UNAVCO POLAR GPS SYSTEM TEST PROCEDURE

Clear Form

Test Procedure Version: 5.0

Date: _____

Project / Network: _____

System ID: _____

Tested by: _____

Upon completion this hardcopy is placed in the appropriate network folder with the Polar Network Operations Engineer.

CONFIGURE DEVICES

Trimble NetRS GPS Receiver

- ☐ NetRS UNAVCO ID: _____
- ☐ Verify all GP data is archived or backed up.
- ☐ Verify / Replace Compact Flash Card (Appendix 1).

  If either:

  1. The Compact Flash Card is NOT California PC, OR
  2. The receiver has been deployed for 2+ years with its existing flash card, install a new, NetRS imaged, California PC FCFI-10GB-22xx 1GB Industrial CF Card.

  CF card model: -_____

  Date CF card imaged: _____

  Person who imaged card: _____

CRITICAL: Imaging a new CF card

A procedure for properly imaging a NetRS CF card has been developed and tested. It is critical to use the correct make and model CF card, and to image the card following an exact procedure. See the INTERNAL UNAVCO document:

Imaging a CF Card for a Trimble NetRS receiver – FCFI-01GB-2230/2232 Series (PDF)

As of May 2016, the *FCFI-01GB-2230/2232 Series* version of this document is used. A dedicated Linux computer and NetRS are available in the UNAVCO repair lab for the sole purpose of imaging and pre-testing CF cards.

- ☐ Perform internal inspection of NetRS (Appendix 1).
- ☐ Delete all data from receiver (Appendix 1).
- ☐ Perform hard reset on receiver (Appendix 1).

  Date of receiver hard reset: _____

☐ Verify or load correct firmware version.

Firmware Version: -

☐ Run Disk Check to verify there are no bad disk sectors (Appendix 1). Watch output from NetRS Serial Port 1 (Monitor port) during disk checks.

Date of Disk Checks: _____

Part 1	Part 2	Part 3	Part 4
☐	☐	☐	☐

☐ Configure receiver. Complete UNAVCO Polar NetRS Configuration Form and attach to this log sheet. Use the correct configuration form for the installed NetRS firmware.

☐ Create and save NetRS configuration file on the receiver. Download and save this configuration file to your computer.

Filename: _____

Trimble NetR9 GPS Receiver:

☐ NetR9 UNAVCO ID: _____

☐ Verify all GP data is archived or backed up.

☐ Perform hard rest on receiver (Appendix 3).

NOTE: A hard reset will delete ALL data files on receiver.

Date of receiver hard reset: _____

☐ Verify or load correct firmware version.

Firmware Version: -_____

☐ Configure receiver. Complete UNAVCO Polar NetR9 Configuration Form and attach to this log sheet. Use the correct configuration form for the installed NetR9 firmware.

☐ Create and save NetR9 Clone file on the receiver. Download and save this Clone file to your computer.

Filename: _____

☐ Optional: Format a 4GB Industrial USB drive for the NetR9 (Appendix 3).

GPS Antenna:

- ☐ Antenna Make and Model: _____
- ☐ UNAVCO ID: _____
- ☐ Antenna Part Number: _____
- ☐ Serial Number: _____
- ☐ Radome Make and Model: _____
- ☐ Radome Serial Number: _____

Iridium Filter for GPS Antenna Line: (Required for NetR9 with Iridium)

- ☐ Make and Model: _____
- ☐ Serial Number: _____

Iridium Modems:

- ☐ Primary Iridium Make and Model: _____

  Primary Iridium UID: _____
- ☐ Secondary Iridium Make and Model: _____

  Secondary Iridium UID: _____
- ☐ Configure modems. Complete UNAVCO Polar Iridium Modem Configuration Form for each modem, and attach to this log sheet.

Radio Modem:

- ☐ Primary Radio Make and Model: _____

  Primary Radio UID: _____
- ☐ Secondary Radio Make and Model: _____

  Secondary Radio UID: _____

Weather Station:

- ☐ Weather Station Make and Model: _____

  Weather Station UID: _____

  Weather Station Serial Number: _____
- ☐ Configure Weather Station by loading the UNAVCO Polar Configuration File.

COMPONENT QUALITY ASSURANCE TESTS

Solar Charge Regulator:

☐ Verify charge voltage range (at room temperature) by connecting a variable DC power supply to the board's battery leads. Measure the voltage with a digital voltmeter instead of the DC power supply display.

Start at 0V and ramp the voltage up, then down. Observe the voltage at which the solar regulator charge LED turns on and off. Repeat this test twice.

ON voltage (approx. ~13.3V at room temp): _____ _____

OFF voltage (max ~13.9V at room temp): _____ _____

Solar Charge Regulator LVD Circuit:

☐ Verify the LVD on/off range (at room temperature) by connecting a variable DC power supply to the board's battery leads. Measure the voltage with a digital voltmeter instead of the DC power supply display.

Start at 0V and ramp the voltage up, then down. Observe the voltage at which the solar regulator's LVD LED turns on and off. Repeat this test twice.

LVD ON voltage (approx. ~12.9V at room temp): _____ _____

LVD OFF voltage (max ~11.0V at room temp): _____ _____

Wind Charge Regulator:

☐ Verify charge voltage range (at room temperature) by connecting a variable DC power supply to the board's battery leads. Measure the voltage with a digital voltmeter instead of the DC power supply display.

Start at 0V and ramp the voltage up, then down. Observe the voltage at which the wind regulator charge LED turns on and off. Repeat this test twice.

ON voltage (approx. ~13.3V at room temp): _____ _____

OFF voltage (max ~13.9V at room temp): _____ _____

GPS ON/OFF Voltage Thresholds:

☐ Connect a variable DC power supply the board's battery leads. For the NetRS, make sure power is connected to both power ports A and B. Measure the voltage with a digital voltmeter instead of the DC power supply display.

Start at 0V and ramp the voltage up, then down. Observe the voltage at which the GPS turns on, then turns off. The GPS must start working properly once the voltage is above the restart threshold, then go through a proper shutdown procedure below the LVD. (Note NetRS restart threshold is fixed at 12.1V). Repeat this test twice.

Restart threshold (programmed): _____ _____
Restart threshold (actual): _____ _____

LVD (programmed): _____ _____
LVD (actual): _____ _____

RF Cables:

- ☐ Visually inspect all RF cables (GPS and Iridium, internal and external cables) for correct cable type, length, and connectors.
- ☐ Check cable: tug test connectors (~10 lbs), verify continuity (< 0.2 ohms), and isolation of sheath and center pin.

Power Distribution Components:

- ☐ Test diodes using multi meter diode test function, positive meter lead on terminal block port upstream of diode, negative meter lead on terminal block port downstream of diode. Voltage drop across each Shottky diode should be about 0.2V.

- ☐ Test all breakers. Use multi meter to measure continuity (resistance) across breaker. Should be short circuit when breaker closed, open circuit when breaker open.

- ☐ Tighten all breaker screw terminals. Use large flat-bladed screwdriver to securely tighten each screw terminal port.

Power system components:

- ☐ If a complete system is being built, the power system components (solar panels, wind turbines, batteries, battery harnesses, and external battery cables) should also be QC checked. See Appendix 2 for instructions.

COLD CHAMBER TEST

Run entire electronics board in cold chamber as follows.

☐ Connect the GPS receiver and Iridium (or radio) modem to the external antenna drops.

☐ Connect the board to one 100 amp-hour battery, also inside the cold chamber. This battery should be fully charged at the start of the test.

☐ Set the modem timer(s) to ~180 minutes on / ~60 minutes off.

☐ Attach the 6-way custom wire harnesses to the solar, wind, battery, load, heat pad, and ground terminal blocks. If wind is not used, attach the wind lead to the solar terminal blocks, and leave the heat pad lead to the ground terminal blocks. Connect this wire harness to the mating harness, which is connected to the Campbell CR1000 data logger next to the cold chamber.

Notes on the Campbell Data logger:

A Campbell CR1000 data logger, with a set of power distribution terminal blocks, is installed next to the cold chamber. The data logger records solar, wind, battery, load, heat pad, and timer switch voltage(s) during the cold test. It also alternates delivery of solar panel power to the solar and wind circuits every 2 hours. A Campbell temperature probe is also attached to the data logger. This probe should be run into the cold chamber.

☐ If communications are used, connect the 2-way custom wiring harness. For a single modem, attach both leads to the modem's positive lead on the timer switch. For dual modems, attach one lead to the modem's positive lead on each timer. Connect this wire harness to the mating harness, which is connected to the Campbell CR1000 data logger next to the cold chamber.

☐ Create a new test directory for the board on the computer. Rename the appropriate Table filenames on the Campbell *Loggernet* software. Make sure all of the voltages displayed by the CR1000 are within reasonable values.

☐ Set up the download system to retrieve SOH and GPS data from this system (Appendix 5).

For XI-100: Auto-RUDICS interval (10 min. typ.) _____

For radio: query/download interval (10 min. typ.) _____

☐ Install second GPS receiver inside cold chamber, connected to the same antenna. This receiver will be used as a comparison, for the 24-hour QC test. If a second board is being tested in the chamber, the receiver on this board can be used for comparison (and vice versa).

☐ Begin Cold Chamber Test

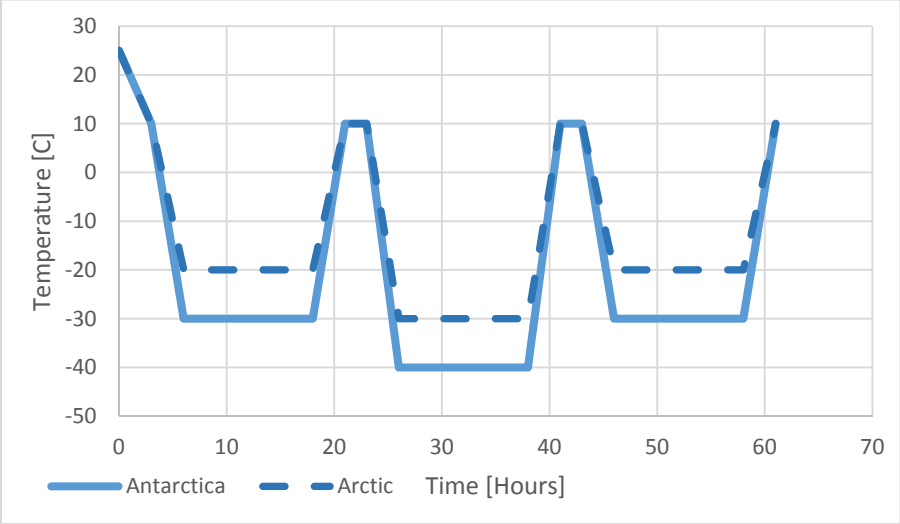
Cold test involves cycles between +10C and two cold temperatures, CT1 and CT2. 58 hours total. It is ideal to begin the cold test in the morning hours, before noon. This way the cold cycles will generally coincide with daylight hours, so regulators are charging the battery while coldest.

First cycle:
Ramp from +10^{0}C to CT1 over 3 hours.
Dwell at CT1 for 12 hours.
Ramp up to +10^{0}C over 3 hours.
Dwell at +10^{0}C for 2 hours.

Second cycle:
Repeat, except cycle to CT2.

Third cycle:
Repeat, except cycle to CT1. No 2-hour dwell at +10^{0}C at end of test.

CT1 (-30^{0}C typ. for Antarctica, -20^{0}C typ. for Greenland): _____
CT2 (-40^{0}C typ. for Antarctica, -30^{0}C typ. for Greenland): _____



☐ Verify system logging GPS data, and modem connecting

Date/Time (UTC) cold chamber started: _____
Date/Time (UTC) cold chamber stopped: _____

☐ 24 hour QC test with comparison receiver

Produce QC reports using TEQC (Appendix 4). If both the test and comparison receivers are downloaded to Skua (with site names TSXX, where 0 < XX < 30), QC plots will automatically be generated by the UNAVCO archive.

Both receivers should have 100% complete observations, similar numbers of IOD or MP slips, similar Obs/slip (usually > 2000), zero clock drift, and similar S/N values from 10°-90° (usually > 40 for L1 and > 22 for L2).

Parameter	This receiver	Comparison receiver
Receiver Name or UID	_____	_____
Possible Obs. > 10^0	_____	_____
Complete Obs. > 10^0	_____	_____
IOD or MP slips > 10^0	_____	_____
Obs. / Slip (o/slps)	_____	_____
Clock Drift	_____	_____
L1 S/N Ration 10^0 – 90^0	_____	_____
L2 S/N Ration 10^0 – 90^0	_____	_____

Attach 24hr QC plot to this log sheet.

UTC Date of 24hr QA/QC test: _____

☐ GPS Receiver Cold Performance

Check the daily QC reports for each day of the cold test. The QC graphs should look normal. The receiver should have 100% complete observations, high Obs./slip >10° (usually > 2000), zero clock drift, and normal S/N values from 10°-90° (usually > 40 for L1 and > 22 for L2).

UTC	QC Plot	S/N L1 (10^0 – 90^0)	S/N L2 (10^0 – 90^0)	Obs./Slip	Clock Drift	Possible Obs.	Complete Obs.
	☐						
	☐						
	☐						
	☐						

GPS Receiver Operation Notes

_____
_____
_____
_____
_____
_____
_____

☐ Dial-up Iridium Modem(s)

If modem did not run continuously at low temperature:

What temp did Iridium stop working? _____
What temp did Iridium start working again? _____

Must have > 85% call connection success rate, with call answered, PPP session established, and state of health data retrieved.

Primary Modem

Successful calls PPP established	Call answered but failed to setup PPP	[% PPP failure] / [% PPP failure + PPP success]

Secondary Modem

Successful calls PPP established	Call answered but failed to setup PPP	[% PPP failure] / [% PPP failure + PPP success]

Iridium Operation Notes:

_____
_____
_____
_____

☐ Xeos Iridium Modem

If modem did not run continuously at low temperature:

What temp did Iridium stop working? _____
What temp did Iridium start working again? _____

Calculate average interval between Auto RUDICS connections. Based on past experience, should be roughly 20-25 minutes (if 10-minute Auto RUDICS interval used and timer set to ON 180 / OFF 60).

[avg interval] = [cold test duration in hours] * [60 minutes] / [number of connections]

Successful Connections	Test Duration (min)	Average Interval

Iridium Operation Notes:

_____
_____
_____
_____

☐ Radio Modem

If modem did not run continuously at low temperature:

What temp did Iridium stop working? _____
What temp did Iridium start working again? _____

Calculate average interval between radio connections. Should be roughly 15 minutes (if 10-minute query/download interval used, and timer set to ON 180 / OFF 60).

[avg interval] = [cold test duration in hours] * [60 minutes] / [number of connections]

Successful Connections	Test Duration (min)	Average Interval

Radio Operation Notes:

_____
_____
_____
_____

☐ Timer(s)

Verify continuous operation with regular modem power cycles during cold test. See output files from Campbell data logger.

Timer(s) Operation Notes:

_____
_____
_____
_____

☐ Solar Charge Controller

Maintains battery charge, with maximum charge voltage within acceptable levels during cold cycles. See output files from *Campbell* data logger.

Accounting for the short-duration voltage overshoot seen when the *FlexCharge* solar regulator charges a cold, full battery with full solar panel power, maximum allowable charge levels are:

Maximum peak charge voltage value at -40^{0}C = 15.45V
Maximum peak charge voltage value at -30^{0}C = 15.40V
Maximum peak charge voltage value at -20^{0}C = 15.25V

Solar regulator peak voltage at CT1: _____
Solar regulator peak voltage at CT2: _____

Solar Charge Operation Notes:

_____
_____
_____
_____

☐ Wind Charge Controller

Maintains battery charge, with maximum charge voltage within acceptable levels during cold cycles. See output files from Campbell data logger.

Accounting for the short-duration voltage overshoot seen when the *FlexCharge* wind regulator charges a cold, full battery with full solar panel power, maximum allowable charge levels are:

Maximum peak charge voltage value at -40^{0}C = 15.85V
Maximum peak charge voltage value at -30^{0}C = 15.80V
Maximum peak charge voltage value at -20^{0}C = 15.65V

Wind regulator peak voltage at CT1: _____
Wind regulator peak voltage at CT2: _____

Wind Charge Operation Notes:

_____
_____
_____
_____

LONG-TERM BURN-IN TEST

Run entire *CGPS* system for one week on the *UNAVCO* roof as follows.

☐ Install the electronics board inside one of the gray enclosures with power from one 100AH battery and one solar panel.

☐ Connect the board to the *Campbell CR300* data logger system. Verify the *Freewave* radio is powered and telemetering data back to the radio connected to the cold chamber computer.

Notes on the *Campbell* Data logger

A *Campbell CR300* data logger is installed in one of the gray enclosures, with cabling connected to the other gray enclosure. It records data from up to four separate boards. It also alternates delivery of solar panel power to the solar and wind circuits every 2 hours.

Data is transmitted to the computer near the cold chamber by a pair of *Freewave* serial radios.

☐ Create a new test directory for the board on the computer. Rename the appropriate Table filenames on the *Campbell Loggernet* software. Make sure all of the voltages displayed by the *CR300* are within reasonable values.

☐ Set the modem timer(s) to the actual settings to be used in the field. Typically 1000 min on / 10 min off for single-modem sites, 1000 min on / 1000 min off for dual modem sites.

Primary timer ON/ OFF settings: _____
Secondary timer ON/OFF settings: _____

☐ Connect new GPS antenna, radome, and antenna cable that will be fielded.

Note: if testing electronics board only, can use existing *GPS* antenna/cable on roof.

☐ Connect Iridium antenna and cable that will be fielded.

Note: if testing electronics board only, can use existing Iridium antenna/cable on roof.

☐ Connect new weather station and cable that will be fielded.

Note: if testing electronics board only, not necessary to attach weather station.

☐ Set up the download system to retrieve *SOH* and *GPS* data from this system (Appendix 5).

For XI-100: *Auto-RUDICS* interval (10 minutes typ.): _____

For radio: query/download interval (10 minutes typ.): _____

☐ Verify system logging *GPS* data, and modem connecting

Date/Time (UTC) burn-in test started: _____
Date/Time (UTC) burn-in test stopped: _____

☐ *GPS* receiver and antenna performance

Check the daily QC reports for each day of the burn-in test. The QC graphs should look normal. The receiver should have 100% complete observations, high Obs/slip >10° (usually > 2000), zero clock drift, and normal S/N values from 10°-90° (usually > 40 for L1 and > 22 for L2).

UTC	QC Plot	S/N L1 (10^0 – 90^0)	S/N L2 (10^0 – 90^0)	Obs./Slip	Clock Drift	Possible Obs.	Complete Obs.
	☐						
	☐						
	☐						
	☐						
	☐						
	☐						
	☐						
	☐						

GPS Receiver Operation Notes

_____
_____
_____
_____
_____
_____
_____

☐ Dial-up Iridium Modem(s)

Must have > 85% call connection success rate, with call answered, PPP session established, and state of health data retrieved.

Primary Modem

Successful calls PPP established	Call answered but failed to setup PPP	[% PPP failure] / [% PPP failure + PPP success]

Secondary Modem

Successful calls PPP established	Call answered but failed to setup PPP	[% PPP failure] / [% PPP failure + PPP success]

Iridium Operation Notes:

_____
_____
_____
_____

☐ Xeos Iridium Modem

Calculate average interval between Auto RUDICS connections. Based on past experience, should be roughly 20-25 minutes (if 10-minute Auto RUDICS interval used and timer set to ON 180 / OFF 60).

[avg interval] = [cold test duration in hours] * [60 minutes] / [number of connections]

Successful Connections	Test Duration (min)	Average Interval

Iridium Operation Notes:

_____
_____
_____
_____

☐ Radio Modem

Calculate average interval between radio connections. Should be roughly 15 minutes (if 10-minute query/download interval used, and timer set to ON 180 / OFF 60).

[avg interval] = [cold test duration in hours] * [60 minutes] / [number of connections]

Successful Connections	Test Duration (min)	Average Interval

Radio Operation Notes:

_____
_____
_____
_____

☐ Timer(s)

Verify continuous operation with regular modem power cycles during burn-in test. See output files from *Campbell* data logger.

Timer(s) Operation Notes:

_____
_____
_____
_____

☐ Solar Charge Controller

Maintains battery charge, with maximum charge voltage within acceptable levels corresponding to temperature inside box. See output files from *Campbell* data logger.

Solar regulator peak voltage: _____

Solar Charge Operation Notes:

_____
_____
_____
_____

☐ Wind Charge Controller

Maintains battery charge, with maximum charge voltage within acceptable levels corresponding to temperature inside box. See output files from *Campbell* data logger.

Wind regulator peak voltage: _____

Wind Charge Operation Notes:

_____
_____
_____
_____

☐ Weather Station

Review RINEX met files, which will be automatically produced by the archiving process and made available on the UNAVCO FTP server. Continuous operation during burn-in test, and reasonable values for pressure, temperature, humidity, wind speed, wind direction.

Weather Station Operation Notes

_____
_____
_____
_____