UM11219

Ringo TEA2016 development software with GUI

Rev. 1.05 — 30 July 2019 **User manual**

Document information

Information	Content
Keywords	TEA2016, LLC, PFC, controller, I2C, USB, parameters, programming, MTP, GUI, Ringo, software, interface
Abstract	The Ringo TEA2016 development software with GUI is a development tool that enables working with the TEA2016 settings using a computer and the TEA2016DB1514 USB I2C interface board. The software and interface are intended for engineering work in a lab environment as part of power supply development.

Revision history

Revision history

Rev	Date	Description
v.1	20190730	Initial version

1 Introduction

The TEA2016 development software Ringo GUI user manual shows how the GUI is set up and what functions it provides.

The working of parameter settings, as part of designing a power supply with the TEA2016, is discussed in the TEA2016 data sheet (Ref. 1) and the application note (Ref. 2). The info buttons in the GUI also provide information on the working of the parameter in a pop-up window.

Note: *Some screenshots of the Ringo GUI may deviate from the version that you are currently using. The reason is that the tool is regularly updated during its development. This document is based on the Ringo v1.25 (February 2019) status.*

1.1 Software license agreement

When starting up the Ringo software, the license agreement, which appears on the screen as a pop-up window, must be accepted.

1.2 Different appearance

Because the Ringo GUI uses functions of the operating system, some (personal) settings in the operating system can influence colors and character appearances. The screenshots in this document may be different from the screens on the computer of the user.

1.3 Fixed window pixel size GUI window.

To avoid issues on showing all functions in an orderly manner, the Ringo GUI uses a fixed pixel size window.

When the GUI is shown on a display (automatically) set on a low resolution, the GUI window may not fit completely on the display. In this case, to show the complete window, the resolution of the display (enforce a higher resolution) or the computer (select a resolution the display can handle) must be adapted.

The pop-up windows are not fixed and scalable.

1.4 64-bit and 32-bit versions

The Ringo software is available in two versions:

- For a 64-bit operating system
- For a 32-bit operating system

2 Setup and functions of Ringo

2.1 Chapters and tabs

The parameters and settings are organized in related sections.

Clicking three large blue buttons gives the option to select three chapters.

Each chapter includes tabs.

General

- Configuration
- Miscellaneous
- Info Sheet

PFC

- Operation
- Protection

LLC

- Operation
- Protection
- Power Good

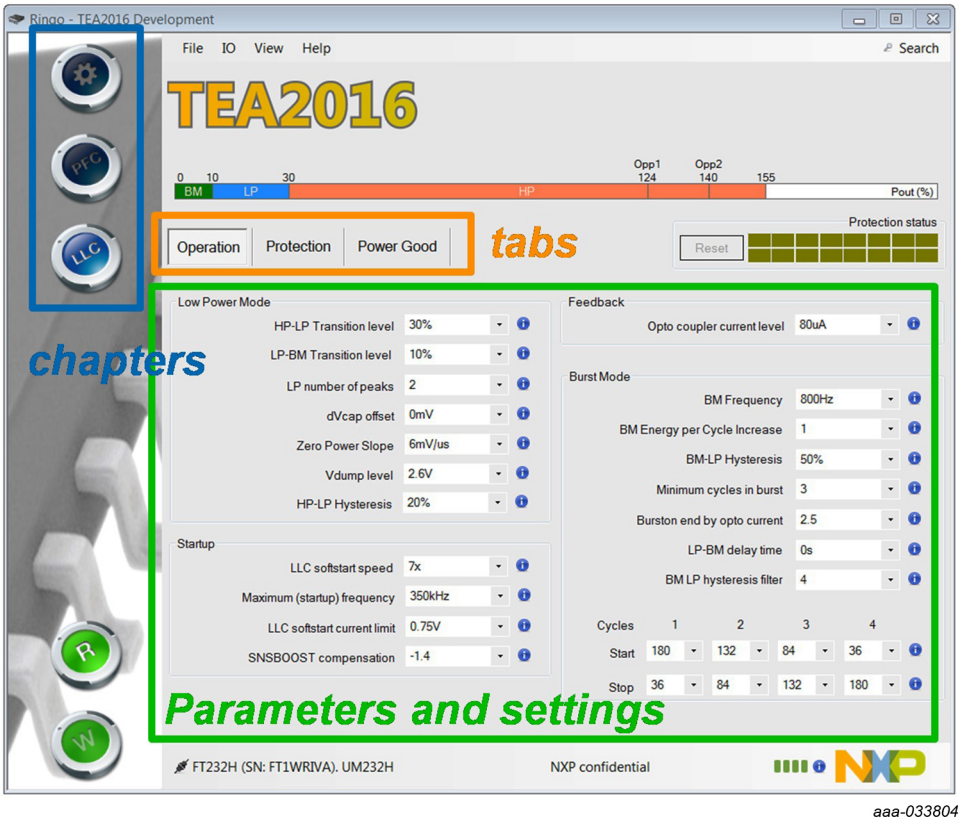

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Figure 1. Three chapters with each two or three tabs containing parameters and settings

Each tab shows parameters and settings. They are grouped in blocks with similar functions.

For example, Figure 1 shows the LLC operation tab that contains four blocks:

- Low Power Mode
- Startup
- Feedback
- Burst Mode

2.2 Selecting a parameter value

Clicking the drop-down button, selects a parameter for modification.

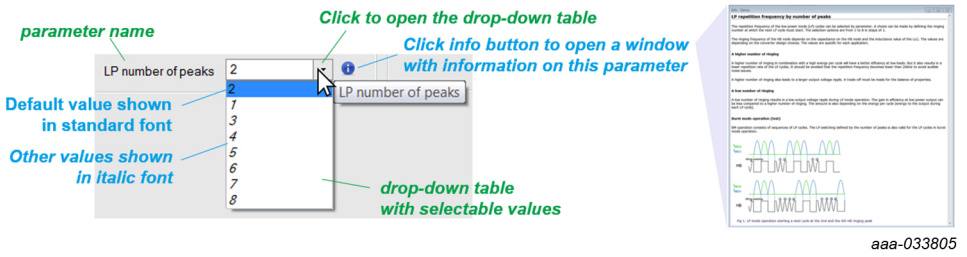

Figure 2. Example of parameter elements

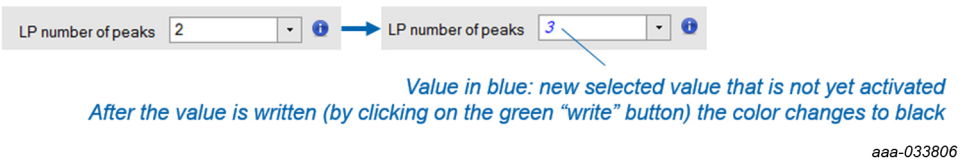

Figure 3. Selected new value in blue becomes black again after it is written (activated)

2.3 Adding modification restrictions

To block modification of one or more parameters. a separate program can be used.

Dragging and dropping the .prf file into the left side of the Ringo GUI activates it. The blocked parameters are greyed out and only show the values.

The ParamEdit.exe tool is included in the Ringo software package. Initially, all parameters are marked with a "v". Removing the mark by clicking it, blocks this parameter after the saved .prf file is activated.

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Figure 4. Several parameters can be restricted for modification (only showing the actual value in greyed out style) using a separate tool ParamEdit.exe

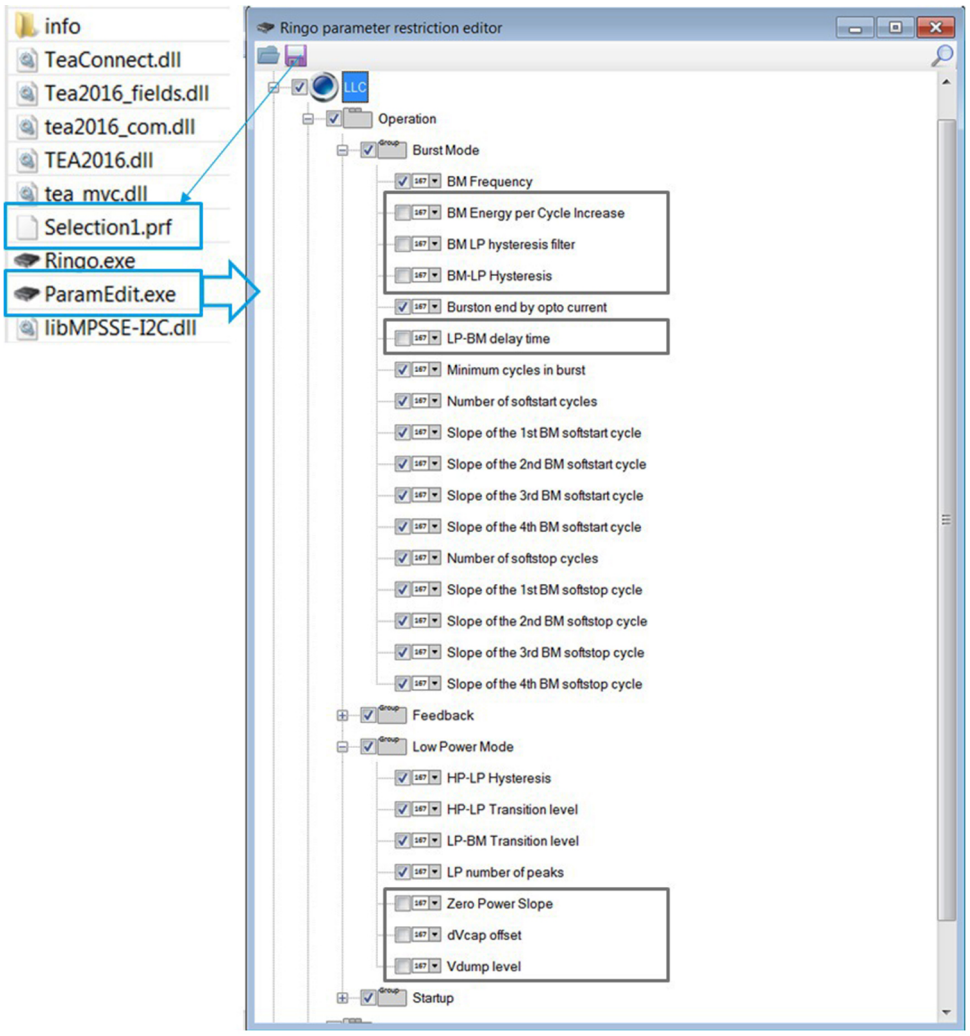

Figure 5. ParamEdit shows a window where parameters can be blocked by removing the "v" mark. The file is saved as .prf.

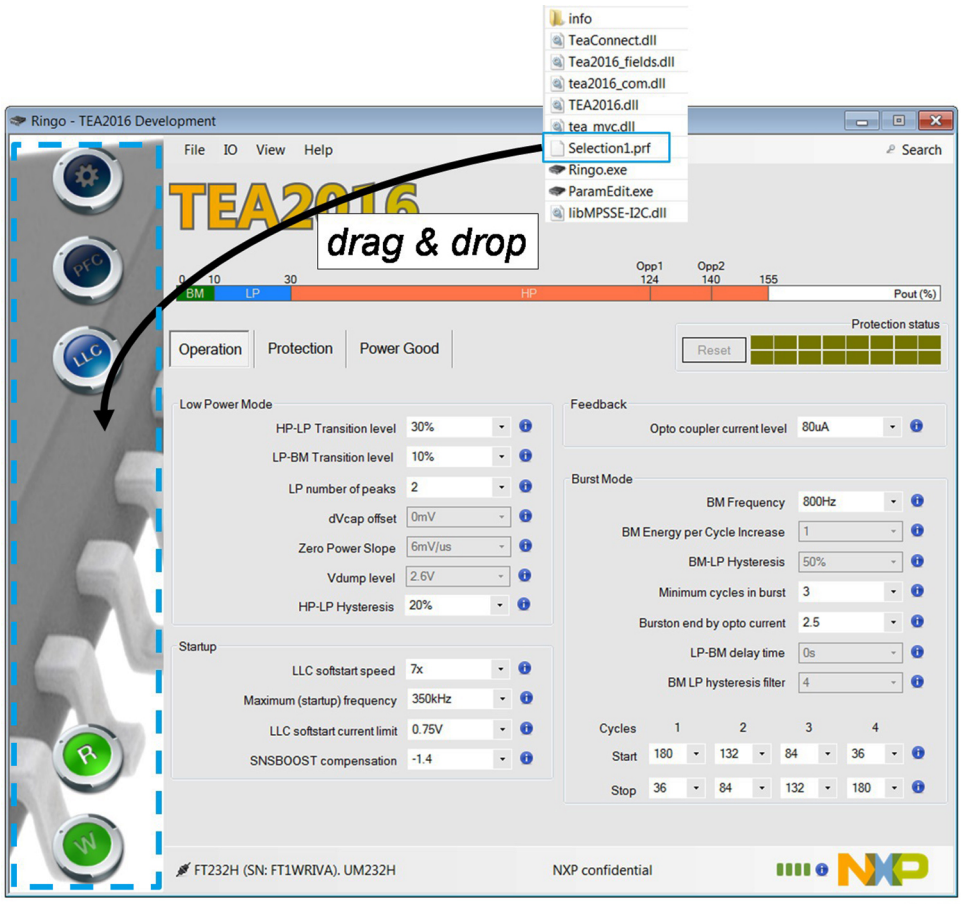

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Figure 6. Dragging and dropping the .prf file into the left side of the Ringo GUI activates it. The parameters blocked for modification are greyed out and only show the value

3 Information

3.1 Protection registers and LEDs

Protections that are triggered are stored in the MTP and shown in the GUI by an LED turning from green to orange. Selecting the LED using the mouse shows the protection name. When the LED is orange, clicking provides extra information.

The reset button clears all protections.

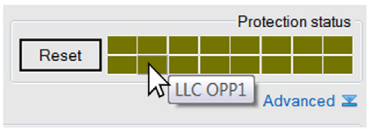

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Figure 7. Protection LEDs

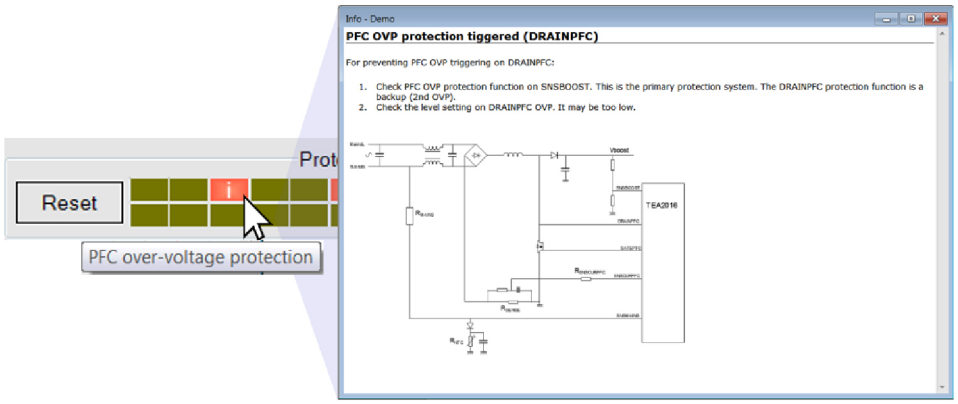

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Figure 8. A triggered protection (orange LED) provides extra information

At start-up, the status of the protection registers is read. These registers are constantly updated during operation.

If a protection is triggered, it is stored in the MTP unless it was already set earlier. It avoids that MTP writes when it is not necessary.

Table 1. Protections registers shown in the GUI

	Protections
1	PFC overcurrent protection
2	PFC overvoltage protection (DRAINPFC)
3	PFC overvoltage protection (SNSBOOST)
4	LLC OPP1
5	LLC OPP2
6	LLC maximum start-up time exceeded
7	LLC overcurrent protection

	Protections
8	LLC overvoltage protection
9	External overtemperature protection
10	Internal overtemperature protection
11	Fast disable
12	LLC maximum on-time exceeded
13	LLC maximum optocoupler current in burst
14	LLC capacitive mode
15	MTP read failure
16	OPP via SUPIC UVP

If the IC is not locked, the protection registers can be reset using the GUI (RESET button). After resetting, the LEDs becomes orange again when the protection is triggered.

If a protection is triggered and showing an orange LED, that does not always mean that the system has stopped operation (and restarted). A timing filter may prevent that the system stops. Or the protection does not lead to stopping but to just limiting a condition. The triggering indicates that this function may be critical and attention is necessary.

3.2 Info buttons

Settings and protection LEDs provide extra information. When clicking the info button, a window with information pops up. The window can be scrolled through and its size can be adjusted. Opening multiple windows at the same time is also possible.

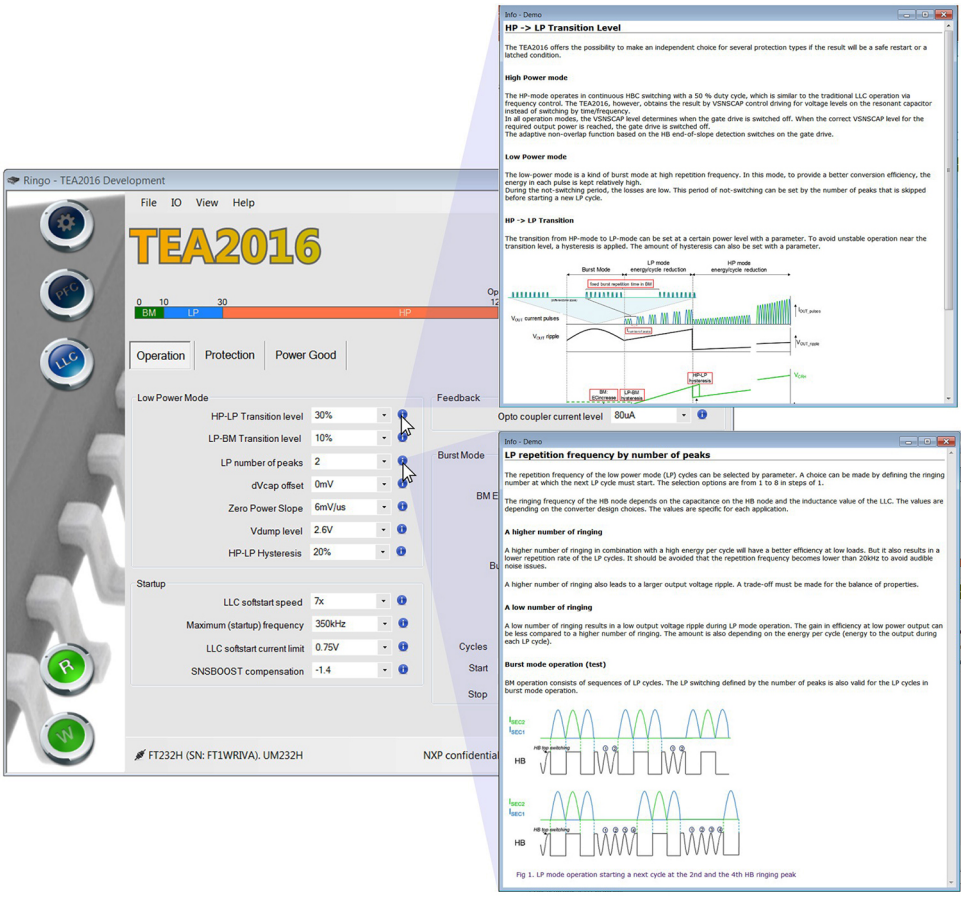


Figure 9. Info buttons provide extra information

3.3 Mode transitions and protection levels on a power scale

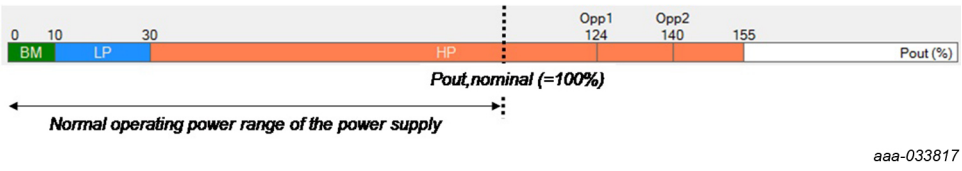


Figure 10. Mode transitions and protection levels on a power scale

Mode transitions levels between the operating modes HP, LP, and BM can be set independently using parameters. Also, protection levels related to output power can be set. These levels are always shown as a reference for parameter design choices that were made.

3.4 Warnings

When a combination of settings is chosen that may be conflicting or runs the risk of creating a problem, a warning is provided to check if the choice is correct. When clicking the general warning box, a pop-up window shows which parameters can be checked.

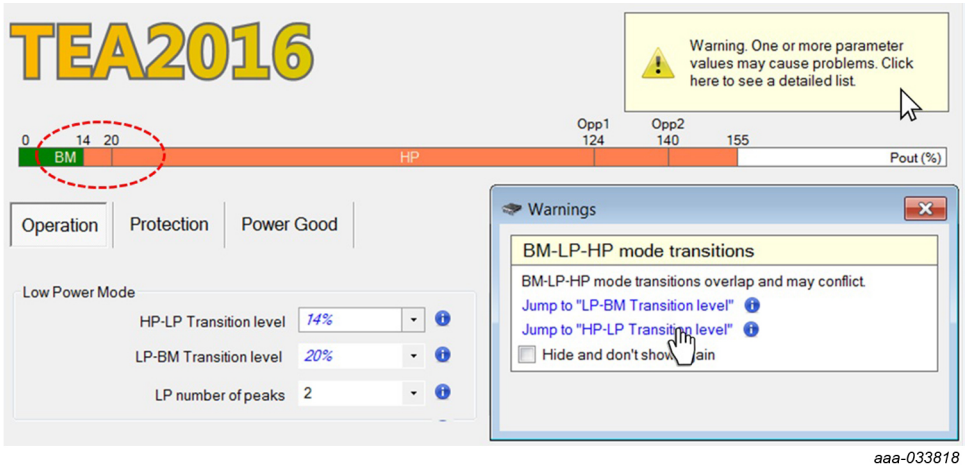


Figure 11. Warning example with pop-up information and link to related parameters

The warning system is a help function for the user and does not provide a full coverage of all possible conflicts.

There is no limit to combinations. The user has full freedom of choice.

3.5 Search function

Ringo includes a search function to find the location of a setting or related settings.

The search function can be activated:

- View menu: select search
- Ctrl+F
- Click the search field in top right corner

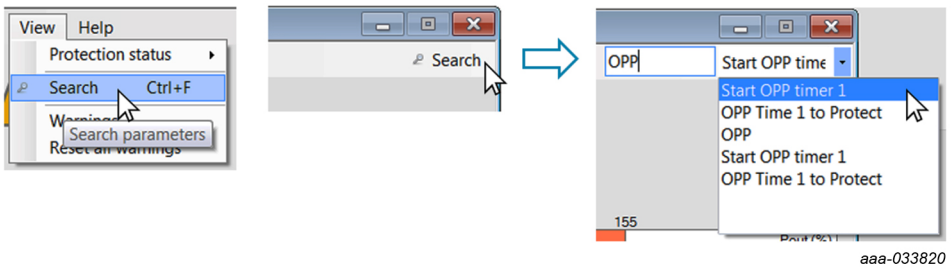


Figure 12. Ringo search function

By clicking one of the search results, the view shows the correct tab and highlights the parameter.

4 Writing and reading settings (IO)

4.1 W and R button

When one or more new parameter values are selected, pushing the Write button activates them. The Write button writes the changed fields to the TEA2016.

To check if the changes were successful, a write action is automatically followed by a read action. If successful, the blue text color of the changed field changes to black.

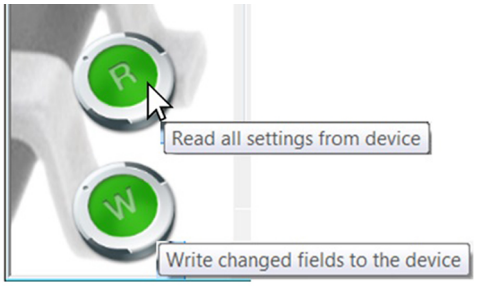


Figure 13. Write and read buttons

The read button can be used for reading (all) device settings. Reading the device settings can be used for double checking or to compare the difference between a loaded .mif file with the actual IC settings.

The Read and Write button functions can also be activated in the IO menu or by pressing F5 and F6.

The IO menu also includes the option to write all parameters instead of only the changed parameters (F7). Only use this option to double check because how many times the MTP fields can be written is limited (guaranteed 200x, in practice 700 times).

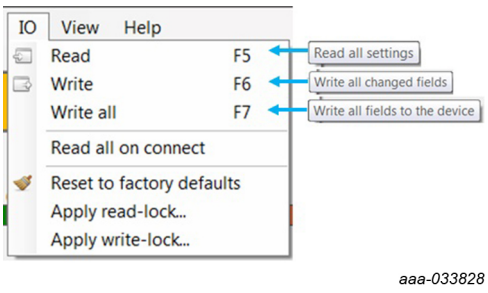


Figure 14. Read and write functions in the IO menu

4.2 Read lock and write lock

After programming, the MTP can be locked for reading and writing settings.

Only a reset to factory defaults, can unlock the IC. After the reset, the IC can be programmed again.

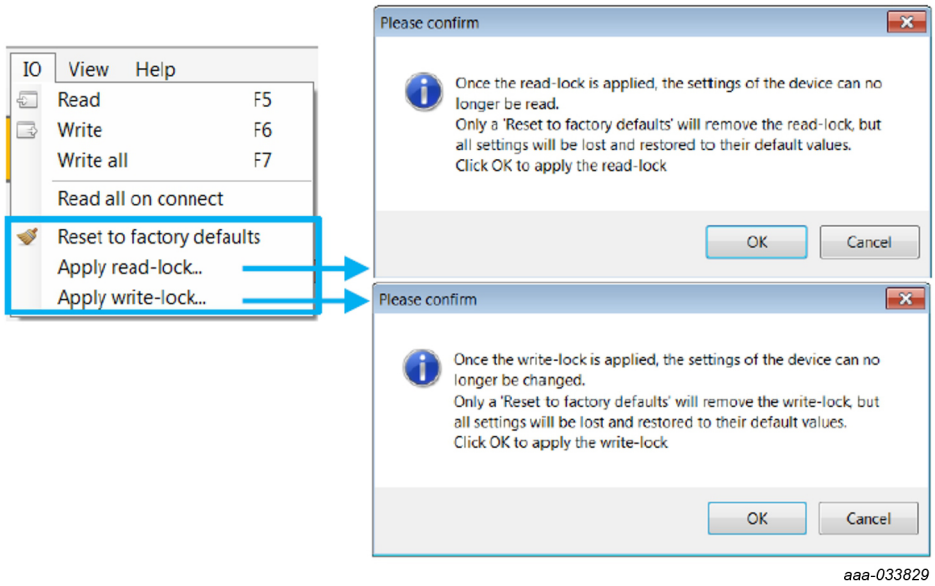


Figure 15. Read lock and write lock

If there are problems, the protection registers and the vendor code (identifier number for a specific product) can still be read for analyses after read lock and write lock.

4.3 Reset to factory defaults

This function restores all default values in the MTP (see Section 5.1.2).

4.4 Info sheet

The info sheet tab contains information about the IC (MTP) status.

The sheet shows that the testing and calibration was completed in the NXP Semiconductors production. It also shows if the settings can be read and/or changed. It reflects the status of the read lock and write lock setting.

The Ringo program calculates a CRC value from the settings, which is then displayed. The value is calculated from the actual values in the Ringo (values displayed onscreen). By reading the MTP content of an IC, the CRC number can be used to check ICs on correct MTP content or for identification of a product version.

The vendor code is a section (MTP page 31, 16 bits) that can be used for identification of the IC (programming) version. The vendor code remains readable also after read lock.

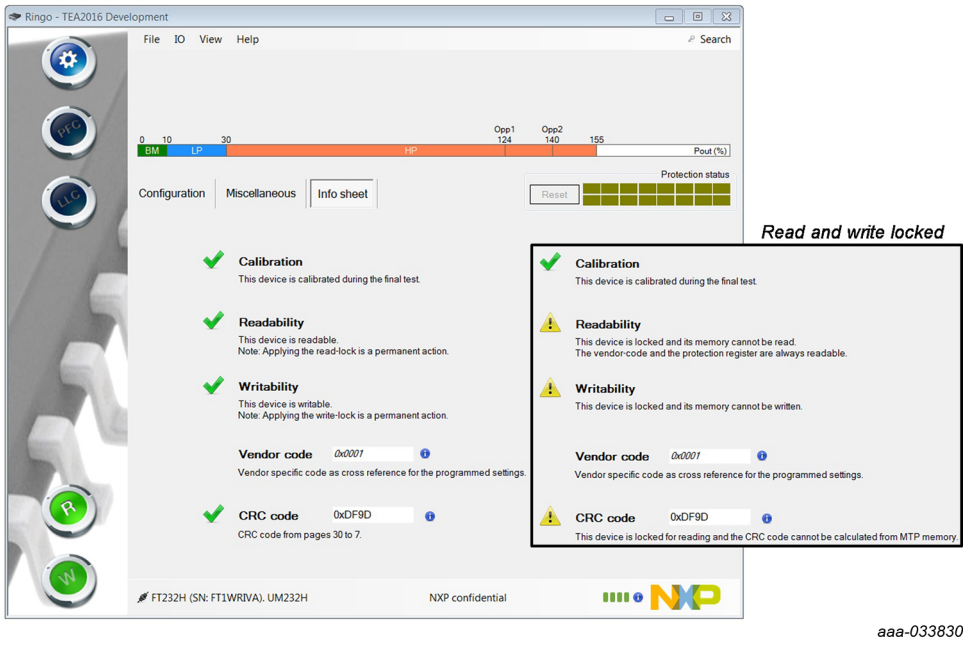


Figure 16. Info sheet

4.5 Connection

The connection is constantly checked by reading the protection status and updating the LEDs (poll protection register).

The status of communication is shown.

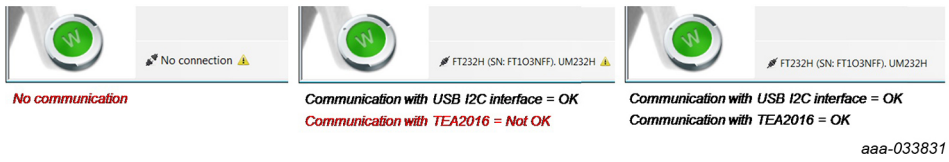


Figure 17. Connection status

4.6 Connection quality

The Ringo GUI is often used with a development version of the controller IC. While the power supply is operation, all I^2C communication is running via pin 7 and pin 12. Changes can be made on the fly.

In this situation, there is a risk of disturbances on the I^2C bus because of the converter switching high dV/dt signals (like HB and DRAINPFC) are causing spikes on the SDA and SCL connection. It can disturb communication. When the disturbances are extreme, ICs connected to the I^2C bus can be damaged.

The connection quality indicator at the bottom of the Ringo GUI screen helps to detect when something is going wrong.

Normally, the indicator provides four green bars. At this level, there may be an occasional error that the system can correct.

When the indicator shows three yellow bars, communication is showing errors often. Moving the I^2C connection cable to a better position may provide good quality again.

When the indicator shows two orange bars or one red bar, the situation is bad and changes are required.

The info button pop-up provides detailed information about what can be done to improve the connection quality. It also provides a method to avoid errors completely.

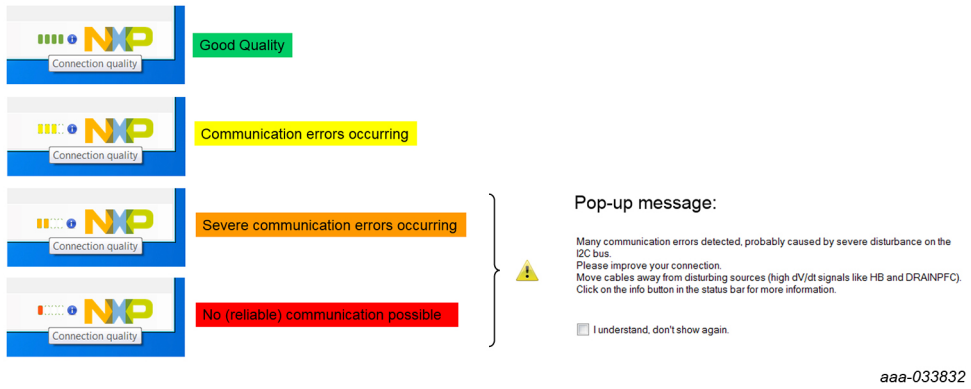


Figure 18. Connection quality indicator

5 TEA2016 MTP and registers

5.1 MTP memory and registers

The MPT in the IC is a permanent (but changeable) memory like a flash memory. When the IC supply voltage goes down, the content remains.

The registers in the IC are a temporary memory. When the supply voltage goes down, the content is lost.

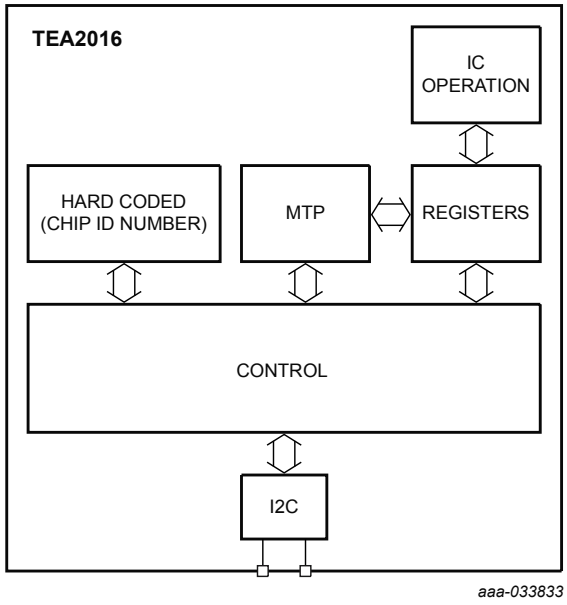


Figure 19. Communication channels with MTP and registers in the TEA2016

5.1.1 IC operation

For correct operation, the stored MTP setting values are copied to the registers of the IC at start-up.

The IC operation works with the register values. It can only store the protection registers in the MTP memory. The user or a programming unit must store or modify the remaining MTP content when necessary.

5.1.2 Default settings

When erasing the MTP (set all values to zero), the settings are at default. The default values show a predefined “middle of the road” type of operation. Most applications run well on default values, but not optimal. In some cases, the default settings conflict with the values of the converter and external component values. The result can be unintended protection triggering.

The “Reset to factory defaults” function in the Ringo GUI can restore the default settings.

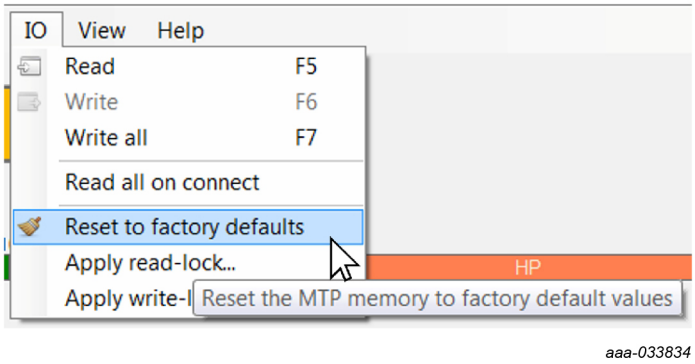


Figure 20. Reset to factory defaults function

5.1.3 Saving and loading setting by .mif file

The user can read and write the MTP and the registers via I^2C. A TEA2016-specific I^2C-based protocol is required for this action.

Settings can be changed individually. A complete collection of settings can be saved on the computer as a .mif file. A saved .mif file can be used to program the MTP of an IC by opening it in the GUI and writing it in the IC.

If the .mif file must contain the IC settings or MTP settings, first read the content again to be sure.

You can use the .mif file to share the settings with other engineers.

When loading settings from a .mif file, they are displayed on the screen for review. The settings must be written to modify the IC settings.

a. Saving to .mif file

b. Loading from .mif file

Figure 21. Save settings to .mif file and load settings from .mif file

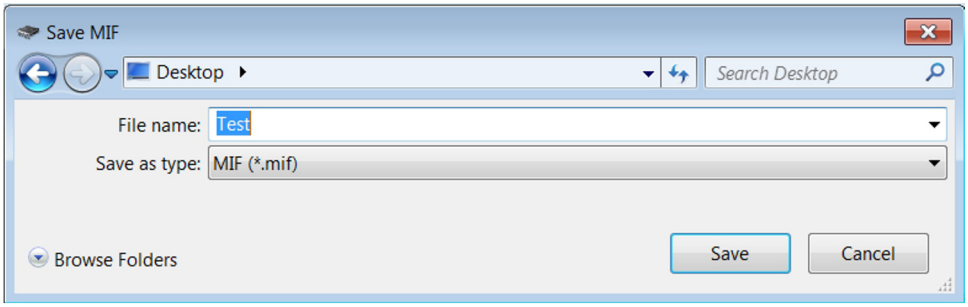


Figure 22. Saving parameter settings as Test.mif file

5.1.4 List of settings

All the settings shown on the GUI screen can be copied and pasted in another computer program.

Make sure that the GUI screen contains the content that you want to copy. If it must show the IC settings or MTP settings, first read the content again to be sure.

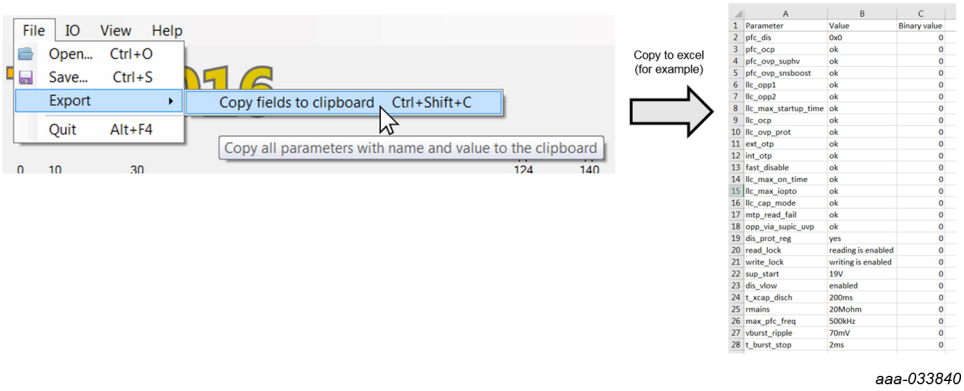


Figure 23. Make a list of settings to use in another computer program

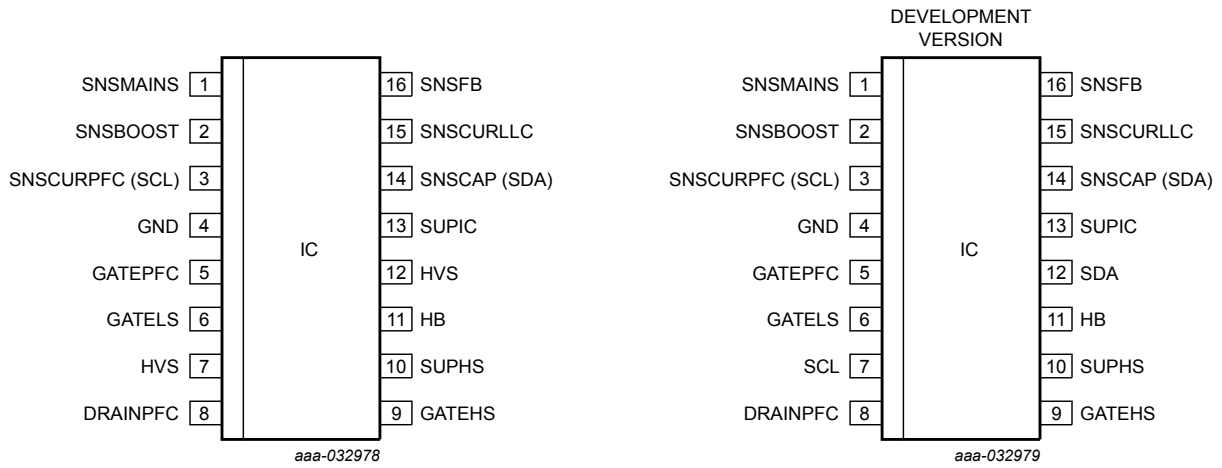
5.1.5 Double check changed settings

The change handling of Ringo is made to provide reliable register and MTP modification and clear representation on the GUI screen. In some situations, it may still be unclear to the user if changes were indeed activated or stored.

To double check, the TEA2016 can be stopped (disconnect the mains voltage) and started again to refresh the settings. At start-up, the IC copies the MTP settings to the registers. With a read action of the Ringo, the settings are copied to the GUI on your screen.

6 I²C communication

Besides the normal TEA2016 ICs, NXP Semiconductors provides special IC versions for product development. The difference is that the development IC samples provide a second I²C interface for easy modification of settings while the IC is operating: changing operation on the fly.



a. Normal version

b. Development version

Figure 24. TEA2016 pinning diagrams

6.1 Development IC samples: SDA and SCL on spacer pins

Connections to the second I²C interface of the IC are provided on the pins that are normally not connected, high-voltage spacer pins 7 and 12.

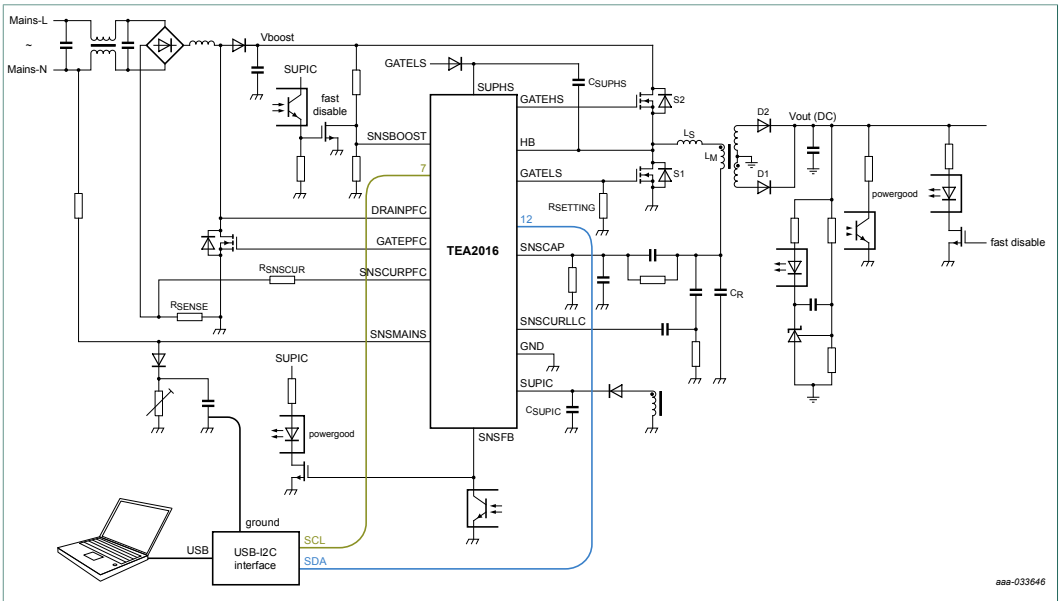


Figure 25. Development IC: I²C connections with spacer pins

The basic I²C interface functions on the combined function pins of the IC are also available on development samples. However, they are disabled because only 1 channel

can be functional. The configuration is set at NXP Semiconductors IC production. It cannot be modified by the user.

6.2 Production IC samples: SDA and SCL on combined pins

The basic I^2C interface in the IC is available on the combined pins SNSCURPFC (SCL) and SNSCAP (SDA). To program the IC, the IC must be put in the disabled condition pulling SNSBOOST to GND. During programming, SUPIC must supply the IC.

Programming can be done on a separate IC (put in an IC socket) or when the IC is mounted on the power supply PCB.

When programming is done while the IC is mounted on the power supply board, the capacitive and resistive loads on the SDA and SCL lines become much higher. The much higher capacitive and resistive loads endanger communication because rise times and fall times of the communication pulses become much slower and distorted. Depending on the application component values, the driver capability of the I^2C interface must be modified to ensure reliable programming.

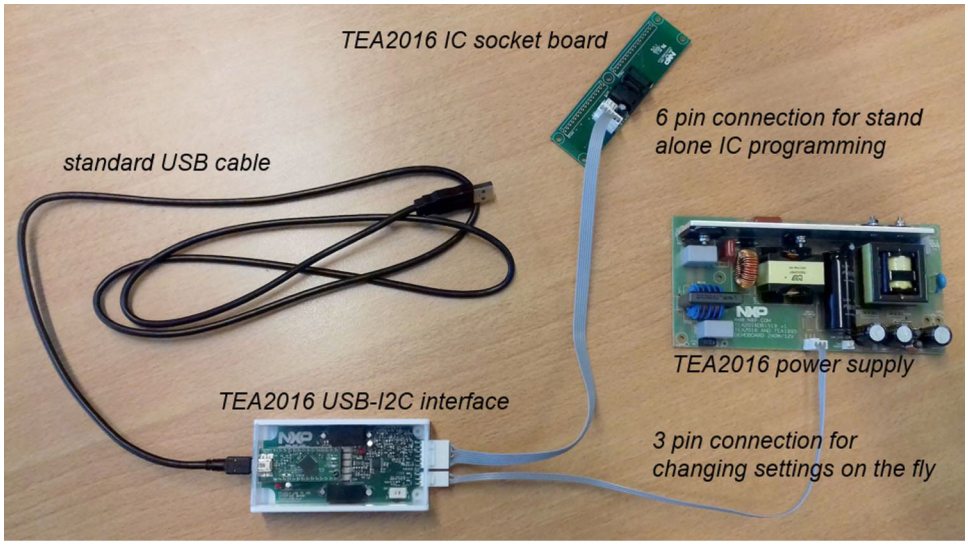


Figure 26. Two TEA2016 programming setups: on-the-fly and standalone

6.3 Graphical user interface (GUI) and USB-I^{2}C interface

During power supply development, the communication with the IC is done by the Ringo software with GUI on a computer and a USB-I^{2}C hardware interface. The TEA2016 GUI provides the correct protocol and offers several options and tools to work with the IC settings.

This document and the USB-I^{2}C interface user manual show how to work with it.

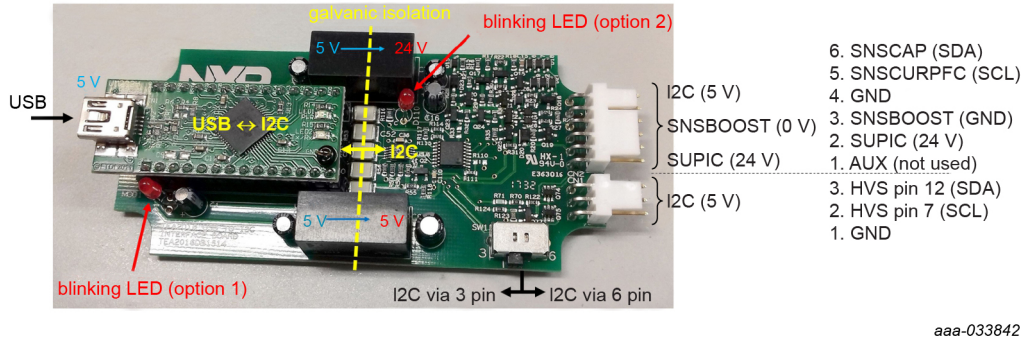


Figure 27. USB I^{2}C interface board TEA2016DB1514 connections and setup

7 Setting modification using an external GATELS resistor value

The TEA2016 offers a possibility to modify a group of settings with an external resistor value on GATELS without MTP programming.

A resistor measurement function in the IC measures the value of the resistor to GND on GATELS. Applying a certain resistor value gives the option to select one of the 4 preselected “menus” each consisting of a group of basic settings related to protections (see Figure 28). It mainly offers a choice between safe restart or latched follow-up character.

Four sets of 8 parameter settings can be chosen. When these sets are programmed, they can be used without reprogramming. Menu R1, Menu R2, Menu R3, and Menu R4 represent the four sets. Figure 28 shows an example of programmed menus.

The 32 fields can be modified independently. However create 4 useful menus that can cover a small variation between applications.

Typically, changing settings with resistor values can be a solution for using the same power supply, changing it from “safe restart” to “latched” using the GATELS resistor value. It is also possible to use different protection power levels (OCP and OPP) in the menus.

Other parameter settings do not change with the resistor value.

aaa-033843

Figure 28. Example of configuration using external resistors

8 References

[1] **TEA2016AAT data sheet** — Digital controller for high-efficiency resonant power supply; 2019, NXP Semiconductors

[2] **UM11235 user manual** — TEA2016DB1514 USB I^2C interface board; 2019, NXP Semiconductors

[3] **UM11234 user manual** — TEA2016 240 W prototype demo board; 2019, NXP Semiconductors

[4] **AN12330 application note** — TEA2016AAT digital controller for high-efficiency PFC and resonant power supplies; 2019, NXP Semiconductors

9 Legal information

9.1 Definitions

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