



LoRaWAN[®] Solenoid Valve Controller

UC51x Series

Communication Protocol



Revision History

Date	Doc Version	Description
Feb. 23, 2021	V 1.0	Initial version
Dec. 1, 2021	V 1.1	Valve control sequence supports 00
Feb. 25, 2022	V 2.0	Add schedule settings and other commands based on hardware 2.x
June 15, 2022	V 2.1	Add the example of GPIO type is DI
Nov. 21, 2022	V 2.2	Add DI type uplink packet
March 20, 2023	V 3.0	Update based on hardware 3.x

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1. Overview

UC51x Series use the standard Milesight IoT payload format based on IPSO. All data are based on following format, the Data field should follow little endian:

Channel1	Type1	Data1	Channel2	Type2	Data2	Channel 3	...
1 Byte	1 Byte	N Bytes	1 Byte	1 Byte	M Bytes	1 Byte	...

Note:

- 1) All explanations and examples in this document are based on HEX format.
- 2) For all Milesight IoT decoder examples please find files on <https://github.com/Milesight-IoT/SensorDecoders>

2. Uplink Payload

Uplink payloads of UC51x Series are made up of device information and sensor data.

2.1 Device Information

UC51x series will report basic device information every time it joins the network.

Channel	Type	Data Size/Byte	Description
ff	01(Protocol Version)	1	01=> V1
	09 (Hardware Version)	2	03 10 => V3.1
	0a (Software Version)	2	03 01 => V3.1
	0b (Power On)	1	Device is on
	0f (Device Type)	1	00 = Class A, 01 = Class B, 02 = Class C, 03 = Class C to B
	16 (Device SN)	8	16 digits

Example:

ff0bff ff0101 ff166415a51585070020 ff090300 ff0a0301 ff0f00					
Channel	Type	Value	Channel	Type	Value
ff	0b (Power On)	ff (reserved)	ff	01 (Protocol Version)	01 (V1)
Channel	Type	Value	Channel	Type	Value
ff	16 (Device SN)	64 15 a5 15 85 07 00 20	ff	09 (Hardware version)	0300 (V3.0)
Channel	Type	Value	Channel	Type	Value
ff	0a (Software version)	0301 (V3.1)	ff	0f (Device Type)	00 (Class A)

2.2 Sensor Data

UC51x series reports valve and pulse data according to reporting interval (20 mins by default) or when the valve status changes. **Battery level is reported every 6 hours for UC511 and every 12 hours for UC512.**

Note: every GPIO interface can only upload either Pulse Counter value or DI status according to configurations.

Channel	Type	Data Size/Byte	Description
01	75 (Battery Level)	1	Unit: %
03 (Valve 1)	01 (Valve)	1	00 = closed, 01 = open
04 (GPIO 1)	c8 (Counter)	4	Unsigned
05 (Valve 2)	01 (Valve)	1	00 = closed, 01 = open
06 (GPIO 2)	c8 (Counter)	4	Unsigned
07 (GPIO 1)	01 (DI)	1	00 = closed, 01 = open
08 (GPIO 2)	01 (DI)	1	00 = closed, 01 = open

Example:

017564 030101 04c84f000000 050100 080100					
Channel	Type	Value	Channel	Type	Value
01	75 (Battery)	64 => 100%	03 (Valve 1)	01 (Valve)	01 => Open
Channel	Type	Value	Channel	Type	Value
04 (GPIO 1)	c8 (Pulse Counter)	4f 00 00 00 => 00 00 00 4f = 79	05 (Valve 2)	01 (Valve)	00 => Closed
Channel	Type	Value			
08 (GPIO 2)	01 (DI)	00 => Closed			

3. Downlink Payload

Downlink is used for controlling the UC51x via network server remotely. Downlink port (Application port) is 85 by default and can be configured via ToolBox.

3.1 Valve Control

UC51x supports instant valve control via downlink payload. **Before control via these commands, ensure the device does not enable any schedule plan, otherwise these commands will not work.**

Basic format:

Channel	Type	Control Field	Sequence	Time Control (Option)	Flow Control (Option)
ff	1d	1 Byte	1 Byte (01 to ff or 00)	3 Bytes (Unit: s)	4 Bytes

Control Field:

Bit	7	6	5	4-2	1-0
Description	0: Disable time control 1: Enable time control	0: Disable flow control 1: Enable flow control	0: Valve close 1: Valve open	000	00: Valve 1 01: Valve 2

Note:

- 1) If you set the sequence as 01 to ff, the sequence should be increased after it has been used in one command sent to devices. For example, if you use command ff 1d 20 01 (sequence 01) to control the valve successfully, the next command should be ff 1d 20 02 (sequence 02). Wrong sequence will cause command invalid.
- 2) If the sequence is up to ff (255), please use sequence beginning as 01.
- 3) If the device receives the control command, it will send reply message start with "fe"; if the command take effect, the device will send one more packet to update the current valve status. For example, if you send command ff 1d 21 01,
Control success: fe 1d 21 01+ 05 01 01 06 c8 00 00 00 00
Control failure: fe 1d 21 01

Examples:

1. Open the valve 2 right away.

ff1d2100					
Channel	Type	Control Field		Sequence	
ff	1d	21 => 0010 0001 Bit5: 1 => valve open Bit0-1: 01 => valve 2		00	

2. Open the valve 1 for 60s.

ff1da0003c0000				
Channel	Type	Control Field	Sequence	Time Control
ff	1d	a0 => 1010 0000 Bit7: 1 => enable time control Bit5: 1 => valve open Bit0-1: 00 => valve 1	00	3c 00 00=>00 00 3c=60s

3. Open the valve 2 until the pulse counter 2 increases 16 pulses.

ff1d610010000000				
Channel	Type	Control Field	Sequence	Flow Control
ff	1d	61 => 0110 0001 Bit6: 1 => enable flow control Bit5: 1 => valve open Bit0-1: 01 => valve 2	00	10 00 00 00 => 00 00 00 10 = 16

4. Open the valve 1 until the 60s passes or pulse counter 1 increases 6 pulses.

ff1de0003c0000600000					
Channel	Type	Control Field	Sequence	Time Control	Flow Control
ff	1d	e0 => 1110 0000 Bit7: 1 => enable time control Bit6: 1 => enable flow control Bit5: 1 => valve open Bit0-1: 00 => valve 1	00	3c 00 00 => 00 00 3c = 60s	06 00 00 00 => 00 00 00 06 = 6

3.2 Schedule Setting

UC51x series supports setting schedule plan to open or close valves at specific time.

3.2.1 Time Setting

1. Set the time zone.

Channel	Type	Description
ff	17	2 Bytes, UTC timezone * 10

Examples:

ff17ecff		
Channel	Type	Value
ff	17	ec ff => ff ec = -20 the time zone is UTC-2

ff171400		
Channel	Type	Value
ff	17	14 00 => 00 14 = 20 the time zone is UTC+2

2. Sync the time to device from network server. Ensure the device LoRaWAN version is

1.0.3 or later before sending command.

ff4a00		
Channel	Type	Value
ff	4a (Sync the time)	00

3.2.2 Set Plan

Basic format:

Channel	Type	Number	Control Field	Repeat Field	Start Time	End Time	Water Volume (Pulse)
ff	4d	1Byte 01 to 10 (1~16)	1 Byte	1 Byte	1 Byte (hour) +1 Byte (minute)	1 Byte (hour) +1 Byte (minute)	2 Bytes

Control Field:

Bit	7	6	5-2	1-0
Description	0: Disable this plan 1: Enable this plan	0: Close 1: Open	0000	01: valve 1 10: valve 2 11: valve 1 & valve 2

Repeat Field:

Bit	7	6	5	4	3	2	1	0
Plan Repeat Day	0	Sunday	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday
Description	When the corresponding bit is set as 1, the plan will execute every this day of the week							

Note:

- 1) If you set two plans with the same number, the later plan will cover the previous plan.
- 2) If repeat field is 00, the plan will only execute once.

Examples:

1. Add plan 1: control valve 1 to open from 9:00 to 9:05, this plan is enabled and only execute once.

ff4d01c100090009050000							
Channel	Type	Number	Control Field	Repeat Field	Start Time	End Time	Water Volume (Pulse)
ff	4d	01	c1 => 1100	00	0900	0905	0000

			0001				
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2. Add plan 10: control valve 2 to open from 20:55 to 21:00, this plan is disabled and execute every weekend (Saturday and Sunday).

ff4d0a4260143715000000							
Channel	Type	Number	Control Field	Repeat Field	Start Time	End Time	Water Volume (Pulse)
ff	4d	0a => 10	42 => 0100 0010	60 => 0110 0000 = Sunday and Saturday	Byte 1: 14 => 20 Byte 2: 37 => 55	Byte: 15 => 21 Byte 2: 00	0000

3. Add plan 2: control valve 1 and valve 2 to open from 10:25 to 10:30 or until pulse counter 1 and pulse counter 2 increase total 6 pulses , this plan is disabled and execute every day.

ff4d02437f0a190a1e0600							
Channel	Type	Number	Control Field	Repeat Field	Start Time	End Time	Water Volume (Pulse)
ff	4d	02	43 => 0100 0011	7f => 0111 1111 = Everyday	Byte1: 0a => 10 Byte 2: 19 => 25	Byte1: 0a => 10 Byte 2: 1e => 30	0600 => 0006

3.2.3 Check Plan Content

Channel	Type	Value
ff	4c	Plan number 01 to 10 (1~16)

Example: Check plan 1 content.

ff4c01		
Channel	Type	Value
ff	4c	01 = plan 1

Reply:

fe4c01c1010905090a0a00			
Channel	Type	Number	Value

fe	4c	01 = plan 1	c1 = 1100 0001 => plan enable, open valve 1 01 = 0000 0001 => every Monday 0905 => start time is 9:05 090a => end time is 9:10 0a00 => 000a = pulse increase 10
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3.2.4 Check and Set Plan Status

Basic format 1:

Channel	Type	Command	Value
ff	4b	00: get plan status 01: set plan status 02: delete plan	2 Bytes Every bit indicate one plan 1: enable ; 0: disable or delete

Basic format 2:

Channel	Type	Command	Number	Enable
ff	4b	03: set one plan status 04: delete one plan	1 Byte, 01 to 10 (1~16)	01: enable 00: disable or delete

Note: When the device has multiple schedule plan settings that are conflicted, the device will only execute one plan whose item number is largest.

Example:

1. Check plan enable or disable status.

ff4b000000			
Channel	Type	Command	Value
ff	4b	00 = get	0000

Reply:

fe4b000200			
Channel	Type	Command	Value
fe	4b	00 = get	02 00 => 00 02 = 0000 0000 0000 0010 Only plan 2 is enabled, other are disabled or do not have content

2. Set plan 2 as enable and others as disabled.

Type 1:

ff4b010200			
Channel	Type	Command	Value
ff	4b	01 = set	02 00 => 00 02 = 0000 0000 0000 0010 Plan 2 are enabled and other are disabled

Type 2:

ff4b030201				
Channel	Type	Command	Number	Value
ff	4b	03 = set	02	01 = enabled

3. Delete plan 10.

Type 1:

ff4b02fffd			
Channel	Type	Command	Value
ff	4b	02 = delete	ff fd => fd ff = 1111 1101 1111 1111 Bit10 = 0 means Delete plan 10

Type 2:

ff4b040a00				
Channel	Type	Command	Number	Value
ff	4b	04 = delete	0a = 10	00 = deleted

3.3 Other Settings

Channel	Type	Description
ff	03 (Reporting Interval)	2 Bytes, unit: s
	10 (Reboot)	ff (Reserved)
	4e (Counter reset)	2 Bytes, Byte 1: 01=GPIO1 counter, 02=GPIO 2 counter Byte 2: 00
	68 (Data Storage)	00: disable, 01: enable
	69 (Data Retransmission)	00: disable, 01: enable
	6a (Data Retransmission Interval)	3 Bytes Byte 1: 00 Byte 2-3: interval time, unit:s range: 30~1200s (600s by default)

Example:

1. Set reporting interval as 20 minutes.

ff03b004

Channel	Type	Value
ff	03	b0 04 => 04 b0 = 1200s=20 minutes

2. Reset the counting of GPIO1 when it works as pulse counter.

ff4e0100			
Channel	Type	Counter	Command
ff	4e	01: counter 1	00

3. Reboot the device.

ff10ff		
Channel	Type	Value
ff	10	ff (Reserved)

4. Historical Data Enquiry

UC51x series support sending downlink commands to enquire historical data for specified time point or time range. Before that, ensure **the device time is correct and data storage feature was enabled to store the data.**

Command format:

Channel	Type	Description
fd	6b (Enquire data in time point)	4 Bytes, unix timestamp
fd	6c (Enquire data in time range)	Start time (4 bytes) + End time (4 bytes), Unix timestamp
fd	6d (Stop query data report)	ff
ff	6a (Report Interval)	3 Bytes Byte 1: 01 Byte 2-3: interval time, unit:s range: 30~1200s (60s by default)

Reply format:

Channel	Type	Description
fc	6b/6c	00: data enquiry success 01: time point or time range invalid 02: no data in this time or time range
20	ce (Historical Data)	Data time stamp (4 Bytes) + Interface Status (1 Byte) + Pulse Counter (4 Bytes) Interface Status: Bit4: valve 1=0, valve 2=1

		Bit2: DI status, close=0, open=1 Bit1: 0=counter mode, 1=DI mode Bit0: 0=valve close, 1=valve open
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Note:

1. The device only uploads no more than 300 data records per range enquiry.
2. When enquiring the data in time point, it will upload the data which is closest to the search point within the reporting interval range. For example, if the device reporting interval is 10 minutes and users send command to search for 17:00's data, if the device find there is data stored in 17:00, it will upload this data; if not, it will search for data between 16:50 to 17:10 and upload the data which is closest to 17:00.

Example:

1. Enquire historical data between 2023/03/09 17:00:00 to 2023/03/09 17:10:40.

fd6c 10a00964 90a20964		
Channel	Type	Value
fd	6c (Enquire data in time range)	Start time: 10a00964 => 6409a010 = 1678352400 =2023/03/09 17:00:00 End time: 90a20964 => 6409a290 = 1678353040 =2023/03/09 17:10:40

Reply:

fc6c00		
Channel	Type	Value
fc	6c (Enquire data in time range)	00: data enquiry success

20ce 3fa10964 0098000000 20ce 3fa10964 1700000000			
Channel	Type	Time Stamp	Value
20	ce (Historical Data)	3fa10964 => 2023/03/09 17:05:00	00: Valve 1 close 98 00 00 00 => 00 00 00 98 = pulse counter of GPIO1 is 152 17=10111=>Valve 2 open, DI status of GPIO2 is open

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