IDS-SL900A-AN5-app

Typical applications for SL900A

Revision 1.0

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1. Scope

This is a quick guide for implementation of different applications using the SL900A device. For detailed information of the SL900A device please refer to the device specification.

2. Passive temperature sensor

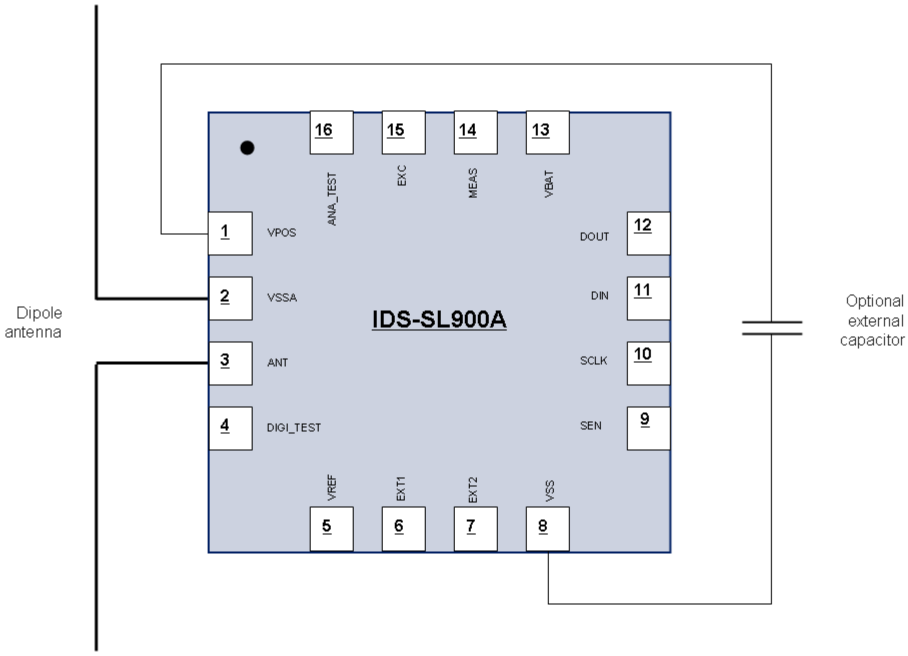

Figure 1: Passive temperature sensor

The SL900A device can be used in fully passive mode, so without a battery supply. For the basic type, only the VBAT and VSSA pins need to be connected (typical 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 en 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 set of commands that need to be supported by the reader are the EPC standard commands (for tag singulation) and the custom “Get Sensor Value” command that is used for temperate conversion.

3. Semi-passive temperature logger

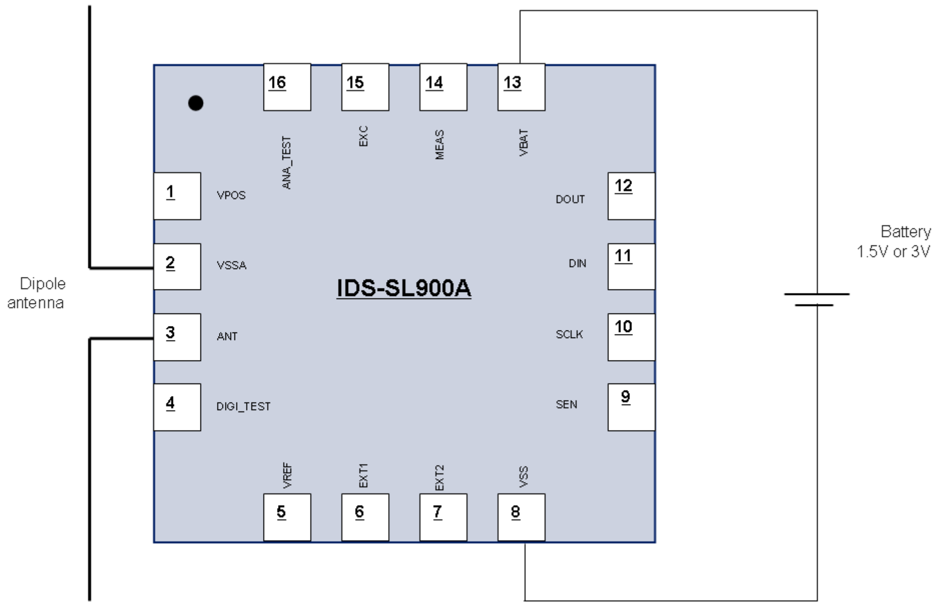

Figure 2: Semi-passive temperature logger

A battery needs to be attached to the SL900A device in order that the logging functions can be used also without the presence of a RFID reader. 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 a transponder can be manufactured on a flexible substrate, if a thin and flexible battery is used. This will implementation will have the lowest manufacturing cost, however it should be noted that the exchanging of such a battery is particularly complicated, if not impossible, so this implementation is typically reserved for disposable transponder. If a reusable transponder is the target a button cell battery and a rigid PCB substrate is a better choice. This rasies the manufacturing cost, however the life time of such a transponder is much longer copmared to the flexible transponder.

The minimum set of commands that needs to be supported by the reader are the EPC standard commands (for tag singulation) and the custom commands “Set Log Mode”, “Initialize”, “Start Logging” and “Stop Logging”.

4. SPI-to-RFID interface

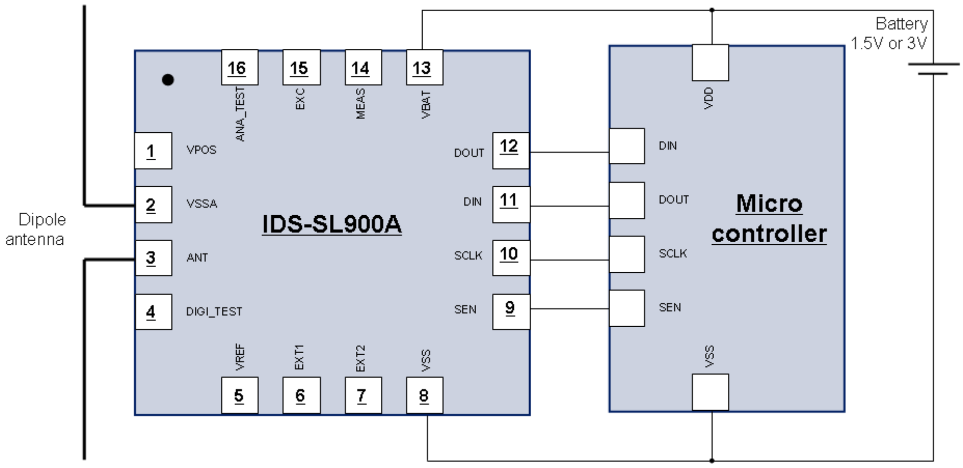

Figure 3: SPI-to-RFID interface

The SL900A has an integrated SPI interface that can be used for attaching 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 can not 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 preferred 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 access to the FIFO the the device that requests it first. If both sides access the FIFO at the same time (same clock period), than 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” 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.

5. Wireless bridge sensor

A bridge sensor can directly be connected with 1 sensing pint to EXT1 and the second sensing point to EXT2, as is shown in Figure 4.

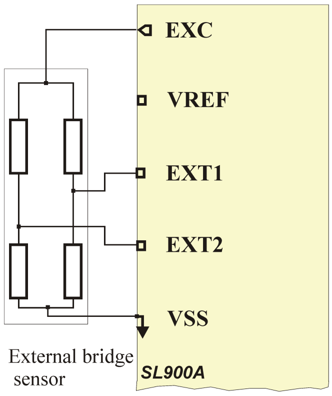

Figure 4: Directly connected resistive bridge sensor

However, due to the typical low sensitivity of bridge sensors, it is advised to use an external instrumentation amplifier, like is shown on Figure 5. In case the bridge resistance is low (lower than 100kΩ), an external voltage regulator with enable input has to be used. The enable input is connected to the EXC output, so that the voltage output of the regulator can be controlled with the SL900A device (the supply voltage is applied only during the conversion time).

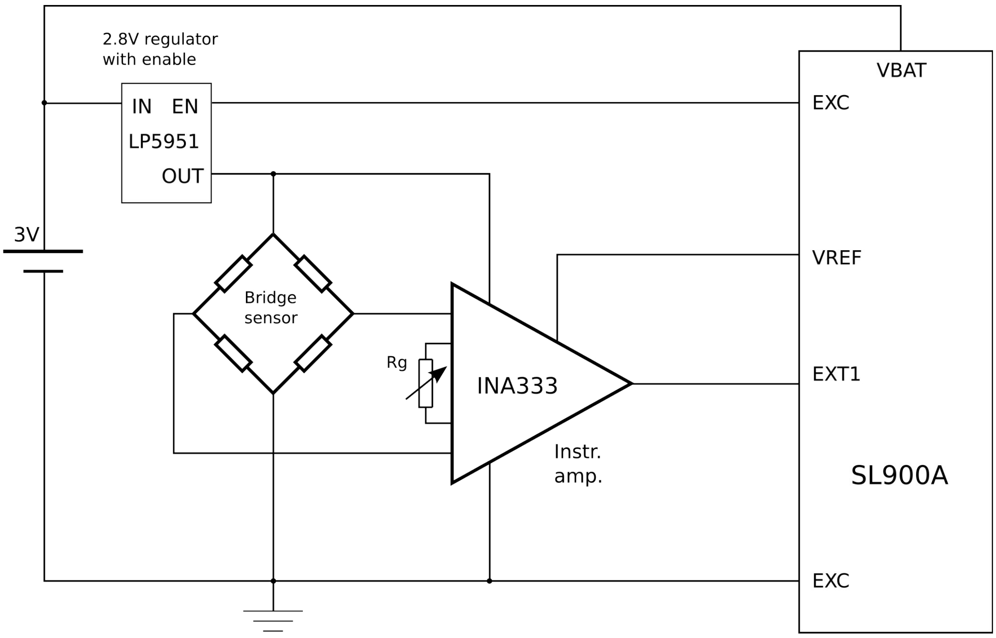

Figure 5: Resistive bridge sensor with external instrumentation amplifier

The VREF reference voltage output is connected to the REF input of the amplifier. This raises 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 are the EPC Gen2 standard commands, and some custom commands. If the bridge resistor transponder will be used for bridge voltage logging, then the “Set Log Mode”, “Set Calibration Data”, “Set SFE Parameter”, “Start Log”, “End Log” and “Get Sensor Value” custom commands need to be implemented. In case the transponder will be used only for instant measurements, then the reader needs to support the “Set SFE Parameters”, “Set Calibration Data” and “Get Sensor Value” commands.

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

1. SFE parameters:

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

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 refenece voltage to GND)
ALL OTHERS	Default (do not change

3. Log mode (for dense mode bridge sensor logging only):

Parameter	**Value**
Logging form [2:0]	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. Tamper-evident transponder

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

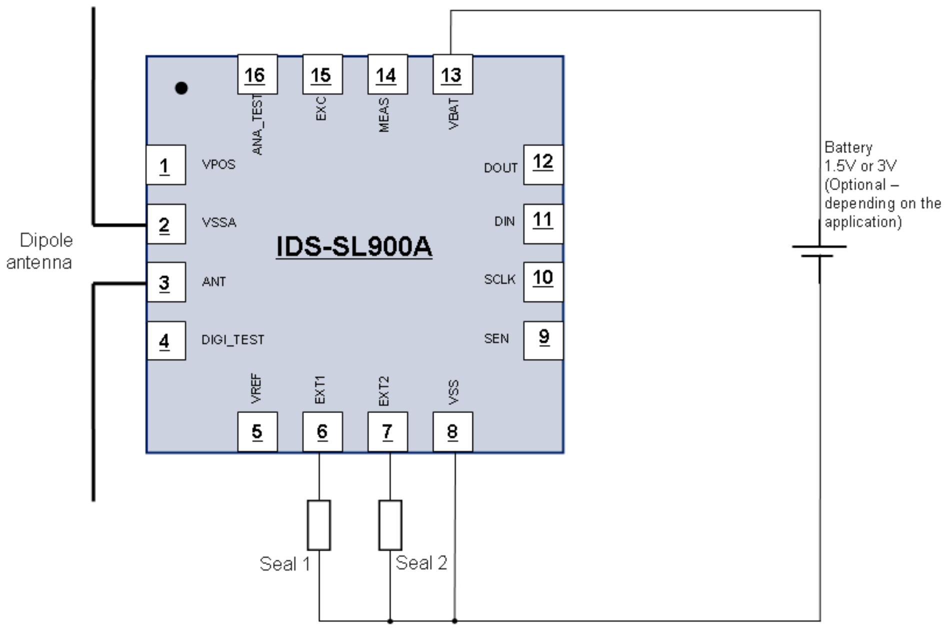

Figure 6: Tamper-evident transponder with 2 seals

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 deposition of a conductive material. If the seal is in tact, the chip will measure a very low resistance, if the seal is broken the device will measure a very high resistance.

It is also possible to implement a larger number of seals using a parallel resistive network (Figure 7). 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 (500kΩ):

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

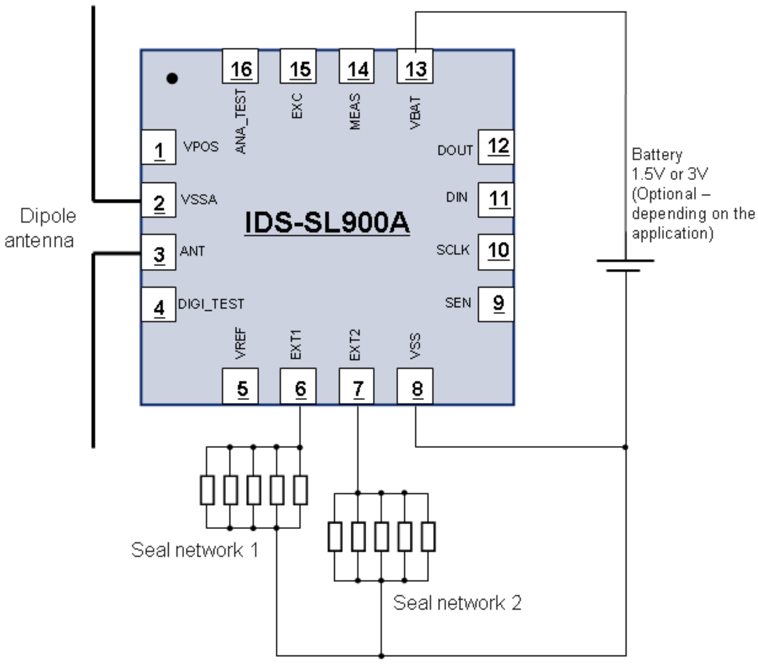

Figure 7: Tamper evident transponder with 10 seals

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	64.5kΩ
Resistor 1 (2MΩ)	66.7kΩ
Resistor 2 (1MΩ)	68.9kΩ
Resistor 3 (500kΩ)	74.1kΩ
Resistor 4 (250kΩ)	86.9kΩ
Resistor 5 (125kΩ)	133.3kΩ

Sales & Marketing Europe
IDS Microchip AG
Wächlenstrasse 5,
CH-8832 Wollerau, Switzerland
Phone: +41 43 844 6253
Fax: +41 43 844 6250
sales@ids-microchip.com

Sales & Marketing Americas
IDS Microchip,
Toronto Office
131 Yorkminster Rd.
North York, ON M2N 2Z5, Canada
Phone: +416 227 9196
Fax: +41 43 844 6250
sales@ids-microchip.com

www.ids-microchip.com