

## Ultra low power DASH7 Arduino Shield Modem

868 MHz

## 1 Introduction

### Features

- Full DASH7 Alliance modem (D7A v1.x) optimized for power, targeted for battery powered sensor application
- Integrated antenna
- Connection to host application using standard UART link at 115200bps and controlled with D7A ALP command set.
- 868 MHz ISM band operation
- Modulation schemes: 2-FSK, GFSK
- Output power up to +5 dBm (at the antenna)
- Data rates 9.6 / 55.6 / 167.7 kbps
- Operates from a single 2.0V to 3.6V supply
- Operating temperature: -40 °C to 85 °C

### Applications

- Wireless sensor network
- Data acquisition equipment
- Security systems
- Industrial monitor and control
- Internet of things (IoT)

### Description

- The SH1030 is a fully integrated DASH7 modem operating in the 868 MHz ISM bands
- Based on STMicroelectronic's SP1ML module with enhanced firmware.
- Compatible with D7A 1.x specification ([www.dash7-alliance.org](http://www.dash7-alliance.org))
- Controlled using an D7A ALP command set over a serial link.
- Allows for bi-directional communication with battery operated sensor and actuators.
- Wizzilab product line at [www.wizzilab.com/products](http://www.wizzilab.com/products)



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## 2 Hardware specification

For more details, see the [SP1ML datasheet](#).

/\ The values indicated below have priority over any value that may be in the datasheet as the chip could boot with more extreme values but would lack some internal functionalities.

### 2.1 Recommended operating conditions

Table 1. Recommended operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
T <sub>A</sub>	Operating ambient temperature range	-40	-	85	°C
V <sub>DD</sub>	Operating supply voltage	2.0 <sup>(1)</sup>	2.4	3.6 <sup>(2)</sup>	V

(1) Below 2.0V the Spirit1 transceiver functions with reduced sensitivity. See Spirit1 Errata for more details.

(2) Above 2.6V the Idle/Stop current consumption is increased. See Figure 2 for more details.

### 2.2 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Min.	Typ.	Max.	Units
T <sub>STG</sub>	Storage temperature range	-40	-	85	°C
V <sub>DD</sub>	Supply voltage	-0.3	-	3.9	V
V <sub>IO</sub>	I/O pin voltage	-0.3	-	5.5	V

### 2.3 I/O operating characteristics

Table 3. I/O operating characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units
V <sub>IL</sub> <sup>(1)</sup>	I/O input low level voltage	-0.3	-	0.3*V <sub>DD</sub>	V
V <sub>IH</sub> <sup>(1)</sup>	I/O input high level voltage	0.7*V <sub>DD</sub>	-	V <sub>DD</sub> +0.3	V

(1) For more details see the STM32L151RB datasheet, I/O port characteristics.

### 2.4 Current consumption

Table 4. Current consumption

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Units
I <sub>CC</sub>	Supply current @VDD 2.4V	Operating mode TX	-	-	22 <sup>(1)</sup>	mA
		Operating mode RX	0.005 <sup>(2)</sup>	0.047 <sup>(3)</sup>	13.5 <sup>(4)</sup>	mA

(1) TX output power 11 dBm

(2) Idle (no RX scan).

(3) RX scan on 2 channels with 200 KHz bandwidth, once per second, see Figure 1.

(4) Continuous RX

## 2.5 Current consumption measurements

Table 5. Test parameters

Parameter	Value
Supply Voltage	2.4 V
Operating mode	RX Scan (Clear Channel Assessment)
RX Scan period	1 s
Number of scanned D7A channels	2
D7A Channel width (normal rate mode)	200 kHz

Table 6. Test results

Result	Tool value (see Figure 1)	Value	Units
Average current consumption	DC	47.6	μA
Idle current consumption	Low	4.8	μA
Max current consumption	High	17.9	mA

Figure 1: Current consumption measurement

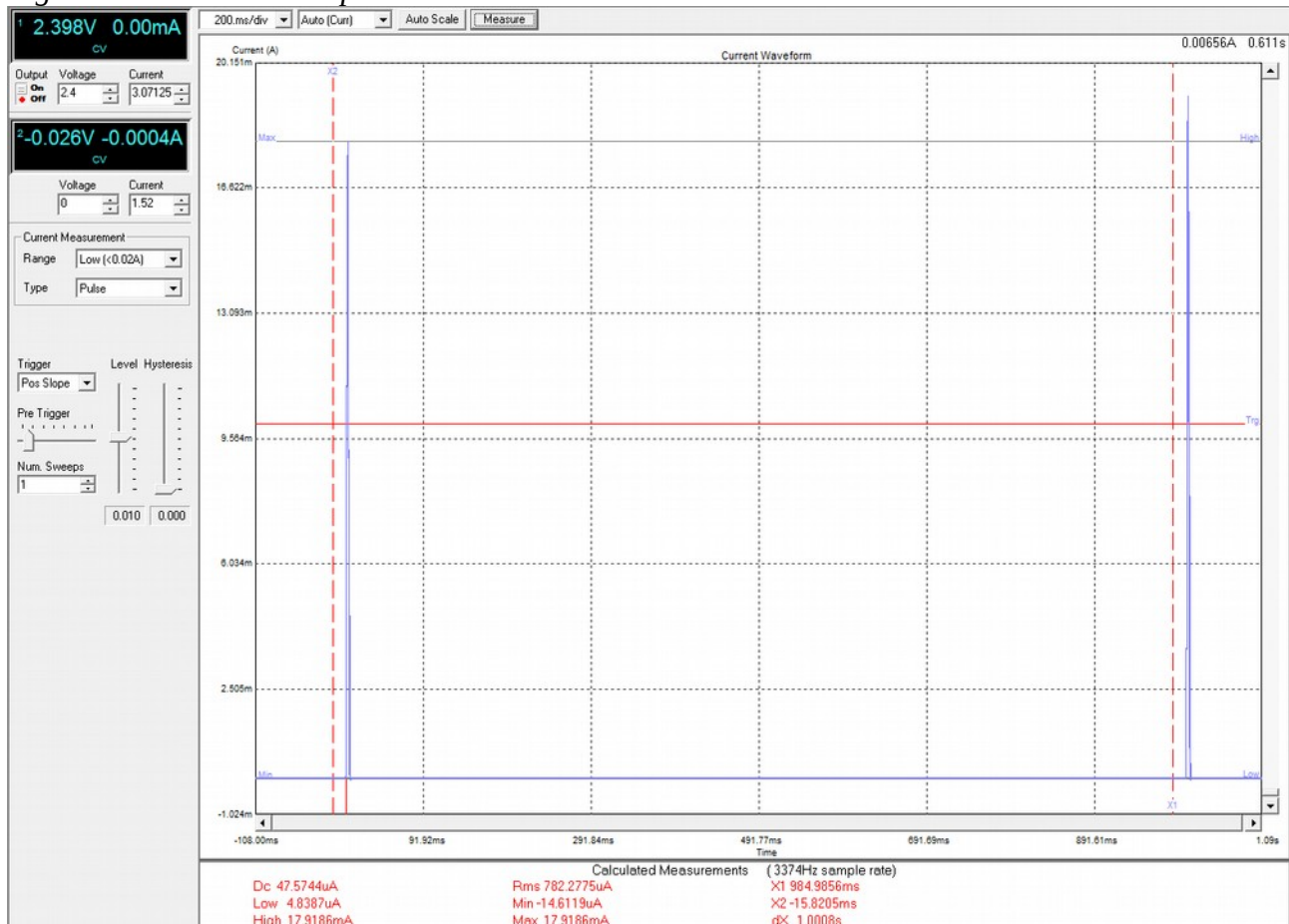
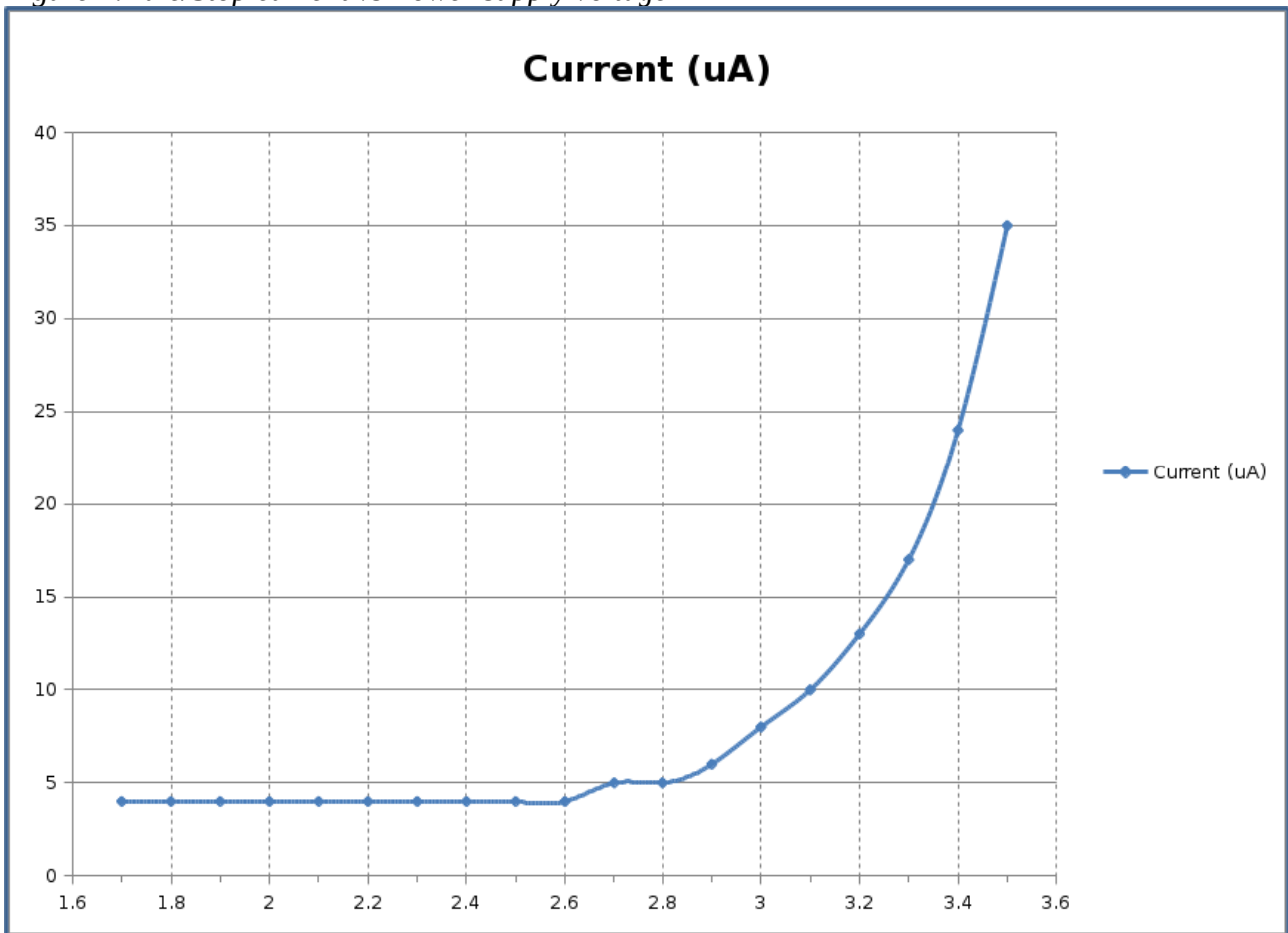


Figure 2: Idle/Stop current vs Power supply voltage



## 3 Operating modes

### 3.1 Data rates

Table 7. Data rates

Parameter	Test conditions	Value	Units
Data Rate	Low rate mode	9 600	baud
	Normal rate mode	55 556	baud
	High rate mode	166 667	baud

### 3.2 RX Sensitivity

The test is performed in real conditions - the receiver and the transmitter are placed at a distance of 5 m in a non-anechoic room with dimensions of 10x10m and the transmission power is ramped up and down. The receiver is in continuous RX and receives D7A packets consisting of 27 uncoded payload bytes encoded with ½ Forward Error Correction channel coding, resulting in 60 encoded payload bytes + 2 bytes sync word + 8 bytes preamble. See the [D7A specification](#) for more details. The test sources are available [here](#). The following values are the RSSI sensitivity limits when 90% of the packets are still received.

Table 8. RX Sensitivity

Parameter	Test conditions	Min.	Typ.	Max.	Units
RX Sensitivity (10% PER)	Low rate mode with FEC	-	-105	-	dBm
	Normal rate mode with FEC	-	-94	-	dBm
	High rate mode with FEC	-	-87	-	dBm

### 3.3 TX Power

Table 9. TX Power

Parameter	Min.	Typ.	Max.	Units
TX Power	-40 <sup>(1)</sup>	-	5 <sup>(1)</sup>	dBm

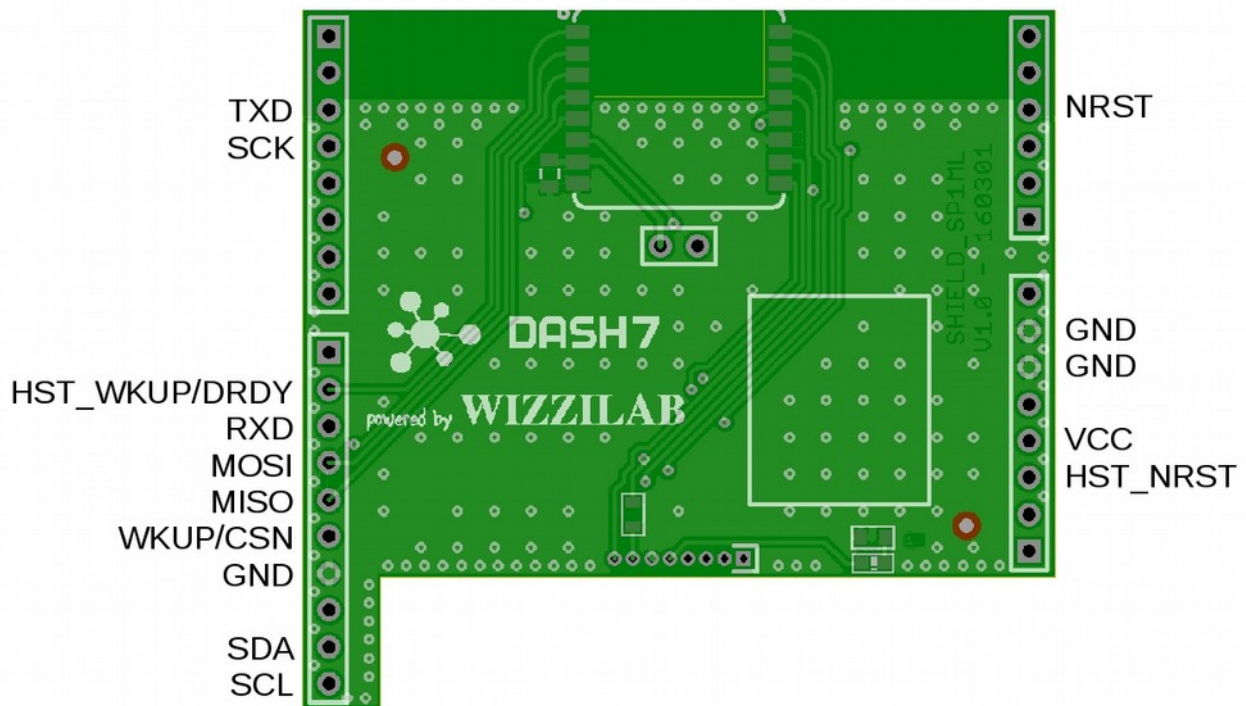
(1) At the antenna. Takes into consideration 6 dB integrated chip antenna insertion loss. The TX power at the Spirit1 RFOUT pin is 11 dBm.

## 4 Hardware design

### 4.1 Pin placement

All non-indicated pins are Not Connected.

Figure 3: Shield pinout (top view)



### 4.2 Pin assignment

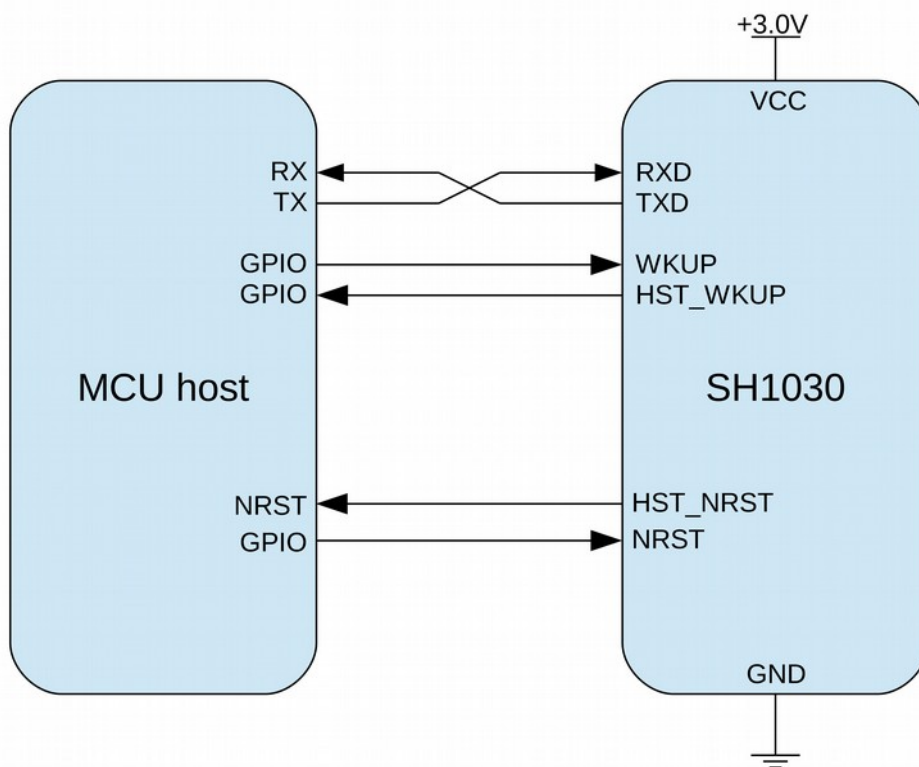
Table 10: Pin assignment

Name	Type	Description
VCC	Power	Supply input voltage
GND	Power	Ground
TXD	O	Serial data out
RXD	I	Serial data in
WKUP	I	Device wake-up pin
HST_WKUP	O	Host wake-up pin
NRST	I	Reset pin

HST_NRST	O	Host reset pin (open-drain)
DRDY	O	Data ready interrupt
MOSI	I	SPI data in
MISO	O	SPI data out
SCK	I	SPI clock in
CSN	I	SPI chip select
SDA	I/O	I2C data
SCL	I	I2C clock

### 4.3 Typical application circuit

Figure 4: Typical application circuit

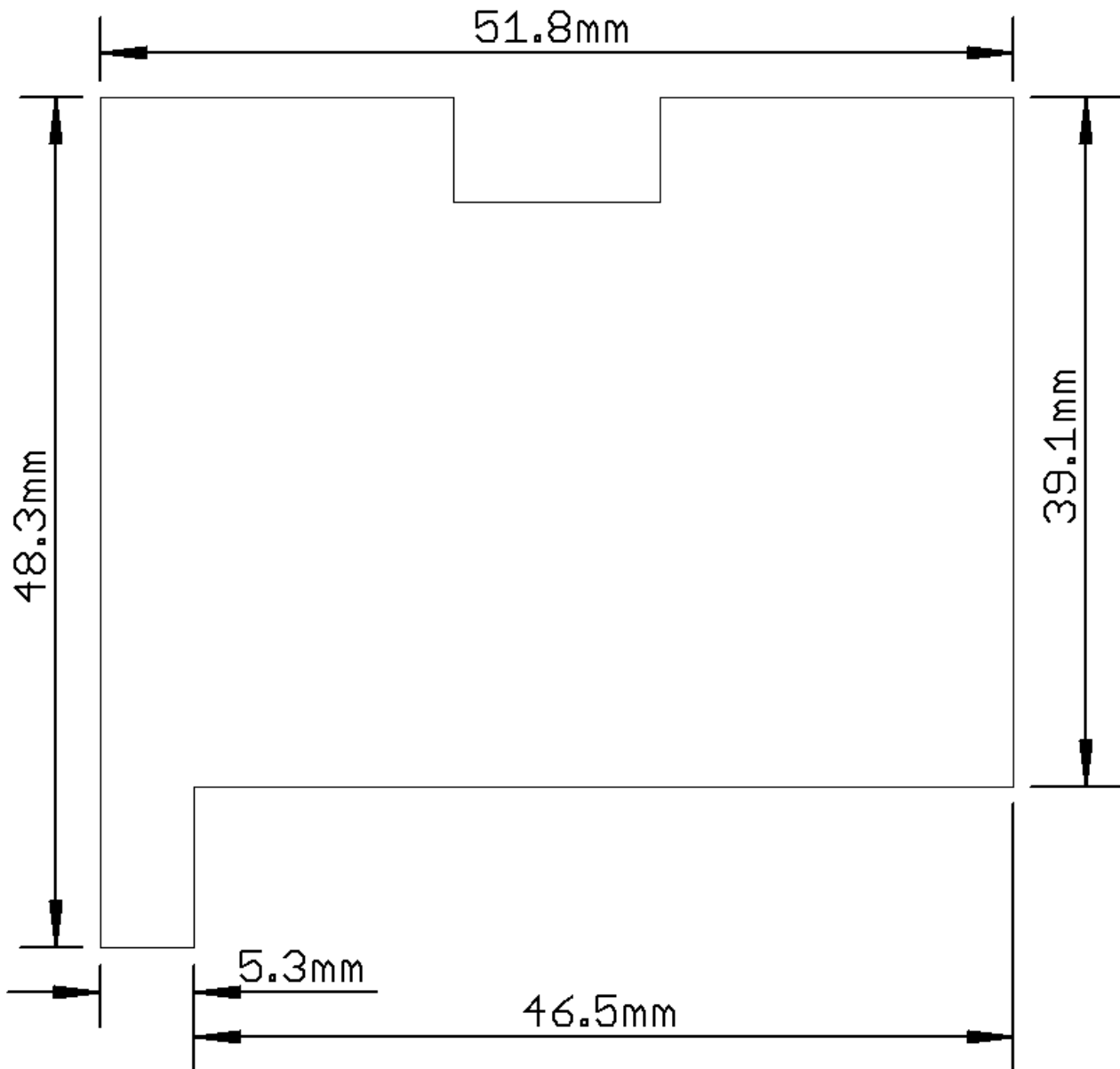




## 4.4 Package mechanical data

All dimensions are in millimeters  $\pm 0.1\text{mm}$

Figure 5: Package mechanical data (top view)



## 5 Modem operations

At boot, the shield's LED will turn on, then turn off when the module is ready.

This module is meant to be used with the [mbed](#) driver whose demo can be found here:  
[https://developer.mbed.org/teams/Wizzilab/code/D7A\\_1x\\_demo](https://developer.mbed.org/teams/Wizzilab/code/D7A_1x_demo)

## **6 Ordering information**

Contact us at : [contact@wizzilab.com](mailto:contact@wizzilab.com)

Or visit our website: <http://www.wizzilab.com/shop/>

## 7 Revision history

Table 11. Document revision history

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
07-Sep-2016	1.0	Document creation.
25-Oct-2016	1.1	Added Operating modes section.
28-Oct-2016	1.2	Added Current consumption measurements section.