



OY1210

LoRaWAN CO2 meter

User manual

Version 0.4

October 2019

Table of Contents

1	Disclaimer.....	3
1.1	Technical support	3
1.2	EU Declaration of conformity	3
2	Warnings.....	4
3	Environmental.....	5
4	Product Description.....	6
5	Installation and activation	7
5.1	LoRaWAN Configuration	8
5.2	Sensor states and state check	9
5.2.1	Re-join functionality.....	10
6	Specification.....	11
7	Battery life.....	13
8	Security	13
9	Protocol.....	13
9.1	LoRaWAN standard commands.....	13
9.2	Unsolicited uplink status commands	13
9.3	Periodic measurement reports	14
9.3.1	Periodic measurement report	14
9.3.2	Measurement value	14
9.3.3	Example: Single measurement report.....	15
9.4	Downlink commands and queries	16
9.4.1	Measurement and reporting interval.....	19
9.4.2	Reset device.....	19
9.5	Uplink query response.....	19

1 Disclaimer

This document represents information on products at the time of publication and is subject to change without prior notice due to product improvements or other reasons. Talkpool makes no warranties based on the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Talkpool reserves all rights to this document and the information contained herein.

1.1 Technical support

Please visit www.talkpool.io for additional information, or contact IoT.support@talkpool.com

1.2 EU Declaration of conformity

EC DECLARATION OF CONFORMITY

certify that the design and manufacturing of this product

WIRELESS CO2 SENSOR /

FUNK-CO2 SENSOR /

TRÅDLÖS CO2 SENSOR /

TRÅDØS CO2 SENSOR /

DRAADLOZE CO2 SENSOR

OY1210 EU868

conforms to the following directives and standards

The Radio Equipment Directive (2014/53/EU),

EN 300 220-1 V2.4.1, EN 300220-2 V2.4.1,

EN 301 489-1 V1.9.2, EN 301 489-3 V2.1.1,

EN 60950-1:2006+A11+A1+A12+A2

EN 62479:2010

RoHS 2.0 Directive 2011/65/EU

European Delegated Directive (EU) 2015/863

REACH regulation 1907/2006 EU

This product was CE marked in year -19



2019-09-10

Managing Director

Stefan Lindgren

2 Warnings

The following safety precautions must be observed during all phases of the operation, usage, service or repair of this Talkpool product.

- Read the product manual.
- Do not modify the product.
- The product should not be exposed to extreme heat or open flame.
- The device must not be exposed to harsh chemical agents or solvents.
- The labelling of the product may not be changed, removed or made unrecognizable.

3 Environmental



This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste by taking it to a collection point designated for the recycling of electrical and electronic appliances. Separate collection and recycling of your waste at the time of disposal will contribute to conserving natural resources and guarantee recycling that respects the environment and human health. For further information concerning your nearest recycling center, please contact your nearest local authority/town hall offices, your household waste collection company or the shop where you bought the product.

4 Product Description

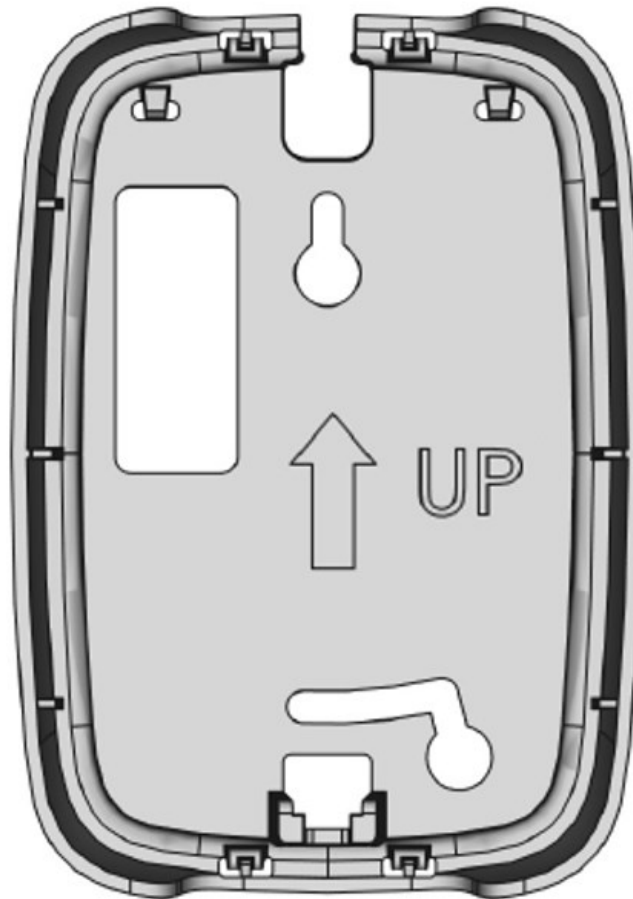


The OY1210 LoRaWAN CO2 meter is designed to measure carbon dioxide, temperature and humidity in indoor environments. The sensor is intended for indoor climate control, air quality monitoring and energy optimizations. It is optimized for reliable and secure measurements with more than 5 years life length on batteries.

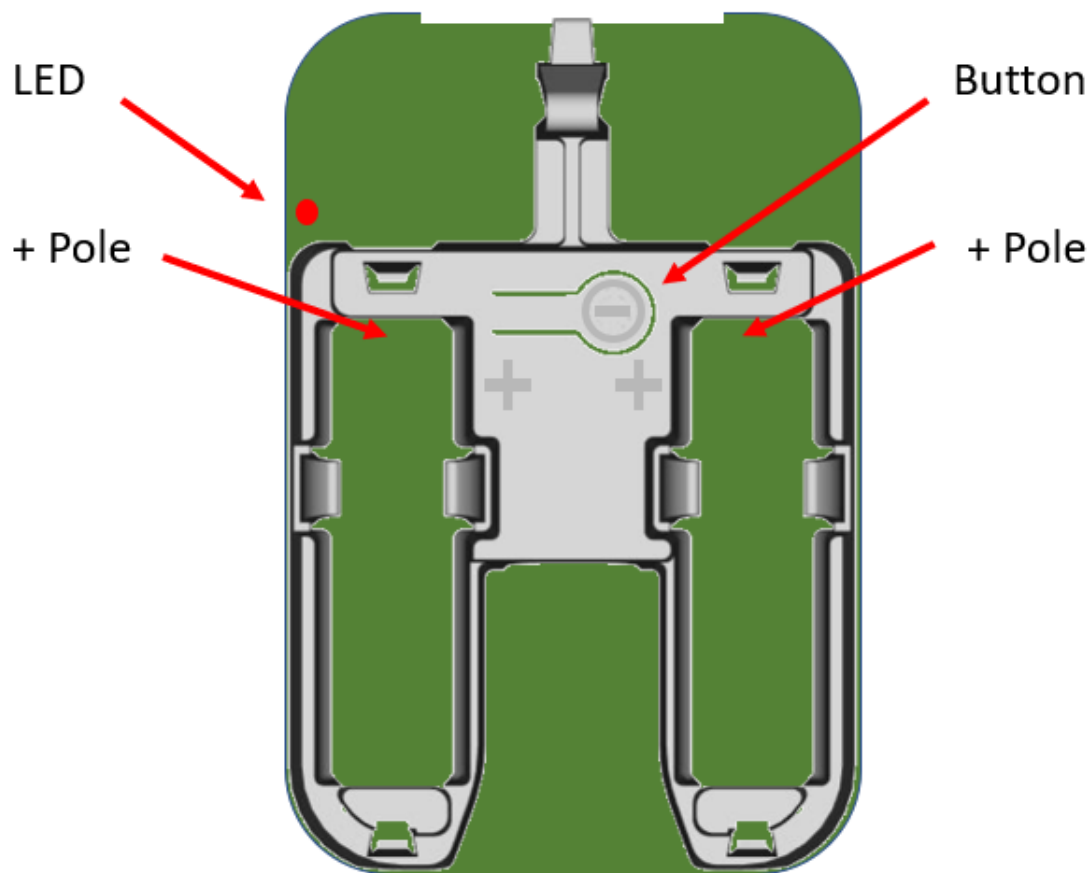
The standard measurement interval is every minute and standard reporting interval is every 20 measurements (resulting in a measurement report transmitted every 20 minutes). The fast measurement interval makes it possible to insert additional transmissions when large changes in the CO2 level are detected, resulting in low reporting latency. By default, CO2 level changes larger than ± 100 ppm from the last transmitted measurement report causes an additional measurement report over the LoRa uplink channel. If the absolute CO2 level is below a certain threshold, by default 750ppm, these additional reporting events are however omitted. All these parameters can be adjusted using LoRa downlink commands if needed.

5 Installation and activation

The sensor consists of a bottom piece, the electronic board and the top cover. Remove the top cover by pressing it upwards and outwards. The electronics are removed by releasing the plastic latch on the top.



The bottom piece is mounted on the wall with the “UP” arrow upwards. It can be mounted either with screws or adhesive tape, both included in the package. The hole pattern matches a standard junction box.



Configure the device in the LoRaWAN server, according to chapter 5.1, and insert the batteries. The sensor starts and flashes 2 + 6 times during the boot-up sequence. The sensor is activated by pressing the push button for 3 seconds until the red LED makes two short flashes.

When the device has successfully joined the LoRaWAN network there will be a 2-second-long flash.

Attach the electronic board to the bottom piece and attach the plastic cover.

5.1 LoRaWAN Configuration

Configuration on the network server is done with AppEUI: 70-B3-D5-D7-2F-F8-18-00 (a.k.a. JoinEUI)

It is possible to order a batch of devices configured with a customer unique AppEUI from the Talkpool OUI range.

The device is configured with device unique DevEUI and AppKey. The DevEUI is printed on device box and the AppKey is distributed by the sales team. The device is default configured for OTA provisioning. Contact the Talkpool team for ABP configuration. The device follows the LoRaWAN standard related Join configuration parameters, such as RX1 and RX2 windows, RX2 downlink frequency etc.

The default setting is ADR enabled.

If you are not experienced of LoRaWAN, contact iot.support@talkpool.com to get started.

5.2 Sensor states and state check

The sensor has five states: Booting, Initial, Joining, Configure and Operational state.

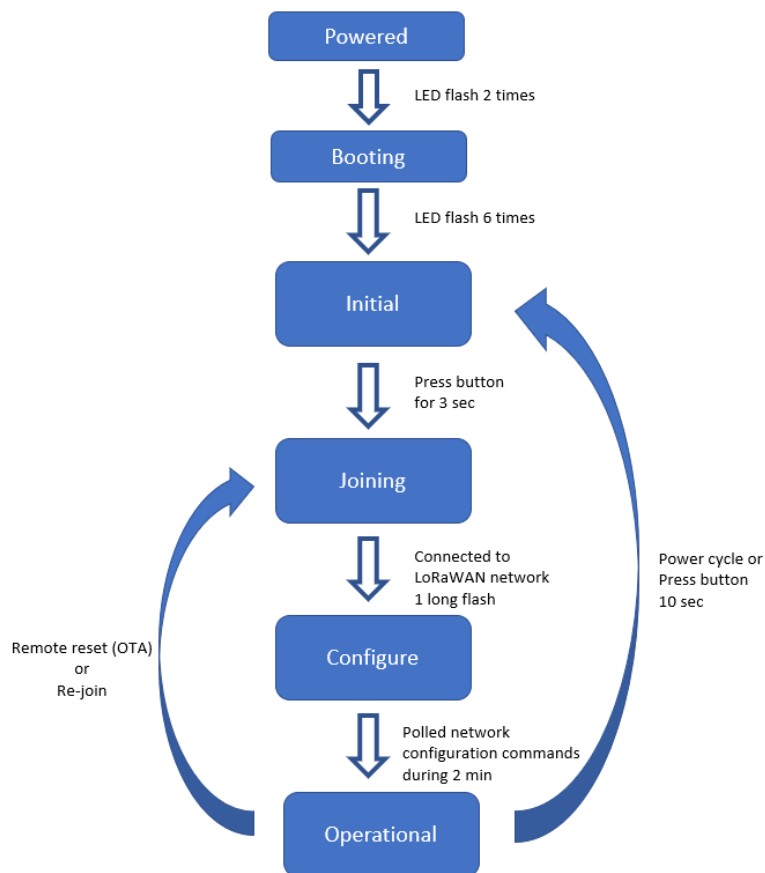


Figure 1 Device states

When the unit is initially powered, it flashes 2 times with the LED, after a few seconds the unit enters initial state automatically. This is indicated by flashing 4 times.

To check the device state, press the button and hold it pressed until the red LED starts flashing after 0.5s.

State	Description	LED response
Initial	Low power state during transport. Radio not active.	1 short flash (0.5 sec)
Joining	Trying to join a LoRaWAN network. The device will remain in this state until successfully joined a LoRaWAN network	2 short flash (0.5 sec)
Configure	Enables quick over-the-air configuration, by polling server after configuration commands during 2 minutes. This is done by sending uplink status command (0x20).	1 long flash (2 sec)
Operational	Joined to a LoRaWAN network, measures temperature and humidity periodically, and sends measurement reports toward a LoRAWAN network.	1 long flash (2 sec)

5.2.1 Re-join functionality

The device supervises its connectivity to the network, by monitoring that periodic downlink messages are received.

The device tries to re-join the network if it has not heard anything from the network for 288 uplinks (4 days @ 20-minute message interval). The device requests and normally gets a downlink ever 64th uplink due to the ADRAckReq functionality.

6 Specification

Operating principle

Non-dispersive infrared (NDIR)	Yes
Sample method	Diffusion

Accuracy and range

Temperature accuracy	$\pm 0,2\text{ }^{\circ}\text{C}$ (conditions $0\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$)
Temperature range	$-20\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$
Humidity accuracy	$\pm 2\%$ (conditions 10-90% RH)
Humidity range	0% to 100% non-condensing
Measurement range CO ₂	400 – 5000 ppm
Accuracy CO ₂	$\pm 50\text{ppm} \pm 3\%$ of reading
RMS noise CO ₂	0.7ppm @ 400ppm 1.4ppm @ 2000ppm (filtered)

Connectivity

Network	LoRaWAN
Frequency bands	868 MHz
Provisioning	Over the air & personalization

Size

Size	111 x 77 x 26 mm
Weight	136g

Security

Algorithms	AES-128
Hardware	Cryptographic co-processor
Features	Secure boot Secure firmware upgrade Hardware based ultra-secure key storage

Battery life

Battery life length	>5 years (at 20-minute intervals, SF12) + 1 year storage
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Battery type	2x Lithium-thionyl 3.6V (replaceable)
Total capacity	7.2Ah

Configuration

Measurement intervals	20 minutes, configurable over the air
Transmission intervals	20 minutes, configurable over the air
Threshold for adaptive reporting	>750 ppm
Step threshold for adaptive report	100 ppm

Unique App EUI available upon request

Enclosure

IP30

Certifications

RoHS compliant

CE

LoRaWAN

7 Battery life

Storage

More than one year without limiting the product life length

Operational

Battery life length >5 years (at 20-minute intervals, SF12) + 1 year storage

8 Security

The device has the following security features:

- Cryptographical coprocessor for ultra-secure hardware based key storage
- Secure boot
- Encrypted FW
- Message encryption (AES-128 bit)
- Message integrity (MIC AES-128 bit)
- No port access to device.

9 Protocol

The protocol consists of different types of data

- LoRaWAN v.1.0.2 standard commands
- Unsolicited uplink status commands during configure state
- Periodic measurement reports
- Downlink commands and queries
- Uplink query response

Note 0x denotation means hexadecimal encoded.

9.1 LoRaWAN standard commands

All standard LoRaWAN v 1.0.2 Rev B are supported. Please refer to the LoRaWAN standard for the protocol definition.

9.2 Unsolicited uplink status commands

The sensor polls the server for configuration parameters the during the **Configure** state. This is done by sending unsolicited uplink status report (0x20). This gives quick feedback to the installer that the installation has been successful and enables downlink configuration

commands to be sent. After approximately 2 minutes the device changes to **Operational** state. See chapter 6.5 for details of the Status report.

Port: **Port 1**

Payload 0x01 20 00

0x01: Data type

0x20: Status command

0x00: Normal startup

The expected behavior is 0x01 20 00. If not contact support.

9.3 Periodic measurement reports

The sensors transmit periodic unsolicited measurement reports or adaptive reports due to changes in CO2 level..

9.3.1 Periodic measurement report

The default configuration is that temperature, humidity and CO2 level are transmitted every 20th minute. The data is packed into minimal number of bytes to conserve energy and to minimize interference.

Port: **Port 2**

Payload: Measurement value (see **chap 9.3.2**)

Size: 5 Bytes

9.3.2 Measurement value

The measurement value for each measurement

Byte 0: Temperature, bit 11 – bit 4

Byte 1: Relative humidity, bit 11 – bit4

Byte 2:

bit 7-4: Temperature, bit 3 – bit 0

bit 3-0: Relative humidity, bit 3 – bit 0

Byte 3-4: CO2 sent as an unsigned 16-bit integer

Byte 0		Byte 1		Byte 2		Byte 3		Byte 4	
Temp bit	11-4	rH bit	11-4	Temp bit	3-0	rH bit	3-0	CO2 bit	16-9

9.3.2.1 Temperature conversion

The temperature measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 °C and the offset is 80 °C, which means the received value should be subtracted by 800 and then divided with 10 to get it in °C.

9.3.2.2 Relative humidity conversion

The relative humidity (RH) measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 % RH and the offset is 25 % RH, which means the received value should be subtracted by 250 and then divided with 10 to get it in % RH.

9.3.2.3 Carbon dioxide (CO₂) conversion

The carbon dioxide (CO₂) measurement in parts-per-million (ppm – 1×10^{-6}). The CO₂ data is averaged over a measurement period. The data is transmitted using an un-signed 16-bit integer. The value 0xFFFF indicates an error in the CO₂ reading, and should be displayed as an alarm or error code in the application, not as a measurement value.

9.3.3 Example: Single measurement report

Data sent on LoRaWAN port 2 : 3e 44 1d 02 1b

(3e1)_{HEX}: (993)_{DEC} => 993/10 -80°C => 19.3 gradC

(44d)_{HEX}: (1101)_{DEC} => 1101/10 – 25% => 85.1 % RH

(021b)_{HEX}: (539)_{DEC} => 539 ppm CO₂

9.4 Downlink commands and queries

To control the sensor application, in-band commands and queries can be sent from the server application. Contact your LoRaWAN network provider for in-band application API.

All downlink application communication is done on LoRaWAN **port 1**.

Downlink command network => device				
Field	Bytes	Value	Description	Note
Type	1	xx	0x01: Set 0x02: Query 0x03: Action	
Index	1	xx	Command Index	
Data			As defined for Command Index only applicable for set-commands	

Port	Index	Description	Uplink Datatype response	Encoding	Valid range	Access	Unsolicited	Description	Note
1	0x03	FW build hash	6 x UInt8			Query	No	Unique number that identifies the firmware version	
1	0x05	Device reset				Action	No	Reset of device	
1	0x06	CPU voltage	UInt8	25mV/LSB	0-3.6V	Query	No	Read CPU voltage. Max/min ranges depend on battery chemistry.	
1	0x0A	CPU temperature	UInt16 Big endian	50C - 0.01C / LSB	-50- +125 C	Query	No	Temperature from CPU sensor with 50 °C offset. Approximately 5 °C accuracy.	
1	0x20	Status	UInt8	Bitfield		Query	Yes	Should be 0, otherwise contact support with error code information.	Cleared through reset
1	0x30	Measurement interval	UInt16 Big endian	Seconds	15-7200	Query Set	No	Measurement interval in seconds controlling how often sensors data is acquired. Default 60 seconds	Setting measurement interval resets the measurement timer.
1	0x31	Measurement cycles per reporting event	UInt16 Big endian	Number of measurement cycles	1-2000	Query Set	No	Maximum number of measurement cycles before transmitting sensor data over LoRa uplink. Default 20 cycles	
1	0x32	CO2 concentration variation threshold	UInt16 Big endian	PPM	0-65535	Query Set	No	Maximum CO2 concentration change from last LoRa uplink reporting event before inserting an additional reporting event. Default 100ppm	Set to 0 ppm to disable all additional reporting events based on CO2 level.
1	0x33	CO2 concentration absolute threshold	UInt16 Big endian	PPM	0-65535	Query Set	No	Minimum absolute CO2 concentration level under which all additional reporting event are omitted. Default 750ppm	
1	0x34	Internal CO2 sensor status bits	UInt32 Big endian	CO2 sensor status	1-2000	Query	No	Query only, for internal use	

2	-	Data	[Uint12, Uint12, Uint16]	(°C + 80)*10 (% RH +25)*10 (ppm CO ²)	0 – 3800 0 – 1500 0 - 65535	-	Yes	Current temperature, humidity and CO2 level.	See Ch 9.3
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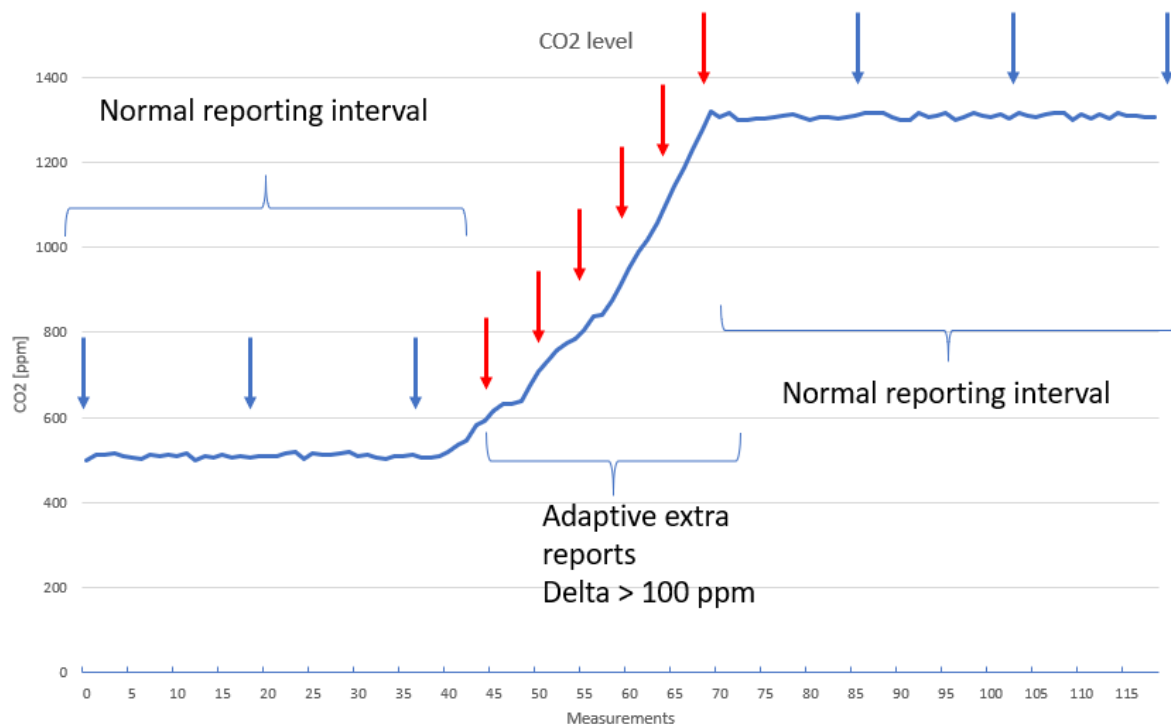
9.4.1 Measurement and reporting interval

Both the measurement interval and reporting interval can be set with downlink commands.

The default setting is a measurement interval of 60 sec. The default reporting interval is every 20th measurement interval.

The device sends extra reports when above a configurable CO2 level, default setting 750 ppm and larger difference than 100 ppm from last report.

The reporting interval counting is reset after an extra measurement report



9.4.2 Reset device

The device can be reset by three methods, long press on button, removal of battery (note the internal SuperCap will power the device for approximately 24 hours without battery), or forced into **Joining** state by OTA commands.

Example: Remote device reset:

Port 1: 0305

9.5 Uplink query response

Uplink messages are sent on port 1 with the following heading:

Uplink command device => network				
Field	Bytes	Value	Description	Note

Type	1	xx	0x01: Data 0x02: Command NACK	
Index	1	xx	Command Index	
Data			As defined for Command Index (only for Type: Data)	

Example:

Port 1: Payload 0x01 20 00

0x01: Data type

0x20: Status command

0x00: Normal startup

The expected behavior is 0x01 20 00. If not contact support.