LoRaONE

Long Range LoRaWAN Network Technology
Low-Power Transceiver Module

User Manual
V1.4

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Long Range LoRaWAN Network Technology, Low-Power Transceiver Module

General Description

The LoRaONE transceiver module uses LPWan LoRa technology for communication with the LoRaWAN network.

The LoRaONE module acts as an AT command communication modem, using the LoRaWAN V1.0.3 protocol and can operate in the protocol classes A and C. It has been designed to be an easy to use, small size and low power AT command LoRaWAN module.

The LoRaONE module features RF, controller and API processor and it follows the AU915/LA915 profiles. The LoRaONE is Anatel and Everynet (EhThingz) certified, saving significant certification costs and time, and can be easily setup to the LoRaWAN network.

The LoRaONE module combines a small form factor 21.5 x 33 x 2.4 mm in castellation SMT format, with 7 GPIOs to connect and control sensors and actuators. The module is connected to a host MCU, through a 9600 bps UART, and can be easily used in a wide range IoT applications.

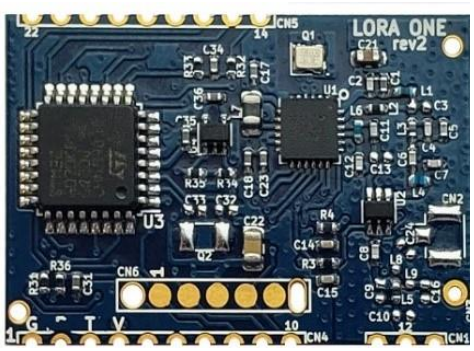

Figure 1 - LoRaONE Module

Features

- Long range communication;
- Low power consumption;
- Supply voltage 3.1 – 3.6 Volts;
- Temperature range: -40°C to +85°C;
- Operates in 915 MHZ Band (AU915 and LA915 Profiles);
- Adjustable output power up to +20 dBm;
- High receiver sensitivity down to -137 dBm;
- Embedded LoRaWAN Class A and C Protocol;
- Easy to use AT command interface over a 9600 bps UART;
- 7 GPIO for control, status and ADC expansion;
- PCB mounting type: Castellation SMT;
- Anatel and Everynet EhThingz Certified;
- Environment friendly

Applications

- Internet of Things (IoT);
- Automation;
- Alarms, Access and Remote Control;
- Logistics, Retail and Tracking;
- Smart City
- Smart Home;
- Smart metering;
- Sensor Networks and Telemetry;
- Agriculture and livestock;

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Block Diagram

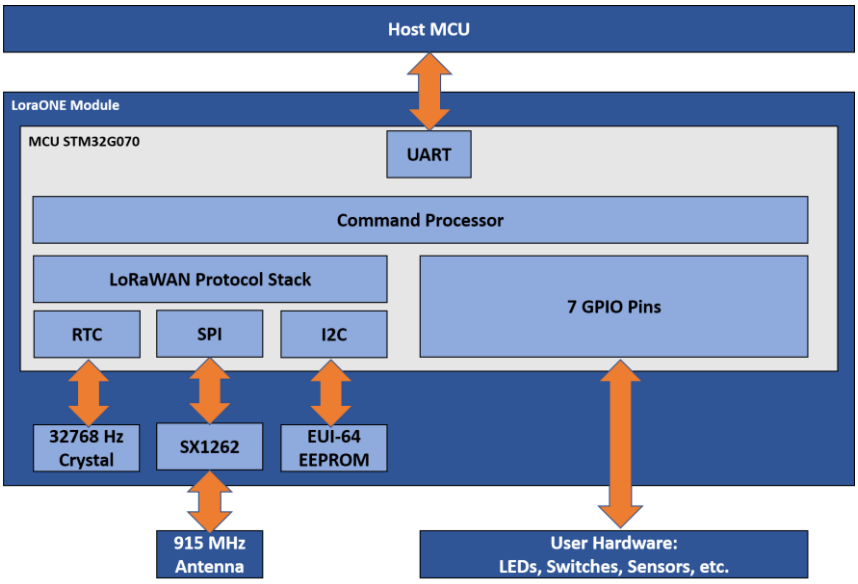


Figure 2 - LoRaONE Module Block Diagram

Antenna Interfaces

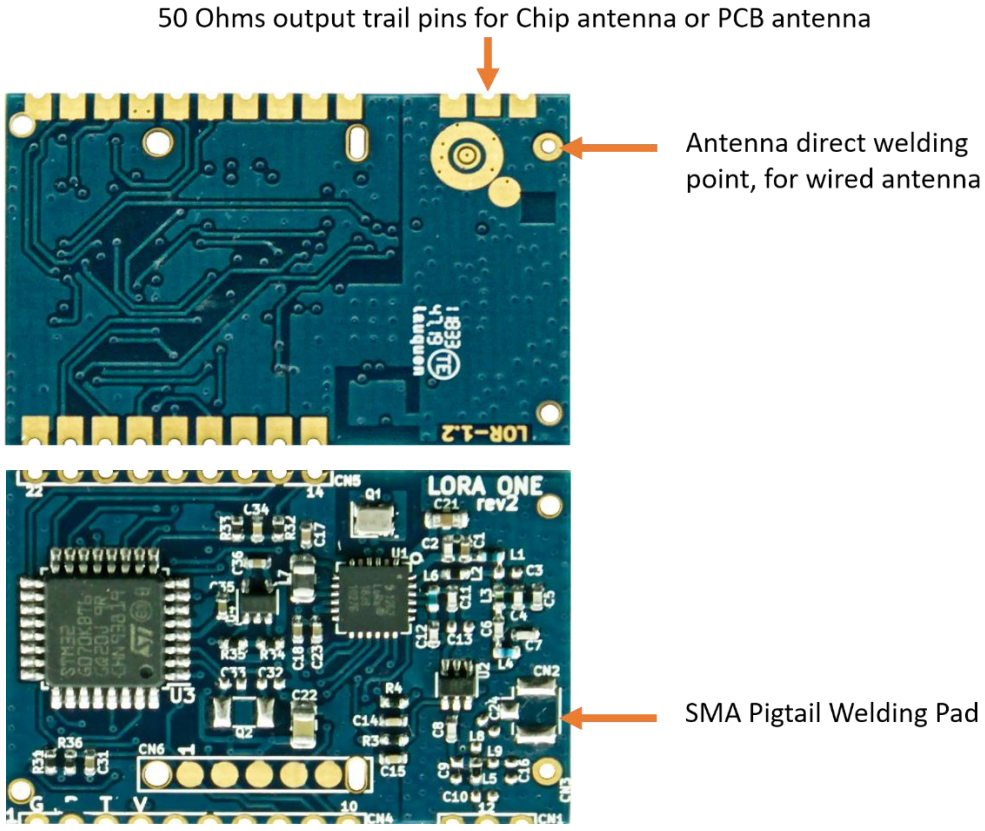


Figure 3 - Antenna interface options

Pinout Description

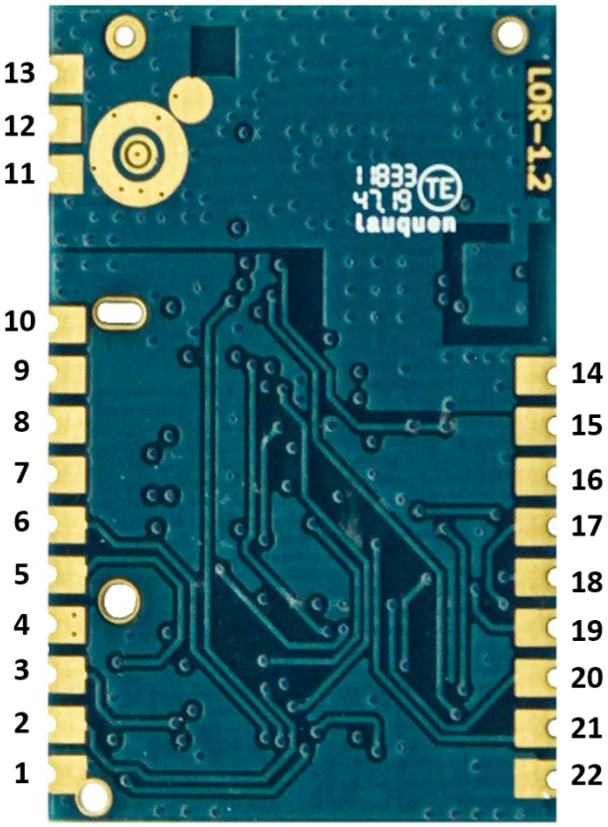


Figure 4 - LoRaONE Module pinout

Pin	Name	Description
1	GND	Connected to Ground
2	mRx	Connected to Host RX
3	mTx	Connected to Host TX
4	VCC	Connected to 3v3
5	CTS	Serial flow control/GPIO
6	RTS	Serial flow control/GPIO
7	---	Reserved
8	RST	Reset
9	---	Reserved
10	---	Reserved
11	GND	Connected to Ground
12	Antenna	Antenna signal output
13	GND	Connected to Ground
14	VBAT	Battery Measurement
15	GPIO7	Generic GPIO
16	GPIO6	Generic GPIO
17	GPIO5	Generic GPIO
18	GPIO4	Generic GPIO
19	GPIO3	Generic GPIO
20	GPIO2	Generic GPIO
21	GPIO1	Generic GPIO
22	GND	Connected to Ground

Table 1 - LoRaONE pinout descritption

Module characteristics

The table 2 lists the LoRaONE module characteristics.

Specification	Min.	Typ.	Max	Units
Core MCU		STM32G070CB/KB*		
Core Radio		Semtech SX1262**		
Supply Voltage	3.1	3.3	3.6	V
Consumption in reception (LNA on)		5.3		mA
Consumption in reception (LNA off)		4.6		mA
Consumption in transmission at 22dBm		118		mA
Consumption in transmission at 20dBm		90		mA
Consumption in transmission at 17dBm		75		mA
Consumption in transmission at 14dBm		63		mA
Consumption in deep sleep mode		5		uA
Power-down reset threshold	1.96	2.00	2.04	V
GPIO pin current (each)		15		mA
GPIO pin current (total)		80		mA
Interface		UART		
Baud rate		9600		bps
LoRaWAN band AU915/LA915		915 to 928 MHz		
LoRaWAN network link budget - Reception		163		dBm
LoRaWAN network link budget - Transmission		159		dBm
Reception sensitivity		-137		dBm
RF connection		three 50 Ohms options, see page 6		
Operating temperature	-40		85	ºC
Operating humidity	10		90	%

Table 2 - LoRaONE module characteristics

*See STM32G070 datasheet for more details. **See SX1262 datasheet for more details.

AT Commands Interface

The AT commands have the standard format **AT+[COMMAND][MODIFIER]**.

There are four command modifiers, as shown on table 3.

Modifier	Description	Example
?	Provides short help of the given command	AT+DEUI?
=[GIVEN]	Used to provide a parameter's value to a command	AT+SEND=2:Hello
[NOTHING]	Used to run a command	AT+JOIN
=?	is used to get the value of a given command	AT+CFS=?

Table 3 - AT Commands modifiers

The response for the command is provided over the UART, following the standard format **<value><CR><LF><Status<CR><LF>.**

<CR> stands for “carriage return” and **<LF>** stands for “line feed”.

When no value is returned, the **<value><CR><LF>** format output is not returned.

Every command, except for **ATZ** that is used for the module Reset, returns a status response over the **<Status><CR><LF>** format. The possible status messages are shown on table 4.

Status Message	Description
OK	Command run correctly without error
AT_ERROR	Generic error
AT_PARAM_ERROR	A command parameter is incorrect
AT_BUSY_ERROR	The LoRa Network is busy, command not executed
AT_TEST_PARAM_OVERFLOW	A command parameter is too long
AT_NO_CLASSB_ENABLE	The end-node has not yet switched to Class B
AT_NO_NETWORK_JOINED	The end-node has not joined the LoRa network
AT_RX_ERROR	Error detected during command’s reception from the host MCU

Table 4 – Status Messages

The table 5 lists the AT Commands used by the module.

AT Command	Description
AT	Test command
ATZ	Reset
AT+DADDR	Receives/Establishes DevAddr
AT+APPKEY	Establishes AppKey
AT+APPSKEY	Establishes AppSKey
AT+NWKSKEY	Establishes NwkSKey
AT+APPEUI	Receives/Establishes AppEui/JoinEui
AT+ADR	Receives/Establishes The ADR
AT+TXP	Receives/Establishes Tx Power
AT+DR	Receives/Establishes the Data rate
AT+DCS	Receives/Establishes ETSI Duty Cycle
AT+PNM	Receives/Establishes the Public Network
AT+RX2FQ	Receives/Establishes rx2 frequency window
AT+RX2DR	Receives/Establishes the Rx2 window data rate
AT+RX1DL	Receives/Establishes the delay of the Rx1 window
AT+RX2DL	Receives/Establishes the DELAY of the RX2 window
AT+JN1DL	Receives/Establishes the delay of join window 1
AT+JN2DL	Receives/Establishes the delay of join window 2
AT+NJM	Receives/Establishes Join mode (0:ABP/1:OTAA)
AT+NWKID	Receives/Establishes Network ID
AT+CLASS	Receives/Establishes the class of the device (A/C)
AT+JOIN	Performs the join procedure
AT+NJS	Receives join status
AT+SENDB	Sends hexadecimal data along with the application port
AT+SEND	Sends text data along with the application port
AT+CFM	Receives/Establishes confirmation mode
AT+SNR	Receives the SNR from the last package received
AT+RSSI	Receives RSSI from the last package received
AT+BAT	Receives battery level
AT+TRSSI	Starts rf RSSI tone test
AT+TTONE	Starts rf tone test
AT+TTLRA	Starts the RF Tx LoRa test
AT+TRLRA	Starts rf Rx LoRa test
AT+CONF	Configures the LoRa RF test
AT+TOFF	Stops the RF test in progress
AT+CERTIF	Places the module in LoRaWAN Certification Mode
AT+EVTCFG	Enable or disable spontaneous events *
AT+RETRY	Get or set the number of retries in send command
AT+FACRES	Run factory reset
AT+FCU	Get or set the Uplink Frame Counter
AT+FCD	Get or set the Downlink Frame Counter
AT+DEUI	Get the Device EUI
AT+RECVB	print last received data in binary format (with hexadecimal
AT+RECV	print last received data in raw format
AT+CFS	Get confirmation status of the last AT+SEND (0-1)

AT Command	Description
AT+CAL	Start clock calibration
AT+CHIPID	Get the unique identification of the module
AT+VER	Get the firmware version
AT+LNA	Turns the LNA ON or OFF
AT+GPIOCFG	Configure a GPIO Pin (since firmware version 1.1.22)
AT+GPIO	Read or Write a GPIO Pin (since firmware version 1.1.22)
AT+SLEEP	Put the module in low power mode (since version 1.1.23)*

Table 5 – AT Commands

*In the **AT+EVTCFG** command, each bit means an event. For example, to activate the event 11 (1000 0000 000) use the command **AT+EVTCFG=0x800 or AT+EVTCFG=2048.**

*When the module is in sleep mode (after a AT+SLEEP), it can be waked from sleep by changing the state of GPIO1 pin.

The table 6 lists the events, as asynchronous notifications, used by the module.

Event	Description
+EVT: 003	Notify Certification Test State
+EVT: 004	An unconfirmed message ended (no more events are expected)
+EVT: 006	We have received a packet (reception done)
+EVT: 007	Transmission done
+EVT: 008, RSSI, snr	RSSI/snr of the last class C package received
+EVT: 009, RSSI, snr	RSSI/snr of the last class A or B package received
+EVT: 010, port	Port and given in hexadecimal received (downlink)
+EVT: 011	Network Server ”ack” uplink data confirmed message transmission
+EVT 012	Network Server is asking for an uplink transmission
+EVT 013, Class (A, B, C)	Switch to class X done
+EVT 014	We have joined the network
+EVT 015	The reception timed out

Table 6 – Events

The table 7 lists the AT Commands, with their respective parameters.

Commands	Input Parameters
AT+DADDR	4 hexa separated by ":" or not
AT+APPKEY	16 hexa separated by ":" or not
AT+APPSKEY	16 hexa separated by ":" or not
AT+NWKSKEY	16 hexa separated by ":" or not
AT+APPEUI	8 hexa separated by ":" or not
AT+ADR	0 or 1 (OFF or ON)
AT+TXP	0 to 10
AT+DR	[0,1,2,3,4,5,6,7]
AT+DCS	0 or 1 (OFF or ON)
AT+PNM	O or 1 (OFF or ON)
AT+RX2FQ	Frequency in Hz
AT+RX2DR	[0,1,2,3,4,5,6,7]
AT+RX1DL	<integer> representing mili seconds
AT+RX2DL	<integer> representing mili seconds
AT+JN1DL	<integer> representing mili seconds
AT+JN2DL	<integer> representing mili seconds
AT+NJM	0 or 1 (OFF or ON)
AT+CLASS	A or C
AT+SENDB	<port>:<binary in hexa> Example 12:abcdef01
AT+SEND	Port:text (example 12:hello world)
AT+CFM	0 or 1 (OFF or ON)
AT+RETRY	0 to 8
AT+FCU	<integer>
AT+FCD	<integer>
AT+LNA	0 or 1 (OFF or ON)
AT+GPIOCFG	<gpio pin [1~7]>,<Pin configuration [0~7]> Where pin configuration can be: 0 – unconfigured 1 - output initially left at 0 2 – output initially left at 1 3 – output open drain initially left open 4 – output open drain initially left close (grounded) 5 – input with no pull 6 – input with pull-up 7 – input with pull-down
AT+GPIO	<gpio pin [1~7]>,<Pin state> Where pin state can be: 0 – Write 0 to an output 1 – Write 1 to an output 2 – Read a pin

Table 7 - AT Commands parameters

Typical Initialization Sequence

1. Set the global application identifier:

   AT+APPEUI=33:33:33:33:33:33:33:33

   OK

2. Set device address:

   AT+DADDR=44:44:44:44

   OK

3. Set Network Session Key:

   AT+NWKSKEY=12:34:56:78:90:AB:CD:EF:12:34:56:78:90:AB:CD:EF

   +HASH: 8A20C220

   OK

4. Set Application session key:

   AT+APPSKEY=12:34:56:78:90:AB:CD:EF:12:34:56:78:90:AB:CD:EF

   +HASH: 8A20C220

   OK

5. Set confirmation mode on:

   AT+CFM=1

   OK

6. Set to ABP initialization Mode:

   AT+NJM=0

   OK

7. Send 1 byte with content equal 0x01 (hexadecimal) in port 1

   AT+SENDB=01:01

   OK

Typical Application Circuit

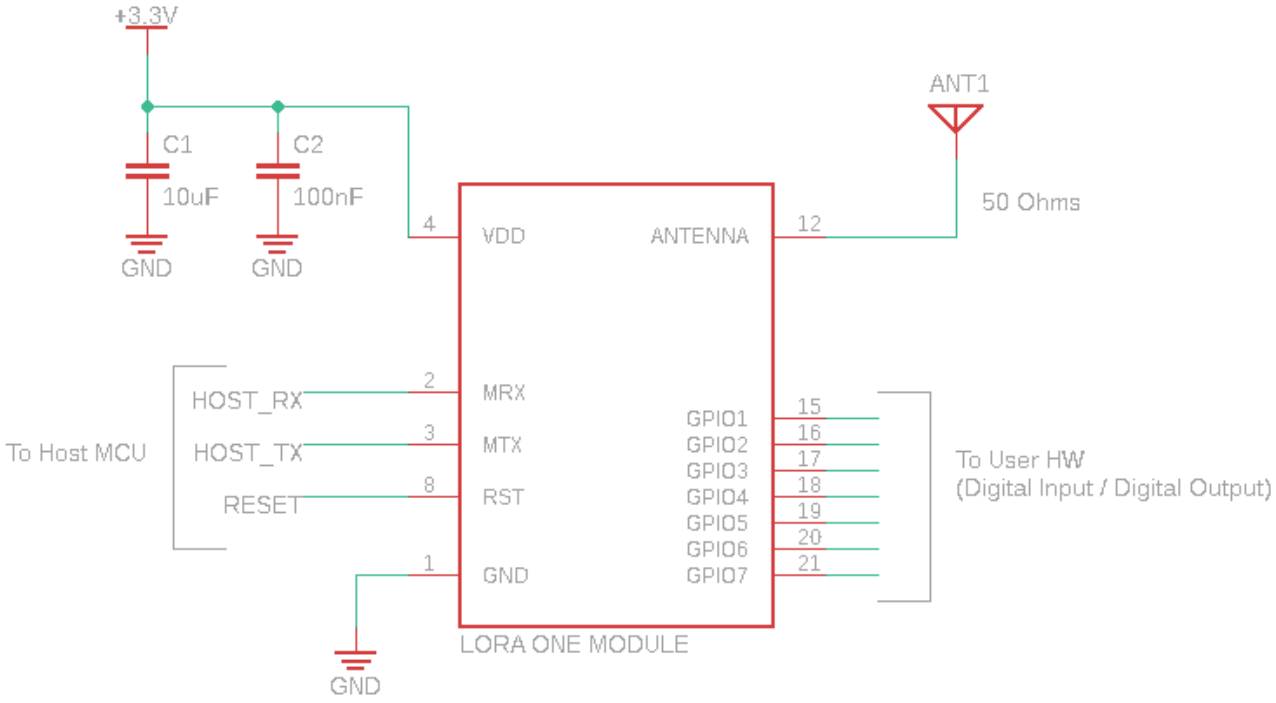
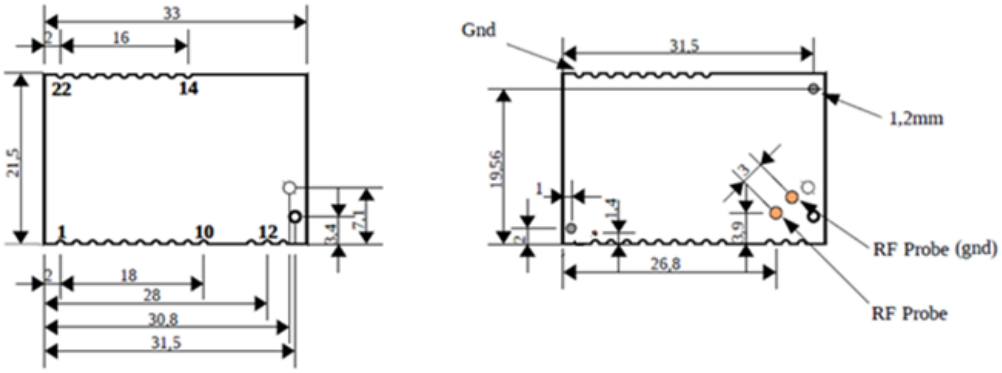


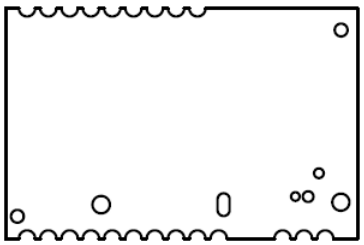
Figure 5- Application circuit

Mechanical Specifications

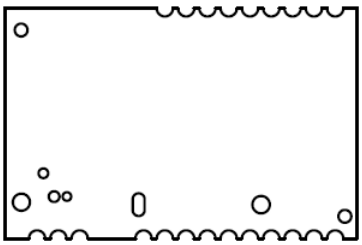


Module thickness: 2.6mm

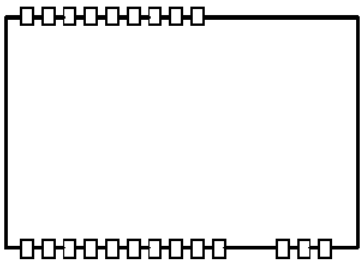
Top View



Bottom View



Top View PCB Footprint



Pad Size

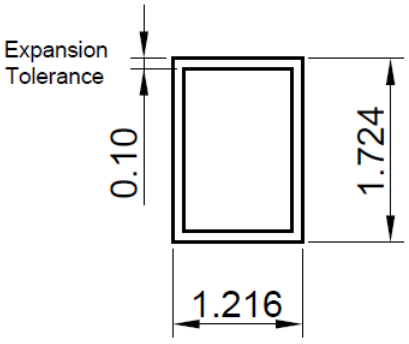


Figure 6 - Mechanical Characteristics

Revision History

Version	Date	Author	Description
1.0	2020-02-03	Marco Vettori	Initial
1.1	2020-02-10	Paulo Pereira	1. Updated table 5 with GPIO Commands. 2. Updated table 7 with GPIO Commands.
1.2	2020-03-11	Paulo Pereira	1. Updated table 5 with Sleep Command.
1.3	2020-06-09	Airton Toyofuku	1. Updated Revision History. 2. Updated text distribuition. 3. Correction of the terminals 2 and 3 for communication with de host mcu in table 1. 4. Correction of the terminal 1 from VDC to VCC 5. Updated the figure 5. 6. PCB thickness from 2.6 to 1.6mm
1.4	2020-08-03	Airton Toyofuku	1. Inclusion of current consumption information in deep sleep mode, in table 2.

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