AMPLITUDE MODULATION DIRECTION FINDING GAUGE FOR FS2004

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Based on Original work by Finn (aka: Wothan) from the A2A Forums

INTRODUCTION

Several years ago a version of a Direction Finding gauge was created specifically for the FSX and P3D versions of the A2A Constellation and the A2A Boeing 377 Stratocruiser. This gauge was, in turn, updated with extra station data and fashioned to the panel for the freeware Martin M130 flying boat modeled by Jens B. Kristensen. Though the aircraft is available for both FS2004 (aka: FS9) and FSX, the gauge was only usable in FSX.

After several months of testing and further modifications, this gauge is now available in its current form for use in FS9. Though the code for the gauge itself would work in FSX, the code has been modified to specifically work with FS9. To use in FSX, the "xml" code would have to be changed so that the gauge would use the default FSX ambient visibility feature as opposed to the additional gauge that is called upon to use the feature in FS9. Even with this basic change, functionality in FSX or beyond cannot be guaranteed.

A MESSAGE OF THANKS

I would like to take this opportunity to thank the various members of the flight simulation community that have contributed to the completion of this project, in particular the work of Ken Lawson and Tom Gibson without whose input and assistance this project would not have been possible. I would also like to thank the original author of this gauge, Finn, without whose permission none of the updates would have been possible in the first place.

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I. INSTALLATION

REQUIREMENTS:

TEXT: This gauge depends on two particular fonts for operation. They are used to give the weather report and the navigational information shown in the above picture. They are "Courier New" and "Freestyle Script". If not installed by default by your particular Windows program, they may be downloaded freely from the internet and installed. If this is necessary, all we ask is that you please insure they are downloaded from a reputable source.

NOTE: Though the gauge will work without these fonts, the look of the gauge will not be what is seen in many screenshots and the information may not be displayed correctly.

ADDITIONAL GAUGES: Apart from the gauges in this package, you will need to follow the following link to download a gauge that will provide visibility reporting. It is located at:

https://www.fsdeveloper.com/forum/resources/ambient-visibility-gauge-fs2004.154/

Once downloaded perform the following steps according to the installation instructions.

INSTALLATION STEPS:

1. Step 1:

After downloading the zip file containing the gauge, place the zip file in a location for safe keeping. At this time extract all the files to a place where you will be able to sort the files for installation. The desktop is usually a good starting point.

2. Step 2:

After decompressing the zip file you will find a folder containing the following:

a. A folder named "Finn_FSX_Docs".
b. A folder named "FS9_Docs_Files".
c. A folder named "KMZ".
d. A folder named "Maps".
e. A folder named "Weatherships_FS9".
f. A folder named "FS9_Docs_Files".
g. This manual.
h. A file named "readme_df_fs9_2021".

3. Step 3:

a. You may place this manual wherever you wish, as long as you can have access to it as needed. There is another copy in the "FS9_Docs_Files" folder as well, so you may use that one if you wish.

b. The "readme_hfdf_fs9_2021.txt" file may likewise be placed where you see fit.

c. At this time you may copy the "Weatherships_FS9" folder IN ITS ENTIRETY AS IS into the main "Gauges" folder of your FS9 installation.

d. Place the "KMZ" and "Maps" folders wherever you see fit. The maps are for reference and contain information you may use for flight planning purposes. The KMZ files are for use in Google Earth.

e. The "hfdf_connie_sound.ini" file goes into the gauges folder as well, while the two text files are the actual lines for the respective panel configuration files that are reproduced below.

4. Step 4:

The documentation folder contains copies of the original FSX documentation and is meant to preserve continuity as well as to give full credit to the original author. You may place this wherever you wish.

5. Step 5:

Begin by installing the gauge from the required, additional package as follows:

1. Place the Fs9GlobalVisibility.gau file into the main FS9 Gauges folder so it will be available to any gauge needing it.

2. Open the panel.cfg file of the aircraft you wish to add it to and add the following line to any [vcockpit] section:

gaugeNN=Fs9GlobalVisibility!Fs9GlobalVisibility,0,0,1,1

Once complete, in the [Window Titles] section add the following after the last "window" entry, changing the "xx" to the next number in sequence. This is repeated in the accompanying text files for simplicity, but is expanded here for explination:

[Window Titles]
Window00= …
Windowxx=Weatherships_FS9

Continuing with the [Window00= …] section, go to the last "gaugeNN=" entry. Copy the following just below this last line, changing the "gaugeNN=" entry to the next series of numbers in your panel configuration:

gaugeNN=Weatherships_FS9!WeathershipsSYS1, 0,0,20,20
gaugeNN=Weatherships_FS9!WeathershipsSYS2, 20,0,20,20
gaugeNN=Weatherships_FS9!HFDF, xx,xx,40,40

NOTE: If you have other "invisible" gauges such as the brake squeaking gauge or something that deploys flaps or other things that are already occupying the "0,0" location on the panel, then just change the first number of the location to "20" for the Weatherships_FS9!WeathershipsSYS1 gauge. The result would be:

gaugeNN=Weatherships_FS9!WeathershipsSYS1, 20,0,20,20
gaugeNN=Weatherships_FS9!WeathershipsSYS2, 40,0,20,20

Notice the change as highlighted in red and underlined.

The Weatherships_FS9!HFDF entry location may be at your choice. It installs into the 2D panel, the virtual cockpit, or both, as an invisible "click spot" which is used to open and close the gauge as necessary. If installing into a virtual cockpit, however, this can often only be done by placing the coordinates over the face of an existing gauge, and it must be a gauge which is not itself "clickable" for its own purposes (a barometer, for example). Manifold Pressure and RPM gauges tend to be a good choice for this. As an example, if your manifold pressure gauge has the following entry:

gauge22=L1049H!ManPres1049H_34, 360,20,150,150

Your Weatherships_FS9!HFDF entry would be:

gaugeNN=Weatherships_FS9!HFDF, 360,20,150,150

These particular examples are for the Jahn/Connie Team L1049H aircraft and relate specifically to the left hand of the manifold pressure gauges in the aircraft's virtual cockpit. Clicking on the face of that particular gauge with these entries will open and close the HFDF panel without interference with the gauges' functionality.

CAUTION: For those that install the gauge over an existing gauge in the virtual cockpit, please bear in mind that the HFDF click spot will take precedence over the underlying gauge's tooltip function. As a result, if you use tooltip readouts to help with power settings it is recommended you change the HFDF size to half that of the overlapped gauge. As an example using the aforementioned Connie gauge:

gauge22=L1049H!ManPres1049H_34, 360,20,150,150
gaugeNN=Weatherships_FS9!HFDF, 360,20,150,75

Notice how the gauge now only occupies half of the vertical space of the manifold pressure gauge by changing the number from 150 to 75 (underlined in red for ease of

visibility in this example). This should give you the HFDF functionality on the upper portion and the tooltip for the manifold reading on the lower portion.

6. Step 6:

To add the actual gauge, add the following [Window] entry at the bottom of the different window sections and before the virtual cockpit sections, if any:

```
[WindowNN]
Background_color=0,0,0
size_mm=810,425
window_size_ratio=1.000
position=0
visible=0
ident=22100
window_size= 0.500, 0.500
window_pos= 0.500, 0.000
zorder=0

gauge00=Weatherships_FS9!WeathershipsGUI,  0,0,810,425
```

Replace the [WindowNN] with the next number in sequence.

NOTE: For those that wish to use the gauge without the notepad option (hence no virtual navigator), change the "size_mm=810,425" entry to read, "size_mm=587,425" instead. This cuts off the notepad in its entirety and will not give you any type of ambient weather information, lat/lon, course corrections, etc.

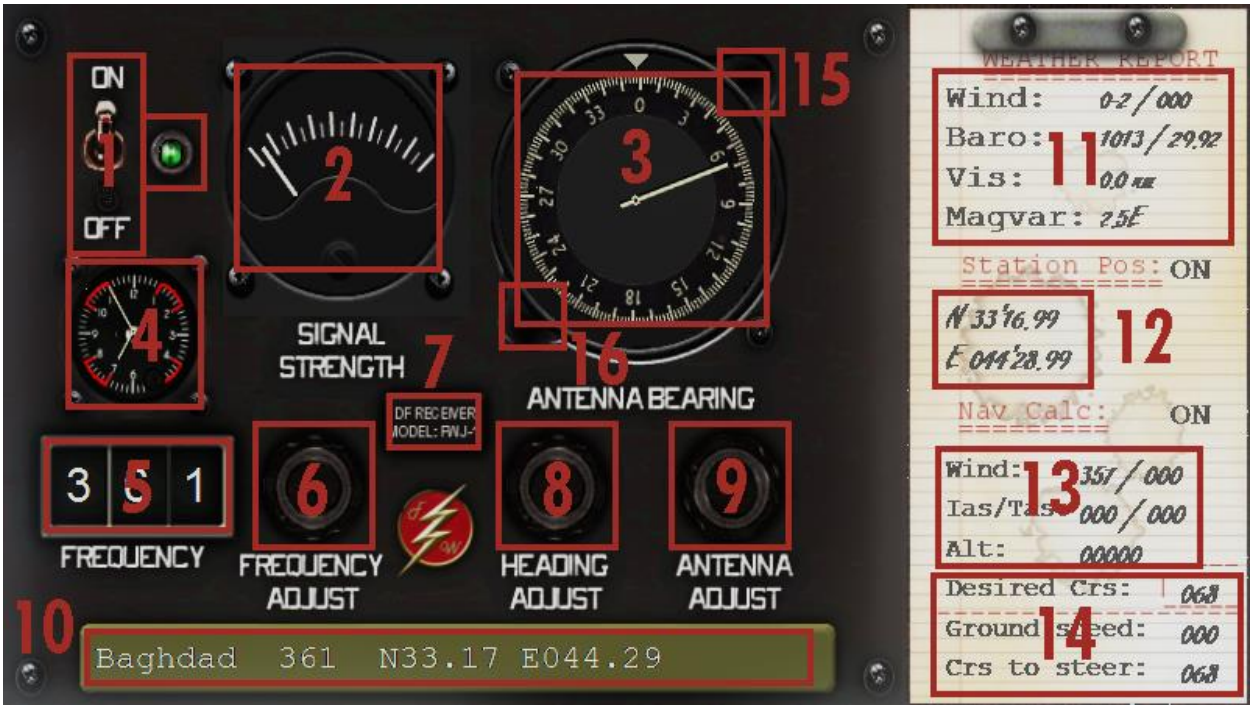
7. Step 7:

This is an optional step, but is highly recommended in order to better help with your flight planning. There are KMZ files located in this folder as well as maps of the different regions where the stations are located. These are meant to be used as reference material during your flight if you use Google Earth as a navigational tool. They include the ocean stations (ships) as well as the land stations for your reference. They may be used from this location or you may copy them to a location where you may keep your KMZ files for future use.

This should be the end of the installation process. If you encounter any issues, go back and check of there are possible conflicts with other gauges in the panel.cfg file.

GLASS EFFECT NOTE: If anyone wants to remove the "glass" effect that the gauge has, just remove the "glass.bmp" file from the gauge folder. It won't affect the operation of the gauge in any way.

II. THE MAIN GAUGE



NOTE: Actual gauge images in-sim will be different since these come from the first, beta version of the gauge. The final gauge is *very* similar, so it was decided to continue with the earlier gauge's images for simplicity in producing this manual and releasing the gauge for general use since the locations of all the functionalities are the same.

1. Power Switch and Lamp

The unit is connected to the main battery. It is not, however, connected to the avionics bus. As a result, you may have power to the unit without the avionics switch in the on position.

2. Station Signal Strength Meter

The signal strength meter displays the relative station signal strength as long as it is within the reception range of the aircraft. The leftmost position of the needle is the weakest while the rightmost position is the strongest. Please be aware that, as with units of the 1930's, there is no position determination; only line of position. In other words, there is a *peak* signal strength when the needle points FROM the station as well as when it points TO the station. The user should have a general idea of where they are with relation to the station that is tuned (e.g. whether you are generally south as opposed to north). Also, unlike the actual units, this unit's functionality is the *inverse* of the actual

units that were used in the past. Back then, it was the *null* and not the *peak* that was used to determine the location of the stations.

3. Antenna Bearing Needle

Needle providing the user with a general bearing which may be to or from the station. The background consists of a dial with numbers on the perimeter. These numbers are bearing numbers. When determining the bearing or line of position, the heading of the aircraft should be dialed into this "card" using the antenna adjustment knob just below this dial. The card is currently set to a heading of 358 degrees in this example.

NOTE: A short-cut has been created whereby the user only has to click on the bottom left for the current magnetic heading or the top right for the current true heading. This makes it much quicker to determine the heading of the aircraft.

4. Clock (Zulu Time)

This clock is permanently set to Zulu time, also known as UTC (Coordinated Universal Time) and Greenwich Mean Time. As such, it will not be affected by flying through different time zones in FS9. Furthermore, there are areas marked in red on the clock face. When ship stations are tuned, the ships will only transmit when the minute hand is in the red areas of the clock.

NOTE: Even if in range, there will be no signal from the Ocean Stations outside of the red areas of the clock.

5. Frequency Window

The frequency the radio is tuned to. This may be adjusted in two ways:

a. By tuning the frequency manually using the knob to the right of the window. Though able to tune the radio manually, it will only increment one unit (i.e. kilocycle) at a time.

b. By selecting the station from the station data bar just below and then clicking on the frequency window. This is the preferred method.

6. Frequency Tuning Knob

This knob may be used to manually tune the frequency. This is limited to one unit of frequency at a time (i.e. one kilocycle/kilohertz of frequency). This is useful if you know the frequency of the next desired station is relatively close to that of the tuned station and wish to manually adjust the frequency.

7. Data Plate (Map Plotting Shortcut)

Data plate for the radio displaying the model name and function of the unit. This is also a "hot spot" used to plot a "direct to" function on the FS9 map/GPS. The "hot spot" is only available when the unit is powered and will plot the station that is currently displayed on the station data bar below, regardless of whether it is in range or not. If the aircraft has a GPS unit on the panel, the plot will appear as a line that is direct to a point labeled "DF-Sta" on the GPS unit.

8. Heading Adjustment Knob

Knob used to adjust the background card of the antenna bearing needle to the current heading of the aircraft. This is used in determining the bearing of the station.

9. Antenna Adjustment Knob

Knob used to adjust the antenna bearing needle in order to receive the strongest signal from the tuned station.

10. Station Data Bar

Data bar containing pertinent information for the stations in the gauge database. This provides the user with the station name, frequency, and latitude and longitude. Once the desired station is displayed (using the mouse scroll or the left/right button on the mouse) it may be tuned into the frequency window by clicking on the window or by using the frequency adjustment knob.

11. Weather Report

Once a station is tuned and in range of the aircraft, the current *ambient* weather will be reported on the notepad. The information displayed is the standard wind direction and speed, barometer setting in metric and imperial measurements, and the visibility in miles. It also displays the ambient magnetic variation.

12. Station Position

The latitude and longitude of the tuned station, if in range, will be displayed in this area. This is a duplicate of the information that is displayed on the station data bar. This may be turned on or off by clicking on the word just to the right of the description text. This is meant to simulate the Navigator writing the position of the tuned station on the notepad.

13. Navigator's Calculations Part I

This is the first part of the simulated navigator. Here the virtual navigator plots the current wind direction and speed at the aircraft's altitude. It then computes the indicated airspeed and the true airspeed of the aircraft.

14. Navigator's Calculations Part II

Based on the reading of the bearing on the antenna bearing dial, the user then inputs the bearing in the upper portion of this area. Based on the weather information from Part I of the Navigator's Calculations, this will then give the actual ground speed as well as the course required to steer to continue on the current bearing to the station. As the flight progresses, this data will change based on the enroute weather.

15. True Heading Select

As mentioned before, this is a "hot spot" that, when clicked, automatically changes the card to the true heading of the aircraft. This function is similar to the frequency select function using the click spot on the frequency window.

16. Magnetic Heading Select

As mentioned before, this is a "hot spot" that, when clicked, automatically changes the card to the magnetic heading of the aircraft. As with the True Heading Select function, this function is similar to the frequency select using the click spot on the frequency window.

NOTE: This is based on the magnetic variation of the aircraft's current position and will change as the aircraft travels.

III. FUNCTIONALITY AND USE

NOTE: This gauge contains tool tips on most of its parts. These tips display either helpful reminders of the parts' function, or the actual information the part is meant to provide. As an example, the Heading and Antenna Adjustment Knobs will display the selected direction in degrees.

NOTE REGARDING OCEAN STATIONS: The Ocean Station ships only transmit during the timeframe on the Zulu Clock painted in RED. When the minute hand of the clock is within these four, individual bands, the Ocean Stations will be received. Any other times, there will be no reception from the Ocean Stations regardless of whether they were in range or not. This limitation DOES NOT APPLY to the land based stations.

1. Introduction

Navigation in the Flight Simulator environment has always been a challenge to replicate, regardless of the version of Flight Simulator that a person may be using. Many of the radio beacons (NDB, VOR) that are available by default are set to various ranges that are not variable. The maximum range for an NDB, for example, has been found to be approximately 108 nautical miles, or 200,000 meters. No matter what a designer may do, the range may not be extended past this using the built-in functionality of the Flight Simulator NDB's. A similar limitation of about 195-200 nautical miles may be found with VOR data.

When creating this gauge, the original author (Finn) wanted to simulate the Ocean Station ships that were available around the world in the middle of the 1950's. The stations were actually high powered NDB stations that were installed on ships that would transmit at certain times of the day, 24 hours a day, and 365 days a year. An aircraft that was in range of one of these ships would be able to get a weather report as well as a bearing to the ship. Two way communications were also available, and several aircraft were able to successfully ditch in the ocean during emergencies thanks to the ability of these ships to contact rescue services based on their contact with the aircraft.

The original gauge only had these Ocean Station ships in its database. These, in turn, would "wobble" in a box that was approximately 200 nautical miles by 200 nautical miles. This "box" was the ship's Station. The ships were considered to be "on station" as long as they were within the 200 nautical mile box. This has been replicated by Finn when the original gauge was produced. This functionality has been preserved and is replicated in this version for FS2004.

After communicating with other members of the flight simulation community, Finn decided to add various land stations to the gauge. These stations were described as High Frequency Direction Finding stations, or "HFDF." Several stations were also described as "LORAN" stations in the original gauge. Since the direction finding

capability of this gauge is demonstrably in the frequency range of NDB radios, the term "DF-Sta" us now used in the plotting of the line on the GPS. The term "Weatherships_FS9" has been used throughout this gauge instead of "HFDF" for all other purposes. The use of the term "LORAN," likewise, has been discontinued in favor of referring to those particular radio stations as simply "Stations." As a result, several of the text entries in the notepad section have been updated to reflect this.

The final result of this conversion to FS2004 is a gauge that will complement the scenery available at the CalClassic website that replicates the actual Ocean Stations formerly located in the Atlantic and Pacific Oceans. It should be taken into account, however, that the stations represented by the scenery will not move, while the ones represented in this gauge will drift within the station box allotted to each ship. When using this gauge in conjunction with the scenery, the user should take this into account. The frequency of the Ocean Station ship should be tuned into this unit for the initial navigational contact. It should also, however, be tuned into the ADF unit of the aircraft as well so that the bearing/RMI gauge may be used to get a bearing to the scenery "checkpoint" of the physical ship. Once in range of the scenery NDB, the communications radio for updated ATIS and communications will be available as well.

NOTE: For navigational purposes in-sim, it is recommended that the user navigate with this particular gauge *only until they are in range of the NDB*. Once in range of the ship's NDB, the user should switch to the ADF or RMI for the final 112nm or so to the scenery's NDB. Bear in mind that the box is 200nm x 200nm in size, so the actual scenery should never be a little more than 100nm or so from any possible location given by this gauge.

2. Preparing for Flight

As with any flight, preflight planning is essential to the use of this gauge. It is not meant as a "stand alone" unit, but rather it is meant to be used as one of several tools available to the user for navigating the world we have at our disposal within Flight Simulator.

Testing has shown that the unit is best used with other gauges that are available to the flight simulator enthusiast. Among these are the virtual E-6B flight computer, the virtual sextant, and Google Earth for plotting bearings as well as the flight plan of the aircraft. Though not a complete listing of available tools, these tools allow for the user to get a basic feel of what navigators and pilots of the era would be offered when using one of several real world equivalents of this generic gauge.

3. Preparation with Station in Range

When first powered, the user should check to see if the power lamp located next to the power switch is lit. Once confirmed, the user is free to begin using the unit to plan the flight. First, the user should scroll through the Station Data Bar until the desired

station information is displayed. Once this is done, the user has the option to either click on the frequency window (the simplest option) or use the Frequency Adjustment Knob to tune the radio to the appropriate frequency. The second step would be to click on the data plate located just above the Station Data Bar in the middle of the unit. This will plot the direct line bearing to the station that has been tuned. This should be done prior to departure while the aircraft is still at the gate or on the ramp and SHOULD NOT be repeated once the aircraft begins to move. This is meant to represent the navigator plotting the straight line distance and bearing to the tuned station from the departure position. This will be available regardless of whether the station is tuned and in range.

Once the station is tuned and plotted, the user should check to see if it is in range. If so, then the "direct to" bearing should be set with the Heading Adjustment Knob in order to match the reading on the card with the bearing. This should be the first "base" reading the user will have after liftoff. Once airborne, the user should wait until they are on course before taking their first reading using the radio.

Once on course to the station the user should set the heading of the aircraft in the radio by using the Heading Adjustment Knob and dialing it into the card in the bearing window. Once done, the Antenna Adjustment Knob should be used to determine the strongest available signal strength. This is done by paying close attention to the Signal Strength needle just to the left of this window. The user should keep in mind that it is important to remember this is just a Line of Position reading and not necessarily a to/from reading. This is why the user should enter the initial bearing to the station at the gate prior to departure and not "re-plot" the bearing with the map shortcut after this point.

Once the strongest reading is complete, the user should then confirm the heading of the aircraft and enter that into the dial using the Heading Adjustment Knob once again. The tooltip on the Antenna Adjustment Knob should give a bearing. The user should then click on the "OFF" next to the "Nav Calc:" entry in the notepad. This turns on the Navigator Calculations which simulate the navigator giving the crew a course to steer to the station based on the bearing the pilot or co-pilot gave to the navigator. To simulate this, the user inputs the bearing number into the Desired Course entry. The course to steer should then be displayed just below.

The user should repeat the process – heading, bearing to peak, heading verification, desired course from the bearing, and course to steer – every time an update is desired when flying to the station when in range. The stronger the signal, the farther to the right the Signal Strength Needle will deflect.

4. Preparations with Station Not in Range

If the station is not in range the only difference is that there will not be any weather information or Signal Strength Needle deflection when the station frequency is entered

into the frequency window. In this case, the "direct to" heading should still be entered into the antenna window with the Heading Adjustment Knob. The main difference is that the Antenna Bearing should be adjusted with the needle straight up, or left to remain at the default position. Since the lat/lon of the desired station is known, the initial plot should still be accomplished as before in order to simulate the navigator plotting the course on the map.

In this case other methods of navigation and wind corrections should be used for the initial segment of the flight until the station comes within range. After the station comes within range, then the aforementioned methods should be used for navigation. As a reminder, any other radio navigation method available in the general area of the Weatherships_FS9 station should be used as primary radio navigation once those are in range and identified.

NOTE: If going from ship to ship in the sim, it would be okay to re-plot the course using the data plate once shortcut once the user determines they are physically crossing over the ship. This would simulate the navigator redrawing the line to the next radio fix or ship. After this, however, the line should not be redrawn.

5. General Notes

The main point the user should take into account when navigating using either method is that station coverage may not overlap. If you are unable to receive a particular station, tune another station that may be close or in a similar area to the one that you are attempting to acquire. Unless you plan on using that particular station as a "direct to" fix, do not plot a "direct to" line to the station in range. Rather, just use it as a bearing reference until the one you desire is in reception range.

Also keep in mind that certain stations have a greater range than others when dealing with the ground stations. The ships, however, are fairly constant in their range.

Remember that if the particular station is not very strong, or if you feel the station should be in range already, you may increase your altitude if possible. The gauge simulates altitude reception gain fairly well at altitudes above 5,000 feet. If simulating flying an unpressurized aircraft, remember the limits of operation unless you are simulating oxygen use.

As stated in previous sections, the ships only transmit when the minute hand of the clock is in one of the four red areas. If you cannot receive the signal from the ship even if it appears to be in the red, wait for about a minute or so and you should have the signal. If not, check to ensure you have properly tuned the ship's frequency.

Station names are made using a combination of the International Phonetic Alphabet adopted in 1956 and the previously used naming conventions that were still in

use by several countries. This gives the gauge a sense of transition between the two eras and is more prevalent in those ocean stations that were operated by the United Kingdom in the Atlantic. The three examples of the "new" phonetics are "MIKE," "VICTOR," and "X-RAY."

IV. THE STATIONS

A. Ocean Station Ships

Station	Frequency	Lat	Lon
ABLE	285	N 62°00′0.00″	W 033°00′0.00″
BAKER	339	N 56°30′0.00″	W 051°00′0.00″
CHARLIE	327	N 52°45′0.00″	W 035°30′0.00″
DOG	354	N 44°00′0.00″	W 041°00′0.00″
EASY	349	N 35°00′0.00″	W 048°00′0.00″
FOX	356	N 35°00′0.00″	W 040°00′0.00″
GEORGE	258	N 46°00′0.00″	W 029°00′0.00″
HOW	343	N 38°00′0.00″	W 071°00′0.00″
INK	227	N 59°00′0.00″	W 019°00′0.00″
JOHNNY	261	N 52°30′0.00″	W 020°00′0.00″
KING	398	N 45°00′0.00″	W 016°00′0.00″
LOVE	330	N 57°00′0.00″	W 020°00′0.00″
MIKE	396	N 66°00′0.00″	E 002°00′0.00″
NAN	278	N 30°00′0.00″	W 140°00′0.00″
OBOE	329	N 40°00′0.00″	W 142°00′0.00″
PIP	347	N 50°00′0.00″	W145°00′0.00″
QUEEN	254	N 43°00′0.00″	W 167°00′0.00″
ROGER	374	N 47°00′0.00″	W 170°00′0.00″
SUGAR	364	N 48°00′0.00″	W 162°00′0.00″
TARE	378	N 29°00′0.00″	W 135°00′0.00″
UNCLE	225	N 27°40′0.00″	W 145°00′0.00″
VICTOR	384	N 34°00′0.00″	E 164°00′0.00″
X-RAY	358	N 39°00′0.00″	E 153°00′0.00″

B. Shore Stations

Station	Frequency	Lat	Long
Prestwick	408	N 55°31'0.01"	W 004°34'60.00"
Shannon	390	N 52°53'60.00"	W 008°55'0.00"
Foynes	393	N 52°36'49.96"	W 009° 7'22.15"
Gander	296	N 48°56'60.00"	W 054°31'0.00"
New York	399	N 40°43'43.31"	W 073°36'4.93"
Lisboa	401	N 38°46'41.25"	W 009° 7'38.10"
Azores	389	N 38°31'47.39"	W 028°37'42.92"
Bermuda	403	N 32°16'27.89"	W 064°49'20.43"
Alameda	405	N 37°47'4.78"	W 122°17'48.66"
Anchorage	413	N 61° 9'26.43"	W 150° 1'52.68"
Honolulu	406	N 21°25'34.32"	W 157°48'44.09"
Midway	409	N 28°12'12.54"	W 177°23'6.46"
Wake	412	N 19°18'28.74"	E 166°37'41.61"
Guam	415	N 13°26'58.33"	E 144°42'48.91"
Manila	411	N 14°29'47.54"	E 120°54'52.54"
Zygi	249	N 35° 5'7.50"	E 033°53'32.63"
Aden	352	N 12°48'59.78"	E 045° 1'39.86"
Nairobi	256	S 01°16'60.00"	E 036°51'0.00"
Malta	357	N 35°53'1.61"	E 014°30'34.23"
Bahrain	359	N 26°13'6.00"	E 050°34'55.00"
Baghdad	361	N 33°16'60.00"	E 044°28'60.00"
Skuvanes	402	N 61°27'22.00"	W 006°49'21.00"
Frederiksdal	404	N 59°59'17.71"	W 044°39'14.00"
Battle Harbour	407	N 52°14'53.14"	W 055°36'18.39"
Bonavista	410	N 48°41'45.66"	W 053° 5'18.24"

V. CONCLUSION

Navigation has vastly improved over the last century from the simple following of roads and landmarks to the Global Positioning System that is in use in both commercial and private aviation today. We hope that by introducing this gauge into the flight simulation community we have been able to recreate, even if only simply, one of the first challenges that aircrews faced in the early years of aviation.

If anyone has any questions or comments you may contact me through e-mail at: rechanij@yahoo.com or through the forum at CalClassics. Please be patient if I don't reply immediately since my family and my regular job will always take precedence, and have been the main reason this has taken so long to release.

VI. LEGAL