Downlink command interface

General remarks

- Parameter changes without the save option are lost after a reset or power cycle.

- Command with the save option permanently store the current parameter settings in flash.

- Use with caution: Certain commands / parameters may render a device unresponsive / unreachable in the field until it is manually reset.

- Send downlink command 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: CRC-16 (Modbus) of | Code | Parameter |. See Section CRC-16 computation function. Online calculator: e.g. https://www.lammertbies.nl/comm/info/crc-calculation.html

- If CRC does not match, 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.
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 (overrides ADR settings).
set dr_min + save	0x000A	… + save settings.
set dr_max	0x000B	Set maximum data rate (overrides ADR settings).
set dr_max + save	0x000C	… + save settings.
set pwridx_min	0x000D	Set minimum Tx power index (overrides ADR settings).
set pwridx_min + save	0x000E	… + save settings.
set pwridx_max	0x000F	Set maximum Tx power index (overrides ADR settings).
set pwridx_max + save	0x0010	… + save settings.

Command	Code	Description
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 param 0	0x0020	Set parameter 0 (0...65534; 65535: invalid).
set param 1	0x0021	Set parameter 1 (0...65534; 65535: invalid).
…	…	…
set param 15	0x002F	Set parameter 15 (0...65534; 65535: invalid).
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; un-saved parameter changes are lost.
factory reset	0xFEF0	Erase settings in flash and reset.

Examples (EU868 band)

set period 600	000102587E51
set period 3600	00010E104854
set period 600 seconds + save	000202587EA1
set period 60 seconds + save	0002003CF5A1
set dr 3	0003000325B0
set dr 3 + save	00040003E401
set adr on	000500002510
set adr on + save	0006000025E0
set adr off	00070000E5B1
set adr off + save	00080000E681
set send_period 10	0011000A26D0
set send_period 10 + save	0012000A2620
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
```

Data rate and power index (EU868 band)

Data rate	Configuration	Bit rate		Power idx	Tx Power
0	SF12 / 125 kHz	250 bit/s		1	14 dBm
1	SF11 / 125 kHz	440 bit/s		2	11 dBm
2	SF10 / 125 kHz	980 bit/s		3	8 dBm
3	SF9 / 125 kHz	1760 bit/s		4	5 dBm
4	SF8 / 125 kHz	3125 bit/s		5	2 dBm
5	SF7 / 125 kHz	5470 bit/s			

Data rate and power index (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;
}
```

Command line interface

Electrical connection

You can use a commercially available USB-to-serial adapter cable to connect a PC to the sensor device. CAUTION: Use adapters with **3 V (max. 3.3 V) TTL** logic levels! 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):

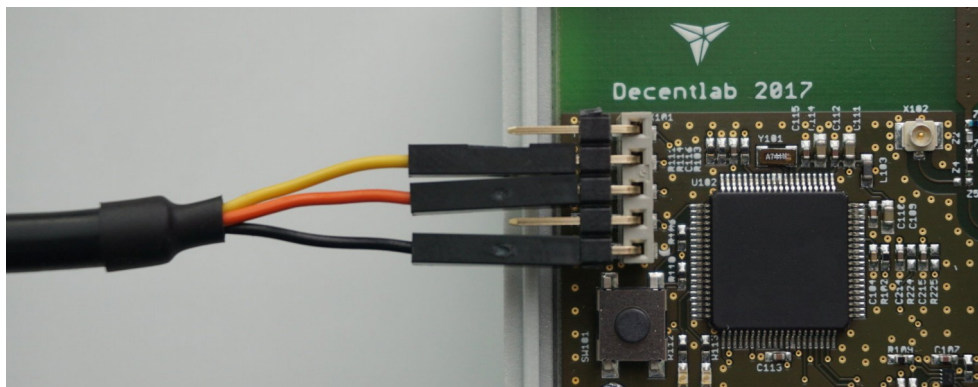| Cable	Device
	TCK
RXD	TXD
TXD	RXD
	RST
GND	GND

Illustration 1: Serial interface connection (3.3 V TTL levels).

General remarks

- The ASCII command line interface is active only for 10 min after device reset / power-up. Entering any character restarts the 10 min timeout period.

- Connect using a serial terminal program with settings 115200, 8, N, 1.

- Characters are not echoed. Enable local echoing in your terminal program if needed.

- Terminate each command with CR ('\r', 0x0D), LF ('\n', 0x0A) or both.

- set and get commands operate on parameters in the device software, not directly on the radio module.

- Some commands only take effect after reset (e.g. set deveui).

- Parameter changes (set …) are lost when the device is reset, except when save is issued.

- save permanently stores current parameter settings in flash.

Command list

`reset`	Reset; un-saved parameter changes are lost.
`version`	Get device software version.
`save`	Save current parameter set in flash.
`factory reset`	Erase settings in flash and reset.
`get period`	Get sampling period in seconds.
`set period <p>`	Set sampling period in seconds (1...65535).
`get send_period`	Get send period relative to sampling period (default: 1).
`set send_period <p>`	Set send period. Examples: p = 0 or 1: send after every sampling; p = 4: send after every fourth sampling.
`get mode`	Get LoRaWAN activation mode.
`set mode otaa`	Select OTAA (over-the-air activation).
`set mode abp`	Select ABP (activation by personalization).
`get dr`	Get default Tx data rate. Actual data rate may vary, if ADR is enabled.
`set dr <p>`	Set default Tx data rate. Used for next Tx. Actual data rate for following Tx may vary, if ADR is enabled.
`get adr`	0: ADR disabled, 1: ADR enabled.
`set adr on`	Enable ADR.
`set adr off`	Disable ADR.
`get pwridx`	Get default Tx power index. Actual power index may vary, if ADR is enabled.
`set pwridx <p>`	Set default Tx power index. Used for next Tx. Actual power index for following Tx may vary, if ADR is enabled.
`get deveui`	Get DevEUI: 8 bytes in hex (16 hex characters).
`set deveui <p>`	Set DevEUI. Issue `save` and `reset` afterwards.
`get appeui`	Get AppEUI: 8 bytes in hex (16 hex characters).
`set appeui <p>`	Set AppEUI. Issue `save` and `reset` afterwards.
`set appkey <p>`	Set AppKey: 16 bytes in hex (32 hex characters). Issue `save` and `reset` afterwards.
`get devaddr`	Get DevAddr: 4 bytes in hex (8 hex characters).
`set devaddr <p>`	Set DevAddr. Issue `save` and `reset` afterwards.
`set nwkskey <p>`	Set NwkSKey: 16 bytes in hex (32 hex characters). Issue `save` and `reset` afterwards.
`set appskey <p>`	Set AppSKey: 16 bytes in hex (32 hex characters). Issue `save` and `reset` afterwards.

`get nodeid`	Get Decentlab device ID (0...65535).
`set nodeid <p>`	Set Decentlab device ID (0...65535).
`get hweui`	Get radio module hardware EUI.
`read`	Read sensors now (and send, if send_period has elapsed).
`get dr_min`	Get minimum data rate (overrides ADR settings).
`set dr_min <p>`	Set minimum data rate (overrides ADR settings).
`get dr_max`	Get maximum data rate (overrides ADR settings).
`set dr_max <p>`	Set maximum data rate (overrides ADR settings).
`get pwridx_min`	Get minimum Tx power index (overrides ADR settings).
`set pwridx_min <p>`	Set minimum Tx power index (overrides ADR settings).
`get pwridx_max`	Get maximum Tx power index (overrides ADR settings).
`set pwridx_max <p>`	Set maximum Tx power index (overrides ADR settings).
`get param <i>`	Get parameter i, i = 0...15.
`set param <i> <p>`	Set parameter i, i = 0...15, p = 0...65534 (65535: invalid).
`get chmask`	Get LoRaWAN channel mask: 9 bytes in hex (18 hex characters).
`set chmask <p>`	Set LoRaWAN channel mask. Issue `save` and `reset` afterwards. See examples (below).
`get join_period`	Get re-join period in hours.
`set join_period <p>`	Set re-join period in hours (0...1000). Examples: 24: re-join network every 24 hours. 0: never re-join.
`<others>`	Invalid command. Answer: `unknown command`.

Examples (EU868 band)

`set dr 3`	Set default data rate: SF9 / 125 kHz. Used for next Tx. Actual data rate for following Tx may vary, if ADR is enabled.
`set pwridx 1`	Set default Tx power index: 14 dBm. 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!

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Specifications in this document are subject to change without notice.

```
set mode otaa      Set OTAA mode; save; reset. Make sure DevEUI, AppEUI and AppKey
save               are valid!
reset
```

`set dr_min 2`	Use only SF10...SF7, overriding ADR settings.
`set dr_max 2`	Use only SF12...SF10, overriding ADR settings.
`set pwridx_min 2`	Use maximum 11 dBm, overriding ADR settings.
`set pwridx_max 1`	Use minimum 14 dBm, overriding ADR settings.
`set param 0 1000`	Set parameter 0 to 1000.
`set param 1 2000`	Set parameter 1 to 2000.

```
set deveui 0123456789ABCDEF                    Device customization: Set DevEUI;
set appeui 000ABC394380221F                    set AppEUI; set AppKey; save to
set appkey 0123456789ABCDEF0123456789ABCDEF    flash; reset device.
save
reset
```

Examples (US915 band)

Note: The examples for EU868 (above) also apply to US915 devices, only that the values for data rates and power indexes differ.

```
set chmask FF0000000000000000    Set LoRaWAN channel mask: Enable channels 0...7, disable
save                             channels 8...71.
reset
```

```
set chmask 00FF00000000000002    Set LoRaWAN channel mask: Enable channels 8...15 and
save                             65, disable all others.
reset
```

```
set chmask 010000000000000000    Set LoRaWAN channel mask: Enable channel 0, disable all
save                             others.
reset
```

```
set chmask 030000000000000000    Set LoRaWAN channel mask: Enable channels 0 and 1,
save                             disable all others.
reset
```

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

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