DATA SHEET

HT2 DC20 S20

HITAG™2 Transponders

Product Specification
Revision 3.0
Public Information

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029830

PHILIPS

CONTENTS

1 FEATURES

- Identification transponder for use in contactless applications
- Operating frequency 125 kHz
- Data transmission and energy supply via RF link, no internal battery
- Reading distance same as writing distance
- Non-volatile memory of 256 bits (128 bit user data and 128 bit control data/secret memory) organized in 8 pages, 4 Bytes each
- 10 years non-volatile data retention
- > 100 000 erase/write cycles
- Selective read/write protection of memory content
- Two coding schemes for read operation: Biphase and Manchester coding
- Effective communication protocol with outstanding data integrity check
- Mutual authentication function
- Read/write mode allows:
    - plain data transmission (password check)
    - encrypted data transmission (crypto mode)
- In read/write mode multi-tag operation possible because of special HALT-function
- Emulation of standard industrial read-only transponders:
    - Public Mode A (MIRO and transponders from µEM (H400x))
    - Public Mode B (according to ISO 11784 and ISO 11785 for animal identification)
    - Public Mode C (PIT compatible mode)

2 GENERAL DESCRIPTION

The HT2DC20S20 is a high performance transponder for bi-directional transmission in half duplex mode between read/write device and transponder.

Data are stored in the transponder in a non-volatile memory (EEPROM). The transponder requires no internal power supply; it derives its power from the magnetic component of the RF carrier frequency generated by the reader. Data are transmitted by modulating this carrier.

The HT2DC20S20 is dedicated for use in secure access systems where the transponder and the reader have to identify each other. The choosable use of cryptography enables highest data security. Providing several operating modes (password, crypto, standard read only modes) the versatile transponder can be used in various applications. The possible use of an installed reader base for read only transponders makes the additional use of HT2DC20S20 or the replacement of read only transponders by HT2DC20S20 very easy.

The HALT-command can be used after finishing data exchange to reach the halt-state. In this state the transponder is muted. This feature can be used to have steady RF field where single transponders are collected one by one. Each transponder is operated and then disabled so it does not interfere with the next transponder. The halt-state can only be exited by switching off/removing the magnetic field.

The EEPROM has a capacity of 256 Bits and is organized in 8 pages of 4 Bytes. The 8 pages are split up into 4 pages containing user data and into 4 pages for control of the memory access and for authentication purposes.

The pages of the transponder memory can be protected against read or write access by setting corresponding memory flags.

Absorption modulation is used to transmit data from the transponder to the reader. The transponder absorbs the magnetic field, which hence modulates the current in the reader antenna. Data transmission to the HT2DC20S20 uses binary pulse length modulation (BPLM).

3 ORDERING INFORMATION

Type Name	Description	Ordering Number
HT2 DC20 S20/F	HITAG 2 S20 Stick	9352 339 40122 *

* minimum Order Quantity: 1000pcs.

4 QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Carrier frequency	125	kHz
Data transmission mode	half-duplex	
Transfer rate – transponder ⇒ reader – reader ⇒ transponder	 4.0 5.2	 kbit/s kbit/s
Coding – transponder ⇒ reader – reader ⇒ transponder	Manchester / Biphase BPLM (binary pulse length modulation)	
Modulation	ASK (amplitude shift keying)	
Memory size	256	bit
Memory organization	8	page
Encrypted mutual authentication - Serial Number - Secret Key - Duration	 32 48 36	 bit bit ms

Special features	• user defined write protection • unique 32 bit serial number for each transponder • read only emulation function (µEM H400x family, ISO 11784 and 11785, PIT compatibility) • encrypted data transmission possible

5 FUNCTIONAL DESCRIPTION

5.1 Memory Organization

The memory of the transponder consists of 256 bits EEPROM memory and is organized in 8 pages with 32 bits each.

Depending on the operation mode the EEPROM is organized as described in the following.

Crypto Mode:

Page	Content
0	Serial Number
1	32 LSBs of 48 bit key
2	16 MSBs of 48 bit Key, 16 bit reserved
3	8 bit Configuration, 24 Bit Password TAG
4	read/write page
5	read/write page
6	read/write page
7	read/write page

Password Mode:

Page	Content
0	Serial Number
1	Password RWD
2	reserved
3	8 bit Configuration, 24 bit Password TAG
4	read/write page
5	read/write page
6	read/write page
7	read/write page

5.2 Operation Modes and Configuration

With the Configuration Byte the operation mode and the access rights to the memory can be selected. During Power-Up of the transponder the Configuration Byte is read from the EEPROM of the transponder.

If you change the configuration, keys or passwords, you have to place the transponder directly on the antenna (0-distance)! In order to avoid any errors do not move the transponder during this write process and be sure that you are in a safe environment without electrical noise.

5.2.1 Modes of Operation

The HT2DC20S20 can be operated in several modes.

Crypto Mode:

Mode for writing or reading the transponder with encrypted data transmission.

Password Mode:

Mode for writing or reading the transponder with plain data transmission.

Public Mode A (Manchester):

Read only mode emulating Philips MIRO transponders resp. µEM H400x transponders.
The 64 bits of the user Pages 4 and 5 are cyclically transmitted to the read/write device.

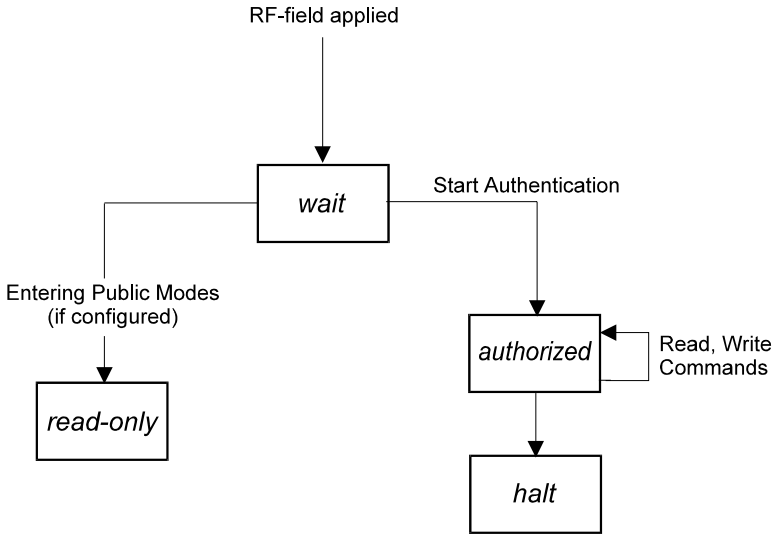
Public Mode B (Biphase):

Read only mode according to ISO standards 11784 and 11785 for animal identification.
The 128 bits of the user Pages 4 to 7 are cyclically transmitted to the read/write device.

Public Mode C (Biphase):

Read only mode emulating the read operation of the PCF793X (with a slightly different Program Mode Check).
In the Public Mode C the 128 bits of the user Pages 4 to 7 are cyclically transmitted to the read/write device.

5.2.2 Status Flow



After entering the RF-field the transponder waits for a command to start the authentication.

After issuing this command the mutual authentication takes place, followed by read- and write commands.
In password mode the data transfer occurs plain, in crypto mode data are encrypted.

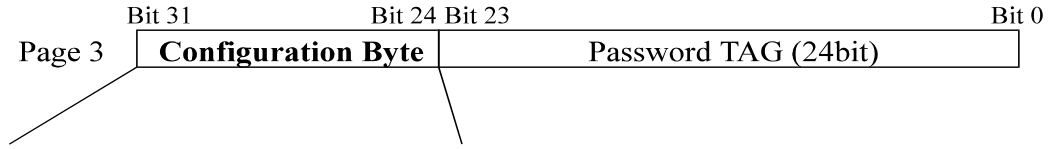
The halt mode can be entered for muting a transponder.

If the transponder is configured in one of the public modes, these modes are entered automatically after a certain waiting time and data pages are sent cyclically to the read/write device.

By issuing the command to start the authentication during the waiting time also public mode transponders can be brought into the authorized state.

5.2.3 Configuration

The Configuration Byte is represented by the first 8 bits of Page 3 of the transponder memory.



7	6	5	4	3	2	1	0

0: Manchester Code (does effect HITAG 2 Operation only)
1: Biphase Code (does effect HITAG 2 Operation only)

Bit 2	Bit 1	Version	Coding	Coding in HITAG 2-Operation
0	0	Public Mode B	biphase	depending on bit 0
0	1	Public Mode A	manchester	depending on bit 0
1	0	Public Mode C	biphase	depending on bit 0
1	1	HITAG 2	depending on bit 0	depending on bit 0

0: password mode
1: crypto mode

0: PAGE 6 and 7 read/write
1: PAGE 6 and 7 read only

0: PAGE 4 and 5 read/write
1: PAGE 4 and 5 read only

THE SETTING OF THIS BIT IS **OTP !**
0: PAGE 3 read/write
1: PAGE 3 read only; Configuration Byte and Password TAG **fixed**

THE SETTING OF THIS BIT IS **OTP !**
0: PAGE 1 and 2 read/write
1: PAGE 1 no read/no write
PAGE 2 read only (when transponder is in password mode)
PAGE 2 no read/no write (when transponder is in crypto mode)

Configuration Byte / Bit 6:

Bit 6 = '0': Page 3 is read/write.
Bit 6 = '1': Page 3 can only be read. This process is irreversible!

ATTENTION: Do not set Bit 1 of the Configuration Byte to '1' before having written the final data into Page 3 (including the Configuration Byte and Password TAG) of the transponder.

Configuration Byte / Bit 7:

Bit 7 = '0': Pages 1 and 2 are read/write.
Bit 7 = '1': Pages 1 and 2 are locked against writing. This process is irreversible!

ATTENTION: Do not set Bit 7 of the Configuration Byte to '1' before having written the final data into Pages 1 and 2 of the transponder.

Standard values for the Configuration Byte:

Password Mode:	0x06
Crypto Mode:	0x0E
Public Mode A:	0x02
Public Mode B:	0x00
Public Mode C:	0x04

5.3 Configuration of Delivered Transponders

HT2DC20S20 transponders are delivered with the following configuration:

Unique Serial Number:

Serial Number:	Read Only	-	fixed

Configuration Byte:

0x06:	Password Mode (Manchester Code)	-	can be changed
	Page 6 and 7 read/write	-	can be changed
	Page 4 and 5 read/write	-	can be changed
	Page 3 read/write	-	can be changed
	Page 1 and 2 read/write	-	can be changed

Values for Transport Passwords, Transport Keys:

Password RWD:	`0x4D494B52`	(= ″MIKR″)
Password TAG:	`0xAA4854`	
Key Low:	`0x4D494B52`	(= ″MIKR″)
Key High:	`0x4F4E`	(= ″ON″)

RECOMMENDATION:
Before delivering transponders to end users, Pages 1 to 3 should be locked (set Configuration Byte / Bit 6 to ‘1’ for Page 3 and set Configuration Byte / Bit 7 to ‘1’ for Pages 1 and 2).

5.4 Definition of Passwords and Keys

Keys are cryptographic codes, which determine data encryption during data transfer between read/write device and transponder. They are used to select a HT2DC20S20 transponder in Crypto Mode. The 16 bit KEY HIGH and 32 bit KEY LOW form one 48-bit key which has to be identical on both the transponder and the read/write device.

Passwords are needed to select a HT2DC20S20 transponder in Password Mode. There is one pair of passwords (Password TAG, Password RWD), which has to be identical both on the transponder and the read/write device.

Password TAG: Password that the transponder sends to the read/write device and which may be verified by the latter (depending on the configuration of the read/write device).

Password RWD: Password that the read/write device sends to the transponder and which is checked for identity by the latter.

It is important that the following values are in accordance with each other, i.e. the respective data on the read/write device and on the transponder have to be identical pairs.

HT2DC20S20 in Password mode:

on the read/write device		**on the transponder**
Password RWD	⇔	Password RWD

as an option (depending on the configuration of the read/write device):

Password TAG	⇔	Password TAG

HT2DC20S20 in Crypto mode:

on the read/write device		**on the transponder**
KEY LOW	⇔	KEY LOW
KEY HIGH	⇔	KEY HIGH

as an option (depending on the configuration of the read/write device):

Password TAG	⇔	Password TAG

The passwords and keys are predefined by Philips by means of defined Transport Passwords and a Transport Key. They can be written to, which means that they can be changed (see also Chapter “Configuration of Delivered HT2DC20S20 Transponders“).

ATTENTION: Passwords and Keys only can be changed if their current values are known!

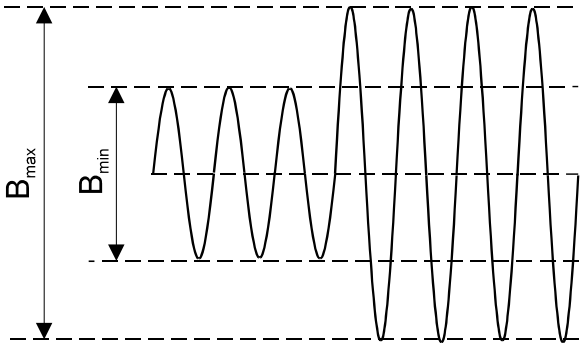
6 ELECTRICAL PARAMETERS

6.1 Electrical Characteristics

T_0 = 8 µs (period length for f_0 = 125 kHz)
All parameters are guaranteed within the temperature range from -40°C to 85°C.

SYMBOL	PARAMETER	CONDITION	MIN.	MAX.	UNIT
f_{RES}	resonance frequency		121	129	kHz
Bw	bandwidth		2.3		kHz
B_{thr}	magnetic flux density, data transmission from transponder to base station	f_0 = 125 kHz	35	400 *	μT_{pp}
B_{prog}	magnetic flux density for programming the EEPROM	m = 0.95 f_0 = 125 kHz $t_{low} = 8T_0$	35	400 *	μT_{pp}
B_{auth}	magnetic flux density for mutual authentication	m = 0.95 f_0 = 125 kHz $t_{low} = 8T_0$	35	400 *	μT_{pp}
B_{read}	field absorption due to the modulation of the transponder	f_0 = 125 kHz B_{field} = 35 μT_{pp}	8		μT_{pp}
Mi_{PRG}	modulation index (m) of the base station for programming and authentication	B_{field} = 35 μT_{pp} f_0 = 125 kHz $t_{low} = 8T_0$	95	100	%

All parameters are characterized with the Scemtec test equipment (STM-1), available from **SCEMTEC, Reichshof-Wenrath,Germany**.



$$m = \frac{(B_{\max} - B_{\min})}{(B_{\max} + B_{\min})}$$

$$B_{read} = |B_{\max} - B_{\min}|$$

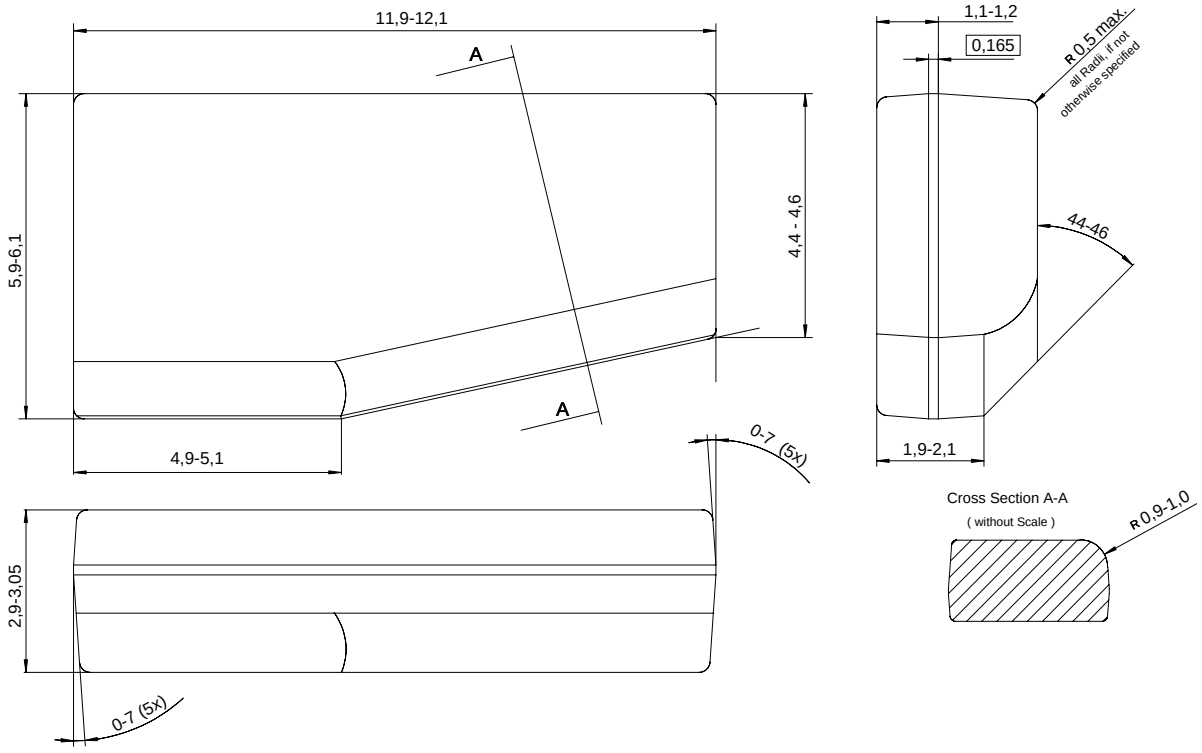
* Maximum available field strength of the test equipment. Transponder limit has not been characterized.

6.2 Limiting Values

Parameter	Condition	Min.	Max.	Unit
No. of erase/write cycles of the EEPROM		100 000		
Data retention time of the EEPROM	@ 55 °C	10		years
Operating temperature range		-40	+85	°C
Storage temperature range		-55	+125	°C
Magnetic flux density			0.2	T

7 MECHANICAL CHARACTERISTICS

Parameter	Value	Unit
Mechanical dimensions	12 x 6 x 3	mm
Protection class	IP67	
Casting material	epoxy resin	
Housing colour	black	
Vibration – 20 - 2000 Hz – 3-axis – IEC 68-2-6, Test Fc	20	g
Shock – 3-axis – IEC 68-2-6, Test Ea	1500	g



Protruding plastic must not exceed
specified dimension by more than 0.2 mm

8 Revision History

Revision	Date	CPCN	Page	Description
2.0	Jan 1999			Initial Version
3.0	July 2006		18	Add Disclaimer Section: - Philips Field of Use - Philips Right to make changes

Definitions

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics section of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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