IXYS
INTEGRATED CIRCUITS DIVISION

NCD1015ZP

50mm Half Duplex Read-Only RFID Transponder

Features

- Reliable Half-Duplex (HDX) Low Frequency (LF) Communications Format
- 64 Bits For Data / Identification Storage
- 134.2 kHz Operating Frequency
- FSK Modulation
- Energy Harvesting Battery-Free Wireless Power
- 16 Bit CRC Error Detection Code Generator
- 10 Year Data Retention

Applications

- Inventory Management
- Ingress/Egress Discovery
- Real-time Container Tracking
- Manufacturing Production Flow Control
- Vehicle Identification
- Security Access Administration
- High Value Asset Monitoring

Description

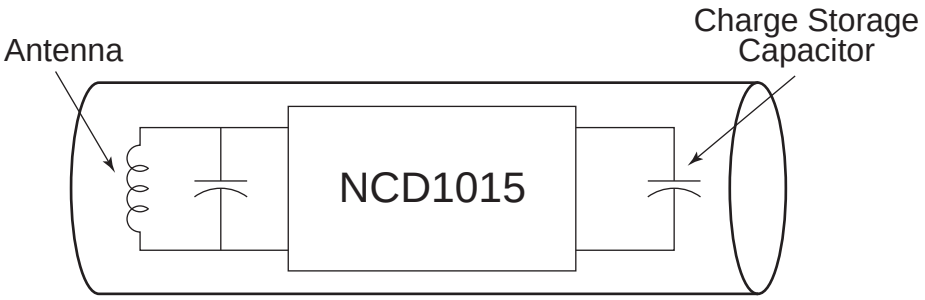
The NCD1015ZP is a passive 50mm cylindrical low frequency half-duplex read-only radio frequency identification (RFID) transponder that operates at a resonant frequency of 134.2kHz. With 64-bits of pre-programmed identification data storage and a 16-bit CRC error checking code generator, the transponder supports ISO 11784 and ISO 11785 standards.

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 that contains the stored 64-bit data, a 16-bit CRC-CCITT error checking code, and the overhead bits necessary to ensure transmission recognition. Transmission of the digital data from the transponder to the reader utilizes an FSK modulation technique where a logic 0 is represented by a 16 cycle burst of 134.2 kHz while a logic 1 uses 124.2 kHz.

Ordering Information

Part #	Description
NCD1015ZP	50mm HDX RFID 64-bit Data Transponder, Pre-programmed Identification Code Bit 1 = 0 :: Non-animal Bits 2 - 16 = 0x0000 Bits 17 - 26 = 0x3D2 (978_d) Bits 27 - 64 :: Unique Identification Code - value will be incremented at the factory to provide a unique code for each device. Maximum number of unique values = 2^{38} - 1 = 0x3FFFFFFFFF (ID Code = 0 not used)
NCD1015ZPC	50mm HDX RFID 64-bit Data Transponder, Custom programmed Identification Code: Contact the factory.

Block Diagram



1. Specifications

1.1 Operating Conditions

Parameter	Minimum	Maximum	Unit
Operating Temperature, T_A	-20	+60	°C
Storage temperature, T_{STG}	-40	+60	°C

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 25°C, 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 = 25°C	f_0	133.6	134.2	134.8	kHz
	-20°C ≤ T_A ≤ 60°C		132.2	-	136.2	
High Bit Frequency	T_A = 25°C	f_1	123.3	124.2	125.8	kHz
	-20°C ≤ T_A ≤ 60°C		122.0	-	126.5	
Data Retention			10	-	-	Years

2. Functional Overview and Description

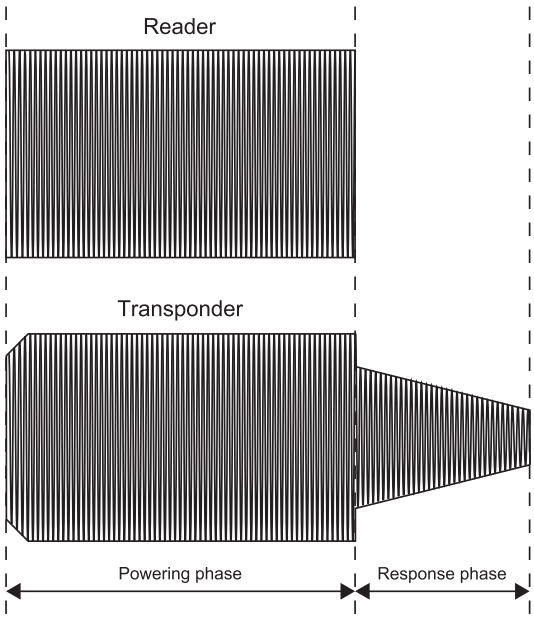
2.1 Overview

The reader and the pre-programmed NCD1015ZP transponder comprise the two elements of a half-duplex wireless communications system operating 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 reader antennae.

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 50 ms using an activation frequency of 134.2 kHz 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 transmits it's stored data. 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 NCD1015ZP 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 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

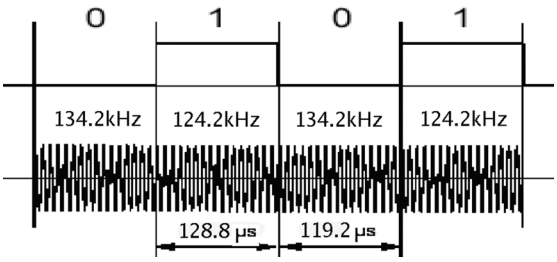
2.3.1 Data Bit Structure

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 output of the last bit, the transponder deactivates.

2.4 Transmission Protocol

2.4.1 Transponder - Response Data Format

An RFID answer by the NCD1015ZP contains a Header, the identification DATA, a CRC value, and a Trailer.

Framed as shown below in Figure 3 the transmitted signal has a fixed length of 128 bits. The Header consists of a16-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.

Depending on the value of the sixteenth Data bit, logical data address [48], the Stop byte value changes. When the identification data stored in the NCD1050ZP complies with ISO 11784, data bit 16 as defined in ISO 11784 will be 0 and the Stop byte value will be 0x7E. For identification data not compliant with ISO 11784 the Stop byte value will be determined by the value stored in the sixteenth bit of the data.

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

Figure 3: Tag Response Frame Format

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] . . = 0x7E - Data bit 16 = 0‡
- Stop Byte [7:0] . . = 0x1E - Data bit 16 = 1‡
- Post Bits [15:0] . . = 0x0000

‡ Data bit position as defined in ISO 11784

2.4.2 CRC - CCITT Error Checking

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

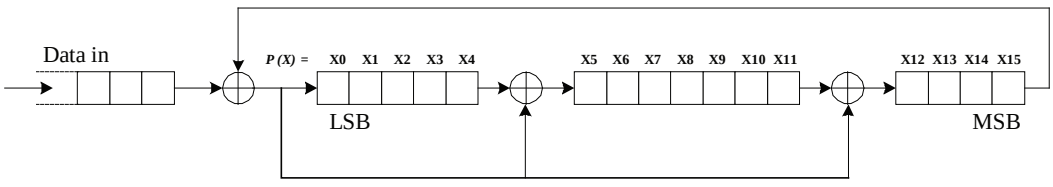
The 16-bit cyclic redundancy code is calculated using the following polynomial:

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

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 initialized 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 zero's).

Figure 4: Schematic Diagram of the 16-Bit CRC-CCITT Generator



3. Mechanical Data

3.1 Dimensions and Material

Parameter	Min	Typ	Max	Unit
Length	51.8	52.3	52.8	mm
Diameter	16.5	17	17.5	mm
Case Material	PA66GF and epoxy			

3.2 Water Resistance

Water IP67. No frequency shift after 1 hour at 20ºC under 1 meter of water.

3.3 Mechanical Shock

Drop test (qualified by similarity)10 times at 30cm (both orientations)

3.4 Thermal Stress

Temperature cycling: 500 times 70°C ⇨ -25°C ⇨ 70°C.
Transition time: 30 minutes
Dwell time at 70°C: 60 minutes)
Dwell time at -25°C: 60 minutes).

For additional information please visit www.ixysic.com

Specifications: DS-NCD1015ZP-R02

12/18/2015