



FLIGHT



ILLUSION

## Installation and User Guide G-Step components

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## 1. General

The G-Step concept is based on a so called “Bus” system, by which all gauges and logic components can be daisy chained. Advantage of this concept is a very serious reduction of wiring and cabling.

Basic component of the G-Step system is the Central Interface Module (CIM). One side of this module is connected to the USB port for communication between the control program and a standard Hard Disk style power connector to power all the connected gauges.

On the other side are four ten pin connectors combining both the power to the gauges and the data interchange between the PC and the gauges. Because of power consumption and signal degradation the number of units that can be connected per connector on the CIM is limited to a maximum of 16.

Due to the daisy chain concept the gauges are in fact all connected in parallel, so a sort of protocol is needed to communicate with one single gauge or logic unit. For that reason each gauge has a unique address –called GaugelID- that enables the control program to exchange data with one particular unit. The address range is in total 255 different addresses varying from 1 to 255.

By default, new gauges get either an address that is specific for a certain gauge type or 255 when the gauge is a universal type. Example: the altitude indicator (a specific fixed function gauge) will at production be set to address 101, but a small generic single needle gauge (that can be used as e.g. flap indicator) will be set to 255.

As addresses must be unique on a daisy chain, you can add only one new generic instrument (with address 255) at a time. The software enables the user to detect the new gauge and the user can then change the address of the gauge to an address that isn't in use yet.

The installation part of the control program allows the user to change addresses but also gauge specific things like the needle speed (for smooth movements), the altimeter mode (Inches HG or mBar), etc. These settings have to be done only once as the address and other settings are saved in the gauge.

## 2. Hardware installation.

The CIM and Gauges must be connected as shown in the picture below.

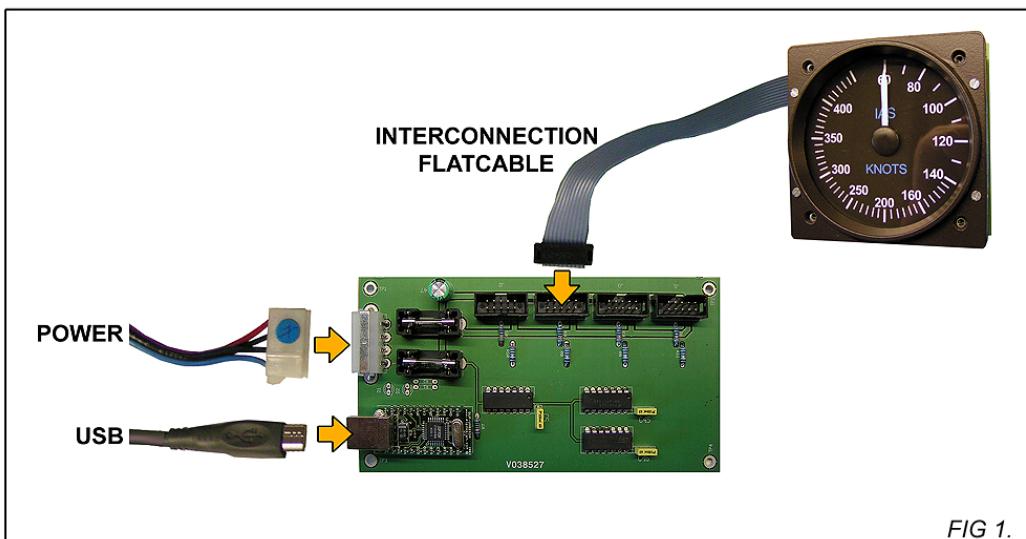


FIG 1.

For the power you can either use a separate PC power supply or -via an extension cable and free power connector - the power supply from the PC. The power consumption will vary with the number of units connected. Roughly each connected G-Step components will draw maximum 50mA from the 5 volts and 20mA from the 12 volts.



**Never connect or disconnect gauges while the power is switched on (this may damage the processor on the gauge)**

On the CIM both voltages are protected via a fuse located closely to the power connector.

The CIM has four mounting holes (each corner), that can be used to mount the CIM.

The mounting holes are connected to ground and can be used to mount the PCB to metal surfaces providing these are either grounded or "floating".



**To prevent short circuits take care to keep the bottom side of the PCB free from metal or other conductive surfaces.**

USB is a standard cable from either the PC directly or a USB hub. The little sub-PCB is a converter that translates the USB interface into serial communication levels as used by the gauges.

The four flat cable connectors on top of the PCB are for connecting the daisy chained gauges. These connectors are identical and can be used as wanted.

All gauges and G-Step components have two interface connectors. Also these are identical and don't care which one you use. We added two connectors per gauge to simplify the daisy chain system. One can be used as the input from the CIM or another gauge and the other one to connect it with a flat cable to the next one. It is also

possible to use cables with more than two connectors, by which one connector on the gauge will remain free. Using a short cable this connector can be used to e.g. a gauge located aside.

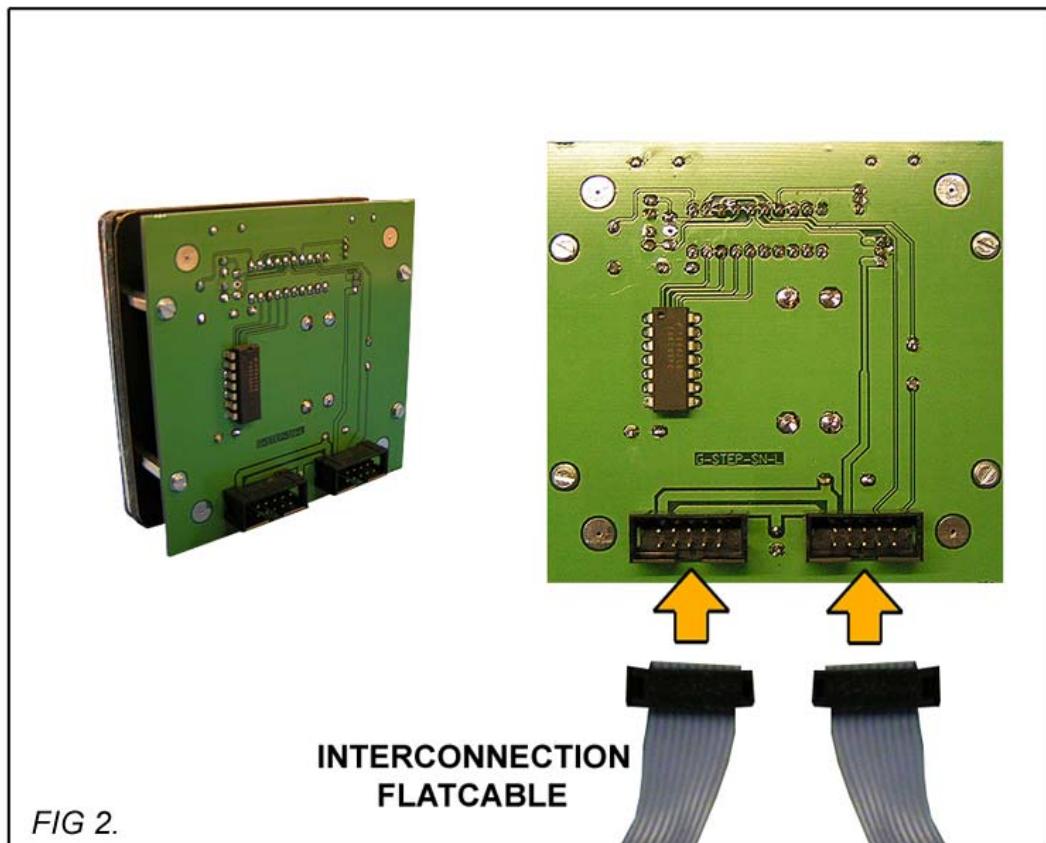
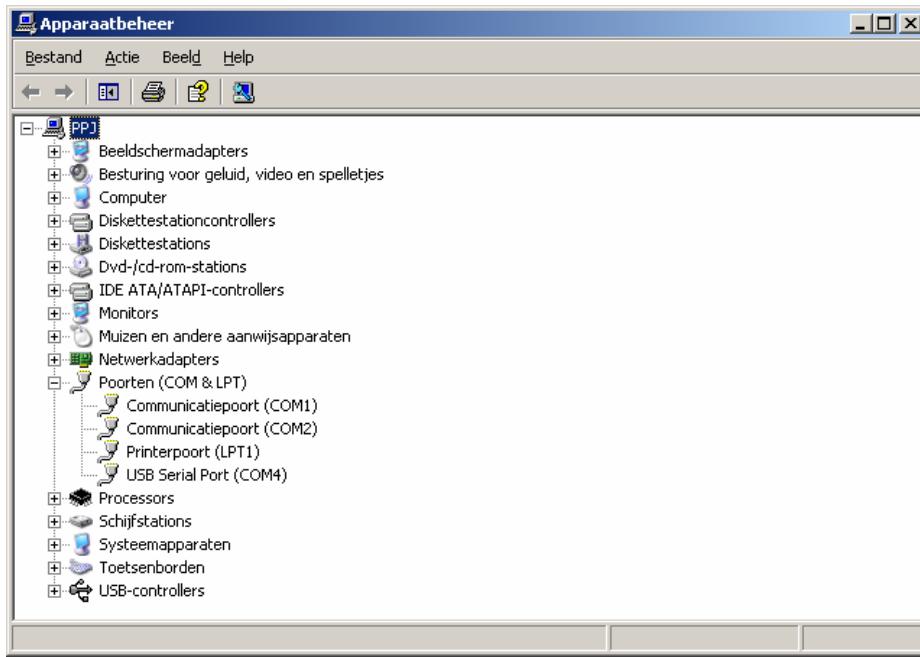


FIG 2.

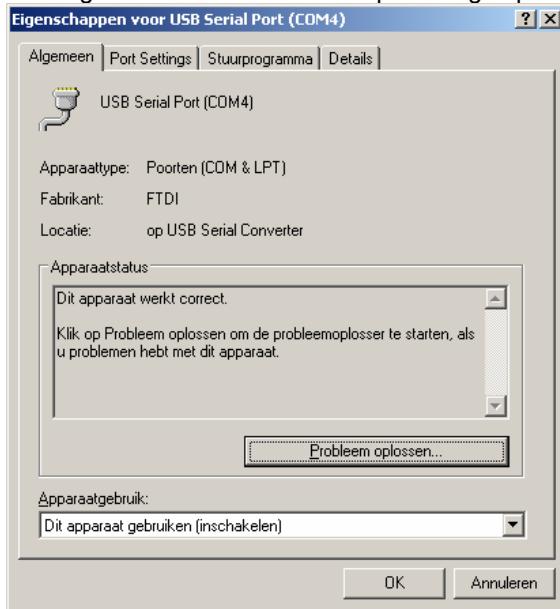
### 3. Software installation.

#### 3.1. Driver installation.

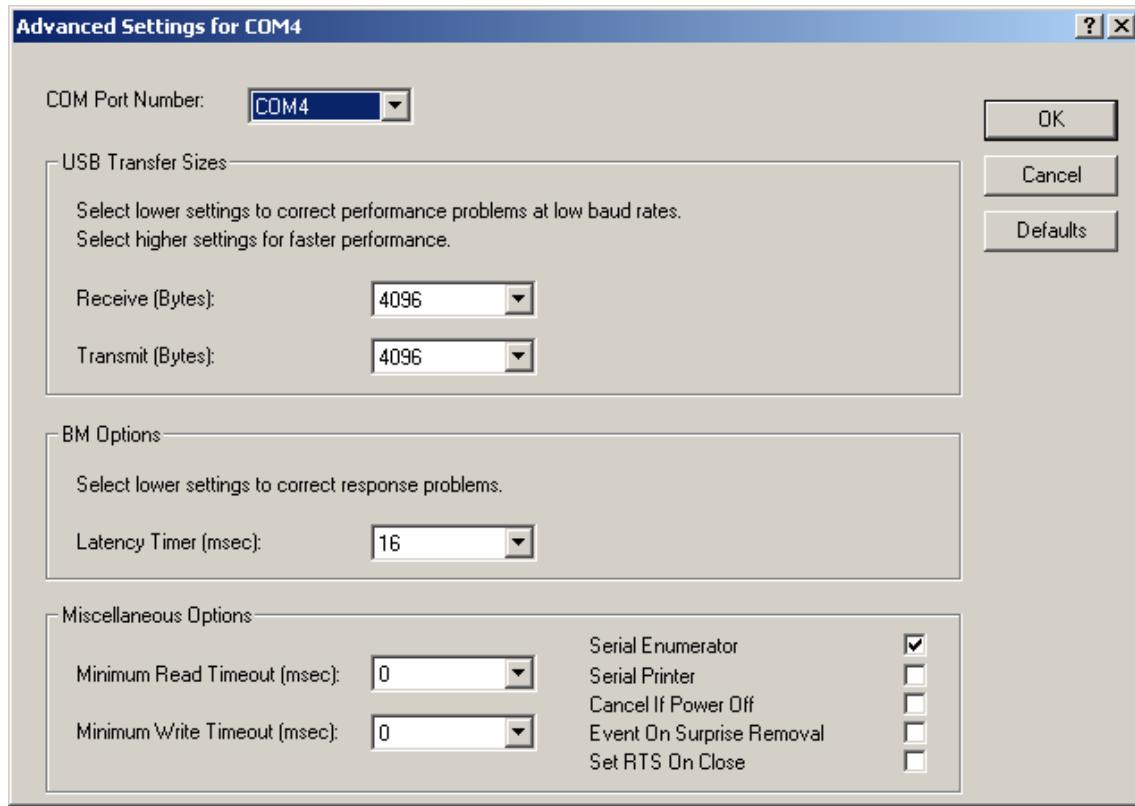
When the CIM is connected properly to USB and Power, the PC can be switched on. Windows will now detect new Hardware. The interface of the instrument cluster uses a translator circuit, to map the USB interface onto a Serial Communication Port. In general PCs have two of these ports so the instrument cluster will be installed as communication port 3. But, depending on your configuration, a higher port number is possible. This mapped communication port requires drivers and Windows installation manager will ask for them. The drivers are located in the folder with the name "USB Port". When driver installation is done this can be checked in the Hardware page via "My computer/System/Hardware". An additional serial port should appear there.



Clicking the –in this case COM4- port brings up the properties of this port:



If wanted, the port number can be changed via the Advanced Port Settings:



The selected comport should of course match the com port selection in the G-Step Control program.

The supplier of the USB to Serial port converter updates the drivers regularly. These drivers can – when needed- be downloaded from <http://www.ftdichip.com>. Use in that case the virtual com port drivers for the FT232B and the operating system you are using. Latest drivers are in the installation package.

No other drivers need to be installed, as the application program communicates with the instrument cluster via this communication port solely. However some support files for the application program are needed. The GSC control program is written in Visual Basic and needs the so called VBrun files for execution.

To use the instruments, FSUIPC in the Flight Simulator Modules folder should be loaded and running. Testing and setting the configuration however can be done without running Flight Simulator.

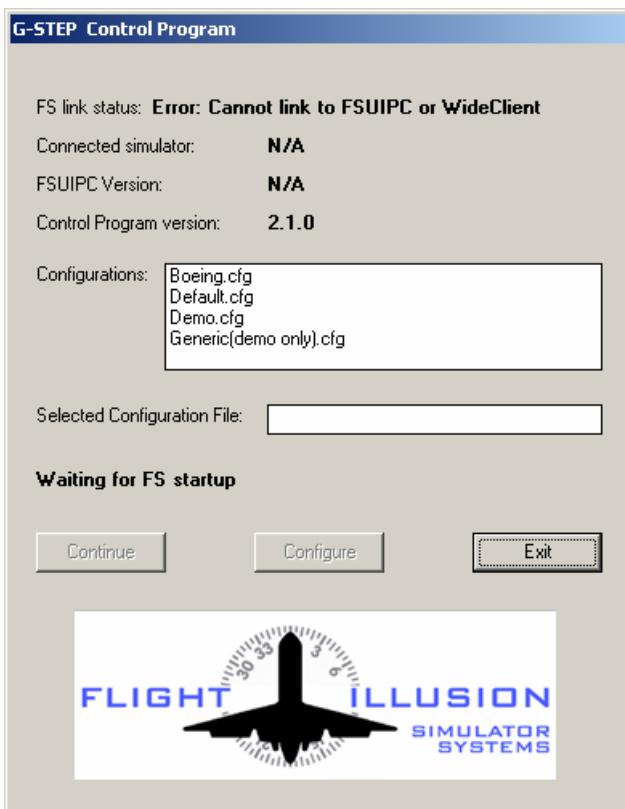
### 3.2. The Application Program

The application program can be installed from the install package via the Setup program. This package can be download from our website. It will install some extra extensions for driving the serial port and will put the Instrument Control program in your program list. For later updates the full installation isn't necessary. In that case just replacing the EXE file is sufficient. Both serial port drivers and the VBrun support files will remain unchanged and will need no update.

The application program (G-Step Control Program .exe) is an intermediate between the G-Step components on one side and Flight Simulator on the other side. Using FSUIPC it reads gauge values and other parameters from FS and calculates the position of needles and displays from that.



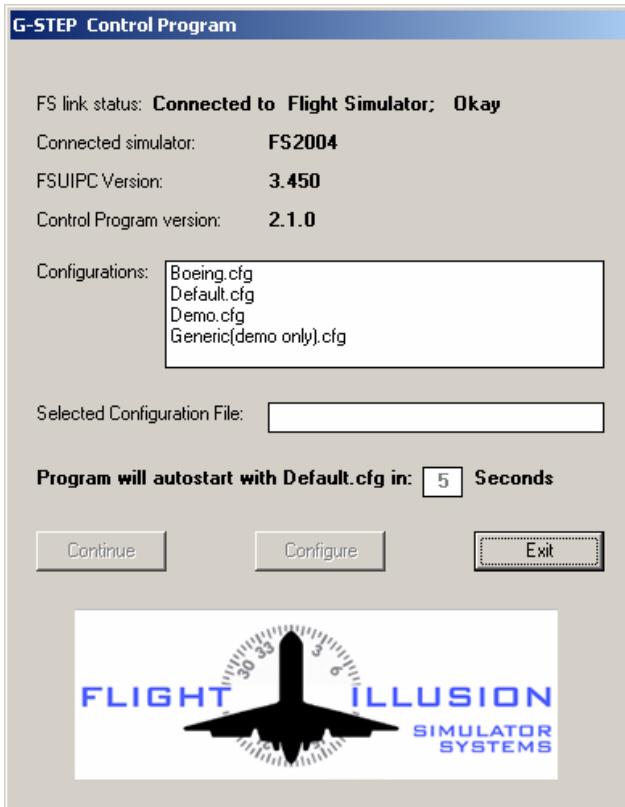
After driver installation is completed this program can be started. Any location will do as no other drivers or references are used. If you start the .exe file you should see this screen:



"FS Link status" shows whether Flight Simulator is running with FSUIPC activated in its module folder. When Flight Simulator loaded and running (including FSUIPC) this should read "connected".

The other fields give data on version and type of programs. The two buttons "Continue and Configure" below the will be enabled as soon as you have selected a configuration file.

If the Control Program is started before FS, it will show the message "Waiting for FS startup". At one second intervals, the program will check whether FS comes up.

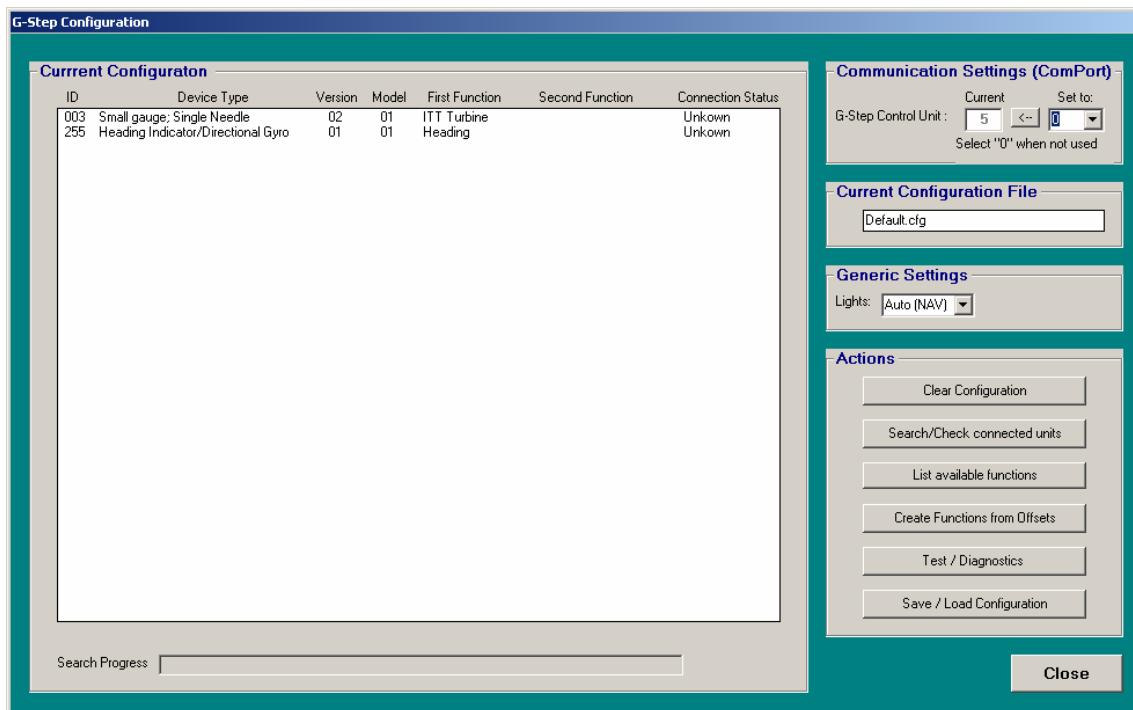


As soon as the connection with FS is made the Wait message will be replaced by an autostart message. If no action is taken, the program will then load the default configuration and start automatically. The autostart function is aborted if one of the buttons is clicked or a configuration file is selected manually.

At first run or when you add or remove G-Step components you should click on the "configure" button. This will open the screen below and gives you the tools to set the gauges and connect them to the various Flight Simulator functions. The configuration files delivered with the installation package are just examples and contain the standard variables, like available functions, types of devices, etc. Together with these you need to create your own configuration file.



After clicking "configure" you get the screen that enables you to create a configuration file that matches your configuration. Any of the supplied configuration files can be used as basis.



This screen shows the contents of the selected configuration left:

- The ID is the GaugeID of the device
- The Device type gives the universal device type, like large, small and number of needles.
- The Version is the level of hardware and micro program.
- Model is an indication for future G-Step Control programs. It will be used for e.g. the faceplate as used on that gauge.
- Then two columns that give the function(s) the device is assigned to. Two columns , as some gauges have a double function (like the dual needle gauge).
- Last field is the connection status. It shows "unknown" when no communication was done yet. After the search/check, it will show either "connected" or "not connected".

Most important part is setting the virtual ComPort to which the Central Interface Module is connected. The pull down list will only list the ports that are available on your computer. Mostly comport 1 and 2 are standard ports. The virtual communication port you added for the CIM will in general be 3 or 4, but any port number can be selected when you change that via the Windows Configuration Setup as described in the Hardware configuration.

To change the Comport select one from the pull-down list and click the set "←" button. The control program will now communicate via this com port. When you save the configuration also this comport number will be written in the configuration file and will be selected at next run.

The box *Current configuration file* shows the active configuration. At distribution some example files are inserted, but these are for demo purposes only and will not automatically contain the configuration you have installed.

**Note on the Configuration file:**

The Configuration file contains both settings for the program itself, like the specification of functions, supported Gauge types, etc. and the user specific configuration data like gauge IDs, assigned functions, etc. For that reason it is possible that the *settings part* of configuration file will change when a new release of the GSC program is distributed. A new package will always contain the latest configuration file matching the released version.

To personalize your configuration file at first start-up you can best click the *Clear Configuration* and then search for connected units. By starting that function the program will try all possible addresses from 1 to 255 and when a unit "answers" it will "tell" which gauge-type it is and which address (GaugeID) it has.

When the search is ready, you should have a list with the connected units and overview of your configuration. When an instrument is already assigned to a FS function, this will also be listed. Otherwise it will show "not assigned".

**IMPORTANT:** Most generic gauges be delivered with the standard address 255. These are gauges that can have more functions, depending on faceplate, number of needles, display, etc. This means that you can add only one new gauge at a time. Before connecting a next instrument you must change the address to a free number.  
Dedicated instruments, like e.g. the Altimeter (101) and Attitude Indicator(103), will have a standard ID at delivery, but you can change that afterwards if wanted. Should a configuration contain one or more gauges with the same address (ID) these gauges will probably not be found at search, simply because two replies at the same time will result in a garbled and not recognized data package.

The *Actions* section contains a number of buttons to maintain, create and test your configuration. Most buttons will be self explaining, but the *Create Functions from Offsets* is more difficult and for advanced users only.

It will open a window enabling users to create or update functions from the raw FSUIPC offsets. To use this, a good understanding of the offsets, data types, etc. is required. In general users will not need this facility, but it is made for the specialist that want to make special functions for non-standard aircrafts. For those users this function is explained in section 9 (Advanced section) of this guide.

## 4. Testing your configuration.

Gauge configuration can be tested by clicking the *Test / Diagnostics* button in the *Actions* section. It will bring up the form below:

**Test & Diagnostics connected gauges**

**Currently Testing Gauge:**

**Gauge type:**  Large gauge, single needle

**Executing command:**

**Command generation**

Command Interval

**Create and test gauge manually**

**GaugeID:**

**Reply:**

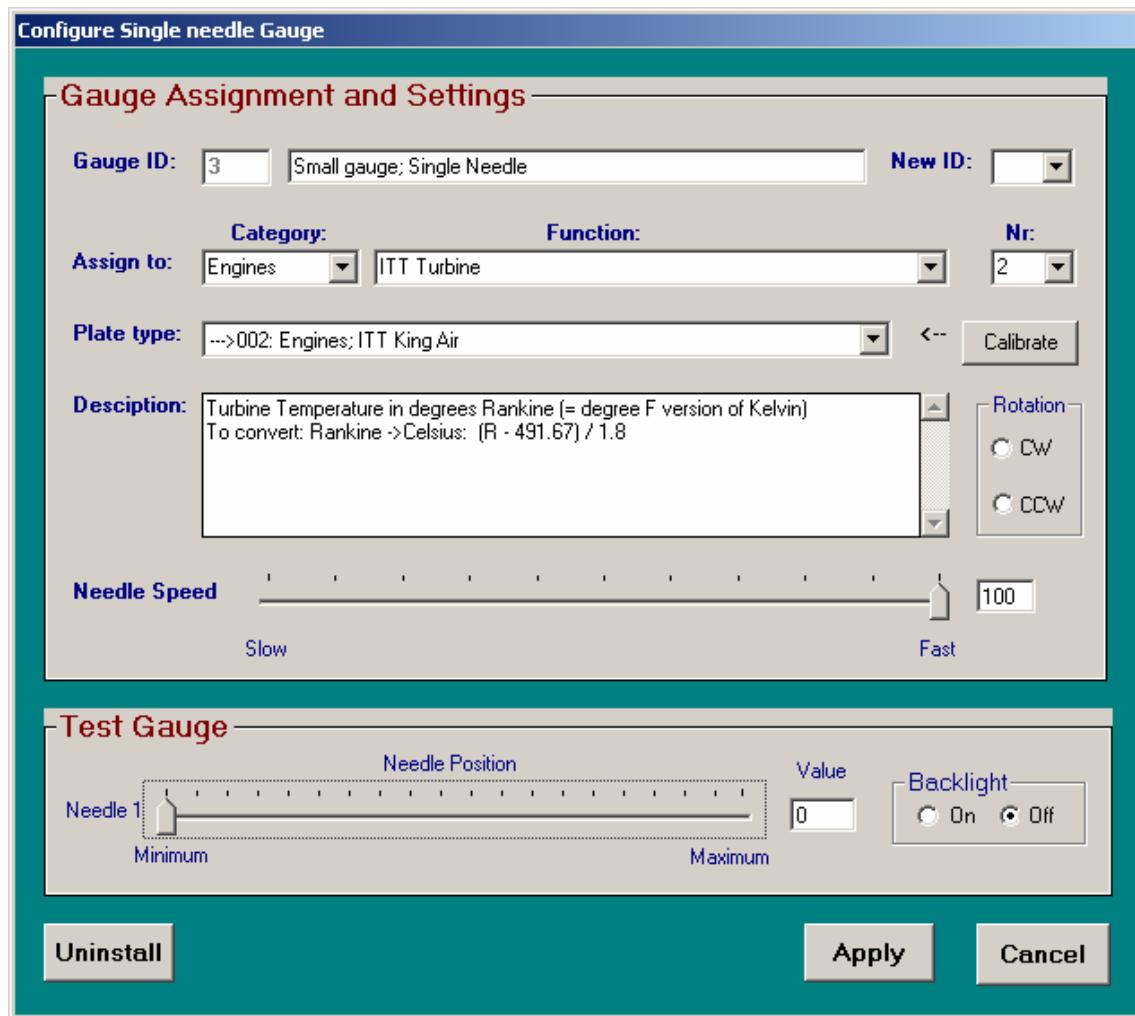
For all gauge types a sequence of commands is predefined, which can be executed either manually step-by-step or automatically. The speed of execution can be adjusted using the command interval slider. Range of this slider is from 40 milliseconds up to 5000 milliseconds (5 seconds).

The lower part (*Create and test gauge manually*) is for diagnostics only and should be used with care. It enables user to “force” a gauge into the configuration and to constantly poll a particular gauge. The *Poll Gauge* button will generate a command to the GaugeID selected in this section and the reply is written into the reply box. This is hexadecimal format and interpretation is more difficult. However in general replies will be 25 characters long and end with “FF”. Receiver progress is monitored by the rotating “cross” on the right site of the reply.

You can add any gauge to the configuration using the *Add to Config* button, but be careful doing that. As you can force any gauge and any gauge type into the configuration, there is a risk that the control program will generate commands that do not match the gauge. So: just use this function for diagnostics and fault finding only.

## 5. Configuring a gauge

Clicking on a gauge will open a set-up screen for that device. The screen you get will depend on the gauge type and contains the settings specific for that gauge. Below the screen for a generic Small Single Needle gauge is given:



On top of this window the current GaugelD and the Gauge Type is shown. Using the drop down "new ID:" you can select another ID. The list will only show the free GaugelDs.

### 5.1 Assigning functions to a gauge

Depending on the gauge type a sub-set of assignable functions is given. The functions are grouped into a number of categories like Engines, Surfaces, etc.

If you select a category, the functions that belong to that category will be given in the function dropdown list.

Next to that a number can be given. Mostly that can be "1", but in particular motor instruments can have a number varying from 1-4. So having, for example, two small single needle gauges, you can assign one gauge to "Oil temperature, left motor (1)" and the other one to "Oil temperature, right motor (2)".

If not appropriate (as the function is single), you can leave it unfilled or zero. In that case the program will assume number one.

The description box is an extended description or remark of the function. It does not effect the operation and can be edited by the user via the button “list available functions” on the configuration screen.

## 5.2 The Plate.

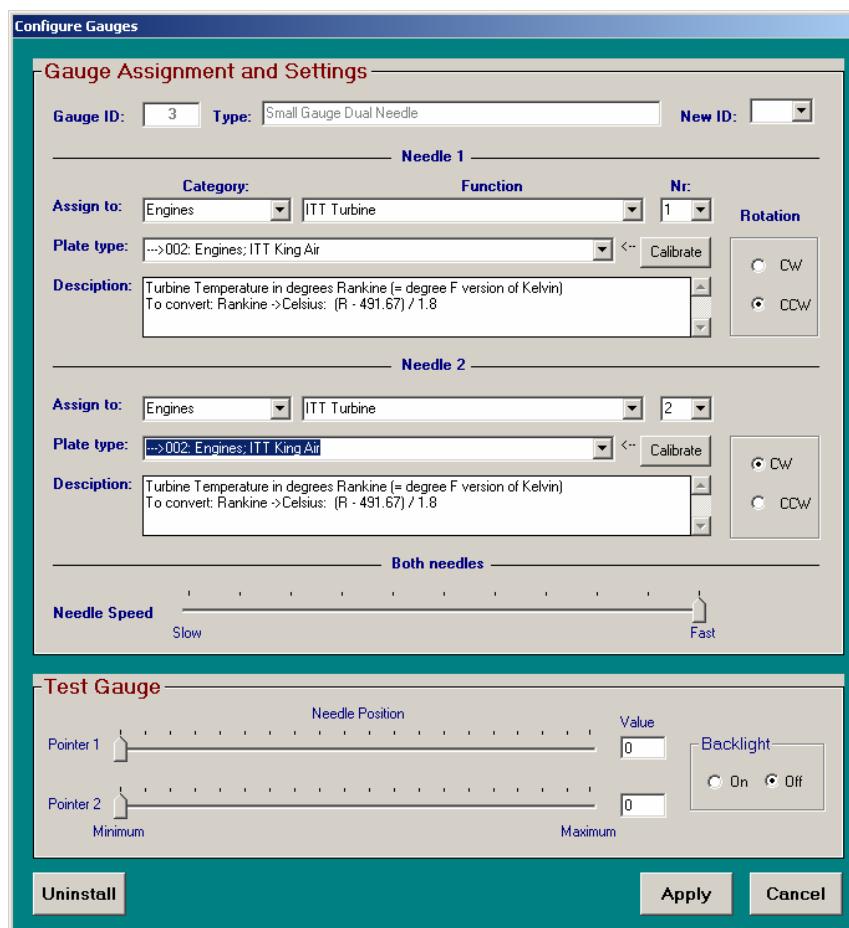
Assignment of a function to a gauge is universal. All aircraft types will have parameters like indicated airspeed, vertical speed, etc. But depending on the aircraft and its construction the gauge indicating that measurement will differ as to range and plate layout. Most gauge plates (when identical to the real aircraft) are not linear, which requires calibration of the needle against the measured value. Using the Plate Type dropdown list, the plate can be selected that matches a particular aircraft. Most standard plates will be included in the default configuration file and can be assigned to a gauge.

For “special” plates however, the user can create its own plate (or modify an existing one) using the Calibrate button to the right of the Plate Type dropdown. This button will open a screen to create, update and test the correctness of a plate. The possibility to create/modify a plate is for advanced users and will in general not be needed by users using the standard G-step gauge range. For those who want to create their own specific plate: the Advanced section describes how to do that.

## 5.3 Needle speed.

The needle speed slider sets the needle speed. Some “nervous” flight simulator readings can be compensated by that function. Most usual setting is around 80% to 90%, but setting will depend on personal preference and the function assigned.

Oil temperature for instance can be set very low, but vertical speed will require a faster needle. Setting too fast can result in a hampering stepper motor and wrong needle positions.



## 5.4 Testing the gauge

To test your settings you can use the Test Gauge slider. A complete 360 degrees rotation of a needle is 1080 steps, but due to the "stop" we loose 45 degrees thereof, so the needle will have 945 positions (0-944).

Backlight can be tested by clicking the on/off selections. Light will remain on or off when you close this window, but when you start the actual simulation, the backlight on/off will be synchronized with the light switches of FS and whether the aircraft has a power source on its main voltage bus. (Battery on or a generator of a running engine). Note: in more complex configurations it is sometimes difficult to locate a gauge just by its ID. Lights on/off then helps you to locate that particular gauge.

By clicking the "Apply" button the settings are saved in the configuration file. From that moment on the instrument is assigned to the selected function and will (if changed) get its new GaugID.

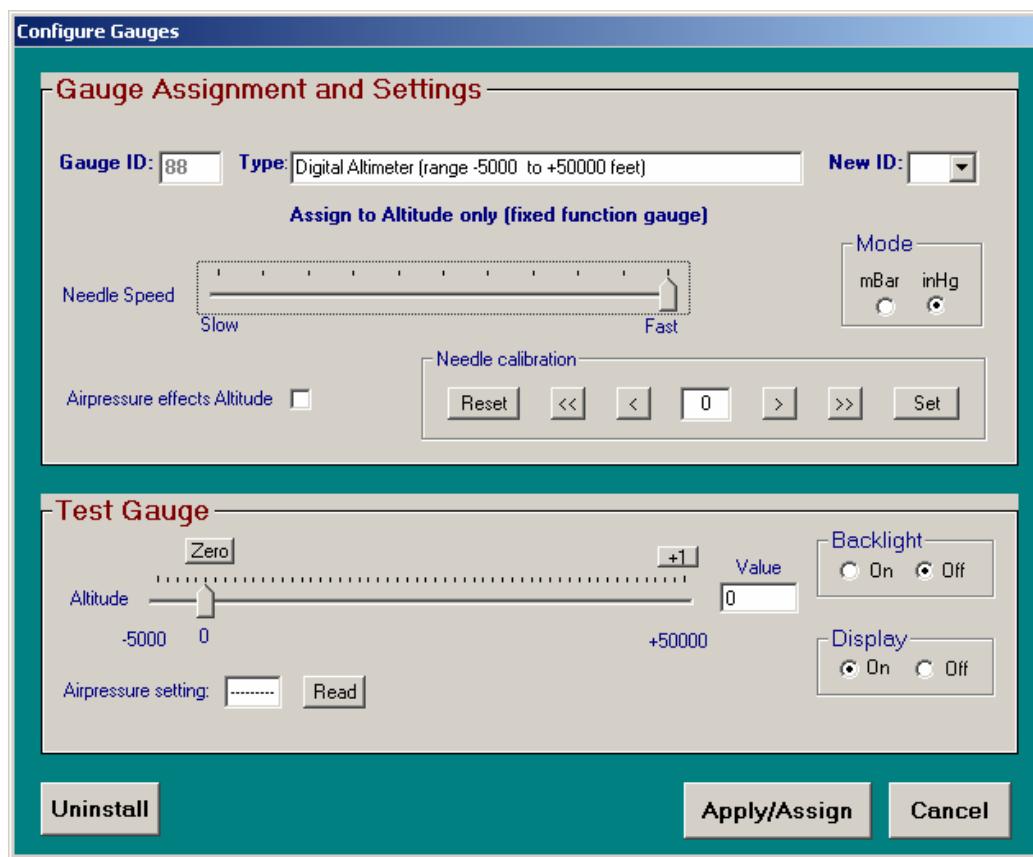
Clicking "Uninstall" will remove the instrument from the configuration. However, the instrument will remain active via the current GaugID and will -at a next search- show up again but then with the "not assigned" label.

By clicking "cancel" no changes to either the configuration or instrument will be made. However, as the needle speed is saved in the instrument itself, this will keep its last speed setting.

The G-step gauge range has some gauges with more functions combined in one gauge. As an example a dual needle gauge (see below) can be configured similar to a single needle, but the assignment is doubled. One for each needle.

## 5.5 The Altimeter

Another instrument type is the Digital Altimeter. Clicking this gauge type will pop up the following window:



As this is a dedicated Gauge it is not possible to assign it to another function. The settings here only effect the Gauge itself.

As mentioned at the previous Single Needle window, the Gauge ID can be changed from its standard "101" to another ID. Mode of the air pressure can be changed from Inch Hg to Millibar, but should of course match the text on the faceplate of the Gauge. Needle speed function is identical to the Single needle gauge.

A special word about the checkbox "Air pressure effects Altitude".

This function is **not** made for Flight Simulator connection and should in general be off. What it actually does is making a direct connection between the air pressure setting and the altitude that belongs to that air pressure. So, should you activate it, the altitude will increase roughly 10 feet per 1/100 inch HG air pressure decrease.

It is made for applications where the setting of the air pressure cannot be effected, making the altimeter more or less "self supporting" as to that. However, for testing the gauge you can temporarily switch it on.

The altimeter has a needle that can make full rotations in both directions. A photo interrupter inside the instrument is used to calibrate the zero position of the needle. But as needle can (depending on assembly) have an other position than the sensor, this difference can be adjusted using the needle calibration box. At Reset, the gauge will search for the photo interrupter and stop there. Using the left and right arrows, the needle can be moved to its corresponding zero position. Then click Set and the displacement is saved in the instrument.

At delivery this is already done so normally it should not be necessary to do this, but we left it in for situations where you disassemble the instrument and would take off the needle.

To check whether the air pressure setting can be read from the instrument, you can click the "Read" button. It should show the same reading as on the display of the gauge. To get the reading you have to click twice.

In the Test Gauge box you can also check the gauge for correct functioning and whether light and displays can be switched on/off. After closing this window, the settings for Display and Backlight will remain, but when you start the simulation the displays and backlight will be synchronized with the FS aircraft. So: there must be a power source for the display (otherwise it will be switched off) and for backlight both power must be there and light switch must be on.

#### **Important note:**

The air pressure setting is read from the instrument about 10 times per second and send to FS. There it will "rotate" the knob on the altimeter on the screen and as such synchronize the on screen altimeter with the external gauge.

You can check whether this reading works on the status screen in run mode. The value there should follow the reading on the instrument display. From there it is fed into FS.

Although possible (as it is an electronic display) it does not work the other way around. So, changing the air pressure by mouse or keyboard will NOT change the display reading of the Gauge. In other words: the G-Step Altimeter Gauge is master.

This is compatible with other analogue simulator gauges, as -should this be realized- a change in air pressure setting by mouse or keyboard would require an extra motor to make the knob and pressure plate rotate.

## 6. Configuration and functions

Back to the main configuration screen.

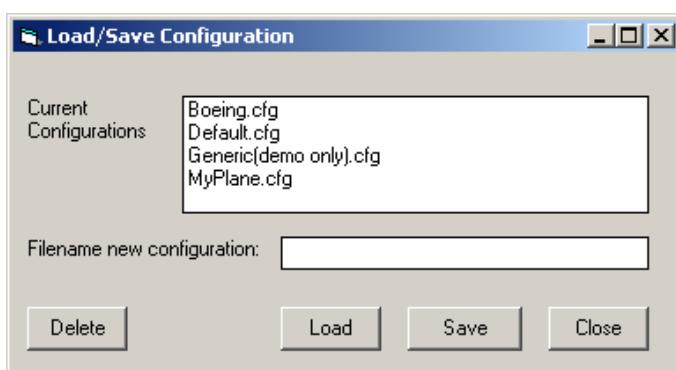
Another button will show the list of available functions. It contains a full list of functions that will be implemented or are already implemented.

List available functions				
Nr	Name	Category	Signal Type	Description
001	Gear control	Plane	On/Off to FS	Gear Handle
002	Flaps control	Surfaces	On/Off to FS	Flaps Control; Value 0% (Retracted) - 100% (Full extended)
003	Flaps control	Surfaces	Value to FS	Flaps Control; Value 0% (Retracted) - 100% (Full extended)
008	FlapsKA	Surfaces	Gauge	Flaps Position Indicator (King Air model)
009	FlapsB7	Surfaces	Gauge	Flaps Position Indicator (Boeing 737 model)
015	Trim Control	Surfaces	On/Off to FS	Trimwheel (0% - 100%)
019	Thrust	Engines	On/Off to FS	Thrust setting (0%-100%)
020	ITT	Engines	Gauge	Turbine Temperature
021	Prop RPM	Engines	Gauge	Propeller Rotations Per Minute
022	Turbine RPM	Engines	Gauge	Turbine Rotations Per Minute
023	Oil Temp	Engines	Gauge	Oil Temperature
024	Oil Press	Engines	Gauge	Oil Pressure
025	Fuel Flow	Engines	Gauge	Fuel Flow Pounds per Hour
026	Torque	Engines	Gauge	Engine torque
027	Bus Voltage	Plane	Gauge	Bus Voltage (Battery/Generator Voltage)
032	Starter Switch	Engines	On/Off from FS	Engine start/ignition switch
034	Battery	Engines	On/Off to FS	Battery switch On/Off
035	Generator	Engines	On/Off to FS	Generator / Dynamo switch On/Off
037	Autofeather	Surfaces	On/Off to FS	Autofeather arm switch On/Off
041	Prop Control	Engines	Value to FS	Propeller lever engine
043	Condition Control	Engines	Value to FS	Condition Lever engine
049	Aeronics	Cockpit	On/Off to FS	Aeronics Master switch On/Off
050	Inner Marker	Radios	On/Off from FS	Inner marker indicator
051	Middle Marker	Radios	On/Off from FS	Middle marker indicator
052	Outer Marker	Radios	On/Off from FS	Outer marker indicator
053	CommUP	Radios	On/Off to FS	Communication Radio Frequency Up
054	CommDN	Radios	On/Off to FS	Communication Radio Frequency Down
055	CommXCH	Radios	On/Off to FS	Communication Radio exchange Active Standby frequencies
059	NavUP	Radios	On/Off to FS	Navigation Radio Frequency Up
060	NavDNN	Radios	On/Off to FS	Navigation Radio Frequency Down
061	NavXCH	Radios	On/Off to FS	Navigation Radio exchange Active Standby frequencies
065	ADF Up	Radios	On/Off to FS	ADF radio frequency Up
066	ADF Dwn	Radios	On/Off to FS	ADF radio frequency Down
071	Pilot heat	Plane	On/Off to FS	Pitot heat switch On/Off
072	Anti-ice	Plane	On/Off to FS	Anti-ice switch On/Off
075	Gear Ind Frrt	Plane	On/Off from FS	Gear indicator lamp Front
076	Gear Ind Left	Plane	On/Off from FS	Gear indicator lamp Left
077	Gear Ind Right	Plane	On/Off from FS	Gear indicator lamp Right
080	HDG hold	Autopilot	On/Off to FS	Autopilot Heading hold
081	ALT hold	Autopilot	On/Off to FS	Autopilot Altitude hold
082	NAV hold	Autopilot	On/Off to FS	Autopilot Nav hold
083	LOC hold	Autopilot	On/Off to FS	Autopilot Localizer hold switch
084	ATT hold	Autopilot	On/Off to FS	Autopilot Attitude hold
085	APR hold	Autopilot	On/Off to FS	Autopilot Approach hold

Not all functions are fully implemented yet, but the list will grow with the types of instruments we supply. At regular times we will update this list and put it on our web-site together with a new version of the control program. As you will see the functions have fixed names, categories, types, etc. However, the description can be edited by the user and also stored in the configuration file. To change a description click on it and it is copied to the line below the list. You can now change the description and by clicking the update button the changes will be copied to the configuration. These updates are made in memory but not saved to the file on disk. If wanted, you can click on "save as" to do so.

Last button on the main configuration screen is the Save/Load button.

It will bring up a small window with the available files and buttons to either save, load or delete a file.

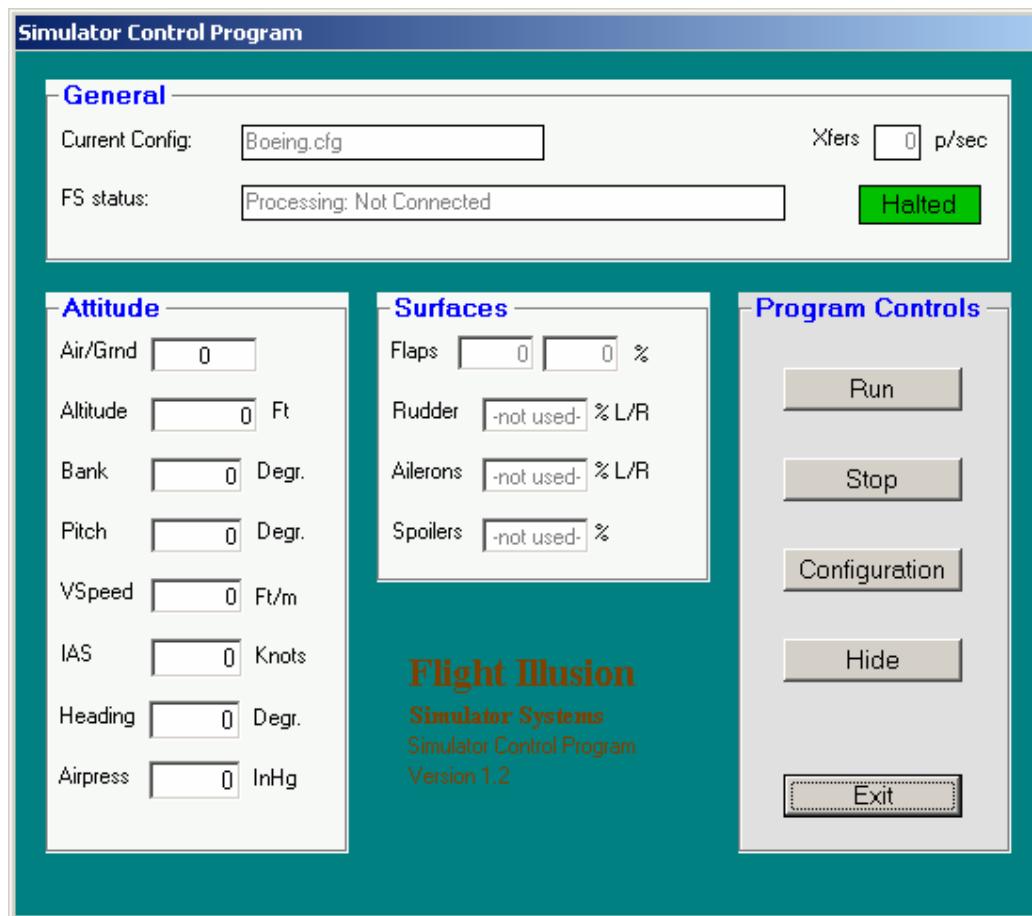


Clicking a filename will copy that file to the new filename box. But you can also type a new filename. Please note the file should have the .cfg file type.  
By clicking delete, save or load, the file corresponding with the "filename new configuration" will be saved, deleted or loaded.



## 7. Running the simulation

When you click Continue on the main start up window you should see the screen below.



On top of the screen the current name of the configuration file is given and the status of the connection between the Control Program and Flight Simulator and FSUIPC.

The Xfers box shows how many times per second the information for setting the gauges is refreshed. The value will depend on the speed of the computer and how much process time for the GS Control program is "allowed" by FS and other active applications.

Some key values are shown on this screen, but not all. Run and Stop control the simulation mode and when running the various boxes will show the actual FS readings. They are just there for test/reference. By clicking "hide" this screen will be minimized and when in Run mode the program will remain active and update the connected gauges.

## 8. Trouble shooting

The basics for good troubleshooting is a step-by-step approach and isolating the problem.

First step is a check whether power is connected to the Central Interface Module and whether fuses are OK. One fuse is for the +12Volts, which is used for backlight only, and the other one for the + 5 Volts driving all other electronics.

When no communication at all check in Windows whether the virtual comport is available and working correctly. And make sure the Communication port number matches the settings of the G-Step control program. If the port number does not exist the GSC program will give a runtime error as soon as you activate a function.

Next you can start the control program without starting flight simulator. And go to the configuration screen. Click clear configuration and search for the connected instruments. All connected instruments should pop up now. If not or one or more are missing, check the flat cables or exchange them. **Before doing so better switch off power** from the Central interface Module.

As mentioned before, the G-Step concept is a bus system where all “participants” are connected in parallel and in order to communicate with a single one, it needs to have a unique address. There are bus protocols to handle that, but in general these protocols create a serious protocol overhead, which will always be there, also at run time. So we decided to use a straight forward concept and keep the auto-addressing out of the run time.

But, as all benefits, it has a disadvantage. Addressing must be done by human intelligence and *only one* instrument at a time. However, if you administer your gauge IDs correctly, you can just disconnect all other gauges and connect only the new one for configuration. This has to be done once. Nevertheless, double addressing can occur and result in “not found” gauges.

Individual gauges can be tested by clicking them. Move needle and test whether you can switch the backlight. In larger configurations it is sometimes difficult to locate a gauge by its Gauge ID. Simple way of locating an instrument is clicking it and switch on/off light to identify it via the Gauge window.

When all gauges can be reached and react on needle and light commands, you can be sure the Hardware and interconnection is OK.

Next problem could be a configuration file that does not match your current configuration. To check that print the list (by e.g. copy screen) of the gauges found during “Search” with a cleared configuration and check if the configuration file you use matches gauge IDs and functions.

If that is all OK, the only problem that can remain is the connection between the GSC program and flight simulator.

To check that load Flight Simulator and AFTER that load the GSC program with the appropriate configuration file. Status of the connection between the GSC control program and FSUIPC and FS displayed on both the main start up screen and the status screen that is shown when clicking “continue”.

It should show “connection OK”.

By depressing the “RUN” button the interface between the GSC program and FS will be activated. Now all boxes should contain the actual FS values, like altitude, IAS, etc. If not the problem is outside the GSC program and probably something wrong with either FSUIPC or FS.

## 9. Advanced section

### 9.1 The Creation and Maintenance of Functions

Users can create their own functions from the full set of offsets available via FSUIPC. This is for users having a good knowledge of how the interface with Flight Simulator works and some basic understanding of the representation of numbers in computers is required.

As said this is for specialists. Wrong definitions and/or functions can “hang-up” the computer and/or make FS functioning wrongly. Not permanently of course, but a re-boot would possibly be required in that case.

It is good practice to back-up a working configuration file by saving it with another name before making changes or additions.

Depressing the Creation and Maintenance button from the configuration screen will open the following page:

The screenshot shows the 'Creation and Maintenance of G-Step Functions' dialog. The top section, 'Raw FSUIPC Offsets', lists various FSUIPC offsets. A specific entry for 'Turb. ENG1 ITT' is selected. The right panel shows its details: Seq. Nr. 584, Offset Hx 2038, Category Engines, Name Turb. ENG1 ITT, Formula #, Multiplier 1, Divisor 1, and Description Jets and turbos only. Below this is a list of 'G-STEP Functions'. One entry, 'ITT Turbine', is selected. The bottom panel shows a table for defining the function. For 'ITT Turbine', the 'Short name' is ITT Turbine, 'Category' is Engines, 'Signal Type' is Gauge, 'Datatype' is Double, 'Offset (1.4)' is 2038, 'PreAdd/Subtract' is -491.67, and 'Multiplier' is 1. The 'Full name/Description' field contains the formula 'Turbine Temperature in degrees Rankine (= degree F version of Kelvin) To convert: Rankine->Celsius: (R - 491.67) / 1.8'.

It is roughly divided into two parts:

- The top part relates to the FSUIPC values that can be imported from a text file (which is standard supplied with the install package).
- The lower part is used to create or update G-Step functions.

### 9.2 The top part

Depressing the Read Raw Offset file button will load the offsets into memory and contains all the known offsets. An offset (its reference) is a 16 bits number represented in hexadecimal format. Clicking a line in the raw offset list will pop-up the details in the right part of the screen. It will show the



Offset, the number of bytes used for the value access mode, etc. Depending on the offset one or more bytes are used. The number of bytes will mainly depend on the precision of the value. FSUIPC uses more representations defined by the number of bytes:

- 1, Byte, an 8 bit value ranging from 0 to 255
- 2, Integer, a 16 bit value ranging from -32767 to +32767
- 4, Long integer, a 32 bits value ranging from -2147483647 to +2147483647
- 8, Floating point, a 64 bits value, for very large numbers (over 300 digits)

The 1,2 and 4 bytes lengths are integers, whilst the 8 byte length can contain fractions as well. Apart from these FSUIPC uses some other representations (like for radio frequency setting).

Internally Flight Simulator uses a bunch of units like miles, meters, feet, Celsius, Fahrenheit, Kelvin, Rankine and more.

Obviously we need in many cases a formula to translate the raw value into a value that matches the gauge. The “formula” box contains the formula to perform that conversion. In some cases this proposed formula isn’t directly usable by the G-Step control program. Most formulas can be simplified to a single multiplier and divisor part, and the boxes below the formula will show that two values. However, some formula’s in the raw file aren’t complete or correct, so just see it as a proposal.

The Copy -> Function button will copy the current raw offset to the lower screen part, but before saving the function to the configuration file it will need some editing and additions.

### **9.3 The Lower Part**

The lower part list box will show the current functions as used by the control program. Currently the Function list contains 300 slots and by clicking one, the function will be copied to the boxes located below the list box for detailed editing.

The “short name” is the name of the function and this name will show up as assignable function in gauge configuration screens. Next to that you can choose a category to which the function should belong.

The “signal type” box is an addition used by the control program. It tells the process what to do with the result when the function is executed. For gauges you can select “Gauge”. Do not select “dedicated gauge” here. This is for gauges that are not freely assignable as they have a unique function.

Data type is already filled in by the “Copy->Function” based on the offset value length. G-step control uses one extra data type: Unsigned integer. This data type contains only positive values ranging from 0-65535.

Next to the data type dropdown box are four boxes for offsets. In the raw offset file each engine has one slot, but of course the naming, definition and processing is identical for all the engines or a multi engine aircraft.

In the control program, these functions are packed together into one slot: Nr 1 for motor one, Nr 2 for the second motor, etc. The Copy button below each box will copy the offset from the offset in upper part of the screen. Name, Formula, etc. will be equal for all of them.

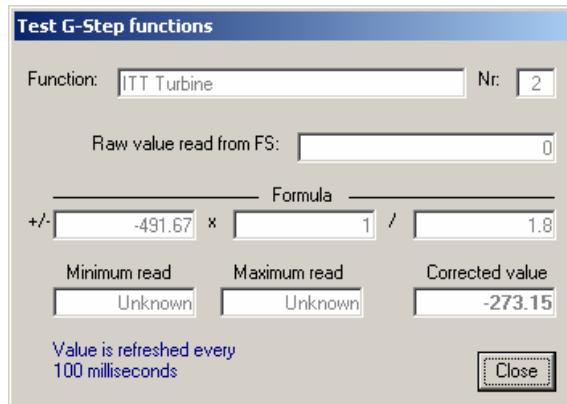
Finally there are three boxes for the transformation of the value. A pre-add/subtract number, a multiplier and a divisor. The pre-add is needed mostly for temperature conversions. In the example it converts Rankine (the Fahrenheit version of Kelvin, so with the absolute zero point temperature) to degrees Celsius.

In formula: Celsius = (Rankine - 491.67) x 1 / 1.8

To test the function and re-calculation you can use the red test button. Please note that you have to save the created or updated function in advance!

Of course FS and FSUIC must be up and running. If so a small window (see below) will show the value read from FS and the corrected value thereof.





Last but not least: Saving the function will update the current function into the current configuration in memory. To save it to the configuration file on disk you should use the save button there.

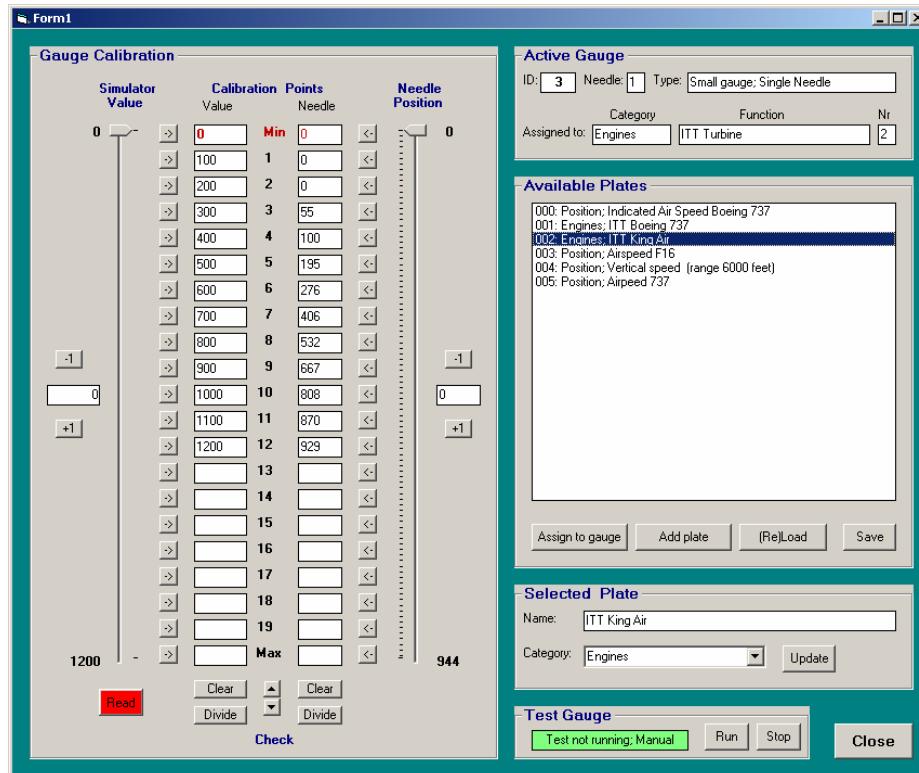
## 9.4 Gauge Calibration and Plates.

Realistic plates are identical to the ones in the real aircraft. These real instruments are as to construction completely different and often driven by analogue sensors and actuators like air pressure, non linear temperature sensors, etc.

On the other hand the G-step needles are driven by high resolution stepper motors and due to that absolutely linear. The "lazy" approach would be to create plates that fit the linear stepper motors, but that would result in plates that would strongly differ from the original.

For that reason the G-Step control program has a built in utility to convert a FS/FSUIPC reading into a plate that is identical to the original aircraft plate.

Clicking the "calibrate" button from a gauge configuration window will popup the screen below. The principle is that a plate is divided into a number of calibration points that must match a certain needle position. Between the calibration points the needle position is interpolated linearly.



On the left Gauge Calibration frame, the left Slider represents the value read from FS and the right part represents the needle position. For the creation of a new plate, you can Clear the row containing the "value boxes".

On top the Minimum value of the offset should be typed in and one of the 20 boxes below the calibration points. For your convenience you can just type the maximum value into one of the boxes and the depress "divide". The in-between boxes will then linearly be divided. Trick here is to "play" with the number of calibration point in order to get nice integer values. But you can also fill the calibration points one by one> To do so use the slider and +/- buttons to set a particular value and then copy this value to the corresponding Calibration Point box using the corresponding little arrow button.

The "Read" button will pop-up the small window as used in during the "Creation and Maintenance of Functions" and can be used to view real FS values for reference.

When left "Value" row is completed, the needle can be calibrated.

For a quick check the needle positions can spread over the calibration points, which would give a full scale linear plate.

Calibration of the needle is done using the slider and +/- buttons on the right side. First select the value to be calibrated on the left side (it will turn red), move the needle to the correct position and click on the small arrow right of the corresponding box. The Value on the right side is now corresponding with that particular Needle position.

When all done, you can check the calibration using the two Up/Down buttons on the bottom of this frame.

The right part of this screen is for the plate "administration". Top part shows the current gauge and its assignments. Below that is a list of available plates, where the current selected plate is highlighted.

Underneath the plate list are buttons to assign the plate to the current active gauge, to save the plate and to add a new plate. Latter button will save the plate ( e.g. when modified) as a new plate. The reload button will restore the original values into the calibration points rows.

When adding a new plate a new plate name and category must be given. The added plate will get a number and will be added to the list of available plates. To remain consistent with previously assigned plates it is not possible to delete a plate.

Last frame on this screen gives the possibility to test the gauge and the (new) plate.

When activated both sliders on the left part of the screen will be "connected" to the real value read from FS. Of course FS and FSUIPC should be Up an Running to do so.

Note:

Creation of new functions and/or new plates can be rather complicated. However, it has to be done only once and increases the functionality seriously.

To get examples you can select the standard available functions and plates. But as –as said before- before updating functions and plates: back-up the working one before, by saving it with another name.