
Renesas ASSP EASY Motor Control Solution

Based on RISC-V

Graphical User Interface operation description

This manual describes in detail the “Graphical User Interface” for evaluation and tuning of the motor control solution.

This manual is organized in the following sections:

- Installation guide
- Connection to the target board
- Speed Control
- Motor tuning
- Parameter description

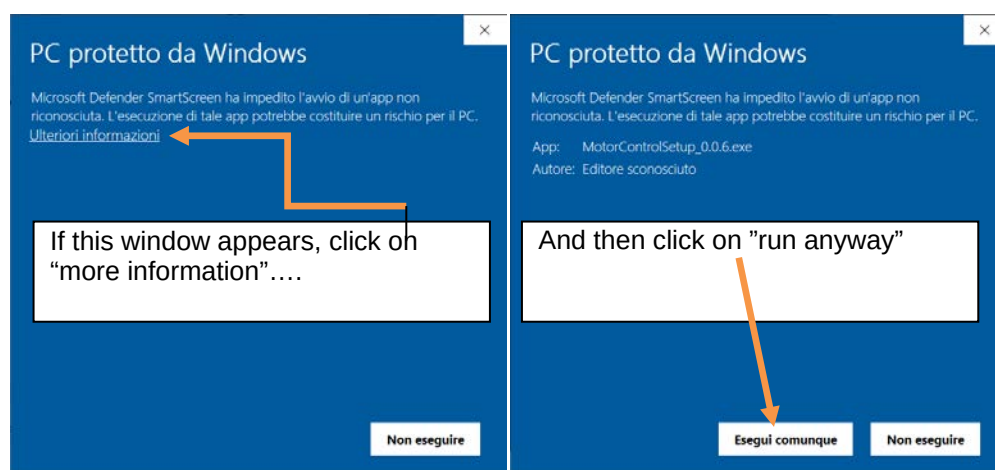
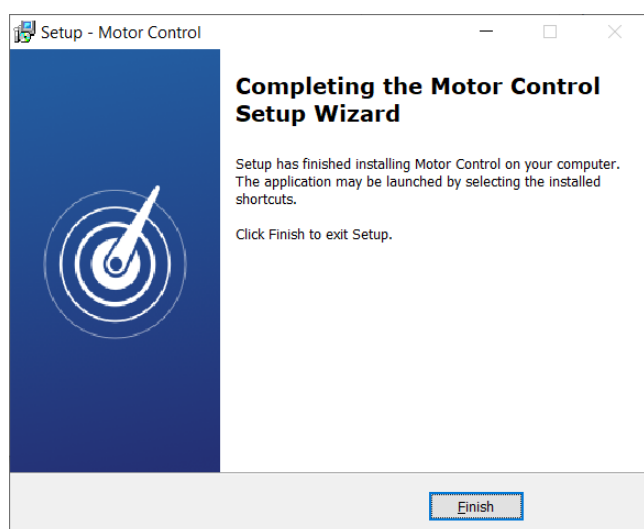
Target Device: R9A02G0204

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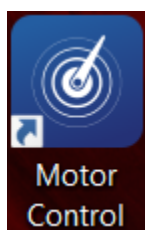
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1. PC Graphical User Interface (GUI) Software Installation

The PC GUI supports 32-bit and 64-bit Windows™ operating systems (Windows 10, 8.1, 8, 7, Vista). **Note: Windows™ Vista, 7, 8 and 10 users must install the software with administration rights.** User may experience a “User Account Control” dialog box pop-up. In such case, enter the administrator password and click **<OK>**. Else, to install right-click on the “**MotorControlSetup_x.x.x.exe**” and select “**Run as administrator**” or double-click on **<MotorControlSetup_x.x.x.exe>** and then follow the on-screen instructions until reaching the following installer screen and then click **<Finish>** to complete installation.



The Motor Control GUI program icon (see below) will be available on the desktop:



The GUI software will be installed by default within the folder “C:\Program Files\BFG Engineering\Motor Control”. As a final step, **it is mandatory to copy the ASSP_V01.ini file**

within the **Motor Control GUI installation folder**. The .ini file is delivered with the installation software and contains some configuration settings for the initial setup.

2. Installing USB Drivers

The ASSP EASY Motor Control Kit features an on-board USB to serial (UART) converter interface, to communicate with the PC. It is mandatory to download and install the respective USB drivers for enabling the communication. Please download and install the latest drivers from <https://ftdichip.com/drivers/>.

(Information about the converter IC is available from the FDTI website).

3. Using the Graphical User Interface (GUI)

Note: Windows Vista and Windows 7, 8 users must run the GUI with administrative rights. To automatically set the administrator privilege level, press the right mouse button over the icon of the GUI, select **"Properties"**, press the left mouse button on the **"Compatibility"** tab and select the checkbox **"Run this program as an administrator"** under the privilege Level; then click **<OK>**.

It is recommended to connect the USB cable to the PC and the board before opening the GUI as this makes the connection process easier. The GUI can be opened without the board being connected.

Double-click on the Motor Control GUI icon to start the program; once opened, use the following procedure to connect the GUI to the kit:

- Click on the **"Settings"** button. Usually, the following window will appear.

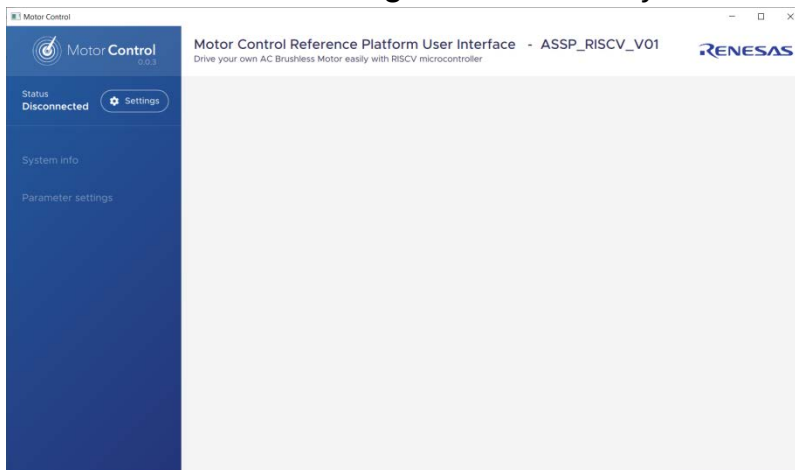


Fig. 1

- Please select the Board Setup .ini file, then select “COM port” or “Auto detect” options and finally configure the baud rate setting which must be set to **19200** or **Auto-detect** as shown in the screenshot:

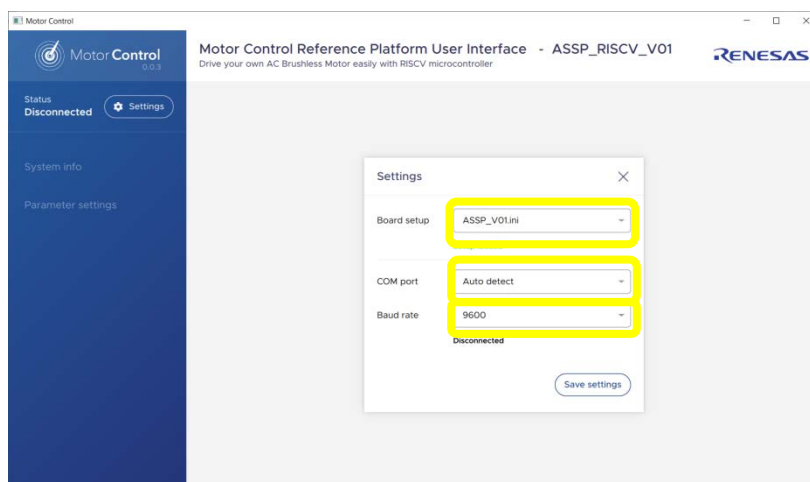


Fig. 2

- Save the settings for future sessions.

If the settings are set correctly, after saving the status will change from 'Disconnected' (black font) to 'Connected' (green font) indicating the connection with the kit is established successfully.

Furthermore, some menu items will appear on the left side of the GUI

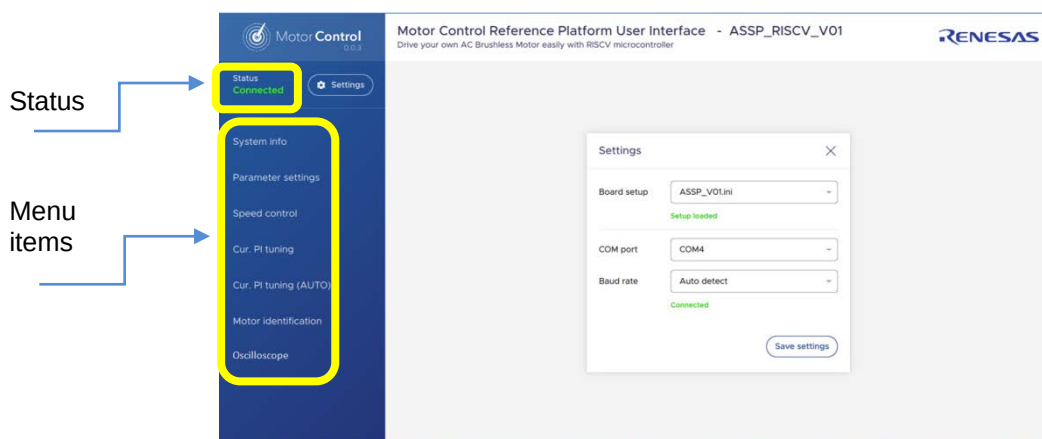


Fig. 3

Now the GUI is ready to be used

4. GUI overview

Below some screenshots to illustrate the various functions provided by the GUI interface.

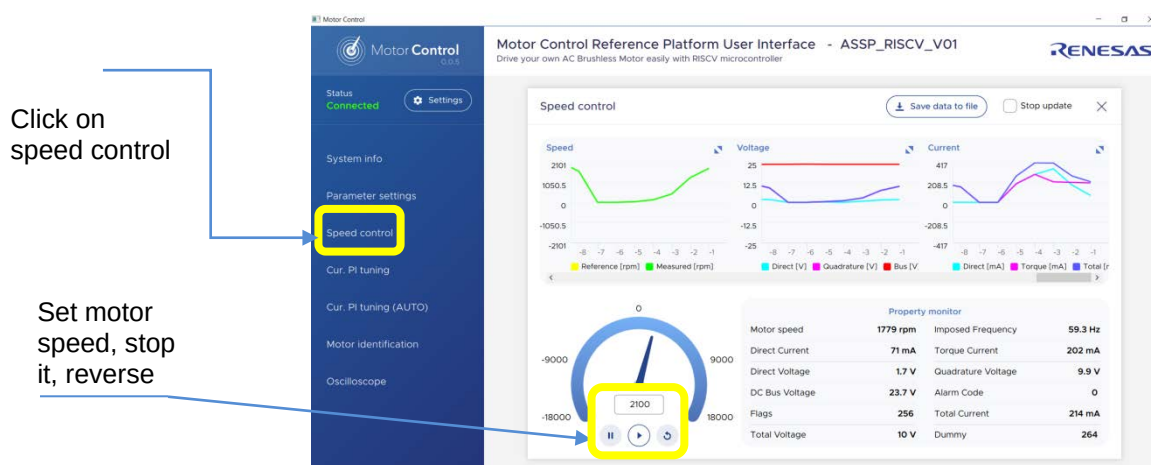


Fig. 4

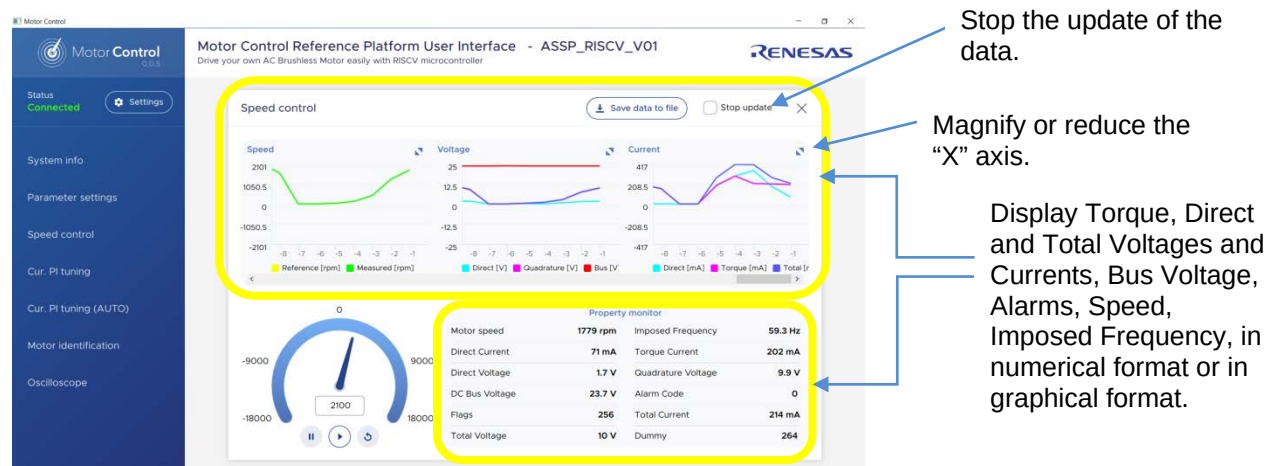


Fig. 5

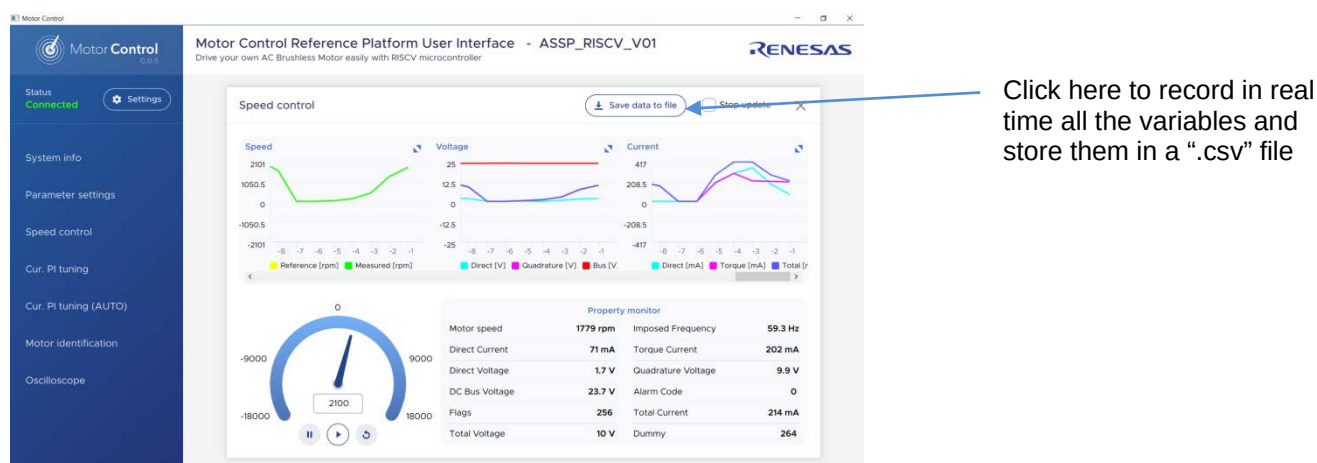


Fig. 6



Fig. 7

As soon as you click, you will be requested to create a file of type ".csv". Give it the desired name and press "Enter" on the keyboard to confirm and save. The recording starts and will be stopped by clicking on the "Stop recording" button

4.1 Parameter settings

Click on "Parameter setting" button to open the parameters list.

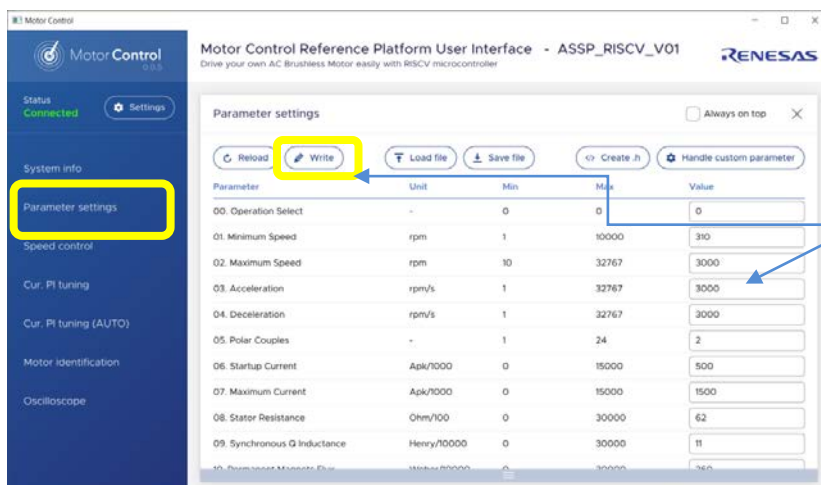


Fig. 8: parameters list

After changing the value of a parameter, click on the "Write" button to store it in the DataFlash.

Note: it is possible to change the value of any parameter; to store its value click on "Write" button.

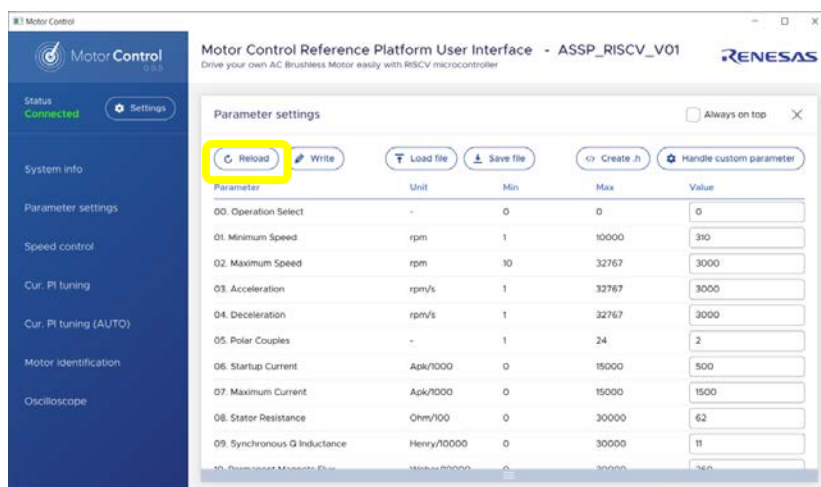


Fig.9

Furthermore, in order to read the parameters stored in the DataFlash, and display them in the parameters window, click on the "Reload" button.

5. Motor Tuning

The menu items “Cur. PI tuning”, “Cu. PI tuning (AUTO)”, “Motor Identification” and “Oscilloscope” on the left-hand side of the GUI are used for the self-calibration of the motor.

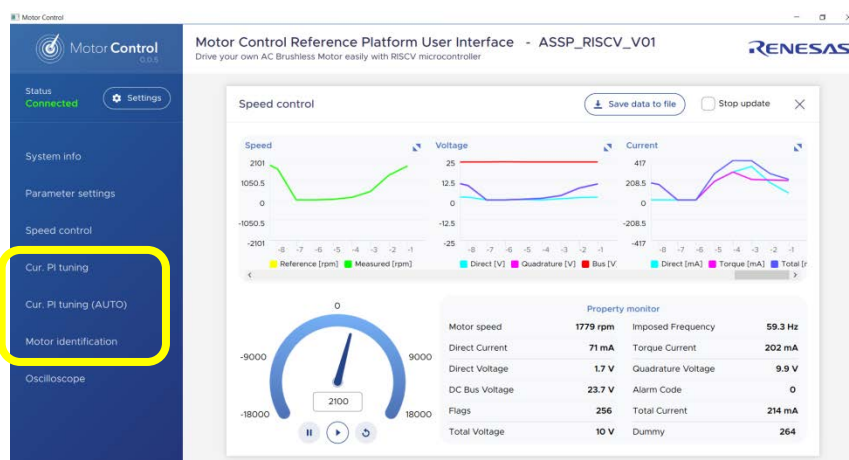


Fig. 10

As first step, it is advised to clean the DataFlash contents and start with the default parameters in the DataFlash.

The first thing to do is to ensure that the inverter board is configured in the default state, and the default parameters are written inside. The procedure below details how to ensure it:

- Click on the “Parameters Setting” button and enter the magic value “33” in the “00. Operation Select” field, then push the RESET button on the board.



Fig. 11

Set the **maximum current** (parameter n°07) as it will influence all the next steps:

- Click on “Parameters settings”, Then enter the value: **1500** (the unit is in mA) and click on “Write” to save the parameter into the DataFlash and close the parameter setting window. The maximum current parameter is fundamental for the auto-calibration. The maximum value allowed by the motor must be used to guarantee the highest resolution.

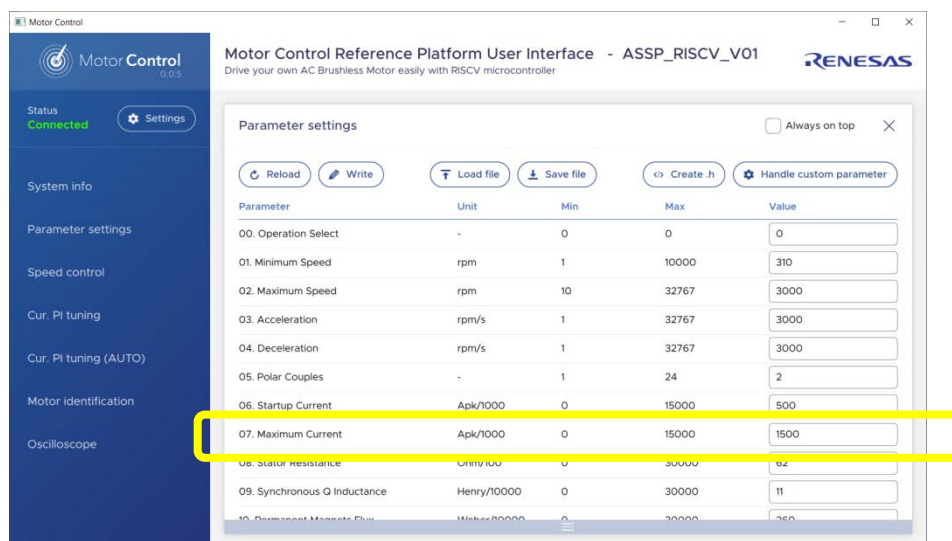


Fig. 12

6. Current PI tuning (AUTO)

- Click now on “Cur. PI tuning (AUTO)” button and press “Start” to perform an automatic Current PI tuning. The two coefficients of the PI current block will be extracted thanks to the embedded software able to generate a step voltage and measuring the motor response.

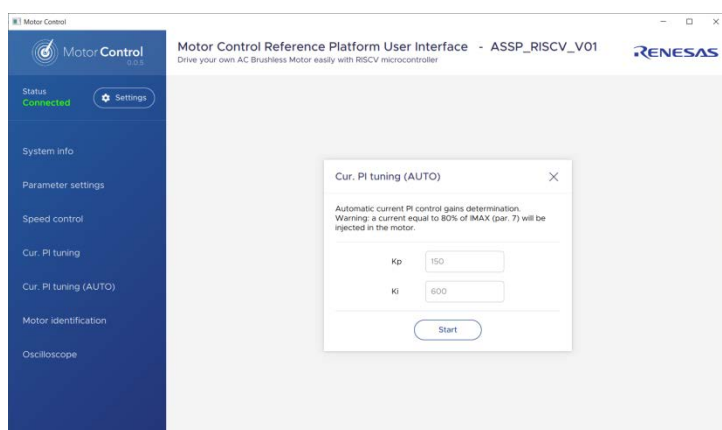


Fig. 13

Note: depending on the motor, the values of the parameters found by the automatic procedure can be too low or too high and the PI current regulator will be not stable. Click on YES button to store the parameters in the Data Flash.

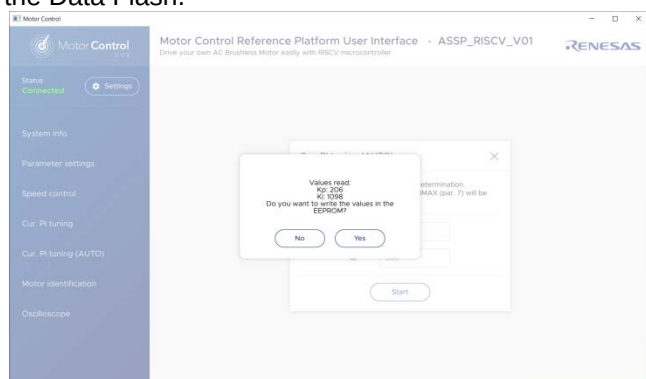


Fig. 14

7. Current PI tuning (manual)

- Now click on the button “Cur. PI tuning” to open the manual current PI tuning window and check the step answer by clicking on “Apply current step” button.

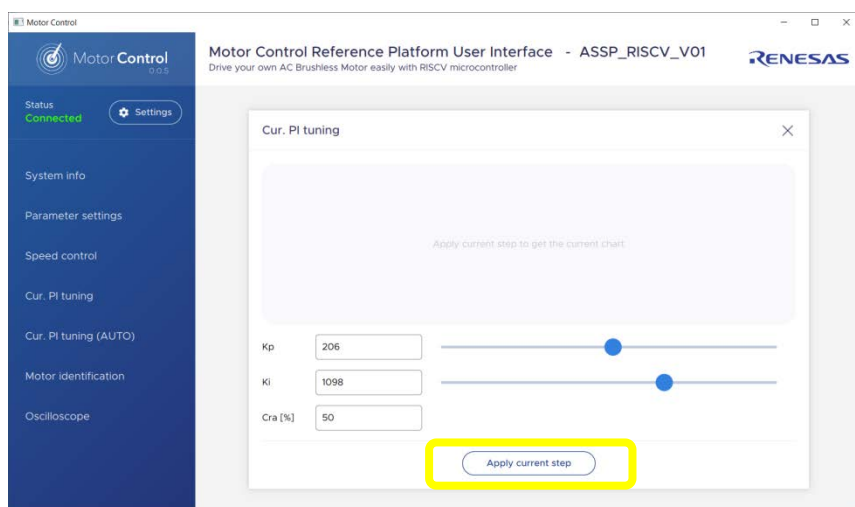
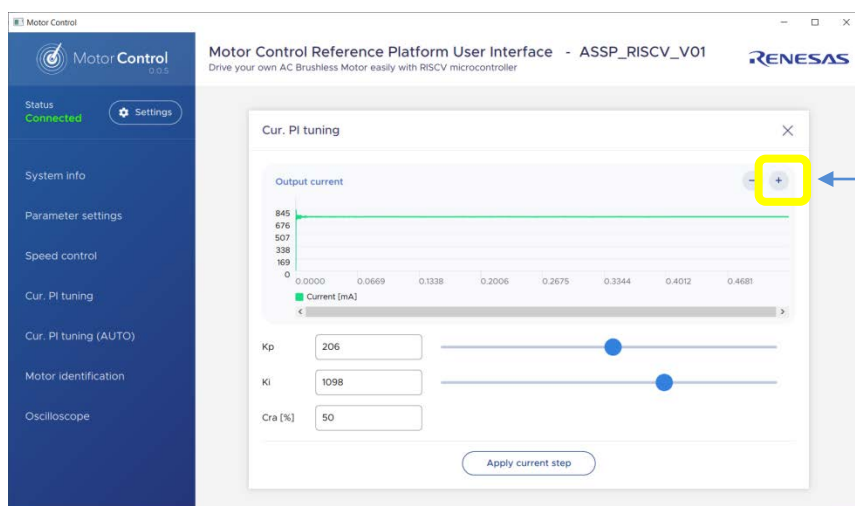


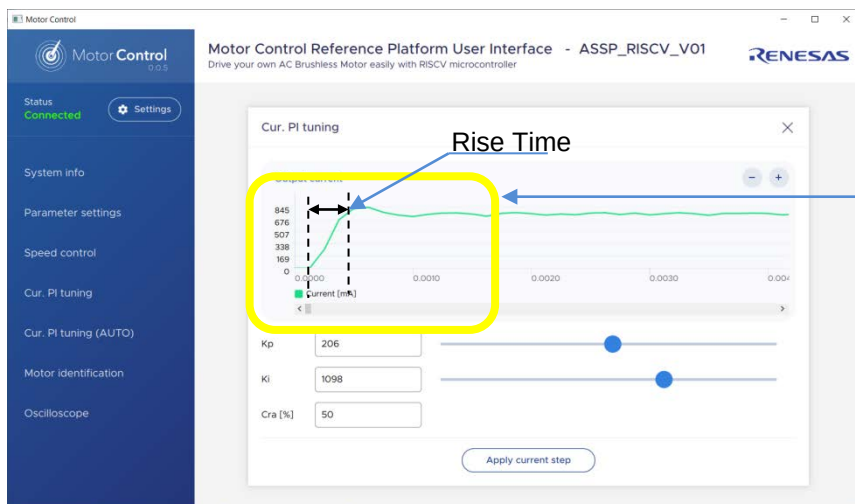
Fig. 15

Note: depending on the motor, the parameters found by the automatic procedure can be too fast or too slow.



Please use the ZOOM to enlarge (see Fig. 17)

Fig. 16



The rise time should be less than 1ms, without high overshoot

Fig. 17

Here below a couple of examples of excessive high overshoot or ringing:

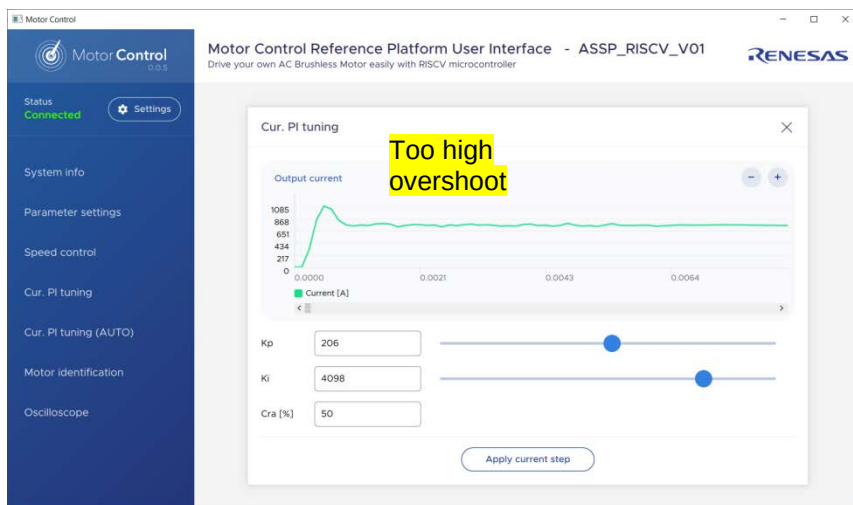


Fig. 18

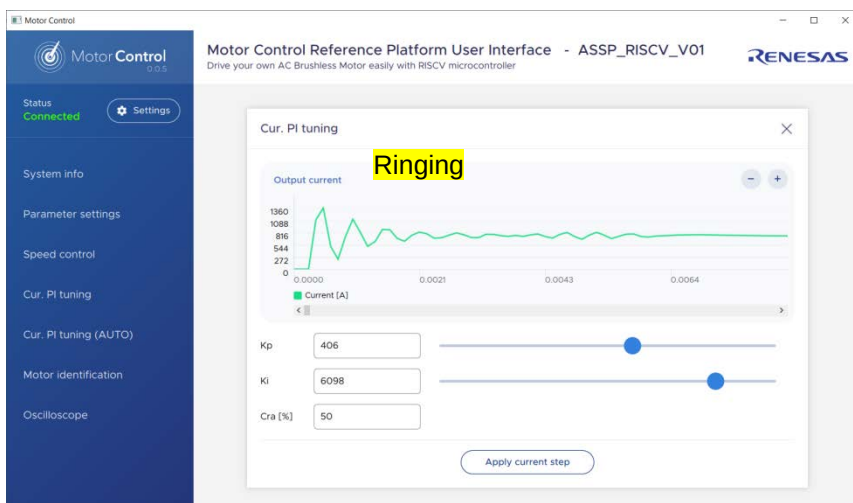


Fig. 19

You can adjust manually the parameters to obtain a better step response and increase the step current level by increasing the percentage of "Cur. [%]" to 90%. The default value is 50%. Once it's done, the window can be closed as the proportional and integral coefficients of the PI current are tuned.

8. Auto Identification

Perform an auto-identification of the motor parameters by clicking on “Motor Identification” and click “start. The GUI shows the actual parameters stored.

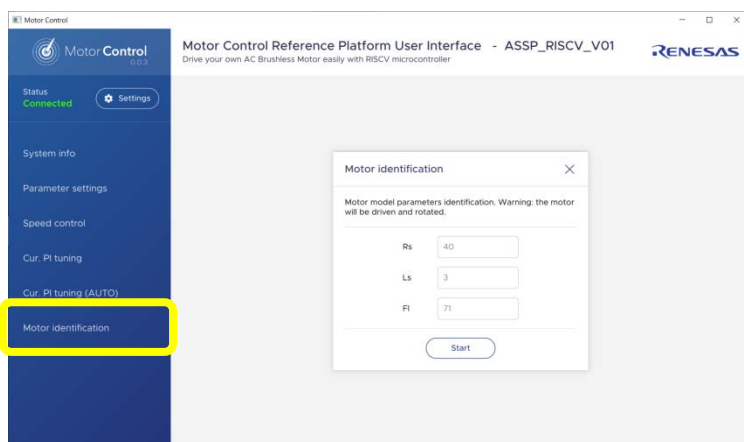


Fig. 20

Click “start” to initiate the identification process (ATTENTION: the motor will be driven and rotated, please leave the rotor free and do not load). At the end of the procedure, three parameters will be calculated: Stator resistance, Synchronous inductance, Permanent magnet flux

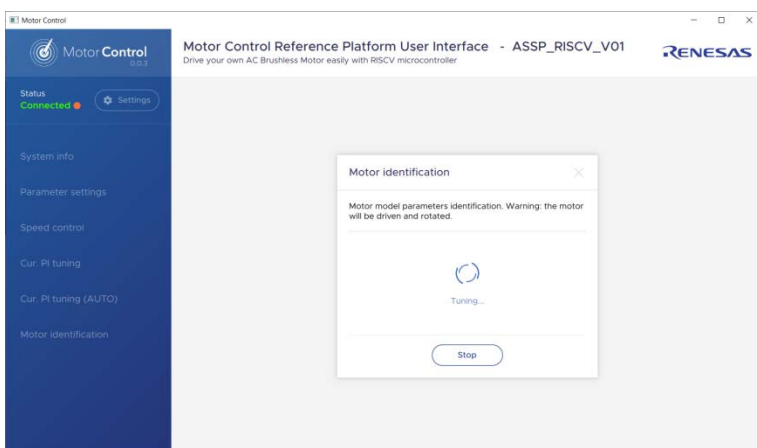


Fig. 21

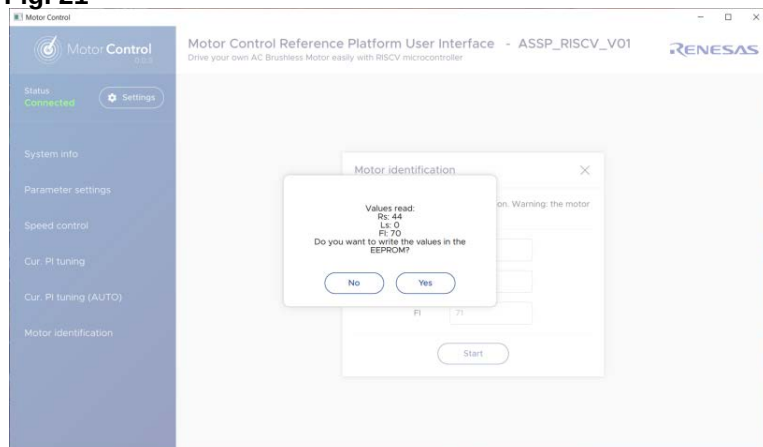


Fig. 22

At the end of the process, you will be requested to store the calculated parameters. Click “YES” and the parameters will be stored.

9. Speed PI Tuning

Now, it is possible to run the motor. Please click on the button: “Speed Control”:
To start the motor, let’s enter a speed in the range of the rated motor speed, in this case **1500 rpm**

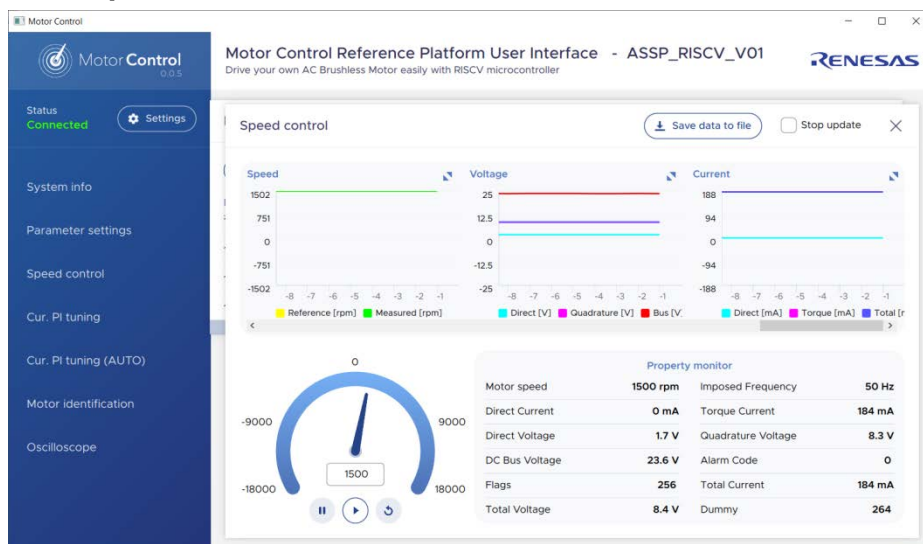


Fig. 24

Please click on the “Oscilloscope” button to see the motor waveforms with the Phase or the current in Y-axis and the time in X-axis.

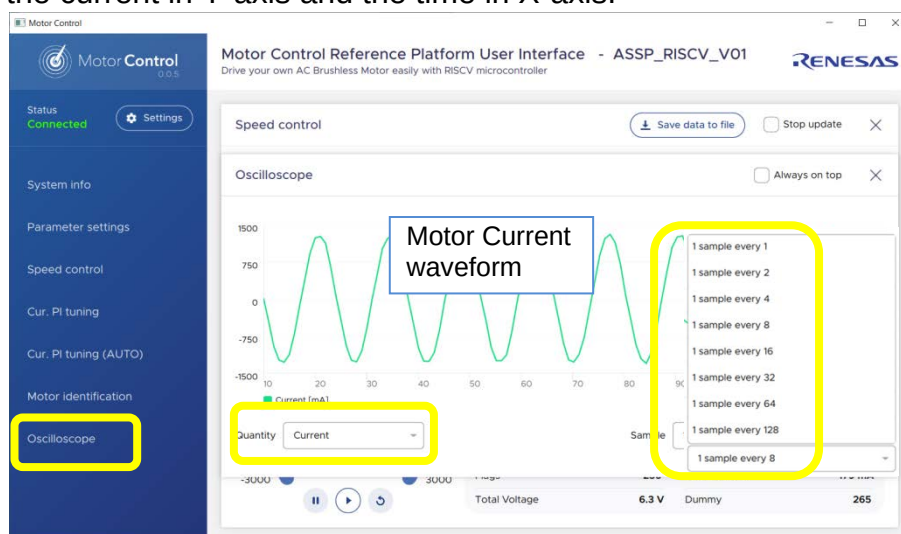
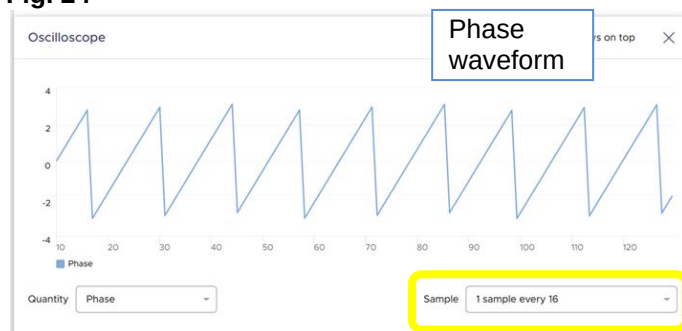


Fig. 23 Please adopt an appropriate time scale: “1 sample every 1” should be used for extremely fast variations when running at very high speed. The setting “1 sample every 128” should be used for extremely slow variations when running at very low speed.

Fig. 24



Start with an intermediate value and adjust it to see some periods of the current or the phase.

Fig. 25

While the motor is running, you can adjust the two speed PI parameters: the proportional and integral terms: #13 and #14.

Please open the Oscilloscope window and the Parameters Setting windows as shown below to check the oscilloscope and to have the possibility to change some parameters “on fly”.

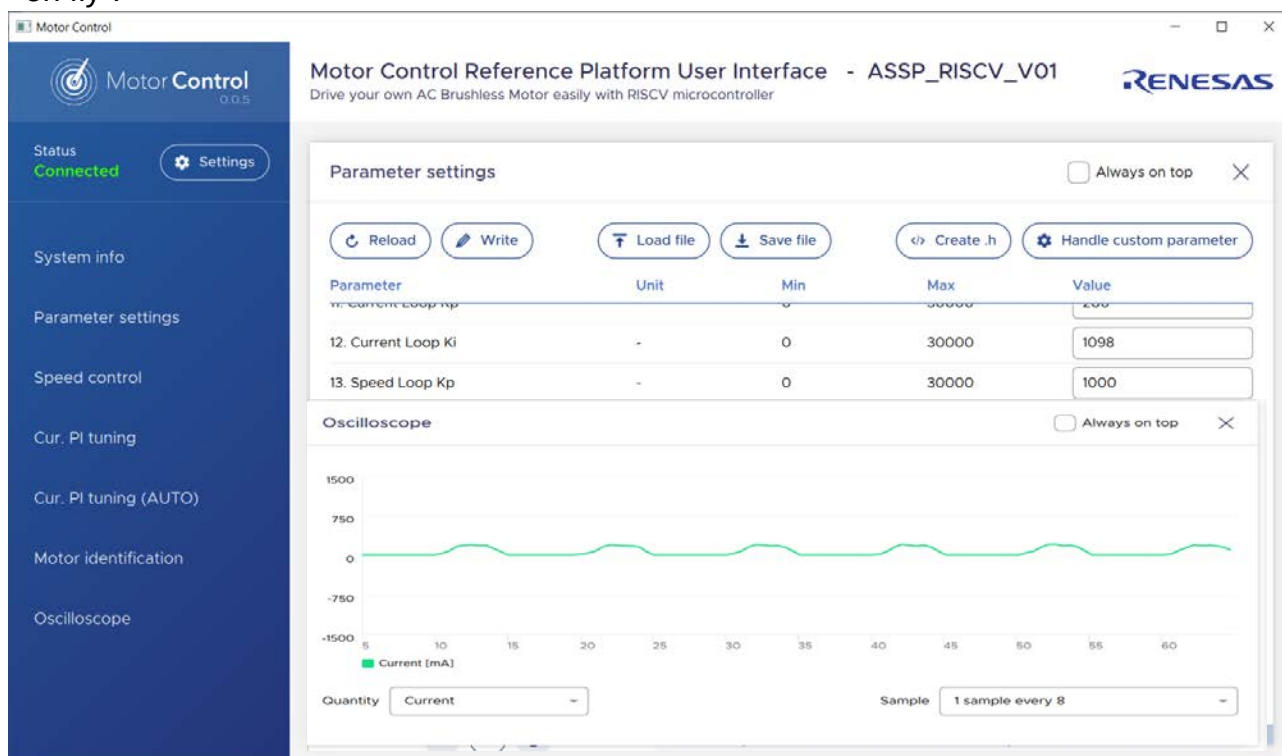


Fig. 26

To tune the coefficients, start by increasing the Parameter n°13 (Kp) until the instability that can be display in the current or phase waveform window.

Add a step of “1000” and click “write” to see the effect and keep on increasing it.

In our case, at **200** it started to be very unstable, but the motor is still running. Set the speed to “0”.

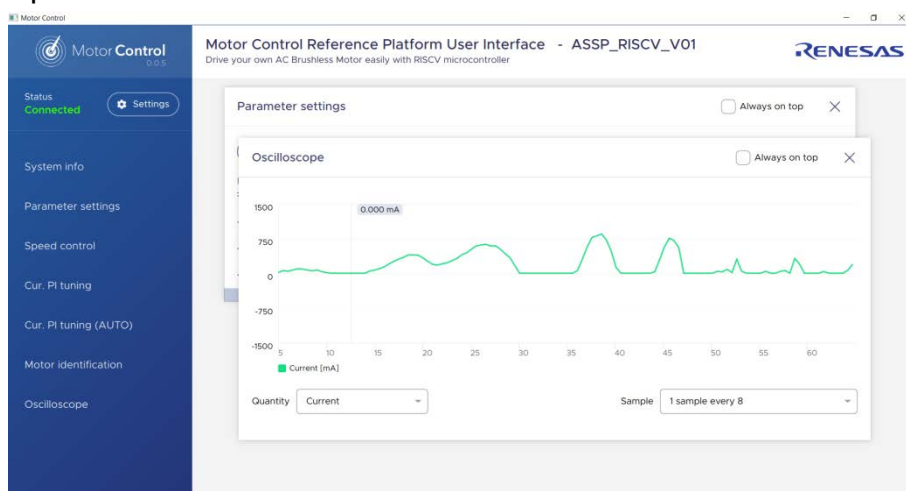


Fig. 27

Then use less than half of the found value or double it: **70 or 400** in our case; click on “write” and set the speed to 1500 RPM.

Do the same for the **parameter n°14** (integral coefficient) which is the speed loop Ki parameter. In our case the critical value is reached at **600** for Ki, so the value to be used is: **200** (half of the value found).

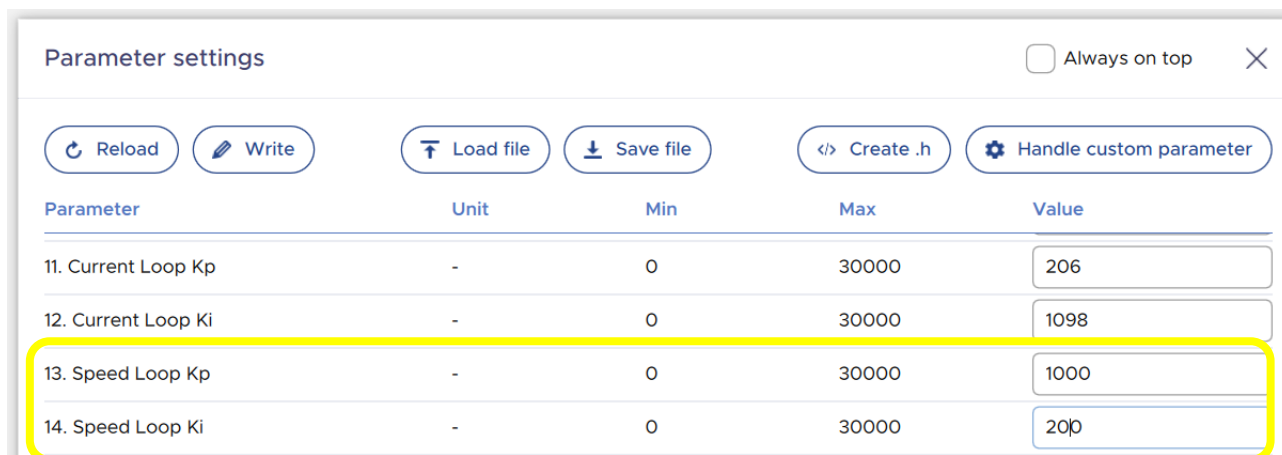


Fig. 28

Test the parameters found in all the speed ranges and different rotations. Finally, the parameters list can be saved in a file in .CSV (“Save” button) or .h file (“Create.h” button) format for further usage and can also be uploaded later.

It is also possible to load a new .csv file by clicking “load file” button.

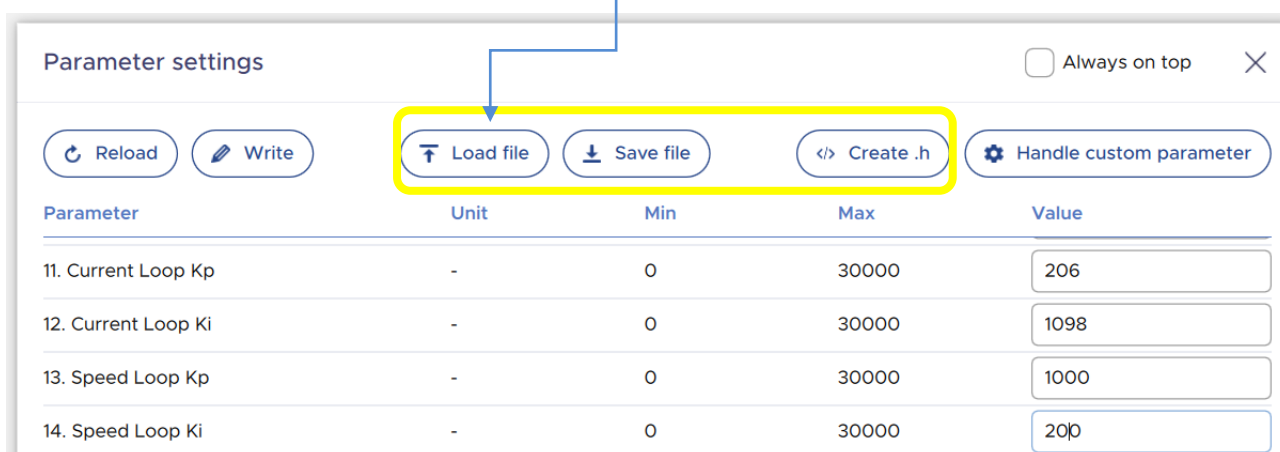


Fig. 29

10. Table of Parameters

Here below the explanation of the parameters:

Parameter number	Short name	Description
0	SEL_OP	Default parameters setting, Used to perform special operations, like default parameter set re-loading, or current PI tuning working mode setting
1	RPM_MIN	Set the Minimum Speed in RPM
2	RPM_MAX	Set the Maximum Speed in RPM
3	R_ACC	Set the acceleration [RPM/s]
4	R_DEC	Set the deceleration [RPM/s]
5	C_POLI	Set the number of polar couples
6	I_START	Set the start-up current (peak) [Ampere/AMP_RES]. Used to specify the peak phase current value to be used during the start-up
7	I_MAX	Set the maximum phase current (peak) [Ampere/AMP_RES]
8	R_STA	Set the stator resistance [Ohm/OHM_RES]
9	L_SYN	Set the synchronous inductance [Henry/HEN_RES]
10	PM_FLX	Set the permanent magnets flux [Weber/WEB_RES]. This value is only used when the exact integration flux estimation algorithm is selected. By default, it's not needed as the approximated integration is selected.
11	KP_CUR	Set the Current loop Proportional coefficient: KP
12	KI_CUR	Set the Current loop Integral coefficient: KI
13	KP_VEL	Set the Speed loop Proportional coefficient: KP
14	KI_VEL	Set the Speed loop Integral coefficient: KI
15	FB_GAIN	Set the flux amplitude feedback gain. This value is only used when the exact integration flux estimation algorithm is selected. By default, it's not needed as the approximated integration is selected
16	PHA_OFF	Set the phase offset [deg]. It is used to add a phase offset to the phase estimation, to reach better alignment
17	ST_TIM	Set the Start-up acceleration time [sec/SEC_RES]
18	Not used	
19	SAM_FRE_DEF	Set the sampling frequency [Hz] of the control loop
20	F_RATIO_DEF	Set the ratio between the PWM frequency and sampling frequency, e.g. if 8000 is set in the parameter #19 and 2 in the parameter #20, the PWM frequency is 16KHz.

It is also possible to change a selected parameter: by clicking on “Handle custom parameter” a pop-up window will appear, allowing to read or to write a parameter stored in a selected address.

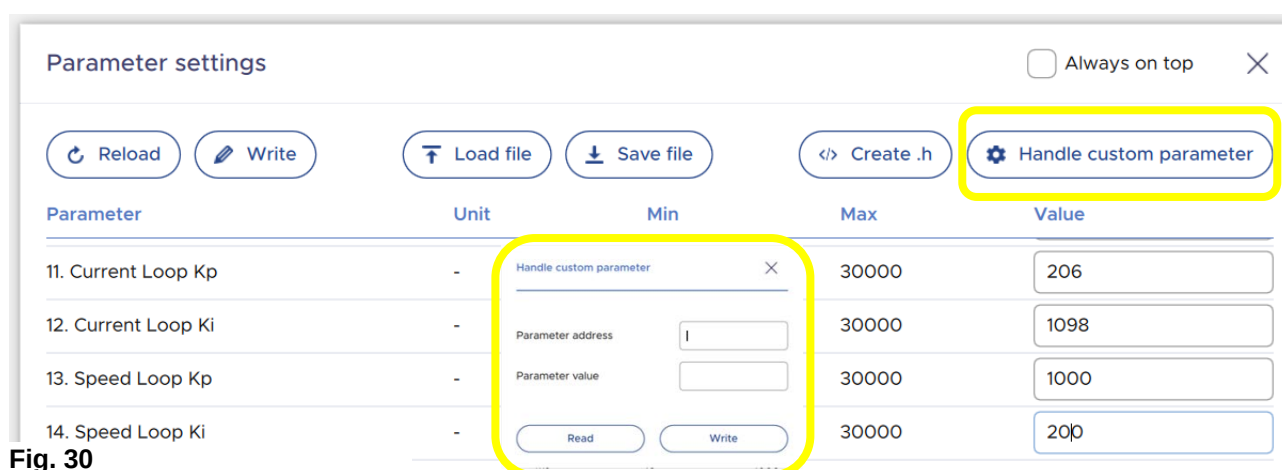


Fig. 30

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact information

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