START DIAG

Customizable Diagnostic Device for Vehicles 12 Volt

StartDiag Mod. 001

Please read this entire instruction manual before proceeding

TomElectronics S.r.l.
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P.IVA 04318830231 - Iscritta al registro delle Imprese Verona n.147330 - REA VR-410236 - Cap. Soc. €10.000 i.v. - PEC: tomelectronics@pec.it

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CAUTION

This TomElectronics Srl product is intended for use **only** on **12 Volt** Vehicles with connector: OBD-II, EOBD or WWHOBD (CAN Bus/only).

Ensure **correct battery polarity** during installation to prevent safety hazards. It is highly recommended to disconnect the device from the OBD port before replacing the vehicle's battery, and to reconnect it only after the replacement is complete.

Selecting an **incorrect CAN bus baud rate** may lead to general vehicle malfunctions. Please pay close attention to this setting.

To ensure **optimal battery life**, disconnect the device during prolonged periods of vehicle inactivity.

To preserve the device's lifespan during extreme weather, remove it from the windshield mount if the cabin temperature becomes excessively high. The product is **fully compliant** with **automotive temperature ranges**.

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PRODUCT DESCRIPTION

Customizable Diagnostic Device for vehicles with CAN Bus, includes PIDs Dashboards and it can execute CAN Bus requests via LUA Scripting.

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Box Content

Inside the box you have:

- 1 x StartDiag Display unit
- 1 x StartDiag Controller unit
- 1 x Double sided micro USB cable
- 1 x OBD-DB15 cable
- 1 x USB microSD adapter
- 1 x microSD card (is already inserted in the Display unit)
- 1 x Windshield support

NOTE: you can use whichever microSD card you want, but keep in mind that the maximum size supported is 32 GB!

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Installation Instruction

Thanks to its modularity, StartDiag System is easy to install and to get start with.

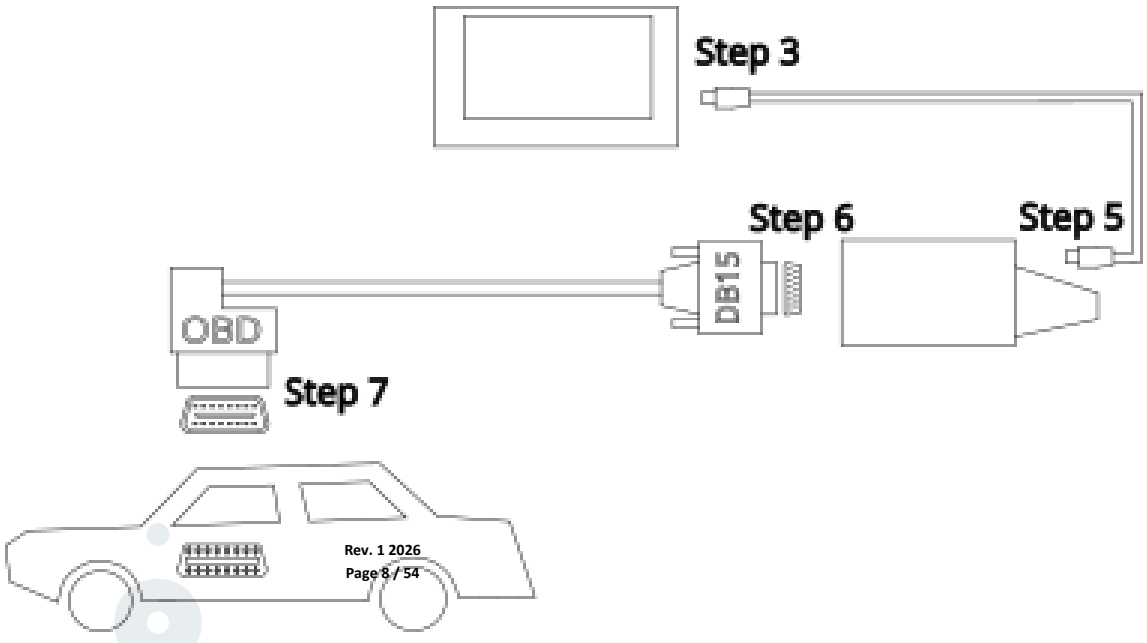
Cable management is the most critical part of the installation to ensure a neat and professional setup.

The steps for the basic installation are the following:
- Decide where you want to have the StartDiag Display unit setup (beware to not obstruct excessively your view of the road!).
- Setup the provided windshield support using the alcohol pad provided to clean the portion of the glass where the support will be installed, this is very important for the robustness of the mounting.
- Connect the microUSB cable to the Display unit and install the unit on the windshield support.
- Decide where you want the Controller module to be mounted and install it securely.
- Connect the other end of the microUSB cable to the Controller unit.
- Connect the DB15 cable to the Controller unit.
- Plug the OBD connector into the vehicle's OBD-II port.

Installation is now completed.

When the OBD connector is plugged in the vehicle, a red led will flash briefly on the Display unit, confirming that power is presented.

The screen of the Display unit will stay black until you touch it (same behavior as when the unit is in standby mode).



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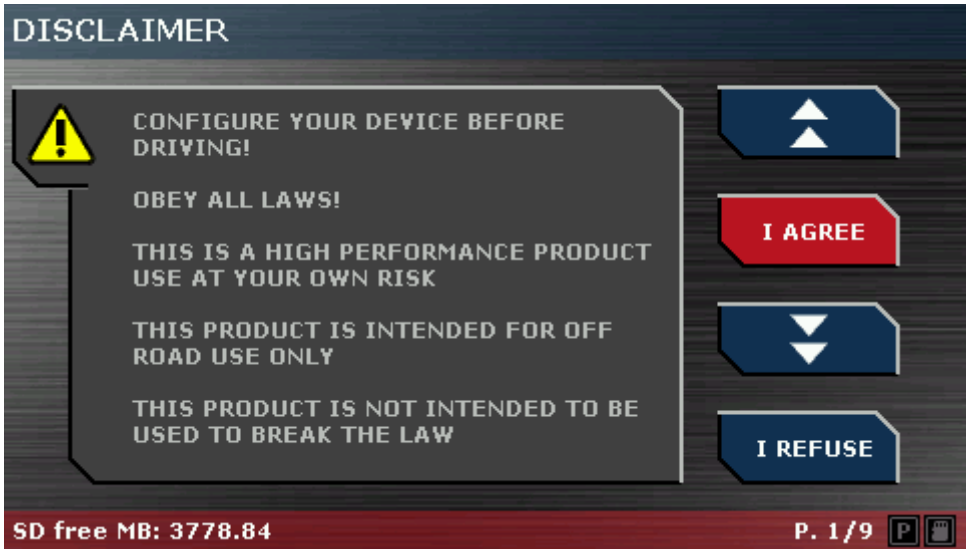
Getting Started

StartDiag System has been designed to be simple to install but even more simple to utilize in the day to day occasions.

First Boot

When you wake up the StartDiag System you are presented with the legal disclaimer, you can disable later on the view of it at boot time form “Settings” → “Global Flags”.



After accepting the disclaimer, the Display unit will go into the main menu.
This is the entry point for the full System functions.

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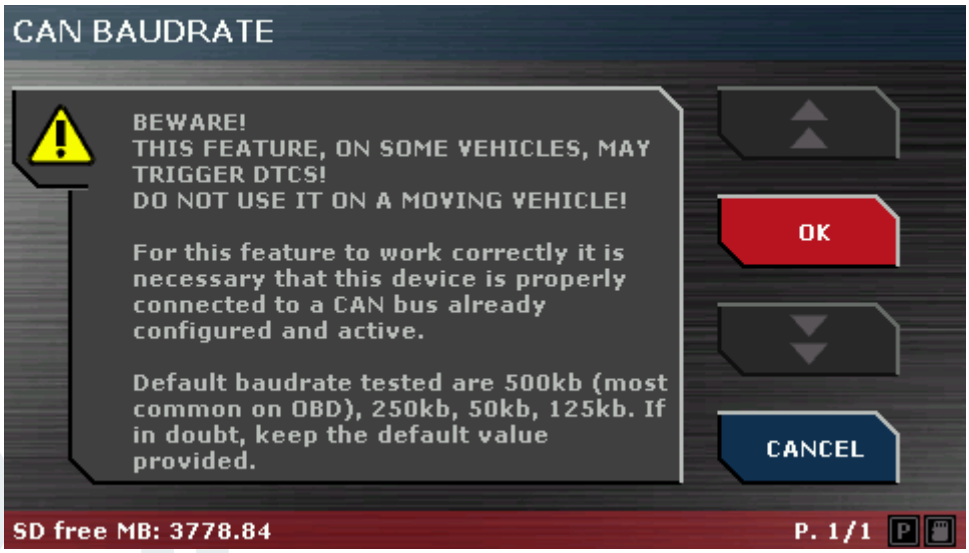
Let's follow together some initial steps to get confidence with StartDiag System.

We start by reading your vehicle's identification number (VIN).
To read the VIN, from the Main Menu you press the "Info" button and then you select "Vehicle Information".

At this point you are presented with a disclaimer with the tile "CAN BAUDRATE".
This is an important point in the usage of StartDiag: the communication with your vehicle are done using the CAN bus which is a standard connection inside all the modern vehicles. This bus connects all the electronic modules inside your vehicle and allows them to communicate with each other.
StartDiag already knows how to talk on the CAN bus, but it needs a key parameter in order to do so: the Baudrate, the speed of the communication.



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The disclaimer you are seeing is shown to your every time StartDiag request you to provide the baudrate to use for the connection.

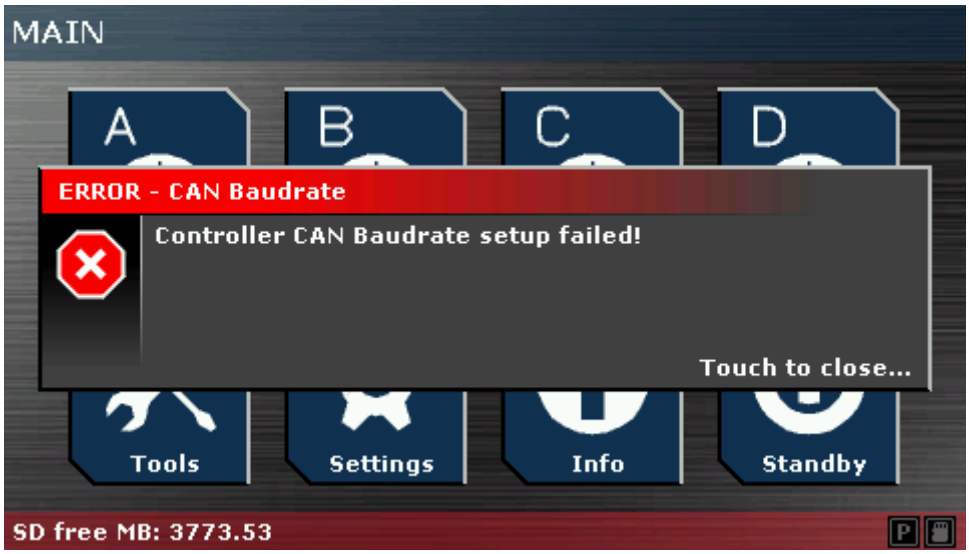
There is a full section of this manual about the CAN baudrate selection for your vehicle (see section "Custom CAN Baudrate" for a deeper explanation on the topic) but for now let's simply apply the golden rule for this procedure: your vehicle must be in key on (engine off is fine and suggested). This is required because with key in first position, the CAN bus is normally active, the ECUs are talking to each other (in fact you can see indication on the dashboards normally) and so StartDiag can simply read on the bus and from there identify the speed used.
Please note that when the CAN baudrate has been verified correctly the first time, it will not be requested again until the StartDiag Display is turned off or a CAN bus communications fails because of bus errors.

Read the disclaimer and when you are ready to proceed, press "OK".

After the disclaimer, you will be asked to input the CAN baudrate for your vehicle. We already provide you with the most common baudrate value used in automotive CAN bus, but if you know that your vehicle uses a different one, this is the time to input the right one.

Confirm your choice with "OK".

Now StartDiag starts to connect to the bus using the most safe configuration possible and the baudrate you provided.
If the procedure doesn't verify the CAN baudrate successfully, an error is shown and the operation ends here.



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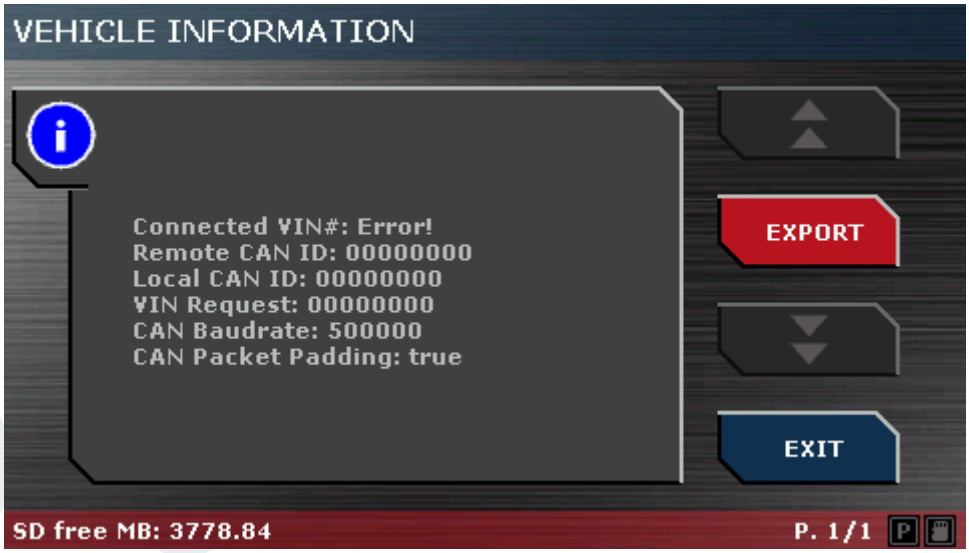
In this case make sure you set the vehicle in key on and check the cables connections before retry.
If this situation persist contact StartDiag Support or check our forum where you can ask for information.

After the CAN baudrate has been correctly verified, the VIN reading procedure starts and tries to read the VIN using the CAN bus. You will be presented with a report of the operation's result.

This report contains the VIN read, information about the request done and the CAN baudrate used (this should match the one identified previously).
If the VIN is missing, invalid or an error indication like in the next screenshot, then your vehicle is not compatible with out current VIN reading procedure, but other feature can still be used and you can tweak it to make it compatible.

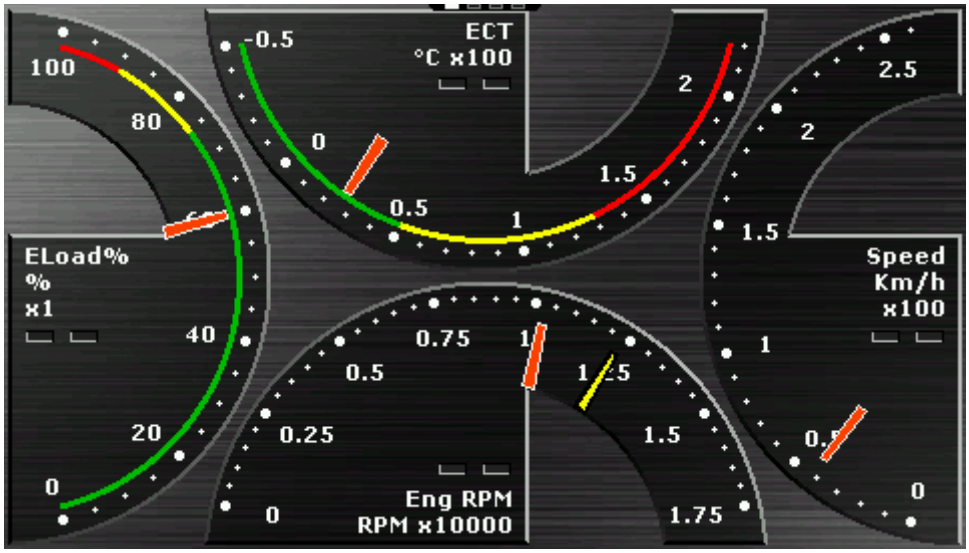


The most important part is the confirmation of CAN baudrate.

If instead of the report you get an error like in the screenshot above, then the script encountered an unexpected behavior and you should contact StartDiag support or check our forum.

After reading the VIN number, let's try out the dashboards.
Again the topic will be explained in deeper details later on in this manual, but we can take a quick look now.
Return the Main Menu and select one of the top 4 buttons with "Dashboards". Out of the box the parameters shown are the same for all the dashboards, but they have different visual layouts.

Note how, if previously you had no error in the CAN baudrate validation, now the CAN baudrate is not requested anymore.



To leave the dashboard, press anywhere on the screen and select the "Main" button to get back to the Main Menu.

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Finally let's explore how to start a LUA script.
To do this, from the Main Menu select "Tools" button and from there select "Execute Scripts".
What you see now is the list with the LUA scripts present on the microSD card in the Scripts folder. Those are the one we provide as examples and initial point for your journey. You will learn later on how to make your own.

Let's note that, even if no CAN baudrate has been previously verified, you are not required to provide one when you work with the scripts. Those are considered standalone entities and each of them is responsible to ask you which one to use or to use one provided in the script itself.
The scripts we provide use the one already verified, if present, if not will ask you which one to use and then will use that. If it is not correct, the scripts will terminate indicating that case.

As an example here, let's start the script "VIN_Info.sds". This will do the same procedure as done from the "Vehicle information" button, just it is started as a standalone scripts.

We reached the end of this initial walkthough for the StartDiag System.

We encountered the most critical aspect of the CAN bus baudrate configuration, we explored the three most common operations done and we saw various examples of the user interface and menus.
Now you had the first hands on experiences with the device and you can dig deeper in the rest of this manual with that knowledge.

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NOTE: The one described here is the behavior that a new unit shows out of the factory. There are many ways to change it and we will discuss them
more in the section “Boot Configuration File”. For example, when you know the correct baudrate of your vehicle you can add it with “useBaudrate = <you baudrate here>” and the System will verify it at boot time and if correct (and key on), then it will not ask you for it.

Example Scripts

On the SD card you will find some example scripts that will help to see how to write scripts, as well as test the CAN BUS connection with your vehicle. This is a brief explanation about them and what each of them do:

CANLog1m.sds: This script is a basic LUA CAN Logger that saves all the CAN packets passing on the connected CAN bus
for 1 minute. NOTE: since this is uses the LUA API and require the LUA subsystem to be running, the capture
performances are slower than the menu activated CAN Logger.

OBDSLog.sds: This script connects to the CAN BUS and follow the SAE specifications to identify the SAE PIDs
(vehicle parameters readable) available and log the standard definitions associated with them.
This is very useful to discover which parameters can be directly integrated into the dashboards.

PIDTest.sds: This script connects to the CAN BUS and tries to read 5 times the same SAE PID using the USD protocol.

VIN_Info.sds: This script connects to the CAN BUS and tries to read the VIN (Vehicle Identification Number) on
all the currently supported CAN IDs and standard Services.

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GUI Introduction

In the example above there are all elements that we are going to discuss in this small section.

In almost all the pages (the only exceptions are the dashboards) on the bottom left corner you can see the current status of the microSD card and the available space. Here you can see possible microSD card errors.

When dealing with menus that are composed of more than a single page (four elements) on the bottom right corner you can see the indication of the current page shown and the total number of pages.

In some cases you can see some buttons that have a double icon (in the example above we are speaking of the blue buttons). Those are double action buttons. The active mode is the one highlighted in white (above the active mode is "selection", which moves the selection up or down accordingly with the button pressed). A long press, more than 2 seconds, on those kind of buttons change the mode (above the alternative mode is "page scroll" in which a single press on the button moves to the next page or the previous one).

In the bottom right corner there are two indicator lights. These indications are present in all the pages, apart for the Dashboards.

The first (the one representing a P) is an indication of the Paranoid Mode (see

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Paranoid Mode for more info about it). When yellow, it indicates that Paranoid Mode is currently active.

The second (the one with the shape of an microSD card) is and indication of the activity on the microSD card. It turns yellow when at least a file is currently open on the microSD card. Generally speaking you should not remove the microSD card is this indication is yellow, as that can corrupt the content of the microSD card and the files on it.

Main Menu

This is the main entry point for all the advanced functions offered by the StartDiag System.

The first row of buttons, named A, B, C and D allows to enter the relative Dashboard.

The second row allows to access various sub-menus:
- Tools (first button to the left) allows to interact with the vehicle using LUA Scripting or reading the trouble codes currently active.
- Settings (second button from the left) allows to configure various aspect of the User Interface of the StartDiag System, including video and audio options.
- Info (third button from the left) shows the information relative to the vehicle and the StartDiag System.
- Standby (last button on the right) allows to put the Display unit in standby mode. This will reduce the power consumption of the StartDiag System (please, remember that Controller is always active, so if you need to leave the vehicle stopped for days

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without recharging the batteries, you may want to opt for disconnecting the OBD plug altogether to preserve battery).

Dashboards

The Dashboards are the main visualization tool that the StartDiag System offers you to show a realtime status of the parameters of the vehicle.

There are four available Dashboards, named A, B, C and D, and each of them can have a totally different configuration respect to the others.
Each of them offers various degrees of configuration:
- you can decide the layout (which also bring different numbers of Gauges)
- you can provide different configuration files

A Dashboard can be thought as a set of sub-elements that we call Gauges.
Each Gauge allows to display a PID (a parameter read from the CAN bus), but also to show the maximum value reached for that PID. Moreover, error indications are presented and, if configured and activated, alarms are also handled for the PID assigned to the Gauge.
Gauges are of two main types: analog and digital.

A single Dashboard can have one of 6 possible layouts and each layout has a set number and types of Gauges.

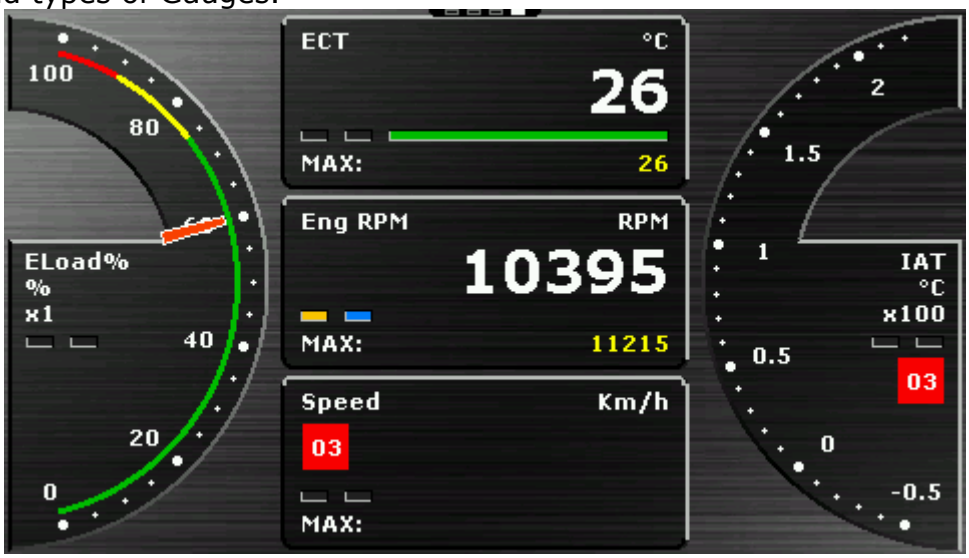

Fig.5.1 - Dashboard View Example with 5 Gauges, 3 configured and 2 not supported

On top, in the center, you can see four small rectangles, where one is white.

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That is a quick reminder of which dashboard is currently displayed, in this example we are using the second one (Dashboard B).

Touching a dashboard at any moment will bring up the Dashboard Menu.

Each gauge has an indication that can be displayed in case of error, reporting the error code which can be used to debug the situation with the help of the section Error Codes.

A note have to be done here: if the errors are all 1 (which means timeout) the most probable cause of errors are:
- Wrong configuration of the Gauge (Ex: the SID requested is not available, or the CAN ID are not correct)
- The key has been turned off (when the key turn off, many ECUs stop every CAN activity immediately, all the ongoing communication stops and all the successive request for data simply go in timeout).
If instead the StartDiag Controller reaches too many CAN error, following the protocol it "disconnect" from the BUS stopping any activity.
This can happen, for example, when working on the bench with only an ECU connected, if that is put in Key OFF condition and it is the only other CAN device in the BUS with he StartDiag System, all the successive CAN communication will fail at low level bringing to its disconnection.

Turning the key back on at this point will **not** restart the requests for the PIDs as a safety measure to avoid that StartDiag System in error could bring down the connected BUS.
The easy solution is to enter the Dashboard Menu and get back to Dashboard, or leave the Dashboard completely going to Main Menu and re-enter.
That will bring the Controller back in working condition.

If in the BUS there are already at least 2 other devices communicating, an automatic procedure from the dashboard itself will try to re-identify the BUS and restart working accordingly.

Each Gauge shows also have 2 small rectangle 'Led'. Normally they are black, and turn on to indicate that one of the any of the following conditions are present:
- The yellow one turns on when a customization is applied to the Gauge by the Config sub-menu.
- The blue one turns on when data shown in the Gauge is subjected of a filtering operation. (See Filter Configuration for more information). Basically this led is telling you that what you see is not strictly speaking real time but a filter is currently being applied to it.

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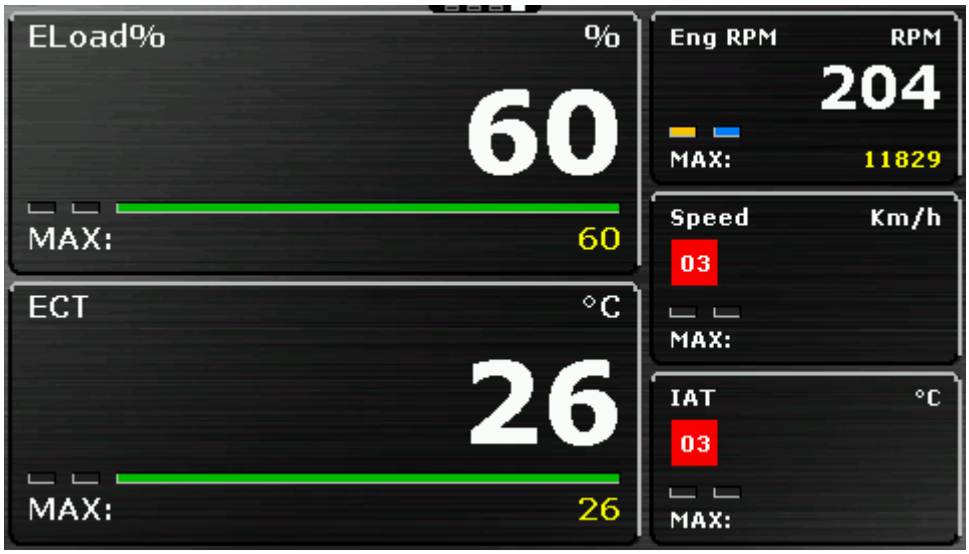

Fig.5.2 - Here you can see the LEDs activated. One Guage has no status active, one have only the filter active and one has both filter and customizations. Two are not used.

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Dashboard Menu

Dashboard Menu is the main interaction point with the dashboards.

Dashboard Menu allows to:
- go to “Previous Dashboard” (first button in the top row)
- start the “Dashboard Log” (second button in the top row, when active it will blink)
- go to the “Main Menu” (third button in the top row)
- “Clear” the currently set maximum values (forth button in the top row)
- go to “Next Dashboard” (last button in the top row)

Together with the “Main Menu” button, in the middle column we can find:
- Back to the dashboard button (second from the top). This is an automatic operation also, which means that if you enter the Dashboard Menu and do not select any other option, when the bar in the "Back" button is filled, the StartDiag Display will show the dashboard automatically.
- “Show Chart” buttons (third from the top) which allows to change the dashboard to a special view of the PIDs.
- “Config” buttons (last button at the bottom) allows to configure the dashboard layout and some parameters of the Gauges in it.

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PID Chart

While a Dashboard is essentially a collection of Gauges, sometimes it is hard to simply follow the trend of a parameter in the time.
Specifically to overcome this issue StartDiag Display offers a second visualization method for the PIDs configured in the current dashboard: the PID Chart.

NOTE: You may see in some occasions a lower number of graphs than the number of PIDs configured. That is probably the case when two lines overlaps. Also, configured PIDs but disabled in the view (no green checkmark) are simply shown in black.

This modality can be activated by the Dashboard Menu and offers a set of line graphs representing the PIDs of the dashboard respect to time.

Please, note that since the display area is shared in common between all the PIDs of the dashboard, there is no units displayed since there is no warranty of compatibility between the given PIDs. The same holds true for the vertical scale, this view is just to show trends and behaviors, not for precise measuring!

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Dashboard Configuration

This menu allows to configure some of the aspects fo the active dashboard: if we were utilizing the Dashboard A and we go to the Dashboard Menu, then Config, we are going to configure only Dashboard A.

The top section of the Dashboard Configuration page is a preview of the currently selected layout with the associated configuration file, while at the bottom there are the buttons to change layout, cancel the changes or saving the current setup.

Each Gauge presented in the preview can be selected, entering a configuration panel where, independently of the Dashboard Script associated to the dashboard, you can change the ranges of displayed values, change the points where the alarms are triggered or enable/disable the alarm indications altogether.

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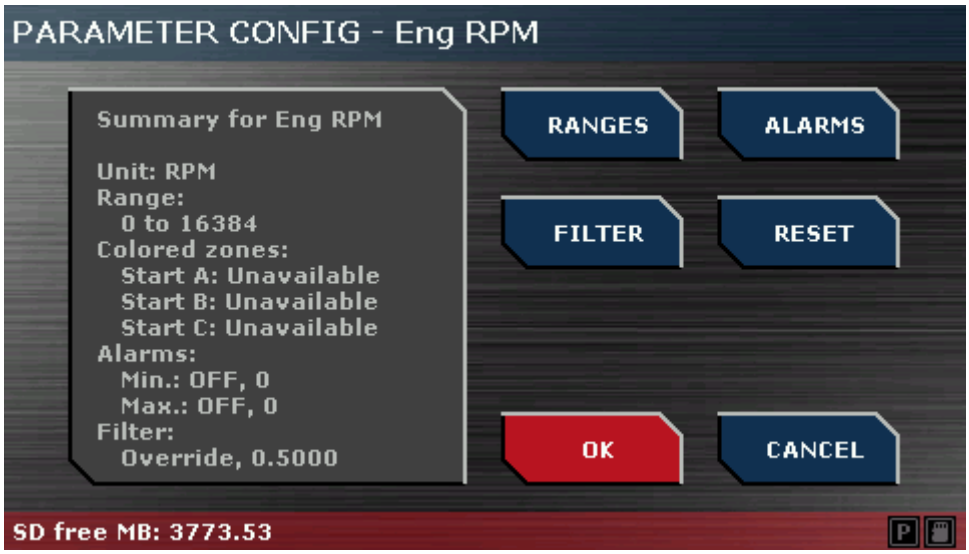

In the screenshot above, the Zones are shown ad Unavailable because they have been not enabled in the Dashboard Configuration script to begin with.
Also Reset in grayed out because there is no customization currently applied to this Gauge.

A specific section handles the explanation of Filter Configuration.

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Dashboard Filter Configuration

As seen in the Dashboard Configuration section, it is possible to configure on StartDiag Display some override value that will take place instead of the ones defined in the Dashboard definition script for each Gauge.

The most simple ones are the Ranges used in the Gauge and the Alarms.

Also the Filter can be changed and adapted. What does the Filter section apply to?

This will not be a deep mathematical explanation, but it will provide you with the basic understanding to use this menu configuration.

Values incoming from StartDiag Controller are directly read from the connected CAN BUS.
The frequency of the readings depends on the BUS conditions, the current work load of the Controller itself and the other connected device that is providing the data to be displayed.

After being received, the data is displayed to you in the StartDiag Display inside one of the available Dashboard.
Here you can see the value changing in real time as the new values come in.

At times, incoming data may refresh so rapidly that the gauges appear overly reactive or 'flicker'.

To ensure a smoother reading, an Exponential Moving Average (EMA) filter has been implemented.

The filter applied is called Exponential Moving Average Filter, you can look it up online, but it is not as complicated as the name may suggest.
Let's take a look at it together.

The main formula is:
Value = (ImmediateValue * Weight) + (OldValue * (1 - Weight))

The idea behind this filter is quite simple, we take the current instantaneous value and we multiply for a parameter called Weight, then we sum it with the previous value shown multiplied by (1 - Weight) [NOTE: it is important that the sum of the two coefficient add up to 1!].
Basically we are taking a part of the current received value and we add it to a scaled value of the previous one. This gives us the current value that will be shown, which later is going to be used as old value the next time that we receive data to be

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presented in the Gauge. It is similar to an average, but instead of giving all the values in the formula the same importance they are scaled giving more relevance to one than the other by tweaking the value of Weight.
A Weigh of 0.9 will give a lot of importance to the new value arrived respect the old one, a Weight of 0.1 will give more relevance to the previous value than the one just arrived.

Let's make an example of value that the filter provide; for this we start by fixing the initial value to 0 and we suppose that we every time the new data is equal to 10:

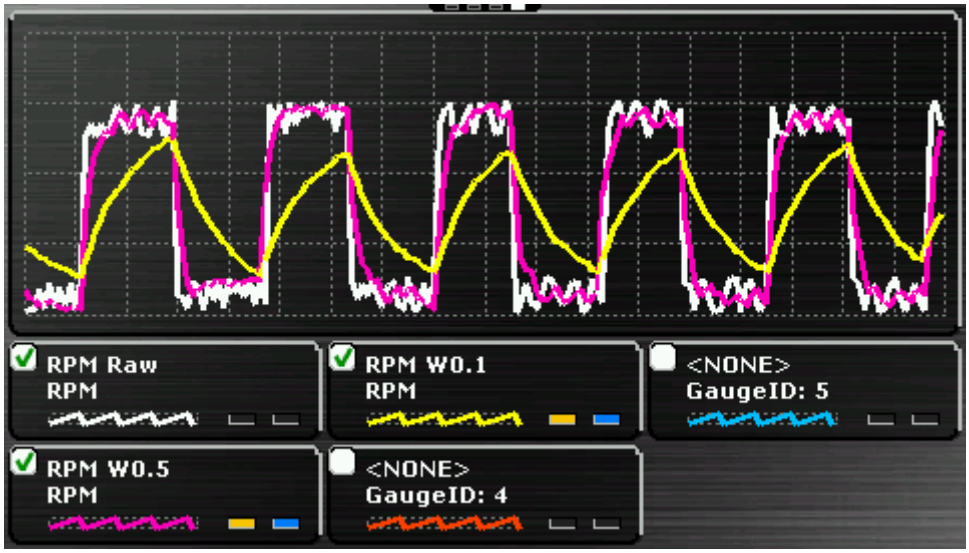

Fig.5.3.1 - Here you can see exmaple of the effect of the filters in Chart View

NOTE: The white graph displays the data as arriving on the CNA BUS. The Pink graph5 shows the effect of the filter with a Weight of 0.5, while the yellow shows the bigger effect of setting the Weight to 0.1.

This kind of filter allows to remove the components that changes very quickly from the incoming data, slowing down the changes of the value displayed and so reducing the flickering effect and slowing down the sudden changes in value represented in a Gauge.

Looking at the formula it is possible to nice a couple of interesting facts:
- Setting Weight = 1 will result in applying no filter at all! In fact in such a case the only relevant component remaining is Value = ImmediateValue
- Setting Weight = 0 will result in a filter that NEVER update the result. (Not a very useful filter indeed)

To avoid the problem of a useless filter, StartDiag System doesn't allow weight to be

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set to 0.

Obviously the application of such a filter have some effect on the number that you see in the Dashboard:
- the values change slower (it a value changes quickly from, let's say 0 to 100, using the filter it will pass from intermediate values that are not really part of the received data but result of the filter action)
- if data reach a maximum values just for a brief period of time, the value presented may not represent that number (we may say the filter tends to smooth the peaks and valleys in the incoming data)
- if the data present a medium value, the stronger the filtering action, the more the data will tend to be flattened toward such value

There are times when the smoothing effect of the filter is useful to allows a simpler visualization of the data coming from an ECM, and there are times when the effect of the filter would not be useful at all, if not even problematic. Because of these, StarDiag Display allows you to override the configuration coming from the Dashboard scripts using the PID Configuration menu.

Here you can see 3 options that will allows you to change the Filter behavior for the selected Gauge:

- Override: allows you to setup a value for the Weight parameter that will be used instead of the one provided by the Dashboard script.

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Selecting Change you will be able to set the Weight you want to use.

- From Suite: let the filter use the value defined in the Dashboard configuration file. (look at the StartDiag Suite Guide for more information about that tool)

- None: disable the filter, you will see the data as they are provided by StartDiag Controller

For more customization that you can directly apply on your StartDiag Display, please refer to Dashboard Configuration.

Tools Menu

This section is particularly relevant since it exposes features related the interaction of the StartDiag System with the vehicle that it is connected to.

"Custom CAN Baudrate" allows you to configure a custom baudrate to be used for the CAN BUS baudrate identification and for successive CAN BUS accesses.

"Execute Script" allows you to select a LUA Script file from the microSD card and to execute it on the currently connected vehicle.

"DTCs" allows you to inspect and clear the diagnostic trouble codes.

"CAN Logger" allows you to start a CAN log session that will remain active until you will manually leave the capture mode. This is very useful to inspect CAN traffic on the connected bus.

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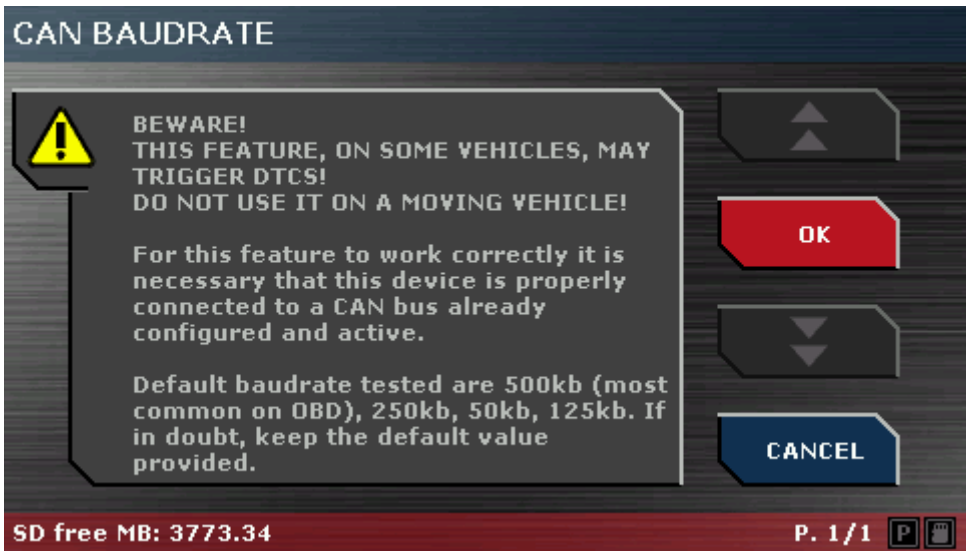
NOTE: CAN Logger can be also started and stopped via LUA Scripting. There is always the possibility that a LUA Script contains some bugs and so it may end before stopping the started Logging session (or the Stop command may have been omitted. In such cases, the CAN Logger button changes name, becomes "CAN Logger Stop" and when pressed will stop the ongoing capture also showing you the name of the relative file.

Custom CAN Baudrate

This procedure allows you to set a custom baudrate for the accesses to the CAN BUS and can be reached from Tools Menu in the Main Menu.
This custom baudrate will be checked before any other default one because ti is considered higher priority (we assume you know the CAN bus you are working with better than us).

In order for this to work properly (as reminded in the first step of the procedure shown below) it is strictly necessary that the CAN bus is already working correctly:
- all the connected Nodes share the same baudrate
- there are at least 2 active nodes connected to the bus and sending traffic (at least one packet every 0.5 seconds)
- the terminations are set correctly for the CAN bus
These conditions are needed since after setting your custom baudrate, w will verify it along with our default ones (just in case yours is not valid but we have a valid one in our default settings).



After the initial reminder, you will be prompted with the request to input your custom baudrate

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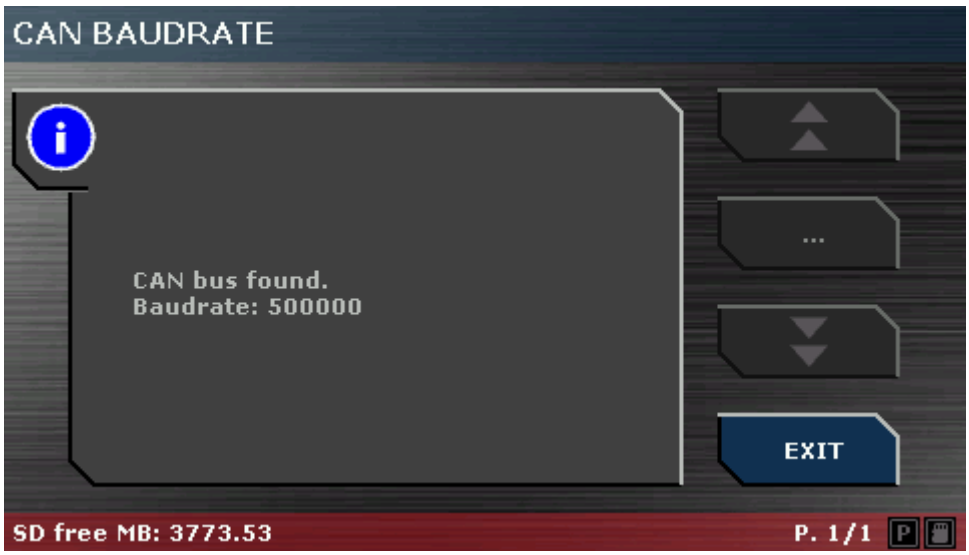
When you enter this page, a suggested value is shown, that you can accept directly if so you desire. This value is 500000 if it is the fist time you enter Custom CAN Baudrate and none was set in the boot.sds file, otherwise we show you the last set value which can be the one configured in boot.sds or one that has previously validated (or set) entering this page previously.
Confirming with OK the procedure will start to verify yours (and if not valid, matching also our default ones) baurdate.

If your custom baudrate is correctly identified, it will be shown to you as in the screenshot below:



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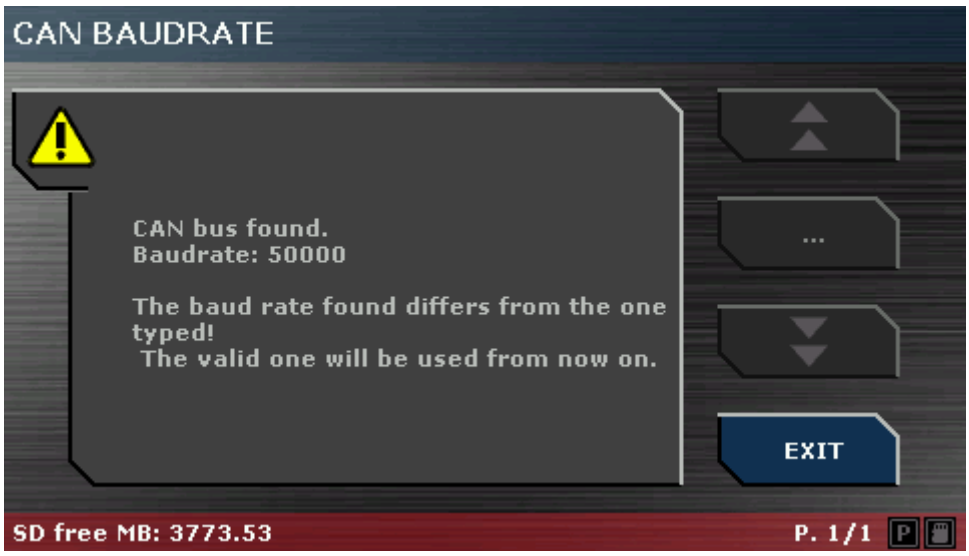
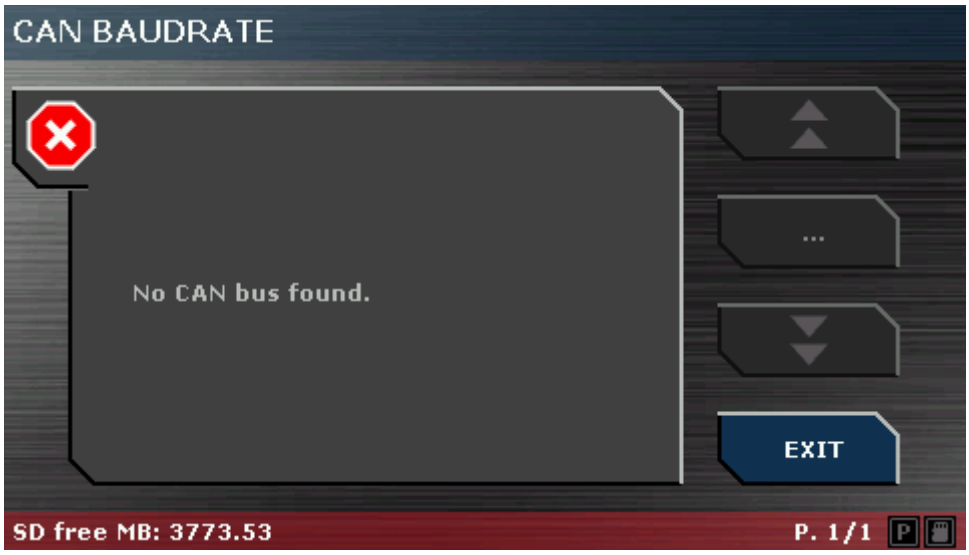
If your custom baudrate is not found, but one of our default ones is found valid instead, the follow screen will present you the result and a beep will also be played (if you did not disabled them in the Settings Menu):



If no valid baudrate is identified, a message will warn you of the situation.



If any baudrate is validate correctly, be it the one you requested or a different one, it will be set as predefined on StartDiag Display for future use.

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If, on the other hand, no baudrate is found, then the one you input will be preserved, because this behavior gives you the most freedom of movement.

StartDiag Controller have some default baudrate that it tries (in this order):
- 500000 (500kb)
- 250000 (250kb)
- 50000 (50kb)
- 125000 (125kb)

NOTE: your custom baudrate can be also one of our default ones, in that case yours (since it has higher priority than the default ones) will still be put first and used, and our "copy" of it will simply not be used.

This procedure can be used if your custom baudrate is in our list but you want to speed up the access to CAN features, since at the first match the CAN bus is considered identified without testing others.
NOTE: Please, remember that since there is not standard way to identify the baudrate of the connected bus, our procedure has to be considered a best effort attempt, with to 100% guarantee that the correct baudrate is found!

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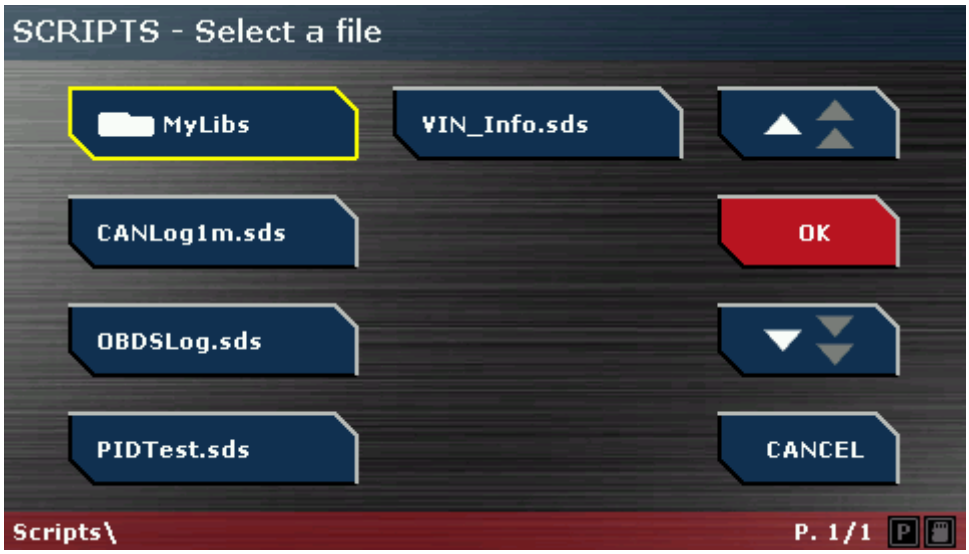
LUA Scripts

This page allows you to select one of the LUA Script Files available on the microSD card.



The page presents a list of files and sub-folders that you can browse for the script file you want to launch.
Select the file you want to run and select "OK", then confirm and let it run.

NOTE: each script execution is standalone and isolated from the others, so you do not have to worry about conflicts between scripts.

For more information about the LUA Scripts development, refer to the StartDiag Developer Guide.

DTCs

DTCs is the acronym of diagnostic trouble codes.

Those are codes that the vehicle on-board computers set to indicate an anomalous condition, normally a malfunction or a non-standard operating condition.

While some of the DTCs are associated with lights on the vehicle dashboard, just the light alone is not particularly useful to identify the root cause of a malfunction. Inspecting the DTCs allows to have a more precise indication about which is the current active error and what to look for.

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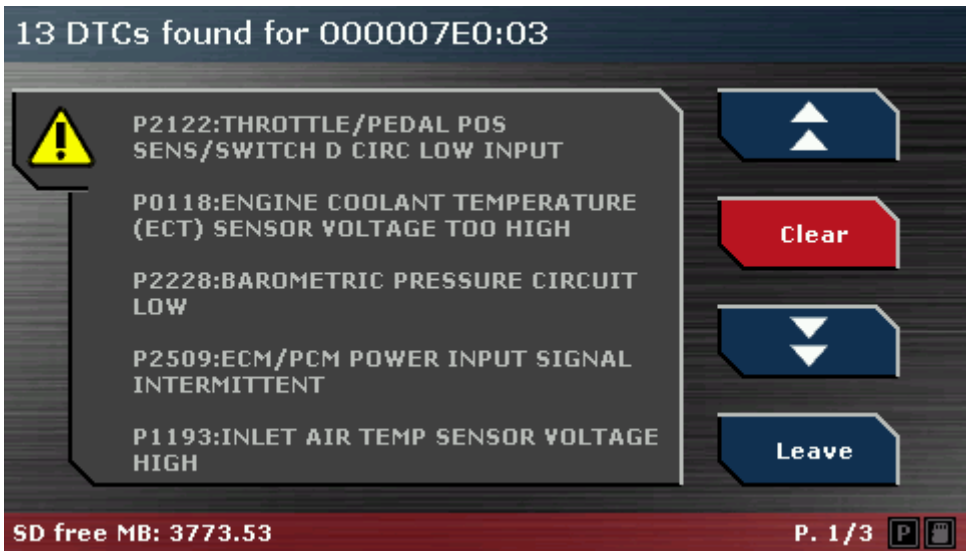
The first step is to Read the DTCs, this is done upon entrance of this page.
A list of the identified DTCs is shown on the left panel, while on the right you can leave the current page ("Exit") or Clear the DTCs ("Clear").



NOTE: if a DTCs is cleared without solving the underlying issue, it will reappear shortly after.

Following the spirit of the device, StartDiag System uses a freely editable file on the microSD card to provide the description to the DTCs.
This means that not only you can customize the description themselves, but also add to the list all the DTCs and descriptions you want!

NOTE: If you want do so, please refer to the script System\CAN\DTC.sds to see the requirements that the description file must respect for that
script to work properly.

DTCs may be present in more then one ECU, so a list of ECUs is checked. For each you may see the list of DTCs set and the request to clear them.

As for any other feature that we provide, our version of the implementation may check ECUs that are not present on your specific vehicle
so that the feature will be available for others. You are free to edit the sciprt file DTC.sds in the System\CAN folder on your SD to adapt it
to your specific needs. This means that the user interface related to the feature may be different than the one represented here.

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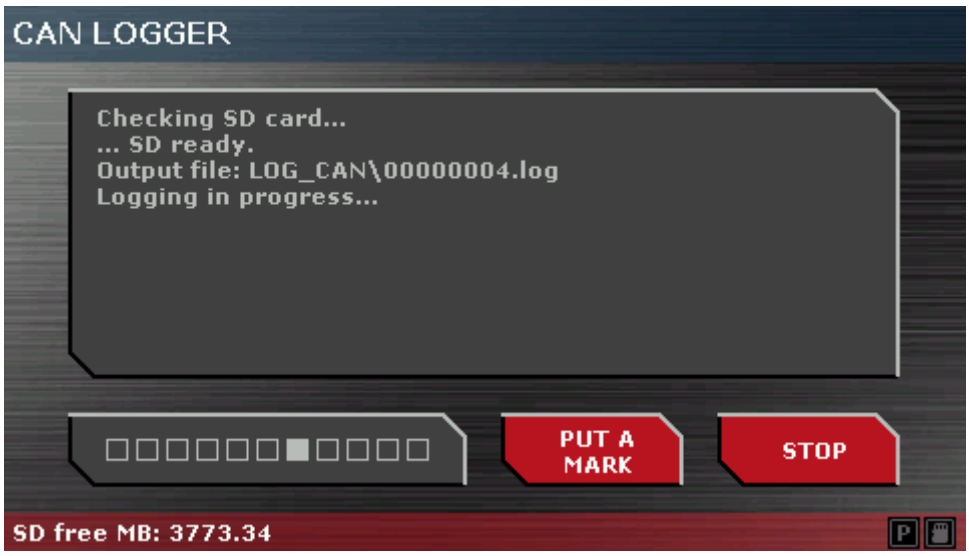
CAN Logger

Sometimes it is very useful to be able to see what is passing on the CAN bus connected to the OBD port.

In those cases the feature of the CAN Logger is very important.

When you select this feature, StartDiag Display units enter in CAN Logger mode and the only option available is to interrupt the logging. This is to allows the maximum performances for the capture and saving of the packets on the microSD card.

While the CAN Logger is active, the blue indication on the StartDiag Controller will turn ON and will stay on for all the duration of the capture.



For convenience, the CAN Logger page displays also the file that will contain this capture.

After starting this mode, pressing "Stop" will interrupt the capture and save the data to the microSD card.

BEWARE! Do not remove the microSD card before having stopped the CAN Logger. Doing so will corrupt the microSD card and the log file will not be generated correctly.

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Settings Menu

This sub-menu is the door that allows to reach the settings to make the device suit your own preferences.

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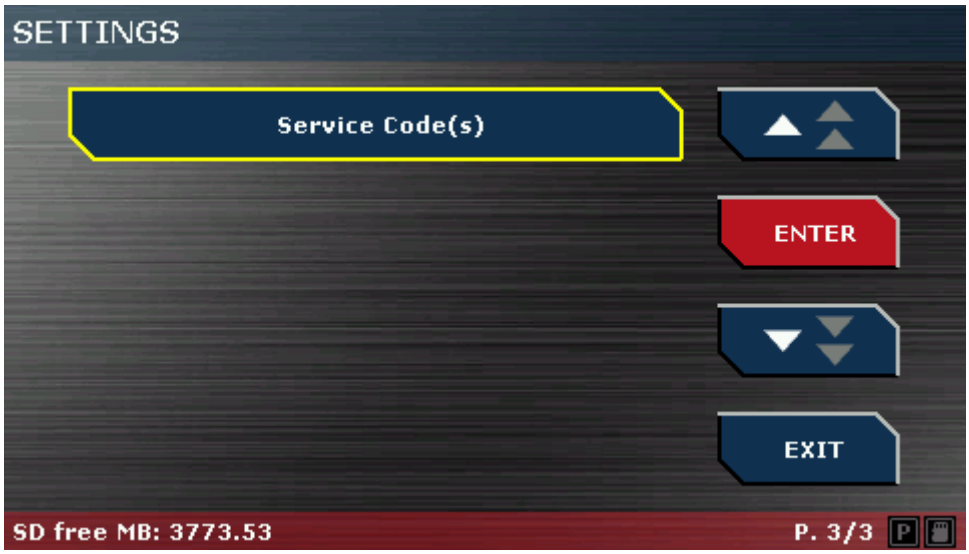

- "Appearance" will let you configure the settings of the GUI.

- "Dashboards" page will allow you to reset the configuration changes done by the Dashboard Configuration page. It is also possible to set the refresh rate for the PIDs (NOTE: this will apply to all the Dashboards and all the PIDs!)
- "Display Brightness" will let you configure the display brightness and the setting of the light sensor located on the front panel of the StartDiag Display unit.

- "Audio" presents the settings for the audio compartment. Here you can change the tones used by the audio notifications and, in case, disable the tones altogether.

- "Notice Window" offers some parameters for the messages used to show information during the StartDiag System utilization.

- "Firmware Update" shows the current version installed and in case allows to install manually updates from the microSD card (normally new firmwares are installed automatically after the updated microSD card is inserted in the StartDiag Display unit)

- "Touchpad Calibration" starts the procedure to calibrate the touch screen. **If the calibration routine is started it is mandatory to complete it, the operation can't be interrupted midway!**

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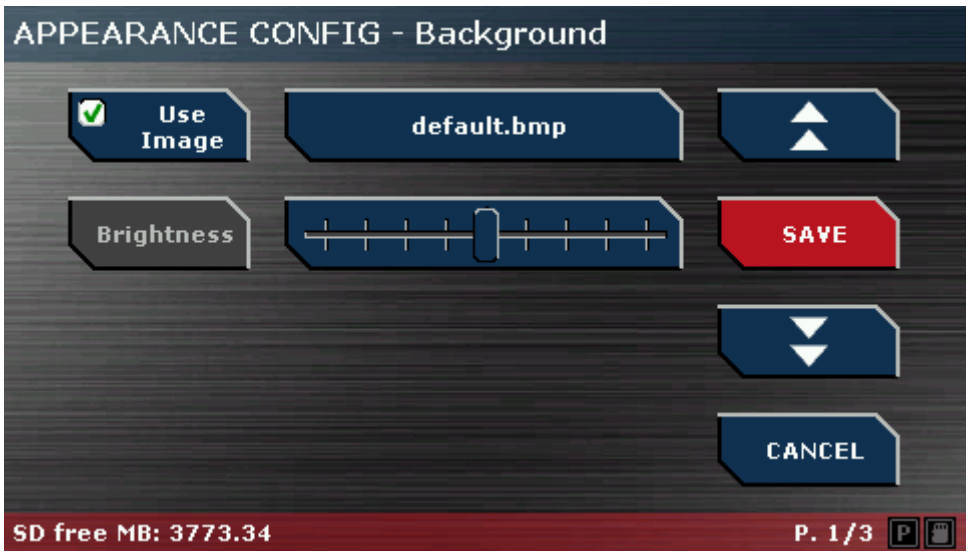
Appearance

The first section of this menu allows you to customize the backround.



Here you will be able to select if to use a background image or not, and in case, which background image to use.

NOTE: the images can be customized by putting new ones on the microSD card in the "Config" folder.
Valid images must be BMP images, 480x272 16bits of color.

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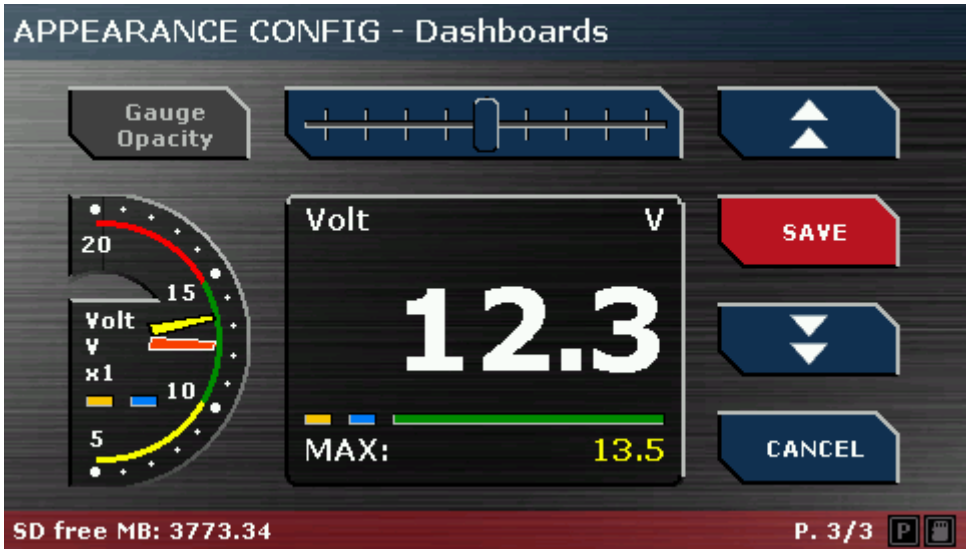
In the second page you can configure the colors and the styles for the menus.



Lastly, the third page allows to configure the transparency of the Gauges in the Dashboards.

Note that this is a single value applied to all the Gauges in every Dashboard!

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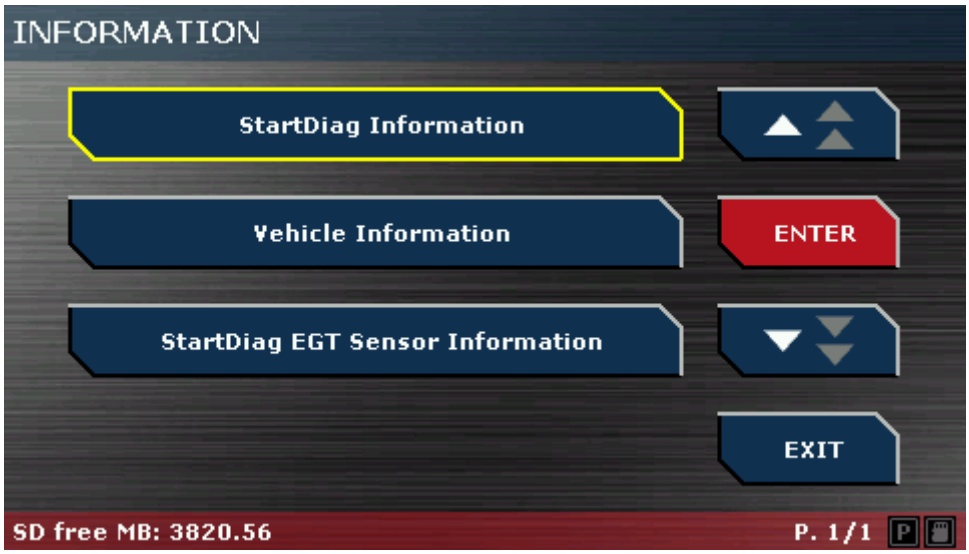
Info Menu

This sub-menu allows to inspect various information about the connected vehicle, the status of the licenses, the firmware version installed on the StartDiag System or connectable external peripherals (Ex: EGT).



- "StartDiag Information" reads the information from the update file available on the microSD card (if any), the StartDiag Display and the StartDiag Controller, and displays those information.

- "Vehicle Information" reads the data from the vehicle connected and displays the identified VIN and some other connection parameters.

- "StartDiag EGT Sensor Information" shows the information about the connected EGT sensor.

Standby

StartDiag System is powered by the OBD port of the vehicle.

Even if not in use, it will drain current from the batteries and that could bring to potential issues if the vehicle is left turned off for longer period of time.

One way to reduce the power consumption is to put StartDiag Display in "Standby" mode, where the unit is basically sleeping and can be turned back on quickly by

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touching the touch screen.
Sometime this is not enough, in fact even if the Display is sleeping, the Controller is always active and ready. If you have to leave the vehicle stopped for longer period of time without allowing the alternator to recharge the batteries or using an external battery charger, it is advised to disconnect the full StartDiag System from the vehicle by simply unplugging the OBD connection.

When ready again to use the StartDiag System, just plug the OBD connector back into the OBD port and you are ready to go.

StartDiag Display advanced customization

The whole StartDiag ecosystem revolves around your needs and aim at offering you all the freedom you may need to customize the tools we provide to your needs.

From the possibility to develop your own StartDiag LUA scripts, to the possibility to change your Display background and the PIDs you want to monitor using the dashboards.

To take things a step forward, StartDiag Display uses custom scripts to provid you some features that you can quickly recall by the StartDiag
Display menu, as Info -> Vehicle Information.

These features are defined by LUA scripts in sds format, that have to be placed inside a specific folder and with a fixed name in order for Startdiag Display to recognize them. All these files are defined inside the System folder in the root of the microSD card.

Inside this folder you find a main configuration file that is loaded when Display boot up or when it wakes up from standby (yes, you can put Display
in standby, extract microSD card, change the content of "boot.sds", put it back in and wake up Display by touching the screen and the new settings will take
effect immediately).
Side by side with "boot.sds", there is "System" you find the CAN folder which define the scripts to be used for interfacing with CAN busses, and here you find:
- "VIN_Info.sds": is the script called when you request Info -> Vehicle information
- "DTC.sds": is the script called when you request the Tools -> DTCs

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Boot Configuration File

To allow you to customize StartDiag System to your needs, at start up (or when it wakes up from standby) StartDiag Display read a configuration file you can customize as you want.
This file, which name must be “boot.sds” and must be in the folder System on the microSD card, allows you to set initialization values for common behaviors of the unit, such the CAN baudrate to use or the status of the Paranoid Mode.

This is an example of content for such a script:

```
--------------------------------------------------------------------------
--  Add your desired settings here.
--  See the guide and examples below.
--------------------------------------------------------------------------
-- Examples:
useBaudrate = 500000 -- Set baudrate to 500000 (can be changed using Tools -> Custom CAN Baudrate button)
useParanoidMode = false -- Disable Paranoid Mode (can be changed using Settings -> PARANOID button)
bootToMainMenu = true -- After Starting Up and Waking Up the Display will not go to Dashboards but directly to Main Menu
advancedCANPassiveTest = true --[[ Needed to be true for vehicles with gateways on OBD port.
                                   When enabled, if only can buadrate passive identification is chosen,
                                   the Controller will be allowed to acknowledge incoming packets
                                   (for wrong baudrate configuration this may lead to CAN bus errors!).
]]
```

NOTE: Even if the file “boot.sds” is a LUA script, it has some limitations. It has been designed to allow you to configure your device at ever boot or wake up, but it have no access to some LUA API that can be normally used by standard scripts. The most notable one is can.init, which imply that “boot.sds” can't really access any of the underlying CAN API. This limitation has been designed to ensure more safety for you.

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Firmware Update

Firmware updates for StartDiag System will be freely available on our reference and support site.
The files are normally presented with the following naming convention: ''StartDiag_MMMM_mm_ll.sdu'' where MMMM is the major version, mm is the middle version and ll is the minor version.
After you downloaded the file from our website, put it in the root of the microSD card and rename it to ''SDUpdate.sdu''.
Insert the microSD card into StartDiag Display and the automatic update should start.
StartDiag system inspects the microSD card every time it is inserted. During this check it will look for a file with the name ''SDUpdate.sdu''. If it is found, the version contained is read and if it is newer than the current version installed, it will automatically warn you and after some seconds it will reboot and the update will start.
The presence of updated firmware is checked also at system power up, in which case the Display starts up without user touch and perform the update automatically.
If for any reason you need to revert to an older version, the procedure is the same to prepare the microSD card.
This time the automatic update will not start (assuming you put an older firmware on the microSD card itself).
In order to start the firmware downgrade, you have to go into "Settings" -> "Firmware Update". At this point you can check a comparison of the currently installed firmware version respect with the one you put on the microSD card, and if you confirm to proceed, the normal update procedure will start.

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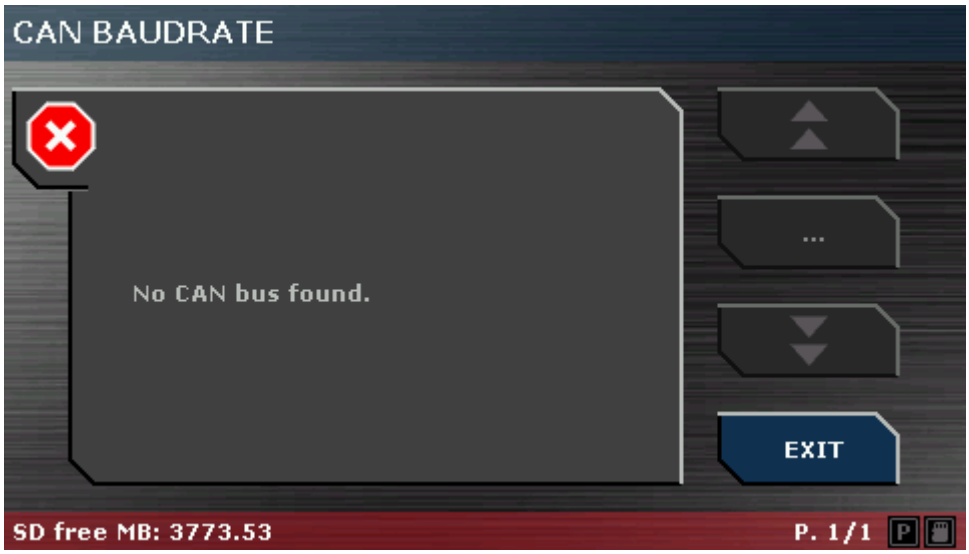
Error Messages

During operation of the device, it is possible to encounter various errors related to potential states of the CAN BUS or the communication between the Dispaly and the Controller.

We can differentiate between two main types of errors: communication errors between Display and Controller before the units boot up, and errors happening after the system finished boot up. In the case of the first type, the units will present to the user the errors in the form of blinking LED patterns with an alternation fo RED blinks and GREEN blinks (see the section "StartDiag Display / StartDiag Controller communication issues" later on).
I the system completes the boot up, then the errors will be presented to the user on the Display's LCD. These can be in the form of Message Boxes which are generally used for errors that require the unit to be restarted or unplugged



or can be smaller Notice Windows.

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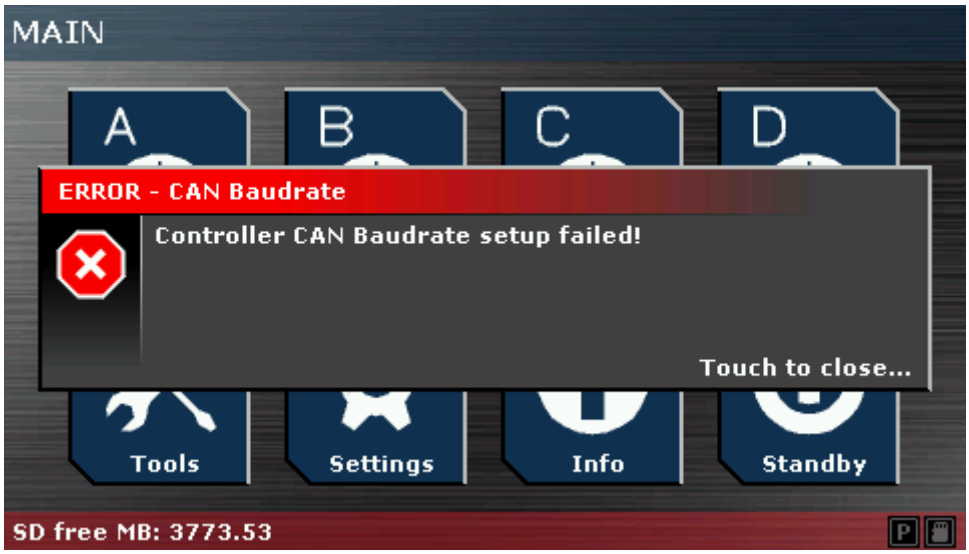

One last possible representation of errors happens in the Dashboards, there the errors related to the PIDs readings are represented mostly as small numbers in a colored square. The number represent the error code, while the color of the square dives information about the nature of the error. For the latter type, you can check the section “CAN Errors” or “J1939 Errors” for some more explanation of the most common numeric errors presented.

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Appendices

Troubleshooting

This section will guide you through some steps to help you diagnose and correct potential issues with the StartDiag System.

This product is very modular, and as such required some connections to be working correctly.

- microSD card issues: microSD cards can have issues, become damaged or need to be formatted. If the microSD card is not recognized, attempt to reformat it to FAT32 using a PC (supports up to 32 GB).

- Device fails to power on: Ensure the proprietary microUSB cable is securely connected between the Display and the Controller.

- StartDiag Display does not start up and the light indications blinks red and green: this normally indicates problems with the data connection between Display and Controller. Please contact your seller for further assistance.

- StartDiag System does not recognize the connected vehicle: make sure that the DB15 is properly connected with StartDiag Controller and the OBD size if properly connected with the vehicle port. If all of this is correct, probably StartDiag does not currently support the connected vehicle, and so it can't read the proper information from the ECUs. Please contact your seller for further assistance.

For all the other cases, please, contact your seller to receive support.

Error Codes

Currently StartDiag System can show some errors depending on the operation that as ongoing at the moment of the issue.

We can split them in various category:
- StartDiag Hardware issues
- StartDiag Display / StartDiag Controller communication issues
- CAN Errors
- J1939 Errors

NOTE: please remember that when error codes are displayed in the Dashboard they

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are represented in hexadecimal format, for example 0A is 10, 0B is 11 an so on.

The descriptions below use decimal notation for the error code.

StartDiag Display / StartDiag Controller communication issues

These errors are related to miscommunication between the two units that build StartDiag System. These can be seen on the Display as Errors and invites you to disconnect the System from OBD port and reconnect. Generally to solve these issues it is enough to follow the instruction displayed.

A special case for these errors is during unit boot up.
In the very early phases of StartDiag Display boot up process, it have to identify the attached Controller and the relative data. If there is any issue during these early moments, since the GUI is not available yet, the error is displayed with alternative blinking of the front facing LEDs on the Display unit.

Those pattern are in the form of RED (NUMBER of GREEN) that repeats itself.
Another category of errors are manifested as RED RED (NUMBER of GREEN) RED RED.

If one of these error persist after disconnecting and reconnecting the units, please contact support providing the information about which unit is affected (Controller or Display) and the pattern you see to receive further assistance.

CAN Errors

CAN errors can be shown in the Dashboard if the CAN communication with the requested ECUs is not working correctly.

All those errors are derived from the Controller and shown on the Display unit.

Below you can find the list of the CAN UDS errors that are currently documented for the Dashboards:

0 = Ok: No Error all went fine

1 = Timeout error: we did not get a response in the prescribed time to a CAN requested

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3 = NAK: using UDS protocol the remote ECU reported an explicit deny to the request done

4 to 19 = Protocol error: One of the steps for UDS protocol was not respecting the required phases

20 = XMIT BUS Error: The controller is not able to send packets on the bus. Generally this is due to Controller becoming the only alive CAN unit on the bus (so the CAN protocol ACK are not received) or the bus has defective units that bring the Controller in BUS OFF state (this situation is describe deeply in the official CAN documentation).Another possible cause for this erro is the use a force configuration file with incorrect parameters for the BUS to which the Controller is currently connected.

21 = Peripheral Disabled error: the requested operation can't be performed because the required peripheral is not active. This normally related to the CAN periphery on the Controller and it can happen is while the Controller is booting, the CAN bus is not active and no communication ongoing on the BUS. This situation prevent StartDiag Controller from being able to identify the baudrate of the BUS and turns of the CAN periphery to avoid to trigger errors on the other units connected to the BUS that may come alive later on.
(If at boot the StartDiag goes straight to Dashboard but the Controller did not identify the BUS parameters, instead of the error 21 the error 11800 which has the same meaning).

NOTE: If you are using a custom LUA script, there you get the same error codes reported here, but with 10000 added, for example NAK becomes 10003. An error of 1 (without 10000 added) indicates that the timeout happened in the communication between Controller and Display and does not happen in Dashboards.

J1939 Errors

J1939 errors can be shown in the if the communications with ECUs are not working as expected.

Below you can find a list of the J1939 errors that are currently documented for the Dashboards:

0 = OK: No error, all was fine

1 = Timeout error: we did not get a response in the prescribed time

3 = NAK: using J1939 protocol the remote ECU reported an explicit deny to the

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request done

7 = Subscribe Error: a request to handle a specific PGN was not able to register in the subscription list on Controller

8 = Connect Error: Controller was not able to connect as prescribed to the J1939 BUS (can be that the used address is already taken)

9 = TX Error: Controller was not able to send data on the BUS

10 = RX Error: Controller was not able to read data from the BUS

11 to 17 = J1939 Protocol Error: one of the phases of the J1939 protocol was not respected

When in a Dashboard, another error can be seen on the Gauges: it may happen that a pink square with the indication "00" is presented. That is not an error strictly speaking, in fact it shows the value of 0. It instead indicates that for the definition of the Gauge, a ValidityTime has been provided and there has been no update to the values before ValidityTime expired. Basically it just indicates that the data shown in the Dashboard is considered Stale (not updated in time).

When entering the Dashboard moreover it can happen the CAN peripheral on StartDiag Controller is not enabled (See the section of "CAN Errors" for a deeper explanation of the cases in which it can happen). In that case also for J1939 Dashboards the error 11800 is presented.

NOTE: If you are using a custom LUA script, there you get the same error codes reported here, but with 10000 added, for example NAK becomes 10003. An error of 1 (without 10000 added) indicates that the timeout happened in the communication between Controller and Display and does not happen in Dashboards.

CAN Baudrate Handling

As explained in a slightly deeper way in StartDiag Developer Guide, CAN bus requires a fixed baudrate for all the nodes to be able to communicate correctly.

The value of the baudrate can't be easily read from the bus, it is possible to try to identify it only if the bus is already alive and other nodes are peaking to each other already, generally
the baudrate is considered a design property of the bus and is known in advance.

StartDiag System, StartDiag Controller specifically, implement two different ways to

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try help you in discovering the baudrate of a connected CAN bus:
- PASSIVE: this is the first approach adopted and connects to the CAN bus in such a way to not disturb it, even if the baudrate set is wrong.
- ACTIVE: this is a second step take if required and if the PASSIVE approach didn't grab any message. Controller enable CAN peripheral and tries to send small messages on the bus, then it evaluates the CAN error received or positive responses.

ACTIVE discovery can introduce CAN bus errors on the bus and that alter the normal flow of messages on the bus itself, potentially disconnecting temporary nodes and triggering DTCs in some cases.

One way to mitigate this problem is to ask you to set the CAN baudrate you want to use for the session. This is done on StartDiag Display and the value can be set only by your direct intervention. No script can alter that value for safety reasons.

The first time you start one of the features of StartDiag that requires Controller to connect to the CAN bus, if there is currently no CAN baudrate set on Display, you will be required
to input a CAN baudrate to use, this will be then sent to Controller and verified, then the result of th test will be presented.
The value you provided will be kept until you change it from using Custom CAN Baudrate, or you can change the configuration file
on the microSD card and reset the Display unit (waking from standby is enough).

Scripts instead are more free to use whatever CAN baudrate they see fit, even invalid ones. Calls to can.init (see StartDiag Developer Guide for more information) without the Active flag set to true will perform only a connection using PASSIVE identification, which is inherently safer. Clearly if it is required to connect to a bus where the baudrate is known but there is communication ongoing, the Active flag is required.

NOTE: Depending on the configuration of the Display, it may happen that the CAN baudrate is requested the moment you connect the StartDiag System to the vehicle or at Display wake up. This can happen if the System is configured to boot/wakeup directly in one of the Dahsboards and no custom baudrate was previously validated correctly (remember that baudrate information are not saved between device disconnections!).

Paranoid Mode

As can be seen in CAN Baudrate Handling, scripts have a lot of potential freedom in using the CAN functions,

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specifically in calling can.init function in "unsafe" mode. (Keep in mind that this "unsafe" operation is required to give you the freedom you need to access various CAN busses).

To give you a safety mechanism, StartDiag implements a mode called Paranoid Mode. This mode can be set in the boot configuration file, and can be independently changed in the Settings menu.

When this mode is active, every time a command or a feature tries to change the CAN baudrate you set on StartDiag Display with a different one, or ask Contorller to use a CAN baudrate different than the one you set on Display, you will be requested if you want to allow the new value, and in case of refuse, the script will terminate preventing scripts from setting baudrate without you know.

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Warranty

European Union (EU) Market

For consumers in the EU, this product is covered by the statutory warranty of 24 months from the date of delivery, in accordance with EU Directive 2019/771. This warranty covers any lack of conformity existing at the time of delivery. For professional use (B2B), the warranty period is 12 months unless otherwise specified by local laws.

NON-European Union Market

TomElectronics Srl warrants to the original purchaser that this product will be free from defects in materials and workmanship for a period of 12 months from the date of original retail purchase.

Warranty Exclusions

This warranty does not cover damage resulting from:

Improper Installation: Damage caused by failure to follow the installation instructions provided in this manual (e.g., incorrect wiring, reversed battery polarity, or incorrect CAN bus baud rate settings).

Misuse: Use of the product outside its intended purpose or technical specifications (e.g., use in 24 V systems if the product is rated for 12 V).

Unauthorized Modifications: Any attempt to open, repair, or modify the hardware or software by unauthorized personnel.

External Factors: Damage caused by accidents, fire, liquid contact, or power surges exceeding the limits.

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Technical Specifications

Feature	Specification
Model	StartDiag Mod. 001
Operating Voltage	9 V – 36 V
Power consumption	Typical: < 500 mA Stand-by: 150 mA
Processor	High-performance 32-bit ARM Core M3
Display	4.3” TFT LCD, 480x272 px
Connectivity	High-Speed CAN Bus (ISO 11898), OBD-II Standard
Memory	Internal flash + microSD slot (up to 32 GB, FAT32)
Operating Temperature	-20 °C to +70 °C (-4 °F to 158 °F)
Housing material	PC + ABS V0
Protection rating	IP20
Dimensions	Display: 126 mm x 76 mm x 23 mm Controller: 140 mm x 79 mm x 23 mm
Weigth	Display: 150 g Controller: 80 g

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Declaration of Conformity

Model number:	StartDiag Mod. 001
Trade Name:	TomElectronics Srl
Responsible Party:	TomElectronics Srl
Address:	Italy (IT)
e-mail:	info@tomelectronics.it

Tested to Comply With FCC Standards.

The device complies with Part 15.103(a) of the FCC rules: A digital device utilized exclusively in any transportation vehicle including motor vehicles and aircraft.

Operation is subject to the following two conditions:
1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation

Model number:	StartDiag Mod. 001
Trade Name:	TomElectronics Srl
Responsible Party:	TomElectronics Srl
Address:	Italy (IT)
e-mail:	info@tomelectronics.it

Tested to Comply with CE Standards: EN 50498:2013

Certificate number: EMC-V200220018156-000
Issued by: TÜV Sud Italia Srl

CANADA: CAN ICES-003 (A) / NMB-003 (A)
This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

RoHS

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