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## 915 MHz LoRa2 IoT Transceiver

### DS0047

DO0100

Technical Datasheet

10/30/2017

2/2/2017

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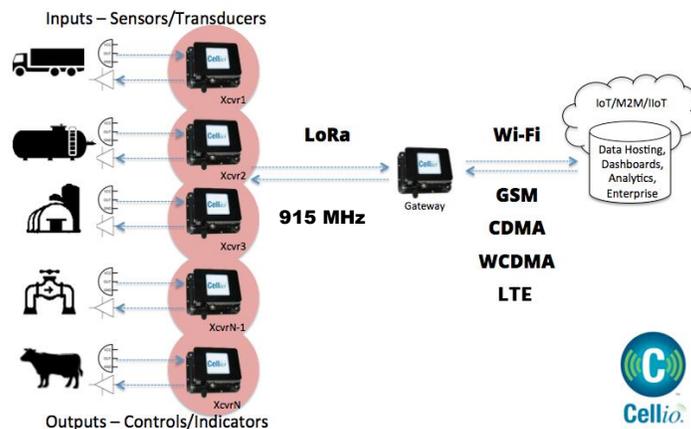


Figure 1: Cellio Transceivers Provide a Wireless Link between Processes

1. Features

- Multiple I/O Options:
  - 3 Digital Input
  - 1 Digital Output
  - 1-Wire bus
  - 5 Single-ended analog input
  - 4-20 mA current sense
  - Sensor power/ground connections
- 915 MHz LoRa Gateway link

– 1 Mile line-of-sight range

- Power
  - 9V battery
- Environmental
  - IP68

2. Applications

- Agriculture
- Automation
- Compliance
- Environmental

- Food and Beverage
- Supply Chain
- Transportation

### 3. Description

Cellio Transceivers link their connected sensors and actuators to the cloud through a wireless connection with a Cellio Gateway. This low cost and easy to install system enables companies to gain visibility into their operations and assets (sensors, instruments, equipment, location, usage, status, decision making, supply chain, operator indicators, etc.).

The Cellio system is suited for single locations as well as extensive enterprise configurations spanning the continent. Partnered with cellular carriers, back-end cloud platforms, sensor instrumentation companies, and technology core companies – full enterprise-level-solution installations can be quick, easily scaled, and very affordable.

### 4. Functional Block Diagram

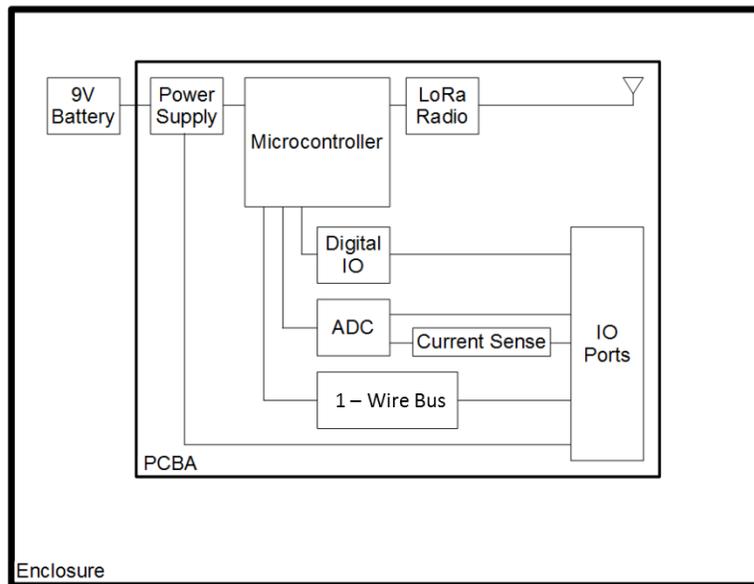


Figure 2: Functional Block Diagram of Cellio Transceiver

## 5. General Purpose IO

### 5.1. Physical Connection

Connections to IO ports are made through screw terminals mounted on the circuit board. Silkscreen labels indicate the port number for each screw terminal. This is shown in figure 3 below.

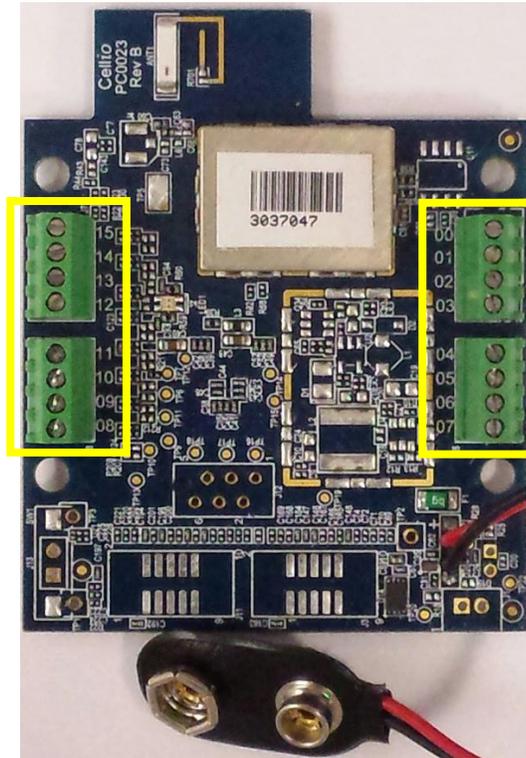


Figure 3: Screw Terminal Locations for IO Port Connections

A cable gland is installed to provide a sealed connection to IO ports. Gland and enclosure screws should be tightened to specified torque to maintain IP68 rating. Torque and Wire specifications for Cellio products are shown below in Table 1 below.

Parameter	Conditions	Min.	Typ.	Abs. Max.	Units
IO port wire dia.	Solid wire	48	-	17	AWG
IO port wire dia.	Stranded wire	48	-	18	AWG
Screw terminal torque	-	-	-	1.7	in-lbs
Gland cable dia.	-	2.9	-	6.4	mm
Gland torque	-	25	-	30	in-lbs
Enclosure screw torque	-	6.5	7.12	7.5	in-lbs

Table 1: Torque and Wire Specifications

## 5.2. DS0047 Port Configuration

Port	Function	Min.	Typ.	Max.	Units	Conversion	Comment
00	9 V Output	7	-	9	V	-	$R_{out} = 10 \text{ k}\Omega$
01	Digital Input	0	-	5	V	$V_{IH,min} = 1.5 \text{ V}, V_{IL,max} = 0.7 \text{ V}$	-
02	Ground	-	-	-	-	-	-
03	Single-ended ADC	0	-	5.0	V	$V_{PORT} = COUNT * 0.000079753 \text{ V}$	$R_{in} = 11.2 \text{ k}\Omega$
04	5 V Supply Output	-	-	150	mA	-	-
05	Digital Input	0	-	5	V	$V_{IH,min} = 1.5 \text{ V}, V_{IL,max} = 0.7 \text{ V}$	-
06	Digital Input	0	-	5	V	$V_{IH,min} = 1.5 \text{ V}, V_{IL,max} = 0.7 \text{ V}$	-
07	Digital Output	0	-	5	V	HIGH: 5 V, LOW: 0 V	-
08	Current Sense, In	0	-	27	mA	$I_{PORT} = COUNT * 0.000837737 \text{ mA}$	-
09	Current Sense, Return	0	-	27	mA	-	-
10	Ground	-	-	-	-	-	-
11	Digital Input, 1-wire	0	-	5	V	$V_{IH,min} = 1.5 \text{ V}, V_{IL,max} = 0.7 \text{ V}$	Configured for 1-wire bus
12	Single-ended ADC	0	-	5.0	V	$V_{PORT} = COUNT * 0.000079753 \text{ V}$	$R_{in} = 11.2 \text{ k}\Omega$
13	Single-ended ADC	0	-	5.0	V	$V_{PORT} = COUNT * 0.000079753 \text{ V}$	$R_{in} = 11.2 \text{ k}\Omega$
14	Single-ended ADC	0	-	5.0	V	$V_{PORT} = COUNT * 0.000079753 \text{ V}$	$R_{in} = 11.2 \text{ k}\Omega$
15	Single-ended ADC	0	-	5.0	V	$V_{PORT} = COUNT * 0.000079753 \text{ V}$	$R_{in} = 11.2 \text{ k}\Omega$

Table 2: IO Specifications for DS0047 Variant

Cellio transceivers are configurable to fit different applications. As a result, each variant may have a different selection of IO ports and different limitations on these ports.

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### 5.3. Functional Description

#### 5.3.1. 5 V Supply Output

This port can be used to supply external sensors with 5 V power at a maximum current of 150 mA. The 5 V supply output is only enabled when the transceiver wakes up to take a reading and check in to a gateway.

#### 5.3.2. Ground Connection

This is the ground reference for the voltage supply ports, digital IO, and single-ended analog inputs. All ground ports are electrically connected on the transceiver PCB.

#### 5.3.3. Digital Input

The digital input port reads a digital signal via a MOSFET. The transceiver firmware compensates for the inverting nature of this circuit topology.

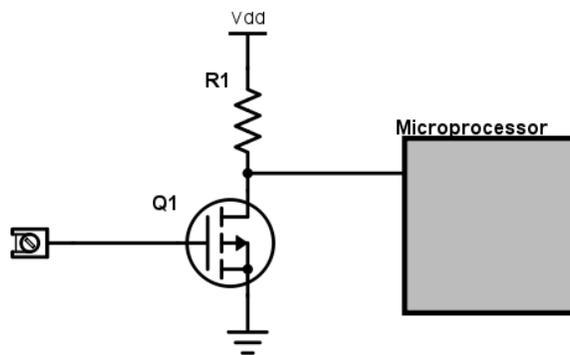


Figure 4: Simplified Block Diagram of Digital Input Port

#### 5.3.4. Digital Output

The digital output port uses an open drain architecture; the transceiver firmware compensates for the inverting nature of this circuit topology. The logic high signal is pulled up to the internal 5 V supply.

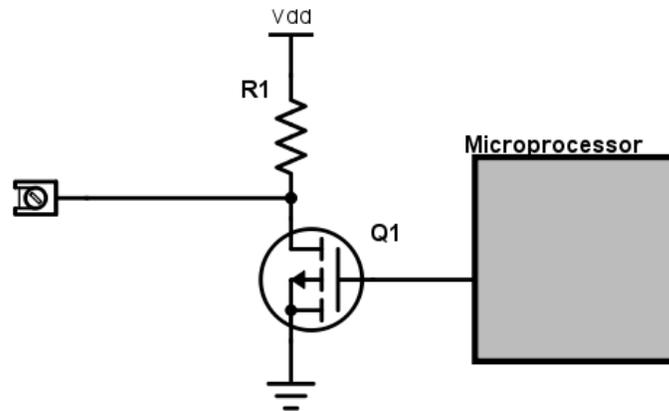


Figure 5: Simplified Block Diagram of Digital Output Port

### 5.3.5. Single-Ended Analog Input

The single-ended analog input is connected to a 15-bit ADC through a resistor divider. Note that this is not a high impedance input. See IO configuration tables for the input impedance on each variant. At 25 °C, the accuracy of this input is 0.2%. At temperatures far above and below 25 °C (-20 °C & 60 °C) the accuracy of this input is 1.3%.

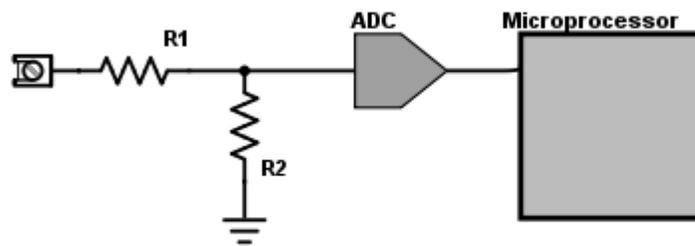


Figure 6: Simplified Block Diagram of Single-Ended Analog Input Port

### 5.3.6. Current Loop Sense

The current sensor has a resolution of 15 bits. The “RETURN” current terminal can be connected directly to ground if desired. The current must flow into the “IN” terminal and out through the “RETURN” terminal. Otherwise, the reading will always be 32767 on the server.

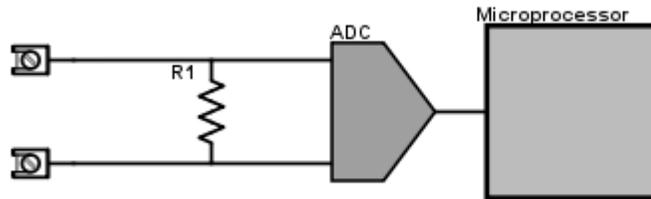


Figure 7: Simplified Block Diagram of Current Sense Input Port

### 5.3.7. 1-Wire Bus

The 1-wire bus utilizes two IO ports on the Cellio transceiver; one digital input for incoming data and one for ground. If needed the 1-wire IO can be used as a fourth digital input.

### 5.3.8. 9 V Output

This port provides a 9 V continuous output via a 10 k $\Omega$  pull-up resistor to the internal battery. This output is active at all times, whether the transceiver is in a wake or sleep state.

## 6. System Power

### 6.1. Battery

A lithium 9 V battery should be used to power the transceiver. Any other battery chemistry may result in reduced battery life.

## 7. Environmental

The electronics in the Cellio transceiver are rated for  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  ambient temperature. The battery may be the limiting factor; please comply with ratings on the installed battery.

## 8. Regulatory Information

Cellio Gateways and Transceivers are designed to the highest standards of safety, but they are radio devices which require specific consideration. Please read and understand all of the safety notices, warnings, and cautions for this product. Device Solutions assumes no liability for failure to comply with the safety precautions. See the Cellio Installation Guide for other details about safety.

This device complies with Part 15 of the FCC Rules. This device complies with Industry Canada's license-exempt RSSs. Operation of the device is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme aux normes d'exemption de licence RSS d'Industry Canada. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas causer

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d'interférence, et (2) cet appareil doit accepter toute interférence, notamment les interférences qui peuvent affecter son fonctionnement.

This product has been tested and complies with the specifications for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used according to the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which is found by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment or devices
- Connect the equipment to an outlet other than the receiver's
- Consult a dealer or an experienced radio/TV technician for assistance

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Cellio products (including hardware and software) are not designed or intended to be fail-safe, or for use in any application requiring fail-safe performance, such as life-support or safety devices or systems, class iii medical devices, nuclear facilities, applications related to the deployment of airbags, or any other applications that could lead to death, personal injury or severe property or environmental damage (individually and collectively, "critical applications").

Cellio products are not designed or intended for use in any applications that affect control of a vehicle or aircraft.

Cellio devices are not suitable for use in explosive environments.

Customer agrees, prior to using or distributing any systems that incorporate Cellio products, to thoroughly test the same for safety purposes. Customer assumes the sole risk and liability of any use of Cellio products in critical applications, subject only to applicable laws and regulations governing limitations on product liability.

FCC ID: OXW-PA0053

IC: 10572A-PA0053

## **9. Support**

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