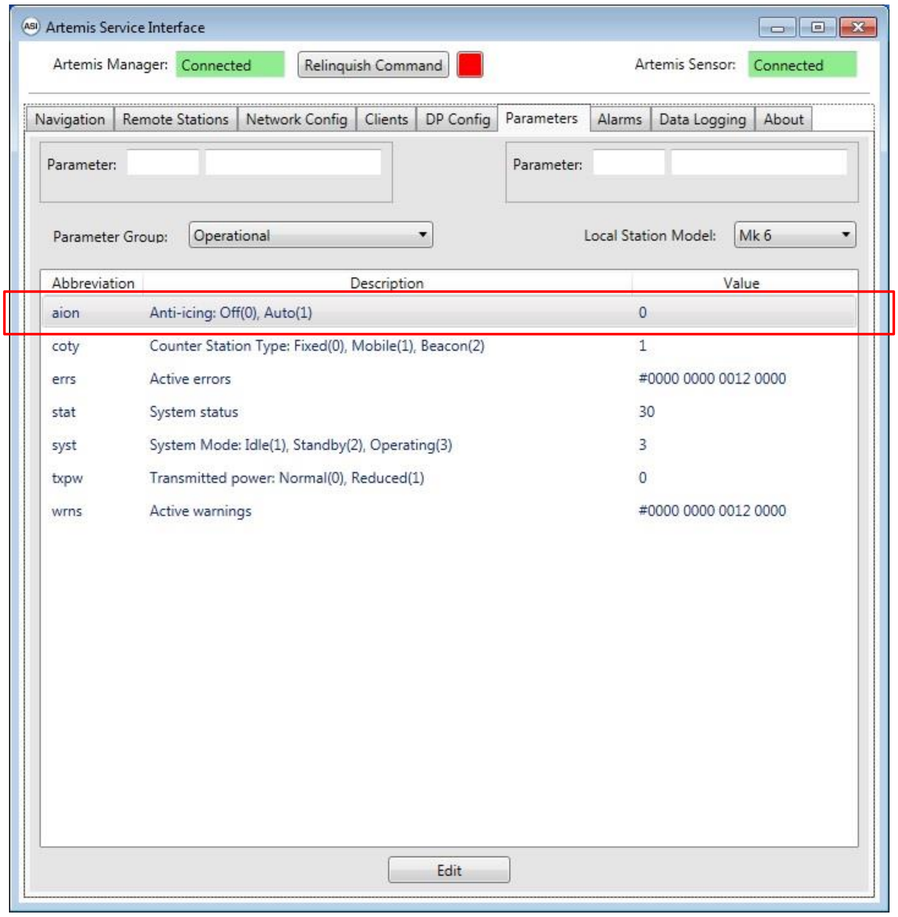


'fdll' default is 14 (10 to 15 range) 'fdls' default is 5000 (4000 - 6000 range), adjusting the value up will result in the time delay increasing and adjusting the value down will result in the time delay decreasing.
As you can see from the photos you will not get 489.0nS on every frequency but you can get very close.

Note this down in section 4.6 of the build record along with the ± x.x nS jitter value. Then from all 4 readings you can work out the average time delay.

8. Anti-Icing

This test can be carried out using the same settings as the fixed delay adjustment.

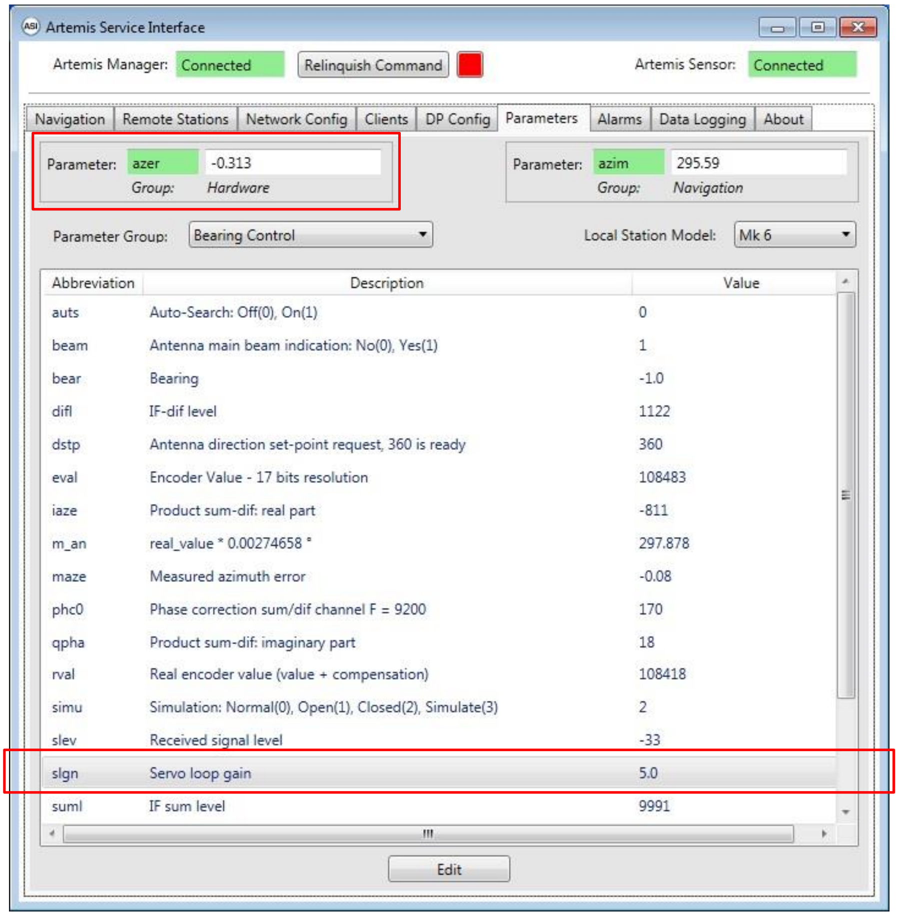


Using a calibrated multimeter set to AC voltage, probe across the heater contacts on the antenna flange and you will see $0V_{AC}$. Turn on the anti-icing using the ASI software ‘aion’ to Auto (On) and the anti-icing will turn on. Probing across the heater contacts will show a voltage of 33 – $36V_{AC}$, then return ‘aion’ to ‘Off’

9. Phase and Servo Test

Using the ASI software change the parameter ‘simu’ from Open Loop to Closed Loop.
Fit the phase / servo tester (nicknamed the ‘horses head’) to the antenna flange.

Turn ‘On’ the horses head and it should start to rotate. Using the delta phase and 180 phase adjustments you can get the horses head to rotate both clockwise and anticlockwise. This will take a bit of playing with to find the best adjustment place for maximum output.



Type into the parameter box 'azer' this is the servo voltage measurement.

Adjust the phase shifter on the horses head till you hit the maximum negative output voltage on 'azer'. The negative voltage, shown above, is the head rotating anticlockwise.

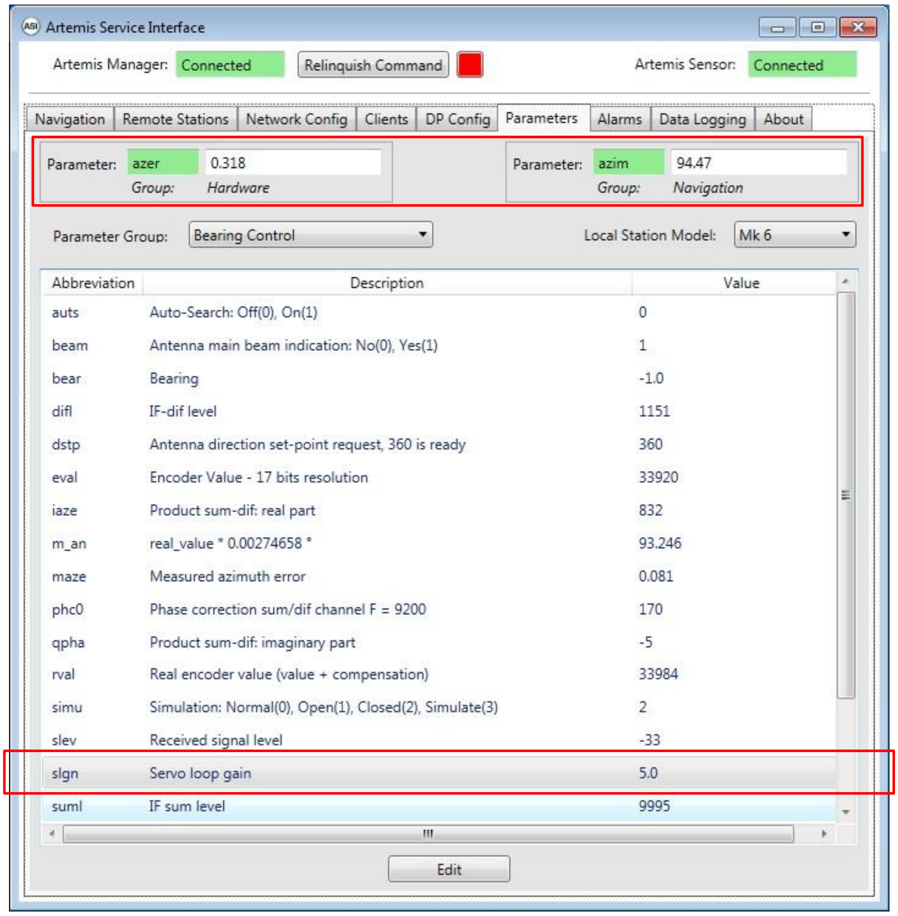
Note down the voltage in section 4.8 of the build record, the build record is filled in mV so -0.313 is -313mV.

Change the servo loop gain 'slgn' from 5 to 4 and note down the voltage again. Repeat with 'slgn' set at 3 and 2.

Adjust the phase shifter on the horses head till you hit the maximum positive output voltage on 'azer'. The positive voltage, shown below, is the head rotating clockwise.

Note down the voltage in section 4.8 of the build record, the build record is filled in mV so 0.318 is 318mV.

Change the servo loop gain 'slgn' from 5 to 4 and note down the voltage again. Repeat with 'slgn' set at 3 and 2.



10. Encoder Readout

This can be done while carrying out the phase and servo test, type in ‘azim’ into the parameter box, as shown above, and allow the unit to rotate through 360 degrees. Watch the ‘azim’ value to make sure there are no sudden jumps in value of the encoder readout.