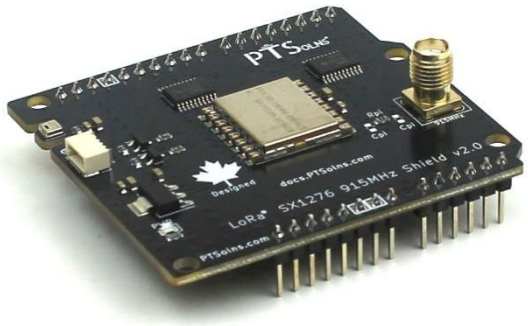
LoRa® SX1276 915MHz Shield

1 DESCRIPTION

The PTSolns *LoRa® SX1276 915MHz Shield* is designed as a practical platform for developing and testing long range wireless and LoRaWAN based applications.



The shield is LoRaWAN compatible and includes an onboard AHT20 sensor for measuring temperature and humidity, allowing sensor data transmission without additional hardware. An onboard QWIIC connector to allow additional sensor modules to interconnect with the shield quickly and easily.

Hardware configuration pins are accessible on the back of the board. The onboard power LED can be disconnected via a rear jumper. The shield is compatible with the PTSolns *Uno R3+,* PTSolns *DIY UNO Kit*, the Uno R3, Uno R4, and other equivalent Uno microcontroller development boards.

Table of Contents

2 DOCUMENT REVISION HISTORY

Current document revision is Rev 0.

3 PRODUCT FEATURES

This section highlights notable features of the *LoRa® SX1276 915MHz Shield.*

3.1 Compatibility

The *LoRa® SX1276 915MHz Shield* is compatible with the following microcontroller development boards:

- PTSolns *Uno R3+*
- PTSolns *DIY UNO Kit*
- Arduino R3
- Arduino R4 Wifi/Minima
- Any other compatible Uno formfactor board with correct pinout (see Section 3.7).

3.2 LoRa® SX1276 915MHz Module and Antenna

The LoRa module onboard the shield is the SX1276 version, suitable for operating in the 915MHz band (North America). This LoRa module operates at 3.3V, meanwhile the development board provides 5V. Therefore, the shield has appropriate logic level shifting (LLS) installed to accommodate the required voltage levels.

The shield uses a 4-layer PCB to maintain a controlled impedance RF path between the LoRa module and the SMA connector, with a solid ground reference to minimize mismatch and parasitics. Certain layout tradeoffs, such as omitting the ICSP header, were made to preserve uninterrupted ground planes and clean RF routing. The removal of the ICSP header improved the RF performance of the shield at the sacrifice of compatibility with other shields not listed in Section 3.1.

The SMA connector is a standard 50Ω coaxial connector.

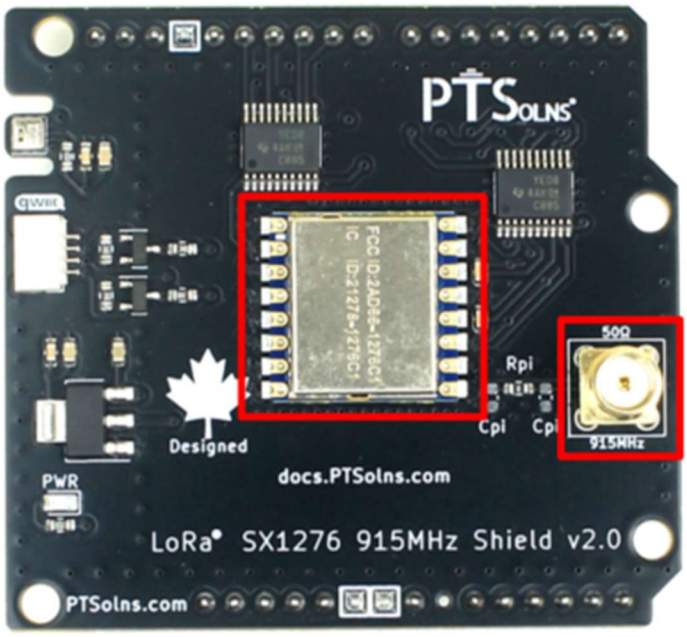


Figure 1: LoRa module and SMA Antenna.

3.3 Onboard AHT20 Temperature & Humidity Sensor

Onboard the Shield is the AHT20 temperature and humidity sensor. The sensor is integrated into the Shield via the I2C bus. The sensor's I2C address is 0x38. Around the AHT20 sensor is a PCB cutout to reduce thermal coupling and improves airflow so the sensor measures ambient temperature and humidity more accurately.

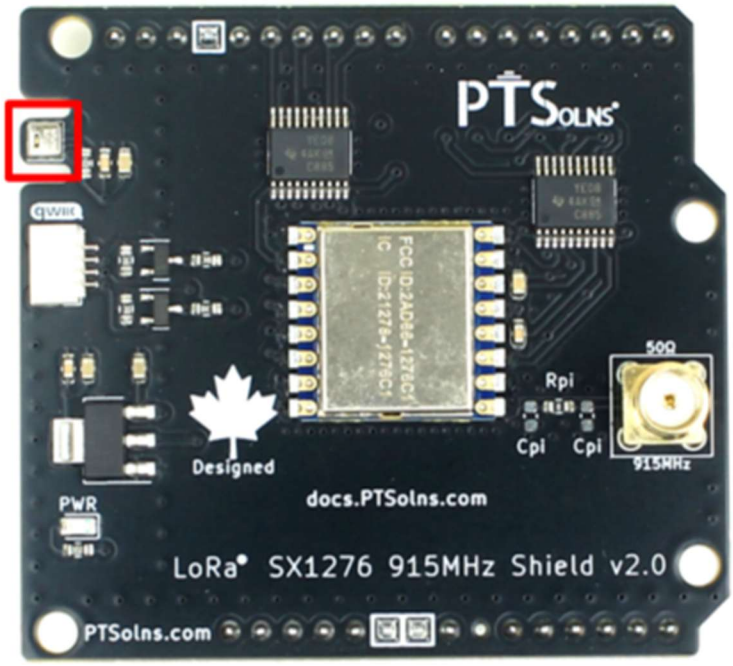


Figure 2: AHT20 Sensor.

3.4 Onboard QWIIC® Connector

Onboard logic level shifting (LLS) to 3.3V made it possible to include the popular QWIIC® connector. This connector can be used to add any other compatible QWIIC connected peripherals.

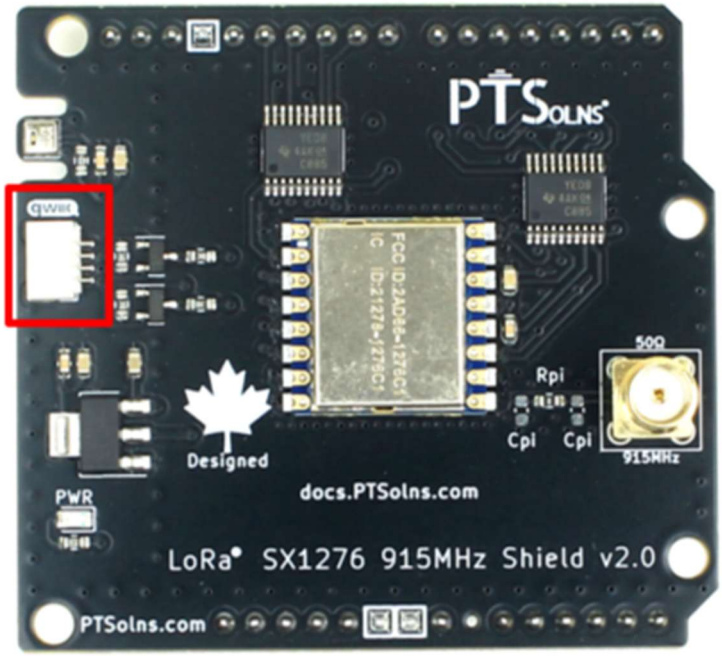


Figure 3: QWIIC Connector.

3.5 Onboard Power LED

An onboard power LED indicates when power is supplied to the Shield. The power LED can be disabled by cutting the “PWR” jumper tracer on the back of the board.

3.6 LoRaWAN Compatible

The *LoRa® SX1276 915MHz Shield* has been tested to be LoRaWAN compatible. The test was performed using The Things Network (TTN) and sending the onboard temperature and humidity readings from the AHT20 as a payload over a nearby gateway to the TTN cloud. See Section 5.2 for more information.

3.7 Hardware Pin Connections

The hardware pin connectors are made on *LoRa® SX1276 915MHz Shield* are outlined in Table 1.

Note that the SPI connections are not on the ICSP header, but rather on the digital pin header. See end of Section 3.2 for more details.

Table 1: Hardware Pin Connections

LoRa SX1276 Pins	**Development Board Pins**	**Notes**
DIO0	D2	Closed jumper on back. Can disconnect by cutting jumper.
DIO1	D3	Closed jumper on back. Can disconnect by cutting jumper.
DIO2	D4	Closed jumper on back. Can disconnect by cutting jumper.
DIO3	D5	Closed jumper on back. Can disconnect by cutting jumper.
DIO4	D6	Closed jumper on back. Can disconnect by cutting jumper.
DIO5	D7	Closed jumper on back. Can disconnect by cutting jumper.
OE	ON / D8	The logic level shifters are enabled by default (ON). If cutting the jumper trace on the back and connecting the jumper to “D8”, the LLS can be enabled/disabled by pin D8. Pull HIGH to enable.
NRESET	D9	
NSS	D10	
COPI	D11	Formerly called “MOSI”. On the digital header (not ICSP header).
CIPO	D12	Formerly called “MISO”. On the digital header (not ICSP header).
SCK	D13	On the digital header (not ICSP header).

AHT20	**Development Board Pins**	**Notes**
SDA	A4	On the digital header
SCL	A5	On the digital header

3.8 Mark of Authenticity

Authentic PTSolns PCBs have a black solder mask color and are marked with the “PTSolns” logo in white silkscreen printing. The “Canadian Designed” symbol, consisting of the Canadian Maple Leaf with the word “Designed” underneath, can also be found on the PCB in white silkscreen printing. The “PTSolns” trademark and the “Canadian Designed” symbols are shown in Figure 4.

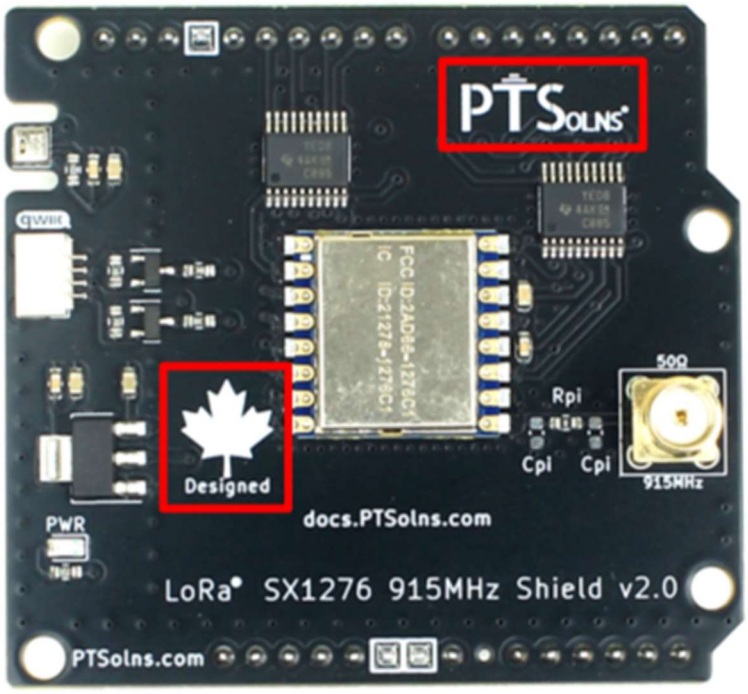


Figure 4: The "PTSolns" trademark and “Canadian Designed” mark found on authentic PTSolns PCBs.

4 PHYSICAL PROPERTIES

The physical properties of the *LoRa® SX1276 915MHz Shield* are outlined in Table 2. The Shield has a standard Uno formfactor with the length slightly reduced.

Table 2: Physical Properties.

	Quantity	Value	Reference
PCB	Length	57.6 mm	Figure 5
	Width	53.5 mm	Figure 5
	Thickness	1.6 mm	--
	Weight (without antenna)	17 g	--
	Color	Black	--
	Silkscreen	White	--
Material	Lead free HASL-RoHS surface finish		--
	FR-4 base		--
Mounting Holes	4x each with 1.651 mm diameter		Figure 6

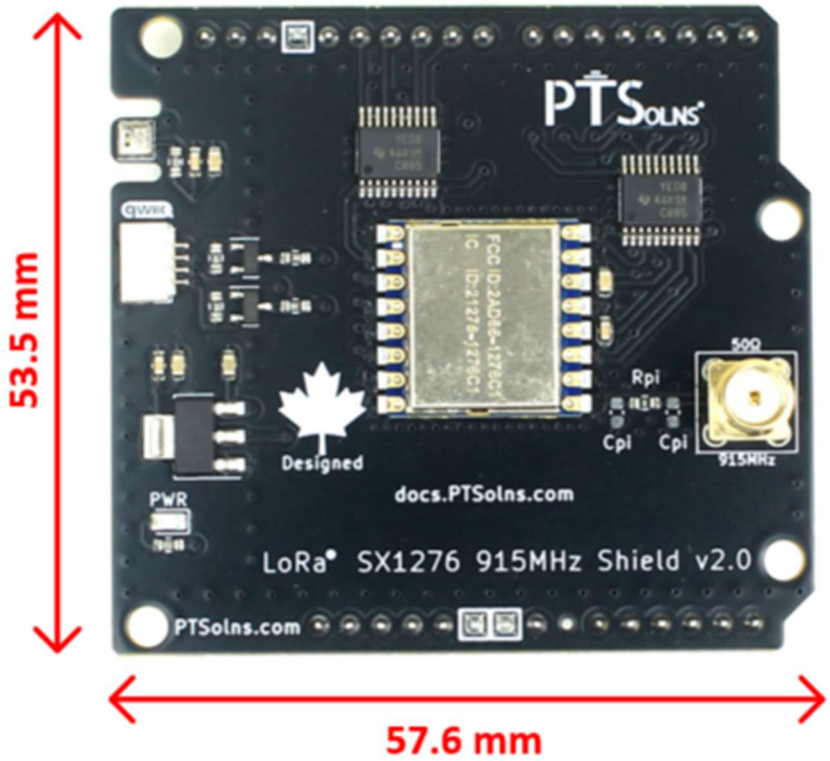


Figure 5: Dimensions of the LoRa® SX1276 915MHz Shield.

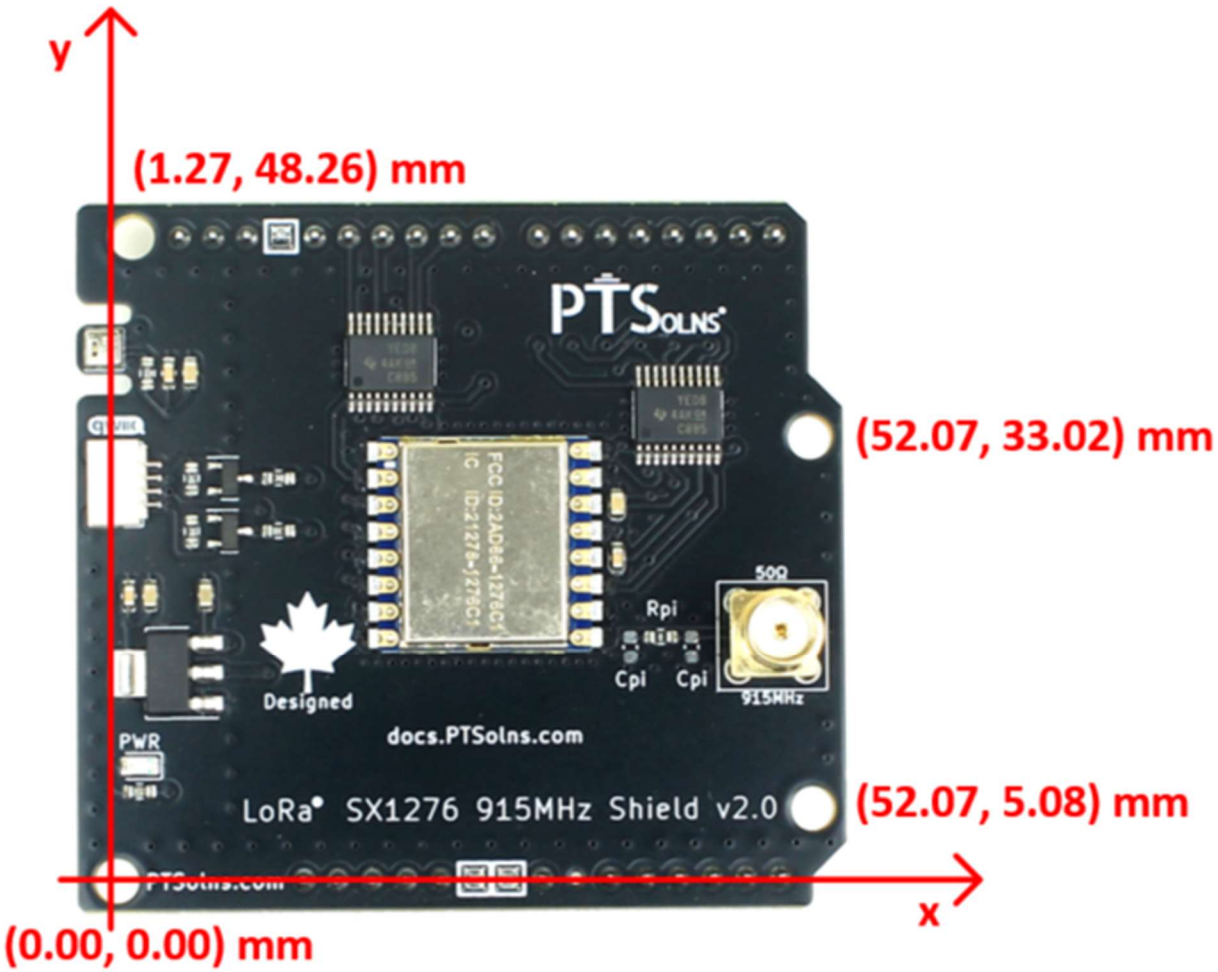


Figure 6: Positions of mounting holes.

5 USAGE AND APPLICATION

This section presents practical applications of the PTSolns *LoRa® SX1276 915MHz Shield.*

5.1 Node-to-Node LoRa Network Application

The *LoRa® SX1276 915MHz Shield* can be used to form a network in which the nodes (LoRa Shield + microcontroller + power source) communicate with each other, similar as shown in Figure 7.

Key Points:

- Communicate between two or more LoRa Nodes
- Private network (typically)
- No gateway required, can be set up anywhere
- No internet required, ideal for standalone projects

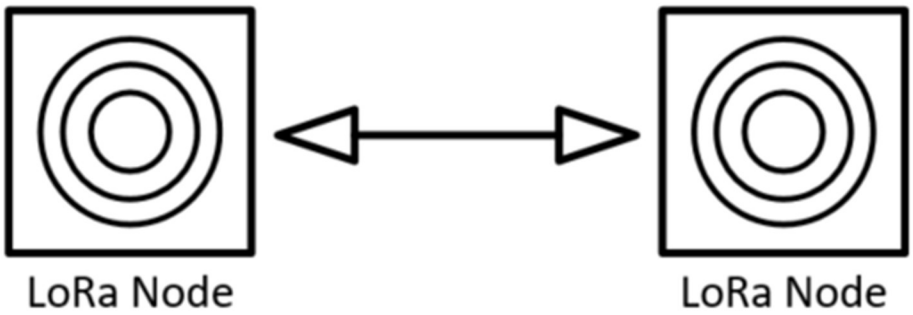


Figure 7: Node-to-Node LoRa Network.

A tutorial of this type of application using the *LoRa® SX1276 915MHz Shield* can be found here:
https://ptsolns.com/pages/node-to-node-lora-network

5.2 Node-to-Gateway LoRa Network Application

The *LoRa® SX1276 915MHz Shield* can be used to form a network in which the nodes (LoRa Shield + microcontroller + power source) communicate with a central gateway, similar as shown in Figure 8. The gateway typically is connected to the internet and the backend cloud.

Key Points:

- Communicate between LoRa Nodes and a gateway
- Private network / Public network
- Works with a single LoRa node, but requires a gateway nearby
- Connected to cloud, ideal for IoT projects

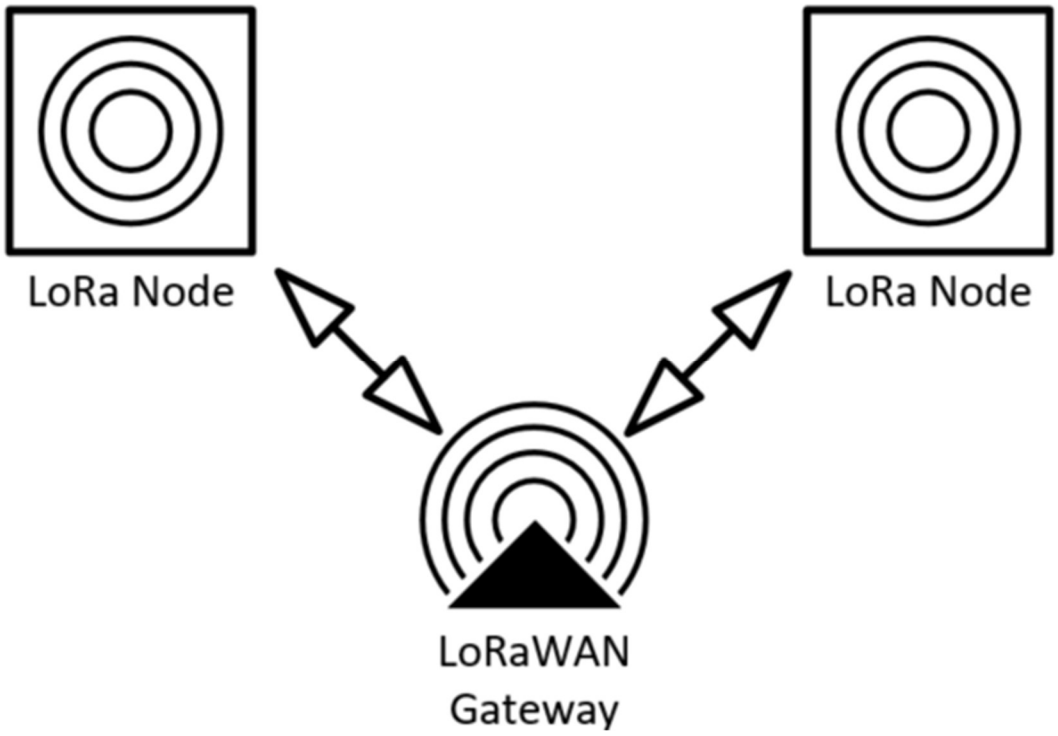


Figure 8: Node-to-Gateway LoRa Network.

A tutorial of this type of application using the *LoRa® SX1276 915MHz Shield* can be found here:
https://ptsolns.com/pages/node-to-gateway-lora-network

5.3 Range Test

The theoretical range the LoRa SX1276 can reliably communicate and the actual real-life range are not the same. Many factors impact the communication range, including:

- Obstructing the Fresnel zone
- Weather and environmental conditions
- Spreading factor bandwidth and data rate configuration
- Electromagnetic interference and channel congestion
- Earth curvature after approximately 8-10+ km
- Antenna gain

In order to show an example application of a realistic LoRa-to-LoRa network, a range test was performed. The transmitter hardware consisted of a PTSolns *LoRa® SX1276 915MHz Shield* stacked on a PTSolns *Uno R3+*. The node was powered by a standard 5V battery pack. The receiver node was similar, except it also had a LCD display that printed out the messages and signal quality parameters in real time.

Considering the test conditions were not ideal, but rather realistic. Trees, electricity poles, and many other objects obstructed the Fresnel zone. Furthermore, the landscape was not fully flat as there were rolling hills all along. The goal of this range test was to show what is possible with this shield under real-life scenario.

Figure 9: Range Test with the LoRa Shield in Rural Real-Life Setting.

The range reliable LoRa-to-LoRa communication remained established was 6.15 km (3.82 miles). The reader is reminded that this range reflects the above-mentioned conditions, but also an rural setting. In an urban environment the expected range will be reduced due to severe Fresnel zone obstruction.

6 REFERENCES

This section lists relevant references.

- Tutorial: Node-to-Node LoRa Network:
  https://ptsolns.com/pages/node-to-node-lora-network
- Tutorial: Node-to-Gateway LoRa Network:
  https://ptsolns.com/pages/node-to-gateway-lora-network
- PTSolns' Documentation Repository Sub-Domain:
  https://docs.PTSolns.com
- PTSolns website:
  https://PTSolns.com
- PTSolns support:
  https://ptsolns.com/pages/contact