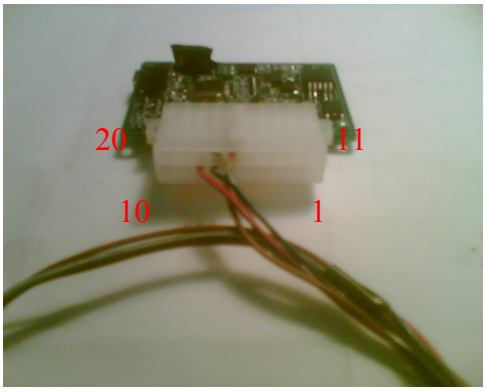
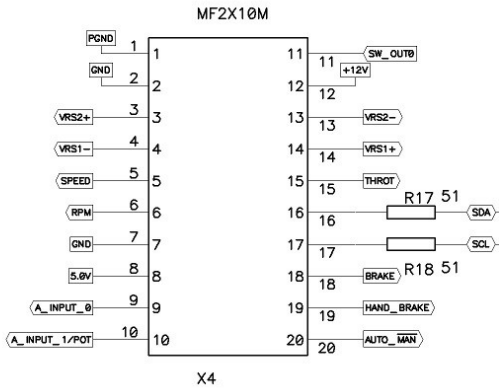
## Connection diagram

Functions of the contacts are listed in the table. Contacts are numbered from right to left as in the photos below.

| Contact | Circuit |
|---|---|
| 1 | Power ground, connected to vehicle earth and one of the contacts of the DCCD clutch |
| 2 | Ground, connected to the first contact |
| 3 | Signal of the rear sensor 2 ABS + |
| 4 | Signal of the rear sensor 1 ABS - |
| 5 | Input of the speed sensor with manual transmission (or speed signal is displayed on the dashboard/ECU) |
| 6 | Reserved |
| 7 | Ground for switches, display, potentiometer etc. |
| 8 | +5V for switches, display, potentiometer etc. |
| 9 | Reserved |
| 10 | Input of the potentiometer wiper to set maximal values of PWM (pulse width modulation) clutch (thumbwheel in case standard wiring of the vehicle is used) |
| 11 | Second contact of the DCCD clutch |
| 12 | +12V, should be protected with 10A fuse |
| 13 | Signal of the rear sensor 2 ABS - |
| 14 | Signal of the rear sensor 1 ABS + |
| 15 | Throttle, 0V – minimal value, +5V - maximal value. Throttle is connected to the standard throttle valve position sensor |
| 16 | Digital signal on the display (data) |
| 17 | Digital signal on the display (synchronization) |
| 18 | Brake pedal switch (0V - pedal is not pressed, +12V – the pedal is pressed) |
| 19 | Handbrake is connected to the standard handbrake switch |
| 20 | Switch button “auto/manual” (activated when short-to-ground) |




## Connection procedures

In the table above those connections, which you don’t have to make yourself, are shown in green colour. Those connections already exist as a part of the standard wiring.

It is recommended to make all connections following the steps described below (photos with examples are attached):

- Securely connect contacts 1 and 2 to the vehicle body. Connect one clutch end to the same point. Photo #1.
- Power contact 12, preferably through the fuse. Power should come in when the ignition is turned on. Channel the power, for example, directly from the cigar lighter or make a connection through the 10A fuse directly to the battery by making a breaking point in normally open relay, which is switched on by the ignition signal.
- Handbrake 19. Start the ignition. On the display the following data are shown: first number – mode, second letter "P" lights up, if the handbrake is lifted up, if the handbrake is down – the letter goes dark.
- Then connect throttle 15. Take the signal from ECU contact. Check the connection: turn on the ignition, choose operation mode #2 by pressing right button on the display, activate the handbrake ("P" lights up) and press the gas pedal. Values change in the range 0-99% (two most right numbers on the display).
- Check the thumbwheel. If it is a standard 83245FE061 type thumbwheel use contacts 7, 8 and 10 by cutting out the potentiometer supplied in the package. Connection is made in the following way: look on the thumbwheel from the connector's side, connector's lock up. There are three contacts: left contact +5, signal and ground. Connect them to the contacts 8, 10 and 7 accordingly.
- Connect contact 18 to the brake pedal switch located on the pedal box. Turn on the ignition, choose mode 3 on the display, and activate the handbrake. When you hit the brakes letter "b" should appear on the display.
- Connect speed sensor 5. To check the connection drive the car forward, choose the operation mode 5 by pressing right button on the display, slightly lift the handbrake until the handbrake switch is activated – at that moment 3 left numbers on the display should show vehicle speed in km/h starting from about 5 km/h. The values should correspond with those on the standard dashboard. Speed signal could be taken either from gear box or from ABS box (for GH body connection could be made to contact #2 (pink) of the square connector B36/i2 located near the relay box behind the glovebox). Probably you should upload parameter *system/t2vkmh = 184* into the controller. It depends on transmission main pair, mainly concerns 5-speed manual transmission. To activate slip control function set front/rear axle speed preferably at the speed of about 100 km/h, rather than at 5 km/h. To do this we should drive directly forward, analyzing front/rear axle speed in the logger window or using recorded log-file (more accurate). Adjustments are made using parameter *system/t2vkmh*. Speed signal on the controller is determined by the parameter settings:

| system/speed_source | Speed Signal |
|---|---|
| 0 | Contact #5, gear box or ABS box sensor |
| 1 | Sensor 1 |
| 2 | Sensor 2 |
| 3 | (Sensor 1+ Sensor 2)/2 |
| 4 | Reserved |

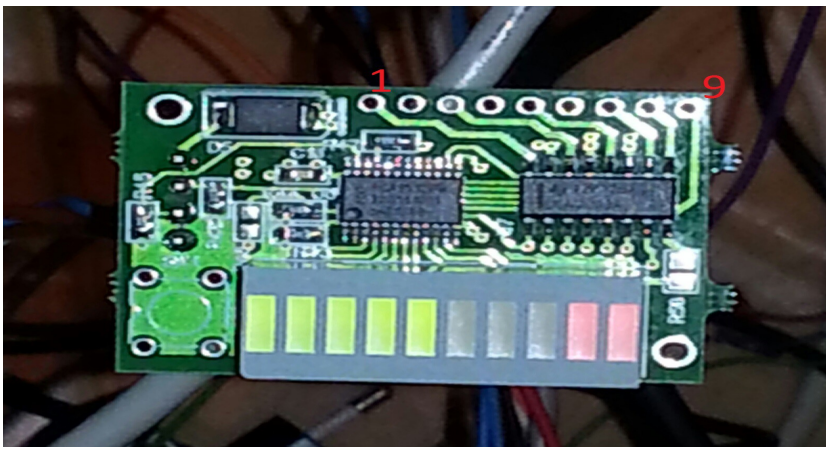
- If you need a speed signal, while you can't see it in gear box or ABS, you can receive the signal from the sensor 1 ABS. To do that set the parameter *Config/System/gearbox_sense = 0*. Adjust the speedometer by changing parameter *Config/System/abs2speed*, default value =8.
- Connect contact 20 "auto/manual" either to the standard "auto/manual" 83245FE041/61 button or any other normally open push button. Second contact of the button should be grounded.
- Connect rear ABS sensors (Photos #3 and #4). Connection should use shielded wire (shielded twisted-pair wire or cheap USB cable). Take off the rear seat, find connectors of ABS sensors, and connect them to the wire. One sensor should be connected to the contacts 14 and 4. The second sensor should be connected to the contacts 13 and 3. For new cars (2008 or later) signals should be taken from the 50 Ohm resistor. The resistor is installed by making a breaking point in the ABS sensor signal wire (you can identify the necessary wire by its low potential (0.5-1.0V), when the ignition is on).
- Place g-sensor in the center of the vehicle (near the handbrake in the same place where standard units are, for example on the bolt M8 of the handbrake from the side, where the gear shift lever is). Remember the orientation – the number on the sensor case, which will be oriented in the direction of the movement. You will need it later to adjust the device (parameter *mode5/g_origin*). Look at the photos #5 and #6. To ensure correct operation it is preferable to set the sensor along the horizontal axis. To do it launch the logger. Both parameters *g _yaw* and *g_longi* should be =128. If it is not so, bend the sensor a little bit away from the car body using a screwdriver. Check the values again until they reach 128. See photo #7.

At this step the device is installed and partly tested.

LED line

Number of red LEDs corresponds with the automatic modes 1, 2 or 5. If the handbrake is activated green LEDs show the clutch lock percentage, at the parking line – position of the thumbwheel. In the manual operation mode green LEDs indicate the position of the thumbwheel, red LEDs are off. Button "auto/manual" switches controller between two pre-set modes of the device. To duplicate work of the standard G11 dashboard it is necessary to connect corresponding LEDs on the dashboard with the board of the LED line. Functions of the contacts (from left to right):

| LED line | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| dashboard | 1 | 2 | 3 | 4 | 5 | Lock | Auto | +12V | ground |




Common anode of the dashboard is connected to the power supply +12V. Output contacts of the line light up LEDs by shorting them to the ground. Line's contact #8 can be left unused.

To make the controller work together with the LED line set the value of the parameter *System/Sub_dash = 2* on the tab *Config* and *System/display_m = 0* (inactive).

## Display

Display has 4 symbols and 4 buttons. The right button sets the operation mode. Operation mode indication has the following view: NMXX, where N – number of the operation mode, M – additional status data (i.e. "auto/manual" etc.). The display reacts if you press and hold the button for at least 0.25s. In other case any action will be considered as contact chatter. The lower button allows saving the operation mode into memory. The top button changes gradually brightness of the display in cycle. There are in total 3 brightness levels. The left button is reserved.


For the controller to operate together with the display set the parameter value *System/display_m = 1* in the tab *Config* and *System/Sub_dash = 0* (inactive).

## Operational algorithm

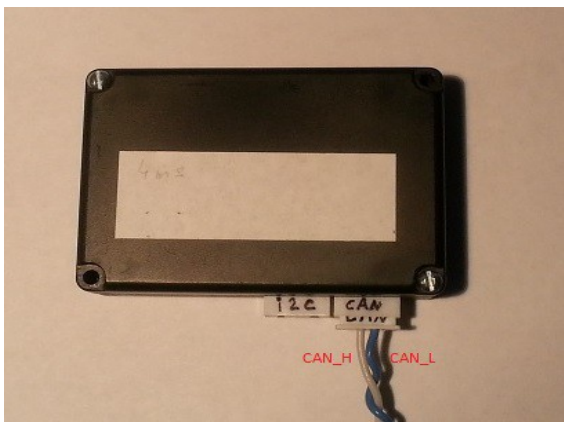
Modes:

1. “Auto” - for the throttle and speed with pre-set minimal value, thumbwheel controlled. Additional speed map for braking, g-sensor map and slip control.
2. Similar to the first mode.
3. “Manual”, thumbwheel controlled. Unlocked, when brakes are activated.
4. The same, but without unlocking.
5. Similar to 1 and 2, but has the steering wheel turning angle map. Active function of power measuring, when the logger is on.

In “auto” operation mode clutch lock percentage from speed (with wide-open throttle (WOT) is represented as follows: lock percentage goes up starting from 10 km/h up to 100 km/h and then goes down by 220 km/h according to the table in *Config/ModeX/speed_derating*.
If g-sensor is activated, the clutch is unlocked in turns according to the 2D map: *Config/ModeX/gsense_2d.*
In this operation mode the clutch can be additionally locked not only depending on the values set by throttle or thumbwheel at slip. In this case the speed of the front and rear axles relatively to each other is monitored. If the speed difference between the axles is more than 5 km/h then additional locking is activated: *Config/ModeX/slip/desired_slip*.
In all modes there is a 5A limitation for the average current going through the clutch.
***To prolong clutch life cycle it is recommended to use auto operation mode at all times*** with just a few exceptions. It is important to remember that severely locked clutch causes excessive heating of the winding, and turning wheel during vehicle movement can cause impact activation of the DCCD clutch.

Sensor of the steering wheel position. CAN controller.

To activate sensor of the steering wheel position connect contacts CAN_H and CAN_L of the CAN controller (see photos, use twisted-pair) to the same name contacts either of the tire CAN (if the sensor of the steering wheel position is already installed by the manufacturer) or to the contacts of the sensor’s connector. In this case between CAN_H and CAN_L signal wires 100 Ohm resistors should be placed close to the controller and the sensor (2 resistors are required at each end of the twisted-pair. If the sensor was pre-installed no further actions are required, since the resistors are already in place). Two other sensor’s contacts left - ground and power +12V. You can use ground and power from the DCCD controller. Connect the second connector of the controller to the same tire to which display/g-sensor/LED linear are connected.



To activate CAN controller set the parameter value *System/CAN/can_mode = 1, Config* tab. Value of the parameter *steering_div* should not exceed transmission ratio of the steering rack. For example, for the low gear ratio rack sti FE600 it is 2.6. So when you turn the steering wheel from the leftmost to the rightmost position you can see permanent change of the angle recorded by the system. Moreover, the value could be even less to get more accurate maps for the small turning angles of the steering wheel, since the leftmost or the rightmost positions of the wheels are not very interesting for the algorithm. For example, set value 2, range 1, turn to the left/right. Parameter *steering_ofs* has signed value (+/-). If the sensor is set correctly and steering wheel is in symmetrical position, the value is 0. The sensor of the steering wheel position should be installed, when the markings on the sensor's display (see user guidelines for FHI) and on the steering wheel coincide in "straightforward" position. When everything is installed as it should be, choose *Config/Mode3/steering/steering_mode =1*, save it, restart the system (turn on/off the ignition), choose mode 5 on the display (=mode 3), turn the steering wheel, check in the Logger window how the parameters *steering1b*, *steer_sign* and *steering2b* are changing. When going through the turn you can see that parameter *steer_mult* is changing according to the map *Config/Mode3/steering/AngleG_2d*, where the first line of the table shows lateral acceleration (128 = 0 g; 191 = -1g; 63 = +1g). "Plus" means that wheels "look" inside the turn. The first column shows steering wheel turning angle. Values in the table are used as multipliers to determine clutch lock percentage in *steer_mult* logger. You can see that if the wheels "look" inside the turn, then the bigger the angle the smaller *steer_mult* value is (if lateral acceleration is constant). This allows to take off the load from the car front and causes oversteer. If lateral acceleration values are high, *steer_mult* parameter should be higher as well, the same is true for counter shifts (wheels "look" outside the turn, map area +g).

You can send all your questions or report discovered bugs to the e-mail: sales@320hp.com
June 29, 2015

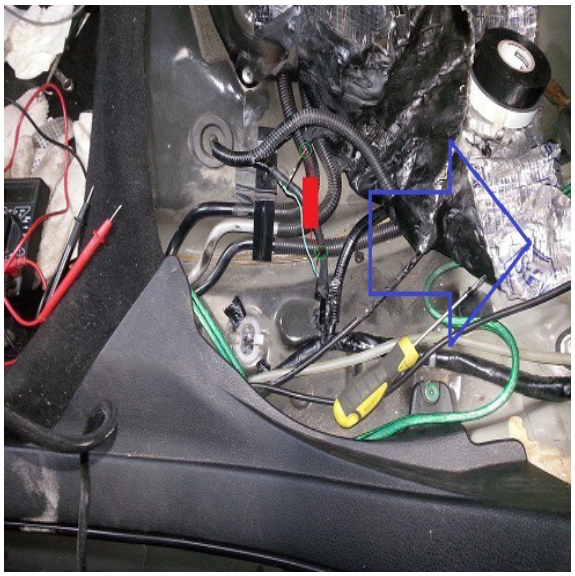
Appendix

Photo #1. Contacts 1 and 2 of the controller and one contact of the DCCD clutch are grounded in one point (Impreza G11 body).

Photo #3. Location of the connectors of the ABS sensors, Impreza G11

Photo #4. Location of the ABS sensors wiring (Forester 8+ and Impreza GH). Make a breaking point, put a resistor inbetween. The signal is taken from its ends. Power cable is left untouched. Sensors cables (Forester 08):

| Sensor | Power | Signal |
|---|---|---|
| left | pale green | black/yellow |
| right | blue | pink |



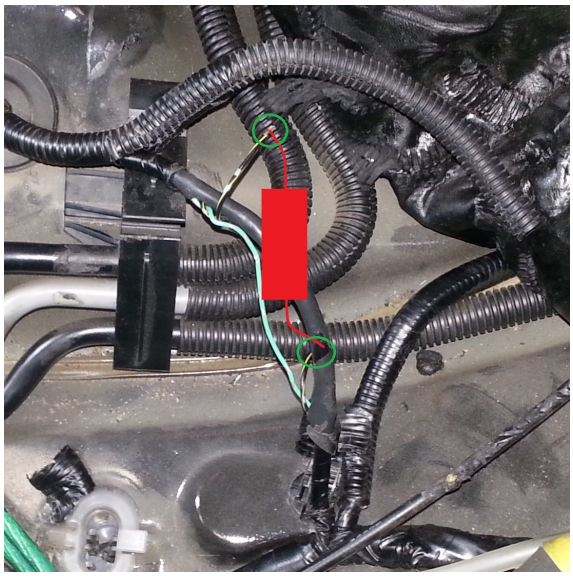
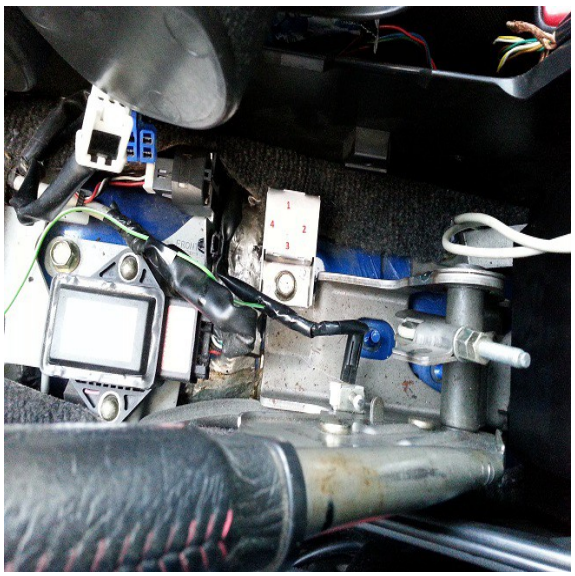
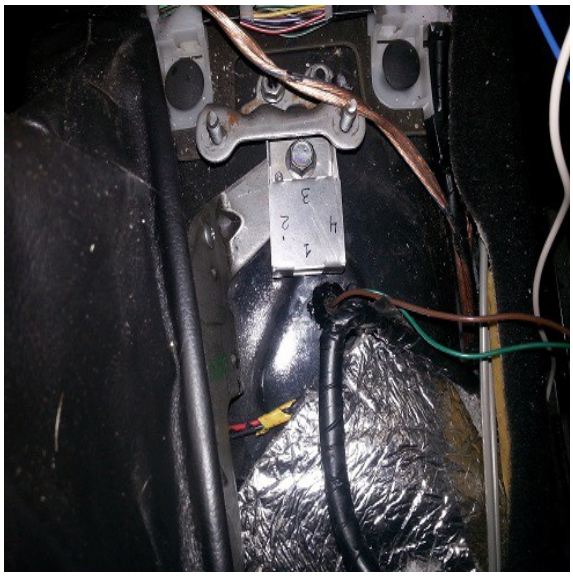


Photo #5 Impreza G11(to the left), Forester 08 and Impreza GH (to the right). Location of the g-sensor. Orientation of the sensor “4” and “3” accordingly.





Photos #5 and #6. Forester 08 and Impreza GH. Standard g-sensor is installed in place.
Note: it is necessary to put a washer under the g-sensor case.

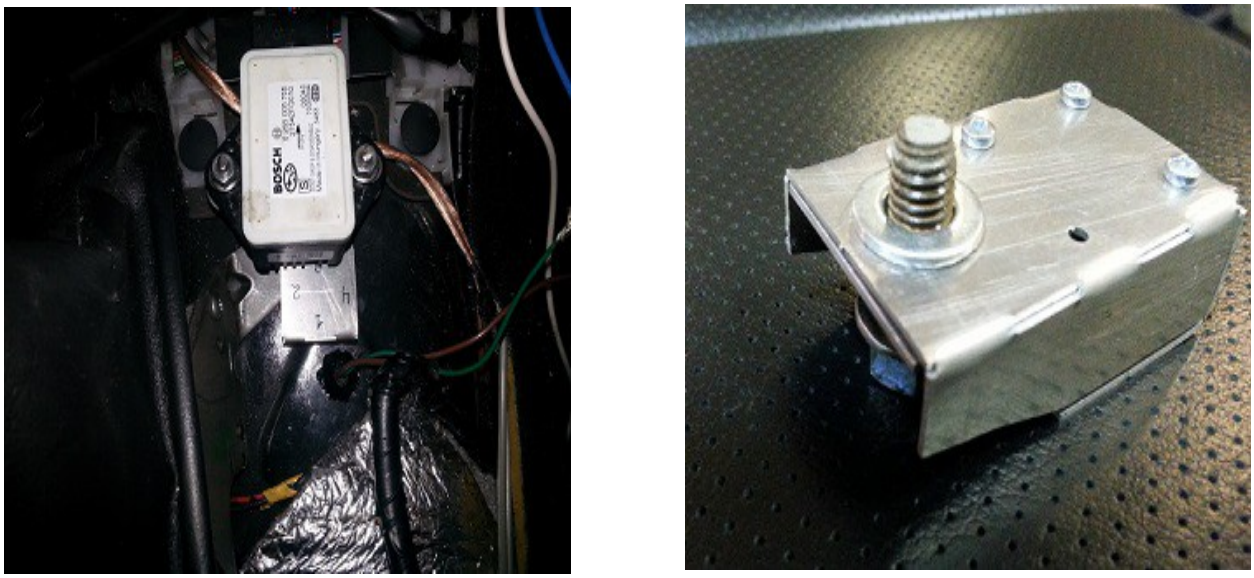


Photo #7. G-sensor adjustment.