



# Strato Pi Logic Controller Advanced Configuration Guide

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## Introduction

This document describes new features of the PIC MCU firmware version 3.1<sup>1</sup> used in the following Strato Pi versions:

- Strato Pi Base
- Strato Pi UPS
- Strato Pi CAN
- Strato Pi CM.

These new features implement an enhanced management of the TX-enable control of the RS-485 line, the possibility to change the timing values related to the watchdog and shutdown features and automatic shutdown of Strato Pi UPS in case of a power outage.

Enabling these features require a simple ASCII-based serial command protocol between the Raspberry Pi and PIC MCU.

On Strato Pi Base, UPS and CAN, GPIO13 is used as a software serial TX line on the Pi, and is connected to the AN11/RB5 pin of the PIC (RX). GPIO19 is used as a software serial RX line on the Pi, and is connected to the AN10/RB4 pin of the PIC (TX).

On Strato Pi CM, GPIO23 is used as a software serial TX line on the Pi, and is connected to the AN11/RB5 pin of the PIC (RX). GPIO24 is used as a software serial RX line on the Pi, and is connected to the AN10/RB4 pin of the PIC (TX).

Communication speed is fixed at 1200 8N1.

The PIC always start with both AN10/RB4 and AN11/RB5 configured as inputs. When the PIC senses a valid command and has to reply, it will switch AN10/RB4 to output and keep it as output indefinitely.

## Command syntax

Commands are always initiated by the Pi. PIC will only reply when a valid command is received.

All commands start with the "X" ASCII character, followed by two characters identifying the specific command and one or more characters for the command's argument. Each command accepts a fixed number of argument characters. No command termination character is required. The PIC replies after the last character forming a valid command and argument is received. It does not reply to an invalid command.

CR/LF characters are always ignored.

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<sup>1</sup> You can check the factory installed version of the Strato Pi controller firmware from the label attached to the back of the Strato Pi board. After the first two alphabetic characters (representing the assembly facility), the third and fourth are the firmware version and subversion numbers.

There is a 5 seconds character timeout when receiving commands. If a character is not received for 5 seconds since the previous character, the command buffer will be reset, and the PIC will start looking for a new "X" ASCII command header character.

All commands use upper case characters only. Lower case characters won't match.

## Raspbian software serial implementations

There are a few software serial Linux modules implementations for Raspbian. We tested the `soft_uart` code by "adrianomarto", on GitHub: [https://github.com/adrianomarto/soft\\_uart](https://github.com/adrianomarto/soft_uart)

After the module is compiled and installed, it can be loaded and configured to use GPIO13 for TX and GPIO19 for RX, for Strato Pi Base, UPS and CAN, with:

```
sudo insmod soft_uart.ko gpio_tx=13 gpio_rx=19
```

For Strato Pi CM use GPIO23 for TX and GPIO24 for RX:

```
sudo insmod soft_uart.ko gpio_tx=23 gpio_rx=24
```

To load the module automatically at boot, add the line:

```
soft-uart
```

to `/etc/modules`, and create a new file `/etc/modprobe.d/soft_uart.conf` to set the module options:

```
options soft_uart gpio_tx=13 gpio_rx=19
```

Or, for Strato Pi CM:

```
options soft_uart gpio_tx=23 gpio_rx=24
```

The protocol is human readable, you can test it with `minicom` or any other terminal program:

```
minicom -b 1200 -D /dev/ttySOFT0
```

On a Raspberry Pi Model 3 B+ and Raspbian Stretch, it has been tested successfully at speeds up to 19200. Data transfer becomes corrupted at 38400.

A different software serial implementation is the `pigpio` Python module: <http://abyz.me.uk/rpi/pigpio/python.html>

## RS-485 control commands

### XSMn - RS-485 TX-Enable Mode

Set the TX-Enable operations mode.

Command	Description	Reply
<b>X SMA</b>	Set TX-Enable automatic mode (factory default)	X SMA
<b>X SMP</b>	Set TX-Enable passive mode	X SMP
<b>X SMF</b>	Set TX-Enable fixed speed mode. In this mode, TX-Enable timing is based on speed, number of bits, parity and number of stop bits set using the control protocol	X SMF
<b>X SM?</b>	Return current mode	X SMn

### XSPrbps - RS-485 communication parameters

Used when TX-Enable operation mode is set to fixed with the XSMF command, must be set to the PI's UART baud rate, number of bits per character, parity mode and number of stop bits.

Command	Description	Reply
<b>X SP?</b>	Return current communication parameters	X SPrbps

For example, the command XSP58N1 sets the communication parameters to the original factory default configuration: 9600 bps, 8 bits, no parity and 1 stop bit.

R parameter	Description	Reply
<b>2</b>	1200 bps	SXP2bps
<b>3</b>	2400 bps	SXP3bps
<b>4</b>	4800 bps	SXP4bps
<b>5</b>	9600 bps (factory default)	SXP5bps
<b>6</b>	19200 bps	SXP6bps
<b>7</b>	38400 bps	SXP7bps
<b>8</b>	57600 bps	SXP8bps
<b>9</b>	115200 bps	SXP9bps

B parameter	Description	Reply
<b>7</b>	7 bit	SXP7ps

B parameter	Description	Reply
8	8 bit (factory default)	SXPr8ps

P parameter	Description	Reply
N	No parity (factory default)	SXPrbNs
E	Even parity	SXPrbEs
O	Odd parity	SXPrbOs

S parameter	Description	Reply
1	1 stop bit (factory default)	SXPrbp1
2	2 stop bits	SXPrbp2

## Shutdown parameters

You can start a delayed power off cycle by rising Raspberry Pi's ShutdownEnable pin (GPIO16 on Strato Pi Base, UPS, and CAN; GPIO18 on Strato Pi CM; RC3 on the PIC MCU).

When ShutdownEnable is set to high, Strato Pi will wait 60 seconds (configurable with the XPWnnnnn command) and then power off the Pi board for at least 5 seconds (configurable with the XPOnnnnn command).

After being powered off, the Strato Pi UPS board will supply power to the Raspberry Pi only when the main power source is restored (the XPPA command can change this behavior, so that the Strato Pi UPS board will always power up the Raspberry Pi board after a power cycle, even when powered by the battery).

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XPWnnnnn - shutdown wait time

Set the shutdown wait time, in seconds.

Command	Description	Reply
XPWnnnnn	Set the shutdown wait time, in seconds (factory default is 60, XPW00060). Min: 0; Max: 99999	XPWnnnnn
XPW?	Return current shutdown wait time	XPWnnnnn

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XPOnnnnn - power-off time time

Set the power-off time, in seconds.

Command	Description	Reply
<b>XPOnnnnn</b>	Set the power-off time, in seconds (factory default is 5, XPW00005). Min: 1; Max: 99999	XPOnnnnn
<b>XPO?</b>	Return current power-off time	XPOnnnnn

## XPPn - power-up mode (Strato Pi UPS only)

Set the power-up mode.

If the ShutdownEnable pin (GPIO16 on Strato Pi Base, UPS, and CAN; GPIO18 on Strato Pi CM; RC3 on the PIC MCU) is set to high when the main power is not present, the Raspberry Pi and the whole Strato UPS board will be powered down after the shutdown wait time, and turned on again only when the main power is restored.

You can change this behavior so that only the Raspberry Pi is turned off, and the power is always restored after the power-off time, even if running on battery, with no main power present.

Command	Description	Reply
<b>XPPA</b>	If the ShutdownEnable pin is set to high when the main power is not present, only the Raspberry Pi is turned off, and the power is always restored after the power-off time, even if running on battery, with no main power present	XPPA
<b>XPPM</b>	If the ShutdownEnable pin is set to high when the main power is not present, the Raspberry Pi and the Strato UPS board is powered down after the shutdown wait time, and turned on again only when the main power is restored (factory default)	XPPM
<b>XPP?</b>	Return current power-up mode	XPPn

## Watchdog parameters

The watchdog is normally disabled. To enable it, set the WatchdogEnable pin (GPIO6 on Strato Pi Base, UPS, and CAN; GPIO22 on Strato Pi CM; RB7 on the PIC MCU) to high (the XWEA command can change this behavior, so that the watchdog is always enabled, and the level of the WatchdogEnable pin is ignored).

While WatchdogEnable is high, the Strato Pi controller will watch for state changes of the WatchdogHeartbeat pin (GPIO5 on Strato Pi Base, UPS, and CAN; GPIO27 on Strato Pi CM; RC4 on the PIC MCU).

You should ensure that WatchdogHeartbeat flips its state between high and low faster than every 60 seconds (the watchdog heartbeat timeout is configurable with the XWHnnnnn command).

If the Strato Pi UPS controller doesn't see WatchdogHeartbeat changing state for more than 60 seconds, it will initiate a shutdown procedure, rising the WatchdogTimeout pin (GPIO12 on Strato Pi Base, UPS, and CAN; GPIO17 on Strato Pi CM; RB6 on the PIC MCU) to high, to signal that a watchdog timeout has occurred.

If possible, you should immediately initiate a software shutdown on Raspberry Pi, and set the ShutdownEnable pin to high.



When ShutdownEnable is set to high or 60 seconds after the timeout, Strato Pi will wait 60 seconds more (configurable with the XPWnnnnn command, see the shutdown wait time above), then power cycle the Raspberry Pi.

## XWEn - watchdog enable mode

Set the shutdown enable mode.

Command	Description	Reply
<b>XWED</b>	Watchdog is normally disabled (factory default)	XWED
<b>XWEA</b>	Watchdog is always enabled	XWEA
<b>XWE?</b>	Return current watchdog enable mode	XWEn

## XWHnnnnn - watchdog heartbeat timeout

Set the watchdog heartbeat timeout.

Note that the watchdog heartbeat timeout, like all other configuration parameters, is a temporary setting. When the timeout expires it will be reverted to the original value (the factory default or the permanent user defined configuration).

This allows, for example, to have a long timeout by default, that is reset to a much shorter value when the application that handles the heartbeat signal has started.

When the watchdog is always enabled (XWEA command), the factory default or user defined configuration of the watchdog heartbeat timeout will be forced to 60 seconds if set to a lower value.

Command	Description	Reply
<b>XWHnnnnn</b>	Set the watchdog heartbeat timeout, in seconds (factory default is 60, XWH00060). Min: 1; Max: 99999	XWHnnnnn
<b>XWH?</b>	Return current watchdog enable mode	XWHnnnnn

## UPS Parameters (Strato Pi UPS only)

In its factory default configuration, Strato Pi UPS doesn't automatically power down the Raspberry Pi when the main power source is not available.

It is the user application that, after being notified that it is running on battery power via the BatteryPower pin (GPIO26 on Strato Pi UPS; RC2 on the PIC MCU), will have to initiate a delayed power off cycle setting the ShutdownEnable pin to high.

This can be changed with the XUBnnnnn command.

## XUBnnnnn - UPS automatic power off

Set the UPS automatic power off timer.

Command	Description	Reply
<b>XUBnnnnn</b>	Set the UPS automatic power off timeout, in seconds. Strato Pi UPS will automatically initiate a delayed power off cycle (just like when GPIO16 is set high) if the main power source is not available for the number of seconds set with this command. Min: 1; Max: 99999	XUBnnnnn
<b>XUB00000</b>	UPS automatic power off disabled (factory default)	XUB00000
<b>XUB?</b>	Return current UPS automatic power off configuration	XUBnnnnn

## Permanently saving the current configuration

The current status of all the configuration parameters can be permanently saved in the Strato Pi controller.

If not permanently saved, the parameters will be reset to the original factory defaults, or to the previously saved user configuration, after every power cycle of the Raspberry Pi.

*Note: the Strato Pi controller's permanent memory can only accept up to 100.000 writes throughout the component's lifetime. To prevent damaging the memory the XCCS and XCCR commands should be executed with a frequency such as to avoid exceeding the maximum number of total memory writes.*

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### XCCn - persistent configuration

Permanently save the current configuration as the new factory default, or restore the original factory settings.

Command	Description	Reply
<b>XCCS</b>	Permanently save the current configuration as the new factory default	XCCS
<b>XCCR</b>	Permanently restore the original factory settings	XCCR