RD6006, RD6012, RD6018, RD6006P
DC Power Supplies
with Custom Firmware by UniSoft

Primary Author: Sunkmail (Scott Mitten)

Contributing Authors: Dougg (Doug G.)

bateau020

A **big thanks** to **UniSoft** for both writing the firmware and technical assistance in creating this document.

This document is user created and definitely has errors and omissions.

Use with Caution.

For any correction or additions to this document, contact Sunkmail by the link provided,
or through the associated forum thread on EEVBlog.com.

Latest Document Change: January 15, 2023

Table of Contents

1. Introduction **4**

2. Document Status **5**

3. Disclaimer **5**

4. Nomenclature & Formatting **6**

5. System Isolation **6**

6. How to Install Custom Firmware **7**

6.1. Prepare the RD60xx 7

6.2. If you use UniSoft's RDFlasher on Windows 8

6.3. If you use Timo Kokkonen's Riden flashtool 10

7. Front Panel Layout **11**

7.1. Display Screen Layout 12

8. System Settings Navigation **12**

9. Global Menu Pages **13**

9.1. ‘Battery’ Icon Page 13

9.1.1. Battery Charger 13

9.2. ‘Gear’ Icon Page 13

9.2.1. Power 13

9.2.2. Display 13

9.2.3. Communication 13

9.2.4. Units 13

9.2.5. Date and Time 13

9.3. ‘Home’ Icon Page 14

9.3.1. Interface 14

9.3.2. Appearance 14

9.3.3. V-SET/I-SET/OVP/OCP/OPP 14

9.3.4. Memory 14

9.3.5. Buzzer 14

9.3.6. Layout 1 14

9.3.7. Colors 14

9.4. ‘Disc’ Icon - Memory Location Values Menu 15

9.5. ‘Screwdriver’ Icon Page 15

9.6. ‘Info’ Icon - Device Information Page 15

10. “Current Session” (CS) Menu Layout **15**

11. “Quick Settings” (QS) Menu Layout **16**

12. Other Settings **16**

13. Button Actions & ShortCuts **17**
13.1. Graph Mode Only 17

14. Description of Each Setting's Options **18**

15. 'Colors Group' Detailed Explanation **52**

16. Graph Display - Detailed Explanation **54**
16.1. Graph (View) Mode 57

17. Calibration and raw ADC values **58**
17.1. How to do the Calibration on the device 58
17.2. How to do the Calibration from the PC software 59
17.3. Raw ADC values 59

18. Hardware Modifications **61**
18.1. Accessing the Internals 61
18.2. External LED - Modification 62
18.3. Front Power Switch - Modification 67
18.4. Improve Internal Thermal Measurement Accuracy 68
18.5. Using the TTL Interface 68
18.6. Output Surge Problem - Hardware Bug, With Fix 69
18.6.1. How to get rid of the problem 69

19. How to Connect with WiFi **72**
19.1. If WiFi Has NOT been previously configured 72
19.1.1. With the help of the mobile app 72
19.1.2. From USB, with RDFlasher 73
19.2. If WiFi has been configured previously 73
19.3. If you want to change the "Server"'s IP address. 73
19.4. If you want to change the AP, or if WiFi no longer works at all, and you want to start all over. 74

20. Other Software and Utilities **74**
20.1. ScreenDumper Utility 74
20.2. How to Change the Boot Logo Image 76

21. Battery Charging Methods with the RD60xx **77**
21.1. Battery chemistries 77
21.2. Connecting a battery 78
21.3. Battery settings 79
21.4. Charging Strategies 79
21.4.1. Time limit 79
21.4.2. Capacity limit 79
21.4.3. Current limit 80
21.4.4. Temperature limit 80
21.4.5. $-\Delta V/\Delta t$ 82
21.4.6. Float Charging (aka Trickle Charging) 83

22. Reference Information: **84**
22.1. Original Riden Manual 84
22.2. Fuses 84
22.3. Short Circuit Response Time Testing 85
22.4. Miscellaneous 86

1. Introduction

This document describes the usage of custom firmware, written by UniSoft, running on the popular "DC Power Supplies" models RD6006, RD6012, RD6018, and the hybrid RD6006P, along with their WiFi enabled variants. ("W" appended to the model name.) The RD60xx_s are manufactured by the Hangzhou Ruideng Technology Co. Ltd. of Zhejiang, China. Hereafter the manufacturer will be referred to as **Ruideng** or **Riden**; the latter is the name that appears on the front of these power supplies.

Electrically the RD60xx units can be termed as DC *buck* converters. They are designed to take an input voltage up to 70 Volts (MAX) DC and step it down to a user-selectable voltage in the 0-60 Volts DC range. The last two digits of the product name indicate the maximum current they can deliver (e.g. the RD6018 can deliver up to 18 Amps). Ruideng has done a good job of documenting their power supplies and postscript files can be found at this url (note: http rather than https)

The RD6006P is newer, and is a hybrid: it is a switching power supply with a linear front-end. Its main advantage over the non-P versions, is that it has lower output noise.

Note that DC power supplies used in electronics, often called lab power supplies, typically take mains AC Voltage as input (85 to 250 Volts AC, 50 or 60 Hertz). Retailers of the RD60xx products usually sell a mains AC adapter with a 65 to 70 Volt DC output and an enclosure box to hold the adapter and the RD60xx.

This document's primary authors each have an RD6018(W) with a 800 Watt AC adapter that outputs around 65-68 Volts DC, without load. As most of the screenshots are from the primary author's equipment, small differences may appear between the reader's PS and other models.

> For example, only the RD6006 has 1 milliAmp (mA) current setting resolution while the two "larger" models have 10 milliAmp current setting resolution. Bigger is not always better.

On 25 June 2020 eevblog user "UniSoft" posted to the 'Test Equipment' board in the "RuiDeng Riden RD6006 DC power supply" thread that announced:

> "I recovered firmware source code of RD6006... Here is my **beta** version, if anyone interested."

Probably before that date he sent beta versions to a Russian electronics board. His bio on EEVBlog gives his nationality as from Kazakhstan, his gender as male, and his location as Shenzhen, China. Other than that we know he writes good firmware and is very responsive to any bug reports.

It seems the manufacturer, Ruideng, has adopted some of UniSoft's ideas and incorporated them in their own recent firmware updates. This can make it a little difficult to identify a feature as a UniSoft addition as it may appear later in Ruideng firmware. But for users of these DC power supplies, this seems like a win-win situation. The source code that generates UniSoft's firmware has not been open sourced. When asked about this UniSoft said that it contained some encryption code that the manufacturer would not want to see made public.

> That said, *UniSoft has stated that he has **no** relationship with, or been offered any financial compensation from, Ruideng.*

The Russian Language Forum where everything started is HERE.

---

2. Document Status

This document was originally created in February 2021.

The most recent beta firmware at the time of this document is version 1h, and also works for the newer hardware versions that have a different LCD (ST7789).

RD6006:	RD60062_V1.38.1h.bin
RD6006P:	RD60065_V1.41.1h.bin
RD6012:	RD60121_V1.34.1h.bin
RD6018:	RD60181_V1.36.1h.bin

All released on 16 July 2022.

Each firmware will also work on the corresponding “W” variants (e.g. RD60xxW), having a WiFi daughter board for remote control and monitoring.

Please Note:

You **MUST** install the correct firmware for your particular RD60xx Model.

Otherwise unexpected behavior can & will occur.

---

3. Disclaimer

While we have made every attempt to ensure that the information contained in this document is correct, The Document Authors, Contributors, and Firmware Author are not responsible for any error or omissions, or for the results obtained from the use of this information. All information in this document is provided “as is”, with no guarantee of completeness, accuracy, usefulness, timeliness or the results obtained from the use of this information, and without any warranties of any kind whatsoever, express or implied, including, but not limited to performance and fitness for a particular purpose.

Any actions you take upon the information in this document are strictly at your own risk. In no event will the Document Authors, Contributors, or Firmware Author be liable to you or anyone else for any decision made or action taken in reliance on the information within this document, or for any consequential, special or similar damages, even if advised of the possibility of such damages. We will not be liable for any losses or damages in connection with the use of this document or the Firmware it references.

---

4. Nomenclature & Formatting

- Items in double quotes (“ ”) refer to *Physical* buttons.
    - `The Font will also be changed to the one used on this line.`
- Items in single quotes (‘ ‘) refer to *unit settings* or *modes*.
- **CC mode** - Unit will attempt to maintain a *Constant Current* (maximum) output, adjusting the Voltage output as required.
- **CV mode** - Unit will attempt to maintain a *Constant Voltage* (maximum) output, as long as the load’s current (Amps) demands are below the ‘I-Set’ Value.
- **Protection Mode** - Unit has sensed a value exceeding its protection setting. (eg OVP, OCP, etc)
    - Output will be immediately turned OFF when entering this mode.
- **Normal Operating Mode** - Unit is not currently experiencing any errors and is not in a protection mode.
- **Graph Display mode** - Any screen showing values graphically via a graph, rather than text.
- **Primary Power Supply** - The Power Supply (PS) that supplies DC power to the RD60xx Unit.
    - MAXIMUM Voltage In = 70V DC. **DO NOT EXCEED**

---

5. System Isolation

Assuming your particular Primary Power Supply output is isolated from the AC mains' protective ground (i.e. green with yellow stripe insulated wire, or bare copper wire; also known as protective earth) then the 3 output terminals on the front of the RD60xx units will also be *isolated*.
This makes the RD60xx unit a floating supply.

Some confusion may arise due to Ruideng's choice of a green terminal as an alternate "+" terminal for battery charging, since many other power supplies choose to have a green "third" terminal on the front of their units connected to the AC mains protective ground.

The USB port on the front of the RD60xx, is galvanically isolated from the rest of the unit. The isolation integrated circuit claims 3000 Volts AC rms isolation (UL certificate number: E494497).

Even without dangerous voltages being involved, it is still possible to have unexpected current flows through the negative terminal (ground) if the USB port were not isolated.
For example, a laptop connected to an external monitor could effectively be tied to the AC mains' protective ground (via the monitor). If a device that was protective ground referenced were connected, by a USB cable, between the laptop and a NON-isolated USB port the device could cause a protection trip or worse.

Therefore, the USB port of the RD60xx unit being isolated is an important safety feature.

6. How to Install Custom Firmware

Required Files and Utilities:

As of this document's latest update:

UniSoft's most recent RD60xx Firmware
as posted on EEVBlog.

Note: You will need to ensure you have the correct Firmware for your RD60xx model.

Windows: UniSoft's most recent 'Flasher' Utility.
Recommended to load the custom firmware when using Windows.

Windows 10 Driver for USB interface connection
Only needed if your computer doesn't see the RD60xx on a Windows 10 computer.

Any OS (MacOS, Linux, Windows): Timo Kokkonen's Riden flashtool.
Requires command line and Python 3.

6.1. Prepare the RD60xx

IF using the default RD60xx (Riden) Firmware:

1. Press "SHIFT"+"MENU" to enter the menu system.
2. Ensure 'Interface' is set to: USB,
   (using the direction keys: ◀ ▶ ▲ ▼)

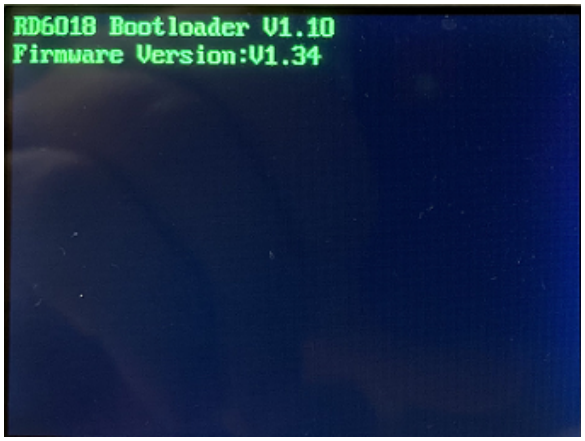
Note:
This image may not perfectly represent the current Riden firmware setting screen. Screen changes may occur between firmware versions.

IF updating an existing UniSoft Firmware:

1) Ensure 'USB Interface' is set to the desired baud rate.
   (115200 is default for Flasher utility.)

In all cases:

2) Make sure any WiFi or serial connection is inactive. If you remotely connect to the PSU while flashing firmware, flashing will fail, and you will need to redo it from the 'Boot' Mode (see below).
3) Confirm the device 'Address'.
4) Turn OFF the Primary Power Supply.
5) Ensure you have a USB cable connected from your computer to the micro-USB port on the front of the RD60xx.



IF any difficulties are encountered, or existing firmware is corrupted:

Press the "ENTER" button while turning ON the Primary Power Supply.

(This will manually put the RD60xx into 'Boot' Mode.)

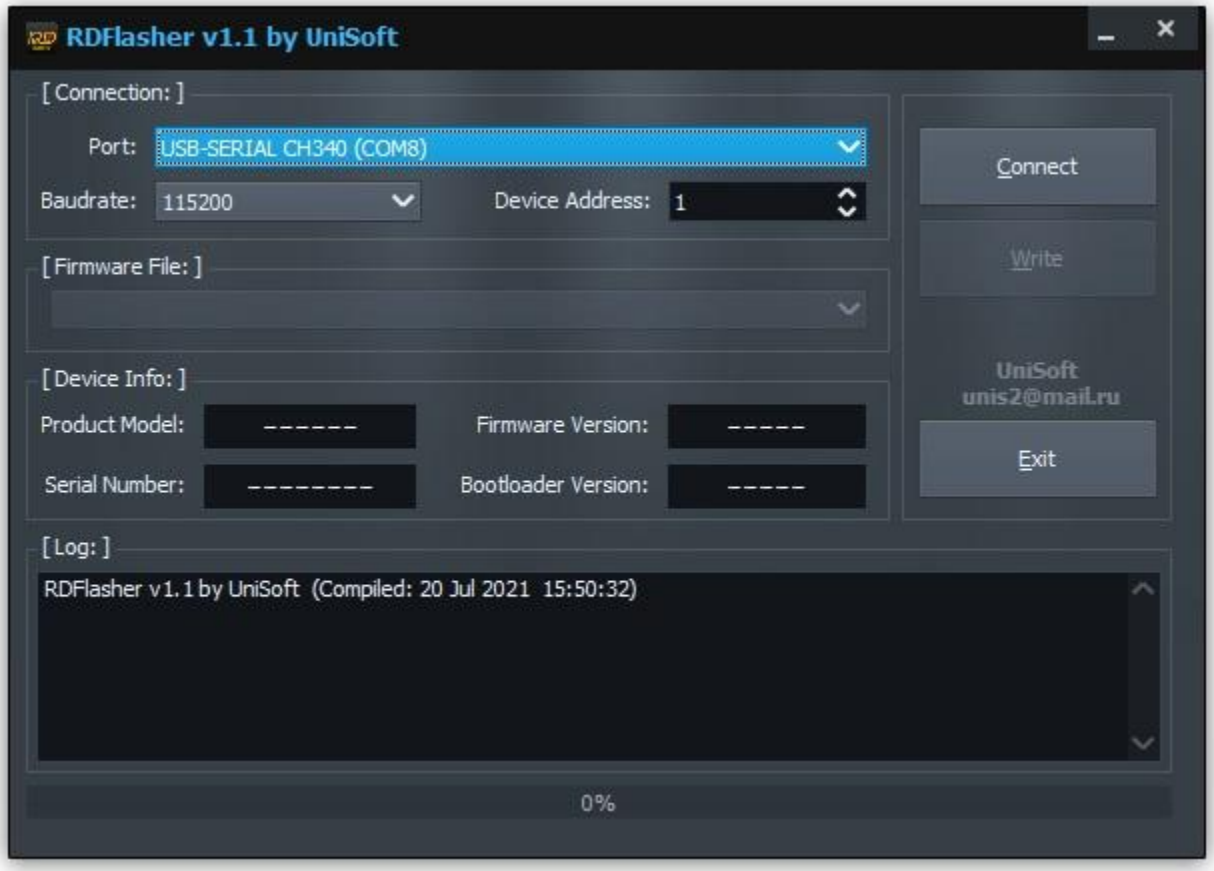
Note:

IF update process fails after manually entering 'Boot' Mode, remove the RTC coin-cell battery and repeat the process.

6.2. If you use UniSoft's RDFlasher on Windows

1) **In your computer's file manager:**
   - Ensure the latest firmware **.BIN** file is in the 'FIRMWARES' sub-folder of the RDFlasher utility.
     - If not, the Flasher will not be able to detect the file.
   - Start 'RDFLasher.exe'

2) **In the RDFlasher utility:**



a) Ensure your Port, Baudrate and Device Address are set for your RD60xx.

b) **Turn ON the RD60xx's Primary Power Supply**, and wait until it has booted.

c) Click the 'Connect' button.

d) Select the desired firmware from the "Firmware File" dropdown box.

e) Click the 'Write' button.

f) Wait for the writing process to complete.

DO NOT turn off the power during this process!

Notes:

If you flash back to the stock firmware from the custom firmware, you should restore default settings:

To reset default parameters: Press "0" while powering on the RD60xx.

6.3. If you use Timo Kokkonen's Riden flashtool

This tool can be used on many devices and OSes that have support for python3: Windows, Mac, Linux. It also works on devices like the Raspberry Pi. It requires use of the command line. Be sure you are familiar with that. Familiarity with Python is not strictly needed.

1) Place the correct firmware file in a directory of your choice. Note the command line path to that file.
2) Make sure you know the serial device that the RD60xx presents to the OS: look what serial device gets created when you connect a USB cable from your computer to the micro-USB port on the front of the RD60xx. The exact name depends on your device and your OS. On MacOS, the device might be something like "`/dev/tty.usbserial-31110`"
3) Make sure you have Python3 installed (any recent Linux and MacOS will have it, Windows may be more troublesome).
4) Make sure you have "`pyserial`" installed. Most modern OS's have it installed. If not, you can install it through pip3 via the command `pip3 install pyserial`. If you don't have pip3, and don't know how to install that, you might also be able to install `pyserial` directly through your OS's package manager (probably as `python3-serial`)
5) Pick a directory you want to install the software in
6) Fetch the software from github, via your preferred method. Some different ways of doing it are:
    a) via command line git, if you have it:
    `git clone git@github.com:tjko/riden-flashtool.git`
    b) via a download of the full zip and subsequent unzip to the desired directory.
    c) via a download of only the python script file flash-rd.py directly to the desired directory.
7) Connect a USB cable from your computer to the micro-USB port on the front of the RD60xx
8) Follow the instructions from github. An example from a Raspberry Pi is mentioned. On MacOS, you might need something like
`python3 flash-rd.py /dev/tty.usbserial-31110 ../RD60121_V1.34.1g.bin`
9) Wait for the writing process to complete.

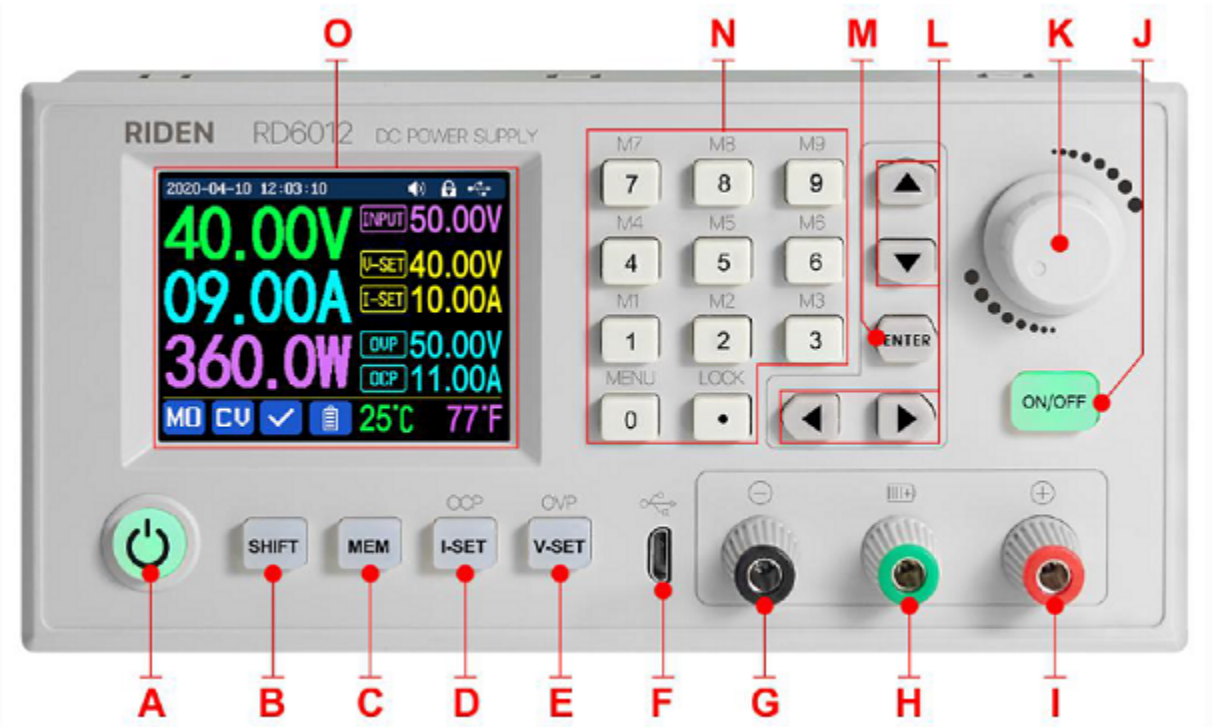
    DO NOT turn off the power during this process!

Notes:

If you flash back to the stock firmware from the custom firmware, you should restore default settings:

To reset default parameters: Press "`0`" while powering on the RD60xx.

7. Front Panel Layout



A "POWER" button

B "SHIFT" button

C "MEM" button

D "I-SET" button

E "V-SET" button

F Micro-USB port

G Negative (-) Binding post / terminal

H Battery Positive Binding post / terminal
Normally: **Battery Charging (+) Output**
See also 'Green Output'

I Positive (+) Binding post / terminal
General Purpose (+) Output

J Output "ON/OFF" button

K "ENCODER" knob

L Direction arrows
"◀", "▶", "▲", "▼"

M "ENTER" button

N Numbered "KEYPAD"

O Display - 'Display Screen Layout' for Detail

Safety NOTE:

The **GREEN** Binding post **IS NOT GROUND.**

7.1. Display Screen Layout

{ToDo: Add info for the areas of the display}
{ie, Status area, The Caption area, Normal operating Icon, Memory location Icon, etc}
{Include Icons that may show up, eg internal Fan, LOCK, buzzer, Etc.}

8. System Settings Navigation

To Enter Global Settings:

(From Any Non-Settings page:)

Press "SHIFT"+"MENU"

To Enter Battery Settings:

(From Any Non-Settings page:)

Press "SHIFT"+"0"

Or long press "SHIFT"

To Change Global Menu Category:

(With No Options selected:)

Press "◀" or "▶"

OR

Rotate "Encoder" Knob

To Enter "Current Session" Settings:

(From Any Non-Settings page:)

"SHIFT"+"▲"

To Enter "Quick Settings":

(From Any Non-Settings page:)

"SHIFT"+ "▼"

To select current menu options:

Press "▲" or "▼"

To Change Selection Value:

Press "◀" or "▶"

OR

Rotate "Encoder" knob

(Numbered settings can also use the numbered keypad)

To 'Backspace' when using the keypad:

Press "▶"

To Confirm Selection:

Press "ENTER"

OR

Press "Encoder" knob

OR

Press "▲" or "▼"

To Backout to Previous menu (and store changes)

Press "Encoder" knob

OR

Press "ENTER"

9. Global Menu Pages

9.1. ‘Battery’ Icon Page

9.1.1. Battery Charger

-- CutOff current
-- I-Off Lockout
-- CutOff Temp.
-- CutOff time
-- CutOff cap.
-- CutOff -ΔV/Δt
-- -ΔV/Δt Lockout
-- 0ΔV/Δt Timeout
-- Reset metrics
-- Charge Buzzer
-- AutoSetLayout

9.2. ‘Gear’ Icon Page

9.2.1. Power

-- Power State
-- Boot Output
-- Boot Keylock
-- Boot MemCell
-- AutoPowerOff
-- Max V-SET
-- Max Power
-- Min Input
-- Power Switch
-- Standby LED
-- External LED
-- ISET > OCP+200
-- OTP (ext)
-- UVP
-- UCP
    -- UCP Trigger
-- ORP
    -- ORP set
    -- ORP delay
-- CC Delay Off
-- SysFailureRst

9.2.2. Display

-- Backlight
-- Screensaver
-- ScrsaverBright
-- ScrsaverActive
-- Update Rate
-- Boot Logo
-- Standby Clock

9.2.3. Communication

-- USB Interface
-- UART Interface
-- UART Baudrate
-- Server IP
-- Address
-- Comm Buzzer
-- Skip keys lock

9.2.4. Units

-- Temperature

9.2.5. Date and Time

-- Date Format
-- Date
-- Time

9.3. ‘Home’ Icon Page

9.3.1. Interface

-- Language
-- Layout

9.3.2. Appearance

-- Digits Style
-- Leading Zeros
-- Status Info
-- Solid Labels
-- 7SegInact.Elem
-- SaveGraphSett.
-- Timer icon
-- T° -EXT icon

9.3.3. V-SET/I-SET/OVP/OCP/OPP

-- Timeout
-- Save Mult.
-- Skip Exit

9.3.4. Memory

-- Hint
-- Confirmation
-- Instant Out
-- Shift Table

9.3.5. Buzzer

-- Mute
-- Key Beep
-- OxP Beep
-- Timer Beep
-- PwrOnBeep
-- AutoPwrOffBeep
-- CV–>CC Beep
-- CC Buzzer
-- Comm Buzzer

9.3.6. Layout 1

-- Small Font

Show [Option]:

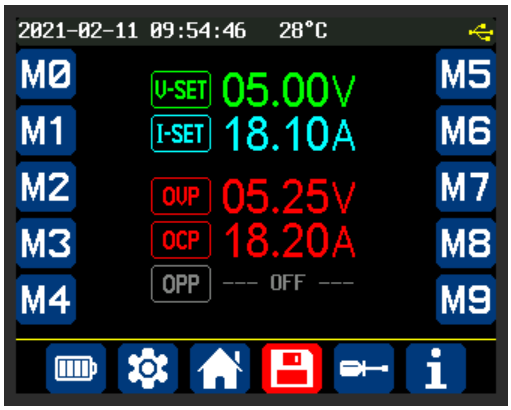
-- Show INPUT
-- Show V-SET
-- Show I-SET
-- Show OVP
-- Show OCP
-- Show OPP
-- Show RL
-- Show T° -EXT
-- Show V-BATT
-- Show T° -BATT
-- Show TIME
-- Show CHARGE
-- Show Ah
-- Show Wh

9.3.7. Colors

‘Colors Group’ Detailed Explanation

-- Voltage
-- Current
-- Current (CC)
-- CurrentBg(CC)
-- Power
-- Input
-- V-SET
-- I-SET
-- OVP
-- OCP
-- OPP
-- ORP
-- RL
-- Ah
-- Wh
-- Ah (L1) -- for layout 1
-- Wh (L1) -- for layout 1
-- Temperature
-- BattVoltage
-- Batt Info
-- Timer
-- Graph (V)
-- Graph (I)
-- Graph (W)
-- Graph (T°)
-- Custom Color

9.4. ‘Disc’ Icon - Memory Location Values Menu



{Add description of how this menu works here}
{placeholder}
{placeholder}
{placeholder}
{placeholder}
{placeholder}
{placeholder}
{placeholder}
{placeholder}
{placeholder}

9.5. ‘Screwdriver’ Icon Page

See How to do the Calibration on the device

9.6. ‘Info’ Icon - Device Information Page

(Read Only)

Product Model
Serial Number
Firmware
Temperature (Internal)

10. “Current Session” (CS) Menu Layout

“SHIFT” + “▲”

--- Timer Mode
-- Timer Off
-- Timer On
-- Timer Reset
-- CC Buzzer

11. “Quick Settings” (QS) Menu Layout

“SHIFT” + “▼”

-- Green Output
-- UVP
-- UCP
    -- UCP Trigger
-- ORP
    -- ORP set
    -- ORP delay
-- Graph Window

---

12. Other Settings

Can Only be Enabled by Panel buttons

-- I-SET	Press “I-SET”
-- OPP	Press “SHIFT” + “MEM”
-- OCP	Press “SHIFT” + “I-SET”
-- OVP	Press “SHIFT” + “V-SET”
-- V-SET	Press “V-SET”

---

13. Button Actions & ShortCuts

Activate Screensaver
"●"

'Current Session' Menu
"SHIFT" + "▲"

Display Layout
"◀" or "▶"

Lock
"SHIFT" + "●"

Mute
"●" + "●"

'Quick Settings' Menu
"SHIFT" + "▼"

Reset Metrics (Ah/Wh/Time)
"MEM" + "●"

Set OPP
"SHIFT" + "MEM"

Status Bar Info Displayed
"▲" or "▼"

13.1. Graph Mode Only

Enter View Mode
"MEM" + "ENTER"

Switch to Auto Scaling
"MEM" + Press/click "ENCODER"

Start / Stop (Pause)
"ENTER"

Select Parameter to Scale
"ENCODER"

Change Offset Y
"▲" or "▼"

Reset Offset Y
"MEM" + ("▲" or "▼")

See 'Graph Display - Detailed Explanation' for full details of graphing mode.

14. Description of Each Setting's Options

-ΔV/Δt Lockout


➥Battery Charger

Settable Range: `01m - 60m.`

Sets the delay before activating the function "CutOff -ΔV/Δt".
Note: This setting is only applicable using the (Green) Battery Charging Binding post.

0ΔV/Δt Timeout


➥Battery Charger

OFF NOT detecting 0ΔV/Δt.
Settable Range: `00m - 60m.`

IF Set,

Timeout for 0ΔV/Δt (if there is no voltage growth during the specified time.) See the function "CutOff -ΔV/Δt".
Note: This setting is only applicable using the (Green) Battery Charging Binding post.

7SegInact.Elem


➥Appearance

ON Disables highlighting of inactive elements in 7-Seg font, when chosen.
OFF No effect

Address


➥Communication

Settable Range: `001 - 255`

Used to uniquely identify unit when multiple devices connected

AutoPowerOff


➥Power Settings

Settable Range: `Never / 00h01m - 59h59m`

Automatically Power off after specified time **IF** RD60xx unit is in idle mode.

Idle mode = output off, no user interaction, no communication.

Any user input or external communication will reset the timer.

AutoPwrOffBeep


➥Buzzer

If AutoPowerOff Enabled:

ON Buzzer will sound when AutoPowerOff is activated (timer reaches `0`).

OFF Buzzer will NOT sound when AutoPowerOff activated.

AutoSetLayout


➥Battery Charger

0 - 4 Will automatically switch to the selected layout when a battery is detected. When the battery is disconnected, it will return to the previous Layout (unless you switched manually).

OFF No effect.

Backlight


➥Display

Settable Range: `0 - 5`

Screen Brightness Selection. Higher setting is brighter.

Boot Logo


➥Display

ON Display Logo/Splash screen on Boot-up.

OFF Enter the main page directly.

Instructions for How to Change the Boot Logo Image.

Boot Keylock


➥Power Settings

ON Activates keypad LOCK at startup.

OFF no keypad LOCK at startup.

Boot MemCell


➥Power Settings

Settable Range: `M0 - M9`

Activates specified memory cell (Memory Location) at startup.
Note: Cell "M0" - holds the last entered values

Boot Output


Power Settings

Disable Output will remain OFF until the "ON/OFF" button is pushed.
Enable Turn on the output automatically upon Boot-up.
LastState Return to the ON/OFF state from the last RD600x shut-off.

This option is for the RD60xx's output when the "Power" button is pressed (Boot-up).

For behavior when the RD60xx unit first receives power from the Primary Power Supply, use the 'Power State' setting.

CC Buzzer


Buzzer

ON Buzzer sounds continuously (for 30 seconds) when in Constant Current (CC) mode.
OFF Buzzer does NOT sound when in CC mode.

This option does NOT affect the operation of the 'CV->CC Beep' option.

CC Buzzer {CS menu}

Same as 'CC Buzzer', above, except:
Operation returns to 'CC Buzzer' value on next Power-On.

CC Delay Off


Power Settings

On disable delay of CC right after Output Enable.
Off no change.

Charge Buzzer


Battery Charger

ON Buzzer sounds once when a Battery Charging cycle completes.
OFF Buzzer does NOT sound when a Battery Charging cycle completes.

Confirmation


Memory

When recalling settings from a Memory Location

ON Pop-up confirmation window - before changing settings
OFF Settings Modified Immediately - without confirmation.

Comm Buzzer


Communication

ON Buzzer sounds once when the software writes new parameter(s) .
OFF Buzzer does NOT sound when Parameter(s) changed.

CutOff -ΔV/Δt


Battery Charger

OFF NOT monitoring for voltage drop during charging.
Value Set in `mV` steps.

IF Set,

- If, [-ΔV/Δt Lockout] (5 minutes by default) after the output is turned on, the voltage drops by more than the specified value, the output will be disabled with the "-ΔV/Δt" status.
- If no voltage rise is detected within [0ΔV/Δt Timeout] (15 minutes by default), the output will be turned off with the "0ΔV/Δt" status.

Notes:

- This setting is only applicable using the (Green) Battery Charging Binding post.
- To be used for Ni based chemistries (NiMh/NiCd).
- Experimental use only, may not work correctly due to the low ADC resolution.
- Algorithm taken from this project.
- For an explanation of the process, see -ΔV/Δt

CutOff cap.


Battery Charger

OFF NOT monitoring for total capacity charged while battery charging.
Value Set in `0.001`Ah steps.

IF Set,

Battery charging cycle will halt once the set value is achieved.

Note:

This setting is only applicable using the (Green) Battery Charging Binding post.

CutOff current


Battery Charger

Value Set in `10mA` steps.

Charging current where the RD60xx unit will consider the battery ‘Full’. (Charging cycle will halt.)
Note: This setting is only applicable using the (Green) Battery Charging Binding post.

CutOff Temp.


Battery Charger

OFF NOT monitoring external probe for Over Temperature while battery charging.
Value Set in 1° steps

IF Set **AND** the temperature reaches, or exceeds, the set value:

- The output will immediately turn OFF.
- The “ON/OFF” button will turn off it’s illumination,
  - or react per the setting of ‘External LED’.
- Charge Status, on the display, will be set to "CHARGE: T°-OFF", indicating that the charging cycle was halted due to temperature.

Notes:

- Disabled by setting to `0`.
- This setting is only applicable using the (Green) Battery Charging Binding post.
- Should be set to a higher value than the ambient temperature for proper operation.
- ‘CutOff Temp’ setting is similar to the ‘OTP (EXT)’ setting, in that both serve the same purpose of setting an upper temperature limit.
  - However, ‘OTP (EXT)’ is a global feature,not limited to battery charging. final safety measure, not specifically for battery charging.

    IF ‘CutOff Temp’ **AND** ‘OTP (EXT)’ are **Enabled**:

    The value of ‘OTP (EXT)’ should be higher than the ‘CutOff Temp’ to ensure proper operation.

CutOff time


➥Battery Charger

OFF NOT monitoring total time of charge while battery charging.
Settable Range: `00h 01m - 99h 59m`.

IF Set,
Battery charging cycle will halt once the set time is achieved.
Note: This setting is only applicable using the (Green) Battery Charging Binding post.

Custom Colors


➥Colors

`

ON Custom Colors are used, where set in the 'Colors Group' menu options.
OFF Default Colors are used.

For information on how to set up the Custom Colors see:
'Colors Group' Detailed Explanation.

CV—>CC Beep


➥Buzzer

ON Buzzer sounds *once* when switching from CV to CC mode.
OFF Buzzer does NOT sound when switching between modes.

Date


➥Date and Time

Rotate the '`Encoder`' knob to the desired value.

Use " ◀ " or " ▶ " to switch selected fields.

Date Format


➥Date and Time

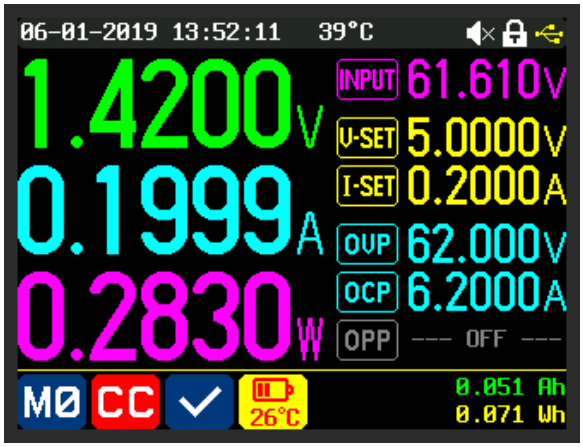
Selectable Options: `YYYY-MM-DD / DD-MM-YYYY`

Digits Style

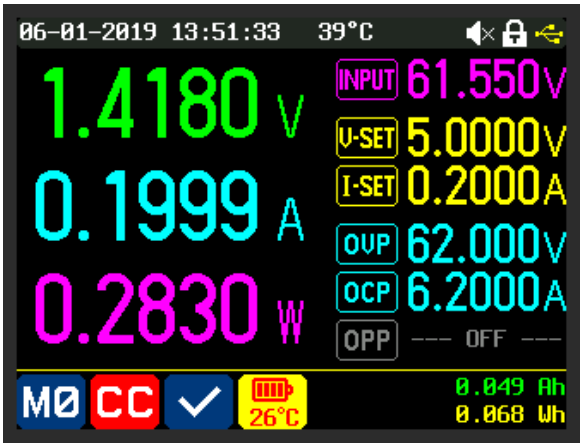

Appearance

Change the appearance of digits on screen.

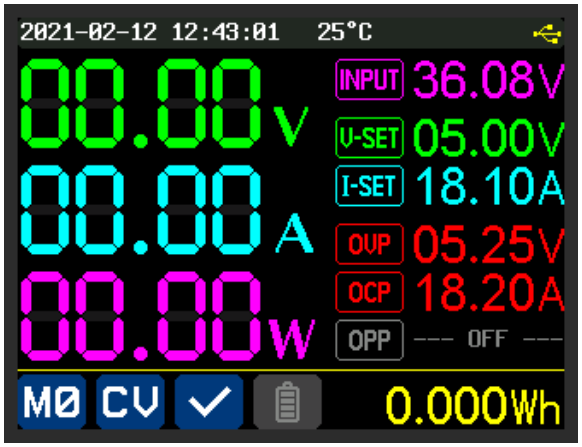
Four options are available:



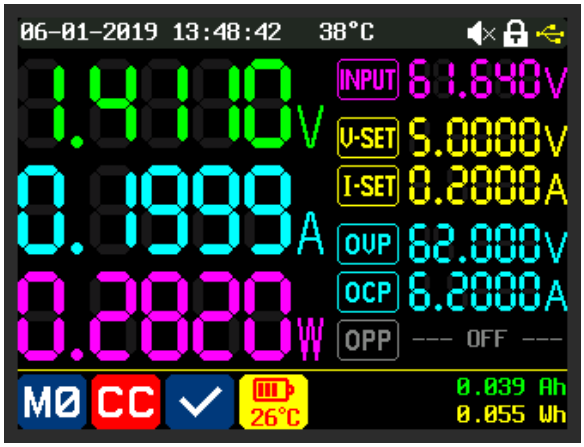
Digits Style: **32×60** [1]



Digits Style: **24×48**



Digits Style: **7-Seg v1**



Digits Style: **7-Seg v2**

[1] The 32x64 font has been replaced by 32x60 in the latest firmware, but is still shown in some pictures in this document.

External LED


Power Settings

IF External LED Modification is installed …

OFF	External LED not used.
OxP	Red in case of OxP (Protection).
CC	Red in CC mode.
CC + OxP	CV - Green, CC - Yellow, OxP (Protection) - Red.
CV-G/CC-R	CV - Green; CC - Red.
CV-R/CC-G	CV - Red; CC - Green.
VG/CR/OxP	CV - Green; CC - Red; OxP (Protection) - Blinking Red.
VR/CG/OxP	CV - Red; CC - Green; OxP (Protection) - Blinking Red.
VG/CY/OxP	CV - Green; CC - Yellow; OxP (Protection) - Blinking Red.

IF the External LED Modification has NOT been made…

This value has NO effect.

Good practice - Set to **OFF**

Hint


Memory

OFF	Memory Hint will not be displayed.
Value	Time, in seconds, that the Memory Hint will be displayed.

When enabled,

Pressing a memory location number (“M1” – “M9”) will display the values stored at that location for the time set.

Pressing the same button again (double press) will apply the settings.

I-Off Lockout


Battery Charger

OFF	NOT monitoring Cutoff Current.
Settable Range:	00m – 60m.

IF Set,

Sets the delay before activating the "Cutoff Current" function.
Note: This setting is only applicable using the (Green) Battery Charging Binding post.

Instant Out

Memory

When recalling settings from a Memory Location

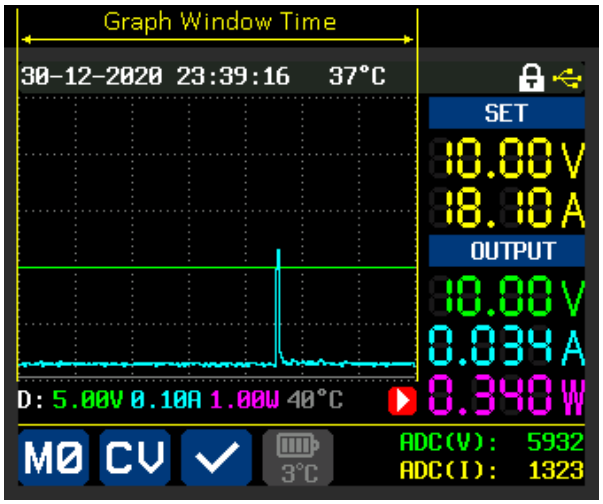
ON Output will turn ON automatically when memory Selected/Recalled.

OFF Output Maintains existing ON/OFF status.

Graph Window

Accessed via Quick Setting Menu (“SHIFT” + “▼”)

Settable Range: 00h 01m - 23h 59m



This is the time of the entire width of the graphing window, as indicated in the image.

Note:
Values will be averaged as needed to fit the desired time.

See ‘Graph Display - Detailed Explanation’ for a detailed explanation of the Graphing Mode.

Green Output

Quick Setting Menu (“SHIFT” + “▼”)

If ENABLED then the GREEN terminal will work as an output over relay.
NOTE! In this mode, the battery detection is disabled, so charger mode will not work.
Temperature/MEM/SHIFT are displayed in GREEN (no space for a separate icon).

I-SET (Set Current, in Amps)

Can Only be Enabled by Panel button “I-SET”

Value of the Current Setpoint, in Amps, for when the unit is in CC Mode.

Rotate “Encoder” knob to desired value.

Use “◀” or “▶” to switch selected multiplier.

OR

Enter the desired value using the Keypad.

A long press on the button opens a menu that allows the settings of an upper and lower limit to the value. These limits are not retained between reboots.

ISET > OCP+200


Power Settings

OFF Prevent current from exceeding the OCP setting.
ON-CODE Allow current to exceed OCP setting - **See conditions, below**.

With 'ISET > OCP+200' **OFF**,
The unit will NOT allow the output current to go above the protection value, as described in the 'OCP' Setting details.

Except, The time from output current reaching the OCP value and the PS turning OFF (Protection Mode) could be delayed by up to 600ms; rather than immediately as a more advanced/expensive PS_s would do.

With 'ISET > OCP+200' **ON**,
The unit **WILL** allow the output Current to go to whatever value is selected (I-SET), regardless of the 'OCP' value.
However, since the value is above the 'OCP' value, Protection Mode will still be activated, after the delay, **IF** the output current has not fallen back below the OCP value.

This setup is for load devices with high in-rush current that lasts less than the delay time:

Output current can go over the OCP value for short bursts, to a MAXIMUM of 'I-SET', and for less than the response delay, up to 600ms.

The response delay is due to a lack of a hardware-implemented 'over current' protection. This is unavoidable with the RD60xx and cannot be corrected in Firmware.

IF the output current reaches 'I-SET' the (Hardware Controlled) fast change to CC mode would lower the Voltage to maintain the I-Set maximum, until after the response delay.

IF the inrush lasts less than the Delay time and then falls below the OCP value, the unit will continue to operate like a normal CV Mode only Power Supply.

However, **IF** the current draw climbs back above the OCP value:

- The RD60xx will **NOT** go into CC Mode.
- The RD60xx **WILL** go into Protection Mode after the response delay

Special Notes:

- This option is for **ADVANCED USERS ONLY**.
  - Improper use **could result in Equipment or Personal Damage**.

- Ensure you understand how this option works before use.

- To enable this option, the '**ON-CODE**' value MUST be set to **11235**.
  (Hint to remember the code: *Fibonacci Sequence*)

  Any other value will result in the option being set to **OFF**.

- On Testing, the Delay is *typically* around 250ms, but has been measured up to 600ms.

Key Beep


Buzzer

ON Buzzer sounds once when any button(s) is pressed.
OFF Buzzer does NOT sound when button(s) pressed.

LOCK

Can Only be Enabled by Panel buttons "SHIFT" + "●"

When enabled, physical buttons and encoder knob have no effect.
Press Lock button combination again to disable.

Language


Interface

Selectable Options:

English
Chinese
Deutsch
Français
Русский

Layout


Interface

Sets Default screen on Power-up

LastState	Layout used last on previous session
0	Default Layout - from original, manufacturer Firmware.
1	Customisable Layout, as selected on the 'Layout 1' Group settings
2	"Layout 2", which is like Battery Charging below, but: if OVP, OCP, OPP is triggered, this parameter will be displayed instead of INPUT.
3	Battery Charging
4	Graph Display Layout

A simplified graphical preview of the selected layout will be shown below the setting.

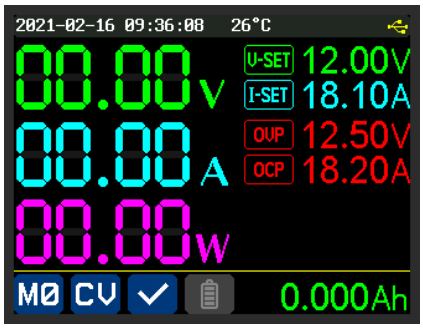
Leading Zeros

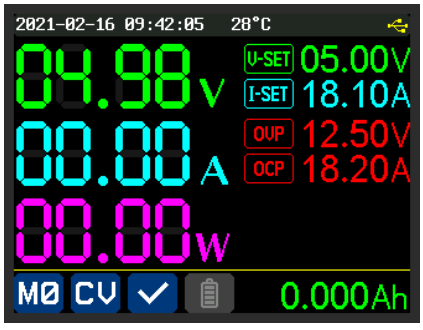

➥Appearance

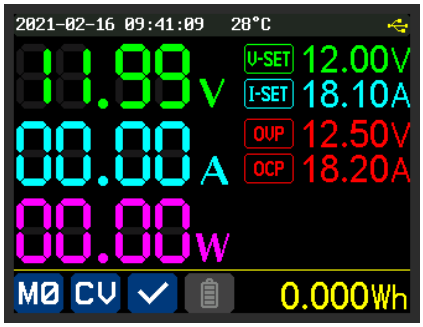
Change the appearance & behavior of digits and decimal points on screen.

Three options are available:

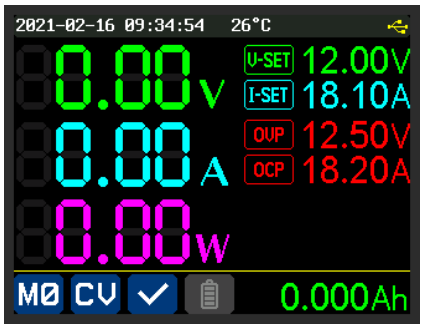
Default:

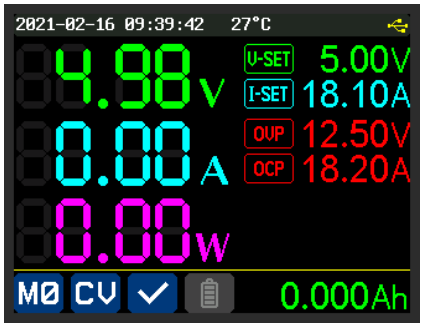


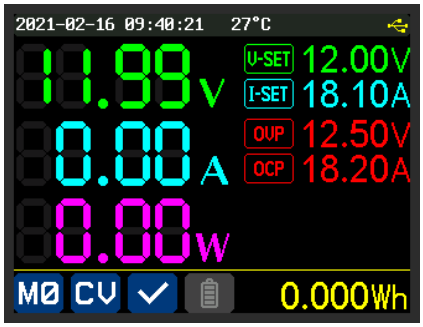




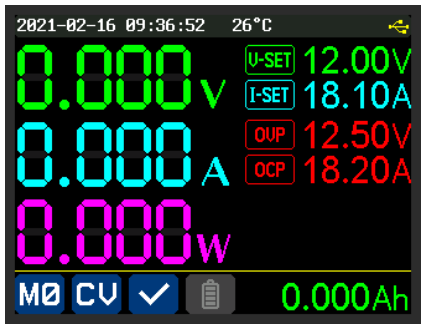
Blank:

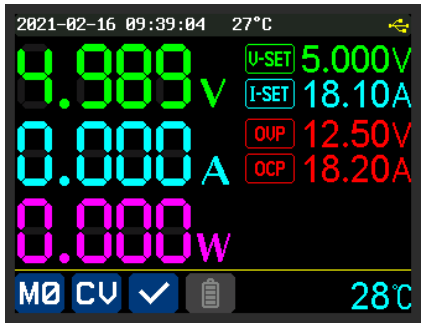


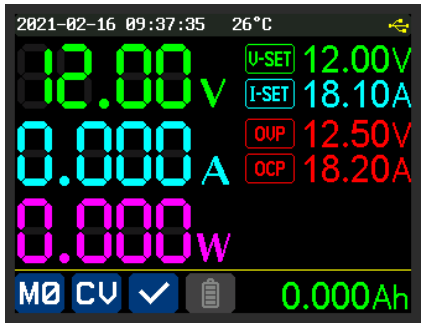




FloatPoint:







Max V-Set


➥Power Settings

Settable Range: OFF, 1.00V - 61.00V.

Limits V-SET

Max Power

➥Power Settings

Settable Range: Up to Maximum Power Rating of the unit.

RD6006: 360W
RD6012: 720W
RD6018: 1080W

Limits output power to set value.

- Protects the primary power supply if not capable of providing full power of RD60xx.

Manufacturer recommended setting:

No higher than 95% of the rated power for the Primary Power Supply.

Example:

IF using a 800W primary supply on an RD6018,
Set the 'Max Power' value no higher than:
`800W x 0.95 = 760W`

Min Input

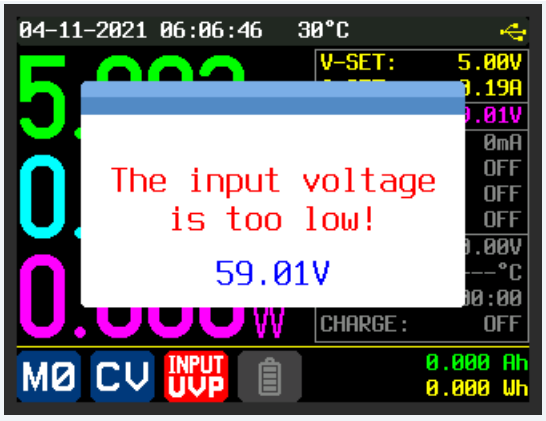
➥Power Settings

Settable Range: OFF, 6.00V - 72.00V. Below 6V = **OFF**

Sets the minimum accepted input voltage. This can be useful if you power the unit via batteries, to avoid over-discharging them.

IF Set, and the input voltage falls below the specified value, then

- the output will be disabled (and will be blocked)
- at the bottom in the status icon "INPUT UVP" will be displayed
- a corresponding message will be displayed on the screen:



Mute


Buzzer

ON Buzzer does NOT sound, regardless of other settings.
OFF Buzzer functions as set by the other Buzzer Group settings.

OCP (Over Current Protection)

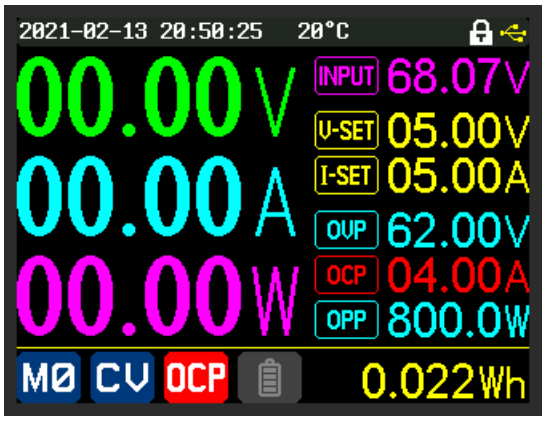
Can only be enabled by Panel buttons (“SHIFT” + “I-SET”)

IF the Output Current exceeds, the set value:

- Unit will enter Protection Mode.
- The output will immediately turn OFF, upon entering Protection Mode. (See Notes: **)
  - (versus the RD60xx unit adjusting output to maintain the ‘I-Set’ value.)
- The “ON/OFF” Button will turn off its illumination,
  - or react per the setting of ‘External LED’.
- The Current measurement value will be changed to the ‘OCP’ display color.
  - See ‘Colors Group’ Detailed Explanation
- The Normal Operating Mode indicator is replaced by a red background white ‘OCP’ Icon.

Notes:

- Disabled by setting to 0.
- When Setting, “SHIFT” button will be illuminated to visually distinguish an ‘OCP’ input from an ‘I-SET’ input.
- **** OCP is controlled via firmware, not hardware ****.
  - As a result, there could be a delay of up to 600ms between the Current reaching the set value and the RD60xx going into Protection Mode.
- Should be set to a higher value than ‘I-Set’ for proper operation.
  - See ‘ISET > OCP+200’ for an Advanced Option that allows this situation.
- Setting OCP lower than I-SET is typically not a good idea.
  - It was done for the example image, below, to deliberately trigger OCP.



Example Screen Image of OCP Protection activated

OPP (Over Power Protection)

Can Only be Enabled by Panel buttons ("SHIFT" + "MEM")

Sets the value for the maximum power allowable in the current session (volatile) or can be stored in the memory location via the  menu.
Maximum power is calculated by multiplying the Voltage (V) and the Current (A) outputs.

IF the total Output Power exceeds, the set value:

- Unit will enter Protection Mode.
- The output will immediately turn OFF.
- The "ON/OFF" button will turn off its illumination,
  - or react per the setting of 'External LED'.
- The Power measurement value will be changed to the 'OPP' display color.
  - See 'Colors Group' Detailed Explanation
- The Normal Operating Mode indicator is replaced by a red background white 'OPP' icon.

Notes:

- Disabled by setting to 0.
- This setting (OPP) does NOT override the 'MAX Power' setting.
- The PC Software and Smartphone App from Ruideng DO NOT recognize this error.

IF the RD60xx enters Protection mode due to OPP:
Connected (Riden) Software, using any interface (USB, UART), will report an OCP Error.

ORP (Over Resistance Protection)

 ➥ Power Settings or Quick Setting Menu ("SHIFT" + "▼")

ON Unit monitors for Over Resistance using 'ORP delay' and 'ORP set' settings.
OFF Unit does NOT monitor Over Resistance events.

IF Set **AND** tripped:

- Unit will enter Protection Mode.
- The output will immediately turn OFF.
- The "ON/OFF" Button will turn off it's illumination,
  - or react per the setting of 'External LED'.
- The Normal Operating Mode indicator is replaced by a red background white 'ORP' Icon.

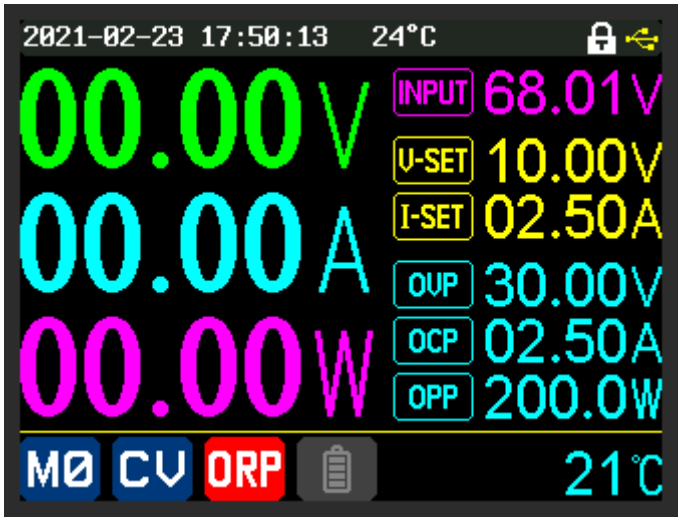
ORP is similar to Inrush Current Limiting (ICL) (on other Power supplies),
ORP trips out the RD60xx, while ICL would place an upper limit on the current it will source.

Notes:

The PC Software and Smartphone App from Ruideng DO NOT recognize this Error.

IF the RD60xx enters Protection mode due to ORP:

Connected (Riden) Software, using any interface (USB, UART), will report an OCP Error.



An example of ORP being tripped.

In this example:

ORP turned **ON**.
'ORP set' value: **6.00 Ω.**
'ORP delay' Set to: **Auto**.

The RD60xx was connected to a 5 Ω, 20 W resistor.

When the RD60xx calculated its effective load resistance (output Voltage divided by output Current measurements) as 5 Ω, the ORP was triggered (as this is less than the 6 Ω from 'ORP set').

Example Note:

It took 1.8 seconds to trip after the ON/OFF button enabled the output.
(With the resistor pre-connected)

It took 1.2 seconds to trip when the resistor was connected while the output was already enabled.

ORP delay

➥ Power Settings or Quick Setting Menu ("SHIFT" + "▼")

Auto Waits until the Voltage has stopped rising for at least 500ms.

Value Set in 0.1s (seconds) steps, up to a maximum of 10 seconds.

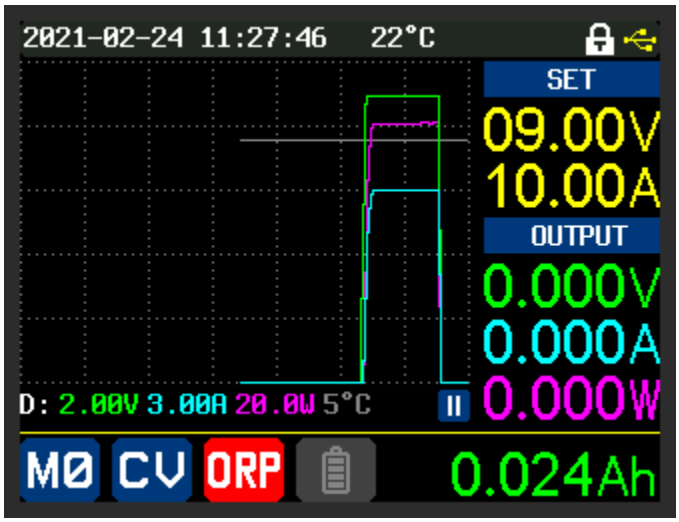
IF 'ORP' ON:

Time the load at the resistance across the Battery (Green) Binding Post and Negative (Black) binding post can be in a fault state, as defined by 'ORP Set', *before* the ORP puts the RD60xx into Protection Mode.

To demonstrate the 'ORP delay' setting: (Using a RD6018)

- 'ORP delay' was set to its maximum value of 10 seconds.
- 'ORP' was set to 1.12 Ω.
- 'Graph Window' was set to 1 minute (its minimum).

- An attached electronic load was set to 1 Ω.
- The electronic load was turned on before the RD6018 output was turned ON.
- Graphing was started about 15 seconds before the RD6018 output was turned ON.



This graph shows:

- RD6018 output was 9 Volts and 9 Amps, in CV mode, for approximately 10 seconds.
- After that time, the ORP tripped out.

This shows the 'ORP delay' setting waits approximately 10 seconds (the set value) *before* determining whether 'ORP' should trip.

(In this example it does trip because the effective load resistance is 1 Ω, which is less than the ORP set value of 1.12 Ω.)

Measured on an oscilloscope (not shown), with the 'ORP delay' at its minimum value of 0.1 seconds, and the 5 Ω resistor setup used in the 'ORP' example:

ORP tripped at 0.14 seconds from the ON button being pressed.
(Measured from when the output voltage started to rise above zero.)

With the RD6018 already ON, it took about 0.7 seconds to trip after the 5 Ω resistor was connected.

ORP set

➥ Power Settings or Quick Setting Menu ("SHIFT" + "▼")

Value Set in `0.01Ω` steps, starting from `0.01Ω`

See 'ORP' Setting for details on use.

OTP (ext) (Over Temperature Protection - External Sensor)

➥ Power Settings

OFF Unit does not monitor for Over Temperature events on the external probe.
Value Set in 1° steps

IF Set **AND** the temperature reaches, or exceeds, the set value:

- Unit will enter Protection Mode.
- The output will immediately turn OFF.

- The “ON/OFF” Button will turn off its illumination,
  - or react per the setting of ‘External LED’.
- The Normal Operating Mode Indicator is replaced by a red background white ‘OTP’ Icon.

Notes:

- Disabled by setting to 0.
- Should be set to a higher value than the ambient temperature for proper operation.
- This setting does NOT affect the RD60xx cooling fan.

  (Which will turn on automatically when the internal sensor reaches 40° C.)
- There is a pre-set, 80° C, non-changeable OTP for the internal sensor.
- The external temperature probe CAN be used in conjunction with this setting to monitor the Primary Power Supply temperature for overheating, if the user wishes to mount the sensor as such.
- The ‘OTP (EXT)’ setting is semi-independent from the ‘CutOff Temp.’ setting used for battery charging.
  - ‘OTP (EXT)’ will trigger Protection Mode during all modes of operation.
    - ‘CutOff Temp.’ only triggers Protection Mode during charging operations.
  - **IF** ‘CutOff Temp’ is enabled:

    This value, ‘OTP (EXT)’, should be set to a higher value than the ‘CutOff Temp’ to ensure proper operation during charging cycles.

OVP (Over Voltage Protection)

Can only be enabled by Panel buttons (“SHIFT” + “V-SET”)

IF the Voltage reaches, or exceeds, the set value:

- Unit will enter Protection Mode.
- The output will immediately turn OFF.
  - (versus the RD60xx unit adjusting its output to maintain the ‘V-Set’ value.)
- The “ON/OFF” Button will turn off its illumination,
  - or react per the setting of ‘External LED’.
- The Voltage measurement value will be changed to the ‘OVP’ display color.
  - See ‘Colors Group’ Detailed Explanation
- The Normal Operating Mode Indicator is replaced by a red background white ‘OVP’ Icon.

Notes:

- Disabled by setting to 0.
- When Setting, “SHIFT” button will be illuminated to visually distinguish an ‘OVP’ input from a ‘V-SET’ input..

OxP Beep


Buzzer

ON Buzzer sounds once when the unit goes into Protection Mode.
OFF Buzzer does NOT sound when going into Protection Mode.

Power State


Power Settings

This option is for the state of the RD60xx itself - **NOT** the RD60xx's Output state

Power On Turn ON RD60xx unit when the Primary Power Supply energizes.
Power Off Do NOT Turn ON RD60xx unit when the Primary PS energizes.
LastState Return to the ON/OFF state from the last Primary PS shut-off.

LastState Requires the button-cell battery to be installed in the RD60xx to operate.

If the battery is NOT installed, the unit will operate as per the **Power Off** option.

Power Switch


Power Settings

IF the Front Power Switch Modification is installed …

ON Enables use of the Front Power Switch.
OFF Disables the Front Power Switch.

IF the Front Power Switch Modification has NOT been made …

ON Will add a few seconds start-up delay. (Otherwise, no effect.)
OFF No effect.

Good Practice - Set to **OFF** if modification has not been made.

PwrOnBeep


Buzzer

ON Buzzer will sound when powering on.
OFF Buzzer will NOT sound when powered on.

Reset metrics


Battery Charger

ON Resets Ah, Wh, and C.Time (Charge Time) when the battery is disconnected.
OFF Continues adding to existing metrics.

Note:
When OFF, the RD60xx requires the user to manually (“MEM” + “●”) reset the metrics as desired.

Save Mult.


V-SET/I-SET/OVP/OCP/OPP

ON Save the multiplier position for future value adjustments.
OFF Multiplier position will return to the lowest position for every change.

Multiplier Position refers to the digit highlighted when changing a setting value.

{ToDo: Add example image}

Note:
Upon each power-up of the RD60xx the multiplier will be reset to the lowest position regardless of this setting.

SaveGraphSett.


Appearance

ON Save the last used Graph Display Settings as default for next use.
OFF Graph Mode will display everything using the default settings each power-up.

Notes:
- Saves graph settings for Vertical Scale and Y-offsets.
- See ‘Graph Display - Detailed Explanation’ for a detailed explanation of the Graphing Mode.

Screensaver


Display

Never Do NOT enable Screensaver after a set time.
Settable Range: `00h 01m - 59h 59m`.

IF NO user input:
Screen brightness will decrease to the ‘ScrsaverBright’ value after set time.

Notes:

Timer will reset with each key press.

Will **NOT activate** if RD60xx **Output ON**.
(Unless 'ScrsaverActive' enabled)

When screensaver is active:
Any key press, except "ON/OFF", will return ther display to the 'Backlight' setting.
A OVP, OCP, OPP, OTP, Battery detect, or Battery disconnect event will return ther display to the 'Backlight' setting.

ScrsaverActive


Display

ON Screensaver can activate when RD60xx Output is ON.
OFF Screensaver will NOT activate with the RD60xx Output enabled.

ScrsaverBright


Display

Brightness of display when 'Screensaver' activated.

OFF Turn off the display (Black Screen) when the screensaver is activated.
Settable Range: `0 - 4`

Notes:

- Values (`0-4`) are equivalent to the same value in 'backlight'.
  - Ie, 'ScrsaverBright' **2** = 'backlight **2**.
- When changing this setting, the display will adjust the backlight to 'preview' the effect.
- 'ScrsaverBright' must be less or equal to the equivalent 'Backlight' value for normal operation.

Server IP


Communication

Settable Range: `000.000.000.000 - 255.255.255.255`

Edit IP address of the server (if it was assigned during WiFi setup).

Note:

This is the IP address of the **server** (it will connect to port 8080).
i.e. your phone, PC, web server, etc...

Shift Table


Appearance

ON Pressing “SHIFT” button will bring up the complete Memory Table

OFF Pressing “SHIFT” button will NOT show the memory table

In either setting, Pressing “SHIFT” will illuminate the button and the unit will await the next button press in the desired button combo.

Note:

Pressing “MEM” + “SHIFT” will bring up the complete memory table, regardless of this setting.

Show [Option]


Layout 1

Each of the Options below have an option of being **ON** or **OFF**.

Show INPUT	Show OPP	Show T° -BATT
Show V-SET	Show RL	Show TIME
Show I-SET	Show T° -EXT	Show CHARGE
Show OVP	Show V-BATT	Show Ah
Show OCP		Show Wh

When ON, the Option’s Value will be displayed when ‘Layout 1‘ is selected as the current screen Layout.

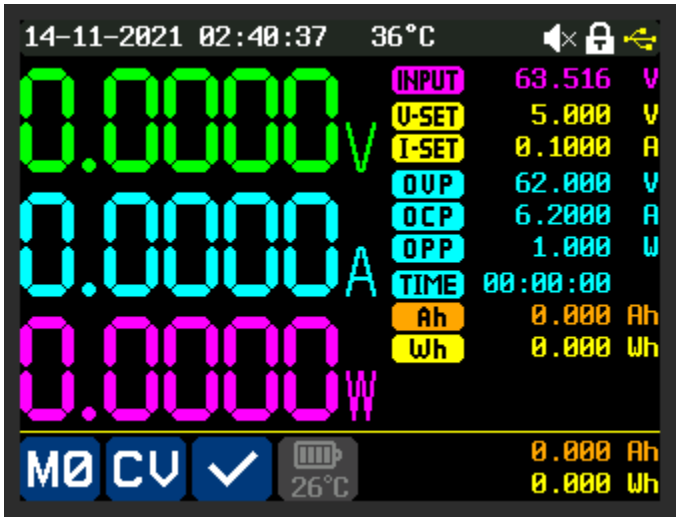
Notes:

- A maximum of 6 ‘Show[Options]’ can be displayed at one time.
  IF more ‘Show[Options]’ are selected:
  The 6 **ON** options closest to the top of the list are shown.

- V-BATT, T° -BATT, and CHARGE are only shown if a battery is sensed on the Charging (Green) Binding Post.

- ‘Show T° -EXT’ and ‘Show T° -BATT’ both reference the external temperature probe.
  - ‘Show T° -EXT’ - ALWAYS shows the temperature.

- ‘Show T° -BATT’ - Shows the temperature ONLY when a battery is detected.



Layout 1 in small font.

Skip keys lock

Communication

ON Prevents LOCKing of the physical buttons while the RD60xx unit is communicating.
OFF LOCKs the physical controls when communicating.

IF OFF,

When the RD60xx is communicating via any interface (Interface-UART or Interface-USB), the unit’s controls are LOCKed and can only be controlled by the remote device. (PC, Smartphone App, etc)

IF ON,

The RD60xx unit can be controlled by the remote device OR the controls on the unit itself.

Skip Exit

V-SET/I-SET/OVP/OCP/OPP

ON Pressing the “ON/OFF” button will NOT exit Voltage or Current adjustments.

OFF Pressing the “ON/OFF” button will accept and exit Voltage or Current adjustments.

IF **ON**,

Pressing “ON/OFF” will toggle the output state only. Any in-process Voltage or Current adjustments are NOT taken into account and the adjustment setting cursor remains active.

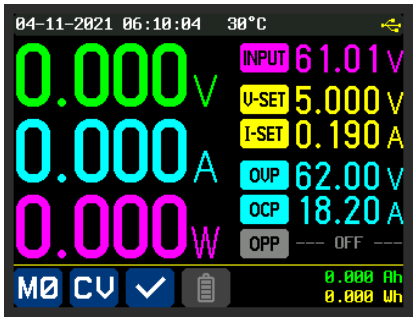
IF **OFF**,

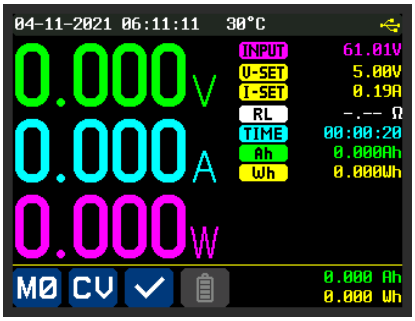
Pressing “ON/OFF” will toggle the output state AND immediately exit, without saving any in-process Voltage or Current setting adjustment.

Small Font

Layout 1

Sets the font size in the labels in Layout 1. :

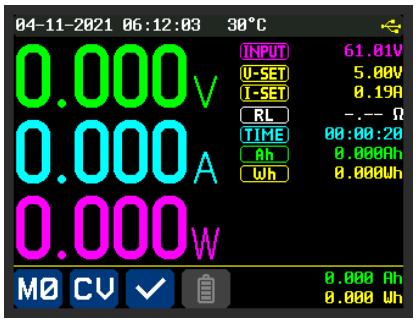
OFF: 

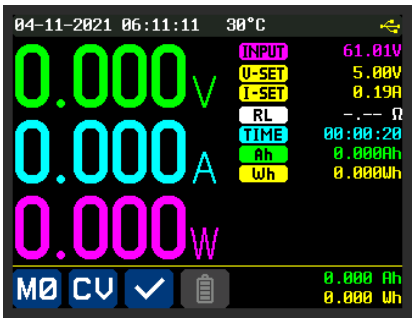
or **ON**: 

Solid Labels

Appearance

Sets the label style:

OFF: 

or **ON**: 

Standby Clock

Display

ON Displays the clock in standby mode
OFF No clock in standby mode

Standby LED


Power Settings

"POWER" Button Illumination when device turned off (In Standby)

Pulsating	Continually sweeps from OFF to full brightness and back.
0%	No illumination in OFF state.
5% - 100%	Continuous illumination at brightness selected. (5% increments)

All options, except **Pulsating**, allow the RD60xx to go into a power-saving sleep mode.
(Lowering standby power usage)

Status Info


Appearance

Default	Cycles through Ah, Wh, and Sys Temp. (see below)
Empty	Do NOT show any Status data.
Ah	Amp Hours accumulated - From Battery Charging Mode.
Wh	Watt Hours accumulated - From Battery Charging Mode.
V-BATT	Battery Voltage - Only displayed if a battery is connected.
T-BATT	External Temperature Value - Only displayed if a battery is connected.
Sys Temp.	Internal Temperature Value.
Ah + Wh	Ah and Wh metrics from Battery Charging mode.
T° INT + EXT	Internal and External Temperature Values.
ORP + Ω	'ORP' setting value and current Load resistance measurement.
ADC V/I	Raw ADC value of Voltage and Current measurements.
ADC IN/BA	Raw ADC value of Input (From Primary Supply) and Battery.
ADC Temp.	Raw ADC value of Internal and External Sensor values.

Notes:

Raw ADC values can be used for calibration purposes.
See 'Raw ADC Values' section for more detail.

SysFailureRst


Power Settings

On	Automatic restart in case of system failure.
Off	no change.

If the firmware hangs/freezes, the Watchdog timer will activate after 20 seconds.
If this option is active, the corresponding message will be displayed and the time will countdown.
After another 10 seconds there will be a restart, if you do not click any key (except Power it immediately restarts).
If the option is not active, or you have pressed any key during the time countdown, then some kind of BSOD will appear.

If you want to see a function in action, go to the calibration menu and enter the password "135666" and double-click on ENTER, after that the firmware will freeze, now wait for 20 seconds (this is for the test).

T° -EXT icon


➥Appearance

ON Battery Charging icon will include the value from the External Temperature Probe.
OFF Battery Charging icon will not include temperature.

Example Icons:

OFF **ON**

Temperature


➥Units

Selectable Options: °C / °F

Changes units for both Internal and External Temperature readings.

Time


➥Date and Time

Rotate the “Encoder” Knob to the desired value

Use “◀” or “▶” to switch selected fields.

*** **If the wrong time is set, it may cause incorrect totals for accumulated values.** ***

Timer Beep


➥Buzzer

ON Buzzer sounds once when an active timer in the ‘Current Session’ (CS) menu reaches zero.
OFF Buzzer does NOT sound when a CS timer reaches zero.

Timer icon


Appearance

ON Normal Operating Mode icon will include the value of any timer currently running.
OFF Normal Operating Mode icon will NOT include any timer information.

Example Icons:

OFF **ON**

Timer Mode {CS Menu}

OFF Output Timer is NOT enabled.
Single Output ON/OFF will go through 'Timer Off' and 'Timer On' once.
Cyclic Output ON/OFF continuously cycles through 'Timer Off' and 'Timer On',

IF 'Timer Off' is set to `00:00:00`, Timer Mode will not do anything.

IF set to **Single**, will need to be re-enable after each use.

Notes:

Timers start when the "ON/OFF" Button is pressed, unless 'Timer Reset' is enabled.

Changing the 'Timer Mode' settings while the output is ON may result in unexpected behavior.

Setting is automatically disabled on power-down.

Timer Off {CS Menu}

Settable Range: `00:00:00 - 99:59:59` (Hours, Minutes, Seconds)

IF Set to `00:00:00`, 'Timer Mode' will not activate.

IF Timer Mode active:

When value reaches `00:00:00`, output will turn OFF.

IF 'Timer On' is set to `00:00:00`,

When 'Timer Off' expires:

Output will turn OFF.
The Normal Operating Mode indicator is replaced by a white on red background 'TIME' icon.

Timer On {CS Menu}

Settable Range: `00:00:00 - 99:59:59` (Hours, Minutes, Seconds)

IF Timer Mode active:

After 'Timer Off' expires and the output is turned OFF.
'Timer On' will then start counting down.
When 'Timer On' expires, the output will turn back ON.

Timer Reset {CS Menu}

IF changing timer values while the output is already ON.

ON ‘Timer Mode’ timers will reset/begin after exiting from the menu.

OFF ‘Timer Mode’ timers will begin when the output is next turned ON.

Notes:

Timer begins counting after enabling the RD60xx output.

(If the output was already enabled, the timer is already running.)

e.g.

If you:

Turn on the output, and wait more than 1 min.
Enter the menu and set the ‘Timer Reset’ to 1 min
Exit from menu (apply setting)

Then:

Output will immediately turn OFF.

(Because 1 min. has already passed since the output was turned ON.)

Enabling this option forces the timer to reset when the settings are applied.

Timeout


V-SET/I-SET/OVP/OCP/OPP

OFF: IV Set Timeout is NOT enabled.

Settable Range: `00m 01s - 99m 59s`

Determines if, and for how long, the unit will wait for data entry when setting a value using the “I-SET” or “V-SET” buttons.

This applies for setting the Voltage, Current, OVP, OCP, or OPP values.

IF Set:

- The timer will reset on any data entry, except “ENTER”.
  - Pressing “ENTER” will apply the current setting.
- The value displayed at the end of the timeout timer will automatically be applied.

V-SET (Set Voltage, in Volts)

Can Only be Enabled by Panel button “V-SET”

Value of the Voltage Setpoint, in Volts, for when the unit is in CV Mode. It also represents an upper limit for Voltage when in CC Mode. Limited by Max V-SET.

Rotate “Encoder” Knob to desired value.

Use “ ◀ ” or “ ▶ ” to switch selected multiplier (cursor location).

OR

Enter the desired value using the Keypad.

A long press on the button opens a menu that allows the settings of an upper and lower limit to the value. These limits are not retained between reboots. For a lasting upper limit, see Max V-Set.

UART Baudrate


Communication

Selectable Options: 9600 / 19200 / 38400 / 57600 / 115200 / ... / 1000000

Only applies to the INTERNAL communication ‘UART Interface’.
(NOT the front panel USB)

IF ‘WIFI’ selected as ‘UART Interface’ setting:
Baud Rate is FIXED at 115200, regardless of value selected.

UART Interface


Communication

Each Interface Option has a unique indicator at top of screen when in use.

OFF	Disable the UART (internal) communication interface
WIFI	Wi-Fi module (if installed)
TTL	Simple UART, 3.3V
RS485	RS485 Module (if installed)

When ‘UART Interface’ changed:
The RD60xx **MUST** be rebooted to apply the modification.

Notes:

- ‘Simple UART’ refers to a Full-Duplex, 3-wire, connection (Rx, Tx, and Gnd), without hardware flow control.
  - The communication speed is set using the ‘UART Baudrate’ setting.
- Front Panel Micro-USB interface can be used concurrently with any of these options.
  Setup via the ‘USB Interface’ setting
- ‘WIFI’ configures the optional WiFi module using AT+ commands.

  See ‘How to Connect to WiFi’ section for details.
- RS485 uses a simple UART + Enable (En) pin Set while communicating.
  - For interface with the optional, proprietary, RS485 module designed for the RD60xx series.

RS485 Interface Mode has NOT Been Tested
(UniSoft kept the original Riden firmware code)

- TTL option can be used for any user-defined connection using a Simple UART (No hardware flow control) configuration with 3.3V logic levels.
  (ie, an additional USB interface, Bluetooth Wireless, Etc)

  See 'Using the TTL Interface' for more details.

- When enabled an associated Icon is displayed at the top of the screen:

  WIFI: 

  TTL: 

  RS485: 

  The Icon Color will change to yellow when actively communicating.
  (See the USB Icon in the 'USB Interface' setting for example.)

Update Rate


➥Display

Regarding measured values, Voltage, Current, Power, Etc.

Extra Slow	Average value of the last 16 measurements
Very Slow	Average value of the last 8 measurements
Slow	Average value of the last 6 measurements
Medium	Average value of the last 3 measurements
High	Value of most recent measurement only

Options DO NOT affect measurement accuracy.
These options are available to smooth measurement Jitter, it is for readability only.

USB Interface

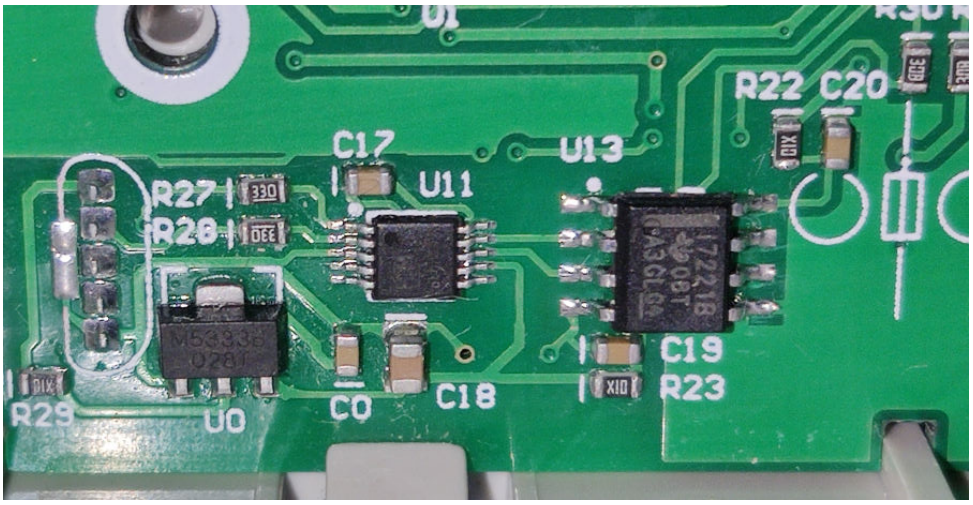

➥Communication

Selectable Options: `OFF / 9600 / 19200 / 38400 / 57600 / 115200 / ... / 1000000`

Selects the Baud Rate for use with the Front Panel Micro-USB connector.

When enabled, a USB icon will be displayed at the top of the screen:

Attention: Baud rate higher than 115200 will not work unless the isolator IC π122U31 is replaced by a faster one, like ISO7221A, ADuM1201ARZ (Both tested). Using baud rate 1000000, reading dump of the screen takes around 2 seconds.



UVP (Under Voltage Protection)

➥Power Settings or Quick Setting Menu (“SHIFT” + “▼”)

Value Minimum allowable output Voltage, during normal operation

IF the Voltage falls below the set value:

- Unit will enter Protection Mode.
- The output will immediately turn OFF.
- The “ON/OFF” button will turn off its illumination,
  - or react per the setting of ‘External LED’.
- The Normal Operating Mode indicator is replaced by a red background with a white ‘UVP’ Icon.

Notes:

- Disabled by setting to 0.
- Protection is not enabled until the Voltage has stopped rising for at least 500ms.
- The PC Software and Smartphone App from Ruideng DO NOT Recognize this error.

IF the RD60xx enters Protection mode due to UVP:
Connected (Riden) Software, using any interface (USB, UART), will report an ‘OVP’ Error.

UCP (Under Current Protection)

➥Power Settings or Quick Setting Menu (“SHIFT” + “▼”)

Value Minimum allowable output Current, during normal operation

IF the Current falls below the set value for more than about a second:

- Unit will enter Protection Mode.
- The output will turn OFF.

- The “ON/OFF” button will turn off its illumination,
    - or react per the setting of ‘External LED’.
- The Normal Operating Mode indicator is replaced by a red background with a white ‘UCP’ Icon.
- Working only in Power Supply mode, no effect in charger mode.

Notes:

- Disabled by setting to 0.
- The same remarks as for UVP probably apply.
- Works in conjunction with UCP Trigger

UCP Trigger (Under Current Protection Trigger value)


➥Power Settings or Quick Setting Menu (“SHIFT” + “▼”)

Value The output Current at which the UCP option gets activated, during normal operation

IF the Current goes above the set value, or when OFF:

- Unit will activate the UCP option

Notes:

- Set to OFF by setting to 0.

---

15. ‘Colors Group’ Detailed Explanation

Most display items’ can be changed to a custom color to fit your individual preferences. The ‘Custom Colors’ menu item is a global On/Off switch for whether the customized colors are used, where customized, or if the entire system uses the default color scheme.

Each item in the ‘Colors Group’ can be individually adjusted to any of the following:

Default *	Default Colour				
RED		MAGENTA		ORANGE	
GREEN		CYAN		OLIVE	
BLUE		DARK BLUE		TEAL	
WHITE		GRAY		PINK	
YELLOW		BROWN		MAROON	

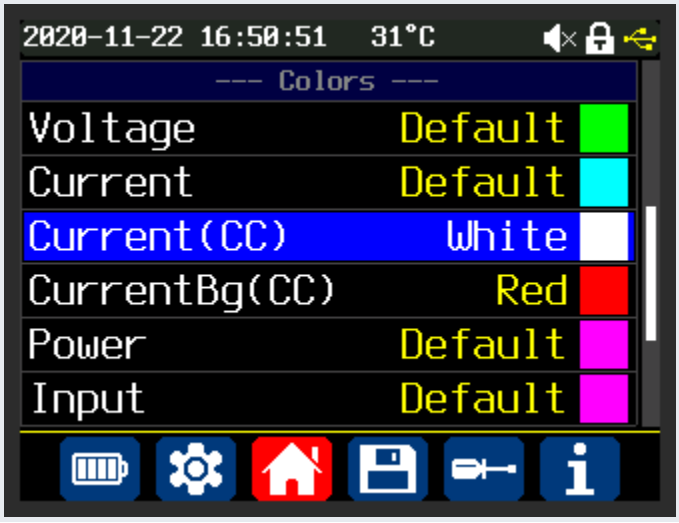
(‘Default’ will show whatever color the default value is for that particular option.)

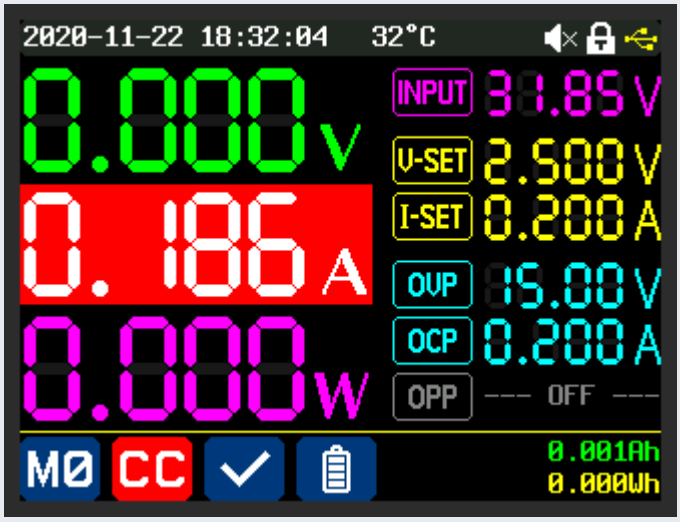
Note:

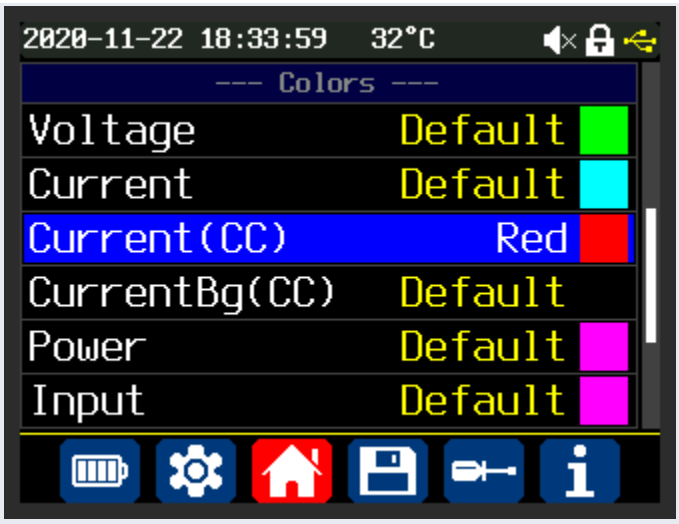
Graph (V)
Graph (I)
Graph (W)
Graph (T°)

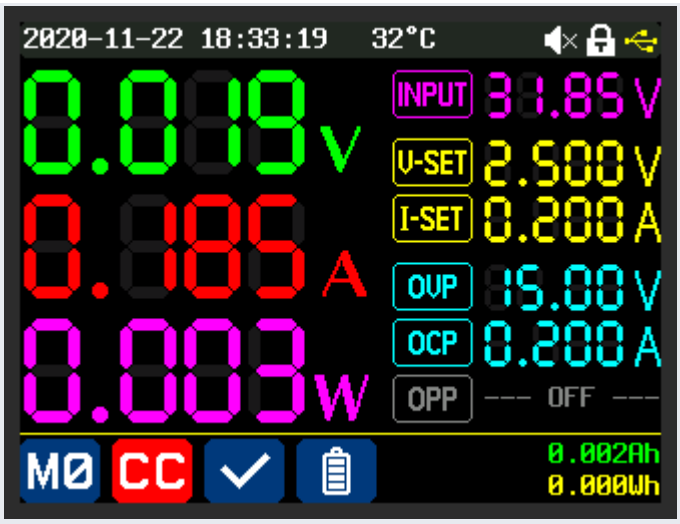
These selections are for the colors displayed in Graph Display mode.

As an alternative, while in CC mode, it is possible to set the font color and the background color, as shown in the examples below.







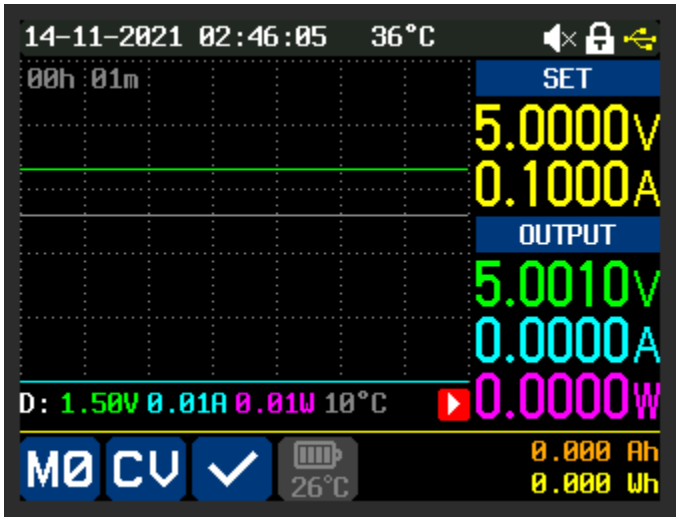


16. Graph Display - Detailed Explanation

(Note: Riden Calls this ‘Curve mode’ in their documentation)

Graph Mode, also known as ‘Layout 3’, is entered by pressing the “◀” or “▶” button until the proper layout is selected.

After running for a short while, graph mode might look like this:



The action of the graph is similar to roll mode in an oscilloscope. The new values are placed at the right margin (axis) and push the older values to the left.

‘V-SET’ and ‘I-SET’ values are shown in the top right in yellow, under the heading "SET".
Under the "OUTPUT" heading are the values measured at the output of the RD60xx.

The value in green on the right is the current Voltage. Under that, in cyan, is the current amperage (the load in this case is a 10 Ohm, 20 Watt resistor). Under that in pink is the current Power being output, which is the product of the previous two values.

Those colors correspond to the units of the lines on the graph. The white/gray line (the topmost line on the graph) is the temperature reading from the External (EXT) Temperature sensor.

The icons and values shown at the bottom of the screen are the same as in other modes.

The line directly below the graph contains the y-axis per-interval amounts.
(The “D:” is believed to indicate ‘Divisions’ - This is part of the original firmware so cannot be said for certain.)

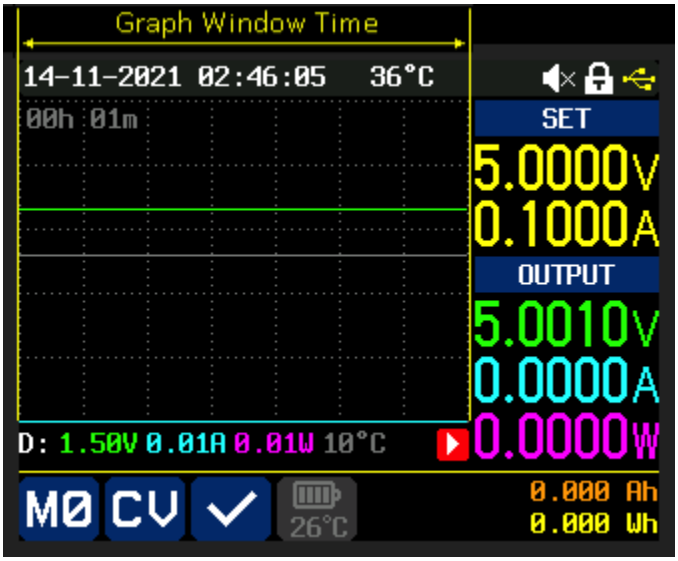
So for Voltage (green) it is 1.00 Volts per division and the green line is constant, at 3 intervals up, so close to 3.00 volts (actually we can see it is 2.995 Volts).

The pause symbol (two, parallel white bars with a blue background) indicates the graph is paused. When running the graph state is shown as a white arrowhead with a red background at the same position.

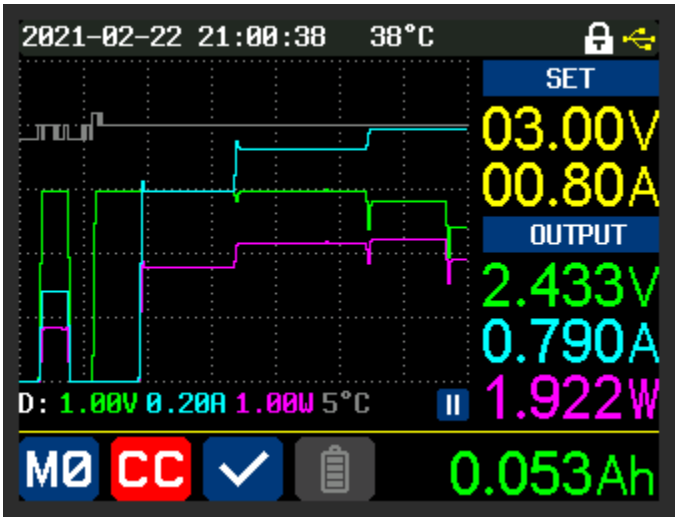
The pause/run state can be toggled by pressing “ENTER” in graph mode.
(Sometimes it needs to be pressed twice).

The rate at which the graph moves is controlled by the ‘Graph Window’ setting found within the ‘Quick Settings’ Menu. “SHIFT”+ “▼”

The fastest setting permitted is 1 minute and that implies that a set of values written at the right margin will take 1 minute to be pushed to the left margin.
If the Graph Window setting was 1 hour then values will take 1 hour to move from the right margin to the left margin.

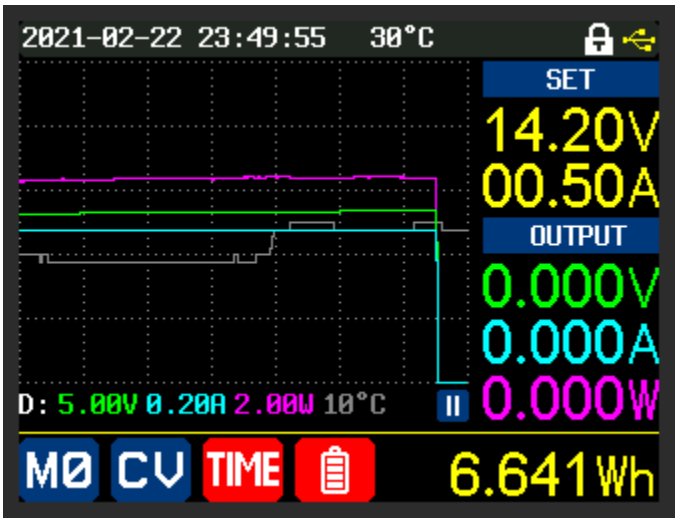


The ‘Graph Window Time’ shown top left, is what is being set in the ‘Graph Window’ setting.
(note that the display of the windows time in top left is missing in some images in this doc, as this is a feature that arrived in firmware version 1e)



This image shows a graph of the RD60xx driving a DC load in CR (constant resistance) mode.

The resistance is lowered in stages until the I-SET value is reached after which the PS goes into CC mode.



This example image shows a graph of trickle charging a 12 Volt lead-acid car battery.

The Battery Charger Group's setting 'Cutoff time' was set to 1 hour and the external temperature sensor was placed under the RD60xx enclosure.

After 1 hour, the charging ceased with 6.64 Watt-hours of energy being transferred.

The battery symbol on the bottom line shows that the RD60xx was used in Battery Mode.

The white TIME, with a red background, is the reason why the charging cycle stopped.

Switch to Autoscaling (Y-Axis):	"MEM" + Press/Click "ENCODER"
Pause/Play:	"ENTER"
Select parameter to scale:	"ENCODER"
Change Offset Y :	"▲" or "▼"
Reset Offset Y:	"MEM" + ("▲" or "▼") - Graph (View) mode Only

{Todo: Integrate below into this section}

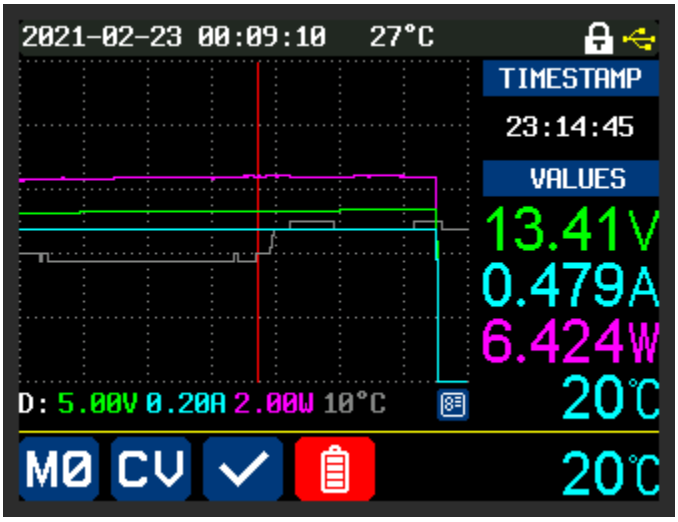
Repeatedly pressing the auto-scaling combo cycles through:
- voltage
- current
- power
- external temperature
- auto-scaling

If it is in one of the first four then the "D" (for division) is in white with a red background. When it is in auto-scaling mode the "D" has the default background.

Organize View mode specific commands better

16.1. Graph (View) Mode

“MEM” + “ENTER”



In Graph (View) Mode, a vertical red Indexing line appears on the graph (it starts at the right margin) and can be moved left and right with the “ENCODER” knob.

Pressing the “ENCODER” knob toggles between coarse and fine adjustment of the Indexing line position.

Where the Indexing line intersects the (Voltage, Current, Wattage, and EXT Temperature) graph lines, the values of those lines are displayed on the right, along with a timestamp that corresponds to the x-axis position.

To Exit Graph (View) Mode, Press “ENTER”.

Note:

“ENTER” Does **NOT** pause/resume the graph while in View Mode

17. Calibration and raw ADC values

Note: Some familiarity with calibration methods is required. Use at least 6 ½ digit known-good multimeters, and allow a warm-up of at least 1 hour before attempting calibration.
The RD uses separate ADC settings for the output regulation (Output V/I) and the display (Back V/I).
Note that the RD will not show negative values, so if you are below 0, it will still show 0. As a result, it is better to calibrate the zero values using small non-zero values.

17.1. How to do the Calibration on the device

The calibration can be done from the “screwdriver” menu.
The calibration process is similar to the process from the PC software.
You could use the Raw ADC Values to derive the correct settings if you want, but it will be easier to interactively use V-Set and I-Set directly from the calibration menu, and go from there.

The password is the same as on the PC software: 168168.

How to use:

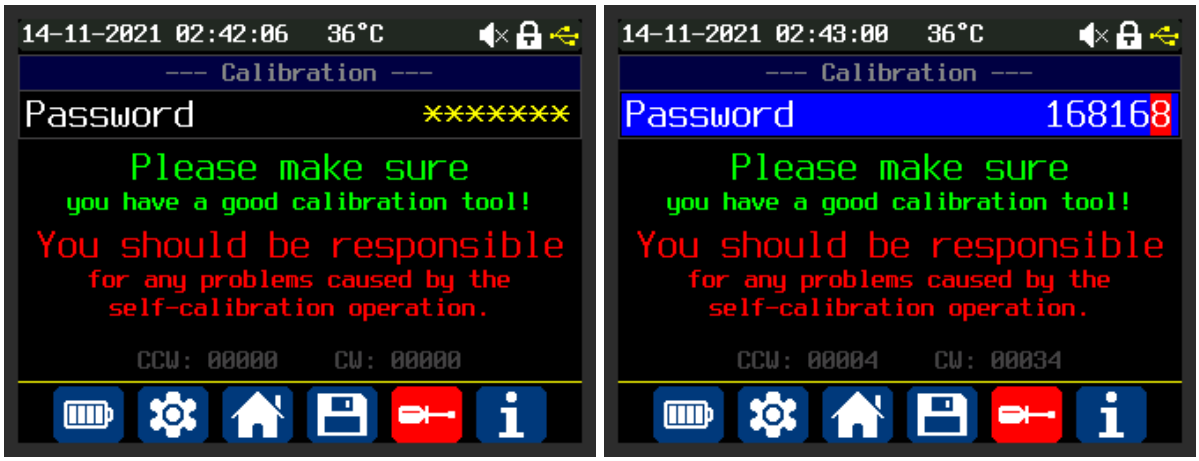
- Go to the “screwdriver” menu.
- Enter the password. Start with an arrow down or up and use a mix of rotary knob and left-right arrow keys to enter the password. Afterwards press ENTER. The number keys do not work for this step.
- If the password is correct, the calibration menu will be displayed. There are all the necessary parameters (including Back V-BAT and BackInput which are unavailable in software).
- After selecting a parameter, the corresponding formula is displayed at the bottom of the display, according to which the firmware calculates the values.
- The changes are applied immediately (in RAM), so you can see the result.
- Click on (SHIFT)+(Dot) sets the selected parameter to the factory setting.
- Select the desired action and press ENTER (!!! The cursor must be on the button !!!)

NOP	No Operation (does nothing, exit the menu without resetting the password)
CANCEL	Cancels all settings (loads current values from EEPROM)
STORE	Stores current changes to EEPROM
RESTORE	Restores factory calibrations (from a backup copy. Similar to holding the button (1) at power on).

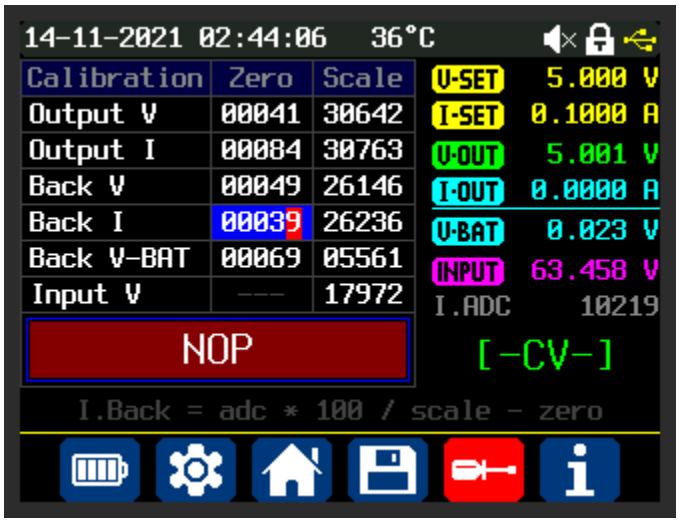
- Clicking on the encoder resets the password and closes the menu

Note:

Calibrations are not saved/restored by themselves. All changes that are not saved with STORE + ENTER, will remain only until reboot.



At the bottom of this menu, there is a text line with CW/CCW counters, these are for testing the Encoder. The counters are reset with UP/DOWN buttons.



17.2. How to do the Calibration from the PC software

From Riden Power Supply Software, Calibration tab, password 168168.

To restore factory calibration (it is unique for each device): Pressing "1" while Powering ON.
You might want to understand the Raw ADC Values for this process.

{ToDo - Add more detail here, add screen shots … }{A}

17.3. Raw ADC values

The raw ADC values, selectable from the 'Status info' setting, can be used to adjust, or confirm, the calibration settings of the RD60xx.

Vout = ADC(V) * backVoltageScale / 100000 - backVoltageZero

Iout = ADC(I) * backCurrentScale / 100000 - backCurrentZero

For example, let's calibrate the "backVoltage" values:

1) Find $ADC(V)_0$, the ADC 'Zero' value:
   - Ensure the output is OFF and the output capacitors are discharged.
     - Observe the value of ADC(V) for a while.
   - Take the highest value and add 1.
     (In this example, the highest value observed was: 143.)
     - **$ADC(V)_0$** = 143 + 1 = **144**

2) Find $ADC(V)_x$, the ADC reading of a known (calibrated) value.
   (For this example let it be 50V)
   - Set output to 50.00V and turn ON.
   - Using the "ENCODER" Knob, adjust output voltage to be as close to 50V, as measured using a calibrated multimeter.
     - Observe the value of ADC(V) for a while.
   - Take the most stable value (usually a middle one).
     (In this example, **$ADC(V)_x$ = 29109**)

3) Calculate calibration constants:

   Scale = (Calibrated Value * 100,000) / ($ADC(V)_x$ - $ADC(V)_0$)
   (In this example, 'Calibrated Value' = 50V, in tens of mV = 5000)
   = (5000 * 100,000) / (29109 - 144)
   = **17262**

   Zero = ($ADC(V)_0$ * Scale) / 100,000
   = (144 * 17262) / 100,000
   = **24**

Notes:

When calculating with the ADC values for current:

- RD60**06** the 'Calibrated Value' is in: **mA** (ie. 1A = 1000)
- RD60**1x** the 'Calibrated Value' is in: **tens of mA** (ie. 1A = 100)

18. Hardware Modifications

18.1. Accessing the Internals

{ToDo: Explain how to get at the insides - remove binding posts)

18.2. External LED - Modification

This modification adds a red LED under the “ON/OFF” Button. In combination with the existing green LED, 3 colors become possible, allowing the button to respond in a variety of ways using the ‘External LED’ setting.

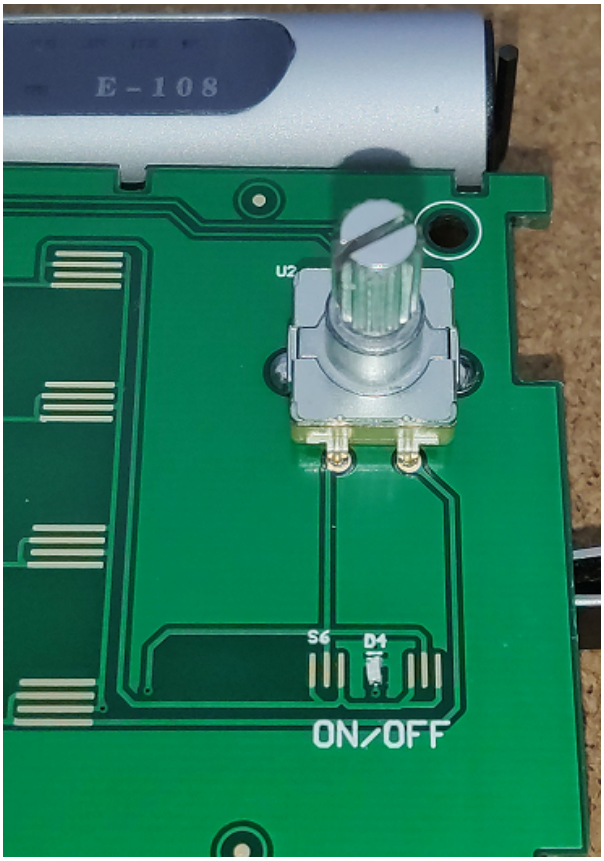
Here is a YouTube video showing one of the options available with this modification:
RD60xx 'External LED' Mod In Action

Here is the link to the Original Posting about this modification on EEVBlog

Materials Needed:

Insulated Hook-up Wire	30 Gauge, or smallest available suggested.
LED	Red, 0603 or 0805 package.
Resistor	470 Ω, surface mount package suggested.

1) Access the Front side of the Front PCB. (See: Accessing the Internals)

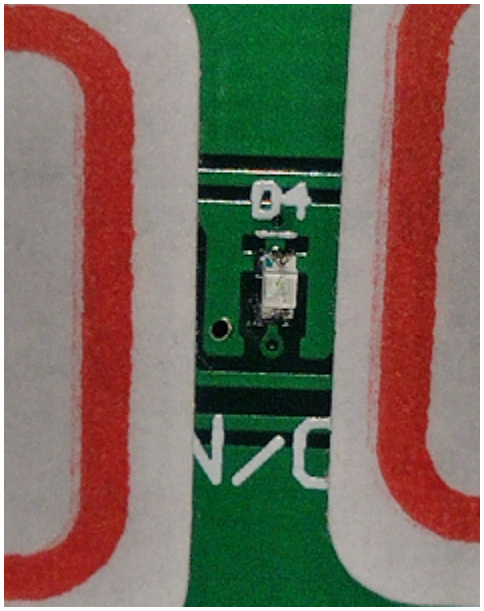


Area of Work - beside LED marked D4

2) Mask off around the area of work.

Not required, but helps prevent accidental damage to the surrounding area.

3) Drill hole at the location shown.

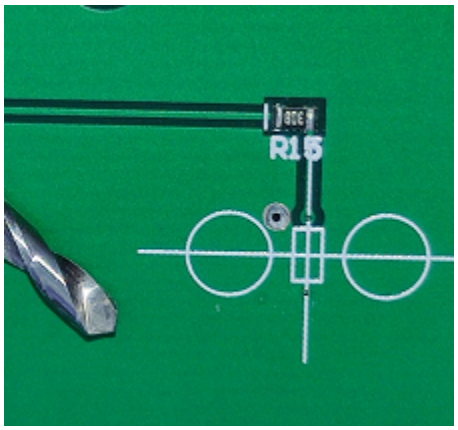


Use the smallest practical drill size to create a hole hook-up wire can pass through.
(0.4mm or next smallest available suggested)

Try to position the hole near the bottom of the copper area.

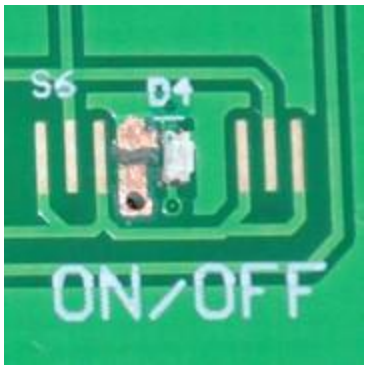
Be cautious to NOT break the trace running below

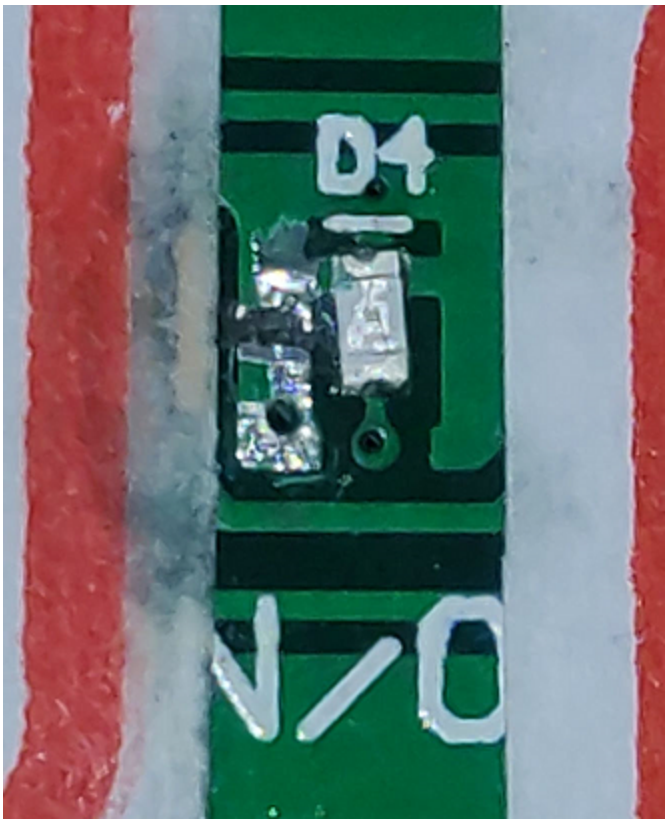
4) Clean up the hole on the rear of the PCB.



Using a larger diameter drill bit, remove any burrs left over from the drilling done in the previous step.

5) Cut the track and prepare pads.





Cut as shown in the image above.

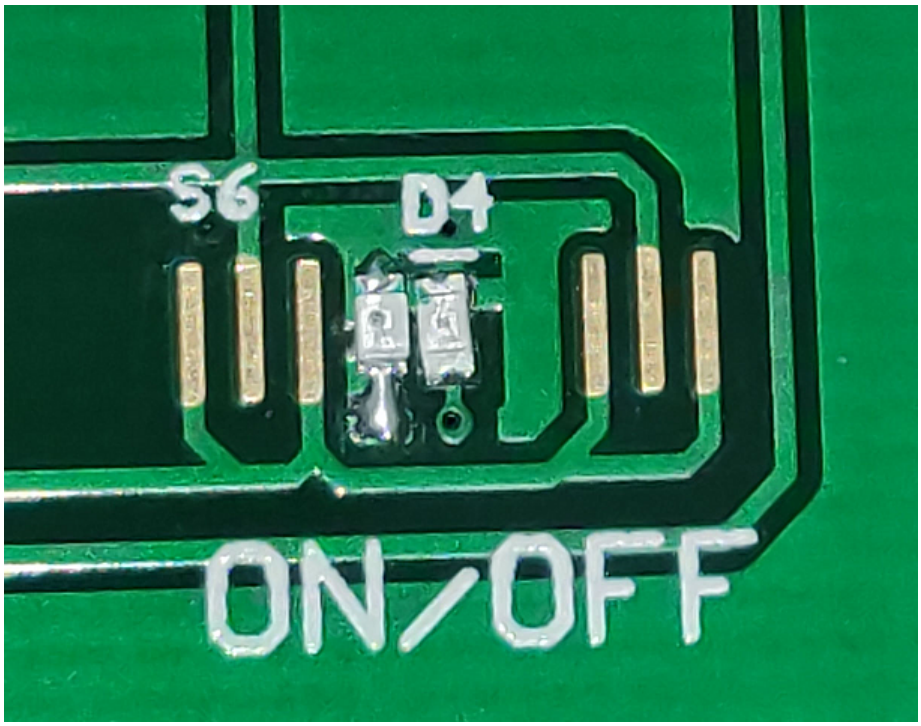
Scrape off some of the solder mask to expose bare copper.

Use a continuity checker to confirm the new island of copper is not shorted to ground.

Tin both pads in preparation for soldering.

(As shown to right)

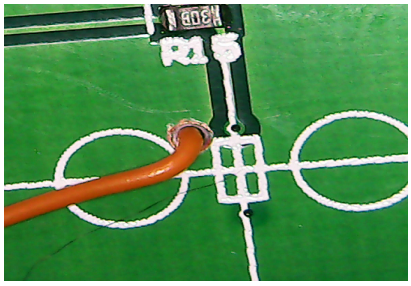
6) Solder in a new Red LED.



Ensure the new LED is in the same orientation as the existing LED.

(This image also shows the next step completed, as seen from the front of the PCB.)

7) Connect hook-up wire from back side of PCB.



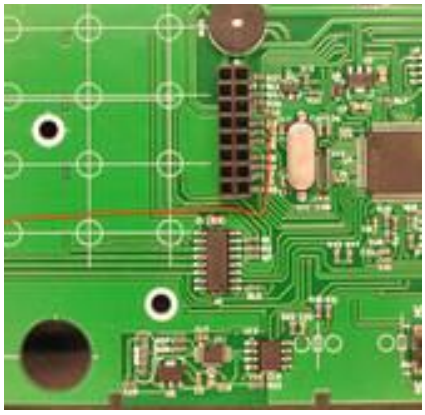
Connect wire to the LED through the newly drilled hole.

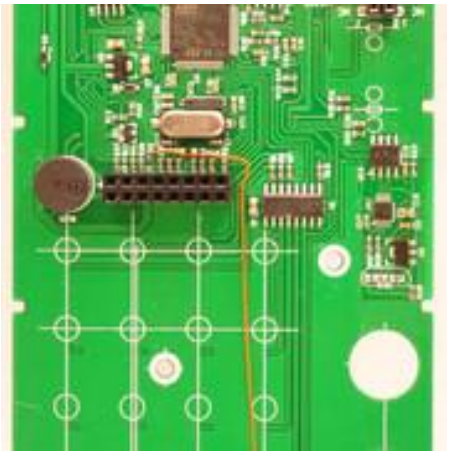
Ensure the wire is fully insulated from the ground plane on the back of the PCB.

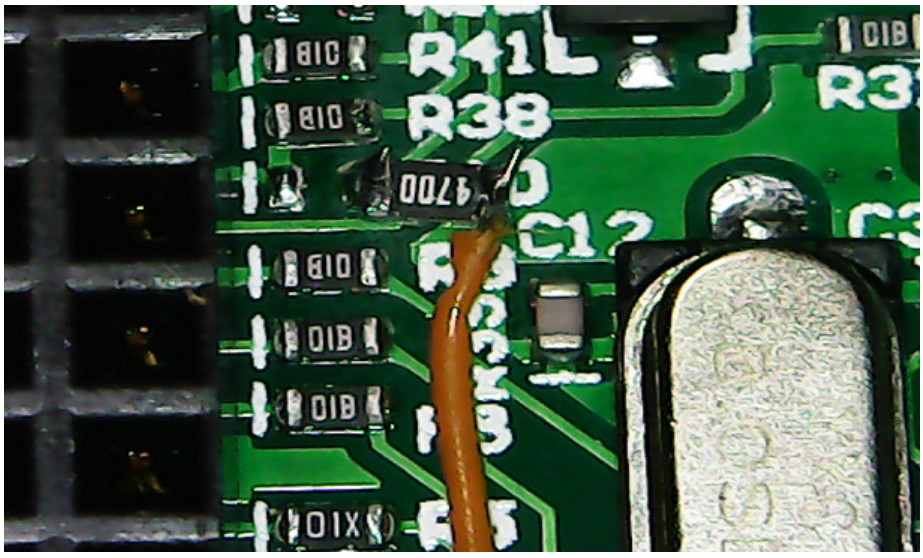
(The wire's insulation should be passing through the hole.)

8) Connect the other end of the hook-up wire to the pad shown, through the 470 Ω Resistor.

The pad is located between the 2x8 header and the crystal







Wire connected to pad '*Below*' R38 through a (0605 package) 470 Ω Resistor.

9) Test / Reassemble Unit.

Here is the result…

As an <u>alternative</u> solution...

Illuminate the button from the side by installing a Bright LED inside the case.

For example:

18.3. Front Power Switch - Modification

{To Do: Insert instructions for adding a front power switch}

{Reference from Change logs:

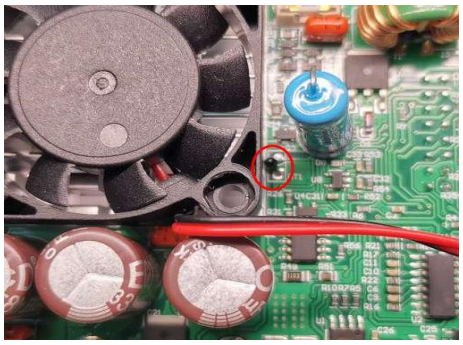
+ Added option "Power Switch" to turn On/Off the primary PSU. (5V standby power supply required). (Note: Adds a 3 second power-on delay).

The control output is routed to the PA14 port (pin 4 of the J2 connector). High level - turn on, floating or low level - turn off.

Note: the maximum load on the port is 20mA !!! (it is better to use an optocoupler).}

18.4. Improve Internal Thermal Measurement Accuracy

Apply thermal paste between the thermistor and heatsink to more accurately display the temperature.



18.5. Using the TTL Interface

User example from EEVBlog forum.

Communication Protocol:

From EEVBlog post:

Protocol reverse engineering HERE.

18.6. Output Surge Problem - Hardware Bug, With Fix

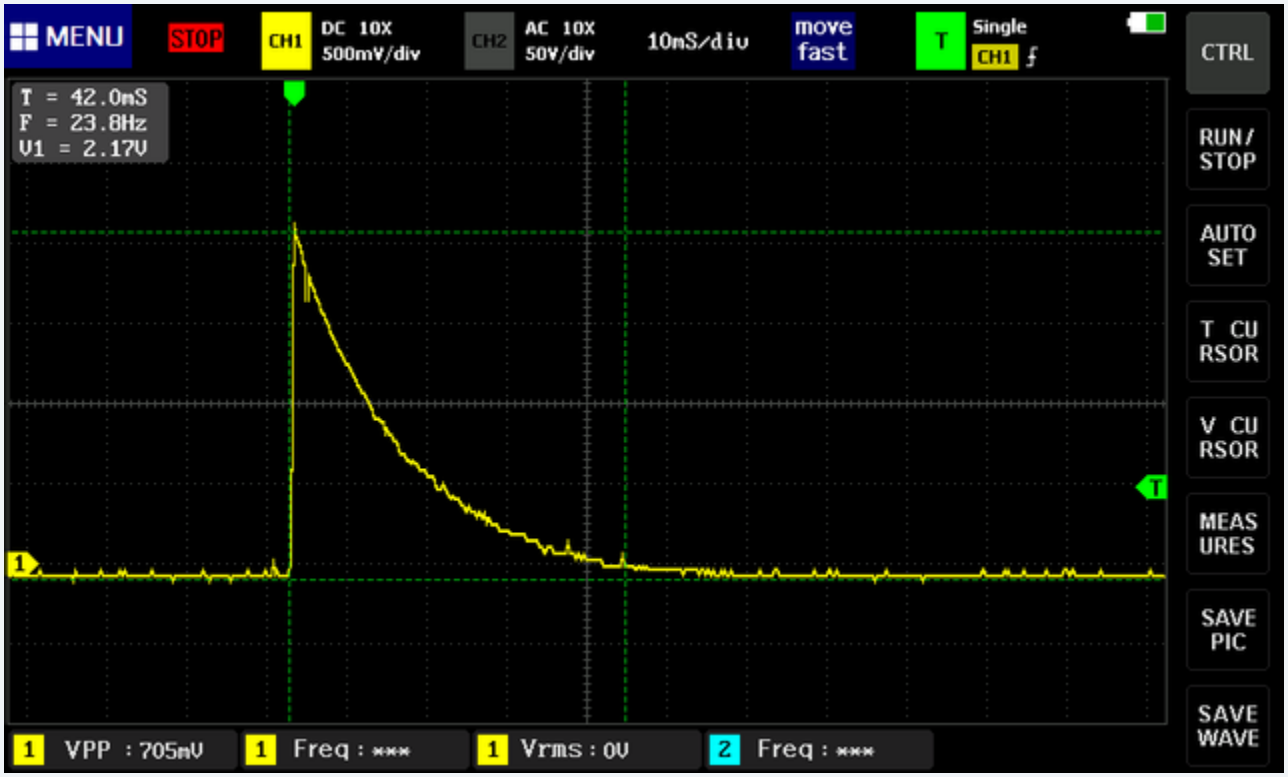
Some RD60xx have a small hardware problem…

Depending on your version and your primary supply, there may be a surge at the output when the primary power supply is turned on.

This occurs regardless of the 'Boot Output' setting.

For further technical info, see the original EEVBlog Forum post HERE.

Below is an oscilloscope screenshot showing the problem on a RD6012:



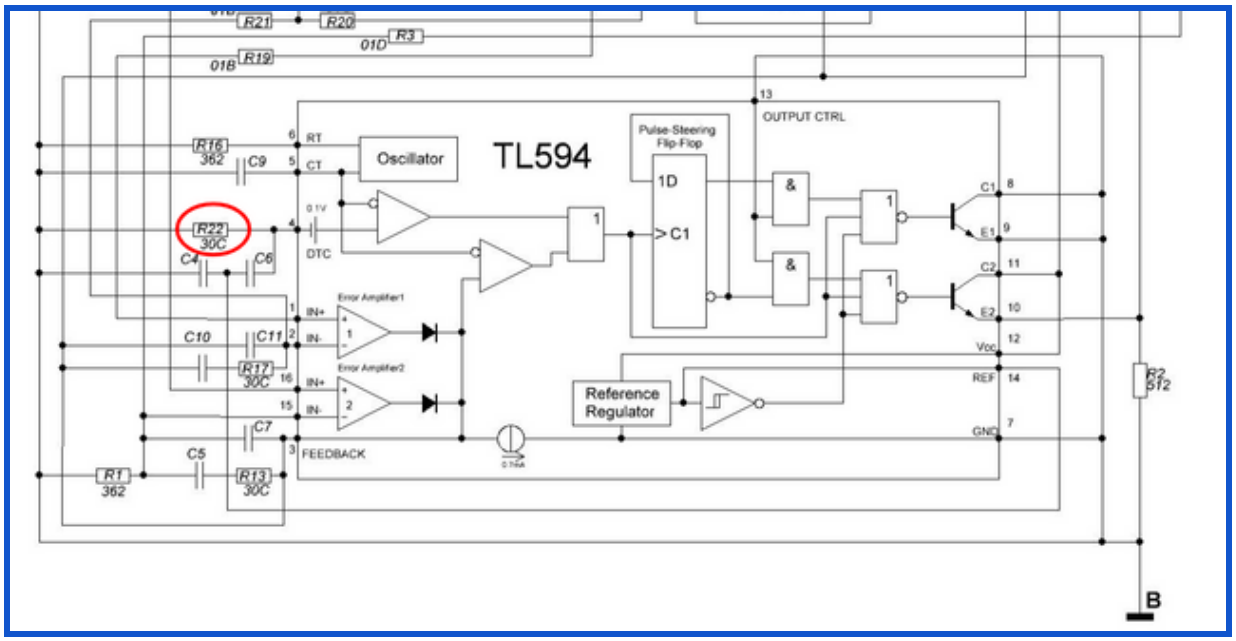
RD6012 output (RED Binding Post) when Primary Power Supply energized.

This is a hardware problem that occurs when the RD60xx's on-board TL594 Integrated Circuit (IC) is first powered, but before the RD60xx unit has entered a stable operating mode.

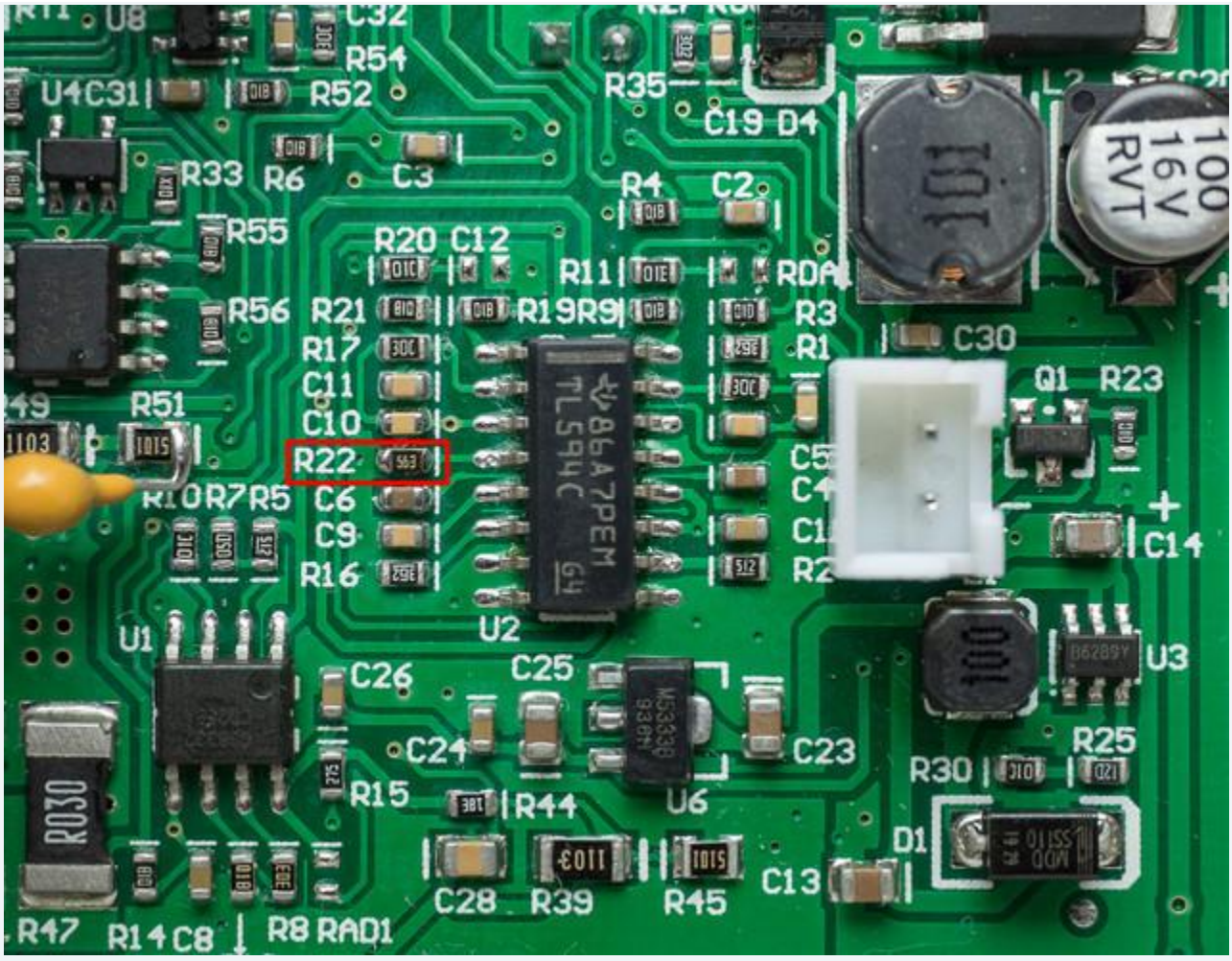
18.6.1. How to get rid of the problem

Replace R22 with a resistor value between 68K - 100K.

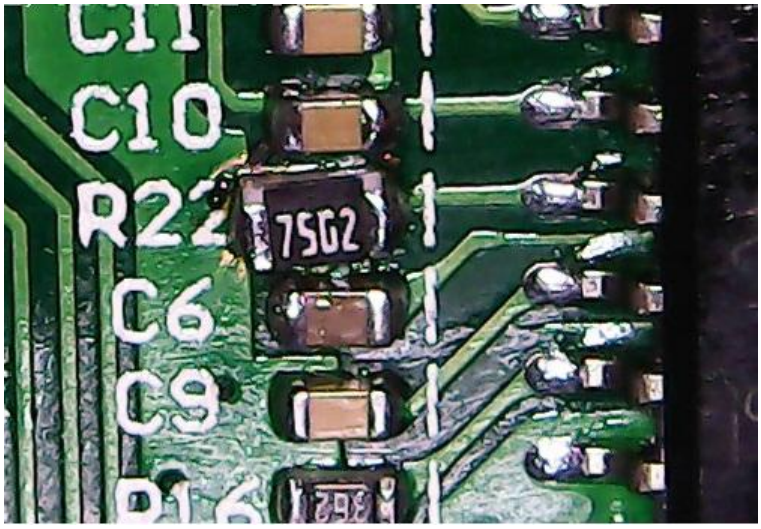
This will increase the turn-on delay time, reducing or eliminating the problem.



Schematic view of the part to replace

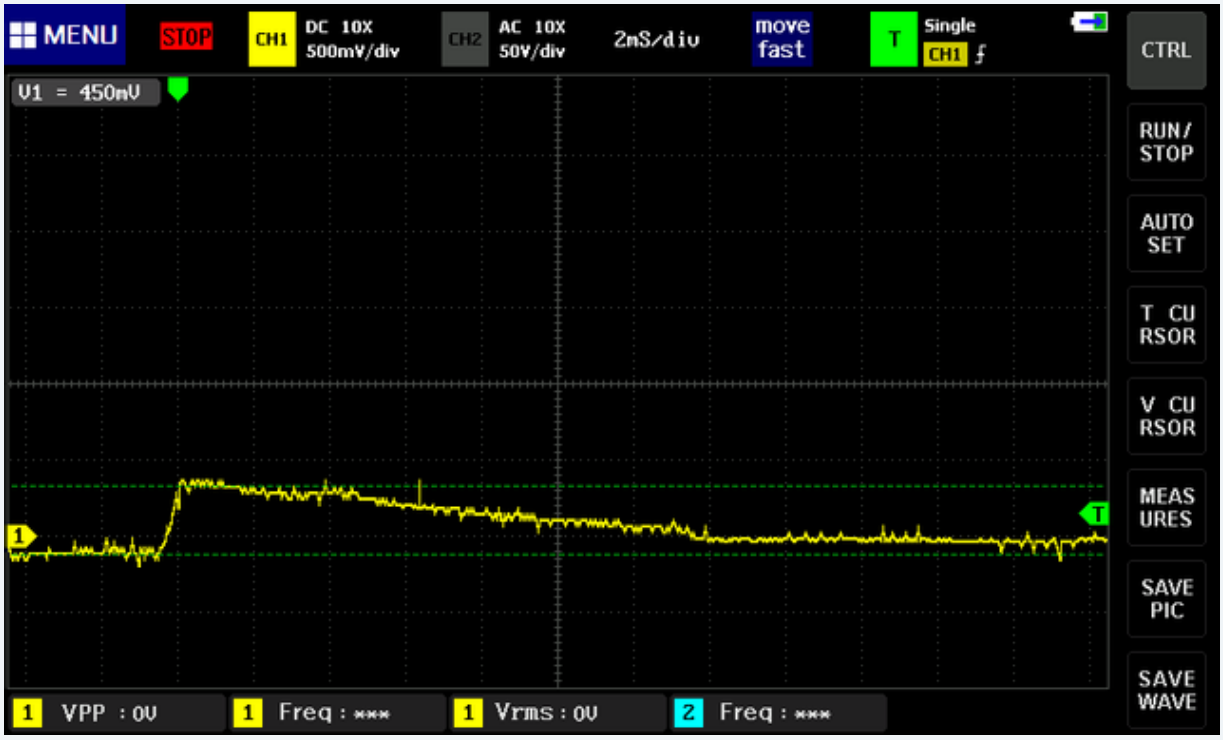


Exact location of R22 on the PCB inside the RD60xx. (With 56K Resistor installed.)



Original components are small 0603 footprints, but the larger 0805 footprint can be used as a replacement with minimal effort. (Need to scrape off a little solder mask)

0805 Components can (fairly) easily fit for mod - (75K Resistor Installed)



The output surge becomes much smaller. (as measured with a 56K resistor installed)

Increasing the resistance of the resistor increases the turn-on delay even more.
Resultantly, the surge at the output will become even less or completely disappear.
(UniSoft suggests a resistor value between 68K - 100K.

19. How to Connect with WiFi

WiFi is only available on the W versions (RD6006W etc). If you bought a non-W version, you can transform it into a W version by simply installing the WiFi module that can be bought separately. The firmware in the RD60xx is already compatible with it.

Please Note: WiFi using 5G or 11AC is NOT supported. Use 2.4GHz WiFi.

This is a limitation of the WiFi module and can not be resolved by the RD60xx Firmware.

What is the WiFi module for and how is it used?

The WiFi connection of the RD60xx allows setting up point-to-point Modbus communication for remote control via an app or specialized software, just like it would over TTL or RS485, but now over WiFi. The WiFi module is only used as a serial-to-WiFi converter. As a result, once configured, the RD60xx initiates a WiFi connection to what it calls a "server", and starts talking Modbus to that and only that server. The WiFi module will not allow incoming IP connections from other devices. The RD60xx expects the "server" to be listening on port 8080.

It is possible to modify the WiFi module's behavior though, as it is built around a very common device (the ESP12-F). See https://cuttlefishblacknet.wordpress.com/2020/03/01/riden-rd6006-wifi/ or https://community.home-assistant.io/t/riden-rd6006-dc-power-supply-ha-support-wifi/163849 and the ESP User Guide.

19.1. If WiFi Has NOT been previously configured

19.1.1. With the help of the mobile app

This uses a method that is also called "Smart Config".

- Select **WIFI** in the 'UART Interface' setting.
- Exit the menu - Press "ENTER" (The setting is saved on menu exit only.)
- Power Cycle the RD60xx device (use the "POWER" button.)
- On Boot-up, you will see red string: **Server IP: ---.---.---.---**
- Run the mobile App.

  (Note: the mobile App must run on a device that is connected to the same 2.4GHz WiFi network that you want the RD60xx to connect to. Do not choose a WiFi network that has guest isolation.)
  - In the app, click on "Network distribution" (in the menu)
  - Enter your home/lab's WiFi AP credentials
  - Click on "Initialization" (at the bottom)
  - After some time, usually 1-2 minutes, the RD60xx will change the string to yellow, which contains IP, and one more string "Connecting wifi...."
    - If this does not happen, search for problems with the network. (this is an infinite loop, firmware just waits for the response from the WiFi module).

What happens during this step?

- The RD60xx and the mobile app use the ESPTOUCH protocol. The RD60xx starts listening to the network (in promiscuous mode) for information that the mobile app sends out over the network. Once the RD60xx has read that information, it will show the IP address read on screen.

- In the App click the checkbox “Device displays Server IP” and click ‘confirm’.

  What happens next?

  - The RD60x will try to connect to that WiFi AP via the information just received.
  - When that is done, the RD60xx will try to connect to the mobile App, by opening a TCP connection to the IP address given before (on port 8080).
  - Once that connection is done, everything is OK.

  This entire last part of the procedure is pretty sensitive and can fail for 3 reasons:

  - You entered the wrong credentials or provided the credentials of an AP that is not on regular 2.4GHz. Check that. Look at the log of your WiFi AP to see if the connection from the RD60xx is accepted..
  - Your WiFi AP has guest isolation. You can only bypass this by disabling guest isolation, or by using a wired network to your PC, and controlling the RD60xx from there.
  - The signal strength was bad. Make sure that the signal strength is strong when you do this procedure, and retry.

- If all goes well, the configuration is done. These steps should only need to be done once.

19.1.2. From USB, with RDFlasher

- Select **OFF** in the ‘UART Interface’ setting.
- Disable output
- Send the command SETUP: SSID, PASSWORD, IP via RDFlasher in the “Config WiFi” menu

  The WiFi module will then try to (re)connect to the AP with entered SSID and Password. That can take more than 20 seconds, and during this time the PSU will be frozen and will not react.

19.2. If WiFi has been configured previously

Run the mobile App or PC App first (it is working as a server), then start RD60xx.

19.3. If you want to change the "Server"'s IP address.

Use the menu entry "Server IP"

19.4. If you want to change the AP, or if WiFi no longer works at all, and you want to start all over.

- Start the RD60xx
- On the startup screen, when it shows the IP address, press “◀”
- RESET will highlight
- Press “ENTER”
- You can now start the WiFi configuration all over.

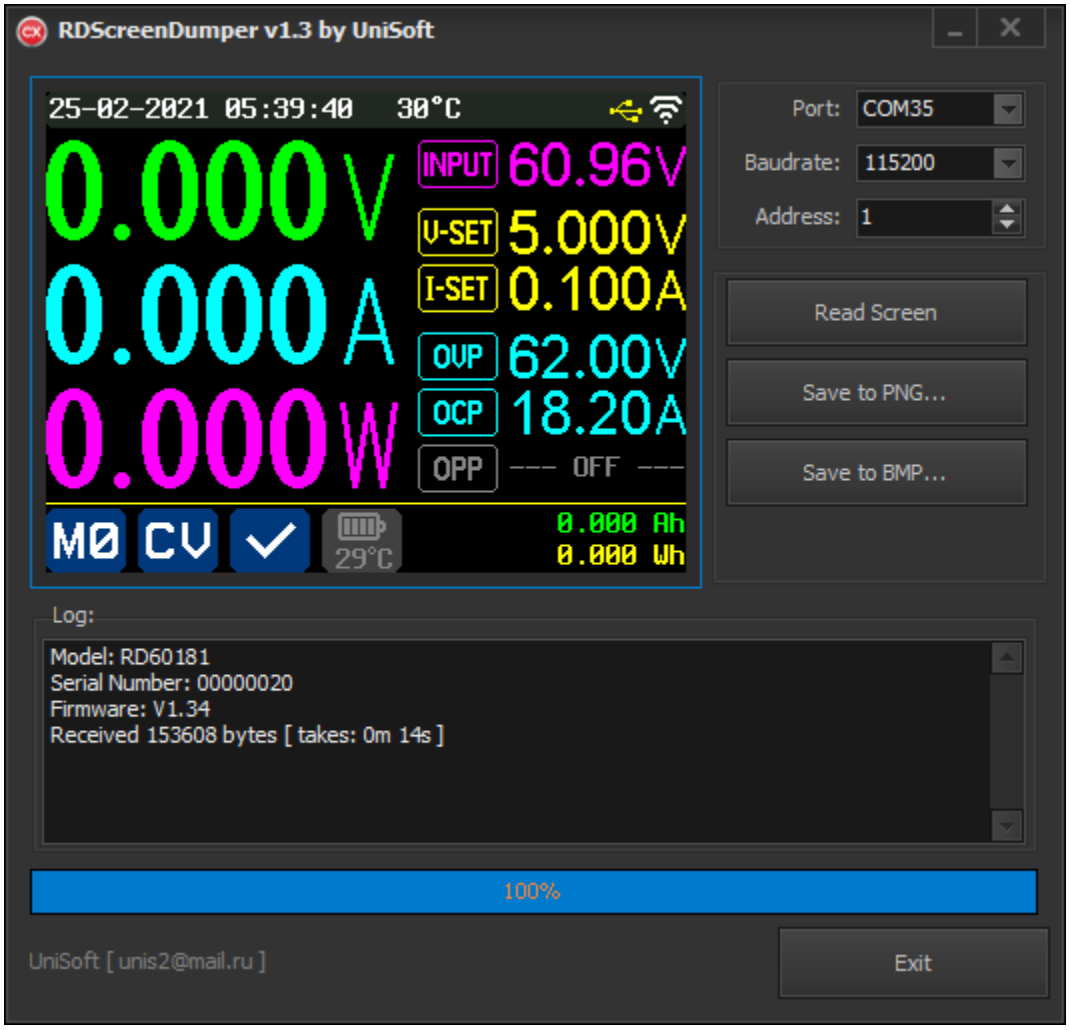
20. Other Software and Utilities

20.1. ScreenDumper Utility

UniSoft’s ‘Screen Dumper’ for Windows, Latest Version

The ScreenDumper utility is connected to your computer in the same way as the RDFlasher utility.

Once connected, you can capture the RD60xx’s Display and save it as an image file.



(Note: This image is from a pre-release of RDScreenDumper v1.3 - v1.6 is the latest released version)

CAUTION!!!!

This utility requires approximately 2 seconds to receive a screen capture from the RD60xx unit at a baud rate of 115200, (Longer for slower speeds,) completely locking the firmware for the duration. Earlier versions for the tool required significantly more time, so it is advised to use the latest version.

During this time the RD60xx **WILL NOT** engage **any safety Protection**.

20.2. How to Change the Boot Logo Image

TODO: Re-Write instructions from original (bad english Riden manual) for changing Boot Logo Image}

21. Battery Charging Methods with the RD60xx

This power supply can be used to charge a wide variety of different battery types and chemistries, and does so by proposing a large variety of charging strategies. This chapter is meant to group them together and to find the right settings for your needs.

Please be aware that although the RD60xx has some nice features for battery charging, it is not a specialist tool for that. High quality dedicated chargers often have more features and built-in intelligence, allowing for example automatic detection of the battery type, or achieve a higher or a faster charge, all while better preserving the battery life.

21.1. Battery chemistries

In order to be able to charge your battery, you must first determine the chemistry of your battery, as many different types exist and that mostly have their own limitations and recommendations on how to maintain them. Some of the most popular modern types are:

- Lead acid (Pb)
- NiMH
- NiCd
- Lithium-ion
- Lithium Polymer (LiPo)

Many more types exist, and most have sub-types. Some types are more suited for standby use, others for deep cycle, as there are types that do or do not support fast charging. Some batteries even have protective circuits in them. This all can be important.

Also, know what you want to achieve. Do you just want a charged battery as fast as possible, do you want the fullest possible battery, or do you want to find the right optimum for a long life of your battery? You will have to choose, as it is very unlikely that you can have all of that at the same time.

Ideally, find out the exact type of battery you have, and determine the best charging approach for what you want to achieve. There are many websites on batteries that can help with determining the best approach for your use case. Unfortunately there are few with in-depth explanations of all different chemistries that exist.

NOTE: The explanations and recommendations here are meant to give an entry level view of the different charging strategies possible with the RD60xx. They are not complete, and may require significant adaptations for your use case. It is highly recommended that you get yourself acquainted with the do’s and don’ts of your battery. **Charging batteries and especially overcharging can be dangerous**. On some battery types, overcharging can result in fire or even explosions.

As a minimum, find out the battery chemistry. That will quickly rule out certain approaches. Find out what charging approaches are suitable for that chemistry. Best is if you can find the manufacturer recommendations for your specific battery.

You will also need to know the capacity of the battery, which is expressed in Ah or mAh. Often, the charge current is chosen depending on the capacity. In that case, recommendations for charge current are likely expressed in “C”, or “Charge rate” or A/Ah. If a battery has a capacity of 2Ah, its C is 2A. If a charge current is expressed as 0.1C, it would be 0.2A for a 2Ah battery, and 70mA for a 700mAh battery.

And of course you must know the nominal voltage of the battery. Do not mistake the nominal battery voltage with the voltage you set on the RD60xx. Every battery type has its own recommended maximum charge voltage, which can be quite a bit higher than the nominal battery voltage. Most charging strategies combine Constant Current (CC) and Constant Voltage (CV) charging in different phases of the charge process. For a simple charger like this, you normally make sure that the CV limit is the maximum charge voltage of your battery. Know that CV limit for your battery.

21.2. Connecting a battery

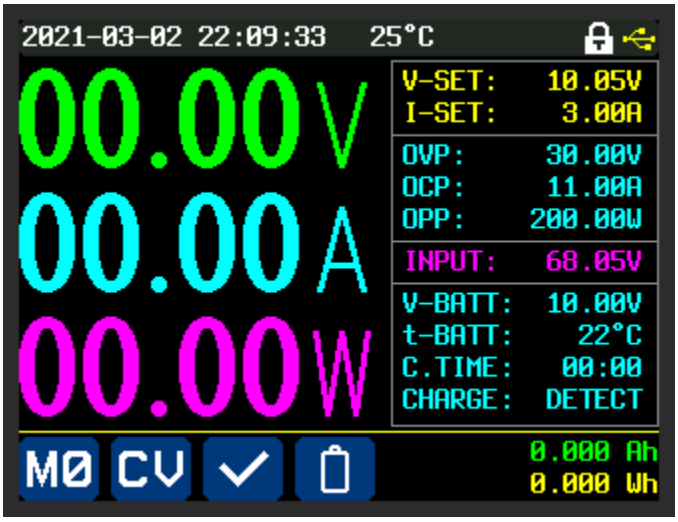
Before connecting the battery, make sure that:

- **The power supply is on, but the output is switched off.**
- **The battery detection is not disabled via the "Green Output" setting.**

Failure to heed these warnings may damage the PSU and the battery.

The battery should be connected to the black (-) and the green terminals (+), or respectively G and H in the image in chapter Front Panel Layout. Do not connect the battery to the red terminal! Doing so will damage the power supply.
When connected, and provided the battery provides more than 0.5V, the battery will be detected, and a battery icon will be lit up at the bottom of the screen. If the battery provides less voltage, it is likely damaged beyond repair anyway. The various battery charging functionality in the RD60xx is not available unless the battery is detected.

You can see information about the battery on multiple screen configurations, the most verbose being this screen (press “◄” or “►” one or more times to get to this layout):



The battery icon is shown mid bottom, and the battery detailed information is shown at the bottom of the right column. The battery icon should be white (not gray), and the text “CHARGE: DETECT” should

be shown. The t-BATT line here refers to the external temperature sensor, and will show “---” if not connected.

21.3. Battery settings

When the battery is detected, entering the menu as usual (via “SHIFT”+”MENU”), will bring you directly to the menu for various battery charging settings. That menu is also identifiable by the battery symbol being highlighted, with a red background, in the bottom left of the screen:  .

See chapter Description of Each Setting’s Options for a description of the various battery menu entries. That menu is mainly focused on when to **stop** charging.
Outside of that menu, but nevertheless crucial for battery charging, you must set a V-SET and I-SET suitable for your battery. These 2 settings will act as upper limits **during** charging.
See below, under Charging Strategies for a somewhat more in depth explanation on how to use all of these settings, depending on your battery’s characteristics.

21.4. Charging Strategies

The chapters below mention some charging strategies, a small explanation of what types of batteries these can be used for, and most importantly, how to configure that in the RD60xx.

21.4.1. Time limit

The simplest method of charging a battery is time limited charge. Provided a relatively low current is used, and the charge time is not too long, most batteries can be charged this way. The downsides are that this method is very unlikely to provide an optimum charge, and when used inappropriately, can severely shorten the battery life or be downright dangerous.
If you use this method exclusively, be prepared to shorten the charge time as the battery ages, or you will end up accelerating the aging even more.

Every type of battery has its own recommendations on how to set the charge current with this method, but in general, charging an empty battery at 0.1C for 10 hours can be relatively safe. If your battery was not empty at the start of charge, you must of course adapt the time.

The RD60xx allows you to set a maximum charge time, via CutOff time.

21.4.2. Capacity limit

Another simple method is the capacity limit. This method works by calculating the time integral of the charging current over the length of the charge process. For example, if you charge a battery with 0.5A for 2 hours, you will have put 1Ah “back into” the battery. As the charge current often changes (lowers) during a charge cycle, this method will help you better tune the charging

than the simple time limit method. It will however still not prevent overcharging, if you set the limit too high.

Every type of battery has its own recommendations on how to set the charge current with this method, but in general, charging an empty battery at 0.1C up to 100% of the rated capacity can be relatively safe. Like with the time limit, the capacity limit you set must be adapted to the initial charge state of the battery, as the charger cannot know the pre-existing charge.

The RD60xx allows you to set a maximum charge limit, via 'CutOff cap.'

21.4.3. Current limit

Another simple method is the current limit. When the charge current drops below a specific limit, the charge is interrupted. This is a very basic method and can be relatively safe. It is however not recommended for NiMH or NiCd batteries, where $-\Delta V/\Delta t$ is better suited. Apart from that, it may fail easily if the charge voltage is set too high. But even when the charge voltage is set correctly, it may fail, especially in worn batteries, due to leakage in the battery. Overall it may be wise to limit this method with other limit methods.

The RD60xx allows you to set a charge current limit, via CutOff current.

> Be aware that this limit is a lower limit, not an upper limit.

21.4.4. Temperature limit

High temperatures can shorten the life of almost all battery types. Also, some battery types, like Lithium-ion and NiMH, show a rather sharp increase in temperature once they reach a full charge.

Therefore, it can be very interesting to use the external temperature sensor of the RD60xx for the charging process, be it for detection of end of charge, or just as an additional safety measure. This is not fool-proof however:

- High charge currents can cause heating by itself, and cut the charging short too soon.
- Detecting a temperature rise in large batteries can be hard due the thermal mass, and/or convection, potentially causing the charge to continue too long.
- In a pack of batteries, some cells will heat up before others. You may be measuring at the wrong location.

The RD60xx allows you to set a maximum temperature, via Cutoff Temp. Be aware that this kind of doubles up with OTP (EXT), but the latter is more to be used as a final safety measure, not specifically for battery charging.

Both of these settings are absolute upper temperature limits, you will NOT be able to:

- Specify temperature slopes (increase or temperature in a specific time), which would be useful for Lithium-ion for example.

- Adapt the charge current to the temperature, as can be interesting for Lead Acid float charging.
- Inhibit charging or adapt the charge current when the temperature is too low, as might be useful for Lithium-ion batteries.

If you want to improve this, you can always hook the RD60xx up to a computer, and act on the temperature from there. You can even add some more sensors that way.

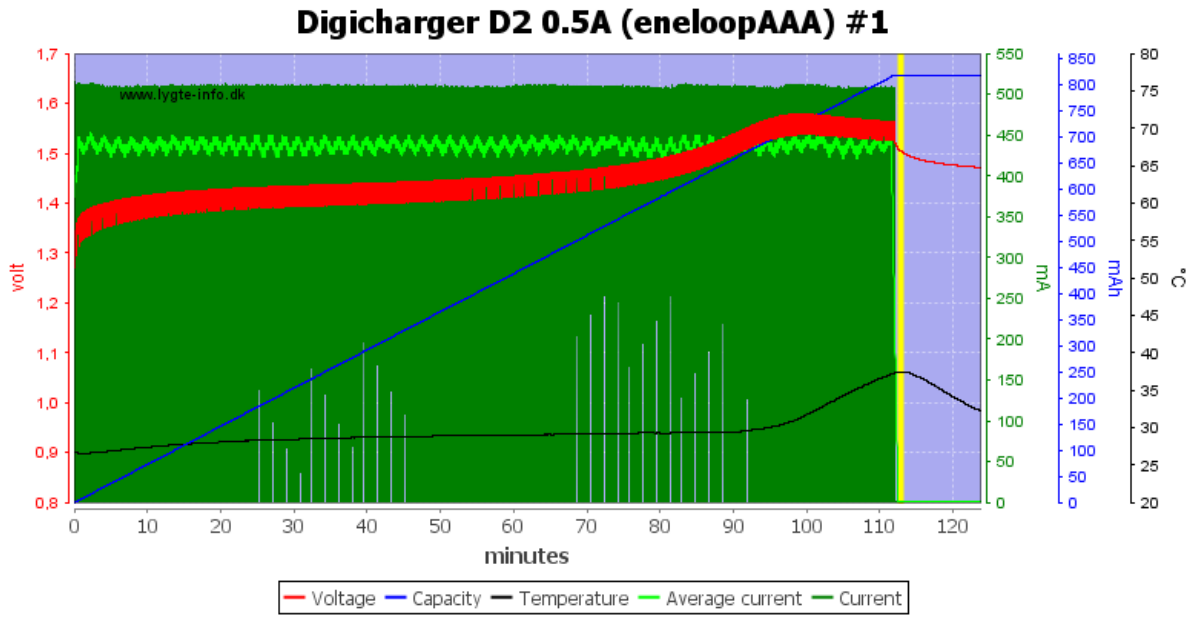
All in all:

- Do not use the temperature monitoring as your only “end of charge” trigger. Combine it with other methods.
- Make sure that the temperature sensor has a good thermal contact, as close as possible to the center of the battery.
- You may want to wrap some thermal insulation around the battery to improve the temperature measurement fidelity. But never airtight, as some batteries gas out (most Lead Acid types for example, even the “airtight”/sealed types).
- Especially for Lithium-ion and NiMH: set the charge current just low enough that it will not cause significant heating during the charge, and you will better be able to detect the sudden temperature rise at the end of charge.

21.4.5. -ΔV/Δt

The dV/dt method, or better, -ΔV/Δt method, is for NiMH and NiCd batteries. These batteries are normally charged with Constant Current (not Constant Voltage). When the battery charges, the terminal voltage slowly rises. But when the battery is near full, the terminal voltage drops again (or stagnates). This voltage drop happens before a temperature rise, so it is very interesting to take into account.

To explain: (full credit goes to the excellent site https://lygte-info.dk/):



-ΔV is voltage drop and Δt is time, i.e. a voltage drop over time.
On the above curve you can see the red voltage line has a small drop at the end, it is the -ΔV/Δt and signals the battery is full.

The RD60xx with the “n” or later firmware has support for this, via CutOff -ΔV/Δt, with the “p” version having added filtering to improve reliability. However, due to the low resolution of the ADC, it is best to combine -ΔV/Δt with CutOff Temp., in order to improve the reliability and safety.

Previous firmwares will not allow you to automate this. Also note that the ORP delay and ORP set settings work differently, and are not suited for this type of cutoff detection.

21.4.6. Float Charging (aka Trickle Charging)

This is the simplest method of charging, but it requires some care. It is normally reserved for Lead Acid or, with precaution, for Lithium-ion batteries. It is not suited for NiMH or NiCd batteries. It consists of applying a constant voltage charge at a rather low current, and can be left on for lengthy periods, without significant damage to the battery.

As lithium-ion batteries do not support overcharging, they can only be float charged at a voltage equal to or slightly lower than the cell voltage, resulting in 0 charge current after the cell is full. If a charge current remains, you will damage the battery.

Lead acid batteries can be float charged with a small charge current remaining when full. That small current is only meant to compensate for the self-discharge of the battery. Therefore, if you set the voltage too high, you will damage (gas out) the battery.

Ideally, the float voltage is determined by the exact battery chemistry and the battery temperature. The latter is not possible with the RD60xx (except when controlled from a PC for example), as the temperature is only used for logging and cut off, not for controlling the charge current or voltage.

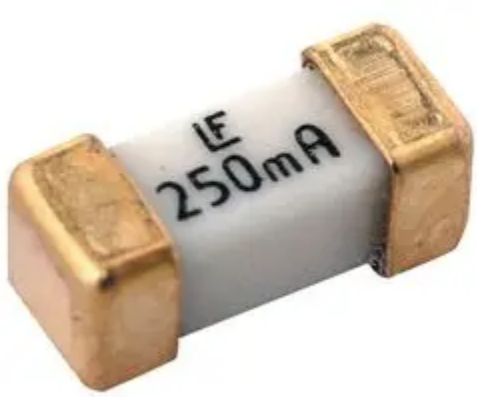
If you want to use this method, set a low max current and a precisely chosen voltage.

22. Reference Information:

22.1. Original Riden Manual

https://drive.google.com/drive/folders/1V0l6P1sIJilN1yBOsTO9YGLVdkuO0cX9

22.2. Fuses



1808 SMD Fuses,

RD6006 - 10A
RD6012 - 20A
RD6018 - 25A

Note: Image for reference only.
Value shown is NOT correct for the RD60xx.

Example datasheet

22.3. Short Circuit Response Time Testing

Test 1:

Setup:

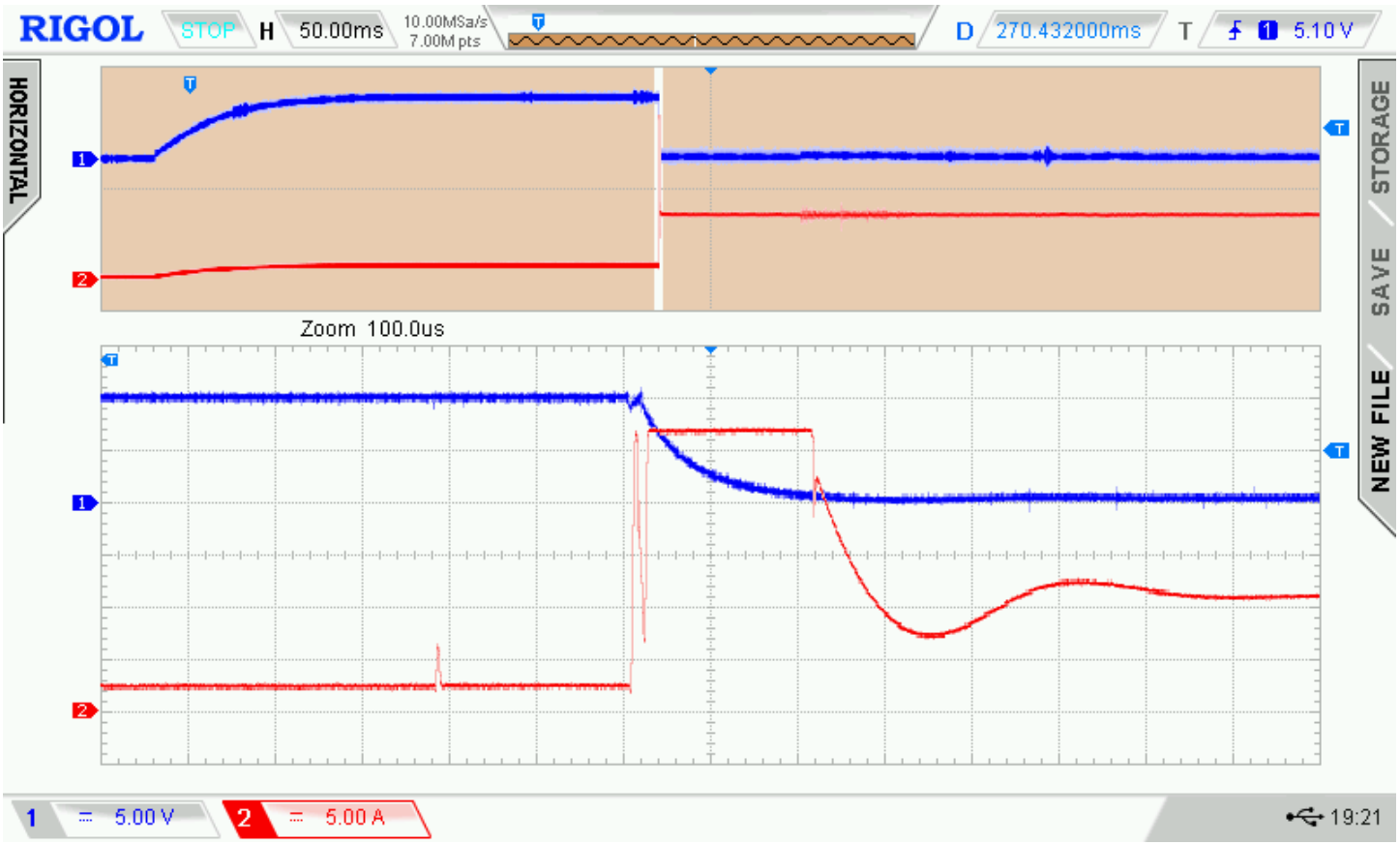
Unit:	RD6018	**Load**:	5 Ohm (Two 10 W, 10 Ω resistors in parallel)
V-SET:	10V	**I-SET:**	10A

Test method:

Output was turned ON and allowed to settle at 10V, 2A.
A short circuit was introduced.

Results:

Starting from 2 Amps, the current goes up to ~ 27 Amps (perhaps higher) for about 200 microseconds then settles back to around 10 Amps after about 600 microseconds.

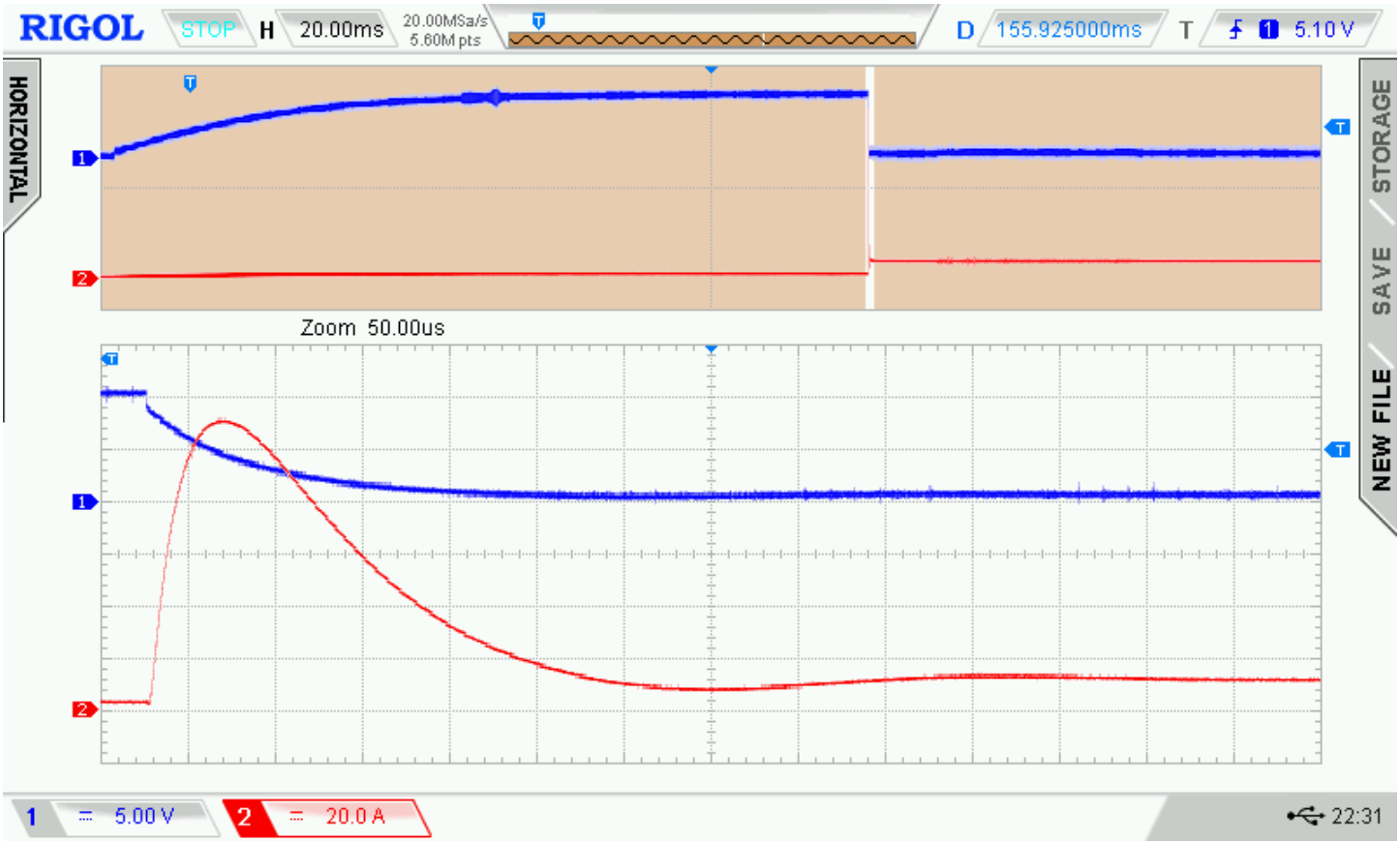


Test 2:

The same test was repeated using a [Fluke 80i-110s AC/DC Current Probe] in ‘High Current’ mode.

Results:

The power at the first voltage and current intercept was around 500 Watts.
The current peaked at over 100 Amps.
(Happily, it is only for about 50 microseconds.)



22.4. Miscellaneous

When the internal fan (the one that is on the module itself) is turned on, a fan icon will be displayed.

Minimum battery voltage: 500mV