IDS-SL13A

Smart Label Chip with Sensor

For Unique Idenfication, Monitoring and Data Logging

Key Features

- High Temperature Range: -40°C to +110°C
- Frequency: 13.56 MHz
- Battery supply: 1.5V or 3V
- Data logging from:
  - o On-chip temperature sensor or
  - o External sensor
- ISO 15693 and cool-Log™ compliant
- Real-time clock for data logging
- Parameter setting and access to EEPROM via serial bus (SPI)
- On-chip 8k bit EEPROM
- Anti-collision capability
- Backup through supply from RF field for EEPROM readout after battery is exhausted

Package Options

- 16-pin QFN (5x5 mm)
- Tested wafer (8")

Description

The IDS-SL13A is an active/semi-passive tag chip optimised for single-cell, battery-powered smart labels with sensor functionality and data logging. 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).

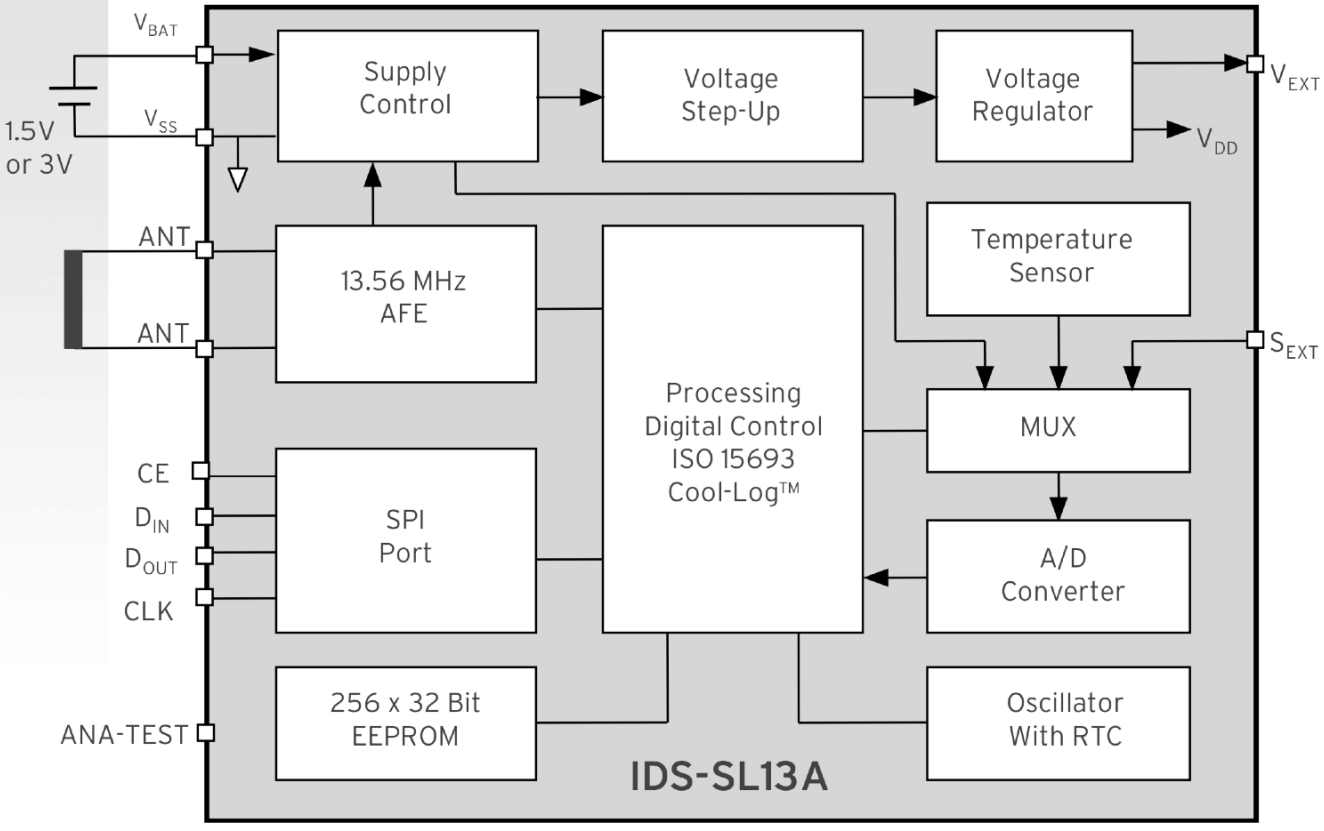
The chip has a fully integrated temperature sensor with a maximum accuracy of 0.5ºC. The external sensor interface (S_{EXT}) is an analogue input and allows the connection of an external sensor.

The SPI port provides direct access to the EEPROM from external circuits.

Applications

- Identfication, monitoring and tracking of temperature-sensitive products
- Temperature monitoring of medical products
- Pharmaceutical logistics
- Monitoring of fragile goods transportation

Block Diagram



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1 Related Documents

Specification (full data sheet): IDS-SL13A_DS

2 Pin and Pad Layout

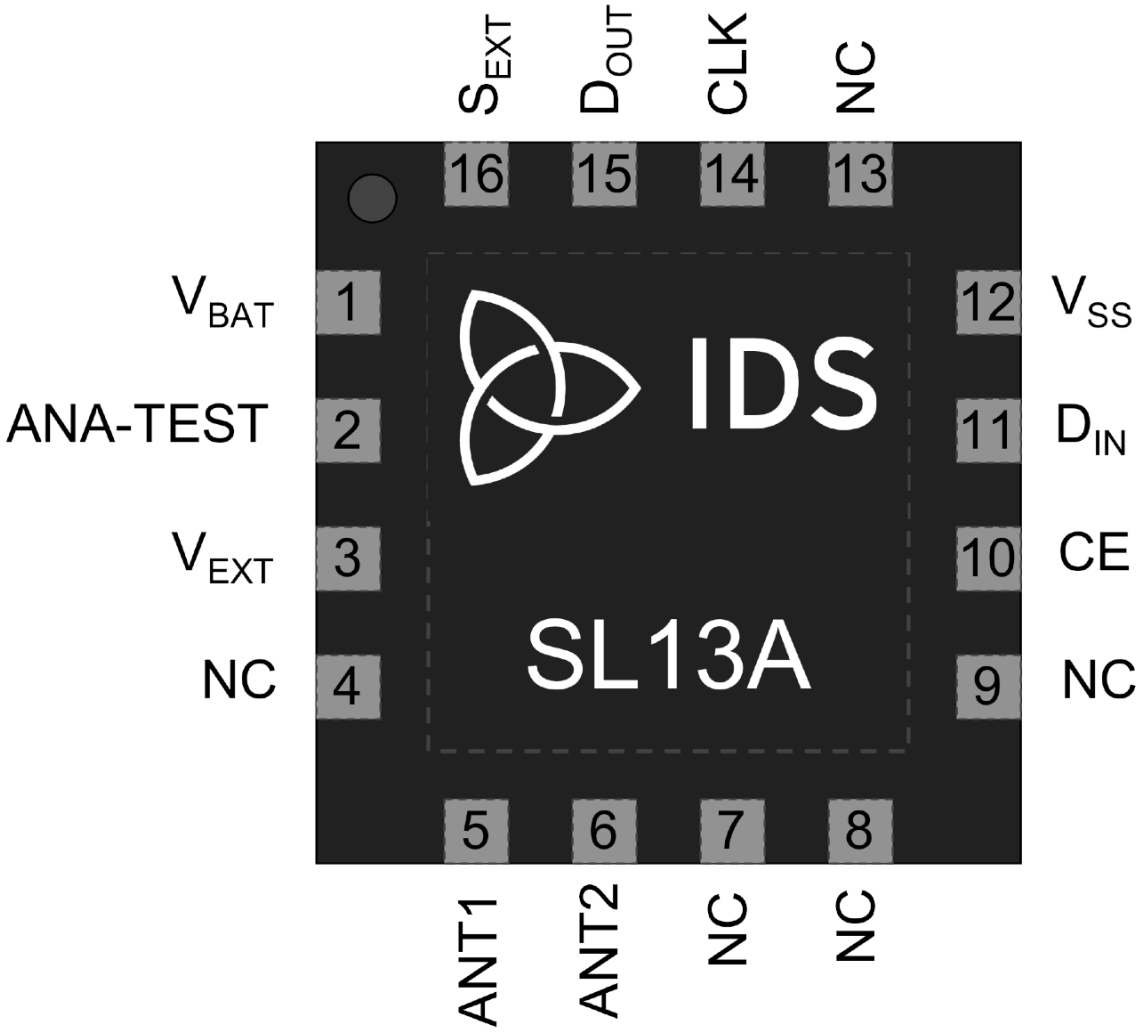


Figure 1: Pin Assignment for 16-Pin QFN (Top View)

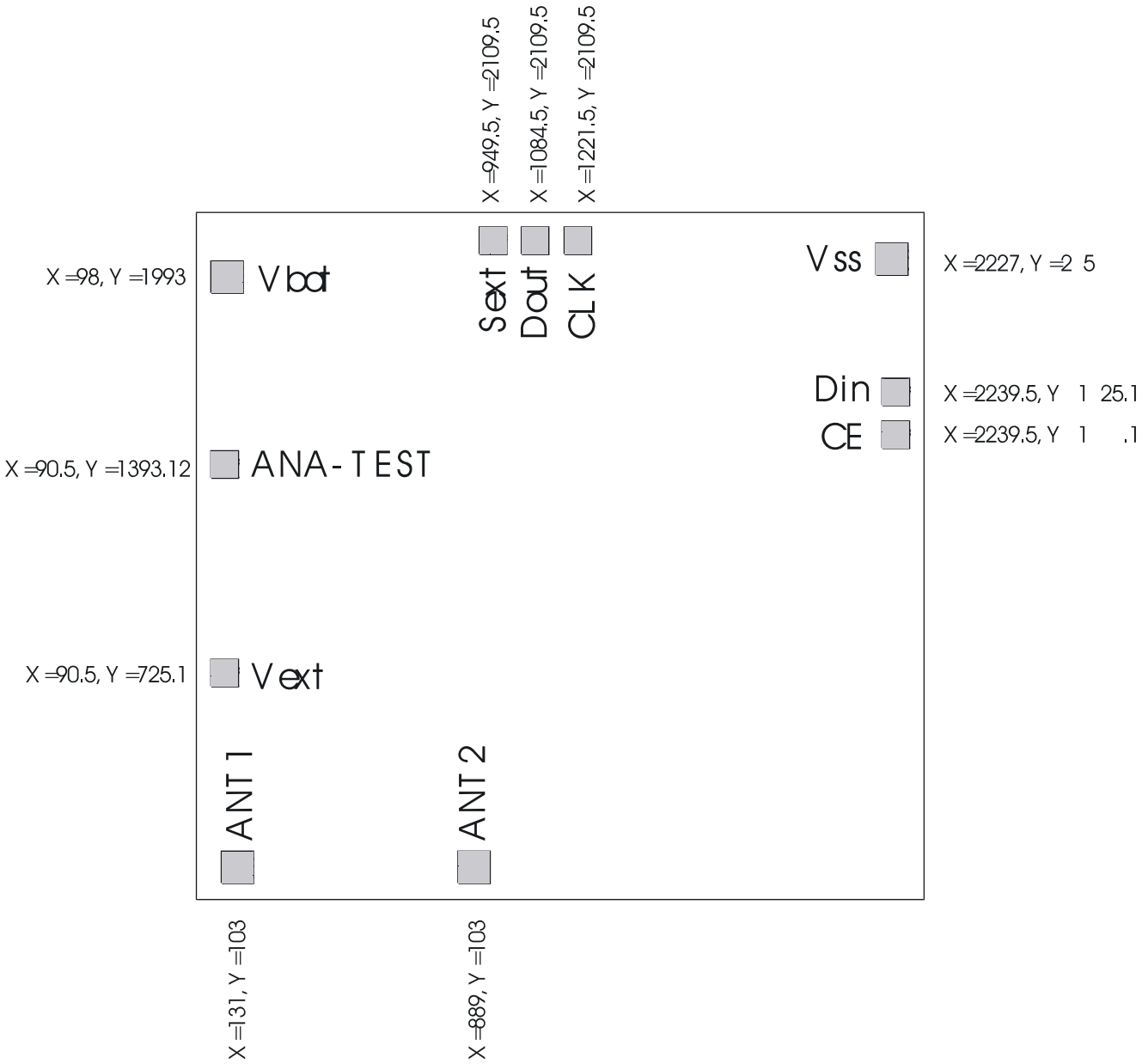


Figure 2: Die Pad Layout (Top View)

Note 1: All dimensions are in microns. Origin is on lower left corner of the chip. The values show the pad center position.

Note 2: If not used, the pads S_{EXT}, D_{OUT} and CLK as well as D_{IN} and CE may be short circuit through a bumping process.

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 V_{EXT}, ANT1, ANT2 ..... 1A

ESD Rating, HBM ..... 2 kV

Maximum Operating Virtual Junction Temperature, T_J ..... +150°C

Storage Temperature Range, T_{stg} ..... -65°C to +150°C

Lead Temperature (soldering, 10 sec.) ..... +300°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 V_{SS}.

4 Operating Conditions

(Operating free–air temperature range)

Input Supply Voltage, V_{BAT} ..... 1.1V to 3.3V, 1.5V typical

Operating ambient temperature range, T_A ..... -40°C to +110°C

5 Functional Description

The IDS-SL13A is a single-chip temperature sensor and data logger designed for use in smart passive and semi-passive labels. Smart semi-passive labels are defined as thin and flexible labels that contain an integrated circuit and a power source, also known as battery-assisted back-scattered passive labels, which enable enhanced functionality and superior performance over existing passive labels.

The IDS-SL13A is operating at 13.56 MHz and is fully ISO 15693 compliant. The chip is supplied from a single-cell battery of typically 1.5V. The on-chip temperature sensor, A/D converter and real-time clock (RTC) accommodate temperature data logging.

5.1 Supply Arrangement

The IDS-SL13A is supplied from either the battery or through the electromagnetic waves from a reader. The device is normally supplied from the battery unless the battery voltage is too low - in this case the device is powered from the RF field. This functionality enables the read out of the log data even in case the battery is exhausted.

The chip automatically detects whether a 1.5V or 3V battery is connected and adapts accordingly. The voltage step-up converter provides an input voltage for the voltage regulator, which provides a regulated voltage of 2V nominal (internal digital supply). The maximum current available from V_{EXT} for external circuitry is 4mA (only when RF field is present) and is regulated to 3.4V.

5.2 Analogue Front End (AFE)

The analogue front end is designed for 13.56 MHz according to ISO 15693. The incoming data are demodulated from the received ASK (Amplitude Shift Keying) signal, which is 10 ~ 30% or 100% modulated. Outgoing data are generated by the IDS-SL13A load variation using Manchester coding with one or two sub-carrier frequencies of 423.75 KHz (f_c/32) or 484.28 KHz (f_c/28).

5.3 Processing and Digital Control

The IDS-SL13A is fully ISO 15693 compliant. Additional data logging commands are handled by the cool-Log™ protocol. Both data coding modes (1 out of 256 and 1 out of 4) are supported by the IDS-SL13A. The reader (interrogator) makes mode selection within the SOF (Start of Frame).

The 1-of-256 data coding mode has a data rate of 1.65 kbit/s (f_c/8192) meaning that the transmission of one byte takes 4.833 ms. The 1-of-4 coding has a rate of 26.48 kbit/s (f_c/512) with the transmission of one byte taken 302.08 µs.

Table 1: Response Data Rate

DATA RATE	ONE SUB-CARRIER	TWO SUB-CARRIERS
Low	6.62 kbit/s (f_c/2048)	6.67 kbit/s (f_c/2032)
High	26.48 kbit/s (f_c/512)	26.69 kbit/s (f_c/508)

5.4 Serial Interface (SPI)

The integrated serial interface (SPI) can be used to read and write the embedded EEPROM and to set the parameters. The SPI interface is a secondary and test interface - the main interface is the RF ISO15693 interface.

5.5 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 9 hours. The accuracy of the timer is ±3%.

5.6 Temperature Sensor

The on-chip temperature sensor can measure the temperature in the range from -20ºC to 60ºC with an accuracy of ±0.5ºC. The reference voltage for the A/D conversion is supplied from an on-chip calibrated bandgap reference.

5.7 A/D Converter

An integrated 10-bit dual slope A/D converter is used for the temperature, battery and external sensor voltage conversions.

5.8 EEPROM Organization and Security

The EEPROM is organized into 3 areas - the System area, User area and Measurement area. The System area has a fixed size and can be accessed only by the proprietary commands. It is protected by the Level 1 password - the System password. The User and Measurement areas reside in the same address space (256 blocks), but have separated passwords - the User password and the Measurement password. The User and Measurement areas can be accessed by the standard ISO15693 read and write commands. The User area size can be set by the Initialize command. The minimum size of the User area is 1 block, the maximum is 256 blocks. The size of the Measurement area is 256 blocks minus User area. All blocks are 32 bits wide.

The password protection restricts only the write-type commands. Read commands are always open. The password protection can be activated for every area individually by writing a value not equal to 0 to the password blocks.

The chip also supports a one-time-use secure mode. When this mode is used, the chip with the Start Log command automatically locks all Measurement blocks. Those blocks cannot be unlocked anymore even if the Level 3 (Measurement) password is known. This mode is intended for high security applications where the 32-bit password does not provide sufficient protection.

6 Applications

6.1 Typical Application

Figure 3 shows a typical application with a 1.5V battery, an antenna coil and an optional external sensor module (semi-passive mode).

Such application is typically used for automatic data logging from on-chip temperature sensor or an external sensor connected to S_{EXT}.

The chip can store up to 762 measurement points. The intervals between measurements as well as the limits are programmable. It is possible to store all measuring points, or only the measurements, which are outside predefined limits.

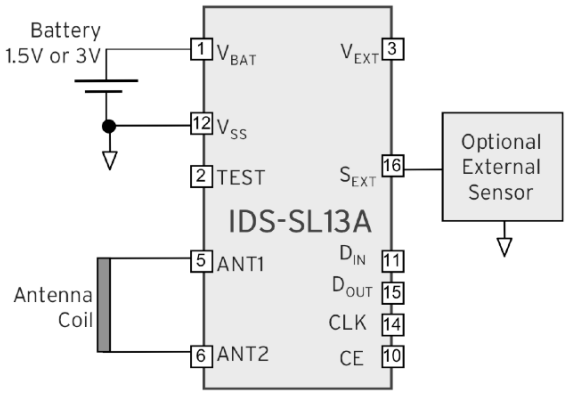


Figure 3: Typical Application

6.2 Passive Mode

Figure 4 shows a typical application without battery (passive mode).

The IDS-SL13A chip also works in passive mode with no battery, without the real-time clock function. This approach is intended for applications in which a reader initiates the logging and time-stamps the logging data.

The chip controls whether it takes data from internal or external sensors. Access to the smart label chip is protected through a 3-level password authentication. Users can add other types of external sensors to monitor shock control, humidity, or other factors.

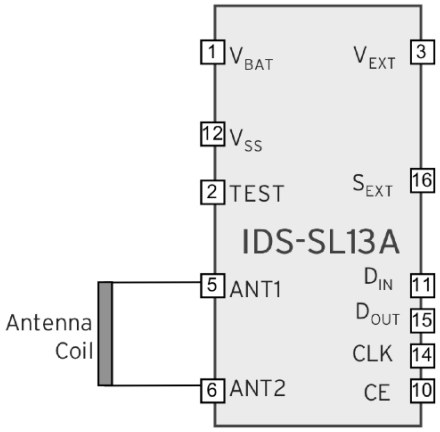


Figure 4: Typical Passive Mode Application

6.3 SPI Communication

Figure 5 shows an application using the SPI interface to communicate with other circuitries.

The Serial Peripheral Interface (SPI) port can be connected to external circuitries for display etc.; this allows further communication between the chip and other circuits such as a wireless transceiver for remote direct access to the logging data and for easy setting of parameters and functions. The chip supports an alarm system and functions that calculate shelf life.

Such applications are possible in both passive and semi-passive mode. In passive mode, the chip provides a supply current of maximum 4 mA from the V_{EXT} assuming a reader provides sufficient power from its field. The V_{EXT} voltage is regulated at 3.4V.

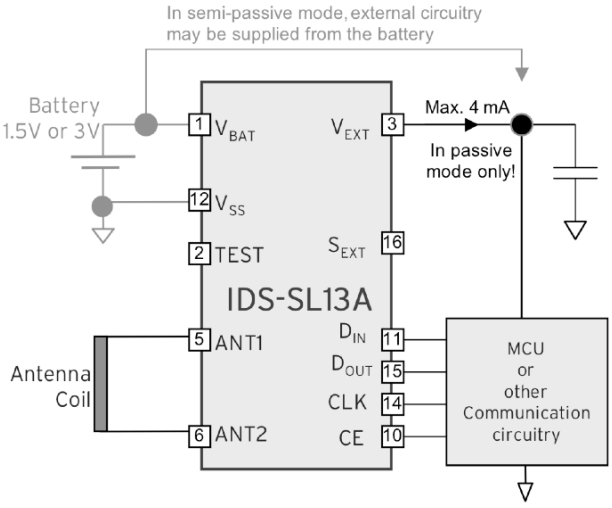
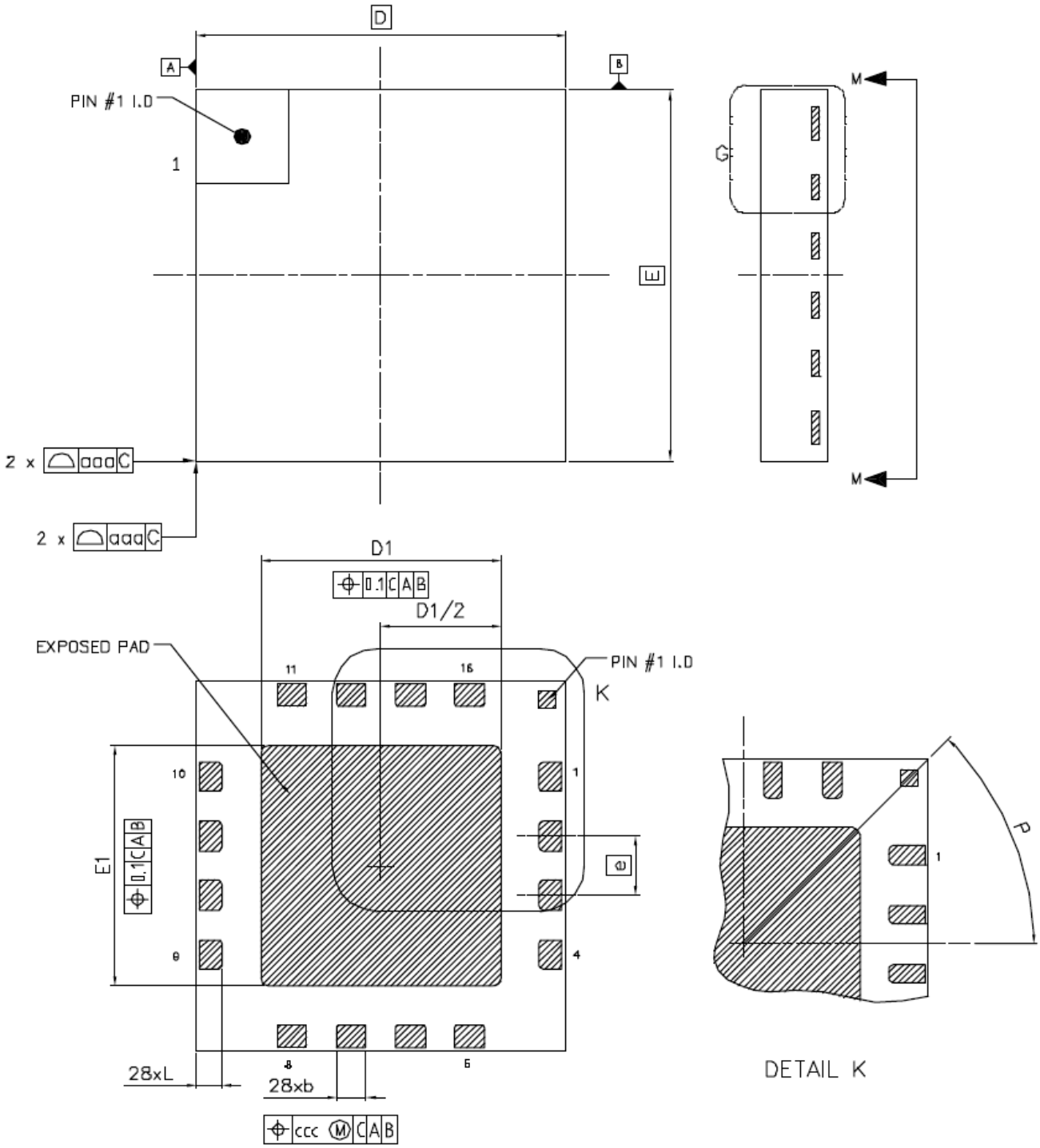
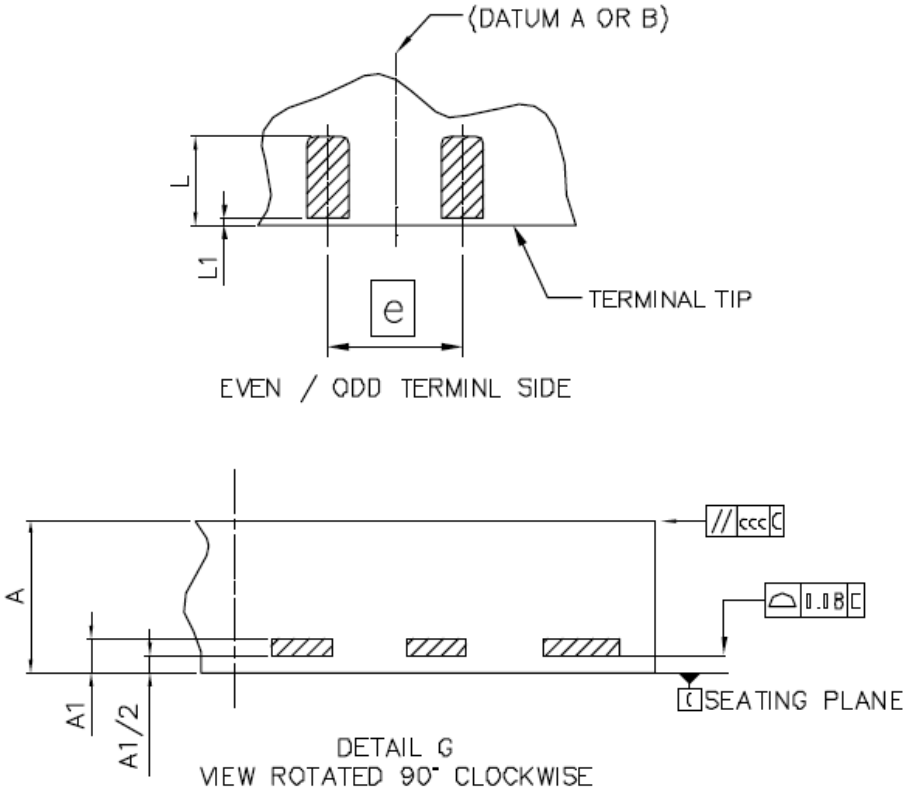


Figure 5: Application with SPI Communication

7 Packaging Information





DIM	MIN	NOM	MAX	NOTES
A	0.80	0.90	1.00	1. Dimensioning and toleranceing confirm to ASME Y14.5M-1994. 2. All dimensions are in milimeters. 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. Coplanaruty 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	45º 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
IDS-SL13A/QFN16/T&R	Smart active label IC with on-chip temperature sensor and 8k EEPROM	-40°C to 110°C	QFN 16LD (5x5 mm) RoHS*	SL13A	Tape & reel 5,000 parts/13" reel
IDS-SL13A/QFN16/Tray					Tray 490 parts/tray
IDS-SL13A/DoW		-40ºC to 110ºC	-		Tested wafers 5 wafers/box

*) Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material

The tested wafers are not physical inked but are delivered with a wafer map specification in Electroglas format.

Order quantities should be a multiple of shipping form.

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