

# Auto-pRES Manual

Version	Date	Revisions
Version 100.0	06-10-2014	New version for RMB2 + VAB Issue C

## *Requirements*

- Computer with Ethernet port and web browser
- Radar unit (ApRES)
- Power cable
- Battery or PSU (6-13V, 1.5 Amp maximum drain)
- Ethernet cable
- 1 or 2 SD-cards (minimum of 1) + card reader.
- Antenna cable x2
- Antenna x2

If data processing is to be undertaken in the field, a copy of Matlab, and the Signal Processing Toolbox will be required on the PC to run the processing scripts. If calculation of vertical strain rates or melt rates is required in the field, the Statistics Toolbox will also be needed on the PC. As at this stage in the development updates to the radar control software are likely to be needed, it will be important to have the supplied serial interface cable etc (see below) and a copy of the Venom IDE (Integrated Development Environment) installed on the PC.

If leaving the instrument in unattended mode, over the winter, for example, a few other items are required:

- Antenna mast (eg, 4-m glacio-pole)
- Iridium+GPS antenna bracket
- GPS antenna and cable, and, if Iridium comms are to be used, Iridium antenna and cable.
- Hose clips or equivalent to attach the antenna bracket to the pole
- Cable ties to tidy up the GPS and Iridium cables
- A small sheet of plywood: the instrument should be buried to a depth that will prevent the temperature it experiences dropping below  $-40^{\circ}\text{C}$ . It would be wise to take a small sheet of plywood or equivalent to cover the instrument before re-filling the hole with snow.
- Some way of marking the site (bamboos with large flags).

**A note about SD cards.** The system has been tested with cards up to 16GB. We have had problems with Transcend 16GB cards, and therefore recommend avoiding them. SanDisk Extreme Pro seem to work well, but are rated only to  $-25^{\circ}\text{C}$  – fine for most summer use and we have used them successfully to  $-40^{\circ}\text{C}$ . Panasonic make a  $-40^{\circ}\text{C}$ , 16GB card, which is relatively slow, but good value. High speed cards are not required for this application. The cards need to be formatted as FAT32.

## *Overview*

The instrument has two modes of operation: Attended Mode and Unattended Mode. On power-up, the configuration file (config.ini) is read from the SD card in Slot 1 (the slot nearest the USB connector on the controller board) and the Ethernet link is tested. If the Ethernet is active (ie a powered-up PC is connected), or if the config.ini file indicates to do so, the radar enters Attended Mode, and will remain in that mode until the power is cycled (or, equivalently, the reset button on

the controller board is pressed), when the config file will be re-read and the Ethernet link tested again. Attended Mode would be used for initially setting up Unattended operation, or for using the radar as a survey instrument – moving from one location to another to obtain measurements from a series of points, to be repeated at some time in the future.

Unattended Mode is entered if no Ethernet link is detected and if the config file is not set to send the radar to Attended mode. In this case all the details of the radar's configuration are determined by the contents of the config file. Initially running in Attended Mode allows the operator to determine the correct settings to be placed in the config file for future Unattended operation. When running in Attended Mode, the config.ini file is used to set the initial radar parameters, some of which can be overwritten from the connected PC.

In Attended Mode, the PC needs no software other than a browser. In that mode, the radar is configured as a webserver.

An Iridium modem can be used in Unattended Mode to allow periodic transfer of a small amount of data and housekeeping information. It can also be used to reconfigure the instrument remotely. The Iridium transceiver has an external antenna that is mounted on a bracket

A GPS receiver is used in both Attended and Unattended Mode to provide an accurate time, and also location information that is used to provide metadata in the Attended Mode data file. Location information is included in Iridium messages. In Attended Mode an internal antenna can be used. For Unattended Mode, an external antenna is mounted on the antenna bracket, beside the Iridium antenna mount.

### ***ApRES radar operation***

The radar transmits a tone that has a nominally constant amplitude (a nominal power of 20dBm, or 100 mW), but whose frequency ramps linearly from 200MHz to 400MHz over a 1-second interval. This is a single chirp. The chirp received from a reflector arrives a short time later, and so is always at frequency slightly lower than the tone presently being transmitted, the difference in frequency being linearly dependent on the range of the target.

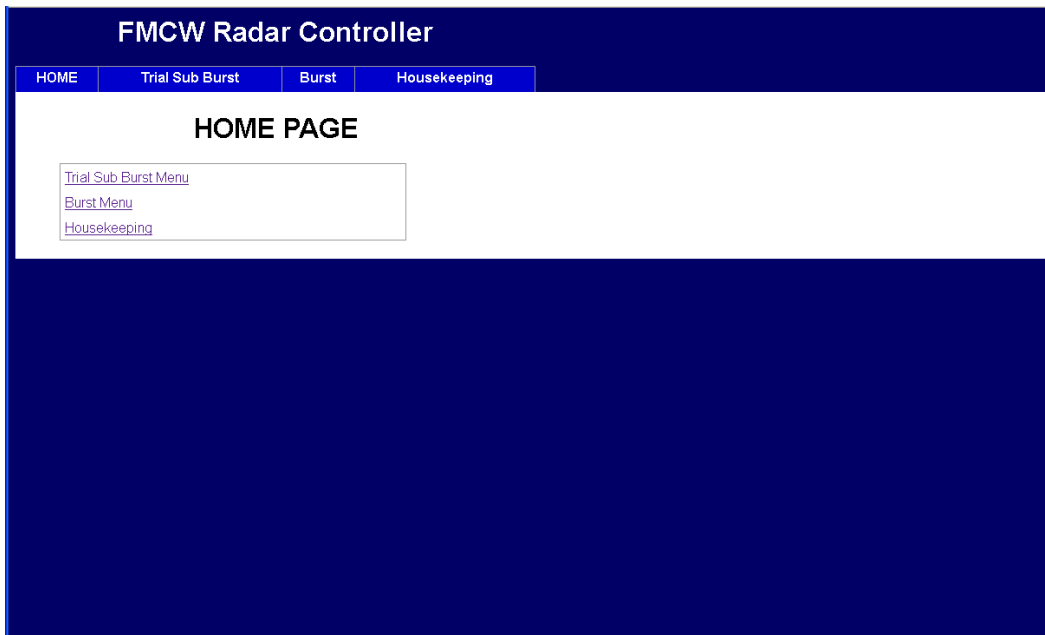
Mixing the received signal with the transmitted signal generates sum and difference frequencies, and the difference frequency (anything from 0 to a few kHz) can be selected by an appropriate filter and recorded. Calculating the spectrum of that signal then gives the standard "A-scope" display.

In the case of ApRES, the phase of the transmitted tone is carefully defined, and by tracking the phase through the processing it is possible to process the data using phase-sensitive techniques.

The output power of the radar is fixed, but an attenuator in the receiver chain and an adjustable gain amplifier in the low frequency "de-ramped" signal can both be adjusted to ensure that a sufficiently strong signal is being recorded, without overloading any of the circuitry. Up to four different attenuation levels can be used in sequence, with the radar automatically cycling through the settings. So if 60 chirps were to be recorded, 15 could be acquired using each of four different combinations of attenuators. In the case of four different settings, that would give a "sub-burst" that was four chirps long. When specifying the number of chirps to be recorded, the operator actually specifies the number of sub-bursts. If only one attenuator setting is used, a sub-burst is equivalent to a chirp.

### ***Attended Mode***

Connect the Ethernet cable to a computer.



Insert an SD card in the Primary SD card slot (the slot nearest the USB port on the VAB – see photograph). In fact, it's not important which slot is used, but making a habit of using the Primary is good practice. When two cards are present, the Primary slot is checked first for a config file, which is copied to the Secondary card, overwriting any config file present.

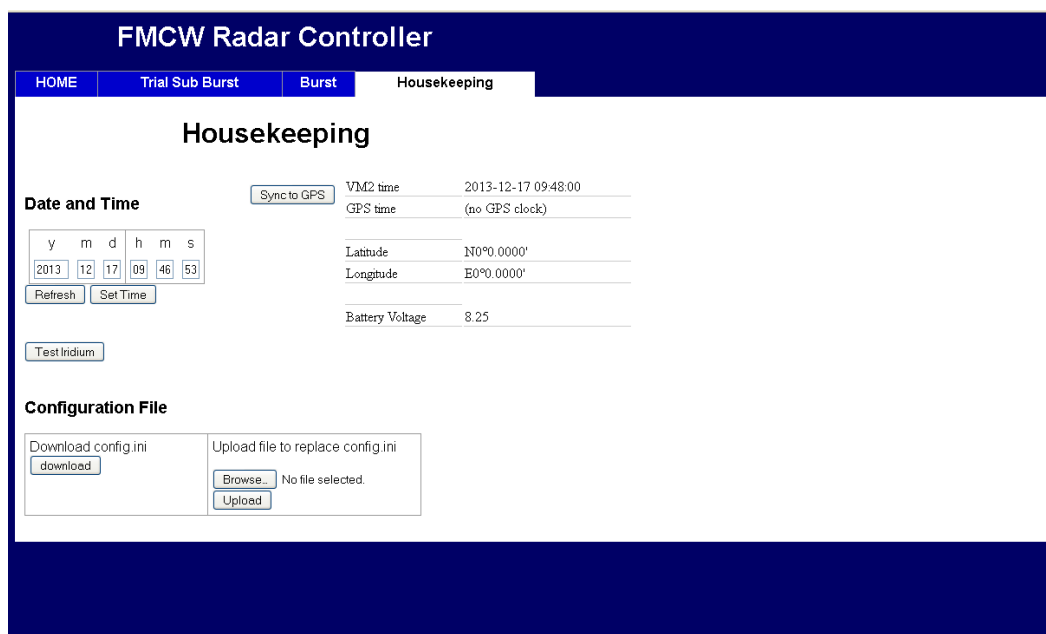
Connect the antennas

Ensure the PC is powered-up, then switch on the radar.

Start a browser on the PC

Navigate to *radar.localnet*. At this point the radar will be functioning as a web server, and the radar controller screen should be displayed. If the browser has problems resolving the name, and all else has failed, then the PC can be set up with a fixed IP address of 192.168.1.1.

Click <Housekeeping> and check the radar's clock. This can be set manually or, if a GPS antenna is connected and has found a satellite, it can be synced to the GPS time. This screen refreshes every 2 seconds. If the GPS fix is good enough, a location will also be displayed.

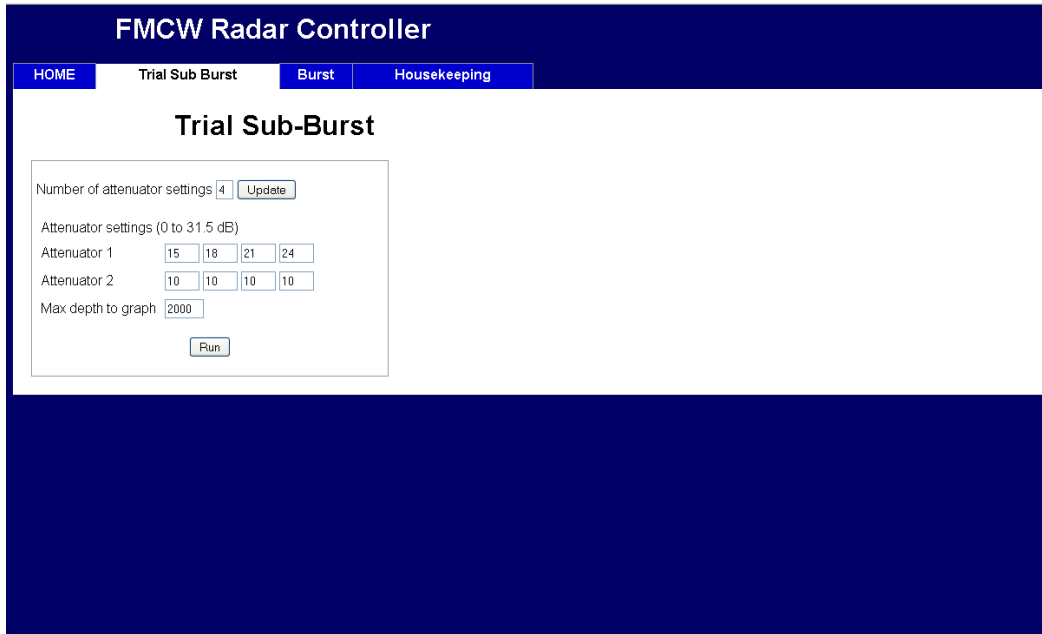


The battery voltage is also displayed.

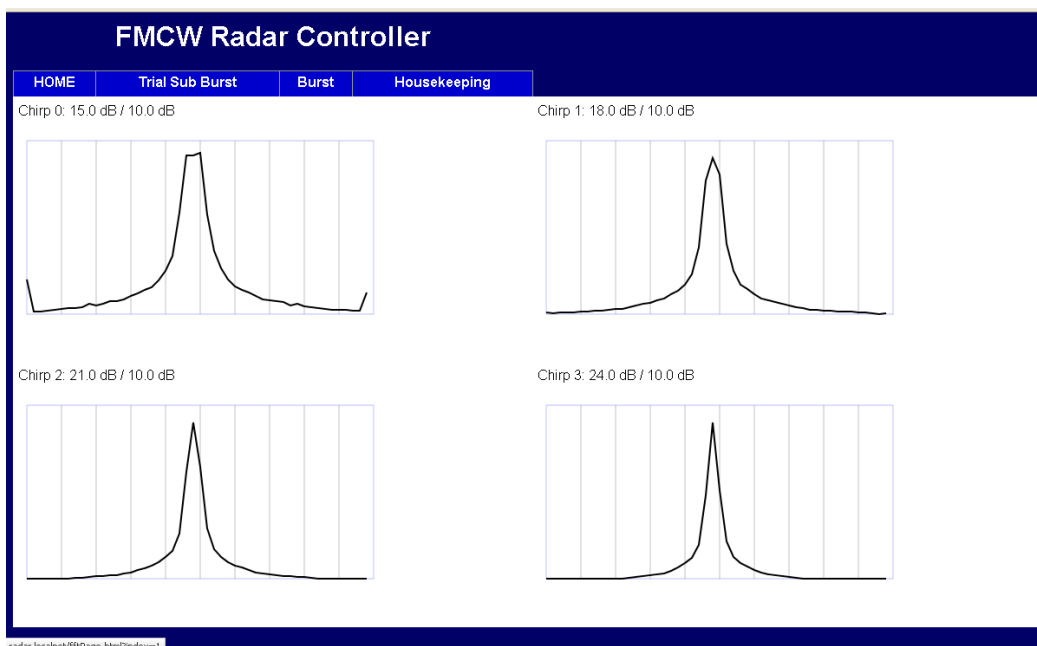
From this screen the config.ini file, if it exists, can be downloaded from the SD card. A new config.ini file can be uploaded to the SD card, overwriting any existing version.

There is also a Test Iridium button. See Iridium Communications section below for details.

Before recording a full burst of data it is necessary to check the attenuator levels by doing a "trial sub-burst".



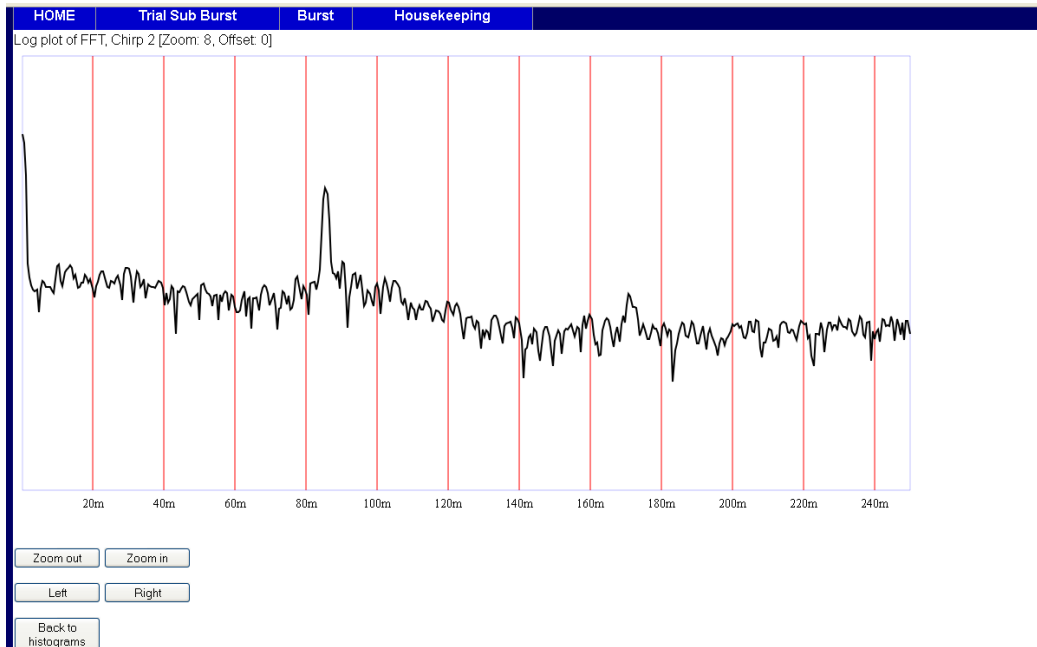
Click <Trial Sub-Burst>, and then select the number of attenuator settings that you wish to try (1 to 4), followed by <update>. Fill out the attenuation values – see the later section discussing criteria for the selection. Click <Test>. The PLL light on the side of the instrument will light while the various chirps are being performed (up to 4). Four histogram panels will be displayed. The histogram will indicate the dynamic range of the analogue to digital converter (ADC) that is being occupied by the signal. For example, if the signal is spending most of the time hard up against the positive and negative limits (ie, the ADC is clipping the signal), then the histogram will begin to develop a "W-shaped" character. If it's spending all its time around zero volts, then there will be a very narrow sharp peak at the centre of the histogram. Ideally, the graph would show a gentle bell shape, with



radar.localnet/fftPage.htm?index=1

no turning up at the upper or lower extremes.

Click on the histogram with optimal characteristics, and wait until the browser displays a range plot of the chirp. The plot can be zoomed and panned using the buttons at the bottom of the screen. The maximum (default) depth for this plot was set on the Trial Sub-Burst page.



When satisfied with the attenuator selection, navigate to the Burst page and set up the required attenuator settings and the number of sub-bursts required, and then click <run>. Remember that the total number of chirps acquired is given by (number of attenuator settings selected) x (number of sub-bursts). So, if two attenuator settings have been selected, and 100 sub-bursts have been requested, the total time for the burst will be 2 x 100 x 1.2 seconds, or around four minutes. In a typical ice shelf situation, with a few hundreds of metres of ice, a single attenuator setting with 20 or so sub-bursts should be more than adequate for getting melt rates, taking less than a minute in total. During the burst, a progress screen is displayed with the chirp count. This screen updates every 2 seconds.

FMCW Radar Controller

HOME Trial Sub Burst **Burst** Housekeeping

**Burst**

Number of sub-bursts

Number of attenuator settings

Attenuator 1

Attenuator 2

Data file name

After the burst is complete, the data file will be downloaded via the browser to the computer's filing system. A copy is retained on the SD card, under a sub-directory named "survey". If a failure occurs during download, the copy will have already been safely stored on the SD card during burst acquisition. Data from Trial Sub-Bursts are discarded.

## ***Unattended Mode***

Typically, a period of unattended operation would be preceded by a quick check in attended mode to ensure that the attenuators were appropriately configured, the clock set, and that the radar was working properly. The config.ini file can at this point be downloaded into a text editor, modified to suit the desired settings, and then uploaded onto the SD card. The radar should then be switched off, the Ethernet cable disconnected, and the instrument then turned on again, when it will start up in unattended mode. The operation of the instrument is then determined by the contents of the config.ini file.

The contents of an example file are copied below, followed by a discussion of the various elements which effectively covers unattended operations.

```
; Configuration file for FMCW radar
; *****
;
; Always start the Web Server (ie always go into Attended Mode), regardless
; of an active Ethernet connection. Default 0.
;
AlwaysAttended=1
;
; Check for an Ethernet connection on power-up (1=yes; 0=no)
; Default=1
;
CheckEthernet=1
;
; Number of sub-bursts in a burst (>=0)
; Default=10
;
NSubBursts=20
;
; Are all the chirps from this burst to be stored individually (0),
; averaged (1) or stacked (2) (Should not be used if nAttenuators>1 or
; if using in MIMO mode)
;
Average=0
;
; Burst repetition period (integer seconds) (>0). Interpretation depends
; on IntervalMode. If IntervalMode = 0 (default), RepSecs is time from
; start of one burst to the start of the next. If IntervalMode = 1,
; RepSecs is interval between end of one burst and start of next.
;
RepSecs=60
IntervalMode=0
;
; Number of samples per burst (>=20000)
; Default=60,000
;
N_ADC_SAMPLES=60000
;
; Maximum length of data file before another one started (>=1,000,000)
; Default=10,000,000
;
MAX_DATA_FILE_LENGTH=10000000
;
; Whether a logging file is to be maintained (default = no (0)).
;
LOGON=0
;
; WatchDog task behaviour. Time in seconds of operation after which;
```

```

; radar will be reset. Assumption is that a fault has occurred if radar
; is active for longer than this time. Watchdog does not operate in
; attended mode. If Watchdog time is set to 0, then the default of 3600
; seconds is used. If set to -1, then Watchdog task is disabled.
;
WATCHDOG_TASK_SECS=3600
;
; In unattended mode, does the radar sleep between bursts (default, 0),
; or does it wait (1). In the sleep case the system is powered down
; between bursts and draws a low current (<200uA). Otherwise system
; remains powered and draws ~1 Amp.
;
SleepMode=0
;
; Activate the GPS receiver each burst? (Default off)
GPSON=0
;
; Undertake daily housekeeping (GPS clock check, Iridium exchange and
; memory card check? (1 = yes, 0 = no)
;
Housekeeping=1
;
; If GPS fix obtained during daily housekeeping, synchronise radar clock
; to GPS time (only if Housekeeping=1)? (1 = yes, 0 = no)
;
SyncGPS=1
;
; If Housekeeping=1, is Iridium messaging enabled? (1 = yes, 0 = no)
; Default = 0
;
Iridium=1
;
; Number of combinations of attenuator settings to be used
nAttenuators=1
;
; Attenuator setting sequences for attenuator 1 (dB) (>0, <=31.5)
; Defaults=30dB.
;
Attenuator1=20,0,0,0
;
; Gain setting for deramp (AF, or audio frequency) amplifier
;
AFGain=10,0,0,0
;
; When used in attended mode, and doing a Trial Sub-Burst, the maximum
; depth that is displayed on the FFT (A-scope) display. This can be
; overwritten from the browser
;
maxDepthToGraph=500
;
; Which Rx and Tx antenna ports are to be used by the radar.
; Only relevant if using the instrument in MIMO mode. The default
; is port 1 for both.
;
RxAnt=1,0,0,0,0,0,0,0
TxAnt=1,0,0,0,0,0,0,0
;
; Whether (1) or not (default:0) the option to change antenna ports is
; available in the Burst and Trial Sub-Burst pages on the browser. Note
; that this does NOT affect the operation of the radar, just the
; availability of the fields in the browser.
;
ANTENNA_SELECT=0
;
; Very much for the advanced user. The DDS programming strings.
; These strings are set by defaults in the instrument and, like the
; rest of the parameters in the config file, do not need to be set here.
; They are included for completeness. See main text.
;

```

```

;Reg00="00000008"
;Reg01="000C0820"
;Reg02="0D1F41C8"
;Reg0B="6666666633333333"
;Reg0C="0000431C0000431C"
;Reg0D="13881388"
;Reg0E="08B500004CCCCCD"
;
; End of configuration file
; *****

```

Some additional notes on the various parameters in the config file:

**AlwaysAttended:** If set to one, this switch causes the web browser to be launched whether or not an active Ethernet port is detected.

**CheckEthernet:** If set to zero, the Ethernet port is not checked on power-up. This defaults to one. Probably best left that way.

**GPSON:** Defaults to zero. If set to one, each time a burst is initiated, the GPS module is activated and if a fix is obtained the GPS location, GPS time and the radar's system time are stored in the data header for the burst on the SD card. Should be set to zero if no GPS antenna is connected, or if there is some other reason to think a fix will not be obtained.

**RepSecs:** If IntervalMode = 0, ensure that the repetition interval is greater than the length of time for the acquisition of an entire burst. If it is shorter, then the radar will continue with an uninterrupted series of bursts, and it is likely that it will not be possible to switch off the unit without losing the final open data file. To estimate the length of the burst, assume that there will be at least 10 seconds of overheads associated with starting up the radar. So the total time =  $nSubBursts * nAttenuators + 10$  seconds. Setting IntervalMode to 1 means that a RepSecs-long delay will be implemented between bursts.

If the total time for a burst lasts longer than the Watchdog timeout interval, which defaults to 3600 seconds, the system will automatically reset itself. This would effectively limit the number of chirps per burst to around 2180. Note that the Watchdog Timer timeout can be adjusted with the WATCHDOC\_TASK\_SECS value, and that the Watchdog is disabled during Attended Mode operation.

**N\_ADC\_SAMPLES:** determines the number of samples per chirp recorded by ADC. This should be set to 40,001 (40kHz x 1 second chirp + 1). Advanced users might want to change it if they are reprogramming the DDS characteristics.

**MAX\_DATA\_FILE\_LENGTH:** Before each burst is recorded then length of the file is checked and, if greater than **MAX\_DATA\_FILE\_LENGTH**, a new file is started. Very large data files should be avoided for two reasons: if for some reason the file is corrupted, fewer bursts will be lost if the file is shorted; and very long files incur time overheads that can run to many seconds while the file is opened and the end of file is found. Very short files are fine, but there will be a lot of them. Each time unattended operation is initiated a new subdirectory is created on the card to hold the files associated with the sequence of bursts.

**Average:** default of 0 means that all chirps are recorded as 2-byte unsigned numbers. If set to 1, all chirps from each burst are averaged and stored in the same format. If set to 2, all chirps from each burst are stacked (summed) and stored as a 4-byte unsigned integer.

**nAttenuators:** this actually means the number of attenuator settings to be used, that is, the number of chirps in a sub-burst (assuming not in MIMO mode – see below). If averaging is enabled (**Average**  $\neq$  0), all chirps in a burst are averaged together. Averaging should not be used when multiple attenuator settings are used.

**Attenuator1:** The values, in dB, for each of up to four settings for the attenuator. Only the first **nAttenuators** values will be used.



**AFGain:** The values, in dB, for up to four settings for the gain in the deramp amplifier. Only the first *nAttenuators* values will be used. Values are either -6, 0 or +6 dB.

**RxAnt** and **TxAnt:** These are lists of 8 elements, each set to 0 or 1. They indicate which Tx Rx ports are active, and these lists are only relevant if the system is being used in imaging (MIMO) mode, that is, if multiple Tx and Rx antennas are connected. For each port Tx port set to '1', a chirp will be transmitted from that port and received on each enabled Rx port (each Rx port set to 1). All of this happens sequentially, so that each enabled Tx port transmits as many chirps as there are enabled Rx ports. It is important to remember that, if *nAttenuators* is set to 2, 3 or 4 (ie, each subburst comprises more than one chirp) this sequence of attenuator settings will be applied to each Tx-Rx pair in turn. So, if *nAttenuators*=4, and 8 Tx ports are enabled, and 8 Rx ports are enabled, each subburst will have a total of  $8*8*4=256$  chirps. It is also important to remember that the use of averaging or stacking (*Average*  $\neq$  0) will cause all of the chirps in a burst to be combined, so all imaging information will be lost.

**LOGON:** Set to 1 to enable the writing of a log file. This is a text file called Log.txt that will be created and maintained on both SD cards. It records the operation of the radar.

**SleepMode:** Set to 0 by default. This will cause the instrument to power down to minimal current draw between bursts. If set to 1, the instrument will not power down between bursts. This is useful to avoid any warm-up artefacts at the start of each burst to maximise precision, but unfeasible for long term deployments. This has no effect during Attended mode. A difficulty is that the PLL light will not be extinguished between bursts, and there is a danger that the radar will be switched off during a burst and the final data file might be corrupted.

**Housekeeping:** Relevant only in Unattended mode. Set to 0 by default. If set to 1, daily housekeeping activities will take place at the end of the first burst after midnight. Iridium communications will be attempted (see below), and the SD cards will be checked and any detected errors will be repaired.

**GPSSync:** Relevant only if housekeeping is enabled. Default 0. If set to 1, during housekeeping activities the radar's internal real-time clock will be synchronised with a valid GPS time.

**Iridium:** Relevant only if housekeeping is enabled. Default 1. If set to 1, an exchange of Iridium SBD messages is attempted during housekeeping activities.

**ANTENNA\_SELECT:** Relevant only in Attended mode. Default 0. If set to 1, the option to select Rx and Tx antenna ports will be available from the Trial Sub-Burst and Burst pages in the browser. Useful for testing during MIMO operation. Has no effect on MIMO operation when running unattended.

**Reg00** to **Reg0E:** These define the nature of the chirp transmitted by the radar. A Matlab tool is available that will allow the chirp properties to be changed. The tool appends the relevant lines to the end of a config.ini file. Those lines are then used on power-up to overwrite the default chirp configuration.

Once the radar has been switched on in unattended mode, there will be a delay of a few seconds, and then the PLL light will come on, indicating that the first burst is underway. When recovering a radar that had been deployed in unattended mode, if a burst is underway wait until the burst has finished and the PLL light is extinguished before switching the system off. This should remove the risk of damage to the final data file.

Note that the format of the active (non-comment) lines in the config.ini file must remain exactly as given above, although the capitalisation of the parameter names is not significant.

## **Data file format**

The data files consist of a series of bursts, each burst comprising a burst header in ASCII, and a sequence of sub-bursts, in binary, each sub-burst consisting of *nAttenuators* chirps. The chirps have no individual header, which means that if there are more than one chirp in a sub-burst, the value

of the attenuator settings cycles through the values in the configuration information, that is, the values in the config.ini file, updated by an ir\_config.ini file, should it exist on the SD card. As an ASCII sequence, the burst header can be read in a text editor and has the following format:

```

*** Burst Header ***
Time stamp=2014-10-06 08:43:52
RMB_Issue=2b
VAB_Issue=C
SW_Issue=101
Venom_Issue=20141002
AlwaysAttended=0
NSubBursts=1
Average=0
RepSecs=10
CheckEthernet=1
N_ADC_SAMPLES=40001
MAX_DATA_FILE_LENGTH=10000000
ANTENNA_SELECT=0
nAttenuators=1
Housekeeping=0
GPSon=1
SyncGPS=0
Iridium=1
WATCHDOG_TASK_SECS=-1
IntervalMode=1
Attenuator1=20,0,0,0
AFGain=-6,0,0,0
TxAnt=1,0,0,0,0,0,0,0
RxAnt=1,0,0,0,0,0,0,0
maxDepthToGraph=500
SleepMode=0
LogOn=1
Reg00="00000008"
Reg01="000C0820"
Reg02="0D1F41C8"
Reg0B="6666666633333333"
Reg0C="000053E3000053E3"
Reg0D="186A186A"
Reg0E="08B5000000000000"
Latitude=0.
Longitude=0.
GPS_Time=0
VM2_Time=0
Temp1=20.8437
Temp2=21.0312
BatteryVoltage=6.543

*** End Header ***

```

The Tx and Rx Antenna select lines define which antenna ports are used and are important if the radar is operated in imaging mode (multiple antennas).

### ***Attenuator settings***

The first stage in deciding attenuator settings is to ensure that the ADC is not clipping, as described in the "Attended Mode" section above. The next stage is to ensure that no component in the receiver chain is near to saturation, and this is most likely to be caused by direct breakthrough between the TX to the Rx antennas, which will feature as high amplitude, short range signals.

For the skeleton slot antennas, the expected breakthrough would require a minimum attenuation of 10dB in attenuator 1; the remaining required attenuation can be split between the two attenuators.

## ***Iridium communications***

An Iridium modem is incorporated in the radar system. At the end of the first burst that finishes after midnight, a set of daily housekeeping tasks are performed, assuming the housekeeping tasks have been enabled in the config.ini file (*Housekeeping=1*).

First, the GPS receiver is activated and a period of up to three minutes is allowed to obtain a fix. If a GPS time has been acquired, the radar's internal clock is optionally synchronised with the GPS time, depending on the setting of *SyncGPS* in the config.ini file.

A message is assembled to be sent via Iridium. The message contains the following basic housekeeping data:

- Latitude, integer 1/10000ths of a degree (4 bytes);
- Longitude, integer 1/10000ths of a degree (4 bytes);
- The radar's time stamp, integer seconds since 0000 01/01/1990 (4 bytes);
- Temperature 1, integer 1/100ths of a degree C (2 bytes);
- Temperature 2, integer 1/100ths of a degree C (2 bytes);
- Free space available on the master SD card in kB, -1 if card cannot be detected (4 bytes);
- Free space available on the secondary SD card in kB, -1 if card cannot be detected (4 bytes);
- Battery voltage in integer 1/100ths of a Volt (2 bytes);
- 50-element histogram from a chirp **using the first pair of attenuator settings** (50 x 1 byte).

The byte order is little-endian.

The message is sent, and any waiting configuration messages that have been sent by the user are uploaded. The radar's present configuration data are overwritten with the new configuration. Although the config.ini file remains unmodified, a new file is created, or over-written if it already exists, called ir\_config.ini. This contains the updated configuration information. In the event of a restart, either attended or unattended, the ir\_config.ini file, if it exists, will supply the configuration.

To send new configuration information to the radar an email is sent to [data@sbd.iridium.com](mailto:data@sbd.iridium.com), with the subject containing the radar's Iridium modem IMEI number (eg. 300234010700342). The email message has no body, but contains base-64 format attachment with the new configuration data. The attachment takes the form of a config.ini file, with all the rules associated with config.ini files, plus the additional constraint that it can have a maximum length of 270 bytes.

If an Iridium configuration update message is received by the radar, it will, at the end of the SBD exchange, send another message containing the updated configuration. This acts as confirmation that the update has been received and actioned.

Note that setting the Housekeeping or iridium flags to zero will have the effect of permanently disabling communications.

If a sequence of configuration messages have been sent to the radar, these will reside in a queue within the Iridium system. If a message in the queue reaches an age of five days, the system deletes all the queued messages. If the radar is able to contact the system this should never happen. The radar's housekeeping process will continue to read queued messages until the queue is empty. Each configuration message will result in an update to ir\_config.ini, and a response SBD message confirming the updated configuration.

To test if the Iridium communications are working correctly a Test Iridium button is available on the Housekeeping page when using Attended Mode. Pressing the button results in the radar attempting to send an SBD message to the Iridium system. Text will appear beneath the button giving the result of the test: either a successful transmission, or a failed transmission. If the transmission failed, the radar will have made three attempts. The third possible response is a failed to communicate with the Iridium modem, which implies a hardware failure in the Radar controller (Modem missing, for example). The timeout on each attempt is 20 seconds, so the process can take up to 1 minute. If successful, a message saying "Hello" will have been transferred via the Iridium system.

## ***More on configuration files***

So there are two types of configuration files, one named config.ini, the other ir\_config.ini, and there are two possible SD cards, if they are both installed and working. When the system powers up, the Primary slot is checked to see if a working SD card is present. If one is present, that card is checked to see if an ir\_config.ini is in the root directory. If so, then that configuration is used for the radar, and the ir\_config.ini is copied to the other card, if it is present. If the ir\_config.ini is not present, a config.ini is sought on the Primary SD card, and used for the configuration, and again copied to the other card. If a config.ini is not found on the Primary SD card, then the other card is checked, first for an ir\_config.ini, and then for a config.ini.

In summary, the order of search for a radar configuration is as follows:

- ir\_config.ini on the Primary card (and copied to Secondary card)
- config.ini on the Primary card (and copied to Secondary card)
- ir\_config.ini on the Secondary card
- config.ini on the Secondary card.

When a config.ini is uploaded from a connected PC, after being written it is copied to the Secondary card. Similarly, after an ir\_config.ini has been created as a result of receiving an Iridium message to update the radar configuration, it is first written to the Primary card, and then copied to the secondary card.

## ***Updating the software***

It is possible that software updates will need to be installed. This is most easily done by having a copy of the Integrated Development Environment for the controller's programming language (Venom2) installed on a PC, downloadable from the Micro-Robotics website (<http://www.microrobotics.co.uk/software/ide.html>, and look for VenomIDE 1.5). Then updates to the Venom language and the radar control program can be uploaded into the radar using the supplied serial communications lead, RS232 level shifter (small pcb) and null modem. If the PC does not have a serial interface port, and a USB-RS232 converter is to be used instead, it will be important to check to make sure the converter works with the system – different models have different properties.

1. Switch off the instrument.
2. Connect the ribbon-type serial lead to the VAB port. The other end of the cable connects to the small pcb level shifter. It's possible to get the plugs on the end of the ribbon cable the wrong way round. Make sure the Vcc on the level shifter matches the Vcc on the VAB port. Use the null modem to connect to the computer serial port, or serial to USB interface.
3. Slide the mode switch No.2 ("Prog.") to "on".
4. If a new version of the Venom2 language does not need to be loaded, only a new radar control program, jump to step 9.
5. To update the Venom2 language, slide switch No.1 ("Boot") to the "on" position. Load the Venom IDE and adjust the terminal settings, if necessary, to 115 kbaud, hardware handshaking, and make sure it's connected to the correct serial port.
6. Switch the instrument on. Under the File menu, click <Download Venom2 Language>, and browse to and select the .s19 file that contains the updated version of the Venom2 language. It takes a few minutes to download.
7. When completed, slide the Boot switch back to "off" and reset the instrument with the pushbutton.
8. Type Y to clear the memory.

9. To reload the radar control programme (for example, after the Venom2 language has been updated, or if a new version of the radar control program has been issued) click <Open Project...> under the File menu and navigate to the .vpj project file in the directory containing the new program files. The program will then load into the IDE.
  10. Make sure the instrument is switched on, with the Prog switch "on", the Boot switch "Off", and the memory cleared. There will be a prompt in the Terminal window to erase the application presently stored in flash memory, to which the answer is Y, and another prompt to erase the memory in RAM, to which the answer is again Y.
  11. Under the Edit menu, click <Download All> (or press <F6>), and then wait for the various files to be downloaded and compiled in the controller.
  12. Type Protect(1) to copy the new program to flash.
  13. Slide the "Prog" switch back to "Off", and switch off the radar.
- The program has now been updated.

