

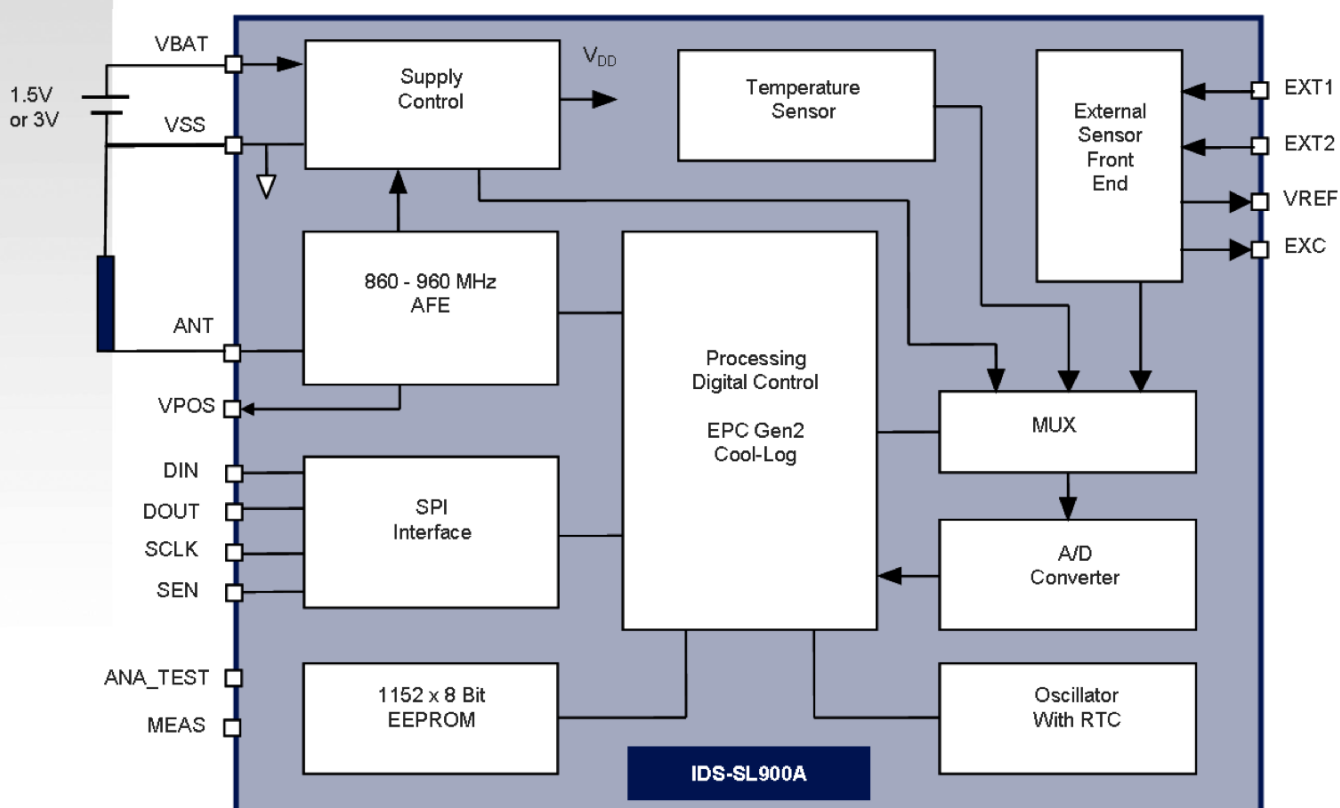
Key Features

- High Temperature Range: -40°C to +110°C
- Frequency: 860 to 960 MHz
- Battery supply: 1.5V or 3V
- Data logging from:
 - On-chip temperature sensor
 - 2 external sensors
- EPC Class 1 and Class 3 Compliant
- Compatible to EPC Gen.2
- Real-time clock for data logging
- External sensor interrupt capability
- Serial peripheral interface
- On-chip 9k bit EEPROM
- Integrated dynamic shelf life calculation
- Advanced logging with 4 user-selectable limits

Package Options

- 16-pin QFN (5 x 5 mm)
- Tested wafer (8")

Block Diagram



Description

The SL900A is an EPC global Class 3 tag chip optimised for single-cell and dual-cell, battery-assisted smart labels with sensor functionality. The chip is ideal for applications using thin and flexible batteries but can also be powered from the RF field (electromagnetic waves from an RFID reader).

The chip has a fully integrated temperature sensor with a typical nonlinearity of $\pm 0.5^\circ\text{C}$ over the specified temperature range. The external sensor interface provides a flexible way of adding additional sensors to the system and supports up to 2 external sensors.

Applications

- Monitoring and tracking of temperature-sensitive products
- Temperature monitoring of medical products
- Pharmaceutical logistics
- Monitoring of fragile goods transportation
- Dynamic Shelf Life applications
- RFID to SPI interface

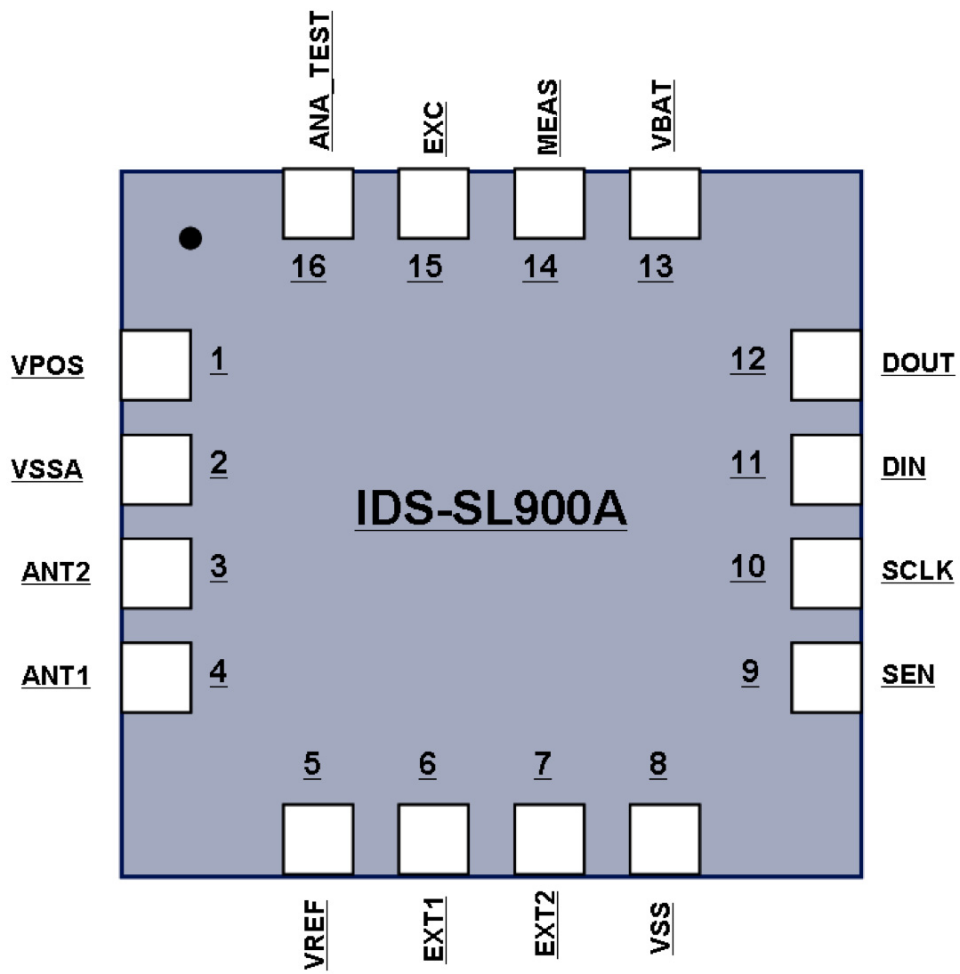
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1 Pin Description

PIN #	PIN NAME	DESCRIPTION
1	VPOS	RF rectifier output
2	VSSA	Chip substrate ground – connect to antenna ground
3	ANT2	Antenna coil – higher capacitance, higher current
4	ANT1	Antenna coil – low capacitance, low current
5	VREF	Reference voltage output (Vo2)
6	EXT1	Analogue input for external sensor
7	EXT2	Analogue input for external sensor
8	VSS	Chip substrate ground – connect to negative battery terminal
9	SEN	Enable input for the SPI interface
10	SCLK	SPI clock
11	DIN	SPI data input
12	DOUT	SPI data output
13	VBAT	Positive supply input
14	MEAS	Test pin for use during test
15	EXC	Supply voltage for the external sensors or a AC signal source for external sensors
16	ANA-TEST	Analogue test pin

2 Pin and Pad Layout



3 Absolute Maximum Ratings

(Operating free-air temperature range, unless otherwise noted)*

Input Voltage Range (see Note 1)	-0.3 V to 3.7 V
Maximum Current VPOS, ANT	1A
ESD Rating, HBM (all pins except ANT1 and ANT2)	2 kV
ESD Rating, HBM (pins ANT1 and ANT2)	1kV
Maximum Operating Virtual Junction Temperature, T_J	+150°C
Storage Temperature Range, T_{stg}	-65°C to +150°C
Lead Temperature (soldering, 10 sec.)	+260°C

*Stresses beyond those listed under »Absolute Maximum Ratings« may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under »Operating Conditions« are not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values are with respect to substrate ground terminal VSS.

4 Electrical discharge sensitivity

This integrated circuit can be damaged by ESD. We recommend that all integrated circuits are handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.

Precision integrated circuits maybe more susceptible to damage because very small parametric changes could cause the device not to meet the published specifications. RF integrated circuits are also more susceptible to damage due to use of smaller protection devices on the RF pins, which are needed for low capacitive load on this pins.

5 Operating Conditions

Input Supply Voltage, V_{BAT}	1.2V to 3.6V, 1.5V typical
Operating ambient temperature range, T_A	-40°C to +110°C

6 Short Description

The SL900A is designed for use in smart active labels (SAL), semi-passive labels and passive labels. Smart active labels are defined as thin and flexible labels that contain an integrated circuit and a power source. SAL includes in its definition both "fully active" smart labels, and semi-active smart labels, also known as battery-assisted back-scattered passive labels, both of which enable enhanced functionality and performance over passive labels. The IC includes sensor functionality and logging of sensor data (see Figure 1 below).

The SL900A is operating at 860 to 960 MHz and is fully EPC global Class 1 compliant. The chip is supplied from a single-cell battery of typically 1.5V, or from a dual cell battery (3V). The on-chip

temperature sensor and real-time clock (RTC) accommodate temperature data logging.

6.1 Supply Arrangement

The SL900A is supplied from either the battery or through the electromagnetic waves from a reader. The device is normally supplied from the battery unless there is no battery attached (passive label), or when the battery is drained.

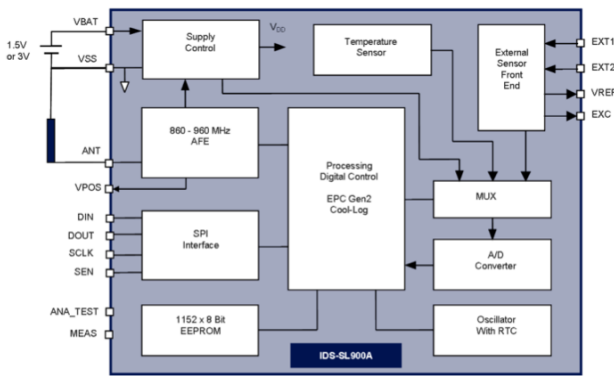


Figure 1: Block Diagram

6.2 Analogue Front End (AFE)

The analogue front end is designed according to EPC Gen 2. The forward link (reader to tag) is amplitude modulated and the backward link (tag to reader) is amplitude modulated (load modulation is used).

6.3 Processing and Digital Control

The SL900A is fully EPC Class 1 compliant, with additional custom commands for extended functions. The maximum transponder to interrogator data rate according to Class 1/Gen.2 is 640 kbit/s. The maximum interrogator to transponder data rate is 160 kbit/s.

DATA RATE	MIN	MAX
Interrogator to transponder	40 kbit/s	160 kbit/s
Transponder to interrogator	5 kbit/s	640 kbit/s

Table 1: Supported Data Rates

6.4 Serial Interface (SPI)

The integrated serial interface (SPI) can be used to initialize the chip and to set the parameters. The logging procedure can be started and stopped with the SPI. The SPI bus can also be used for the communication between a microcontroller that is attached to the SL900A and the RFID reader.

6.5 Real-Time Clock (RTC)

The on-chip real-time clock (RTC) is started through the **START LOG** command in which the start time is programmed in UTC format. The interval for sensing and data logging can be programmed in the range from 1 second up to 8 hours. The accuracy of the timer is $\pm 3\%$.

6.6 Temperature Sensor

The on-chip temperature sensor can measure the temperature in the range from -20°C to 60°C with a typical accuracy of $\pm 0.5^{\circ}\text{C}$.

6.7 External Sensors

The on-chip external sensor front end provides a flexible interface for analogue external sensors. It has an auto-range and interrupt function. It supports various types of analogue sensors from pressure, humidity, temperature, light ...

6.8 Analogue to Digital Converter

The chip has an integrated 10-bit analogue to digital converter with selectable voltage references. It is used for conversion of temperature, external sensors and battery voltage.

6.9 External Sensor Interrupt

The external sensor inputs EXT1 and EXT2 can be used for event-triggered logging. In this mode the logging is not triggered in predefined time intervals from the internal timer, but can be triggered externally, either with a sensor, switch or a microcontroller.

The interrupt source can be the EXT1, EXT2 input or both, were the EXT1 input has the higher priority. The user application can select which measurements are triggered by the interrupt event.

In the interrupt mode the sensor value is stored together with the 32-bit real time clock value. For a correct real-time clock value the correct Start time has to be supplied. The interrupt mode is started with the **START LOG** command and the correct setting in the registers (**SET LOG MODE** command).

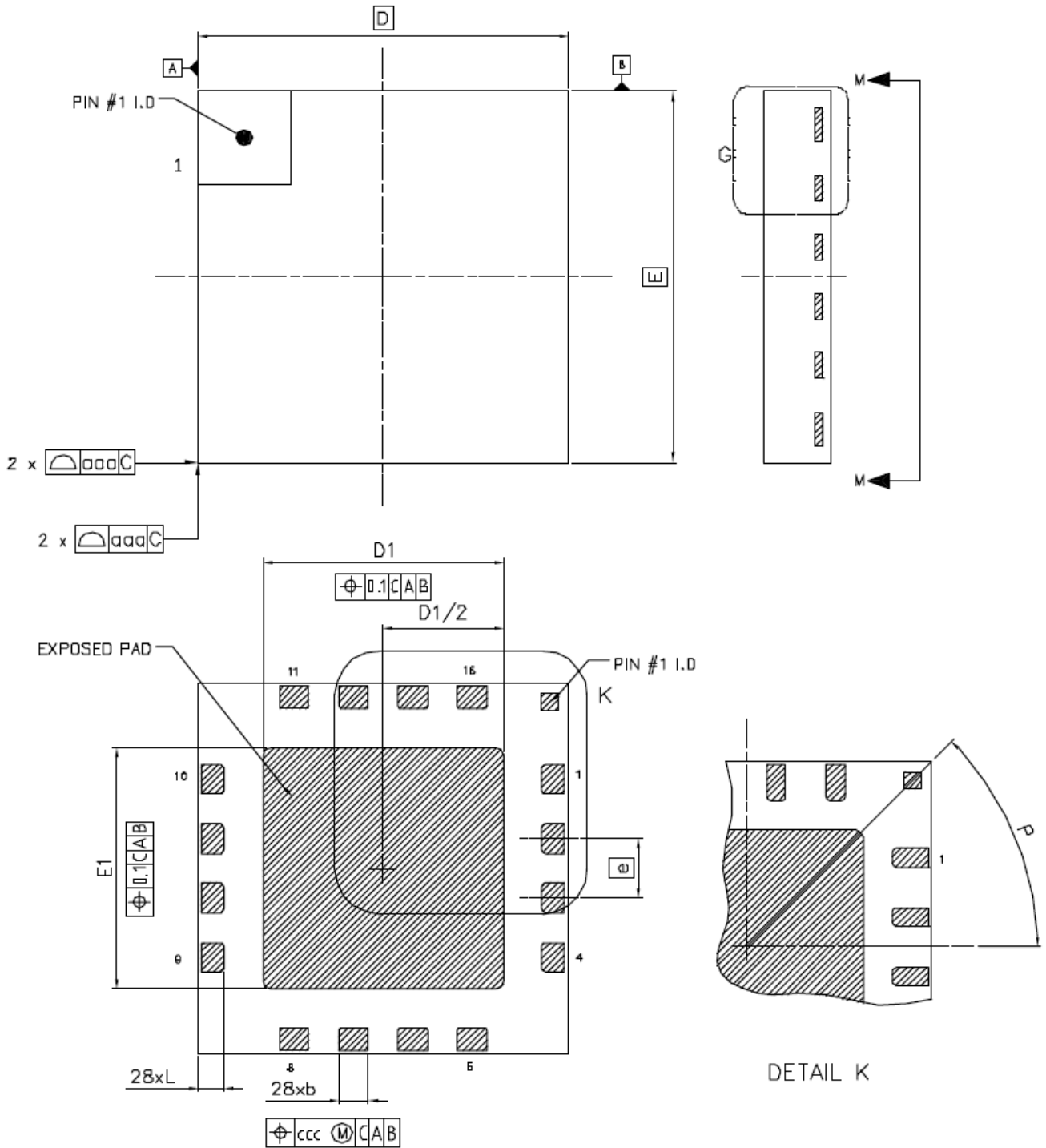
6.10 Data Protection

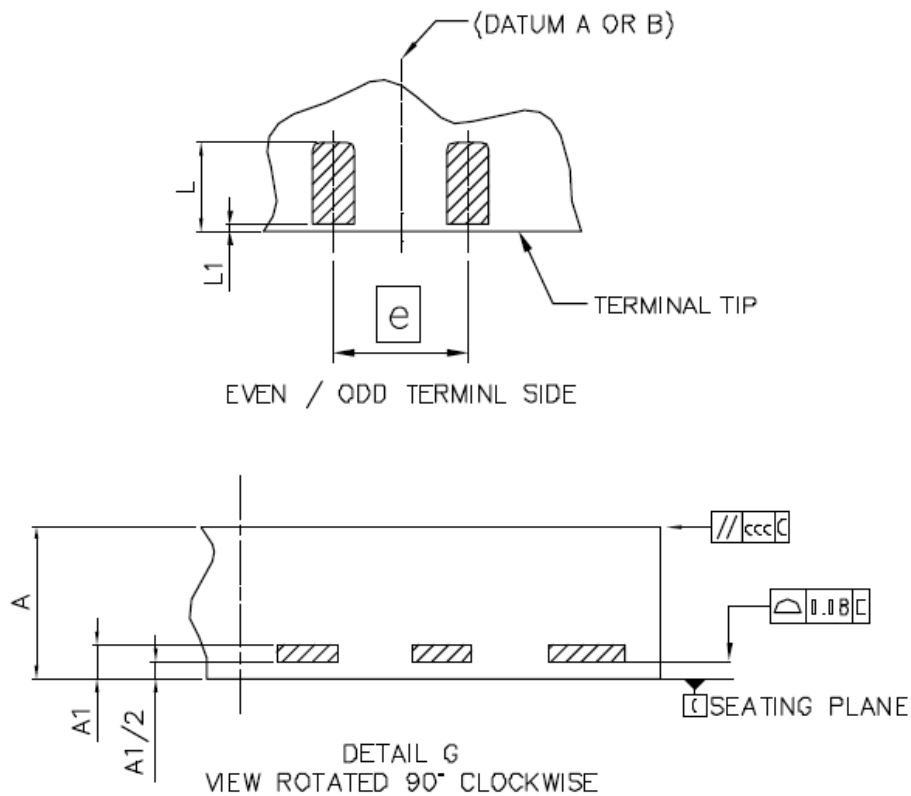
Additional to the Gen2 lock protection, the SL900A offers read/write protection using 3 password sets for 3 memory areas. Each 32-bit password is divided into 2 16-bit passwords, where the lower 16 bits are reserved for the Write protection and the higher 16 bits are reserved for the Read/Write protection.

6.11 Shelf Life

The SL900A device has an integrated shelf life algorithm that can dynamically calculate the remaining shelf life of the product. It has an automatic alarm function for the shelf life expiration. This can be used to directly drive a LED or as an interrupt for an external microcontroller.

7 Packaging Information





DIM	MIN	NOM	MAX	NOTES
A	0.80	0.90	1.00	1. Dimensioning and tolerancing confirm to ASME Y14.5M-1994. 2. All dimensions are in millimeters. Angles are in degrees. 3. Dimension b applies to metallized terminal and is measured between 0.25mm and 0.30mm from terminal tip. Dimension L1 represents terminal full back from package edge up to 0.1mm is acceptable. 4. Coplanarity applies to the exposed heat slug as well as the terminal. 5. Radius on terminal is optional.
A1	0.203 REF			
b	0.33	0.40	0.47	
D	5.00 BSC			
E	5.00 BSC			
D1	3.15	3.25	3.35	
E1	3.15	3.25	3.35	
e	-	0.80 BSC	-	
L	0.255	0.355	0.455	
L1			0.10	
P	45° BSC			
aaa		0.10		
ccc		0.10		

The reflow peak soldering temperature (body temperature) is specified according IPC/JEDEC J-STD-020C “Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices”.

8 Ordering Information

ORDERING CODE	DESCRIPTION	OPERATING TEMPERATURE RANGE	PACKAGE TYPE	DEVICE MARKING	SHIPPING FORM
SL900A/QFN/T&R1	Smart active label IC with on-chip temperature sensor and 9k EEPROM	-40°C to 110°C	16-LD QFN (5 x 5 mm)	SL900A	Tape & reel (1,000/reel)
SL900A/QFN/T&R5					Tape & reel (5,000/reel)
IDS-SL900A/DoW			-		Tested wafers

Order quantities should be a multiple of shipping form.

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