DATA SHEET

HT2 DC20 S20
HITAG™2 Transponders

Product specification
Revision 2.0

March 1998

PHILIPS

CONTENTS

HITAG™2 Transponders

HT2 DC20 S20

1   FEATURES

- Identification Transponder for use in contactless applications
- Operating frequency 125 kHz
- Data transmission and supply energy via RF link, no internal battery
- Reading distance same as writing distance
- Non volatile memory of 256 bits (128 bits user data, 128 bits control data/secret memory) organized in 8 pages, 4 bytes each
- 10 years non-volatile data retention
- >100000 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).

HITAG^{TM}2 Transponders

HT2 DC20 S20

3   ORDERING INFORMATION

EXTENDED TYPE NUMBER	IC VERSION	PACKAGE	DRAWING	TEMPERATURE RANGE (°C)
HT2 DC20 S20/F	VLOCS1 V0	SOT385-1	SOT385BA3	−40 to +85

4   QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Carrier frequency	125	kHz (typical)
Data transmission mode	half-duplex	
Transfer rate		
• transponder -> reader	4.0	kbit/s
• reader -> transponder	5.2	kbit/s
Coding		
• transponder -> reader	Manchester / Biphase	
• reader -> transponder	BPLM (binary pulse length modulation)	
Modulation	ASK (amplitude shift keying)	
Memory size	256	byte
Memory organization	8 (blocks)	page (each 16 byte)
Encrypted mutual authentication		
• Serial Number	32	bit
• Secret Key	48	bit
• Duration	36	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

HITAG™2 Transponders

HT2 DC20 S20

5 BLOCK DIAGRAM

HT2 DC20 S20

CONTACTLESS INTERFACE

RECTIFIER
VOLTAGE LIMITER

POWER-ON
RESET

CLOCK
RECOVERY

MODULATOR

DEMODULATOR

CONTROL LOGIC

DATA
ACQUISITION

EEPROM
ACCESS CONTROL

CALCULATION UNIT
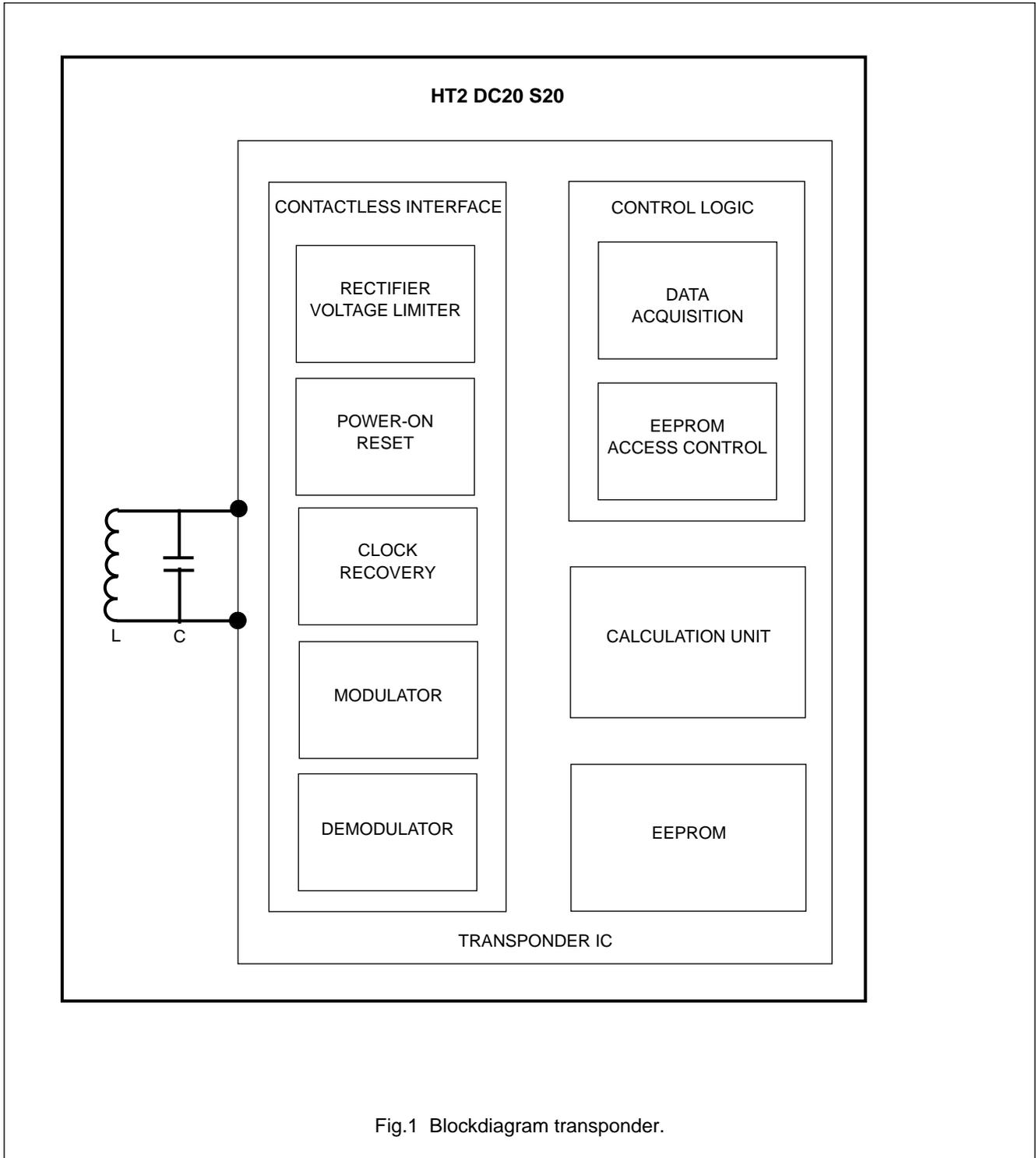
EEPROM

L   C

TRANSPONDER IC

Fig.1 Blockdiagram transponder.

HITAG^{TM}2 Transponders

HT2 DC20 S20

6   GENERAL FUNCTIONAL DESCRIPTION

6.1   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.

Table 1   Memory organization

PAGE	CONTENT
Crypto Mode:	
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:	
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

6.2   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.

6.2.1   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. mEM 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.

6.2.2   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.

HITAG™2 Transponders

RF-FIELD APPLIED

WAIT

START AUTHENTICATION

ENTERING PUBLIC MODES
(if configured)

AUTHORIZED

READ, WRITE
COMMANDS

READ-ONLY

HALT

Fig.2 Status flow.
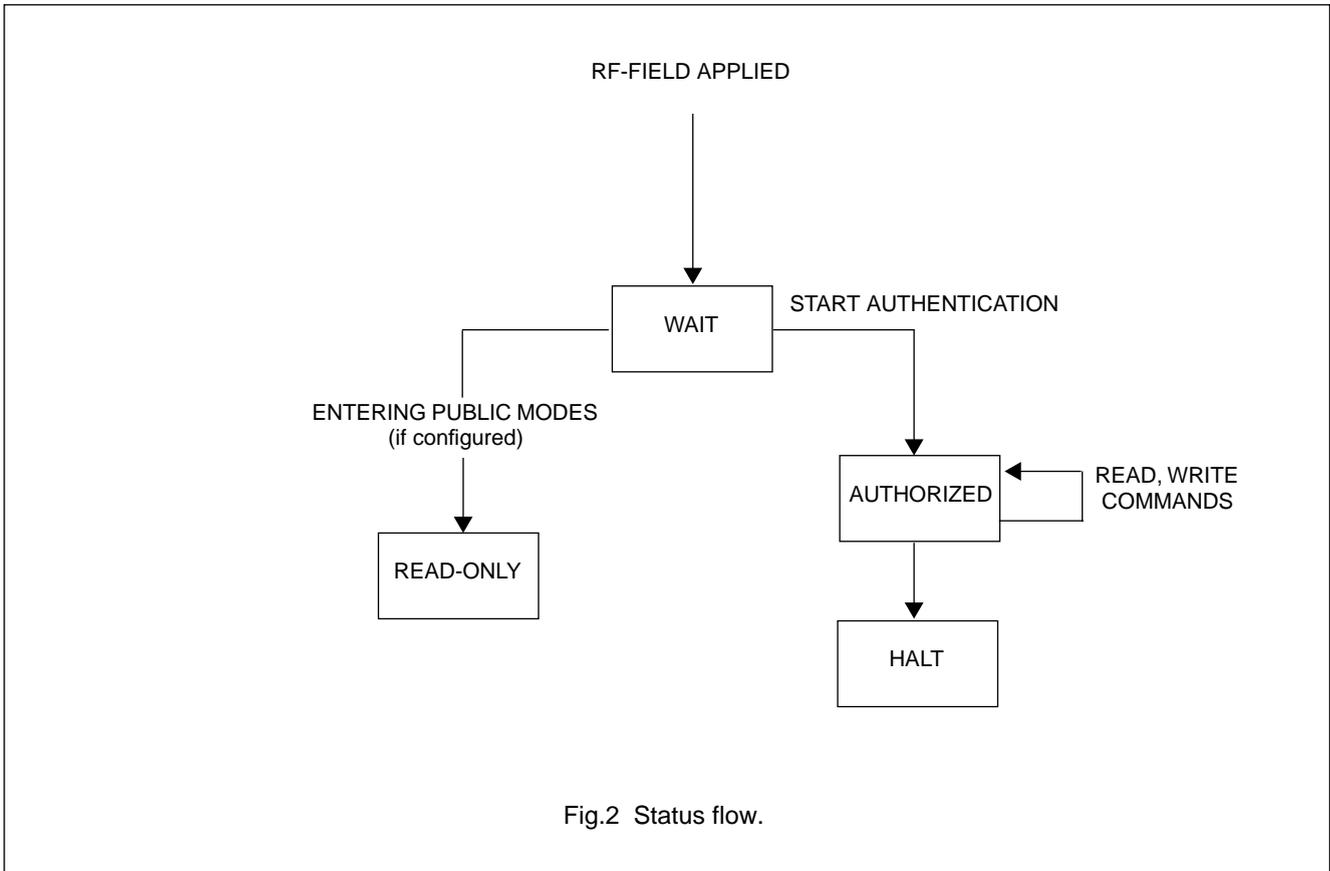
HITAG™2 Transponders

HT2 DC20 S20

6.2.3 CONFIGURATION

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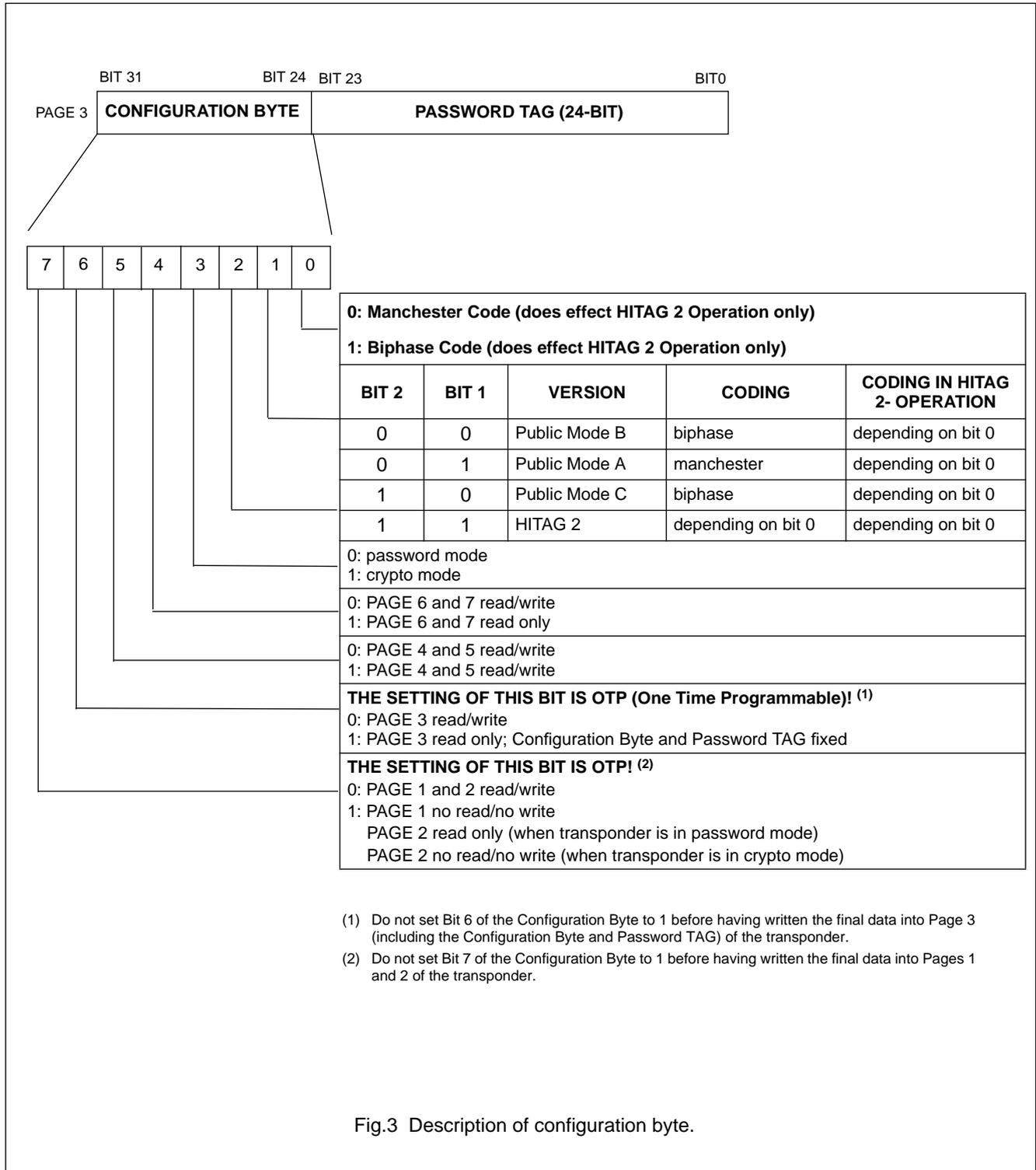

BIT 2	BIT 1	VERSION	CODING	CODING IN HITAG 2- OPERATION
0	0	Public Mode B	biphase	depending on bit 0
0	1	Public Mode A	manchester	depending on bit 0
1	0	Public Mode C	biphase	depending on bit 0
1	1	HITAG 2	depending on bit 0	depending on bit 0

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

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

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/write

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

THE SETTING OF THIS BIT IS OTP! (2)
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)

(1) Do not set Bit 6 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.

(2) 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.

Fig.3 Description of configuration byte.

HITAG^{TM}2 Transponders

HT2 DC20 S20

Table 2   Standard values for the Configuration Byte

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

6.3   Configuration of Delivered Transponders

Table 3   Configuration of Delivered Transponders

HT2DC20S20 transponders are delivered with the following configuration:

NAME	DESCRIPTION	REMARK
Unique Serial Number:		
Serial Number	Read Only	fixed
Configuration Byte:		
0x06:	Password Mode (Manchester Code)	can be changed
	Page 6 and 7 read/write	
	Page 4 and 5 read/write	
	Page 3 read/write	
	Page 1 and 2 read/write	
Values for Transport Passwords, Transport Keys:		
Password RWD:	0x4D494B52 (= "MIKR")	
Password TAG:	0xAA4854	
Key Low:	0x4D494B52 (= "MIKR")	
Key High:	0x4F4E (= "ON")	

Note

1. 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).

HITAG™2 Transponders

HT2 DC20 S20

6.4 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.

Table 4 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

Table 5 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).

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

7   LIMITING VALUES

All values are in accordance with the Absolute Maximum Rating System (IEC 134).

PARAMETER	MIN.	MAX.	UNIT
number of erase/write cycles of the EEPROM	100000		
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 (resistivity against magnetic pulses)		0.2	T
vibration • 10 – 2000 Hz • 3-axis • IEC 68-2-6, Test Fc		10	g
shock • 3-axis • IEC 68-2-27, Test Ea		1500	g

HITAG^{TM}2 Transponders

HT2 DC20 S20

8   ELECTRICAL CHARACTERISTICS

T0 = 8 ms (period length for f0 = 125 kHz). All parameters are guaranteed within the temperature range from T_{amb} = −40°C to +85°C.

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

SYMBOL	PARAMETER	CONDITION	MIN.	MAX.	UNIT
f_{RES}	resonance frequency		121.0	129.0	kHz
B_W	bandwidth		2.3		kHz
B_{THR}	magnetic flux density, data transmission from transponder	$f_{CARRIER}$ = 125 kHz	35	400 [1]	μT_{pp}
B_{PRG}	magnetic flux density for programming the EEPROM	m = 0.95 f_0 = 125 kHz t_{LOW} = 8 T_0	35	400 [1]	μT_{pp}
B_{AUTH}	magnetic flux density for mutual authentication	m = 0.95 f_0 = 125 kHz t_{LOW} = 8 T_0	35	400 [1]	μT_{pp}
B_{READ}	field absorption due to the modulation of the transponder	$f_{CARRIER}$ = 125 kHz B_{FIELD} = 35 μT_{pp}	8		μT_{pp}
M_{IPRG}	modulation index (m) of the base station for programming and authentication	$f_{CARRIER}$ = 125 kHz B_{FIELD} = 35 $\mu Wb/m^2$ pulse width 8 T_0	95	100	%

Note

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

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

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

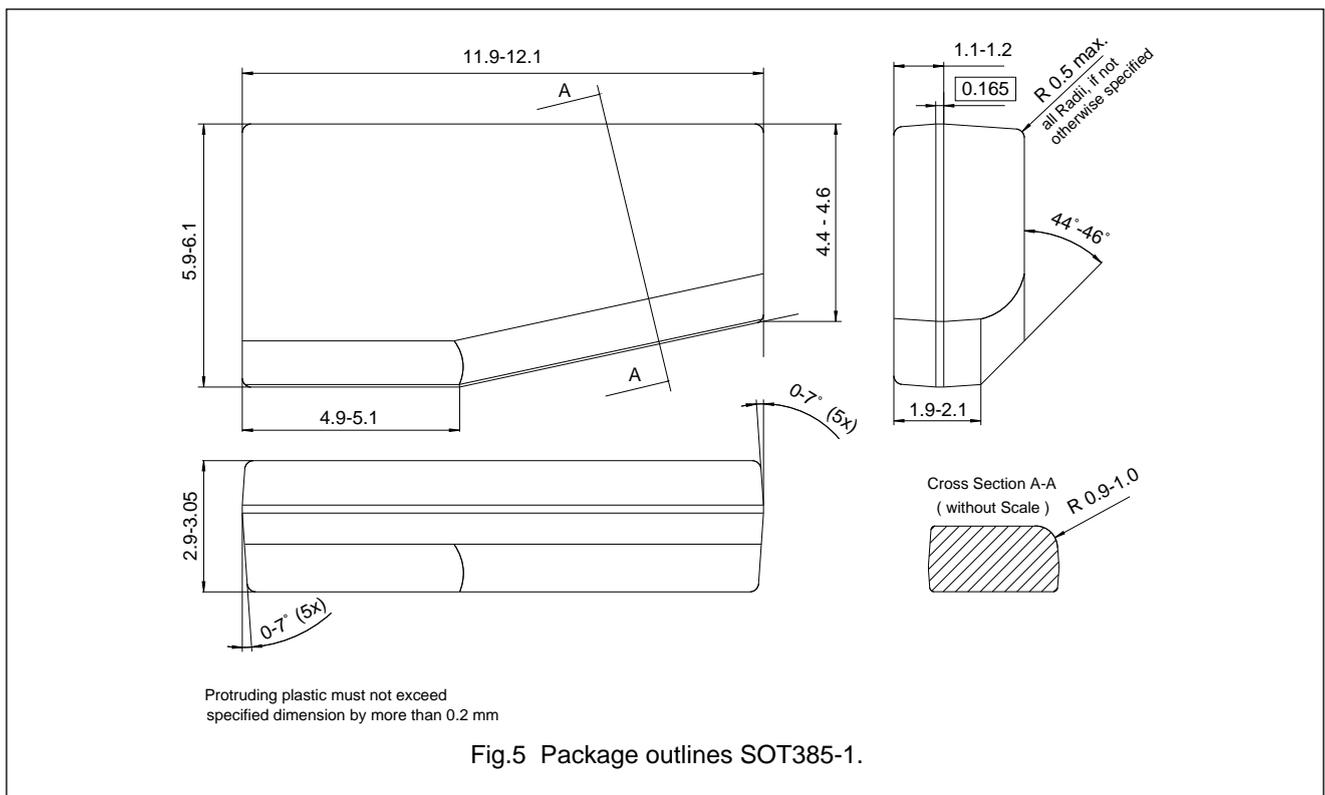Fig.4   Definition of modulation index.
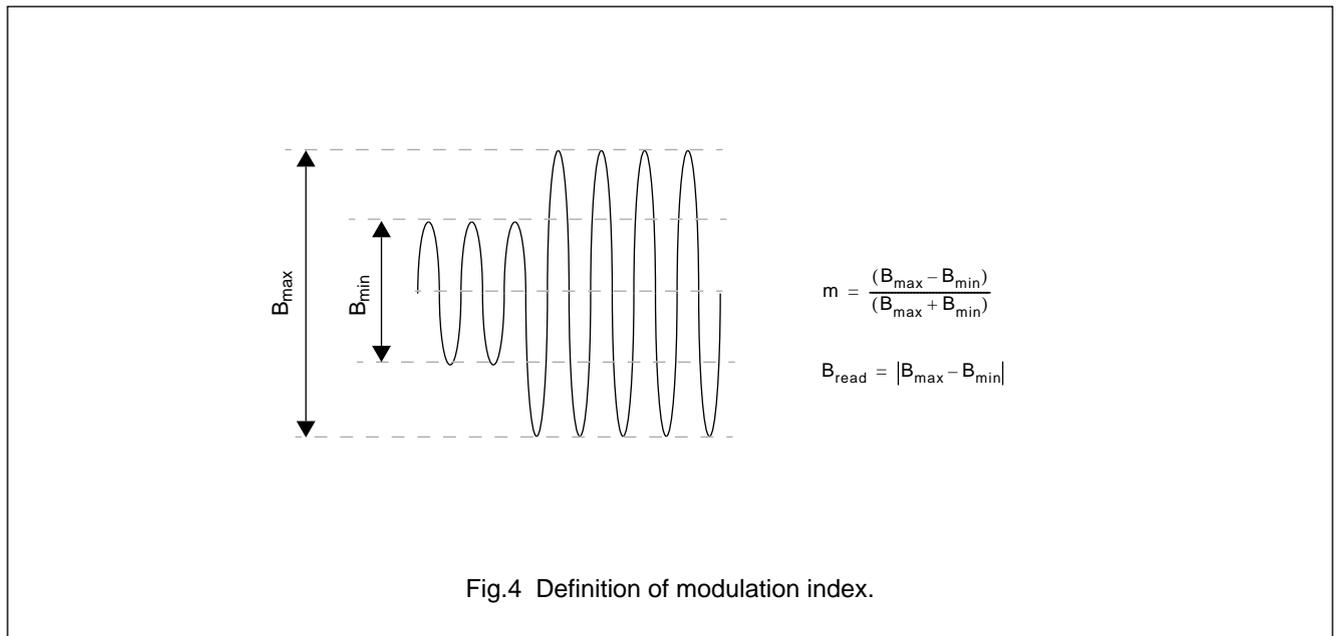
HITAG^{TM}2 Transponders

HT2 DC20 S20

9 MECHANICAL CHARACTERISTICS

The transponder is sealed in epoxy resin moulding compound. The outline of the package is given in Fig.4. The designation of the package is SOT385-1.

PARAMETER	VALUE	UNIT
mechanical dimensions	12 x 6 x 3	mm
protection class	IP67	
casting material	epoxy resin	

Fig.5 Package outlines SOT385-1.

10 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 sections 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.	

11 LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so on their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

NOTES

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213, Tel. +43 160 1010,
Fax. +43 160 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 0044

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580920

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 0966

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax.+381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: http://www.semiconductors.philips.com

Let's make things better.

**Philips
Semiconductors**

PHILIPS