Gear Control Unit

GCU7 Manual

Contents

1) GENERAL OPERATING GUIDE

- In order to shift from Neutral to 1st, you need to press clutch + N/R button + paddle up. Clutch and N/R checking can be deactivated in the software, but we do not recommend it. There's always a chance that someone would accidently touch the paddle while the car is running, causing the car to start driving without driver control.
- Similarly, when shifting from 1st to Neutral (or Neutral to Reverse), you need to press clutch + N/R button + paddle down. Again, Clutch and N/R button can be deactivated in the software.
- In H pattern mode, pressing the clutch + N/R button for 3 seconds restores the gear to neutral from any position (even if invalid)
- For H pattern, synchromesh mode (with clutch actuator), to shift from neutral to 1st, you need to press brake and shift up. When you release the brake, car will start moving.

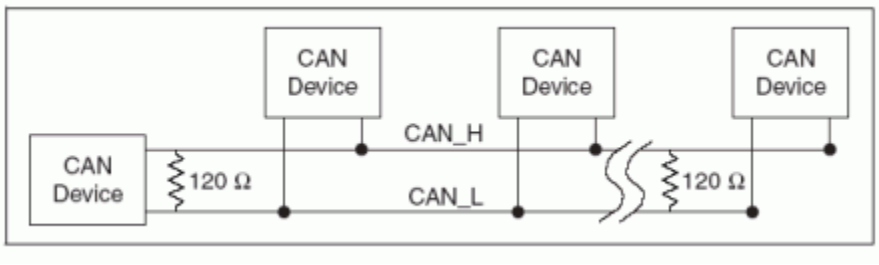
2) CONNECTING TO THE GCU

GCU7 uses CAN BUS to connect to the computer so special interface is needed.
GCU Interface uses FTDI drivers which are usually already installed by default. If you're having detecting USB device, go to FTDI site and download the VCP drivers for your OS.

If you have USB CAN 3 and GCU with LED diode (on the side), you don't need to do anything else. CAN Interface port is high speed (CAN FD) and is already terminated so you just need to connect the connector. All GCU shipped after March of 2020 have LED on the side.

For GCU without the LED connector, follow the instructions below:

Each CAN BUS must be properly terminated (by 100-120 ohm resistor) on each side.



If you're connecting to a car that already has a CAN BUS, nothing is really needed, because your CAN BUS is already properly terminated. You just need to connect the CAN+ and CAN- to existing line and that's it. If your car does not have CAN BUS or you're only connecting the GCU7 on a test bench, you need to **insert a jumper** in the GCU interface to successfully connect to the GCU.

Please note: all GCU interfaces come with jumpers installed so if you're connecting to the existing CAN BUS, you need to remove the jumper.

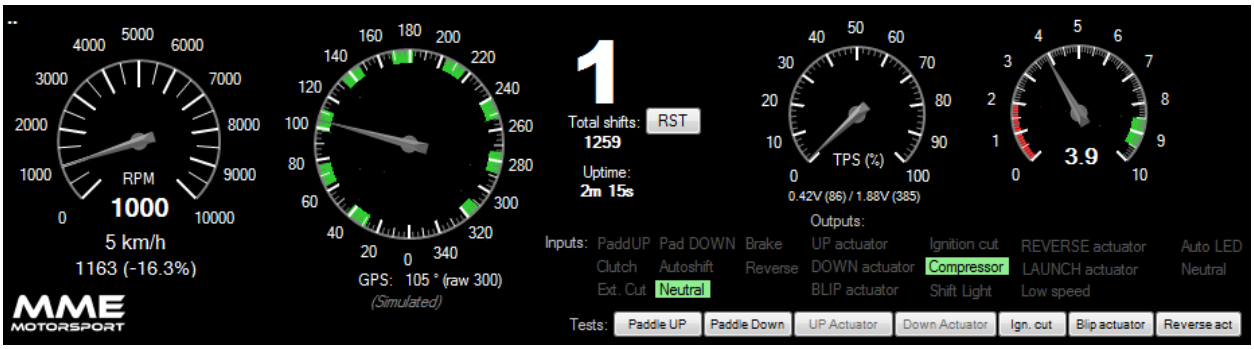
3) UPGRADING THE FIRMWARE

Please note that firmware and software are published together and they must match. If they do not match, serious problems can occur so always make sure the version of the firmware and software is the same!

Steps to upgrade the firmware:

- Download and run the new software
- Wait for the device to connect and read the settings from the device. Make sure you wait for all the settings to load!
- Save the settings to a file, let's call this file "before.dat"
- Open upgrade window, click open and select firmware .bin file (that matches the version of the software)
- Click connect to device and turn the device off and on so device is found and is ready to upgrade.
- Once it's connected, click write new firmware and wait for it to finish.
- Turn the device off and on, wait for the settings to finish loading, then open the "before.dat" file using the file->load settings and send new settings to the GCU. After the upgrade, all outputs are disabled due to safety reasons, so you need to send the settings to the GCU to activate them back.
- Turn the device off/on and enjoy the new firmware ☺

4) GAUGES OVERVIEW



RPM

RPM Gauge shows number of RPM.
Below the RPM you will see current wheel speed (only if wheel speed sensor is enabled) along with the ideal (calculated) rpm according to the gear ratio, rpm and final drive. Clutch slip % is also shown.

GEAR POSITION SENSOR - GPS

Gear position sensor as the GCU sees it. Green field represents a gear and the range where gear is valid. Gear ranges are only used if GCU is in “Sequential” mode. In H-Paddle Shifter mode, gear position is calculated based on the position of the actuators & shifting direction. GPS value under the gauge is degrees and raw value of the position sensor in the brackets.
If vehicle speed is enabled, you will find detected speed under the RPM along with the calculated rpm based on the current gear.

THROTTLE POSITION SENSOR – TPS

0 - 100% of the throttle pedal pressed.
If Integrated DBW is selected you will also see voltages for PPS1 & PPS2 (below the gauge)

AIR PRESSURE

Air pressure in bar if air pressure transducer is used, otherwise only simulated number is shown (minimum pressure from the compressor tab)

CURRENT GEAR

Gear which the gearbox is in. Total shifts is number of shifts since the last counter reset. Counter can be reset by pressing the **RST** button next to the gear.

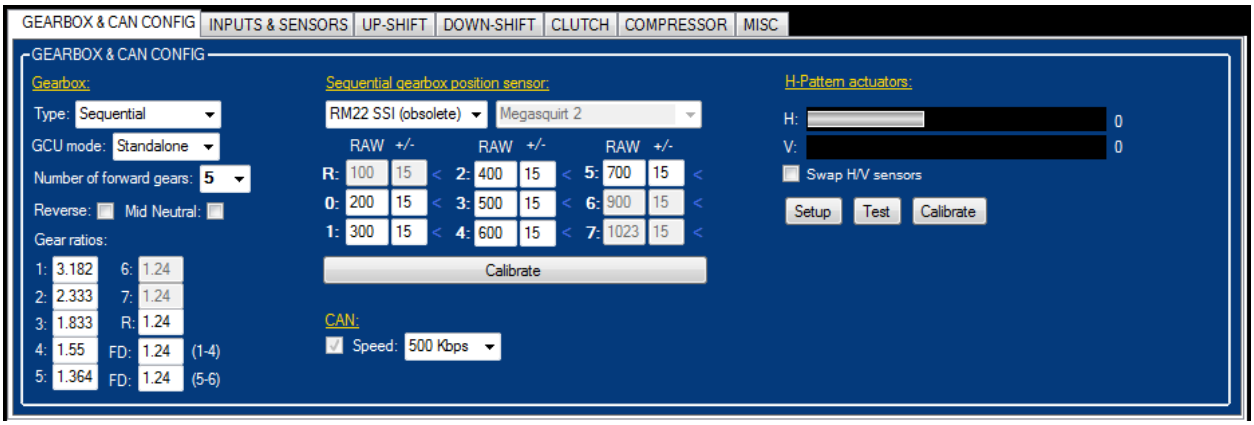
INPUTS & OUTPUTS

Status of each input and output. If active, it’s marked with green box.

TESTS

By pressing one of the buttons it manually triggers the command. Please note that UP and DOWN actuators are only available when Sequential Gearbox is used.

5) GEARBOX & CAN CONFIG



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changed to GCU - F5) in order to take effect.

GEARBOX

There are currently two types of gearboxes supported. Sequential & H-Paddle Shifter (Synchro / Dogbox).

Gearbox Type: Sequential
This is regular sequential gearbox with up/down movement. Only two valves (1 two way actuator) is used in this configuration.

Gearbox type: Type: H / Synchro or H / Dogbox
H-Paddle is MME Motorsport actuator assembly that controls 8 valves and shifts any H pattern. For more H-Paddle Shifter options see *H-Paddle Shifter actuators*.

Number of forward gears is in the **Number of gears** dropdown.

Reverse
Defines if gearbox has reverse gear or not.

Mid neutral
If gearbox with neutral between the 1 and R is used (like Sadev ST75), this option is used to allow the GCU to shift only partially. See *MISC* for setting up the neutral.

Gear ratios
Gear ratio for each gear. GCU will calculate the safe RPM for each gear, according to max engine RPM under the **Down** tab. See Downshifting for more info.
FD is final drive ratio and is currently only used for if speed sensor is enabled. Can be ignored in most of applications. You can set a ratio for gears 1-4 and separately for 5-6. If you have only one final drive, you need to enter the same one in both windows.

CAN BUS

Enable to use CAN BUS support. Power to the GCU must be cycled if CAN BUS is enabled (and was previously disabled). If **CAN BUS speed** is unknown, 500 Kbps and 1000 Kbps are common values in automotive industry.

GEAR POSITION SENSOR

Gear position sensor is only available in Sequential mode.

There are 3 types of Gear Position Sensor available.

Type: Potentiometer
This is standard 3 pin potentiometer found on almost every sequential gearbox. When this type is selected, GCU pin A2 must be connected to analog 0-5V sensor. This sensor must first be calibrated. See GEAR CALIBRATION below.

Type: CAN
Reads the gear position from CAN BUS. This sensor must first be calibrated. See GEAR CALIBRATION below.

Type: RM22
This is SSI sensor found in one of the older designs. It is now absolete.

CAN Device
If gear position is connected to the ECU and your ECU supports sending the value to the CAN BUS, select the ECU you have. If your ECU is not in the list, please contact us with car info and ideally CAN BUS dataset so we include this in the software & firmware.

Gear calibration
In sequential mode, gears must be calibrated. By clicking **Calibrate** it will walk you through all of the gears and store the values for each gear in the boxes next to the gear. Numbers in boxes are values (0-1024) where gear is detected. You should shift up & down few times to see if the range is correct and adjust accordingly. Second box next to a gear is the window in which this gear is still valid. Alternative to the calibration is to just shift to a desired gear and press “<” label next to the box.

H-PADDLE ACTUATORS

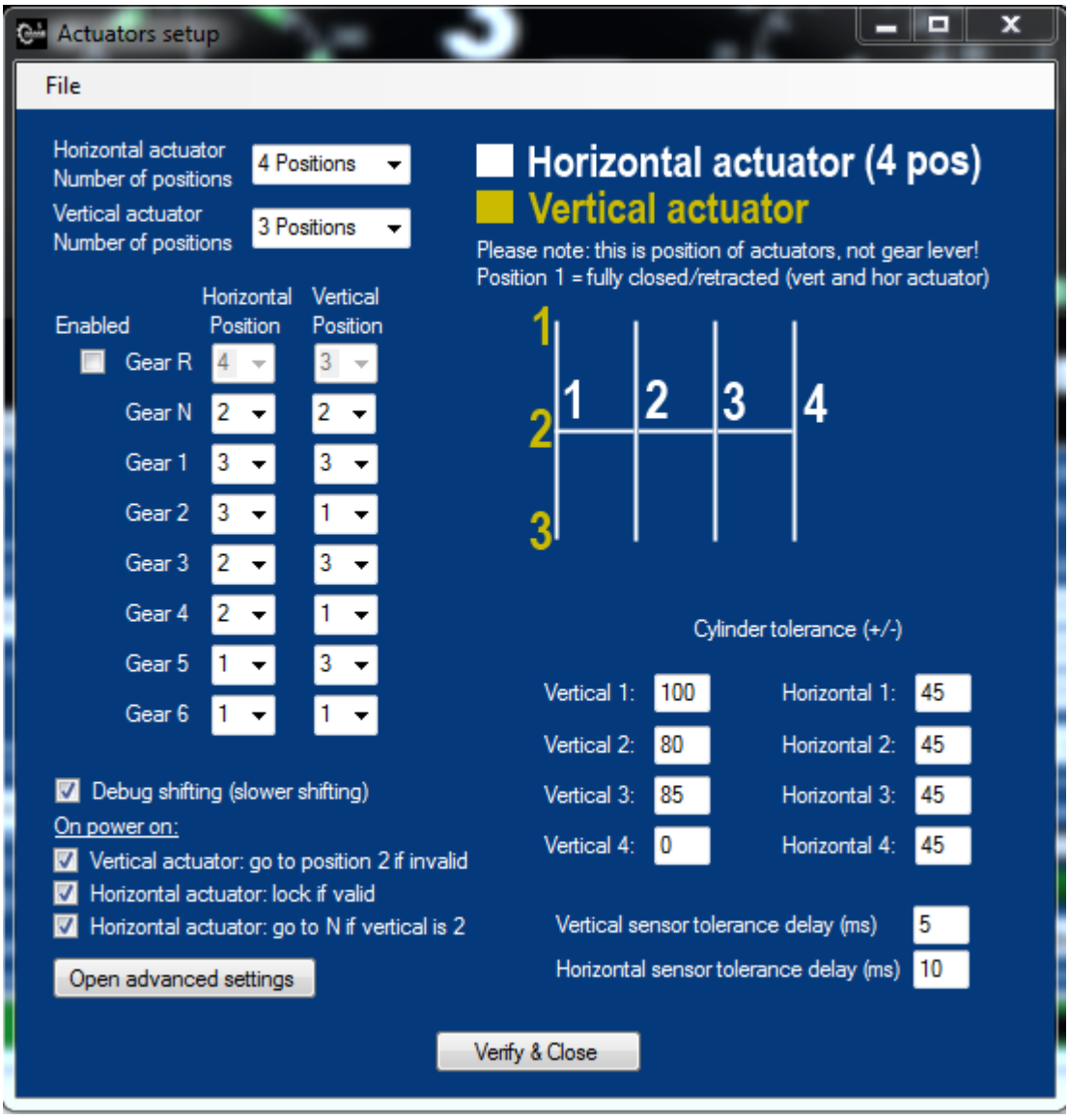
Only used if GCU is in H-paddle Shifter mode.
Window shows the position of each actuator (H = horizontal, V = vertical). Before first use (or if actuators seem off), actuators need to be configured and calibrated. Click **Setup** configure the gearbox shifting pattern (which way is reverse, 1st – 6th gear and so on), actuator tolerance and other H-Paddle Shifter actuator related parameters and then **Calibrate** and follow the instructions. You can calibrate the actuators using the **Test** button too. For more info on setup, see H-PADDLE-SHIFTER ACTUATOR SETUP
If H/V sensors are incorrectly wired, you can swap them in the software by checking the **Swap H/V sensors.**

Test window is used to verify the valve connections and allows you to turn on/off individual actuator valve or test programmed patterns.

a. H-PADDLE SHIFTER ACTUATORS SETUP

This screen can be opened by clicking the **Setup** button on GENERAL/SENSORS tab in H-Paddle Shifter actuator region.

Before configuring the shift patterns, make sure your Number of gears parameter is correct (GENERAL/SENSORS)



For each gear you need to set the position of each actuator.

Vertical actuator (See shift pattern image) usually has 3 positions. Position 1 is fully closed, Position 2 is half-way open, Position 3 is fully opened.

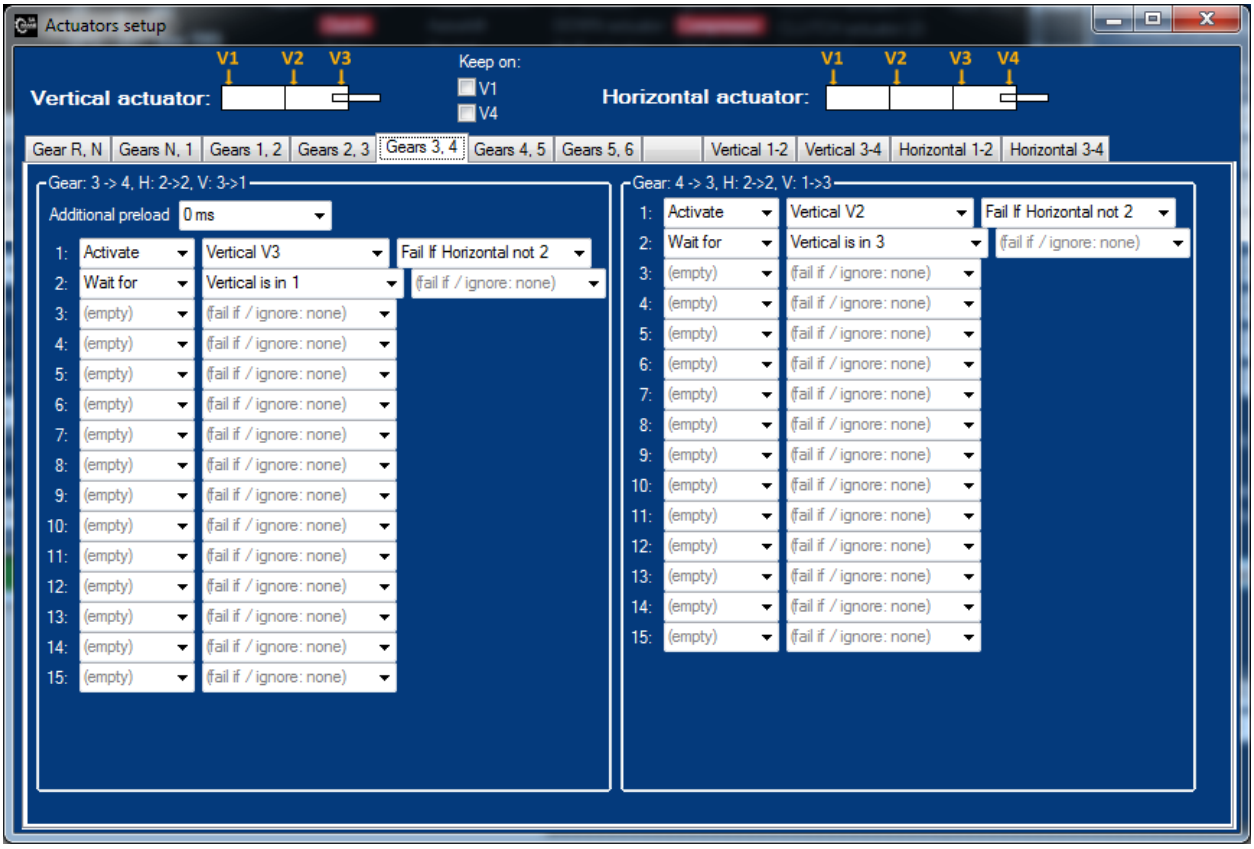
Horizontal actuator can have 2, 3 or 4 positions, depending on number of gears and shift pattern. Position 1 is fully closed.

On power on options allow to set up what actions are taken when you power up the gcu**. Vertical actuator: go to position 2 if invalid** will move the vertical actuator to position 2 if position on power up is not in the middle (2), completely out (3) or completely in (1). This allows you to always start with a neutral gear if car stops somewhere "in between". **Horizontal actuator: lock if valid** means that we lock horizontal actuator from moving on power on if it's in correct position (either 1, 2, 3 or 4 – depending on the number of positions). This allows you to have direct shift ready when you start the car. If this actuator is not locked, when shifting, GCU will run 3 commands, first it will move to neutral, then it will move horizontal actuator in desired gear position and lastly, it will move vertical actuator to "in gear" position. **Horizontal actuator: go to N if vertical is 2** will move the horizontal actuator to N position if vertical is middle (neutral) position and lock horizontal position.

Cylinder tolerance allows to set how much +/- of each position is still valid. For most applications, 60 is ok. Depending on selector wear or free-travel of each gear this will have to be adjusted.
Typical value: 60 for the vertical and 50 for horizontal.

Vertical/Horizontal sensor tolerance sets how much time (in milliseconds) particular sensor needs to be in position to treat it as "stable".

b. H-PADDLE SHIFTER ACTUATORS SETUP - ADVANCED



General operation for H pattern:

- Before doing any modification of the procedures, make sure mechanical actuator travel is correctly set and that mechanical linkages are working so they can shift correctly. Calibration of positions must be performed using Test window and basic moves should be done and verified by manually opening the valves and testing the POS 1, POS 2.. buttons (Test window)
- There are 3 valves in the vertical actuator. V1 is valve that activates the first chamber, V2 is second chamber, V3 is the last chamber. Activating V3 will move the cylinder completely in. V2 will move the cylinder completely out. V1 in theory, should move the cylinder to middle position, however – because of the very high speed that our valves reach, activating the V1 will overshoot the rod. To overcome this, we first actuate the V1, then after a while we activate the V3 that blocks the overshoot. This all has to be timed perfectly, otherwise the shift will not be successful.

  Similar to this, when going back from position 3 (completely out), to position 2, we first activate V1. Because rod is already completely out, rod will not move. We only move the chamber piston and hold it there. After some time, we activate the V3 which pushes the rod back to the middle position (remember, V1 blocks the rod to go further back).

  Horizontal actuator is the same, but has smaller diameter and has 4 shorter chambers.

- There are 6 tabs that have procedures for direct gear shifts, that is Gear RN/NR, N1/1N, 12/21, .. 56/65. There direct procedures are only used when last gear was successful and horizontal actuator is locked. Locked horizontal actuator means that there are valves open that prevent the horizontal actuator to move. If shift is not successful, all valves are closed and next shift happens using different rules: Vertical 1-2, 3-4 and Horizontal 1-2,3-4.
  After the unsuccessful shift (or after horizontal actuator not being locked) we do 3 phase shifting:
  Phase 1 - vertical actuator goes to neutral. Depending on where the actuator currently is, moves to position to either from 3 or from 1. Procedures for these moves are defined in Vertical 1-2 and 2-3. Position 1 means procedure when going to position 1, Postion 2 – Forward when going to Position 2 while moving out (forward) and Position 2 – Backward when going to Position 2 while moving in (backward).
  If vertical actuator is already in middle position, we skip this phase.
  Phase 2 – horizontal actuator moves to correct position defined by the gear pattern. Similar to vertical, there are different procedures depending on where the current position is and where it has to go to.
  Phase 3 –vertical actuator moves to correct position defined by the gear pattern. Again, there are different procedures depending on where the current position is and where it has to go to.

Valve procedures:

Each procedure line has 3 different selectors.
1 – Command
2 – Parameter
3 – Condition

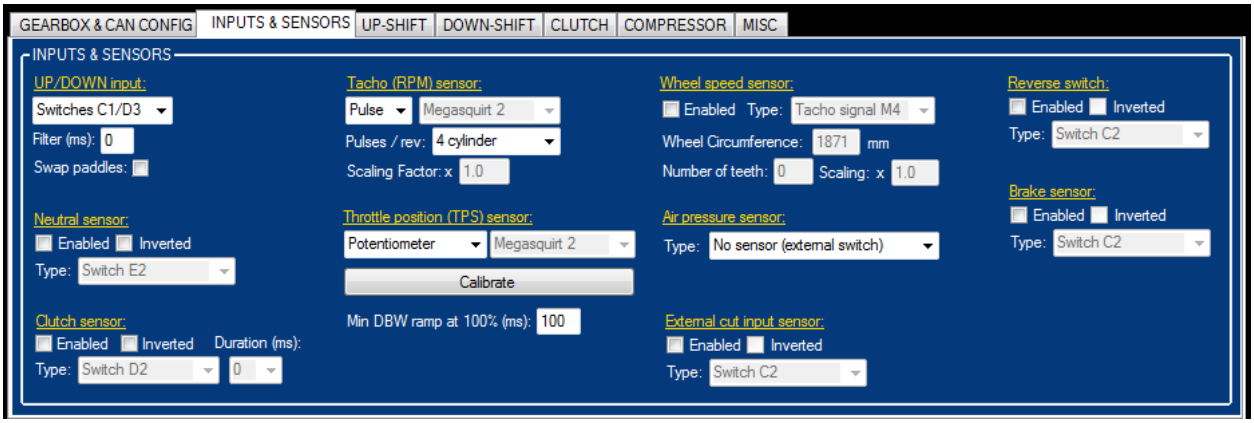
<u>Command and Parameter:</u>
For command you have 2 options: Activate, Deactivate, Wait for.
Activate/Deactivate – activates/deactivates the valve defined by the parameter selector.
Wait for – waits for whatever is specified by the parameter selector:

- Fixed: 5-100ms – fixed delay
- % of Distance to P – gcu will wait for the position to reach specified percentage of move towards P. For example, if we are in Position 1 and we activate V1 (meaning we are going towards position 2), setting 50% of distance to 2 would mean that gcu waits until actuator is in the middle (50%) between 1 and 2. Please note that valve that gets activated/deactivates last defines which actuator we wait for. For example: if we do Activate H horizontal V2, this means that Wait for will wait for horizontal actuator.

Condition:

If condition specified by the selector is met, procedure will fail with error. Please note that these conditions are checked before command is executed.

6) INPUTS & SENSORS



UP/DOWN input

Switches C1/C3

Paddles are connected to the C1 and C3 inputs. Switches need to close to ground when active. To limit false triggering you can add **Filter (ms)** in milliseconds. Entering 50 here would mean that switch needs to be stable for the duration of 50ms (must not switch on and off) before it is detected as a full press.

MME HCU: if MME hand controls are used, this needs to be selected.

Swapping the paddles can be enabled by checking the **Swap paddles.**

NEUTRAL/REVERSE (N/R) SENSOR

It is recommended that Neutral/Reverse sensor is enabled and working. It acts as a safety so you don't accidently shift to neutral from first (or to reverse!) in a race or accidently shifting up while car is running unattended (warming up).

Type: Switch E2

Switch is connected to E2 input. Switch needs to close to ground when active.

Type: MME PDU

Switch is connected to wireless control using MME PDU and configured there.

Type: MME HCU D1-D8

If using MME hand controls, this is where you define which button on the steering wheel is used as a neutral. Make sure the button is properly configured in the HCU configurator. It should be a momentary switch.

CLUTCH SENSOR/SWITCH

This switch is activated when clutch is pressed, either manually or automatically. For most applications,
Type: Switch D2 is used. If switch is on, when it should be off (mechanically), you can **Invert** it.
If switch is disabled, switch is always off so every function in the system that counts on it, will fail.
Duration in milliseconds specifies how long we wait for the sensor to stabilize.
If MME Clutch Actuator is used, type should always be MME CA/CCU.
Typical value: 5 ms

TACHO (RPM) SENSOR

There are two types of TACHO sensors supported.

Type: Pulse
This is standard 0-12V pulse generated by the ECU. See ECU pinout for your car.
When this type is selected, GCU pin M4 must be connected to the corresponding pin on your ECU.

Type: CAN
Reads the RPM from CAN BUS.

CAN Device
If CAN is enabled select the ECU you have. If your ECU is not in the list, please contact us with car info and ideally CAN BUS dataset so we include this in the software & firmware.

Pulses / Rev
This is where you select how many cylinders you car have. This also depends on the tacho output of your ECU so try few options if RPM reading is off.
Not used if CAN is used.

Pulses / Rev – Custom
If you car has unsupported TACHO pattern or is strangely off, you can enter a factor here.
Not used if CAN is used.

THROTTLE POSITION SENSOR – TPS

There are two types of TPS readings available

Type: Potentiometer
This is standard 3 pin potentiometer found on almost every car. When this type is selected, GCU pin B1 must be connected to analog 0-5V sensor. This sensor must first be calibrated. See TPS CALIBRATION below.

Type: CAN
Reads the TPS value from CAN BUS. No calibration is needed.

Type: Integrated DBW
This option is only supported in GCU versions that have 2 CAN BUS connectors and a LED indicator on top. These GCU can control the DBW directly. See wiring.

CAN Device
If CAN is enabled select the ECU you have. If your ECU is not in the list, please contact us with car info and ideally CAN BUS dataset so we include this in the software & firmware.

TPS calibration
TPS sensor must first be calibrated. TPS sensor is calibrated in a way that user presses and releases the pedal and GCU stores the sensor value and calculates the % of pedal press.
To start, click the **CALIBRATE** button and follow the instructions. Press the throttle & click the button again, then release it and click the button again. Don't forget to send the data to the GCU.

WHEEL SPEED SENSOR

Enable this if you have wheel speed sensor install (Not needed in most of applications).

AIR PRESSURE SENSOR

Type: No sensor (external switch)
This option is used if you have pressure switch installed on the bottle. All MME bottles come with pressure switch installed.

Type: 10 bar ratiometric (0.5 – 4.5V)
Analog pressure transducer should be connected to pin A1. Sensor should read 0.5V at 0 bar and 4.5V at 10 bars.

EXTERNAL CUT INPUT SENSOR

External cut input sensor is used as additional trigger that instructs the GCU to cut the ignition.
Please note that this is not the Ignition cut output (pin G2).
An example of external cut input would be if your ECU only has 1 input for ignition cut and you have GCU configured to send the Ignition cut output to that pin and you still want to use the cut sensor on the gear lever. When you manually shift (using the gear lever) GCU will detect this move and send the cut signal to the ECU. This way you can configure fast closed loop shift even if the ecu doesn't support it.

Type: Switch C2
Switch is connected to C2 pin. Switch must close to ground when active.
If sensor is on when it should be off, you can check the **Inverted** option.

REVERSE SENSOR

Reverse sensor is a separate switch that identifies the reverse gear and should not be used on a gearbox that has gear potentiometer and that potentiometer shows the reverse (most gearboxes are like that)

Type: Switch C2
Switch is wired to C2 pin and must be closed to ground when active. If sensor is on when it should be off, you can check the **Inverted** option.

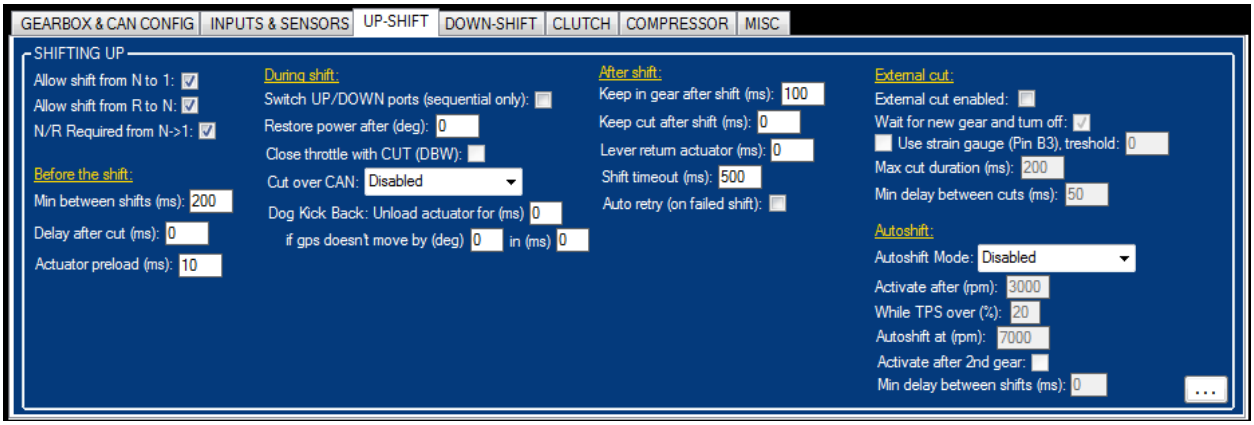
BRAKE SENSOR

Brake sensor is only used with MME Clutch Actuator (CA) and is not needed in most applications.

Type: Switch C2

Switch is wired to C2 pin and must be closed to ground when active. If sensor is on when it should be off, you can check the **Inverted** option.

7) UP-SHIFT



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changed to GCU - F5) in order to take effect.

Allow shift N to 1: If disabled, the only way to shift from neutral to 1st, is by hand. If in H-Paddle Shifter mode to shift to 1st gear, beside this switch enabled, clutch button must also be pressed.
Typical value: Disabled in Sequential mode, Enabled in H-Paddle Shifter mode

Allow shift from R to N: if disabled, the only way to shift from reverse to neutral, is by hand.
Typical value: Disabled in Sequential mode, Enabled in H-Paddle Shifter mode

N/R Required from N->1: if enabled, the only way to shift to 1st gear is by holding the N buton while pressing the up paddle.
Typical value: Disabled in Sequential mode, Enabled in H-Paddle Shifter mode

Before the shift:

Min between shifts: the time in milliseconds allowed between shifts.
Typical value: 150 ms

Delay after cut: how many milliseconds after we cut the power, we actually shift. Please note that this parameter excludes the **Actuator preload**. If you want to use delay after cut, actuator preload must be set to zero.
Typical value: 0 ms

Actuator preload: how many milliseconds before the cut, we start the shift. Air valves usually need around 20ms to fully open, so we can preload the actuator before cutting. Use higher value if pipes to the valves are longer. Please note that this parameter excludes delay after cut. If you want to use actuator preload, delay after cut must be set to zero.
Typical value: 15 ms for dogbox.

During shift:

Switch UP/DOWN ports (sequential only): if checked, up and down output ports are swapped.

Restore power after (deg): This option allows you to return the power before the gear is completely in. If this option is used, it's very important that the engine ECU takes care of the soft power return (gradually applying the full power). This way UP shift can be much smoother with shorter cut.
Typical value: 0 degrees.

Close throttle instead of CUT: If checked, instead of cutting the coil supply or sending "cut" signal, GCU will close the throttle (only available if MME TBC or GCU DBW is used).

Cut over CAN: If enabled, you GCU will send the cut signal to various supported devices. If your device is not listed, let us know.

Dog Kick Back: Unload actuator for (ms_1) if gps doesn't move by (deg) in (ms_2): if either of the values is zero, dog kick back strategy is disabled. If all are > 0, GCU will monitor how many **deg** barrel moves in **ms_2** milliseconds. If it doesn't move **deg** degrees or more, actuator is interrupted for **ms_1** milliseconds.
Typical value: 0 or 8ms if it doesn't move 20 degrees in 50 ms.

After shift:

Keep in gear after shift (ms): how many milliseconds after the gear is engaged, we're still pushing in.
Typical value: 50 ms

Keep cut after shift: how many milliseconds after the gear is engaged, we're still cutting the power.
Typical value: 0 ms

Lever return actuator: one some sequential gearboxes, when actuators are mounted, the return spring is too soft to return the gear lever back into the position. What this does is it pushes the actuator back for specified milliseconds. Only used in Sequential mode.
Typical value: 10 – 15ms if return is slow in sequential mode.

Shift timeout: how many milliseconds we wait for shift to be finished. If gear is not engaged in this period, all the actuators are unlocked and power is restored.
Typical value: 500ms in dogbox, 1500 in synchro

Auto retry (on failed shift): if shift is not successful, this option allows the GCU to shift again once again. If shit is not successful the second time, shift will fail. Not recommended in sequential mode and should be disabled.
Typical value: Disabled.

Autoshift:

Autoshift Mode: Defines the mode used. See below.

Activate after (rpm): After which RPM, Autoshift becomes active. RPM must be over this value to start and, when active, If the rpm drop below this rpm, Autoshift is stopped. Please note that this is NOT the rpm where GCU will shift the gear. That is defined in **Autoshift at**. Only used with 2 stage Autoshift.

While TPS over (%): This is the minimum TPS that needs to be set in order for the Autoshift to work. If TPS drops below this value, Autoshift stops.

Autoshift at (rpm): At which RPM GCU will shift up.

Activate after 2nd gear: If this option is enabled, shifting 1-2 is done manually by the driver and Autoshift will only work in 2-3 and higher. Only used with 3 stage Autoshift.

Autoshift Mode: 3 Stage
In order to use this mode, ECU must support launch control. GCU (Pin G1) will send »Launch« request to the ECU and ECU input must be configured that when this happens, ECU goes into the launch mode (Limit the RPM)
Procedure to start:
- Holding Autoshift button for more than 2 seconds, activates the Launch control. GCU sends active low (ground) signal to the ECU via G1. ECU Must be able to enter Launch state. LED will be blinking slowly.
- While still holding the Autoshift button, we accelerate to a point that we don't need the Launch mode anymore to accelerate freely (car gets enough grip to be able to push 100% throttle)
- We release the button and GCU deactivates the Launch mode (Pin G1), turning the Launch mode inside the ECU off. LED is blinking faster.
- GCU will autoshift to the next gear when RPM is higher or equal to **Autoshift at (rpm)**. If **Activate after 2nd gear is** enabled, it will only shift when in 2nd or higher gear. Driver needs to shift to 2nd gear in this case manually by the paddle.
- Autoshift will continue to shift for as long as TPS is higher than **While TPS over (%)** and Paddle up/down is not pressed. If TPS drops under the **While TPS over (%)** or up/down is pressed by the driver, Autoshift will stop. LED is turned off.

Autoshift Mode: 2 Stage
Procedure to start:
- Driver must turn the autoshift mode on with the autoshift switch. It's important that this switch is toggle (fixed position) and not momentary type. LED will turn on.
- When RPM is over the **Activate after N** rpm & **While TPS is over %,** autoshift mode is activated. LED will be flashing.
- When RPM reaches the specified **Autoshift AT** rpm, it will automatically shift up. LED will still be flashing.
- If throttle is below While TPS over (%) or if paddle up/down switch is pressed, auto shift is automatically disabled. LED will be off.
- To turn on the auto shift mode driver must switch the autoshift off and on again.

Autoshift Mode: Rally: up shift only
- Autoshift switch must be on. LED will be on.
- When RPM is over or equal than **Autoshift at (rpm)** & throttle is higher or equal than **While TPS is over %** it will automatically shift up.
- If Autoshift switch is deactivated, autoshift is disabled.

External cut:

External cut enabled: If enabled it allows to cut the engine via external switch. For this option, external swith should first be configured on INPUT & SENSORS

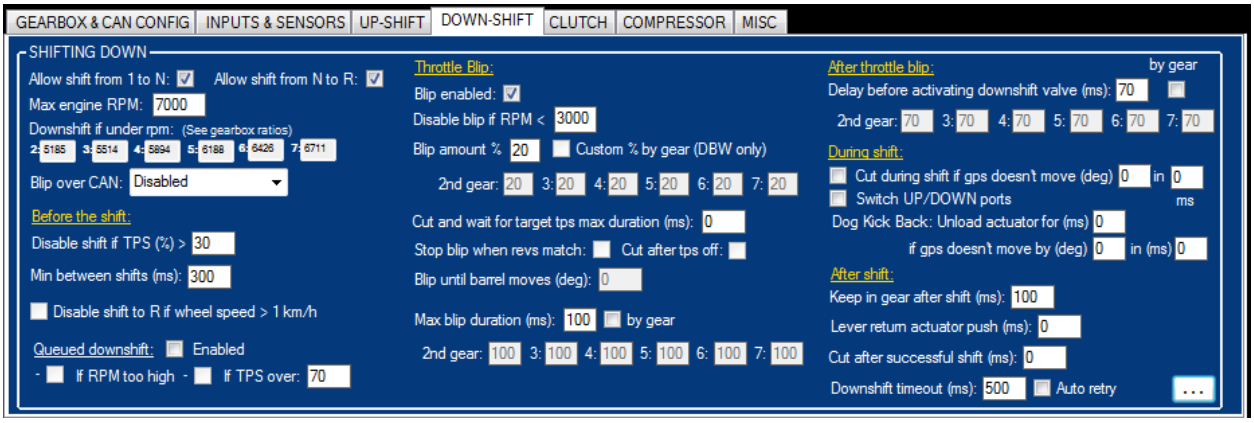
Wait for new gear and turn off: If enabled, cut will be active for as long as the gear is not engaged, but not more than **Max duration.** If this option is disabled, cut will be active for fixed time, **Max duration.**
Typical value: Enabled.

Use strain gauge (pin B3), treshold: if this option is enabled, voltage on B3 pin will tell the GCU to shift if voltage is over the **treshold**. Please note that voltage here is represented with a 10 bit value, so 0 = 0V and 1024=5V. You can see current voltage in digital form next to the treshold window. See SETTING UP GEAR LEVER SHIFT + PADDLE SHIFT TOGETHER

Max duration: Specifies the maximum duration of engine cut. Also see External cut - Wait for new gear and turn off
Typical value: 600 ms.

Min delay between cuts (ms): Specifies the delay between last active cut and the next cut. You will not be able to trigger the cut if last cut ended less than **ms** ago.
Typical value: 200 ms.

8) DOWN-SHIFT



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changed to GCU - F5) in order to take effect.

Allow shift 1 to N: If disabled, the only way to shift from 1st to Neutral is by hand. If in H-Paddle Shifter mode to shift to Neutral gear, beside this switch enabled, clutch & n/r button must also be pressed.
Typical value: Disabled in sequential mode, Enabled in H-Paddle Shifter mode.

Allow shift N to R: If disabled, the only way to shift from Neutral to Reverse is by hand. If in H-Paddle Shifter mode to shift to Reverse gear, beside this switch enabled, clutch & n/r button must also be pressed.
Typical value: Disabled in sequential mode, Enabled in H-Paddle Shifter mode.

Max engine RPM: Specifies the maximum rpm engine is allowed to reach after a downshift. Exact downshift rpm is calculated based on a gear and gear ratio (see GENERAL/SENSORS). Which is the calculated rpm is shown for each gear in the boxes below.
Example: If Max RPM for your engine is 6300 rpm and your second gear ratio is 3.571, GCU calculates the **Downshift if under rpm** for second gear is 3928. What this means is that in second gear, you will not be allowed to shift over 3928 rpm. If you'd shift down in second to first over 3928 rpm, in you would reach more than 6300 rpm in 1st gear which is more than **Max Engine RPM** is.

Blip over CAN: If enabled, GCU will send the blip signal to various supported devices. If your device is not listed and has this option, let us know.

Before the shift:

Disable shift if TPS > %: If throttle is applied (more than **Disable shift if TPS >**) we don't want to allow downshift.
Typical value: 20 %

Min between shifts: the time in milliseconds allowed between shifts.
Typical value: 150 ms

Disable shift to R if wheel speed > 1km/h: if checked, the only way to shift to reverse is if car is not moving. Only used if wheel speed sensor is enabled.
Typical value: unchecked

Queued downshift:

If **Enabled**, GCU will allow the gears to be queued if **RPM is too high** or **If Throttle is over** degrees. What this does is it allows the driver to preselect the desired gear while pushing the throttle. When throttle is released and "safe" rpm is reached, GCU will automatically downshift. The harder you brake, the faster GCU will downshift.
Typical value: Throttle is over 90 %, RPM is too high disabled.

Throttle blip:

Blip enabled: Enables throttle blip actuator. Throttle blip must be connected to GCU Pin J3. See wiring diagram.
If DBW inside the GCUor MME Throttle Body Controller is used you can specify just how much you want to blip the throttle (**Blip amount**), otherwise this option is disabled and you need to set the travel mechanically. If MME TBC is used, you can set custom % for each gear using the **Custom % for each gear.**
Typical value: Enabled on a dogbox, Enabled on synchro with DBW.

Disable blip if RPM <: If RPM is under this value, blip is not used. On a dogbox, blipping in low rpm actually does more harm than good, so we don't want the blip in low rpms.
Typical value: 3000.

Cut and wait for target tps max duration: if > 0, cut is applied together with blip until TPS reaches **Blip amount**. If tps is not reached within the milliseconds specified, cut stops.
Typical value: 0 ms

Stop blip when revs match: if enabled, blip is applied until rpm for target gear is reached (or **Max blip duration** has elapsed). Currently only used with clutch unit. If clutch is not used, leave this disabled. If **Cut after tps off** is enabled, GCU cuts the ignition as soon as these RPMs are reached (instead of just lifting off the throttle)

Blip until barrel moves: Stops blip when relative movement of the gear position sensor is N degrees.
Typical value: 0.

Max blip duration: Specifies what the maximum throttle blip duration is (in milliseconds). Even if specified degrees are not reached, GCU stops the throttle blip. If **by gear** is enabled you have an option to specify max duration for each gear. Note - you are entering values for current gear. So, if you're in 3rd gear, shifting to 2nd, you need to enter value for 3rd gear. If duration is 0 ms, blip for that gear is disabled.
Typical value: 100 ms.

After throttle blip:

Delay before activating valve: how many milliseconds after the throttle blip is closed we activate the downshift actuator. If **by gear** is enabled you have an option to specify delay for each gear.
Note - you are entering values for current gear. So, if you're in 3rd gear, shifting to 2nd, you need to enter value for 3rd gear.
Typical value: 20 ms.

During shift:

Cut during shift if gps doesn't move (deg) in (ms): if checked, GCU will monitor how much barrel moves in specified time. If barrel doesn't reach **deg** in **ms** time, cut is applied for the duration of the shift. If either of the values is 0, cut is applied every time.
Note – only works for gears 2-7
Typical value: 0ms or 50% of the degrees between gears in 50 ms.If for example there are 40 degrees between gears, good value to start is 20 degrees in 50 ms.If barrel doesn't move the 20 degrees in 50ms, GCU applies the cut to help disengage the gear.

Switch UP/DOWN ports (sequential only): if checked, up and down output ports are swapped.

Dog Kick Back: Unload actuator for (ms_1) if gps doesn't move by (deg) in (ms_2): if either of the values is zero, dog kick back strategy is disabled. If all are > 0, GCU will monitor how many **deg** barrel moves in **ms_2** milliseconds. If it doesn't move **deg** degrees or more, actuator is interrupted for **ms_1** milliseconds.
Typical value: 0 or 8ms if it doesn't move 20 degrees in 50 ms.

After shift:

Keep in gear after shift (ms): how many milliseconds after the gear is engaged, GCU keeps the actuator active.
Typical value: 50 ms

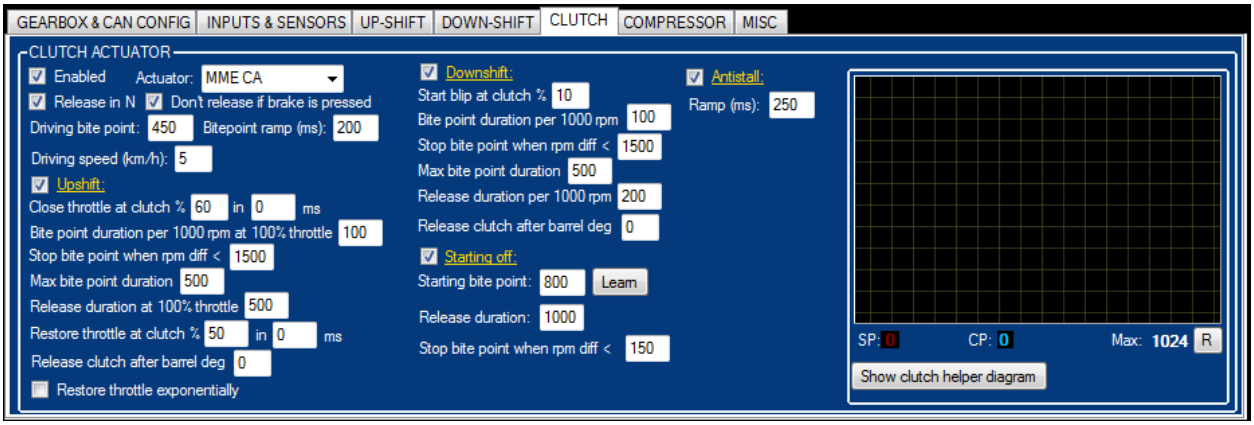
Lever return actuator: one some sequential gearboxes, when actuators are mounted, the return spring is too soft to return the gear lever back into the position fast enough. What this does is it pushes the actuator back for specified milliseconds. Only used in Sequential mode.
Typical value: 10-15 ms.

Cut after successful shift: the time in milliseconds we cut the power after the shift is complete.
Typical value: 30 ms

Downshift timeout: how many milliseconds we wait for shift to be finished. If gear is not engaged in this period, all the actuators are unlocked and power is restored.
Typical value: 500ms in dogbox, 1500 in synchro

Auto retry (on failed shift): if shift is not successful, this option allows the GCU to shift once again. If shit is not successful the second time, shift will fail.
Typical value: Disabled.

9) CLUTCH



Driving bite point: After the shift, this is the position we call bite point and this is the position clutch will go to. Start with the same value as starting bite point (make sure you learn it first). It's easier to test it when downshifting (blip should be turned off for this setup). If, when you down shift, car just doesn't want to synchronize and looks like the clutch is pressed more (for like 1-2 seconds, depending on the max bite point duration setting) then suddenly jerks, it means this value is too high. Do it in -10 steps. Increase it if immediately, after the shift, car jerks too much. How fast the clutch ramps to the bitepoint is defined in milliseconds with **Bitepoint ramp (ms).**

Release in Neutral: If enabled, clutch will be released when you shift to neutral.

Don't release if brake is pressed: If enabled, clutch will be pressed when brake is applied in neutral gear and release when brake is off (if release in N is checked)

Driving speed (km/h): this is the speed that defines that the car is driving normally. This speed is also used as a treshold for the antistall algorithm. If speed drops below this speed and brake is applied, antistall procedure will start.

Upshift:

Close throttle at clutch X in Y ms: When clutch engaging and it reaches X percent, throttle closes in Y milliseconds. This allows smooth transition of clutch/throttle. Duration is only available if TBC module is used.

Bite point duration per 1000 rpm at 100% throttle: Duration in milliseconds that we hold the clutch at bite point. This duration depends on how much the rpm difference between current and target gear is and how much throttle is applied.
Example: value = 100ms, shifting from 2nd to 3rd gear, at 5000 rpm, at 100% throttle, drops us to 3000 rpm. RPM difference is 2000 rpm which means total bite point duration is 200ms. If we did the same at

50%, this value would be 400ms. You can use **Show clutch helper diagram** to see diagram of the parameters entered.

Stop bite point when rpm diff <: if at any time rpm difference (while shifting) is less than **Stop bite point when rpm diff <,** clutch returns to zero (in **Release duration at 100% throttle** time)**.**

Max bite point duration: maximum time allowed for bite point. After this period, clutch returns to zero (in **Release duration at 100% throttle** time)

Release duration at 100% throttle: Duration in milliseconds that we release the clutch in (at 100%). Example: if this value is 100ms and you applied only 50% throttle, this duration will be 200ms.

Restore throttle at clutch % X in Y ms: after the clutch is returning to zero and it reaches below X %, we restore the throttle back in Y milliseconds. This allows smooth transition of clutch/throttle. Duration is only available if TBC module is used.

Release clutch after barrel deg: when barrel reaches this value (delta), GCU will automatically start to release the clutch. Clutch takes some time to respond (around 100-200ms) so we can release the clutch when we're almost in to make shifting faster.
Typical value: 18

Restore throttle exponentially: instead of returning the throttle linearly, we return it exponentially. Only available if Integrated DBW or MME Throttle Controller is used.

Downshift:

Start blip at clutch % X: when clutch is engaging, we start the throttle blip at X percent.

Bite point duration per 1000 rpm: Duration in milliseconds that we hold the clutch at bite point. This duration depends on how much the rpm difference between current and target gear is.
Example: value = 100ms, shifting from 3rd to 2nd gear, at 5000 rpm, rpm rises to 7000 rpm. RPM difference is 2000 rpm which means total bite point duration is 200ms. You can use **Show clutch helper diagram** to see diagram of the parameters entered.

Stop bite point when rpm diff <: if at any time rpm difference (while shifting) is less than **Stop bite point when rpm diff <,** clutch returns to zero (in **Release per 1000 rpm** time)**.**

Max bite point duration: maximum time allowed for bite point. After this period, clutch returns to zero (in **Release duration per 1000 rpm** time)

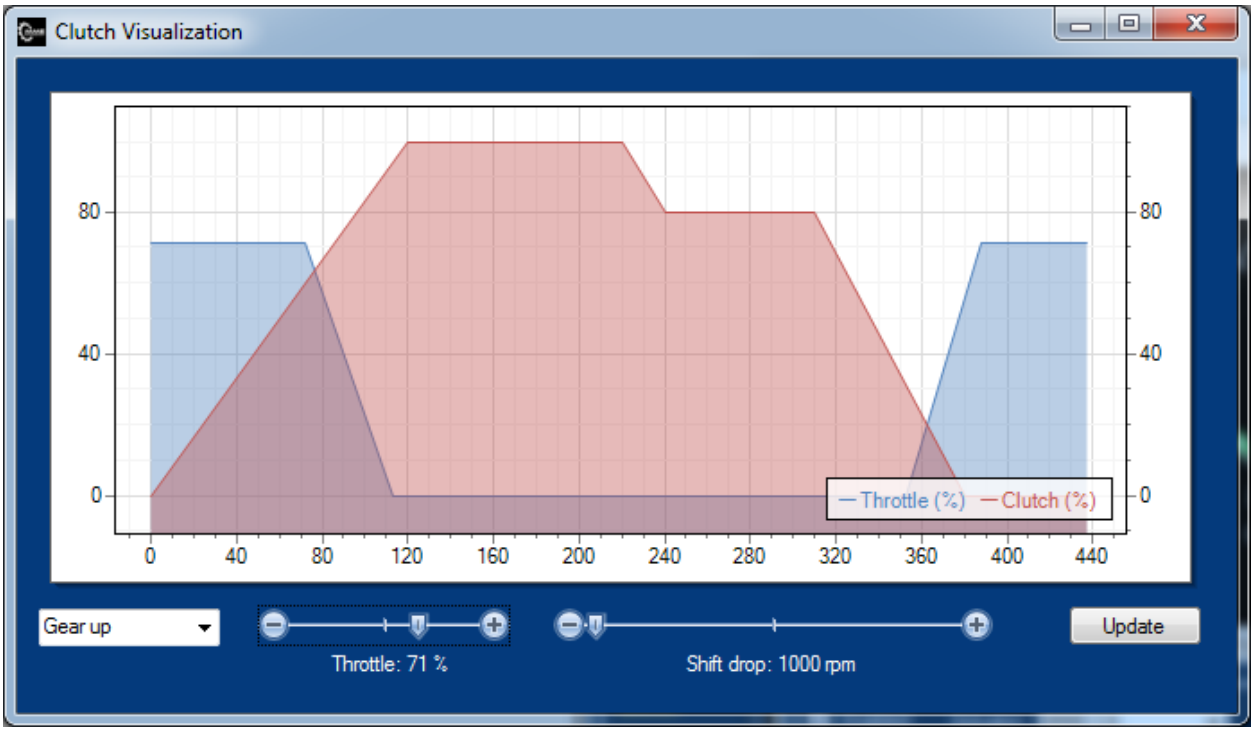
Release clutch after barrel deg: when barrel reaches this value (delta), GCU will automatically start to release the clutch. Clutch takes some time to respond (around 100-200ms) so we can release the clutch when we're almost in to make shifting faster.
Typical value: 20

Starting off:

Starting bite point point: For the first time and after some time, it's advised to learn the bite point. This is done by pressing **Learn** button. Procedure to learn the bite point:
- put the car in first gear and press the brake (clutch should be fully in)
- click **Learn** button
- release brake
- clutch will start to move slowly. As soon as you feel the car changing noise/moving, press the brake again.
- this is it. No other actions needed. You can experiment with few different "feeling points" to get optimal result.

Stop bite point when rpm diff <: if at any time rpm difference (while starting) is less than **Stop bite point when rpm diff <,** clutch returns to zero (in **Release duration at 100% throttle** time)**.**

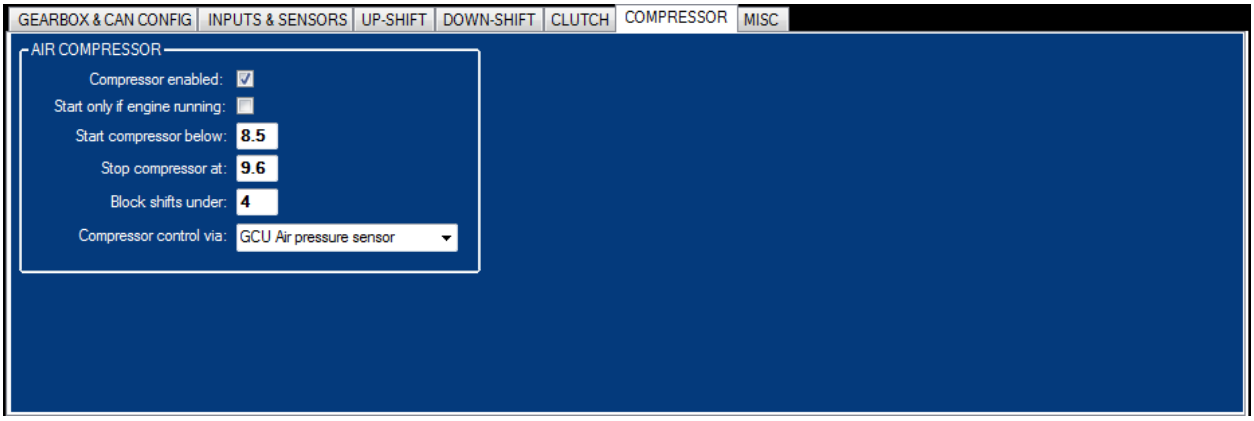
Release duration at: Duration in milliseconds that we release the clutch in when brake is released.



Antistall:

If **Enabled** antistall will trigger automatically in specified **Ramp (ms)** if wheel speed drops below the **Driving speed (km/h)** and brake is applied. If brake is not applied,antistall is disabled. Antistall is not possible without **Starting off** enabled.

10) COMPRESSOR



Compressor enabled: check this if you want GCU to control the compressor. GCU will always wait 15s before turning it on for the first time. It does this by activating signal output F3. Output can only be used as a signal to activate relay coil. It cannot be used to directly power the compressor.

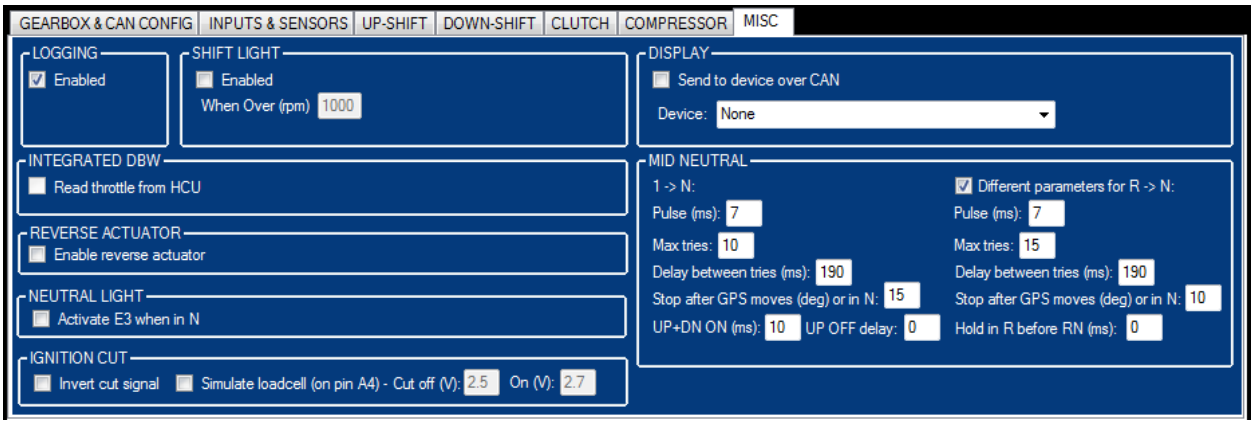
Start only if engine is running: if this enabled, gcu will not turn the compressor on unless the engine is running (rpm over 800).

Compressor operation:
GCU will start the compressor if pressure is below **Start compressor below** and will run it until **Stop compressor at** is reached. If pressure is below **Block shifts under** GCU will prevent the driver from shifting.

Compressor control via: GCU Air Pressure sensor
This option will use analog pressure sensor on pin A1. Before using this, you need to configure it under INPUT & SENSORS / Air pressure sensor.

Compressor control via: External Switch
This option assumes you have external pressure switch installed that turns the compressor on/off. When this option is selected, GCU will only delay the power on and control it if car is running or not.

11) MISC



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changed to GCU - F5) in order to take effect.

On power on options allow to set up what actions are taken when you power up the gcu**. Vertical actuator: go to position 2 if invalid** will move the vertical actuator to position 2 if position on power up is not in the middle (2), completely out (3) or completely in (1). This allows you to always start with a neutral gear if car stops somewhere “in between

LOGGING

Leave it **Enabled** if you want to use GCU logging features.

SHIFT LIGHT

If **Enabled** GCU will activate the output F1 (active low) if current engine rpm is higher than **RPM**. See wiring diagram for more info.

INTEGRATED DBW

Read throttle from HCU: if checked, GCU will try to read throttle position from Hand Control Unit (HCU) and override the throttle if it's higher than the manual (foot) throttle. See SETTING UP DRIVE BY WIRE.

REVERSE ACTUATOR

Enable reverse actuator: if enabled, GCU pin F2 will be used as a reverse actuator. This means that when you shift to reverse, GCU will not shift up/down actuators, but separate, reverse actuator connected to pin F2.

NEUTRAL LIGHT

When **Activate E3 when in N** is active, output on E3 will be active when in neutral.

IGNITION CUT

If **Invert cut signal** is checked, cut output (Pin G2) is active when cut is off.
If **Simulate loadcell (on PIN A4)** is checked, GCU will output **Cut off (V)** voltage on PIN A4 when cut is not active and **Cut on (V)** voltage when active. Good example of this would be 2.5V for cut off and ~3V for cut on.

DISPLAY

Send to device over CAN: If this is enabled, GCU will output can bus dataset with gear, rpm, button pressed etc. If *MME Motorsport DASHBOARD* is used, this is the dataset that is broadcasted to the bus:

CAN2.0B, 11 bit, 8 bytes. 16 bit values sent high byte first (MSB)

BASE ID: 1983
DLC: 8
BYTE 0: gear number [0-8], 8 being reverse.
BYTE 1: air pressure. To get pressure in bar you need to divide it with 10.
BYTE 2: active switches [*B0 – up sw, B1 – down sw, B2 – clutch sw, B3 – auto sw, B4 – N switch, B5 – ext cut sw, B6 – brake sw, B7 – reverse sw*]
BYTE 3+4: engine rpm
BYTE 5: active outputs [*B0 – autoshift on, B1 – autoshift led on, B2 – cut on*]
BYTE 6: error number [*0 – no error, 1 – gear not reached, 2 – incorrect gear reached, 3 – unknown gear, 4 – timeout waiting, 5 – cylinder not in correct position, 6 – throttle too high, 7 – shift too early, 8 – pressure too low, 9 – shift from NR not allowed, 10 – shift from 1N not allowed, 11 – rpm too high, 12 – neutral not detected, 13 – clutch not released in time, 14 – clutch not pressed, 15 – clutch not detected*]
BYTE 7: free

Blink gear over RPM: It's possible for the GCU to blink the gear when over certain RPM.

MID NEUTRAL

When enabled (see GENERAL under GEARBOX) it allows the GCU to shift partially to neutral between 1 and R. It does this by pulsing the valve, while checking if the gear is neutral or has moved for more than **Stop after GPS moves** degrees. **Pulse** is the amount of time valve is open, **Max tries** is how many times we activate it and **Delay between tries** is the duration before we do another cycle (valve is closed during this time). If needed, you can enable **Different parameters for R->N** to have different parameters for R-N. To slow down the actuator, it's also possible to hold UP+DOWN valve for **UP+DOWN ON** duration and then turn UP off after **UP OFF delay.** Similary, for RN, you can first activate reverse (already in reverse so no movement is allowed) for the duration of **Hold in R before RN** and then release the reverse before shifting to N.

Typical value: Pulse: 8ms, Max tries: 5, Delay: 450ms, Stop after gps moves: 10

12) SEQUENTIAL GEARBOX – QUICKSTART

Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changes to GCU - F5) in order to take effect.

After successfully connected to the GCU7 (green bottom bar in the software), go to the **GENERAL/SENSORS** tab and:

- Select **GEARBOX Type** to Sequential.
- Under **GEARBOX Function**, Select Standalone if you want the GCU to take care of the cutting, blip signal and every other operation needed to shift. If you have Engine ECU capable of complete paddle shifting logic, use Ext. Logic. Please note: if you only do the cutting with Engine ECU, you still need the Standalone, because GCU7 will still need to send a signal to cut.
- Adjust **NEUTRAL SENSOR** and **CLUTCH SENSOR** accordingly. If you will shift with the paddles from N->R, R->N, N->1 or 1->N you need to enable this switch. For more info setting the clutch sensor see GENERAL/SENSORS in chapter II.
- Verify that all connected inputs are working correctly. In the top right corner you can see if GCU7 sees the signals. Inputs to look for and: UP paddle, DOWN paddle, Neutral*, Clutch*.
- Verify the **UP**, **DOWN, BLIP** and **Ignition CUT** outputs by pressing the output tests. Please note that if you're using engine ECU to do Ignition CUT and Blip, you need to connect wires G2 (White/black) for the Ignition CUT and J2 (Yellow/Pink) for the throttle blip and configure them accordingly in the ECU software. They're active low which means that they close to ground when they're active.
- Enter number of gears and gear ratios in the **GEARBOX** group and go to **DOWN** tab and adjust the **Max engine RPM** parameter. This is the absolute maximum engine rpm you will able to reach when downshifting. Go back to the **GENERAL/SENSORS** tab.
- If you use pressure sensor (usually not the case), enable the **AIR PRESSURE SENSOR** and enter max sensor pressure. Currently, we only support 4-20 mA sensors (connected to GCU7 pin A1).
- Adjust **TACHO SENSOR** and **TPS**, including the TPS Calibration process if needed (**Calibrate** button). Make sure the RPM and TPS are working properly. For more info see GENERAL/SENSORS in chapter II.
- Under **GEAR POSITION SENSOR** click the **Calibrate** button and follow the instructions to calibrate the position sensor. What this will do is it will ask you to go through all gears and store the position to each gear. You can then adjust the tolerance or gear position values for each gear by entering the number of degrees in the dropdown. Clicking on the **<** next to the gear will store current gear position value into the field.

Go to **UP** tab and:

- Adjust **Allow shift from N to 1** and **R to N** accordingly.
- Put these to 0: **Delay after cut**, **Keep cut after shift**, **Don't cut if TPS <**, **Actuator preload**, **Lever return actuator**. Increase **Delay after cut** if engine is slow to respond to the cut.
- Disable: **Auto retry on failed shift**, **Autoshift** and **External cut**.
- Set **Min between shifts to** 200ms.
- If you have MME TBC module installed (drive by wire), uncheck the **Close throttle instead of CUT.**

Under **DOWN** tab:

- Adjust **Allow shift from 1 to N** and **N to R** accordingly.
- Adjust the **Max engine RPM** parameter. This is the absolute maximum engine rpm you will able to reach when downshifting.
- Disable: **Allow partial shift**, **Queued downshift** and **Autoretry on failed shift**.
- Enable Blip and set **Max blip duration** to 150ms. If you have MME TBC, put 30% into **Amount** and leave the custom % for each gear unchecked.
- Set **Delay before activating the valve** to 10ms.
- Set the **Disable blip if RPM** to 3000 and **Close blip** to 0ms. If you use MME TBC, you can also adjust the blip % for each gear. Good value for every gear to start is 30%. Uncheck if MME TBC is not used.
- Set **Cut with blip + max cut duration** to 50 ms
- Set **Blip until barrel moves (deg)** to the half travel between the gears. For example: if you have 2nd gear at 100 degrees and 1st gear at 160 degrees, total travel between the gears is 60 degrees. Put in half of it, 30 degrees, or a little less.
- Leave **Rev match** unchecked.
- Set **Keep in gear after shift** to 100ms.
- Set **Cut after successful shift** to 50ms.
- Set **Downshift timeout** to 500ms.

Under **COMPRESSOR** tab:

- Enable the Compressor.
- Adjust **Start only if engine running** accordingly.
- Set **Compressor control via** to External switch.

You're all set ☺

13) H PATTERN GEARBOX – QUICKSTART

Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU or Send Changed to GCU - F5) in order to take effect.

After successfully connected to the GCU7 (green bottom bar in the software), go to the **GENERAL/SENSORS** tab and:

- Select **GEARBOX Type** to H-Pattern. If you have our clutch actuator and this is synchromesh gearbox, choose H / Synchromesh, otherwise H / Dogbox.
- Under **GEARBOX Function**, Select Standalone if you want the GCU to take care of the cutting, blip signal and every other operation needed to shift. If you have Engine ECU capable of complete paddle shifting logic, use Ext. Logic. Please note: if you only do the cutting with Engine ECU, you still need the Standalone, because GCU7 will still need to send a signal to cut.
- Adjust **NEUTRAL SENSOR** and **CLUTCH SENSOR** accordingly. If you will shift with the paddles from N->R, R->N, N->1 or 1->N you need to enable this switch. If you're using clutch actuator, clutch sensor has to be enabled and Type set to MME CA/CCU.
- Verify that all connected inputs are working correctly. In the top right corner you can see if GCU7 sees the signals. Inputs to look for and: UP paddle, DOWN paddle, Neutral*, Clutch*.
- Verify the **Ignition CUT, Blip (**if present) outputs by pressing the output tests.
- Enter number of gears and gear ratios in the **GEARBOX** group and go to **DOWN** tab and adjust the **Max engine RPM** parameter. This is the absolute maximum engine rpm you will able to reach when downshifting. Go back to the **GENERAL/SENSORS** tab.
- If you use pressure sensor (usually not the case), enable the **AIR PRESSURE SENSOR** and enter max sensor pressure. Currently, we only support 4-20 mA sensors (connected to GCU7 pin A1).
- Adjust **TACHO SENSOR** and **TPS**, including the TPS Calibration process if needed (**Calibrate** button). Make sure the RPM and TPS are working properly. For more info see GENERAL/SENSORS in chapter II.

Go to **UP** tab and:

- Adjust **Allow shift from N to 1** and **R to N** accordingly.
- Put these to 0: **Delay after cut**, **Keep cut after shift**, **Don't cut if TPS <**, **Actuator preload**, **Lever return actuator**. Increase **Delay after cut** if engine is slow to respond to the cut.
- Disable: **Auto retry on failed shift**, **Autoshift** and **External cut**.
- Set **Min between shifts to** 200ms.
- If you have MME TBC module installed (drive by wire), uncheck the **Close throttle instead of CUT.**

Under **DOWN** tab:

- Adjust **Allow shift from 1 to N** and **N to R** accordingly.
- Adjust the **Max engine RPM** parameter. This is the absolute maximum engine rpm you will able to reach when downshifting.
- Disable: **Allow partial shift**, **Queued downshift** and **Autoretry on failed shift**.
- Enable Blip and set **Max blip duration** to 150ms. If you have MME TBC, put 30% into **Amount** and leave the custom % for each gear unchecked.
- Set **Delay before activating the valve** to 10ms.
- Set the **Disable blip if RPM** to 1000 for a synchromesh or 3000 for a dogbox and **Close blip** to 0ms. If you use MME TBC, you can also adjust the blip % for each gear. Good value for every gear to start is 30%. Uncheck if MME TBC is not used.
- Set **Cut with blip + max cut duration** to 50 ms
- Set **Blip until barrel moves (deg)** to 27 degrees.
- Leave **Rev match** unchecked.
- Set **Keep in gear after shift** to 100ms.
- Set **Lever return actuator** to 0ms.
- Set **Cut after successful shift** to 50ms.
- Set **Downshift timeout** to 500ms for a dogbox, otherwise 1500ms if you have synchromesh gearbox.

Under **COMPRESSOR** tab:

- Enable the Compressor.
- Adjust **Start only if engine running** accordingly.
- Set **Compressor control via** to External switch.

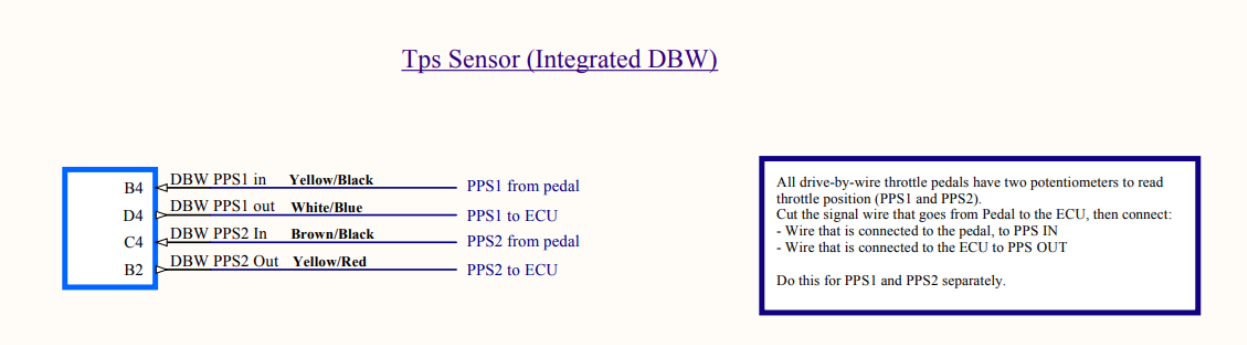
Under **CLUTCH** tab:

- Leave the **Enabled** unchecked and skip this chapter if you have a dogbox, otherwise leave it checked.
- Under Starting off: Set **Starting PID** to 0.1, 0.1, 0 and **PID2** to 0.1, 0.1, 0. **Stop bitepoint when rpm diff** to 100, **Release duration at 100% throttle** to 1500. Clutch actuator needs to be configured before continuing. Put the car in first gear and press brake, clutch should be pressed by the actuator. If it is not, do not continue. If clutch is pressed, while holding the brake, press the Learn button and release the brake. Clutch should start moving slowly. Once your car starts to change noise, press the brake again. Bite point is now learnt (this value is read only so the only way to see it is to load the settings from the GCU and it change). Send the settings to the GCU and try releasing the brake, car should start moving. For more info about setting the PID for starting off, see CLUTCH.
- Set **Driving bite point** to 100 less than the starting bite point. To properly tune this value see CLUTCH.
- Under Upshift: set **Close throttle at clutch** to 30 % in 0ms, **Bite point duration per 1000 rpm at 100% throttle** to 0, **Stop bite point when rpm diff** to 200, **Release duration at 100% throttle** to 1000, **Restore throttle at clutch** to 90 %. See CLUTCH for more info on setting these later on.
- Under Downshift: set **Start blip at clutch** to 20%, **Bite point duration per 1000 rpm** to 2000, **Stop bite point when rpm diff** to 200, **Max bite point duration** to 2000 and **Release duration per 1000 rpm** to 500. See CLUTCH for more info on setting these later on.

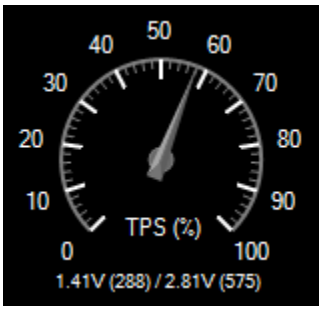
14) SETTING UP DRIVE BY WIRE

Before starting, you need to identify the potentiometer wires on the pedal. On most cars there are 2 potentiometers (even 3 in some cases).What you need to do is put the GCU in the middle of the pedal and ECU so GCU is able to control blip the throttle automatically.

From the GCU's wiring diagram:



After you set the **TPS/Type** to Integrated DBW and if everything is connected properly, you should see voltages under the TPS gauge:



There are 2 versions possible:

- First one is V1/V2 where V2 is 2xV1. It's important that in this configuration V1 is lower than V2. If it's the other way around, you need to switch the wires so you get correct reading.
- Second one is V1/V2 where V2 is inversed V1. If V1 is 0.5, then V2 is 4.5V. When you press the pedal, V1 increases, while V2 decreases. Again, V1 needs to be smaller than V2. If it's the other way around, you need to switch the wires so you get correct reading.

After you have the wiring set, you need to calibrate the throttle. You do this by pressing the CALIBRATE button and following the instructions. Once everything is finished, make sure you send the settings to GCU (F5) and you can try testing the blip. TPS should move with the pedal. You can do blip test by pressing the **Blip actuator** test button. The duration and amount of the blip when clicking the test button is defined by **Max blip duration (ms)** and **Blip amount %.**

For tuning the blip, see TUNING – DOWN SHIFT

15) SETTING UP GEAR LEVER SHIFT + PADDLE SHIFT TOGETHER

GCU supports having 2 ways to shift simultaneously. This way you can use GCU to do closed loop shift if you decide to shift via paddles or use your existing gear lever to shift.

A) <u>If you have a switch that gets triggered when you move the gear lever:</u>
You have to wire gear lever/gearbox switch to GCU PIN C2 (Ext. Cut Switch) and enable external cut in UP-SHIFT/**External cut enabled**. Note that all switches inside GCU are active low, which means they are active when they are connected to ground. Enable **Wait for new gear and turn off** to enable closed loop, disable the **Use strain gauge** and set **Max cut duration** to what you want to max cut duration to be. If gear is not engaged within that time, cut will automatically stop and power will be restored. 300ms is a good start. Set **min delay between cuts** to 200ms, which limits the re-triggering of the cut.

B) <u>If you have a strain gauge/loadcell sensor that outputs voltages when you move the gear lever:</u>
You have to wire loadcell output (0-5V) to GCU PIN B3 (Strain Gauge Voltage) and enable external cut in UP-SHIFT/**External cut enabled**. Enable **Wait for new gear and turn off** to enable closed loop, enable the **Use strain gauge** and save settings to GCU (F5). You will see a number changing next to **treshold** box. This is the digital value of the load cell GCU is reading (5V is 1024). Move the gear lever and set the number you'd like GCU to trigger the cut. As soon as this number is higher than the **treshold**, GCU will start the cut.
Set **Max cut duration** to what you want to max cut duration to be. If gear is not engaged within that time, cut will automatically stop and power will be restored. 300ms is a good start. Set **min delay between cuts** to 200ms, which limits the re-triggering of the cut.

16) TUNING - UP SHIFT

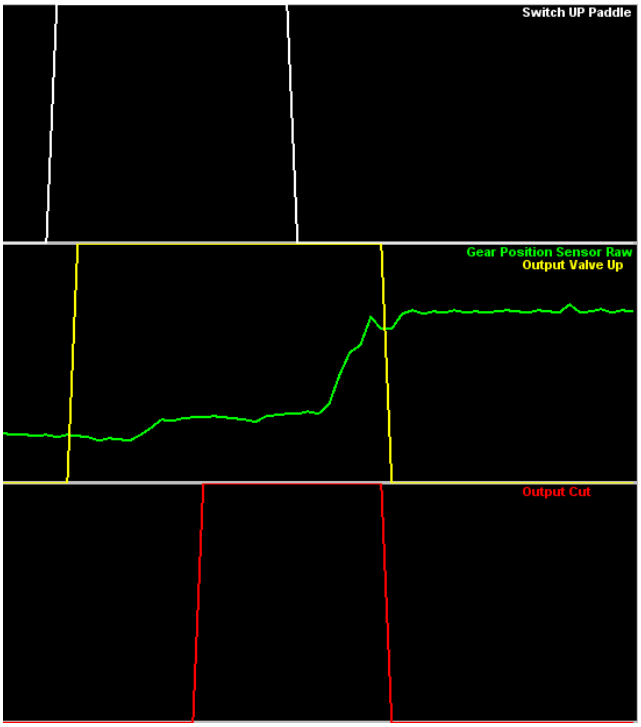
GCU has datalogging capabilities that allow you to capture all shifting events. Logs can be accessed using menu **Log/Read full data from GCU** or using Log manager and download each session. As these logs tend to get huge, we recommend reasing the log before testing the parameters & then downloading the log. Downloaded logs require additional Megalogviwer software to be installed. Software can be downloaded here: https://www.efianalytics.com/MegaLogViewer/download/

You should always verify the parameters with datalogging.

For upshift to be successful, there are 2 most important factors:

- Engine cut is agressive enough to do fast torque reduction
- Delaying the shift so engine has time to unload the gearbox properly

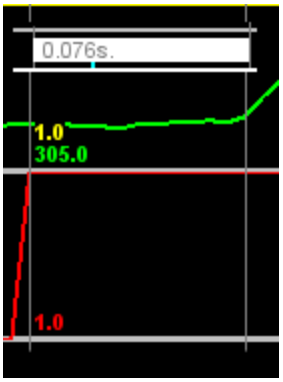
Here's an example of incorrectly tuned up shift:



You can see that after pressing the paddle (white), shift actuator (yellow) is activated which immediately starts pushing the gearbox barrel forward (green). Because cut happens too late (red), gearbox is struggling with the shift and barrel doesn't move which means the gearbox is unable to change gears because the engine has not reduced the power enough. At 75% of the cut duration, gear engages which means that engine has reduced the torque enough.

There are 2 parameters that define how fast actuator is activated.
First one is **Delay after cut (ms)** and second **Actuator preload (ms)**.
Actuator preload 10ms means that we first move the actuator and then start the cut after 10ms, while Delay after cut 10ms means we cut for 10ms and then move the actuator.
Both at 10ms for example means no delay. We cut immediately when we activate the actuator.

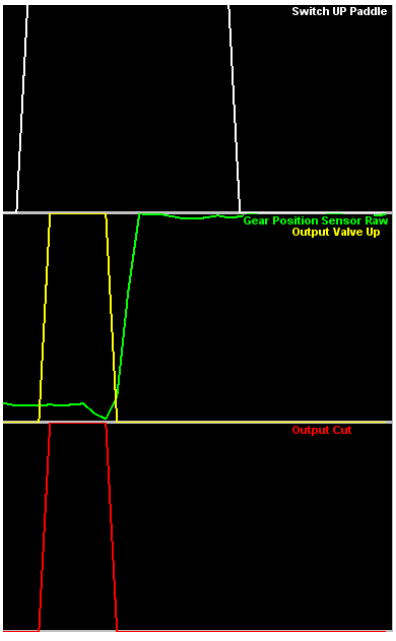
If we go back to the example, just by removing the Actuator preload (setting it to 0) and adding 75ms delay after cut, makes things much better. 75ms is the amount of time current ECU cut strategy needs to unload the gearbox:



Another important factor are ECU settings. It's very imprtant that there are no fixed durations and that ECU cut is set so cut is active for as long as GCU has the cut signal active.

Most cars work best at around 90% ignition cut + ignition retard. How much retard is needed depends on the car. Values from 10 to 20 degrees work best.

Example of perfect up shift:



17) TUNING - DOWN SHIFT

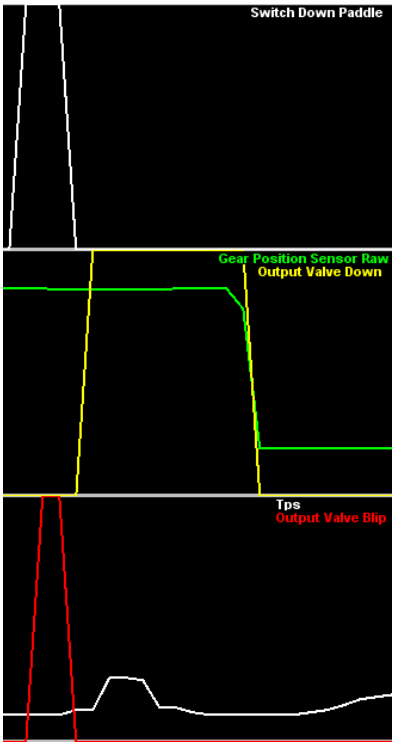
GCU has datalogging capabilities that allow you to capture all shifting events. Logs can be accessed using menu **Log/Read full data from GCU** or using Log manager and download each session. As these logs tend to get huge, we recommend reasing the log before testing the parameters & then downloading the log. Downloaded logs require additional Megalogviwer software to be installed. Software can be downloaded here: https://www.efianalytics.com/MegaLogViewer/download/

You should always verify the parameters with datalogging.

For down shift to work correctly, here is an order of events that must follow to make the shift as smooth as possible:

- Throttle blip is activated. It should be long and big enough to get the engine to respond with the “wuf”. **Blip amount** (TPS %) and **Max blip duration** are the parameters that define this. 25% and 100ms is a good starting point. It should not rev too much, just enough so it transfers the torque from negative (gearbox pushing the engine) to positive torque (engine pushing the gearbox)
- In the moment blip is closed (when positive torque is being transferred to negative), we must start the shift. When shift starts is defined by **Delay before activating.** 50ms is good start.

Example of good down shift:



Here you can see that we add blip, then later on start the actuator. You can see that it takes some time that engine reacts to the blip (red). You can see the amount of TPS it reaches (white).

The longer the downshift, the rougher will the shift be so you want to make the shift as fast as possible. If there's too much throttle, engine will push the gearbox forward. One way of preventing this is to add cut after the shift. In most cases, if blip is properly tuned. this is not needed.

18) FREQUENTLY ASKED QUESTIONS AND TROUBLESHOOTING

Can't connect to the GCU

If you see a red DISCONNECTED bar in the bottom it means that either USB CAN interface is not plugged in or you don't have proper drivers installed. On Windows 7 and newer, drivers are automatically installed once you plugged in, but it could take up to 5 minutes from the to finish loading. If you have Windows XP you need to install the drivers from the drivers folder.

If you see an orange CAN INTERFACE CONNECTED, WAITING FOR THE GCU bar in the bottom, it means that USB CAN interface is successfully detected and that you need to connect the GCU can bus.
Reasons for GCU not responding:
- GCU is not powered properly (L1 needs 12V and M1 needs GND)
- CAN BUS speed is incorrectly set (You can change interface speed in top right corner)
- CAN BUS is not properly terminated. If you're connecting to the existing CAN BUS line, it's a good chance that CAN BUS is already terminated, so you need to remove the jumper from the USB CAN Interface (See CONNECTING TO THE GCU). If GCU is not connected to an external CAN BUS line, USB CAN Interface needs to have the jumper inserted! To check if CAN BUS is properly terminated, remove the USB Interface from the USB port, power off all the devices (that are connected to the CAN BUS) and measure resistance between CAN+ and CAN-. Existing network should have reading between 50-60 ohms, while no CAN BUS should have 100 ohms (with jumper inserted). Please note that you need to measure with car turned off and usb interface disconnected from the USB PORT.

I can shift up, but can't shift down

First, verify that paddles are correctly configured and detected (GENERAL/SENSORS).
Most common reason is caused by TPS being incorrectly set up. GCU will prevent down shift if TPS is too high. How high it can be is configured by the **Disable shift if TPS** setting in the DOWN tab. Make sure you have TPS properly setup, correct **TPS type** selected (GENERAL/SENSORS) and calibrated. See GENERAL/SENSORS for more info.
Second most common reason are **Gearbox ratios** (GENERAL/SENSORS - GEARBOX) & **Max engine RPM** (DOWN) being incorrectly set RPM sensor

Blip works when I activate it from the software, but does not work when shifting

First, make sure the blip is enabled (DOWN/**Blip enabled** checked). Blip will not work if RPM is lower than the number specified in DOWN/**Disable blip if RPM <.** What this does is it prevents the blip to work in lower rpms. Enter 0 here to enable blip for all rpms or if RPM signal is not working properly. Lastly, check if DOWN/**Blip until barrel moves (deg)** is 15 or more. What this does is it activaing the blip until gear position reaches this degrees (relative).

Cutting doesn't seem to work when I shift up

Most common reason for the cut not to fire is when clutch is pressed. Make sure that clutch switch is working properly (input button must »light on« when you press the clutch. Invert it if needed). If you do not have clutch switch installed, you need to disable it. Cut will also not work for N->1 and R->N shifts.

I can shift all gears but N, R and 1st (from N)

Make sure you have Neutral and Clutch Sensor properly configured. When shifting up from Neutral or Reverse, check **Allow shift from N to 1**, **Allow shift from R to N** and **N/R Required from N->1** under UP tab, if they're properly set. Same goes for **Allow shift from 1 to N** and **Allow shift from N to R** under DOWN tab. Also, see GENERAL OPERATING GUIDE on how to shift.

Compressor doesn't turn on

If your car is not running and you want compressor to run, you need to uncheck the **Start only if engine running** under AIR COMPRESSOR tab. Please note that only way of GCU detecting car is running is by properly reading the RPM. If you don't see any RPM reading, this setting will not work properly.
Please note that GCU waits 15s after power on to turn on the compressor.
If the Output status in the GCU software shows **Compressor** is active and compressor still isn't running and air bottle is not full, check the fuse on the bottle. If fuse is not blown, check if it's properly wired. Pin 86 of the relay should have 12V on it and pin 85 switches to ground when GCU has compressor output active.

Gear indicator doesn't show correct gear

It might need to be calibrated:
- Put the car in reverse (or in neutral if you don't have reverse)
- Turn the power off and on (ideally just the display) 6 times, immediately after the LEDS light on and before real gear is shown
- R will start blinking. Display is now learning the value for reverse. If you don't have reverse, wait for it to start blinking N
- N will start blinking. While N is blinking, shift to neutral and wait until it starts to blink next gear.
- Do this for all other gears until is stops blinking

19) PINOUT

GCU	Function	Wire color	Note
A1	Pressure transducer	Yellow	Input [0-5V]
A2	Gear position for sequential gearbox or Gear position Vertical for H pattern	Blue	Input [0-5V]
A3	Ground for sensors	Black	Ground
A4	Gear output	White/Red	Output [0-5V], 200 mA
B1	Throttle position sensor	Red/Blue	Input [0-5V]
B2	DBW PPS2 OUT	Yellow/Red	Output [0-5V]
B3	Strain Gauge Voltage for sequential gearbox or Gear position Horizontal for H pattern	Green	Input [0-5V]
B4	DBW PPS1 IN	Yellow/Black	Input [0-5V]
C1	Up paddle switch	White	Input [active low]
C2	Ext. Cut switch / Brake Switch / Reverse Switch	Green/Black	Input [active low]
C3	Auto switch	White/Green	Input [active low]
C4	DBW PPS2 IN	Brown/Black	Input [0-5V]
D1	N.C.		
D2	Clutch switch	Brown	Input [active low]
D3	Down paddle switch	Violet	Input [active low]
D4	DBW PPS1 OUT	White/Blue	Output [0-5V]
E1	N.C.		
E2	N/R switch	Brown/Red	Input [active low]
E3	Vertical valve 2 for H pattern	White/Grey	Output [active low]

E4	N.C.		
F1	Shift Light	Brown/Blue	Output [active low]
F2	Reverse valve	White/Pink	Output [active low]
F3	Compressor relay	Pink/Green	Output [active low]
F4	N.C.		
G1	Auto Launch	Pink/Brown	Output [active low]
G2	Ignition cut	White/Black	Output [active low]
G3	Vertical valve 3 for H pattern	Grey	Output [active low]
G4	N.C.		
H1	Horizontal valve 3 for H pattern	Yellow/Brown	Output [active low]
H2	Horizontal valve 4 for H pattern	Brown/Green	Output [active low]
H3	Up valve output for sequential gearbox or Horizontal valve 2 for H pattern	White/Yellow	Output [active low]
H4	N.C.		
J1	Vertical valve 1 for H pattern	Yellow/Grey	Output [active low]
J2	Throttle blip valve	Yellow/Pink	Output [active low]
J3	Vertical valve 4 for H pattern	Green/Blue	Output [active low]
J4	CAN-	Grey/Green	
K1	Down valve for sequential gearbox or Horizontal valve 1 for H pattern	Grey/Brown	Output [active low]
K2	Auto LED	Green/Red	Output [active low]
K3	N.C.		
K4	CAN+	Grey/Pink	

L1	Ignition 12V	Red (0.75 mm^2)	Ignition switch
L2	N.C.	N.C.	
L3	5V supply for sensors	Pink	Max 100 mA
L4	N.C.		
M1	Battery -	Black (0.75 mm^2)	
M2	Coil supply OUT	Yellow/Green (1.5 mm^2)	12V output
M3	Coil supply IN	Yellow/Green (1.5 mm^2)	12V input
M4	Tachometer (RPM)	Yellow/Blue	Input [0-20V]

Notes:

1. Input [active low] means that switch is activated with ground applied to the input.
2. Output [active low] means that when active, output is switched to ground so when you wire the valve, one wire needs to be 12V from L1 (ignition switch and fused - not directly to battery!) and the second wire to this output.