NCD1025_50RWG
50mm Half Duplex
RFID Temperature Sensor

Features

- Reliable Hal-Duplex (HDX) Low-Frequency (LF) Communications Format
- Temperature range from 11ºC to 39ºC, with ±0.8ºC accuracy
- Different temperature ranges are possible, upon customer request
- 64 Bits for Data / Identification Storage
- 134.2kHz Operating Frequency
- FSK Modulation
- Energy Harvesting Battery-Free Wireless Power
- 16 Bit CRC Error Detection Code Generator
- 10 Year Data Retention

Applications

- Wireless Temperature Measurements inside Liquids
- Wireless Temperature Measurements inside Walls
- Animal Temperature Measurement inside Ruminal Boli
- Real-time Container Tracking with Temperature Measurement
- Manufacturing Production Flow Control with Temperature Data

Description

The NCD1025_50ROG is a passive 50mm cylindrical low frequency half-duplex read-only radio frequency identification (RFID) transponder with embedded on-chip temperature sensor that operates at a resonant frequency of 134.2kHz.

With 64-bits of pre-programmed identification data storage and a 16-bit CRC error checking code generator, the transponder supports the modulation scheme and data frame format described in ISO11784 and ISO11785 standards. Transmission of the digital data from the transponder to the reader utilises an FSK modulation technique where a logic 0 is represented by a 16 cycle burst of 134.2kHz while a logic 1 uses 124.2kHz.

Using the power acquired from harvesting the RF energy transmitted by the RFID reader, the passive transponder responds by sending out a 128-bit packet, containing the stored 64-bit data, a 16-bit CRC-CCITT error checking code, temperature information and the overhead bits necessary to ensure transmission recognition. Temperature information is contained in the last 16 bits, which can be recovered by dedicated readers. Exploiting its patented technology, the reading distance achieved for wireless temperature reading is very close to the one achieved for ID-only reading.

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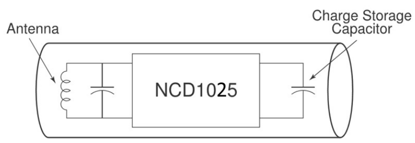
Ordering Information

Part #	Description
NCD1025_50ROG	50mm HDX 64-bit Data RFID Temperature Sensor pre-programmed identification code and temperature range Bit 1 = 0 :: Non-animal Bits 2 - 16 = 0x0000 Bits 17 - 26 = 0x3D2 (978d) Bits 27 - 64 :: Identification code - value will be incremented at the factory to provide a unique code for each device. Maximum number of unique values = 238 - 1 = 0x3FFFFFFFFF (ID Code = 0 not used) Temperature Range 11ºC … 39ºC
NCD1025_50ROGC1	50mm HDX 64-bit Data RFID Temperature Sensor pre-programmed identification code (see above) and custom temperature range. Contact the factory
NCD1025_50ROGC2	50mm HDX 64-bit Data RFID Temperature Sensor custom programmed identification code and temperature range. Contact the factory

Block Diagram



1. Specifications

1.1 Operating Conditions

Parameter	Minimum	Maximum	Unit
Operating Temperature [1]	-20	+60	°C
Storage Temperature	-40	+60	°C

[1] The tag is operative in the complete temperature range, but temperature reading is only meaningful within 11ºC and 39ºC

1.2 Electrical Specifications

Unless otherwise specified, minimum and maximum values are guaranteed by production testing or design. Typical values are characteristic of the device at 25ºC, and are the result of engineering evaluations. They are provided for informational purposes only and are not guaranteed by production testing.

Parameter	Conditions	Symbol	Minimum	Typical	Maximum	Unit
Charging duration required for transmission			15	50		ms
Low bit frequency	T_A=25ºC	f_0	132.1	134.7	136.4	kHz
High bit frequency	T_A=25ºC	f_1	120.1	123.7	126.4	kHz
Writing endurance			100 k			cycles
Data retention			10			years

1.3 Temperature information

NCD1025_50ROG is calibrated to measure temperature in the range 11ºC to 39ºC, with ±0.8ºC accuracy.

2. Functional Overview and Description

2.1 Overview

The reader and the NCD1025_50RWG transponder comprise the two elements of a half-duplex wireless communications system with temperature sensor functionality. It operates in a sequential mode with time-separated power and data transmission cycles. Power transfer to the transponder (tag) is accomplished by electromagnetic coupling of the transponder and the reader antennae.

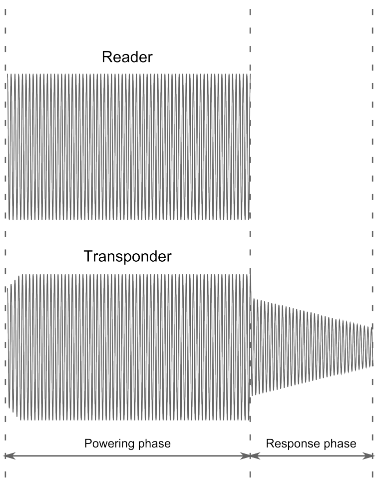
The ID code stored in the 64-bit memory can be reprogrammed using a suitable programmer.

The tags are delivered calibrated to operate in the temperature rang.

2.2 Power Transfer

As shown below in Figure 1, an activation field sourced by the reader supplies power to the transponder at the beginning of a read request. The reader generates an electromagnetic field for 50ms using an activation frequency of 134.2kHz to energize the resonant circuit of the transponder. During this Powering Phase, circuitry within the transponder rectifies the induced voltage to charge an internal storage capacitor. Energy held by the storage capacitor provides the means by which the transponder measures the temperature and transmits it's stored identification data together with the temperature information. The reader terminates the activation field to indicate it is ready to receive data from the transponder.

Figure 1. Activation and Read Phases: Voltage at the Reader's Exciter and Transponder Coils



2.3 Communication Interface – Tag to Reader

Frequency Shift Keying (FSK) modulation is employed by the NCD1025_50RWG to transmit the stored data immediately after detecting the end of the reader's activation field. As can be seen in Figure 1, the tag's transmit (Response Phase) directly follows the Powering phase.

Transfer of the stored digital information and temperature information is accomplished by using two discrete frequencies, one for a logic "1" (High) and another for a logic "0" (Low). The nominal frequencies used for data transmission are:

- f_1=124.2kHz is for logic high data encoding
- f_0=134.2kHz is for logic low data encoding

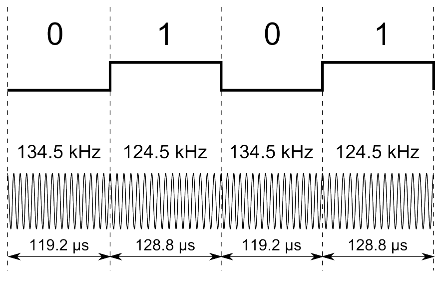
2.3.1 Data bit structure

Data bits are transmitted as 16 cycles of their respective frequency. Because a logic high (1) data bit uses a lower frequency than that for a logic low (0), the duration of a 1 bit is longer than a 0 bit. The duration for logic 1 and logic 0 bits is given below.

- $t_{d1} = 16/f_1 = 16/124.2kHz = 128.8us$
- $t_{d0} = 16/f_0 = 16/134.2kHz = 119.2us$

Figure 2 illustrates the FSK encoding principle used to transmit the stored data.

Figure 2. FSK Transmission Used During the Read Phase



2.3.2 Transponder Data Rate and Data Coding

The data coding is based on the NRZ method thus achieving an average data rate of ~8kbit/s based on an equal distribution of '0' and '1' data bits.

2.3.3 Completion of Transmission

Following the input of the last bit, the transponder deactivates.

2.4 Transmission Protocol

2.4.1 Transponder - Response Data Format

An RFID answer by the NCD1025_50RWG contains a Header, the identification DATA, a CRC value, a Trailer, and temperature information.

Framed as shown below the transmitted signal has a fixed length of 128 bits. The Header consists of a 16-bit Pre-Bits leader followed by an 8-bit Start byte. Following the CRC error checking value is the Trailer consisting of an 8-bit Stop byte followed by the 16-bit Post, which contains temperature information.

The Data, CRC, Stop and Post data will be transmitted starting with the LSB and ending with the MSB.

Pre-Bits		Start		Data		CRC		Stop		Post	
1	16	17	24	25	88	89 (LSB)	104	105	112	113	128

All signals are coded [MSB:LSB].

- Pre-Bits[15:0]…..=0x0000
- Start Byte [7:0] ..=0x7E
- Data[63:0]……… =Data
- CRC[15:0]……….=Data CRC
- Stop Byte[7:0]….=0x12
- Post Bits[15:0]….= follows the structure below

SIGN(ND)	ND		NDCAL	
1	2	11	12	16

2.4.2 CRC-CCITT Error Checking

The CRC generator circuitry generates 16 bits CRC to ensure the integrity of the transmitted and received data packets. The reader and transponder use the CRC-CCITT (Consultative Committee for International Telegraph and Telephone) algorithm for error detection.

The 16-bit cyclic redundancy code is calculated using the following polynomial:

$$P(X) = x^{16} + x^{12} + x^{5} + x^{0}$$

The implemented version of the CRC check has the following characteristics:

Reverse CRC-CCITT 16 as described in ISO/IEC 13239 and used in ISO/IEC 11784/11785

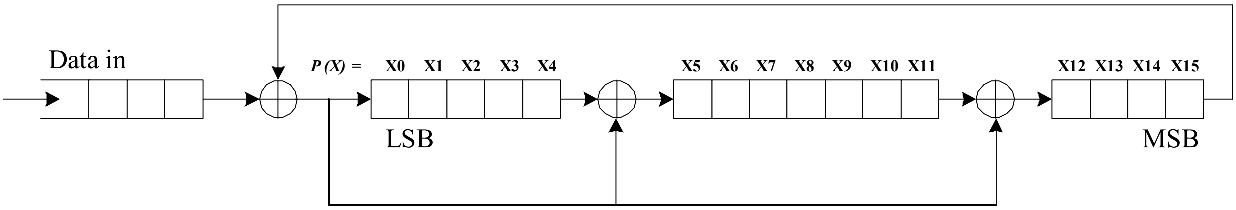
The CRC 16 bit shift register is initialised to all zeros (0x0000)

The incoming data bits are XOR-ed with the MSB of the CRC register and is shifted into the register's LSB

After all data bits have been processed, the CRC register contains the CRC-16 code.

Reversibility - The original data, together with associated CRC, when fed back into the same CRC generator will regenerate the initial value (all zeros).

Figure 3. Schematic diagram of the 16 bits CRC-CCITT generator



2.5 Temperature Data

The temperature can be recovered from the POST applying following equation:

if ND < 1023

if SIGN(ND) = '0' → T = -0.01608783 * ND + 25.198395

if SIGN(ND) = '1' → T = 0.01608783 * ND + 25.198395

if ND > 1023 Out of Range (OoR)

NDCAL is not used for this calculation

Mechanical Data

2.6 Dimensions and material

Parameter	Minimum	Typical	Maximum	Unit
Length	49.5	51	52.5	mm
Diameter	14.8	15.0	15.2	mm
Weight		20		
Case Material	Borosilicate glass			
Protection Class	Hermetically sealed			
Hydrolytic Class (ISO 719)	HGB 1			
Acid Class (DIN 12116)	S 1			
Alkali Class (ISO 695)	A 2			
Thermal Shock Resistance	>50			ºC

For additional information please contact info@ixys.es