

DecentLAB

DEVICE CONFIGURATION INTERFACES

VERSION 1.5.1

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COMMAND LINE INTERFACE

The command line interface allows the user to configure a device using a set of simple text commands (ASCII). In order to send commands to the device, the device is connected to a PC via a serial connection (USB-to-serial cable). The commands are entered in a serial terminal program (e.g. putty) running on the PC.

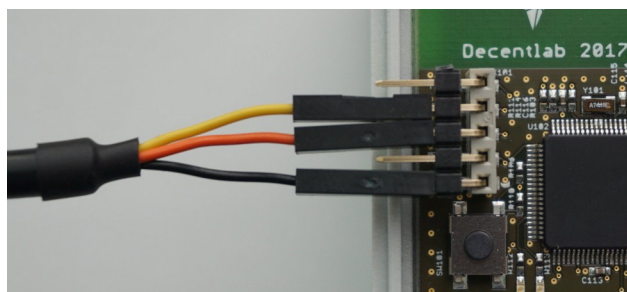
ELECTRICAL CONNECTION

The device can be connected to a PC using a commercially available USB-to-serial cable.

CAUTION: Use USB-to-serial cables with 3 V TTL logic levels (maximum 3.3 V)!

Recommended cable: “TTL-232R-RPi Debug Cable for Raspberry Pi” by FTDI chip. Connect 3 wires to the device connector (female pin header socket, 2.54 mm pitch) as shown in the following illustration.

Cable	Device
	TCK
RXD	TXD
TXD	RXD
	RST
GND	GND



GENERAL REMARKS

- The command line interface is active for 10 min after device reset or power-up. Entering any character restarts the 10 min timeout period.
- Configuration of the serial connection: 115200, 8, N, 1.
- Characters are not echoed by the device. Enable local echoing in your terminal program if needed.
- Terminate each command with CR ('\r', 0x0D), LF ('\n', 0x0A) or both.
- Some commands only take effect after reset (e.g. “set chmask + save”).
- Parameter changes are lost after a reset without using the command “save”.
- The command “save” permanently stores the current settings in flash.
Exception: for saving the LoRaWAN keys, please follow the command sequence in the examples.

COMMAND LIST

<code>reset</code>	Reset device. Unsaved parameter changes are lost.
<code>sleep</code>	Enter sleep mode (power off).
<code>version</code>	Get device software version.
<code>save</code>	Save current parameter set in flash.
<code>save keys</code>	Save LoRaWAN keys in flash (DevEUI, AppEUI, AppKey, DevAddr, NwkSKey, AppSKey). See examples.
<code>factory reset</code>	Erase settings in flash and reset.
<code>get period</code>	Get sampling period in seconds.
<code>set period <p></code>	Set sampling period in seconds (1...65535).
<code>get send_period</code>	Get send period relative to sampling period (default: 1).
<code>set send_period <p></code>	Set send period. Examples: p = 0 or 1: send after every sampling. p = 4: send after every fourth sampling.
<code>get mode</code>	Get LoRaWAN activation mode.
<code>set mode otaa</code>	Select OTAA (over-the-air activation).
<code>set mode abp</code>	Select ABP (activation by personalization).
<code>get dr</code>	Get default TX data rate. Actual data rate may vary, if ADR is enabled. ¹
<code>set dr <p></code>	Set default TX data rate. Used for next TX. Actual data rate for following TX may vary, if ADR is enabled. ¹
<code>get adr</code>	0: ADR disabled, 1: ADR enabled.
<code>set adr on</code>	Enable ADR.
<code>set adr off</code>	Disable ADR.
<code>get pwridx</code>	Get default TX power index. Actual power index may vary, if ADR is enabled. ¹
<code>set pwridx <p></code>	Set default TX power index. Used for next TX. Actual power index for following TX may vary, if ADR is enabled. ¹
<code>get deveui</code>	Get DevEUI: 8 bytes in hex (16 hex characters).
<code>set deveui <p></code>	Set DevEUI. Please follow the command sequence in the examples.
<code>get appeui</code>	Get AppEUI: 8 bytes in hex (16 hex characters).

¹ See Section "LoRaWAN data rates and power index".

<code>set appeui <p></code>	Set AppEUI. Please follow the command sequence in the examples.
<code>set appkey <p></code>	Set AppKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.
<code>get devaddr</code>	Get DevAddr: 4 bytes in hex (8 hex characters).
<code>set devaddr <p></code>	Set DevAddr. Please follow the command sequence in the examples.
<code>set nwkskey <p></code>	Set NwksKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.
<code>set appskey <p></code>	Set AppSKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.
<code>get nodeid</code>	Get Decentlab device ID (0...65535).
<code>set nodeid <p></code>	Set Decentlab device ID (0...65535).
<code>read</code>	Read sensors now (and send, if send_period has elapsed).
<code>send</code>	Read sensors now and send data.
<code>get dr_min</code>	Get minimum data rate (dr_min overrides ADR settings). ¹
<code>set dr_min <p></code>	Set minimum data rate (dr_min overrides ADR settings). ¹
<code>get dr_max</code>	Get maximum data rate (dr_max overrides ADR settings). ¹
<code>set dr_max <p></code>	Set maximum data rate (dr_max overrides ADR settings). ¹
<code>get pwridx_min</code>	Get minimum TX power index (overrides ADR settings). ¹
<code>set pwridx_min <p></code>	Set minimum TX power index (overrides ADR settings). ¹
<code>get pwridx_max</code>	Get maximum TX power index (overrides ADR settings). ¹
<code>set pwridx_max <p></code>	Set maximum TX power index (overrides ADR settings). ¹
<code>get param <i></code>	Get device specific parameter i, i = 0...15.
<code>set param <i> <p></code>	Set device specific parameter i, i = 0...15. Range: p = 0...65534; 65535: parameter is ignored.
<code>get chmask</code>	Get LoRaWAN channel mask: 9 bytes in hex (18 hex characters).
<code>set chmask <p></code>	Set LoRaWAN channel mask. Issue "save" and "reset" afterwards. See examples.
<code>get join_period</code>	Get re-join period in hours.
<code>set join_period <p></code>	Set re-join period in hours (0...1000). Examples: p = 24: re-join network every 24 hours. p = 0: never re-join.

<code>get linkcheck_period</code>	Get linkcheck period (default: 36). ²
<code>set linkcheck_period <p></code>	Set linkcheck period. ²
<code>get linkcheck_tolerance</code>	Get linkcheck tolerance (default: 6). ²
<code>set linkcheck_tolerance <p></code>	Set linkcheck tolerance. ²
<code>get linkcheck_limit</code>	Get linkcheck limit (default: 12). ²
<code>set linkcheck_limit <p></code>	Set linkcheck limit. ²
<code><others></code>	Invalid command. Answer: "unknown command".

EXAMPLES

BASIC EXAMPLES

<code>set dr 3</code>	Set default data rate to 3 (= SF9 / 125 kHz in EU868) ¹ . Used for next TX. Actual data rate for following TX may vary, if ADR is enabled.
<code>set pwridx 1</code>	Set default TX power index to 1 (= 14 dBm in EU868) ¹ . Used for next TX. Actual power index for following TX may vary, if ADR is enabled.
<code>set adr on</code>	Enable ADR from now on.
<code>set mode abp</code> <code>save</code> <code>reset</code>	Set ABP mode, save, reset. Make sure DevAddr, NwkSKey and AppSKey are valid!
<code>set mode otaa</code> <code>save</code> <code>reset</code>	Set OTAA mode, save, reset. Make sure DevEUI, AppEUI and AppKey are valid!
<code>set dr_min 2</code>	Limit data rate to 2 or higher, overriding ADR settings. ¹
<code>set dr_max 2</code>	Limit data rate to 2 or lower, overriding ADR settings. ¹
<code>set pwridx_min 2</code>	Limit power index to 2 or higher, overriding ADR settings. ¹
<code>set pwridx_max 1</code>	Limit power index to 1 or lower, overriding ADR settings. ¹
<code>set param 0 1000</code>	Set device specific parameter 0 to 1000.
<code>set param 1 2000</code>	Set device specific parameter 1 to 2000.

² See Section "Link check feature".

LORAWAN KEYS CONFIGURATION FOR OTAA

Note: Devices use OTAA by default. Please follow the command sequence below for configuring the LoRaWAN keys. It is important to set all necessary keys, because the command "save keys" erases all previous keys.

```
reset (using serial interface or push button)
sleep
set deveui 0123456789ABCDEF
set appeui 000ABC394380221F
set appkey 0123456789ABCDEF0123456789ABCDEF
save keys
(wait until completion, about 8 sec)
reset
```

LORAWAN KEYS CONFIGURATION FOR ABP

Note: Devices use OTAA by default. Please follow the command sequence below for configuring the LoRaWAN keys. It is important to set all necessary keys, because the command "save keys" erases all previous keys.

```
reset (using serial interface or push button)
sleep
set devaddr 013F4B90
set nwkskey FEDCBA9876543210FEDCBA9876543210
set appskey 0123456789ABCDEF0123456789ABCDEF
save keys
(wait until completion, about 8 sec)
reset
```

CHANNEL MASK CONFIGURATION (US915)

set chmask FF0000000000000000	Set LoRaWAN channel mask: Enable channels 0...7, disable channels 8...71.
save	
reset	
set chmask 00FF00000000000002	Set LoRaWAN channel mask: Enable channels 8...15 and 65, disable all others.
save	
reset	
set chmask 010000000000000000	Set LoRaWAN channel mask: Enable channel 0, disable all others.
save	
reset	
set chmask 030000000000000000	Set LoRaWAN channel mask: Enable channels 0 and 1, disable all others.
save	
reset	

```
set chmask FFFFFFFFFFFFFFFFFF    Set LoRaWAN channel mask: Enable all channels (0...71).
save
reset
```


DOWNLINK COMMAND INTERFACE

The downlink command interface allows the user to configure a device by sending messages to the device over the air (downlink messages). In order to send messages to the device, the device has to be connected to a LoRaWAN network.

GENERAL REMARKS

- The downlink commands are a subset of the serial command line interface. Please refer to the command line interface description for more details.
- Parameter changes without the “save” option are lost after a reset or power cycle.
- Commands with the “save” option permanently store all the current parameter settings in flash.
- CAUTION: certain commands / parameters (e.g. “sleep”) may render a device unresponsive and unreachable in the field. A manual reset may be necessary.
- Send downlink commands using LoRaWAN port 1.

DOWNLINK COMMAND FORMAT

Code	Parameter	CRC
------	-----------	-----

- Code: 16-bit unsigned integer, see table below.
- Parameter: 16-bit unsigned integer. Set to 0x0000 if not used.
- CRC: 16-bit CRC-16 (Modbus) over “code” and “parameter”. See Section “CRC-16 computation function”. Online calculator: e.g. <https://www.lammertbies.nl/comm/info/crc-calculation.html>
If the CRC is incorrect, the command is ignored.

COMMAND LIST

COMMAND	CODE	DESCRIPTION
set period	0x0001	Set sampling period in seconds (1...65535).
set period + save	0x0002	... + save settings.
set dr	0x0003	Set default TX data rate. Used for next TX. Actual data rate for following TX may vary, if ADR is enabled. ¹
set dr + save	0x0004	... + save settings.
set adr on	0x0005	Enable ADR.
set adr on + save	0x0006	... + save settings.
set adr off	0x0007	Disable ADR.

set adr off + save	0x0008	... + save settings.
set dr_min	0x0009	Set minimum data rate (dr_min overrides ADR settings). ¹
set dr_min + save	0x000A	... + save settings.
set dr_max	0x000B	Set maximum data rate (dr_max overrides ADR settings). ¹
set dr_max + save	0x000C	... + save settings.
set pwridx_min	0x000D	Set minimum TX power index (overrides ADR settings). ¹
set pwridx_min + save	0x000E	... + save settings.
set pwridx_max	0x000F	Set maximum TX power index (overrides ADR settings). ¹
set pwridx_max + save	0x0010	... + save settings.
set send_period	0x0011	Set send period. Examples: 0 or 1: send after every sampling. 4: send after every fourth sampling.
set send_period + save	0x0012	... + save settings.
set join_period	0x0013	Set re-join period in hours (0...1000). Examples: 24: re-join network every 24 hours. 0: never re-join.
set join_period + save	0x0014	... + save settings.
set pwridx	0x0015	Set default TX power index. Used for next TX. Actual pwridx for following TX may vary, if ADR is enabled. ¹
set pwridx + save	0x0016	... + save settings.
set linkcheck_period	0x0017	Set link check period (default: 36).
set linkcheck_period + save	0x0018	... + save settings.
set linkcheck_tolerance	0x0019	Set link check tolerance (default: 6).
set linkcheck_tolerance + save	0x001A	... + save settings.
set linkcheck_limit	0x001B	Set link check limit (default: 12).
set linkcheck_limit + save	0x001C	... + save settings.
set param 0	0x0020	Set device specific parameter 0. Range: 0...65534; 65535: parameter is ignored.
set param 1	0x0021	Set device specific parameter 1. Range: 0...65534; 65535: parameter is ignored.
...	...	...

set param 15	0x002F	Set device specific parameter 15. Range: 0...65534; 65535: parameter is ignored.
set param 0 + save	0x0030	... + save settings.
set param 1 + save	0x0031	... + save settings.
...	...	...
set param 15 + save	0x003F	... + save settings.
reset	0xFEFE	Reset device. Unsaved parameter changes are lost.
factory reset	0xFEf0	Erase settings in flash and reset.
sleep	0xFEf1	Enter sleep mode (power off).

DOWNLINK COMMAND EXAMPLES

set period 60 seconds	0001003CF551
set period 600 seconds	000102587E51
set period 3600 seconds	00010E104854
set period 60 seconds + save	0002003CF5A1
set period 600 seconds + save	000202587EA1
set period 3600 seconds + save	00020E1048A4
set dr 0	0003000024F0
set dr 1	00030001E431
set dr 2	00030002E571
set dr 3	0003000325B0
set dr 4	00030004E7F1
set dr 5	000300052730
set dr 0 + save	00040000E541
set dr 1 + save	000400012580
set dr 2 + save	0004000224C0
set dr 3 + save	00040003E401
set dr 4 + save	000400042640
set dr 5 + save	00040005E681
set adr on	000500002510
set adr on + save	0006000025E0
set adr off	00070000E5B1
set adr off + save	00080000E681
set send_period 1	00110001E191
set send_period 10	0011000A26D0

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set send_period 20	001100142E50
set send_period 1 + save	00120001E161
set send_period 10 + save	0012000A2620
set send_period 20 + save	001200142EA0
set param 0 1000	002003E85001
set param 0 1000 + save	003003E89500
set param 1 2000	002107D08253
set param 1 2000 + save	003107D04752
reset	FEFE00003C50
factory reset	FEF00000FF31

APPENDIX

LINK CHECK FEATURE

The link check feature enables the device to determine if it is connected to the LoRaWAN network or not. If it is not connected, it will try to join the network. The link is checked periodically by requesting an acknowledgment packet (ACK) from the network. If an ACK is received, the device knows that it is connected. If no ACK is received, the device will continue requesting ACKs with increasing transmit power and spreading factor until it receives an ACK, or until the link check limit is reached. If the link check limit is reached, it will try to re-join the network.

The following configuration parameters are available:

- `linkcheck_period` (default: 36): Request an ACK for every nth transmission. `linkcheck_period = 0`: link check feature is disabled.
- `linkcheck_tolerance` (default: 6): After requesting n ACKs without receiving one, switch to higher transmit power and higher spreading factor (increase range).
- `linkcheck_limit` (default: 12): After requesting n ACKs without receiving one, re-join the network.

LORAWAN DATA RATES AND POWER INDEX

EU868 BAND

DATA RATE	CONFIGURATION	BIT RATE	POWER IDX	TX POWER
0	SF12 / 125 kHz	250 bit/s	0	---
1	SF11 / 125 kHz	440 bit/s	1	14 dBm
2	SF10 / 125 kHz	980 bit/s	2	11 dBm
3	SF9 / 125 kHz	1760 bit/s	3	8 dBm
4	SF8 / 125 kHz	3125 bit/s	4	5 dBm
5	SF7 / 125 kHz	5470 bit/s	5	2 dBm

US915 BAND

DATA RATE	CONFIGURATION	BIT RATE	POWER IDX	TX POWER
0	SF10 / 125 kHz	980 bit/s	5	20 dBm
1	SF9 / 125 kHz	1760 bit/s	7	16 dBm
2	SF8 / 125 kHz	3125 bit/s	8	14 dBm
3	SF7 / 125 kHz	5470 bit/s	9	12 dBm
4	SF8 / 500 kHz	12500 bit/s	10	10 dBm

CRC-16 COMPUTATION FUNCTION

```

////////////////////////////////////
// CRC-16-IBM (used by Modbus, USB, others. polynomial: 0x8005 / 0xA001)
////////////////////////////////////
uint16_t crc16(uint8_t* buf, uint16_t size) {
    uint16_t crc;
    uint8_t n, m, x;
    crc = 0xFFFF;
    m = size;
    x = 0;
    // loop over all bits
    while (m > 0) {
        crc = crc ^ buf[x];
        for (n=0; n<8; n++) {
            if (crc & 1) {
                crc = crc >> 1;
                crc = crc ^ 0xA001;
            }
            else {
                crc = crc >> 1;
            }
        }
        m--;
        x++;
    }
    return crc;
}

```

DISCLAIMER

Specifications and information in this document are subject to change without notice.

Decentlab products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

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