Gear Control Unit

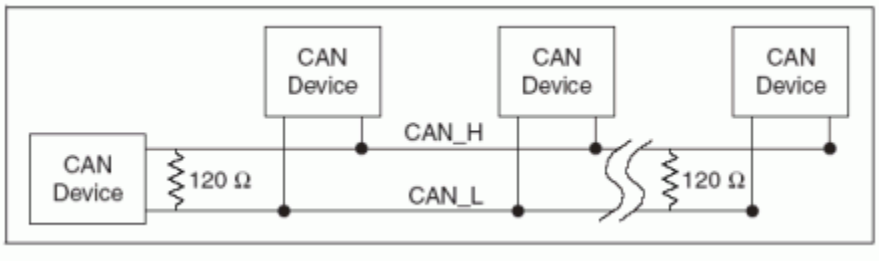
GCU7 Manual

Contents

I. CONNECTING TO THE GCU

GCU7 and newer units use 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.

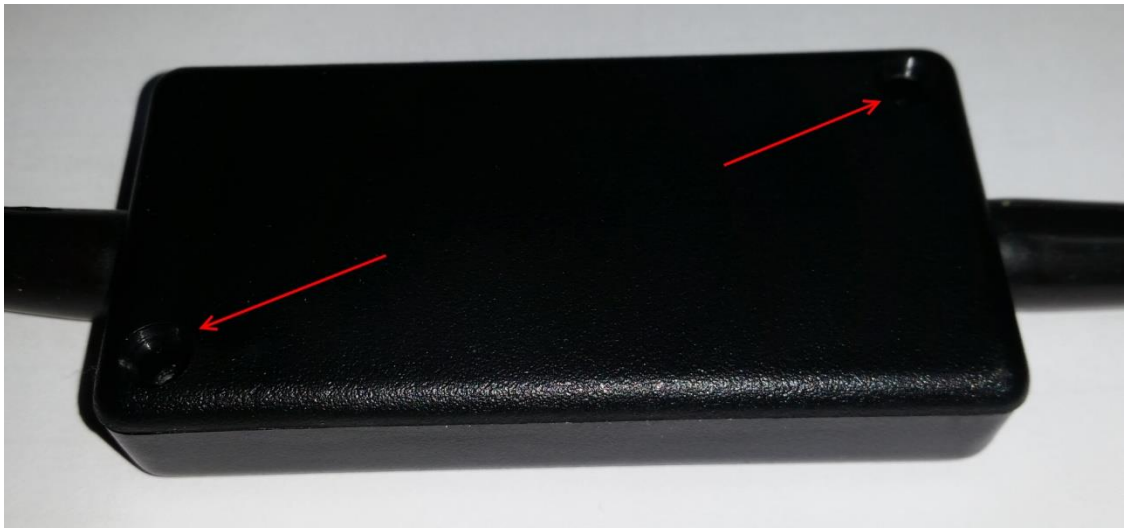
Each CAN BUS must be properly terminated (by 100-120 ohm resistor) on each side.



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.

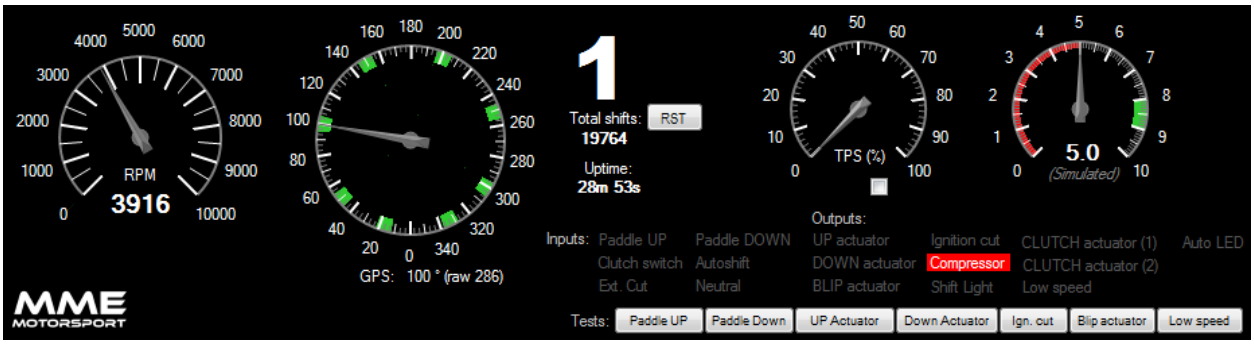
Remove the two screws:



Insert a jumper:

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.

II. GAUGES OVERVIEW



RPM

RPM Gauge shows number of RPM.

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.

THROTTLE POSITION SENSOR – TPS

0 - 100% of the throttle pedal pressed.

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.

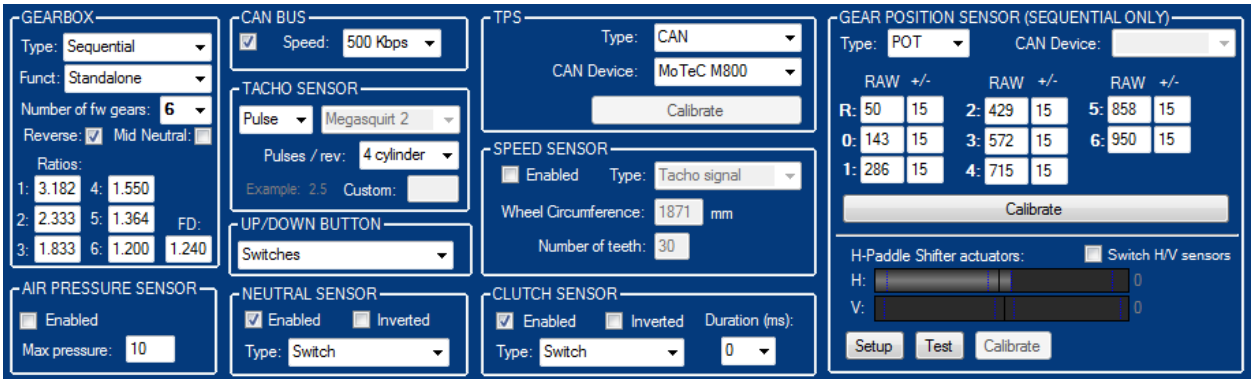
INPUTS & OUTPUTS

Status of each input and output. If active, it’s marked with white on red.

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.

III. GENERAL/SENSORS



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU) 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 / Gearboxes
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.

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/LOGGING* 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.

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. ***Please note that with GCU7 only way to communicate with is through the GCU Interface which is CAN based, so CAN BUS cannot be disabled for any GCU7 or newer devices.***

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.

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.

TACHO 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.

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. What this does is it walks you through all of the gears and stores the values for each gear. Numbers in boxes are degrees where gear is detected. You should shift up & down few times to see if the range is correct and adjust accordingly. Dropdown next to gear degrees represent the +/ degrees that gear is still engaged.

AIR PRESSURE SENSOR

Enabled if pressure transducer is installed on the bottle and connected to the GCU Pin A1. If you haven't specifically ordered this, this sensor is not available.

NEUTRAL SENSOR/SWITCH

This switch is used to prevent downshifts from 1st to N accidently. For most applications, **Type** Switch is used. If switch is on, when it should be off (mechanically), you can **Invert** it.
This switch is mandatory in H-Paddle shifter mode.

CLUTCH SENSOR/SWITCH

This switch is activated when clutch is pressed, either manually or automatically. For most applications, **Type** Switch 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.
Typical value: 0-5 ms

SPEED SENSOR

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

H-PADDLE SHIFTER ACTUATORS

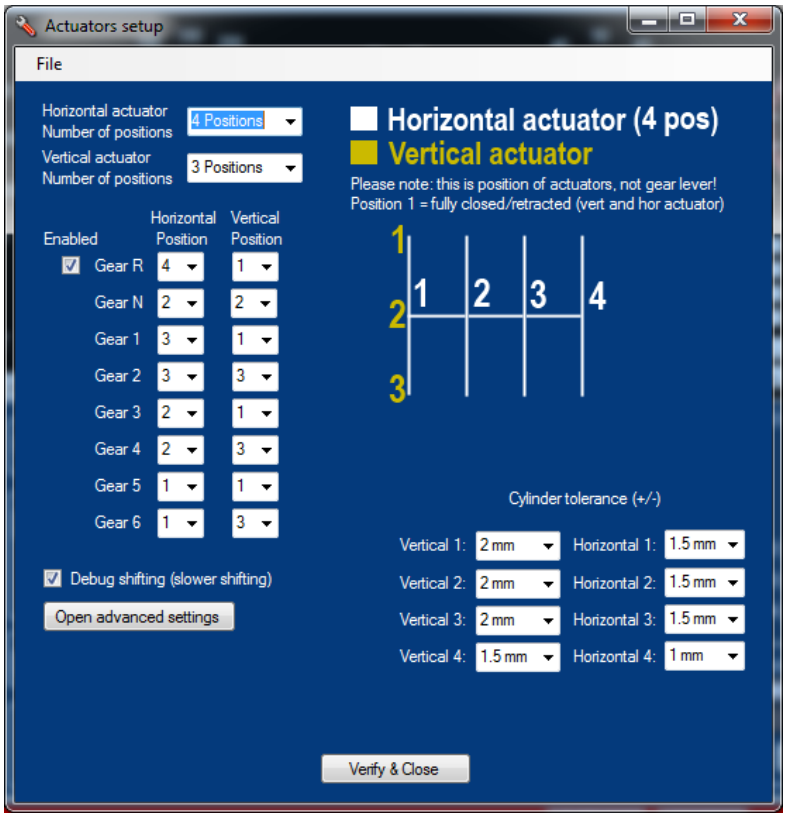
Only used if GCU is in H-paddle Shifter mode.
Window shows the position of each actuator. Before first use (or if actuators seem off), actuators need to be configured and calibrated. Click **Setup** configure the gearbox shifting pattern (which way is reverse, 1^{st} – 6^{th} gear and so on), actuator 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

Test window is only used to verify the valve connections and allows you to turn on/off individual actuator valve.

IV. 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)



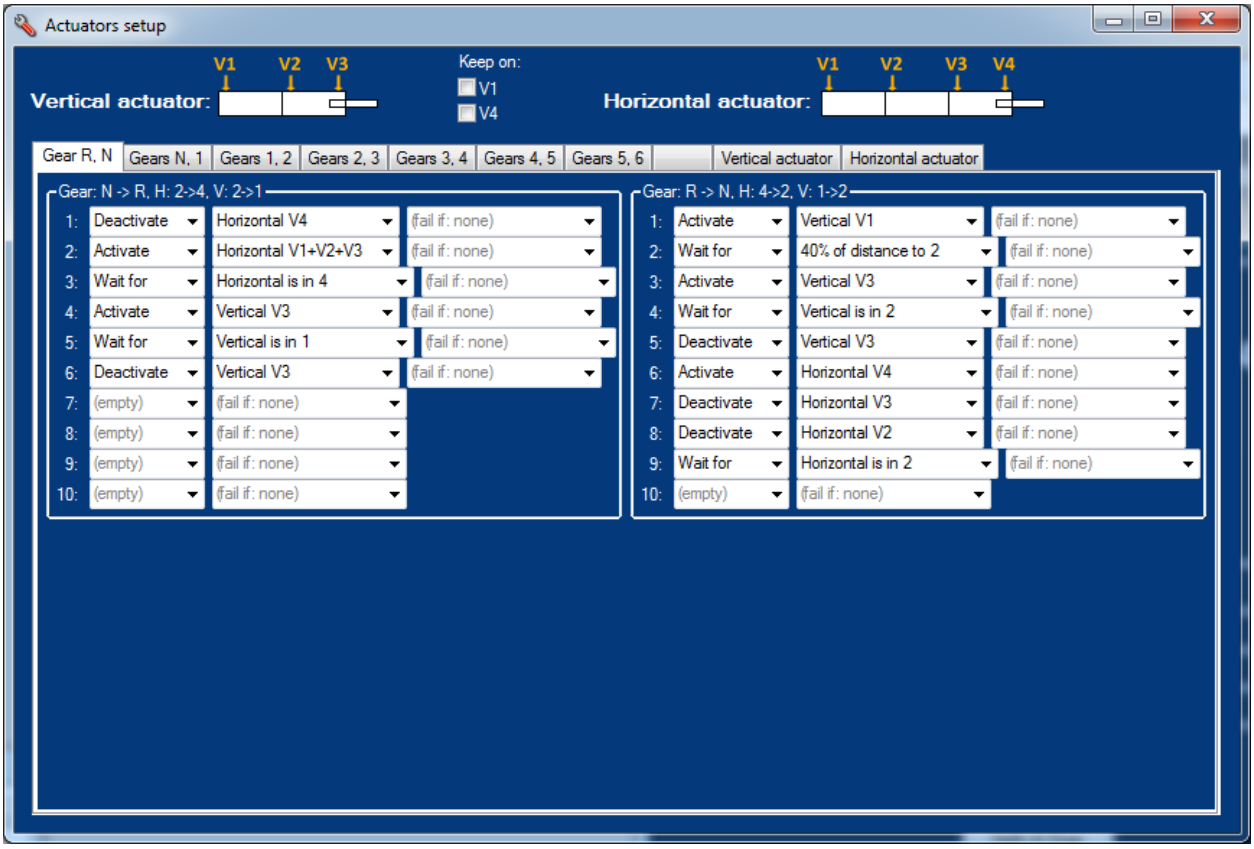
For each gear you need to set the position of each actuator.

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.

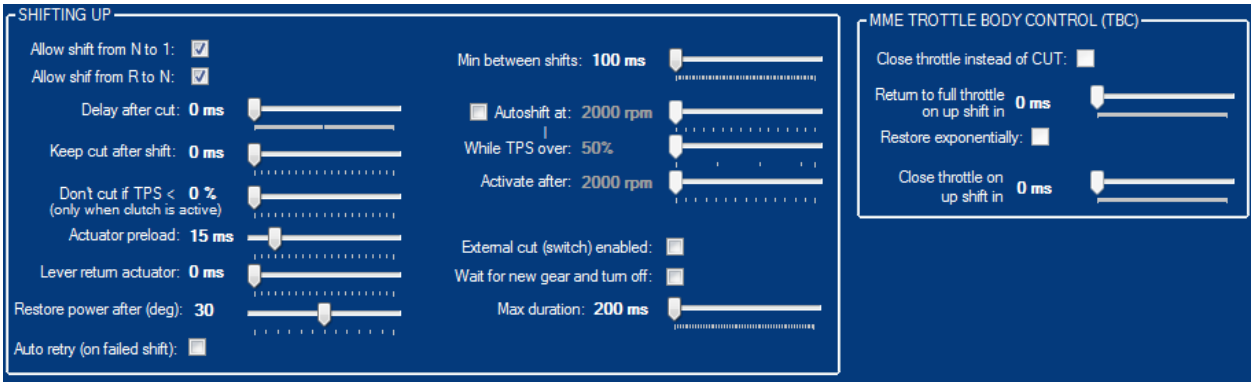
Actuator tolerance allows to set how much +/- mm of each position is still valid. For most applications, 2mm is ok. Depending on selector wear or free-travel of each gear this will have to be adjusted.
Typical value: 2 mm for the vertical and 1mm for horizontal.

V. H-PADDLE SHIFTER ACTUATORS SETUP - ADVANCED



Here you can program the valves for each shift. More info on setting up these parameters coming soon.

VI. UP



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU) 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

Delay after cut: how many milliseconds after we cut the power, we actually shift.
Typical value: 0 ms

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

Don't cut if TPS < %: if throttle pedal is below %, we will not cut the power.
Typical value: 10 % for dogbox, 0 % for synchro.

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.
Typical value: 15 ms for dogbox.

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.

Restore power after (deg): This option allows you to return the power before the gear is completely in. 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.
Typical value: 0 degrees.

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.
Typical value: Disabled.

Min between shifts: the time in milliseconds allowed between shifts.
Typical value: 350 ms

Autoshift: If enabled, auto shift function allows automatic shifting at specified RPM (**AT)**, while keeping the throttle above specified % (**White TPS is over)**. Auto shift switch (toggle type) must be connected to GCU Pin C3 (see diagram). LED indicator can also be connected to GCU Pin K3 (see diagram).

How does autoshift work?
- 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 & **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 released (under the specified %) 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.
Typical value: Activate After RPM 3500 rpm, TPS is over 90%

External cut enabled: If enabled it allows to cut the engine via external switch. For this option, GCU Pin C2 must be connected.
Typical value: Enabled for sequential (if system has a mechanical load/cut switch), Disabled for H-Paddle Shifter Mode.

External cut - 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.

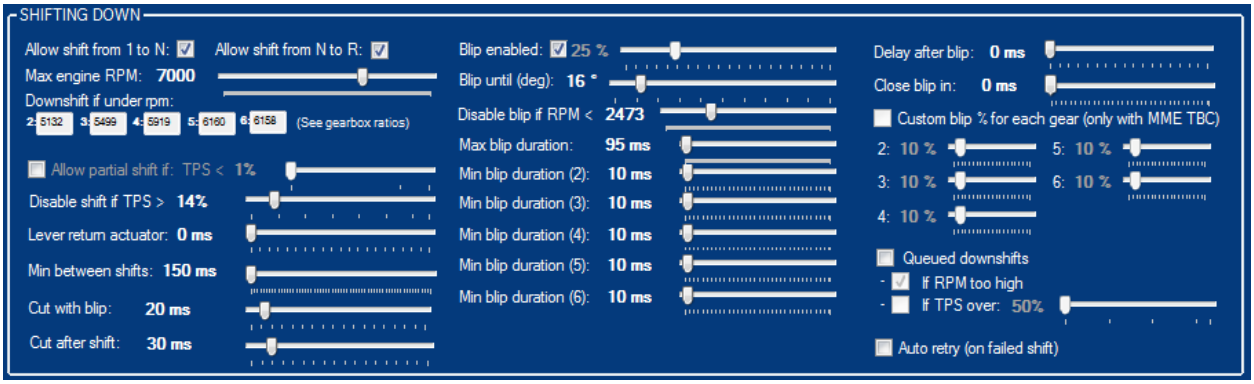
External cut - Max duration: Specifies the maximum duration of engine cut. Also see External cut - Wait for new gear and turn off
Typical value: 600 ms.

MME THROTTLE BODY CONTROL (TBC)

Only used if MME throttle body controller is used and selected under the GENERAL/TPS Can Device.

- **Close throttle instead of CUT:** if MME TBC is used, GCU will command the TBC to close the throttle on shifting up so the TBC will mechanically close the throttle body and you can keep your foot down.
  Typical value: Enabled on DBW with TBC and synchromesg gearbox, Disabled otherwise.
- **Return to full throttle on up shift:** specifies how fast full power will return to your car. When using close throttle on synchromesh gearbox you might experience unpleasant kick while flooring the throttle and shifting. What this does it returns to full throttle slower so you don't get this rough shift.
  Typical value: 300-500ms on a synchro, 0 for dogbox
- **Restore exponentially:** if enabled, tps will be restored (after cut) exponentially, instead of lineary.
- **Close throttle on upshift in:** specifies how fast the throttle closes.
  Typical value: 0ms

VII. DOWN



Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU) 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 & neutral 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 & neutral 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.

Disable shift if TPS > % / Allow partial shift if TPS < %: If throttle is applied (more than **Disable shift if TPS >**) we don't want to allow downshift so we don't destroy the gearbox. With **Allow partial shift** we specify just how much throttle still can be applied to allow downshift.
Typical value: For a dogbox Disable shift if TPS > 20, Allow partial shift if TPS < 10.For synchro Disable shift if TPS > 5, Allow partial shift if TPS < 0.

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: 10-15 ms.

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

Cut with blip: the time in milliseconds we cut the power the same time we apply the blip. This allows us to fully open the throttle before giving it the power to blip.
Typical value: 20 ms

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

Blip enabled: Enables throttle blip actuator. Throttle blip must be connected to GCU Pin J3. See wiring diagram.
If MME Throttle Body Controller is used you can specify just how much you want to blip the throttle (in %), 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.
Typical value: Enabled on a dogbox, Enabled on synchro with DBW.

Blip until deg: Keeping throttle blip on for N degrees, then stop. It works best if you leave the throttle blip on just before gears start to engage.
Typical value: 80% of the degrees between gears

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.

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.
Typical value: 150 ms.

Min blip duration: Specifies what the minimum throttle blip duration is (in milliseconds) no matter the degrees. It can be set for each gear separately. Usually, the higher the gear, less blip is required. Value is also smaller the faster the engine responds. Combination of blip degrees (either mechanical or dbw via MME TBC) and duration is the actual amount of blip.
Typical value: 50 - 70 ms for a dogbox

Delay after blip: how many milliseconds after the throttle blip we activate the downshift actuator.
Typical value: 0 ms.

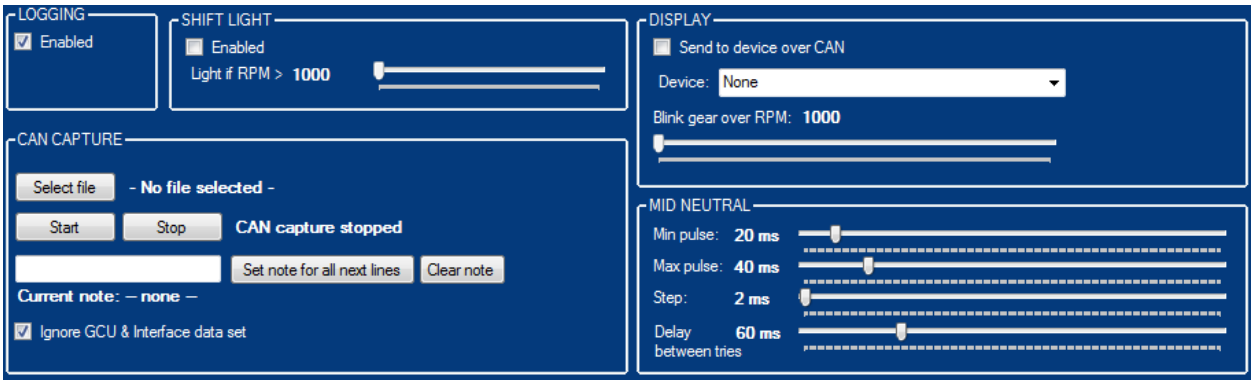
Close blip in ms: how many milliseconds does it take to close the blip (ramp). Only used with MME TBC module.
Typical value: 0 ms.

Custom blip % for each gear: here you can set custom percentage for each gear. Higher gears require less blip than lower ones.

Queued downshifts:
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.

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.

VIII. MISC/LOGGING



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

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.

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:
BASE ID: 1983
DLC: 6
BYTE 0: gear number [0-7], 7 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*]
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*]

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 partially and increasing the pulse duration, while checking if the gear is neutral. **Min pulse** is the starting pulse, **Max pulse** is the maximum pulse, **Step** is the increase between the tried and **Delay between tries** is the duration we wait before doing another step.

Typical value: Min pulse: 20ms, Max pulse: 40ms, Step: 2ms, Delay between retries: 60 ms

IX. SEQUENTIAL GEARBOX – QUICKSTART

Please note: if any parameter is changed, settings must be sent to the GCU (Settings – send to GCU) 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** and **Ignition CUT** 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.

- Under **GEAR POSITION SENSOR** click the **Calibrate** button and follow the instructions o 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 for each gear by entering the number of degrees in the dropdown.

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**.
- 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 and all other **Min blip** durations to 70ms.
- Set **Delay after blip** to 0ms.
- 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.

Under **COMPRESSOR** tab:

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

You're all set ☺