



Application Note

SL900A

Typical Applications

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1 General Description

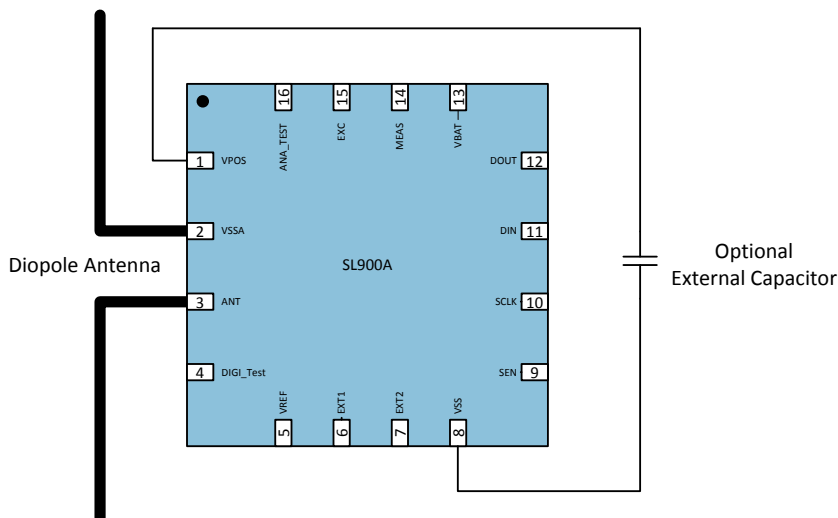
This document describes typical applications for the SL900A device. For detailed information of the SL900A device please refer to the device specification.

2 Passive Temperature Sensor

The SL900A device can be used in fully passive mode without using a battery supply. For the basic type, only the VBAT and VSSA pins need to be connected (typically a dipole antenna is used). The device is completely powered from the RF field using the integrated RF rectifier. The read range in fully passive mode is around 70% lower, compared to the battery assisted mode. The reading range can be extended if an external capacitor is connected between the VPOS (rectified RF voltage) and VSS pins.

The typical application for such an arrangement is a passive temperature sensor. The SL900A device in this case is used for identification and reading of the current temperature. The minimum command set that need to be supported by the reader is the EPC standard command set (for tag singulation) and the custom “Get Sensor Value” cool-Log™ command used for temperature conversion.

Figure 1: SL900A as a Passive Temperature Sensor



3 Semi-Passive Temperature Logger

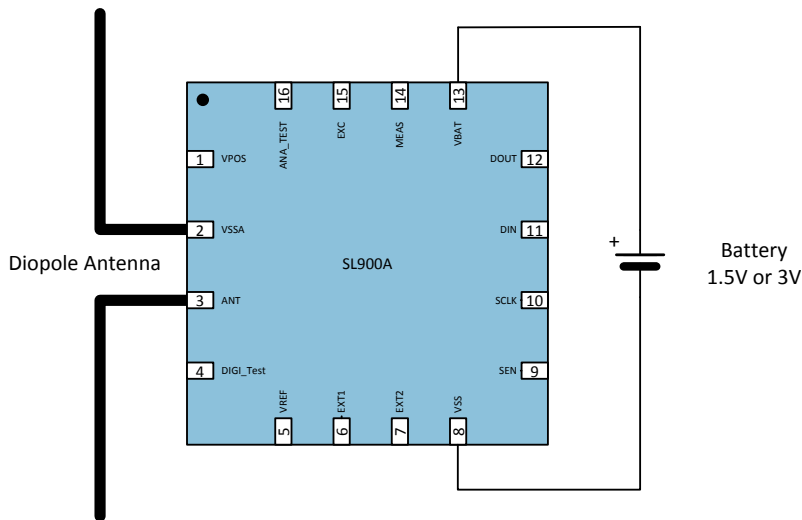
A battery needs to be attached to the SL900A device in order for the logging functions to work without the presence of a RFID reader RF field. The battery needs to be connected between the VBAT and VSS pins. A 1.5V or 3V (single cell or dual cell) battery can be used. The maximum battery voltage is 3.6V.

Such transponders can be manufactured on a flexible substrate, if a thin and flexible battery is used. This implementation will have the lowest manufacturing cost, however it should be noted that the exchange of such batteries is particularly complicated, if not impossible. So this implementation is typically done for disposable transponders. If a reusable transponder is the target a button cell battery and a rigid PCB substrate is recommended. The minimum set of commands that needs to

be supported by the reader are the EPC standard commands (for tag singulation) and the custom cool-Log™ commands:

- Set Log Mode
- Initialize
- Start Logging
- Stop Logging

Figure 2: SL900A used as Semi-Passive Temperature Logger



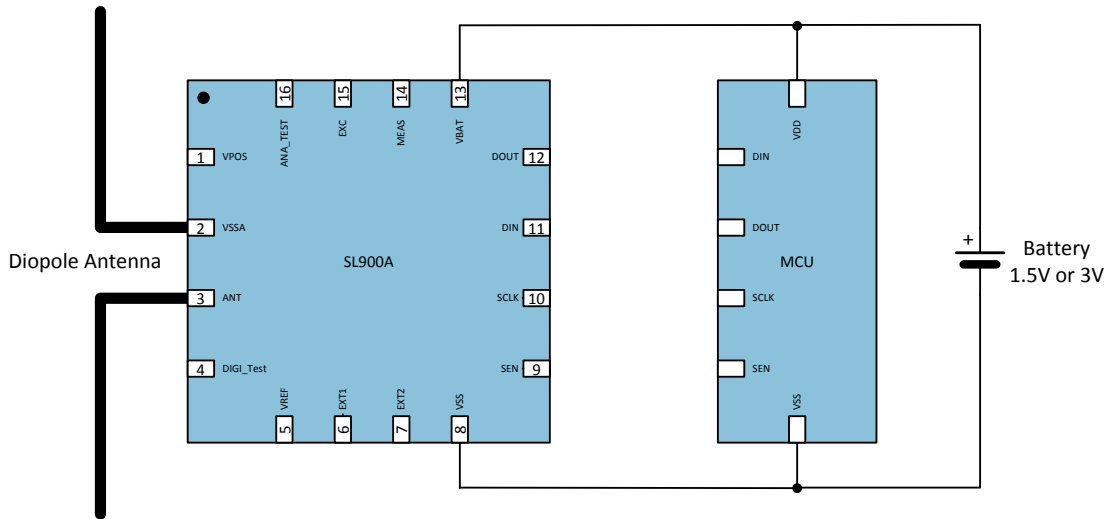
4 SPI-to-RFID Interface

The SL900A has an integrated SPI interface that can be used for communication with a micro controller. The micro controller can be used for various tasks and for different applications. The pins required for the SPI interface are SEN (enable), SCLK (clock), DIN (serial data input, MOSI) and DOUT (serial data output, MISO). The SL900A is a pure slave device and it cannot initiate the communication. The communication needs to be initiated by the micro controller. The SPI pin voltage needs to be equal to the VBAT voltage, so it is recommended that the SL900A and the micro controller are supplied from the same source.

The integrated FIFO register can be used for fast data transmission between the micro controller and the RFID reader, without the need to write to the EEPROM. The FIFO is 8-bytes deep and can be accessed by the micro controller and the reader. Before accessing the FIFO, the FIFO status needs to be read in order to check that the FIFO is not used by the other side. Basic arbitration is implemented and it gives FIFO access to the device that requests it first. If both sides access the FIFO at the same time (same clock period), then the priority is given to the SPI interface (micro controller).

The minimum set of commands that needs to be supported by the reader are the EPC Gen2 standard commands and the “Access FIFO” cool-Log™ custom command. The “Access FIFO” command is used to read and write the FIFO (up to 8 bytes at once) and to read the FIFO status byte.

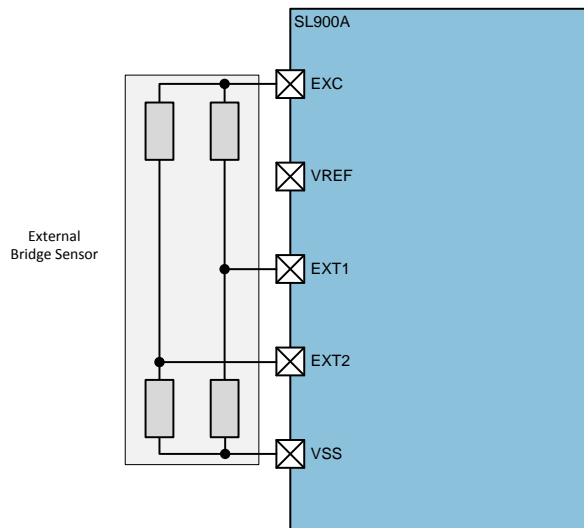
Figure 3: SPI to RFID Interface



5 Wireless Bridge Sensor

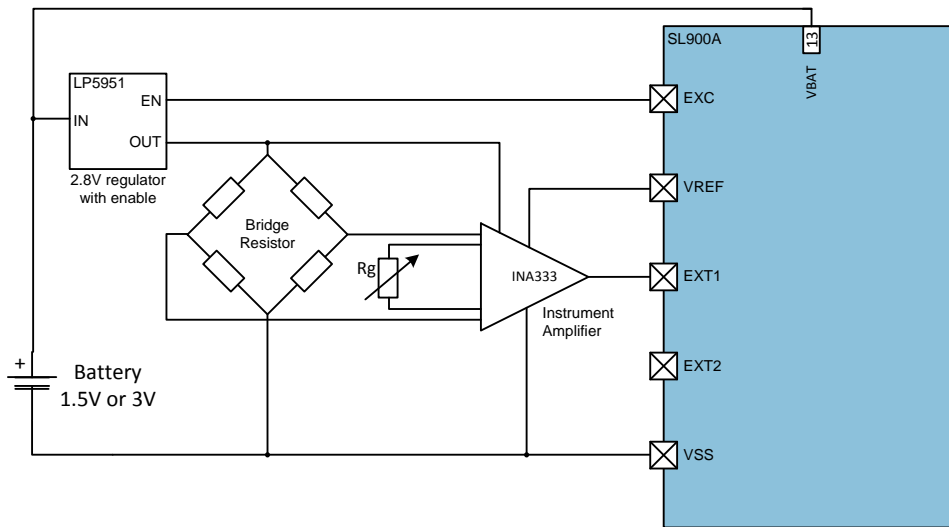
A bridge sensor can directly be connected with 1 sensing point to EXT1 and the second sensing point to EXT2, as is shown in the figure below:

Figure 4: Directly connected Resistive Bridge Sensor



However, due to the typical low sensitivity of bridge sensors, it is recommended to use an external instrumentation amplifier, like is shown in the figure below. In case the bridge resistance is low (lower than 100kΩ), an external voltage regulator with enable input should be used. The enable input is connected to the EXC output, so that the voltage output of the regulator can be controlled by the SL900A device (the supply voltage is applied only during the conversion time).

Figure 5: Resistive Bridge Sensor with an external Instrumentation Amplifier



The VREF reference voltage output is connected to the REF input of the amplifier. This increases the DC voltage of the bridge signal to the input voltage of the integrated AD converter. The Rg resistor is used for gain selection – the value is dependent on the bridge sensitivity.

The minimum set of commands that needs to be supported by the reader is the EPC Gen2 standard command set, and some custom commands. If the transponder will be used for bridge voltage logging, then the:

- Set Log Mode
- Set Calibration Data
- Set SFE Parameter
- Start Log
- End Log
- Get Sensor Value

cool-Log™ custom commands need to be implemented.

In case the transponder will be used for instant measurements only, then the reader needs to support:

- Set SFE Parameters
- Set Calibration Data
- Get Sensor Value

The setup of the SL900A device for bridge sensor support needs to be done as follows:

5.1 SFE Parameters

Parameter	Value
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Parameter	Value
Rang [4:0]	Don't care
Seti [4:0]	Don't care
EXT1 [1:0]	0b01
EXT2	Don't care
Autorange disable	Don't care
Verify sensor ID [1:0]	0b01 : If the external sensor value is used for limits comparison 0b00 : If the temperature sensor is used for comparison

5.2 Calibration Data

Parameter	Value
sw_ext_en	1 (enable signal on EXC pin)
Coars1 [2:0]	User-defined (lower reference voltage)
Coars2 [2:0]	User-defined (higher reference voltage)
gnd_switch	User-defined (connects lower reference voltage to GND)
ALL OTHERS	Default (do not change)

5.3 Log Mode (for dense mode – bridge sensor logging only)

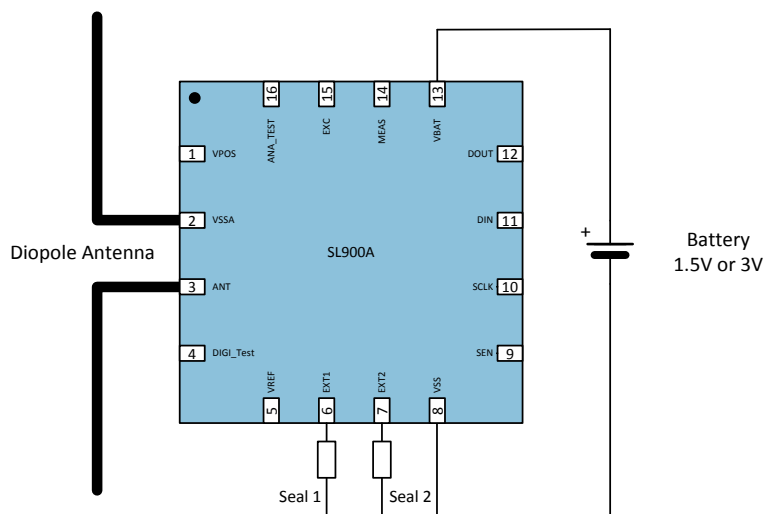
Parameter	Value
Logging form [2:0]	0b000
Storage rule	0
Ext.1 sensor enable	1
Ext.2 sensor enable	0
Temp sensor enable	0
Battery check enable	0
Log interval [14:0]	User-defined logging interval (in seconds)

6 Temperature-Evident Transponder

The tamper-evident transponder can be used in fully-passive or semi-passive mode. The fully-passive transponder can be used in applications where it is important to know that the tagged item has been tampered with, while the semi-passive transponder can be used to provide the information at what time the item has been tampered.

The SL900A device can be used with 2 independent seals that are connected to the external sensor input pins (EXT1 and EXT2 to VSS). The seals can be implemented as thin layer of a conductive material. If the seal is intact, the chip will measure a very low resistance. If the seal is broken the device will measure a very high resistance.

Figure 6: Tamper-Evident Transponder with 2 Seals

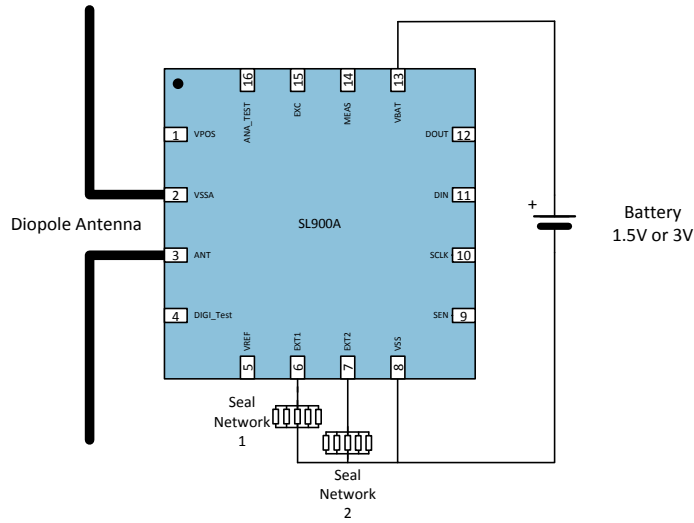


It is also possible to implement a larger number of seals using a parallel resistive network (Figure below). If all resistances have the same value, it will not be possible to detect which seal is broken, only the number of broken seals. In case the exact seal position needs to be detected, the parallel resistive network must have different resistance values.

Example parallel network with 5 equal resistors (500k Ω):

Number of broken seals	Resistance Value
0	100k Ω
1	125k Ω
2	166.7k Ω
3	250k Ω
4	500k Ω
5	∞ (open)

Figure 7: Tamper-Evident Transponder with 10 Seals



For broken seal position detection it is advised to use 2 independent resistor networks like shown on Figure 7. This will increase the overall sensitivity of the detection.

Example parallel network with 5 different value resistors:

Position of broken seal	Resistance value
0	64.5k Ω
Resistor 1 (2M Ω)	66.7k Ω
Resistor 2 (1M Ω)	68.9k Ω
Resistor 3 (500k Ω)	74.1k Ω
Resistor 4 (250k Ω)	86.9k Ω
Resistor 5 (125k Ω)	133.3k Ω

7 Contact Information

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9 Revision Information

Changes from 1-00 (2013-Jun-06) to current revision 1-01 (2014-Jul-22)	Page
Update to corporate format	1-12

Note: Page numbers for the previous version may differ from page numbers in the current revision.