

DECENTLAB

DEVICE CONFIGURATION INTERFACES

VERSION 1.6.0

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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.

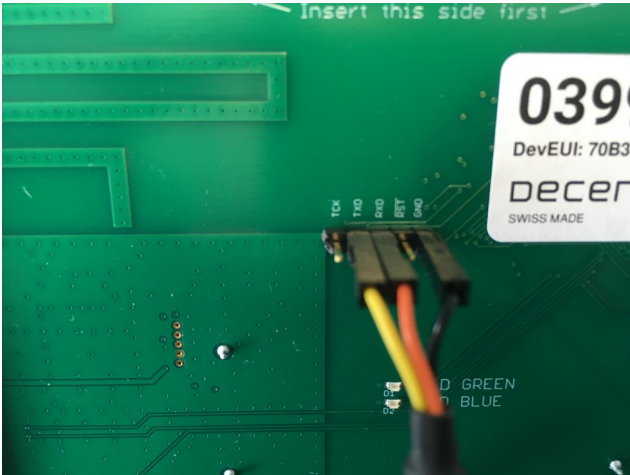
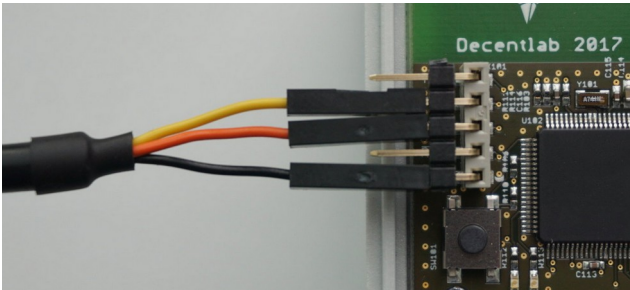
ELECTRICAL CONNECTION

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 illustrations.

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

COMMAND	DESCRIPTION	FIRMWARE
reset	Reset device. Unsaved parameter changes are lost.	≥ 0.2.7
sleep	Enter sleep mode (power off).	≥ 1.5.0
version	Get device software version.	≥ 0.2.7
save	Save all current parameters in flash.	≥ 0.2.7
save keys	Save LoRaWAN keys in flash (DevEUI, AppEUI, AppKey, DevAddr, NwksKey, AppSKey). See examples.	≥ 1.5.0
factory reset	Erase settings in flash and reset.	≥ 0.2.7
get period	Get sampling period in seconds.	≥ 0.2.7
set period <p>	Set sampling period in seconds (1...65535).	≥ 0.2.7
get send_period	Get send period relative to sampling period (default: 1).	≥ 1.4.0
set send_period <p>	Set send period. Examples: p = 0 or 1: send after every sampling. p = 4: send after every fourth sampling.	≥ 1.4.0
get mode	Get LoRaWAN activation mode.	≥ 0.2.7
set mode otaa	Select OTAA (over-the-air activation).	≥ 0.2.7
set mode abp	Select ABP (activation by personalization).	≥ 0.2.7
get dr	Get default TX data rate. Actual data rate may vary, if ADR is enabled. ¹	≥ 0.2.7

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

COMMAND	DESCRIPTION	FIRMWARE
set dr <p>	Set default TX data rate. Used for next TX. Actual data rate for following TX may vary, if ADR is enabled. ¹	≥ 0.2.7
get adr	0: ADR disabled, 1: ADR enabled.	≥ 0.2.7
set adr on	Enable ADR.	≥ 0.2.7
set adr off	Disable ADR.	≥ 0.2.7
get pwridx	Get default TX power index. Actual power index may vary, if ADR is enabled. ¹	≥ 0.2.7
set pwridx <p>	Set default TX power index. Used for next TX. Actual power index for following TX may vary, if ADR is enabled. ¹	≥ 0.2.7
get deveui	Get DevEUI: 8 bytes in hex (16 hex characters).	≥ 0.2.7
set deveui <p>	Set DevEUI. Please follow the command sequence in the examples.	≥ 0.2.7
get appeui	Get AppEUI: 8 bytes in hex (16 hex characters).	≥ 0.2.7
set appeui <p>	Set AppEUI. Please follow the command sequence in the examples.	≥ 0.2.7
set appkey <p>	Set AppKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.	≥ 0.2.7
get devaddr	Get DevAddr: 4 bytes in hex (8 hex characters).	≥ 0.2.7
set devaddr <p>	Set DevAddr. Please follow the command sequence in the examples.	≥ 0.2.7
set nwkskey <p>	Set NwksKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.	≥ 0.2.7
set appskey <p>	Set AppSKey: 16 bytes in hex (32 hex characters). Please follow the command sequence in the examples.	≥ 0.2.7
get nodeid	Get Decentlab device ID (0...65535).	≥ 0.2.7
set nodeid <p>	Set Decentlab device ID (0...65535).	≥ 0.2.7
read	Read sensors now (and send, if send_period has elapsed).	≥ 0.2.7
send	Read sensors now and send data.	≥ 1.4.2
get dr_min	Get minimum data rate (dr_min overrides ADR settings). ¹	≥ 1.2.0
set dr_min <p>	Set minimum data rate (dr_min overrides ADR settings). ¹	≥ 1.2.0
get dr_max	Get maximum data rate (dr_max overrides ADR settings). ¹	≥ 1.2.0
set dr_max <p>	Set maximum data rate (dr_max overrides ADR settings). ¹	≥ 1.2.0
get pwridx_min	Get minimum TX power index (overrides ADR settings). ¹	≥ 1.2.0
set pwridx_min <p>	Set minimum TX power index (overrides ADR settings). ¹	≥ 1.2.0

COMMAND	DESCRIPTION	FIRMWARE
get pwridx_max	Get maximum TX power index (overrides ADR settings). ¹	≥ 1.2.0
set pwridx_max <p>	Set maximum TX power index (overrides ADR settings). ¹	≥ 1.2.0
get param <i>	Get device specific parameter i, i = 0...15.	≥ 1.4.0
set param <i> <p>	Set device specific parameter i, i = 0...15. Range: p = 0...65534; 65535: parameter is ignored.	≥ 1.4.0
get chmask	Get LoRaWAN channel mask: 9 bytes in hex (18 hex characters).	≥ 1.4.1
set chmask <p>	Set LoRaWAN channel mask. Issue "save" and "reset" afterwards. See examples.	≥ 1.4.1
get join_period	Get re-join period in hours.	≥ 1.4.2
set join_period <p>	Set re-join period in hours (0...1000). Examples: p = 24: re-join network every 24 hours. p = 0: never re-join.	≥ 1.4.2
get sensor_period <i>	Get (sub-)sampling period of sensor i, i = 0...9, relative to sampling period (default: 1).	≥ 1.4.4
set sensor_period <i> <p>	Set (sub-)sampling period of sensor i. Examples: p = 1: sensor i is sampled every sampling period (default). p = 0: sensor i is never sampled (off). p = 4: sensor i is sampled every fourth period.	≥ 1.4.4
get linkcheck_period	Get linkcheck period (default: 36). ²	≥ 1.5.0
set linkcheck_period <p>	Set linkcheck period. ²	≥ 1.5.0
get linkcheck_tolerance	Get linkcheck tolerance (default: 6). ²	≥ 1.5.0
set linkcheck_tolerance <p>	Set linkcheck tolerance. ²	≥ 1.5.0
get linkcheck_limit	Get linkcheck limit (default: 12). ²	≥ 1.5.0
set linkcheck_limit <p>	Set linkcheck limit. ²	≥ 1.5.0
get port	Get LoRaWAN uplink port (1...223, default: 1).	≥ 1.6.0
set port <p>	Set LoRaWAN uplink port (1...223, default: 1).	≥ 1.6.0
<others>	Invalid command. Answer: "unknown command".	

² See Section "Link check feature".

EXAMPLES

BASIC EXAMPLES

set dr 3	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.
set pwridx 1	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.
set adr on	Enable ADR from now on.
set mode abp save reset	Set ABP mode, save, reset. Make sure DevAddr, NwksKey and AppSKey are valid!
set mode otaa save reset	Set OTAA mode, save, reset. Make sure DevEUI, AppEUI and AppKey are valid!
set dr_min 2	Limit data rate to 2 or higher, overriding ADR settings. ¹
set dr_max 2	Limit data rate to 2 or lower, overriding ADR settings. ¹
set pwridx_min 2	Limit power index to 2 or higher, overriding ADR settings. ¹
set pwridx_max 1	Limit power index to 1 or lower, overriding ADR settings. ¹
set param 0 1000	Set device specific parameter 0 to 1000.
set param 1 2000	Set device specific parameter 1 to 2000.

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
    
```

Note: For firmware versions lower than 1.5.0, use the following sequence: reset; set deveui; set appeui; set appkey; save; 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
```

Note: For firmware versions lower than 1.5.0, use the following sequence: reset; set devaddr; set nwkskey; set appskey; save; reset.

CHANNEL MASK CONFIGURATION (US915)

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

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 ENCODER

The Decentlab online downlink command encoder provides an easy way to generate the command codes using a graphical interface: <https://www.decentlab.com/support/downlink-command-encoder>

The respective source code is available here: <https://github.com/decentlab/decentlab-decoders>

Decentlab Downlink Command Encoder

Compatible firmware version
1.6.0

Command
set period
Set sampling period in seconds (1...65535).

Parameter value
600

Hex-encoded command
000102587E51

Base64-encoded command
AAECWH5R

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	FIRMWARE
set period	0x0001	Set sampling period in seconds (1...65535).	≥ 0.2.7
set period + save	0x0002	... + save settings.	≥ 0.2.7
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	≥ 0.2.7
set dr + save	0x0004	... + save settings.	≥ 0.2.7
set adr on	0x0005	Enable ADR.	≥ 0.2.7
set adr on + save	0x0006	... + save settings.	≥ 0.2.7
set adr off	0x0007	Disable ADR.	≥ 0.2.7
set adr off + save	0x0008	... + save settings.	≥ 0.2.7
set dr_min	0x0009	Set minimum data rate (dr_min overrides ADR settings). ¹	≥ 1.2.0
set dr_min + save	0x000A	... + save settings.	≥ 1.2.0
set dr_max	0x000B	Set maximum data rate (dr_max overrides ADR settings). ¹	≥ 1.2.0
set dr_max + save	0x000C	... + save settings.	≥ 1.2.0
set pwridx_min	0x000D	Set minimum TX power index (overrides ADR settings). ¹	≥ 1.2.0
set pwridx_min + save	0x000E	... + save settings.	≥ 1.2.0
set pwridx_max	0x000F	Set maximum TX power index (overrides ADR settings). ¹	≥ 1.2.0
set pwridx_max + save	0x0010	... + save settings.	≥ 1.2.0
set send_period	0x0011	Set send period. Examples: 0 or 1: send after every sampling. 4: send after every fourth sampling.	≥ 1.4.0
set send_period + save	0x0012	... + save settings.	≥ 1.4.0
set join_period	0x0013	Set re-join period in hours (0...1000). Examples: 24: re-join network every 24 hours. 0: never re-join.	≥ 1.4.2
set join_period + save	0x0014	... + save settings.	≥ 1.4.2
set pwridx	0x0015	Set default TX power index. Used for next TX. Actual pwridx for following TX may vary, if ADR is enabled. ¹	≥ 1.4.5

COMMAND	CODE	DESCRIPTION	FIRMWARE
set pwridx + save	0x0016	... + save settings.	≥ 1.4.5
set linkcheck_period	0x0017	Set link check period (default: 36).	≥ 1.5.0
set linkcheck_period + save	0x0018	... + save settings.	≥ 1.5.0
set linkcheck_tolerance	0x0019	Set link check tolerance (default: 6).	≥ 1.5.0
set linkcheck_tolerance + save	0x001A	... + save settings.	≥ 1.5.0
set linkcheck_limit	0x001B	Set link check limit (default: 12).	≥ 1.5.0
set linkcheck_limit + save	0x001C	... + save settings.	≥ 1.5.0
set port	0x001D	Set LoRaWAN uplink port (1...223, default: 1).	≥ 1.6.0
set port + save	0x001E	... + save settings.	≥ 1.6.0
set param 0	0x0020	Set device specific parameter 0. Range: 0...65534; 65535: parameter is ignored.	≥ 1.4.0
set param 1	0x0021	Set device specific parameter 1.	≥ 1.4.0
...
set param 15	0x002F	Set device specific parameter 15.	≥ 1.4.0
set param 0 + save	0x0030	... + save settings.	≥ 1.4.0
set param 1 + save	0x0031	... + save settings.	≥ 1.4.0
...
set param 15 + save	0x003F	... + save settings.	≥ 1.4.0
set sensor_period 0	0x0050	Set (sub-)sampling period of sensor 0.	≥ 1.4.5
set sensor_period 1	0x0051	Set (sub-)sampling period of sensor 1.	≥ 1.4.5
...
set sensor_period 9	0x0059	Set (sub-)sampling period of sensor 9.	≥ 1.4.5
set sensor_period 0 + save	0x0060	... + save settings.	≥ 1.4.5
set sensor_period 1 + save	0x0061	... + save settings.	≥ 1.4.5
...
set sensor_period 9 + save	0x0069	... + save settings.	≥ 1.4.5
reset	0xFEFE	Reset device. Unsaved parameter changes are lost.	≥ 0.2.7
factory reset	0xFEf0	Erase settings in flash and reset.	≥ 0.2.7
sleep	0xFEf1	Enter sleep mode (power off).	≥ 1.5.0

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
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	16 dBm
1	SF11 / 125 kHz	440 bit/s	1	14 dBm
2	SF10 / 125 kHz	980 bit/s	2	12 dBm
3	SF9 / 125 kHz	1760 bit/s	3	10 dBm
4	SF8 / 125 kHz	3125 bit/s	4	8 dBm
5	SF7 / 125 kHz	5470 bit/s	5	6 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.

CONTACT INFORMATION

www.decentlab.com/contact

mail@decentlab.com

+41 44 809 35 90

Decentlab GmbH
Kriesbachstrasse 30
8600 Dübendorf
Switzerland

REVISION HISTORY

VERSION	DATE	PAGES	CHANGES
1.5.1	17.06.2019		Initial release. Valid for firmware versions \geq 1.5.0.
1.6.0	13.07.2021		Add commands supported by firmware version 1.6.0. Add information about firmware versions for each command. Add information about previous firmware versions.
1.6.0	28.02.2022		Add section: Downlink command encoder.
