Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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SPSXT001

Smart Passive Sensor™ for Temperature Sensing

ON Semiconductor®

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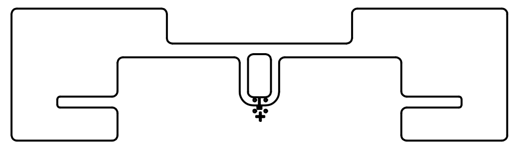


RF TAG 101.60x31.75MM
CASE 888AF/AG

ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

Description

The SPSXT001 is a battery−free wireless sensor for temperature monitoring on non−metal surfaces. Smart Passive Sensors use the Magnus−S3® Sensor IC from RF Micron, a UHF RFID chip that is powered by RF energy harvesting from the UHF reader. The Magnus−S3 utilizes the patented self−tuning Chameleon™ engine that adapts the RF front−end to optimize performance in various environmental conditions. These sensor tags function in either the FCC defined UHF band or the ETSI UHF band.

The small form factor and battery−free capabilities of Smart Passive Sensors allow them to be designed into applications where size and accessibility are at a premium.

Features

- Single IC, Smart Passive Sensing
- Small Form Factor Packages
- Non−metal Temperature Sensing
- On−chip RSSI Sensor
- 64 bit TID and 128 bit EPC + 192 Bit User Defined Memory
- EPC Class 1 Gen 2 v.2.0.1 ISO 18 000−6C Compliant
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Medical
- Industrial
- Facilities Management
- Cold−chain Logistics

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Max	Unit
Human Body Model (Note 1)	ESD	±1	kV

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Non−repetitive current pulse at T_A = 25°C, per JS−001 waveform.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Operating and Storage Temperature Range (Note 2)	T_{OP}, T_{stg}	−20 to +60	°C

2. Shelf Life − minimum 2 years from date of manufacturing.

Table 1. ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Parameter		Min	Typ	Max	Units
Operating Frequency (Note 3)	FCC	902		928	MHz
	ETSI	866		868	MHz
Read Sensitivity (Note 4)			−16		dBm
Sensor Code range		0		511	codes
RSSI Code range		0		31	codes
TID				64	bits
EPC (Note 5)				128	bits
User Memory				192	bits
Calibration temperature			30		°C
Temperature accuracty @ 30°C			±0.5		°C
Codes per °C			7.5		codes

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
3. Band specific part numbers can be found in the ordering information table
4. Measured in free space, anechoic chamber with a linearly polarized antenna at 50 cm read distance
5. User Memory can be configured to be an EPC extension, effectively making a 272 bit EPC code

Tag Memory

Memory Configuration

Memory is organized according to the EPCglobal Generation−2 UHF RFID specification. There are two possible configurations for the EPC ID:

- 8−word EPC code and 9 free words in the USER memory bank, as shown in the Memory Map
- 17−word EPC code and no free USER memory (EPC lengths above 11 words may not be supported on all readers.)

The 8−word configuration is the default. To change to the 17−word configuration, write 0001_h to the EPC Bank, word address 14_h. The memory can be reset to the default 8−word EPC configuration by writing 0000_h to the same location. This EPC configuration can be configured and reconfigured repeatedly as long as the EPC memory bank is not permanently locked by a LOCK command. Once the EPC memory bank is permanently locked, it cannot be reconfigured.

Reserved Memory − Passwords

Reserved Memory contains the ACCESS and KILL passwords. There is a 32−bit Access Password and a 32−bit Kill Password. The default for both Kill and Access Passwords is 0000_h.

Access Password

The Access Password is a 32−bit value stored in Reserved Memory 20_h to $3F_h$ MSB first. The default value is all zeroes. Tags with a non−zero Access Password will require a reader to issue this password before transitioning to the secured state.

Kill Password

The Kill Password is a 32−bit value stored in Reserve Memory 00_h to $1F_h$, MSB first. The default value is all zeroes. A reader shall use a tag's kill password once to kill the tag and render it silent thereafter. A tag will not execute a kill operation if its Kill Password is all zeroes.

EPC Memory − EPC data, Protocol Control Bits, and CRC16

As required by the Gen−2 specification, EPC memory contains a 16−bit cyclic−redundancy check word (StoredCRC) at memory addresses 00_h to $0F_h$, the 16 protocol−control bits (StoredPC) at memory addresses 10_h to $1F_h$, and an EPC value beginning at address 20_h.

The protocol control fields include a five−bit EPC length, a one−bit user−memory indicator (UMI), a one−bit extended protocol control indicator, and a nine−bit numbering system identifier (NSI).

On power−up, the IC calculates the StoredCRC over the stored PC bits and the EPC specified by the EPC length field in the StoredPC. For more details about the StoredPC field or the StoredCRC, please see the Gen 2 specification.

The StoredCRC, StoredPC, and EPC are stored MSB first (i.e. the EPC's MSB is stored in location 20h).

Tag Identification (TID) Memory

The read−only Tag Identification memory contains the manufacturer−specific data. The manufacturer Mask Designer ID (MDID) is 824_h (bits 08_h to 13_h). The logic 1 in the most significant bit of the MDID indicates the presence of an extended TID consisting of a 16−bit header and a 48−bit serialization. The Magnus−S3 model number is in bits 10_h to $1F_h$ and the EPCglobal® Class ID ($E2_h$) is in 00_h to 07_h.

Table 2. MEMORY MAP

Bank #	Bank Name	R/W	Bit Address	Description LSB MSB	Default Value
11	USER	READ ONLY	E0–EF	Temperature Sensing Enable	N/A
			D0–DF	RSSI Threshold	N/A
		READ/WRITE	B0–BF	Temperature Calibration Data	N/A
			A0–AF	Temperature Calibration Data	N/A
			90–9F	Temperature Calibration Data	N/A
			80–8F	Temperature Calibration Data	N/A
			70–7F		0
			60–6F		0
			50–5F		0
			40–4F		0
			30–3F		0
			20–2F		0
			10–1F		0
			00–0F		0
10	TID	READ ONLY	50–5F	TID[15:0]	
			40–4F	TID[31:16]	
			30–3F	TID[47:32]	
			20–2F	Extended TID Header	
			10–1F	Tag Model Number	
			08–13	Manufacturer ID	
			00–07	Class ID	
01	EPC	READ/WRITE	90–9F	EPC#[15:0]	0
			80–8F	EPC#[31:16]	0
			70–7F	EPC#[47:32]	0
			60–6F	EPC#[63:48]	0
			50–5F	EPC#[79:64]	0
			40–4F	EPC#[95:80]	0
			30–3F	EPC#[111:96]	0
			20–2F	EPC#[127:112]	0
			10–1F	StoredPC[15:0]	0
			00–0F	StoredCRC[15:0]	0
00	RESERVED	READ ONLY	E0–EF	TEMPERATURE CODE	
			D0–DF	RSSI CODE	
			C0–CF	SENSOR CODE	
		READ/WRITE	30–3F	Reserved for future use	
			10–1F	Kill Password[15:0]	
			00–0F	Kill Password[31:16]	

Temperature Sensor Functions

Temperature Requests

The Magnus−S3 includes a precise temperature−sensing circuit. The circuit generates a TEMPERATURE CODE when it receives a Temperature Request command. The TEMPERATURE CODE is a 12−bit number which can be converted to temperature reading.

The temperature−sensing circuit runs in response to a Temperature Request, which is a standard SELECT command with the parameters given below:

- MemBank set to 0x3 (11b)
- The Temperature Sensing Enable address (0xE0) in the Pointer field
- Length set to 0x0 (a zero length Mask)
- Mask field empty

The highest precision is achieved when the Temperature Request is followed by 2.5 ms of continuous wave output from the reader before any subsequent commands are sent. This provides time to complete and store the TEMPERATURE CODE in the TEMPERATURE CODE register in the RESERVED Memory Bank.

Reading the Temperature Code

The TEMPERATURE CODE is a 12−bit value, stored in the least significant bits from 0xE0 to 0xEF in the Reserved Memory Bank. This value can be accessed with a standard READ command. Higher TEMPERATURE CODE values correspond to higher temperatures. The TEMPERATURE CODE is converted to a precise temperature measurement with a linear mapping characterized by the equation: $T = aC + b$. T is the temperature in °C. C is the TEMPERATURE CODE read from the sensor. The a and b constants are custom to each chip. For more details on the temperature calibration procedure, please refer to Application Note AND9213.

Temperature Calibration Data

Magnus−S3 chips come with temperature calibration data stored in the User Memory Bank in addresses 0x80 through 0xBF. This data is generated from a single−point calibration conducted on each chip during manufacturing. If greater precision is desired, the user can calibrate the chip at a second temperature, and add this to the existing calibration data.

On−Chip RSSI Code

Magnus−S3 incorporates circuitry that measures incoming signal strength and converts it to a digital value: the On−Chip RSSI (Received Signal Strength Indicator) Code. This can be communicated to a reader and used for control purposes. The On−Chip RSSI Code has a 32−level range, represented by a 5−bit number.

The On−Chip RSSI Code, in word $D0_h$–DF_h in the Reserved Bank, will be returned as the 5 LSBs of a response to a standard READ command specifying word address D_h. Magnus−S3 must first receive an On−Chip RSSI Request before the On−Chip RSSI Code becomes available.

On−Chip RSSI Requests

On−Chip RSSI Request is a tool for a reader to specify that it wants to hear only from tags that are seeing a desired amount of received signal strength. It allows a reader to limit its communications only to nearby tags – or conversely, to "mute" nearby tags in order to attempt communication with tags receiving weak signals.

The On−Chip RSSI Threshold "address" ($A0_h$ of the User Bank) is used only by Magnus−S3 to interpret a SELECT command and is not an actual memory location. It is sent by the reader using a standard Gen 2 SELECT command. The 6−bits of On−Chip RSSI Threshold Value/Control are communicated as part of the Mask sent to the tags.

The list below from the Gen 2 version 2.0.0 spec shows the format of a SELECT command. To send an On−Chip RSSI Request, the reader issues a SELECT command with:

- MemBank set to 3_h (11_b)
- The On−Chip RSSI Threshold address ($A0_h$) in the Pointer field
- Length set to 00001000_b (the On−Chip RSSI request value consists of the lower 6 bits of an 8−bit Mask)
- The On−Chip RSSI request in the lower 6 bits of the Mask, consisting of a leading bit for control followed by 5 bits for the On−Chip RSSI Code at which the reader wants to define the tags' response/no−response threshold.

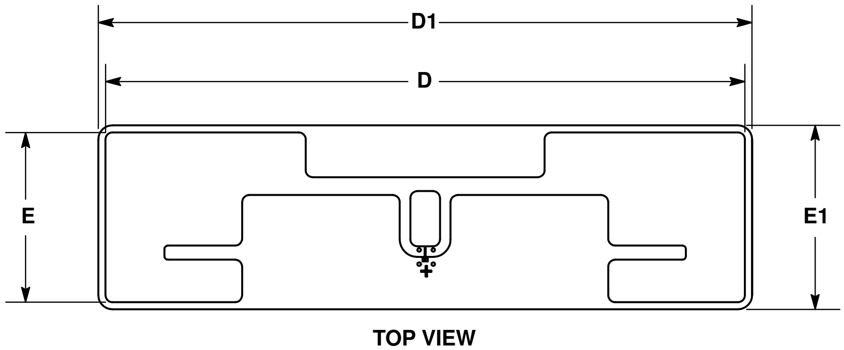
The control bit determines whether the threshold value is interpreted by Magnus−S3 as a lower or upper threshold. Specifically, if the control bit is set to 0, it will respond if its internally generated On−Chip RSSI Code is less than or equal to the threshold value. If the control bit is 1, it will respond if its On−Chip RSSI Code is greater than the threshold.

ORDERING INFORMATION

Device	Feature	UHF Band	Attach Material	Package	Shipping
SPS1T001PET	Moisture	FCC 902–928 MHz	Non−metal	Case 888AF	1000 / Reel
SPS2T001PET	Moisture	ETSI 866–868 MHz	Non−metal	Case 888AG	1000 / Reel

PACKAGE DIMENSIONS

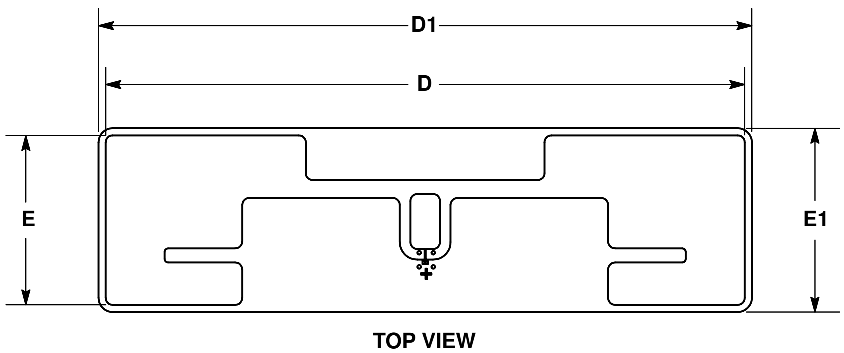
RF TAG 101.60x31.75MM
CASE 888AF
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. ANTENNA SIZE DETERMINED BY DIMENSIONS D AND E.
4. LABEL SIZE DETERMINED BY DIMENSIONS D1 AND E1.
5. LABEL IS 0.076 THICK PET TAPE. ANTENNA IS 0.009 THICK ALUMINUM.

	MILLIMETERS		
DIM	MIN	NOM	MAX
D	90.40	90.50	90.60
E	23.90	24.00	24.10
D1	101.10	101.60	102.10
E1	31.25	31.75	32.25

RF TAG 101.60x31.75MM
CASE 888AG
ISSUE A



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	MILLIMETERS		
DIM	MIN	NOM	MAX
D	90.40	90.50	90.60
E	23.90	24.00	24.10
D1	101.10	101.60	102.10
E1	31.25	31.75	32.25

PUBLICATION ORDERING INFORMATION

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