POLE*STAR* VVT/GCU *HS100*

Setup Software

Operating instructions V2.4.0

POLE*STAR* Systems
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Chapter 1

Introduction

Overview

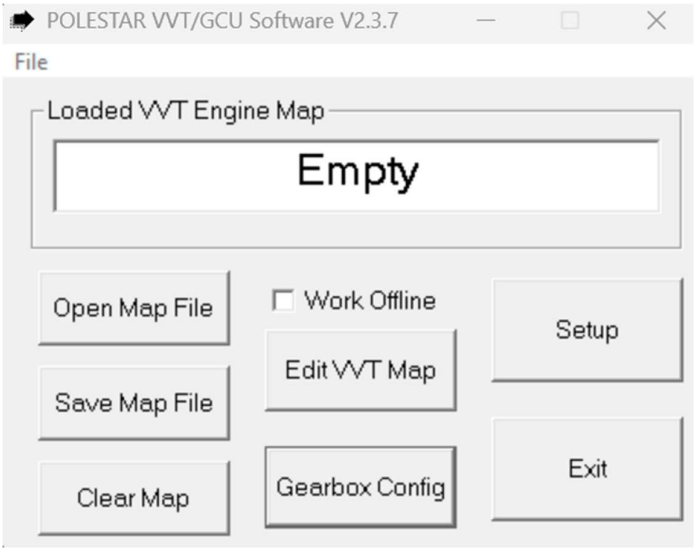
The POLE*STAR* VVT/GCU HS100 setup software is an integrated software package allowing the configuration of all the functions of the GCU100.

The software will run on MS Windows 7, 10 and 11

Getting started

Figure 1 shows the main menu display of the POLE*STAR* VVT/GCU Software. This screen has selection buttons for all the major functions of the system. Many of these are available from the pull down *File* menu.

The *Work Offline* check box allows a VVT table to be entered into a map and stored in a file when not connected to an GCU.



• Figure 1: Main Menu window

Certain options of the software are only relevant when using each type of system. Use the *Setup* window to configure the software for the correct GCU type this is described in detail in the next chapter. In order to connect to the GCU it is also necessary to configure the COM port number used for the communication. This is also selected from the *Setup* window. Please refer to Chapter 2 for full details of the program and GCU setups.

Also on the main menu display is the *Loaded Engine Map* box. This box contains details about the engine VVT map currently loaded into the software from the computer's hard disk (or read back from the GCU. This will always display as "Empty" if your GCU does not support VVT operation.

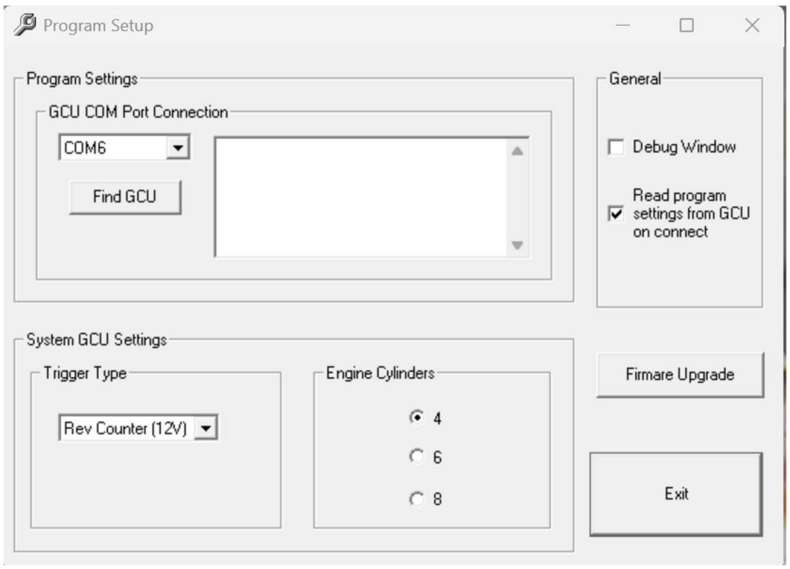
The Open, Save, Clear and Edit buttons, and the Work Offline check box only operate on VVT maps and are not used if you GCU only supports gearbox control. The Gearbox config button causes the software to connect to the GCU over the USB connection and read back and display the gearbox configuration.

Chapter

2

Software and GCU Setup

Setup of both the GCU and the POLE*STAR* software is performed from the *Setup* button on the main window . When this option is clicked the Setup window shown in below will be displayed.



The top section of the window is concerned with configuration of the POLE*STAR* software itself. The lower section allows setting of parameters within the system GCU.

When the PC software is first installed the check box *Read Program settings from GCU on connect* will be check. This is the normal default value for this setting. When set this way when the setup program connects to the GCU it reads back the program settings from the GCU itself. This includes the *Trigger Type,* the *Engine Cylinders* and the *Swap paddles* status.

If you uncheck the *Read Program settings from GCU on connect* checkbox the when the setup software connects to the GCU the settings in the GCU are compared to the current program settings**.** If these settings do not match you will be prompted as to whether you wish to allow the setup program to change the setting in the GCU. **Please only allow the PC software to change a setting in the GCU if you are absolutely sure this is what you want to do!** All of these setting in the GCU should have been set correctly for your GCU before you received it.

If the GCU and program settings do not match it is more likely that you will need to use this setup window to change the settings of the PC software to match your GCU, or re-check the *Read Program settings from GCU on connect checkbox.* These settings are automatically saved on your PC when you exit this window.

Program Settings

Com Port

This allows the selection of which Com Port on the PC will be used to communicate with the GCU. By default COM1 is used.

Find ECU

This button can be used to find out which COM port an ECU is using. Before clicking this button connect the GCU to a USB port on the computer and switch it on. Now click the *Find ECU* button. The software will then scan each COM port on the computer and try and find the GCU. If this works the COM port number will appear in the list, If this function fails to find the GCU you can also do the following.

The POLE*STAR HS* GCU connects directly to a PC using USB, however it appears to Windows as a COM port. The number assigned to the COM port is one of the mysteries of Windows! This software can only support COM ports numbered less than 16. If the *Find* GCU fails to find the GCU then the best way to find out the COM port number Windows has assigned to the GCU is as follows.

Before plugging the GCU into your PC open the Setup window from the *Setup* button on the Main Window. Click on the down arrow next to the COM1 displayed, you will then see a list of all the valid COM ports on the PC, make a note of all the COM port numbers in the list, then close down the Setup window by clicking on Exit. Now plug the USB cable into the GCU and connect it to a USB port on your PC. Wait until Windows completes the installation of the software drivers. Now open the Setup window again and check the list of COM ports, a new one should appear in the list this is the one being used by the GCU, select that one as the COM port for the software to use.

General

Debug Window

If you check this box then all communication with the GCU is displayed in a debug window. Please only use this function when directed to do so by POLE*STAR* Systems.

Read program setting from GCU on connect

It is recommended that the check box is left checked unless you are explicitly wanting to change a setting on the GCU. When this box is checked the software will read back all the settings from the GCU and configure the software accordingly. If the box is left unchecked then the settings on the PC are compared to the settings on the GCU if there is a mis-match you will be prompted as to whether you want to change the GCU setting to match those of the PC software.

System GCU Settings

Trigger Type

This section allows the correct trigger type and to be selected. This is basically how the GCU receives it's RPM reference from the engine. It must be set correctly for how the GCU has been wired into the car. The ECU can share the VR crank sensor being used by whatever engine ECU is being used. Alternatively it can use a 12V rev counter output signal generated by some ECUs, or the low tension side of the ignition coil. When using a rev counter output signal the number of cylinders in the engine must also be configured.

Engine Cylinders

The POLE*STAR HS* GCU can be configured to support 4, 6 or 8 cylinder engines, This setting is only used for the VVT function of the GCU.

Swap Paddles

This setting allows the paddle inputs to be swapped over without needed to re-wire. So for example if the car is wired so the left paddle is used for down shifts and the right paddle is used for upshifts it is possible by checking the box to swap the functions of the paddles over.

Chapter

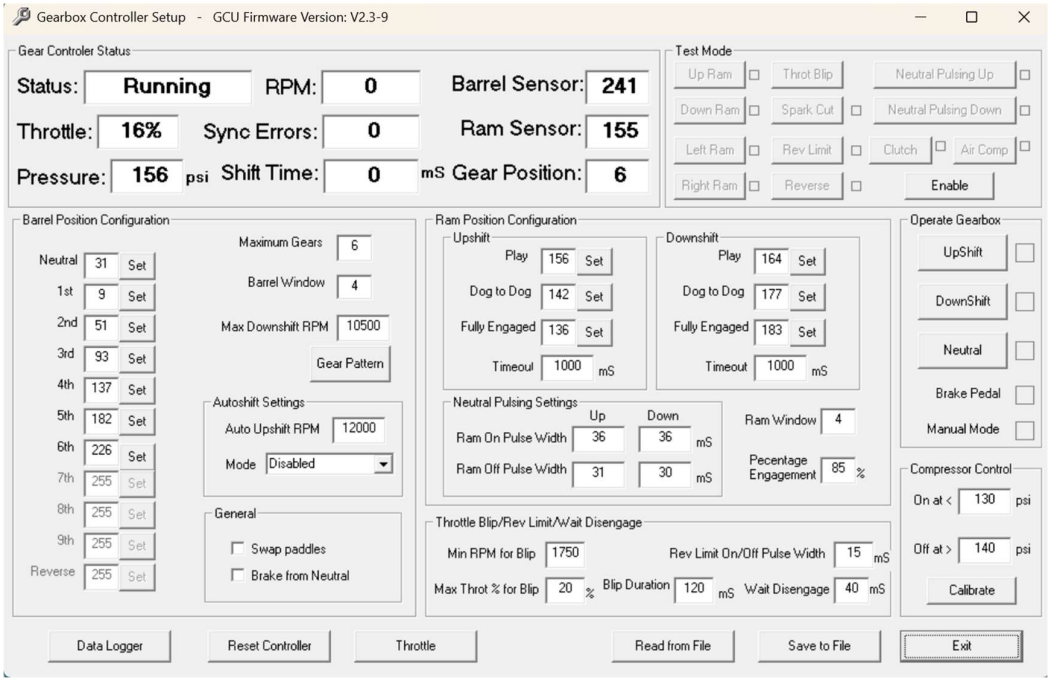
3

Configuring the GCU

Before configuring the POLE*STAR* HS100 GCU it should be connected via a USB cable to the PC on which the program is running.

After clicking on the *Gearbox Config* button the program will try and establish a connection to the GCU, it will display a message of “Initialising System” in the *Gear Controller Status-Status* box until the connection is complete. This message should only appear for a few seconds, if it remains on the screen indefinitely then check that the cable between the PC and the ECU is fitted correctly. Also check that power is applied to the GCU (i.e. the ignition is switched on). Also check the PC software is configured to use the correct COM port number (refer to chapter 2, Com Port section)

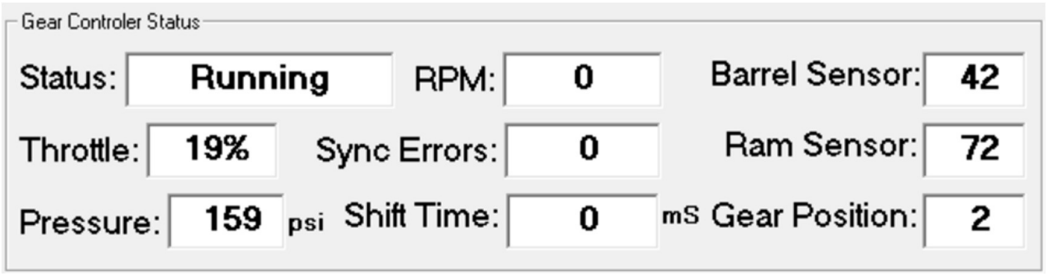
Once the communication path between the GCU and the PC has been established, if you have the *Read Program Settings from GCU on connect* check box set in the Setup window (the default state) then all the settings in the GCU are read back to the PC along with all the gearbox configuration data. The *Status* box should then display *Running*.



Once the initialisation is complete the GCU *Gearbox Controller Setup* window is displayed as shown above, this window contains various constantly updated parameters as read back from the GCU as it is operating.

This window allows all the gearbox setup parameters to be changed. It will at first appear very complex, but it is broken down into a number of different areas of configuration and display.

Gear Controller Status



This frame contains all the continuously updated status being received from the GCU as follows:

Status

This displays the current communication status between the GCU and the laptop. *Initialising, Running* or *Re-connecting*

Throttle Position

The current throttle position of the engine

Pressure

Displays the current air reservoir pressure (if connected)

RPM

The engine RPM as measured from the Rpm sensor input

Sync Errors

This displays a count of the number of times the GCU has not seen the “missing tooth” in the correct position when using a 36-1, or any other X-1 or X-2 style trigger wheel. If the GCU is configured to use a 12V rev counter input for the RPM reference this value always displays as 0.

Shift Time

Displays the time in milliseconds of the last gear change.

Barrel Sensor

Displays the current reading from the barrel sensor. This sensor is generally used to identify which gear is currently engaged. It reads from 0 to 255.

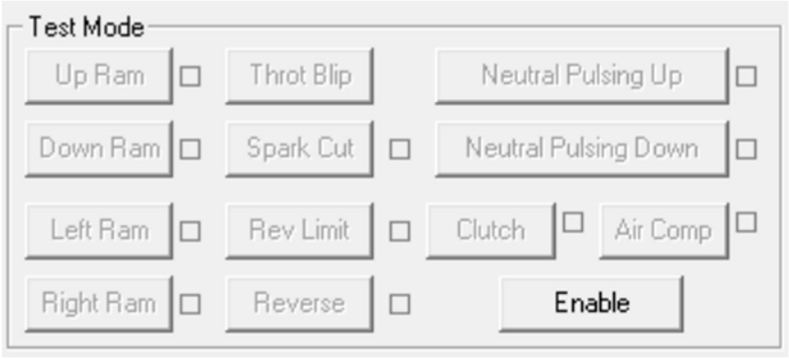
Ram Sensor

Displays the current reading from the Ram sensor. This sensor is used by the GCU to monitor the position of the gear selector actuator arm. It reads from 0 to 255

Gear Position

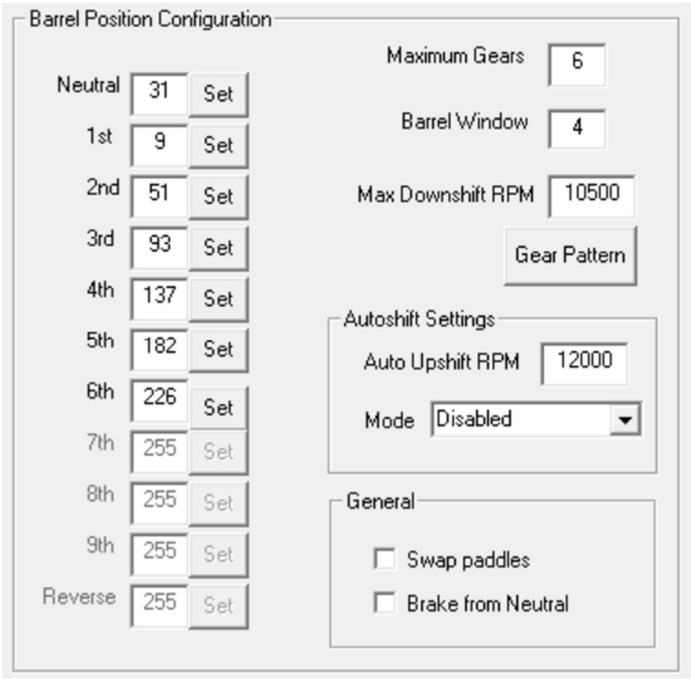
The current gear position based on the current barrel sensor reading and the barrel position configuration table.

Test Mode



The buttons in this frame are usually greyed out, they only become active when the Enable button is pressed. This switches the GCU in to a test mode. When in Test Mode the normal operation of the GCU is suspended. The Up/Down paddles and Neutral switch are disabled. When in this mode the rest of the buttons in this frame can be used to test the operation of all the individual actions of the GCU, like the Up/Down RAM, the clutch actuator (if fitted) the Spark cut used during and upshift etc. This mode is also required when first configuring the settings of the GCU.

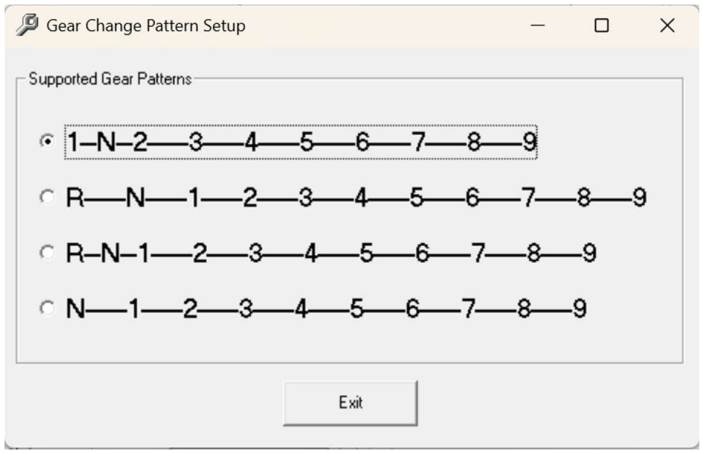
Barrel Position Configuration



This section is primarily used to setup the GCU with the barrel position readings which represent each of the gear positions in the gearbox. It is also used to configure the gearshift pattern of the gearbox and how many gears there are in the gearbox.

Gear Pattern

The first thing to configure in the frame is the Gear Pattern by pressing the Gear Pattern button. The following new window will then appear.



Select the check box for the gear pattern which matches the pattern of the gearbox being used. Now Exit from this window. **The GCU must be powered down and back up after a change to the gear pattern.**

Maximum Gears

The next thing to configure is the maximum number of gears in the gearbox, this is done in the Maximum Gears box, just type in the correct number.

Barrel Window

This number defines the allowed variance from a configured barrel position reading for a gear for the GCU to still consider that the gearbox is engaged in that gear. The barrel sensor can be reading plus or minus this amount from the configured value in the gear position table. The default is 4 and usually works fine with most gearboxes.

Max Downshift RPM

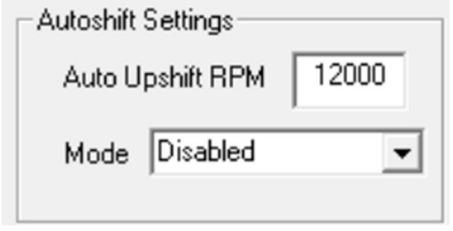
The value configured in here depends on the gap between the gear ratios in the gearbox. Basically the GCU will not allow a downshift if the current engine RPM is above this configured value. It is used to prevent the driver from downshifting too early and causing the engine to over rev.

Gear Positions

The left hand side of the frame contains the gear position table which must be configured so the GCU know the barrel sensor reading of each gear in the gearbox, including neutral. The simplest way to configure this is to use Test Mode as follows.

1. Press the *Enable* button in the Test Mode frame to put the GCU in Test Mode..
2. Use the *Up Ram* and *Down Ram* buttons to drive the actuator arm and cause the gearbox to select each gear in turn. The ram is activated on the first press of the button and released when it is pressed again. It is easiest to start with either the highest or lowest gear in the gearbox (not somewhere in the middle) to ensure you know which gear you are actually configuring. When finding a gear position **IT IS VERY IMPORTANT** to be sure that the gear is fully engaged. The car should be raised on axle stands so the driving wheels can be rotated to make sure the gear dogs engage fully for each gear selection. It is very easy to put a gear into a “dog-to-dog” state where the dogs are not fully engaged, particularly when the engine is not running and the gearbox is not rotating. The best method is to activate the ram then rotate the diving wheels to make sure the gear is engaged. If the gearbox has gone “dog-to-dog” it is usual to hear a “click” when rotating the wheels as the gear dogs fully engage.
3. When a gear has been fully selected just click the Set button adjacent to the box for that gear. The current reading from the barrel sensor is then saved in that box. Alternatively you can type the number in manually.
4. Repeat this for each gear in the gearbox.
5. Go back over each gear position two or three times and check the reading is the same or within the configured window. Also check the gear position is correctly reported in the *Gear Controller Status* section.

Autoshift Settings



The GCU can perform an automatic up shift if required. The RPM at which this shift takes place and the auto upshift mode are configured in this section of the frame. A number of different auto upshift modes are supported. Click on the down arrow to display the menu.

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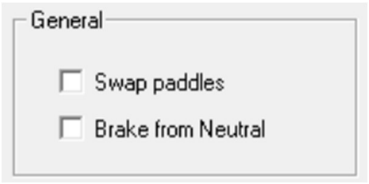
Disabled: The default, no auto upshifting will take place.
Always: In this mode the GCU will automatically upshift from 1st to 2nd, then 2nd to 3rd etc. when the target RPM is reached. The auto shifting will stop whenever a downshift is called. It is then re-enabled after the next manual upshift.
Always (not in 1st): This is the same as the previous mode, but it requires a manual shift from 1st to 2nd to begin the auto shifting.
Hold Up Paddle: When in this mode the driver must continue to hold the up shift paddle after the first upshift for the auto upshift to stay active. Once the paddle is released the GCU goes back to manual changes until the paddle is held again after another upshift.

General



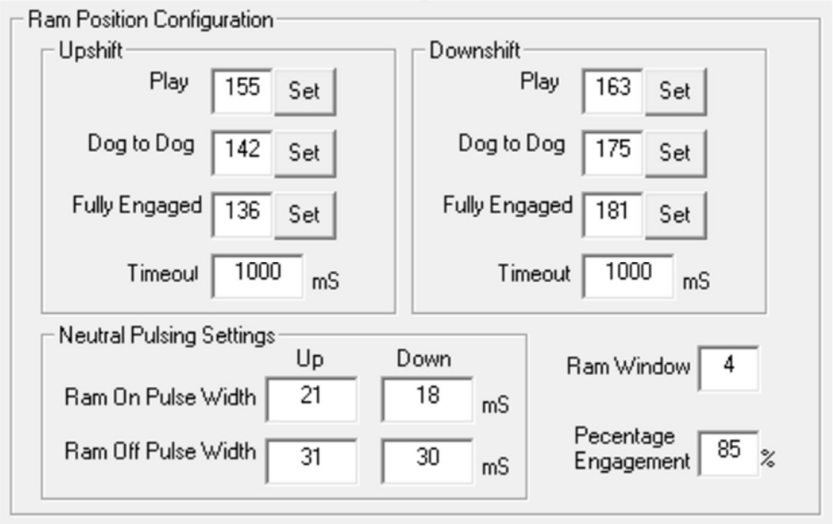
Swap Paddles

This setting allows the paddle inputs to be swapped over without needed to re-wire. So for example if the car is wired so the left paddle is used for down shifts and the right paddle is used for upshifts it is possible by checking the box to swap the functions of the paddles over.

Brake from Neutral

This setting allows you to configure the GCU to require that the brake pedal is pressed before it is possible to select a gear whilst currently in neutral. This is a safety feature to prevent the accidental selection of a gear when there is no driver in the car,

Ram Position Configuration



This section is used for configuring the positions of the gearbox actuator during upshifts and downshifts. It also allows the a pulsing settings to be configured which are used for selecting neutral on gearboxes where neutral is located at half a position between two gears (typically on a motorbike gearbox).

Upshift and Downshift

These two sections configure the same parameters, one for the upshift direction and the other for the downshift direction of the actuator arm. It is very important that these positions are configured as acutely as possible to ensure smooth up and down shifts.

Play

The number in this box is configured to be the ram sensor reading when the actuator arm has taken up all the slack in the mechanism and is just about to start the change in to the new gear. This is configured by manually applying pressure to the actuator arm in the upshift direction until you just feel resistance, then click on the *Set* button next to the *Play* box in the Upshift section of the window, this will save the current reading from the ram sensor. Repeat this procedure in the downshift direction.

Fully Engaged

This number is configured to be the ram sensor reading when the actuator arm has completed a gearchange and the new gear is fully engaged (but before it has been release to the rest position). This value can be set using Test Mode. If the GCU is not already in Test Mode click the Enable button in that section of the window.

Now use the *Up Ram* and *Down Ram* buttons to change to a gear somewhere in the middle of the available gears (typically 3rd in a 6 gear gearbox). Now use the *Up Ram* again to select the next gear, make sure the gear is fully engaged by rotating the wheels on the car. Once you are sure the gear is fully engaged and with the actuator still being pushed by the ram click on the *Set* button next to the *Fully Engaged* box in the Upshift section of the window. Repeat this procedure when doing a downshift from here and *Set* the Fully Engaged position in the downshift direction.

Dog to Dog

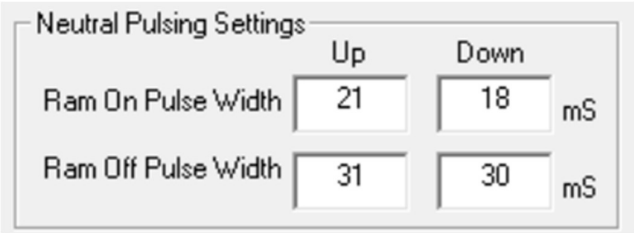
This number is configured to be the ram position when a gear change becomes stuck when the gear dogs clash and the gear does not get selected immediately. Finding this position can be a little tricky. You know when you have found the position when you actuate the ram in either the upshift or downshift direction and it requires the wheels to be rotated to before the gearbox "clicks" fully into gear. If when activating the ram the gearbox always goes immediately fully into a gear, rotate the wheels a little and try again. Once you are certain you have located the dog-to-dog position in the upshift direction click on the *Set* button next to the *Dog to Dog* box in the Upshift section. Repeat this procedure in the downshift direction.

All the above setting should be checked a few time to be sure they are repeatable and correct.

Timeout

This number configures the maximum amount of time (in milliseconds) the GCU will attempt to complete a gear change. If the change takes longer than this a timeout will occur and the GCU will return to idle and deactivate the gearchange actuator.

Neutral Pulsing Settings



This section is used to change the settings used when selecting neutral in a gearbox where neutral is located half way between two other gears (typically between 1st and 2nd on a motorbike gearbox).

When selecting neutral on this gearbox type the GCU will "nudge" the actuator ram in the up and down direction until it detects that neutral has been selected. The values in these boxes control the strength of the nudge. The settings can be configured independently for both the upshift and downshift directions of the ram.

The settings shown in the picture mean that when neutral is being selected in the Up direction (from 1st) it will be pulsed so that the ram is switched on for 21mS and then switched off for 31mS. The settings in the down direction will cause the ram to be switched on for 18mS and then switched off for 30mS.

By increasing the On time the nudge is harder, reducing the On time softens the nudge. These values can only be set by experimentation to find the right values that allow a reliable neutral selection. It is recommended that these settings are made when the oil in the gearbox is warm, and checked again when the oil is cold as the temperature can affect the amount of nudge required without causing too much overshoot.

Ram Window

This number defines the allowed variance from a configured ram position reading for one of the upshift and downshift settings that the GCU still considers that the position has been reached. The ram sensor can be reading plus or minus this amount from the

configured value of the upshift or downshift settings. The default is 4 and usually works fine with most gearboxes

Percentage Engagement

This configuration defines the point at which the engine sparks are re-enabled during an upshift. In order to perform a full throttle upshift the GCU will temporarily cut the ignition to the engine so the torque load is removed from the gearbox. The percentage value in this box controls how fully engaged the gear has to be before the engine is re-enabled. The GCU will calculate this based on the *Dog to Dog* and *Fully Engaged* positions and the percentage configured. A value of 85% is recommended.

Throttle Blip/Rev Limit/Wait Disengage

This section is used to configure a few miscellaneous parameters.

Min RPM for Blip

This value defines the lowest RPM at which the GCU will perform a throttle blip during a down shift. This needs to be set slightly above the engines idle RPM. It prevents a blip when shifting down to 1st when stationary with the clutch depressed and the engine idling.

Max Throt % for Blip

This value controls whether a throttle blip is performed during a down shift. If the throttle is already open by this amount or more then the throttle blip does not happen for this gear change.

Blip Duration

This value controls how long the throttle blipper is activated during a down shift. Higher values cause the throttle to open wider and cause the engine to blip to a higher RPM. This value should be set as low as possible but high enough for smooth downshifts. Values from 100 to 300 milliseconds (mS) are typical.

Rev Limit On/Off Pulse width

This value is used during a down shift to try and resolve a situation when the gear change gets stuck due to the gears going “dog-to-dog”. When this happens the GCU will enable and disable the sparks to the engine in an attempt to rotate the engine side of the gearbox into a different position so the dogs can engage correctly. The number defines the on and off time of the pulsing. Values of 10 to 150mS are typical.

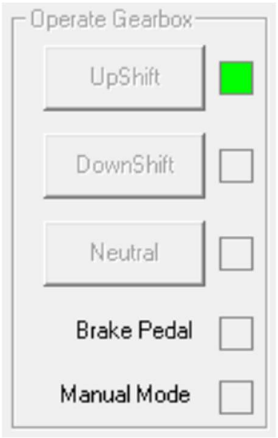
Wait Disengage

The value is used by the GCU when performing a down shift. It defines the amount of time the GCU waits before it decides the a downshift is stuck in the dog-to-dog state.

When this time expires the GCU will either activate the clutch (if the clutch actuator is fitted) or start using the rev limiting/pulsing regime defined in the previous paragraph. Values of 20 to 100mS are typical.

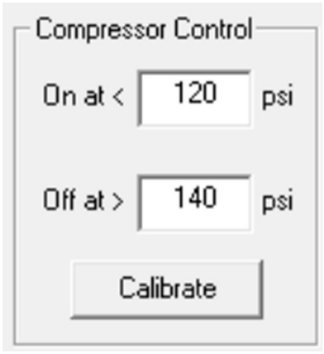
Operate Gearbox

This section of the window allows the GCU to be operated from the computer. The *Upshift*, *Downshift* and *Neutral* buttons mimic the behaviour of the gear change paddles on the steering wheel. The boxes adjacent to the buttons can be used to test the function of the paddles and neutral button. When a paddle is pulled the box should light up green showing that the GCU can see the action. This also happens when the GCU is in Test Mode. The image below shows the Upshift paddle being pulled when the GCU is in Test Mode.

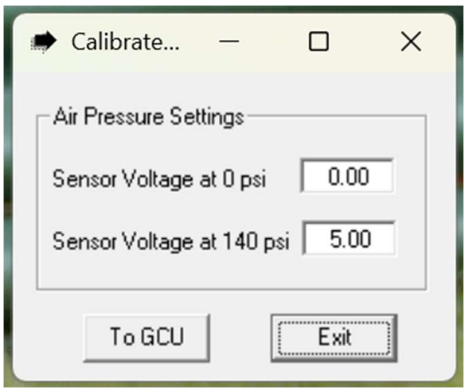


The last box indicates whether the GCU is currently in Manual Mode. This mode is selected when the Manual Mode input pin is switched to ground. In this mode the Upshift and Downshift paddles directly operate the actuator ram. In this mode the clutch pedal MUST be used. It should only be used in an emergency when it is suspected there is a problem with a sensor or the GCU setups are incorect and there is no laptop available to resolve the situation.

Compressor Control



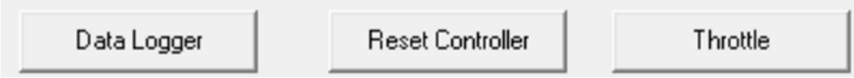
The GCU has the ability to control an air compressor. It requires feedback from an air pressure sensor on the compressor reservoir which reads in the range or 0-5V. This senor needs to be calibrated using the *Calibrate* button. Pressing this button will show the following window,



The voltages produced by the senor at 0psi and 140psi needs to be entered into this window and then sent to the GCU using the *ToGCU* button. These values should be available from the air compressor manufacturer.

Once these calibration values have been set the on and off threshold for the compressor should be set in the previous window. The GCU will switch on the compressor if the pressure drops to, or is lower than the value in the *On at* < box. The GCU will switch off the compressor once the pressure reaches, or is higher than the value in the *Off at* > box.

Miscellaneous Action Buttons



Data Logger

This buttons is used to upload logging data from the GCU and the erase the GCU's internal logging area. Only use this when directed by Polestar.

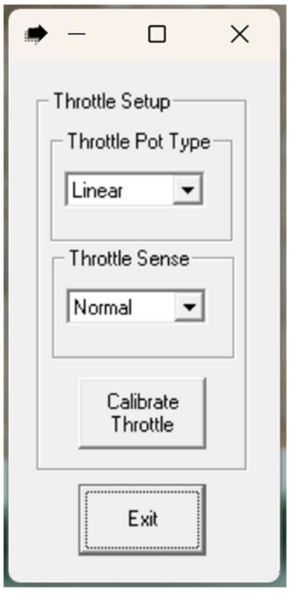
Reset Controller

This causes the GCU to restart as if it has just been powered up. If the GCU is not working but is still communicating with the PC then press this button to force a reset.

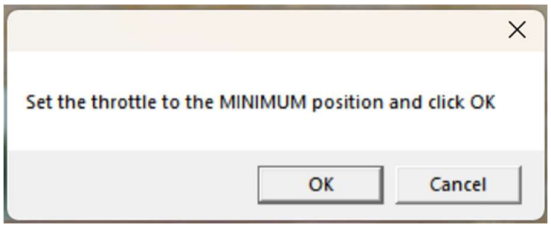
Throttle

The GCU needs to know the current throttle position of the engine. The GCU needs to be calibrated to the throttle sensor being used. The throttle position needs to be a signal between 0 and 5V generated by the engine ECU. Pressing this button opens the *Throttle Setup* window below,

Basically the GCU needs to know what the voltage measurement from the signal is for 0% and for 100% throttle. The following procedure should be followed WITHOUT the engine running but with the ignition switched on so that the GCU has power.



If you now click on the *Calibrate Throttle* button a new window will appear asking for the throttle position to be set to the minimum or fully closed (idle) position. Click OK when is the throttle is in this position.



A new window will appear asking for the throttle to be set to fully open or maximum position. Whilst holding the throttle in this position click OK. The throttle is now calibrated. Click 'Exit' to return to the normal mapping window.

The throttle position should now change from 0% to 100% as the throttle is opened and closed.

It may also be necessary to select either a *Logarithmic* or *Linear* throttle pot type. In order to select the correct throttle pot type do the following. After performing the above calibration procedure press the throttle until the status window displays 50% throttle opening. Check by examining the actual throttle position that it is indeed at 50% opening. If it is not, try selecting the other throttle pot type and repeat the test. Select the throttle pot type which gives a reading of 50% which is closest to the throttle actually being open 50%.

The *Throttle Sense* drop down list can be set to *Normal* or *Inverted*. When in *Normal* mode the GCU expects the voltage from the throttle sensor to increase as the throttle opens. When in Inverted mode the GCU expects the voltage from the throttle sensor to decrease as the throttle opens. This setting must be set base on how the throttle pot has been wired.