HITAG 1

Transponder IC

Rev. 3.0 — 26 February 2010
187530

Product data sheet
CONFIDENTIAL

1. Introduction

HITAG 1 is part of the well known and established HITAG family.

Contactless read/write systems based on HITAG 1 passive transponders are suitable for various applications.

The HITAG product family can be used, in the proximity area (operating range up to about 200 mm) as well as in the long range area (operating range up to about 1000 mm).

2. General description

HITAG 1 based transponders are highly integrated and do not need any additional components beside the external coil.

Data between Key (RWD) and transponder is transmitted bidirectionally, in half duplex mode. The HITAG 1 transponder IC offers also an encrypted data transmission.

The Anticollision (AC) Mode, which is used mainly in long range operation, allows to handle several transponders that are at the same time in the communication field of the antenna, thus achieving highest operating reliability and permitting to handle several transponders quickly and simultaneously.

The HITAG 1 transponder IC provides two protocol modes, Standard and Advanced Mode. The Advanced Protocol Mode operates compared to the Standard Protocol Mode with an increased number of Startbits and a 8-bit Cyclic Redundancy Check (CRC) sent by the transponder IC at read operations.

HITAG 1 transponder IC offer a memory of 2 kbit.

3. Features and benefits

- Identification transponder for use in contactless applications
- Operating frequency 125 kHz
- Data transmission and energy supply via RF link, no internal battery
- Non-volatile memory of 2 kbit
- Organized in 64 pages, 4 bytes each
- 10 years non-volatile data retention
- 100 000 erase/write cycles
- Selective read/write protection of memory content
- Mutual authentication function

4. Applications

- Logistics
- Asset tracking
- Gas cylinder ID
- Industrial automation

5. Ordering information

Table 1. Ordering information

Type number	Package			
	Name	Description	Type	Version
HT1ICS3002W/V9F	Wafer	sawn wafer on FFC, 150 μm, 8 inch, UV, inked and mapped	-	-
HT1MOA2S30/E/3	MOA2	plastic leadless module carrier package; 35 mm wide tape	-	SOT500-2

6. Block diagram

The HITAG 1 transponder IC requires no external power supply. The contactless interface generates the power supply and the system clock via the resonant circuitry by inductive coupling to the RWD. The interface also demodulates data transmitted from the RWD to the HITAG 1 transponder IC, and modulates the magnetic field for data transmission from the HITAG 1 transponder IC to the RWD.

Data are stored in a non-volatile memory (EEPROM). The memory has a capacity of 2 kbit and is organized in blocks.

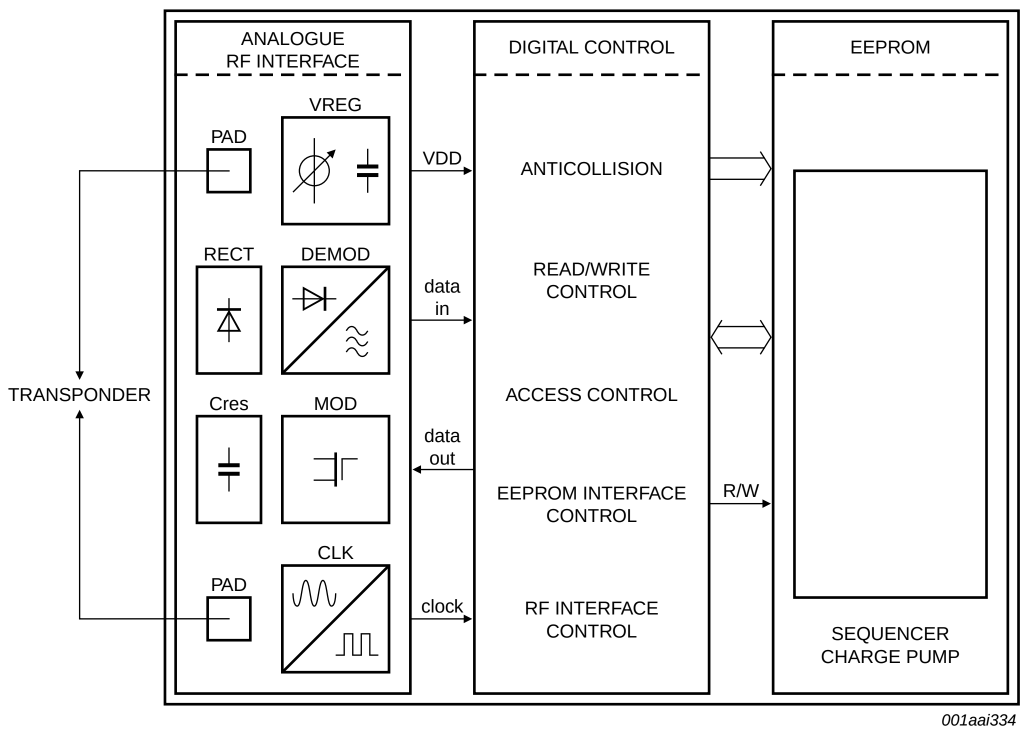


Fig 1. Block diagram of HITAG 1 transponder IC

7. Pinning information

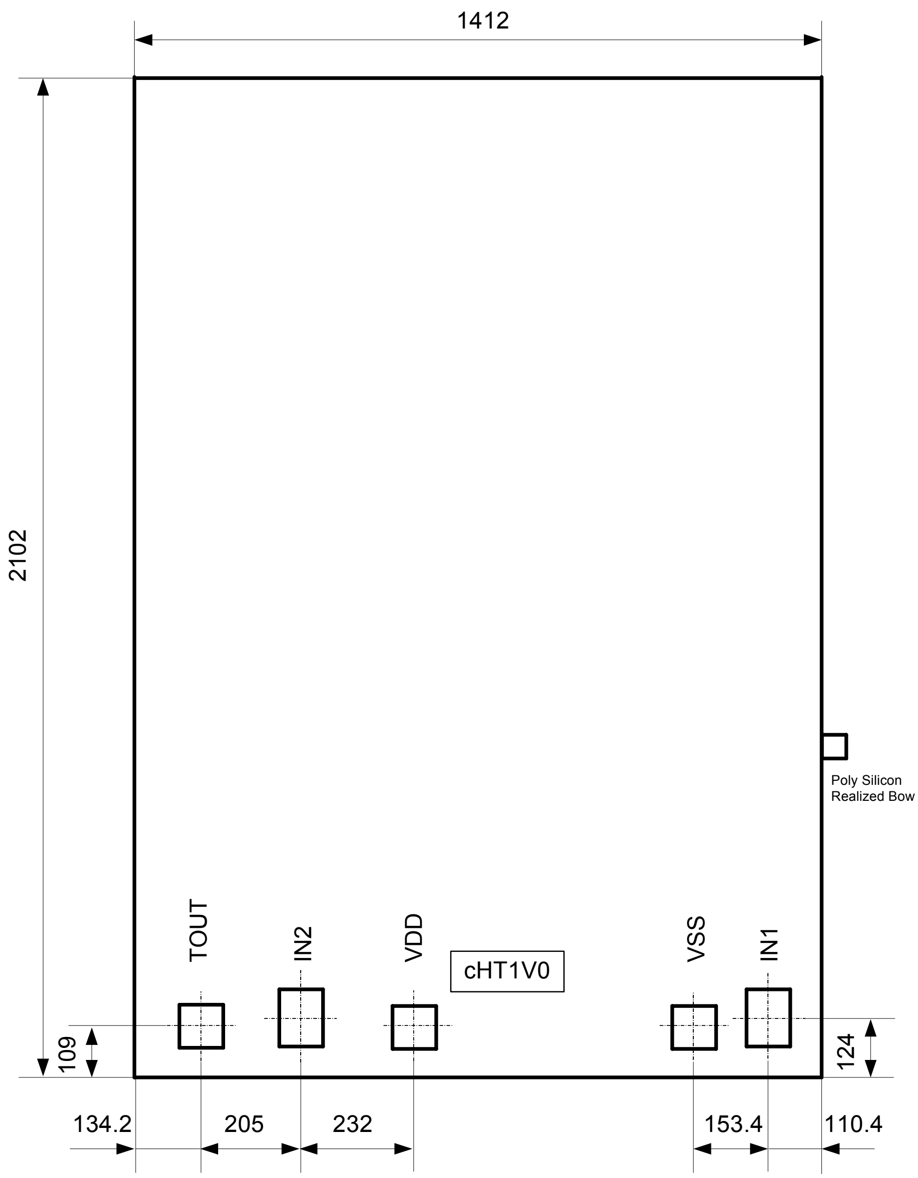


Fig 2. Bond plan of HT1ICS3002 [units in µm]

8. Mechanical specification

8.1 Wafer specification

See Ref. 2 "General specification for 8'' wafer on UV-tape"

8.1.1 Wafer

• Designation:	each wafer is scribed with batch number and wafer number
• Diameter:	200 mm (8'')
• Thickness:	150 µm ± 15 µm
• Process:	C150EE
• Batch size:	25 wafers
• PGDW:	8610

8.1.2 Wafer backside

• Material:	Si
• Treatment:	ground and stress release
• Roughness:	R_a max. 0.5 µm, R_t max. 5 µm

8.1.3 Chip dimensions

• Die size without scribe:	2102 µm x 1412 µm = 2968024 µm
• Scribe line width:	
X-dimension:	108 µm
Y-dimension:	108 µm
• Number of pads:	5

8.1.4 Passivation on front

• Type:	single layer
• Material/Thickness:	TEOS 300 nm, Nitride 700nm

8.1.5 Bondpads

• Pad size:	
– IN1, IN2	120 x 90 µm
– TOUT, VSS, VDD	90 x 90 µm
• Material:	AlCu

8.1.6 Fail die identification

Every die is 100% electrically tested. Identification of dies which do not confirm with the electrical parameters is done by inking and wafer mapping.

Electronic wafer mapping (SECS II format) covers the electrical test results and additionally the results of mechanical/visual inspection.

See Ref. 2 “General specification for 8’’ wafer on UV-tape”.

8.1.7 Map file distribution

See Ref. 2 “General specification for 8’’ wafer on UV-tape”.

9. Functional description

9.1 Memory map

The 2 kbit memory area of the HITAG 1 transponder IC is divided into 16 blocks. Each block comprises 4 pages with 4 bytes (1 byte = 8 bits) each. A page is the smallest access unit.

Addressing is done pagewise (page 0 to 63) whereas access is gained either pagewise or blockwise by entering the respective start address.
Block access is only available for blocks 2 to 15, page access is available for pages 0 to 63..

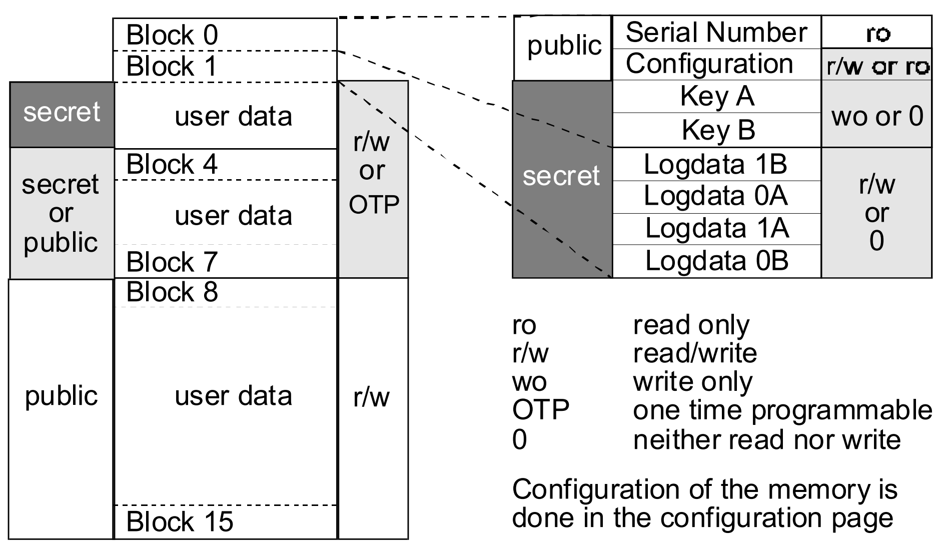


Fig 3. Memory map

Areas (or settings) with light dark background can be configured by the customer within the Configuration Page (page 1 of block 0).

9.2 General definitions

Secret memory areas:
These memory areas can only be accessed encrypted after an authentication.

Public memory areas:
Access to these memory areas is in plain and requires no authentication.

Block 0 defines the unique serial number (programmed during production), the Configuration Page and the Keys.

Block 1 defines the Logdata.

Blocks 4 to 7 can be configured either as secret or public areas. Access to Blocks 2 to 7 can be set either to read/write or read only.

Keys and Logdata can be modified and also locked to prevent them from being accessed.

Finally the Configuration Page itself can be set to read only.

Attention:

It is extremely important to be particularly careful when using the Configuration Page, Keys and Logdata as an error can result in loss of access to the secret area on the transponder.

Changing of the Configuration Page (page 1), Keys and Logdata must be done in secure environment.
It is recommended to put the transponder close to the antenna (zero-distance) and not to remove it during programming!

9.2.1 Definition of the Keys

Keys are cryptographic codes, which determine data encryption during data transfer between the RWD and transponder.

The keys (Key A and Key B) are predefined (see Table 5 “Delivery configuration”) by NXP Semiconductors by means of defined transport keys (both keys show the same bitmap) and can be changed by the customer.

9.2.2 Definition of the Logdata

Logdata represent "passwords" needed to gain access to secret areas on the transponder. Every key (Key A and Key B) includes a pair of Logdata. This Logdata pair has to be identical both on the transponder and the RWD.

Table 2. Definition of the Logdata

Key	Logdata	Description
ad Key A	Logdata 0 A	"Password A" that the transponder sends to the RWD and which is verified by the latter.
	Logdata 1 A	"Password A" that the RWD sends to the transponder and which is checked for identity by the latter.
ad Key B	Logdata 0 B	"Password B" that the transponder sends to the RWD and which is verified by the latter.
	Logdata 1 B	"Password B" that the RWD sends to the transponder and which is checked for identity by the latter.

The Logdata are also predefined (see Table 5 “Delivery configuration”) by NXP Semiconductors using defined transport Logdata (all Logdata show the same bitmap). Both can be changed by customer. Logdata 0A and 1A, as well as Logdata 0B and 1B do not have to show the same values, but Logdata 0A/B and 1A/B have to be identical on the RWD and on the transponder!

Attention:
Keys and Logdata can only be changed if the transport key and the transport Logdata are known!

9.2.3 Configuration of transponder

HITAG 1 IC can be configured via the Configuration Page.

9.2.3.1 Organization of the Configuration Page

The Configuration Page (page 1) consists of 2 bytes configuration data (byte 0 and 1) and 2 bytes for free use (byte 2 and 3).

7	6	5	4	3	2	1	0	7	6	......	1	0	7	6	......	1	0	7	6	......	1	0
byte 0								byte 1					byte 2					byte 3				

The bits in Configuration Page bytes 0 and 1 determine the configuration of the memory (secret/public, read/write (r/w), read only (ro), write only (wo) or neither read nor write). The configuration bytes can be freely allocated until the Configuration Page is locked (bit 4 of byte 1 is set to ’0’). After lock these bytes are read only bytes and cannot be changed any more.

Attention:
Once set to read only the Configuration Page cannot be changed back to read/write again (transponder is hardware protected)!

Configuration Page: Byte 0

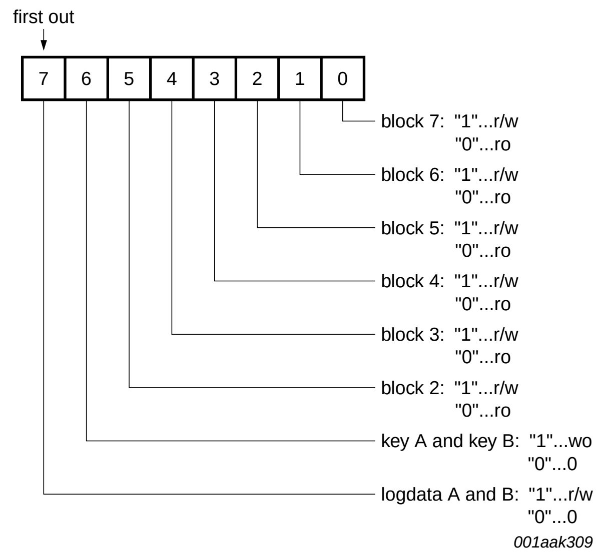


Fig 4. Configuration Page: Byte 0

Table 3. Description of Configuration Page: Byte 0

Bit	Description
0 to 5	determine if the corresponding block can be accessed ro or r/w '1': the corresponding block can be read and written '0': the corresponding block can only be read. The configuration is identical for all 4 pages within the corresponding block.
6	is used to protect the keys A and B against further write operations '1': Keys can only be written to. '0': Keys cannot be accessed.
7	is used to protect the Logdata A and B against further write operations '1': Logdata can be read and written to. '0': Logdata cannot be accessed.

The bits can be changed until bit 4 of byte 1 of the Configuration Page is set to '0'.

Configuration Page: Byte 1

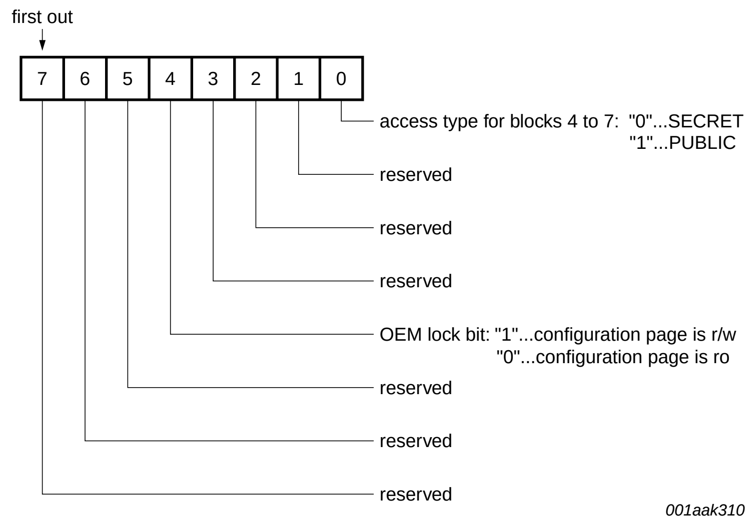


Fig 5. Configuration Page: Byte1

Table 4. Description of Configuration Page: Byte 1

Bit	Description
0	determines if block 4 to 7 must be accessed enciphered or plain '0': Access type for blocks 4 to 7 is SECRET. '1': Access type for blocks 4 to 7 is PUBLIC.
1, 2, 3, 5, 6, 7	reserved, must not be changed
4	locks the Configuration Page. '1': Configuration Page can be read and written to. '0': Configuration Page can only be read. This process is irreversible!

ATTENTION:

When writing a new value to Configuration Page byte 1, Bit positions marked as "reserved" must not be altered.

It is recommended to read out the content of the Configuration Page byte 1, mask out the reserved bits and change the values of bit 0 and bit 4 accordingly.

Do not set bit 4 of the Configuration Page byte 1 to '0' before having written the final data into the Configuration Page.

9.2.3.2 Delivery configuration of HITAG 1

The HITAG 1 transponder IC is pre programmed by NXP Semiconductors with the following configuration:

Table 5. Delivery configuration

Unique serial number	
Serial number	read only
Configuration Page: Byte 0	
Logdata	'1' = r/w
Key A, Key B	'1' = wo
Blocks 2 to 7	'1' = r/w
Configuration Page: Byte 1	
OEM Lock bit	'1' = Configuration Page is r/w
Blocks 4 to 7	'1' = public
Transport values for Logdata and keys	
Logdata A and Logdata B	0000 0000h
Key A and Key B	0000 0000h

9.3 HITAG 1 transponder IC air interface

9.3.1 Electromagnetic characteristics

9.3.1.1 Magnetic flux densities

Since magnetic coupling is used for the data transmission between transponder and RWD the magnetic field is the most important attribute. Figure 6 shows the direction of the magnetic field lines with the transponder placed in the antenna field.

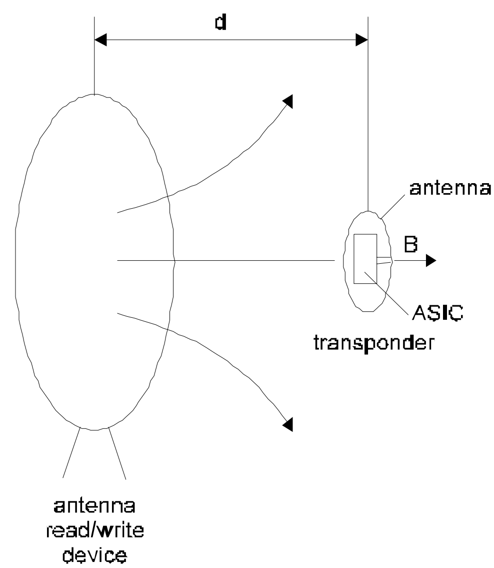


Fig 6. Magnetic coupling between RWD and transponder

9.3.1.2 Equivalent circuit for data and energy transfer

Figure 7 shows the model for the transmission channel realized as an inductive coupled circuit. The primary side (L1) represents the RWD antenna and the secondary side (L2) the antenna of the transponder.

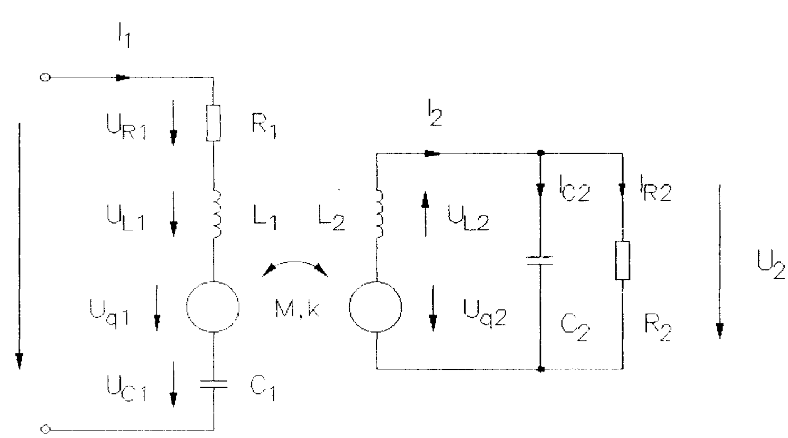


Fig 7. Equivalent circuit

9.3.2 Data transmission transponder → RWD

9.3.2.1 Coding

Load modulation is used, when transmitting data from the transponder to the RWD. For the transmission of data to the RWD two different codings are used.

Table 6. Coding and Bit length

Mode	Coding	Bit length T[1]	Bit rate
Anticollision Mode	AC	64 T_0	2 kbit/s
SELECT Mode	Manchester	32 T_0	2 kbit/s
HALT Mode	Manchester	32 T_0	2 kbit/s

[1] T_0 ... Carrier period time ($^1/_{125}$ kHz = 8 μsec nominal)

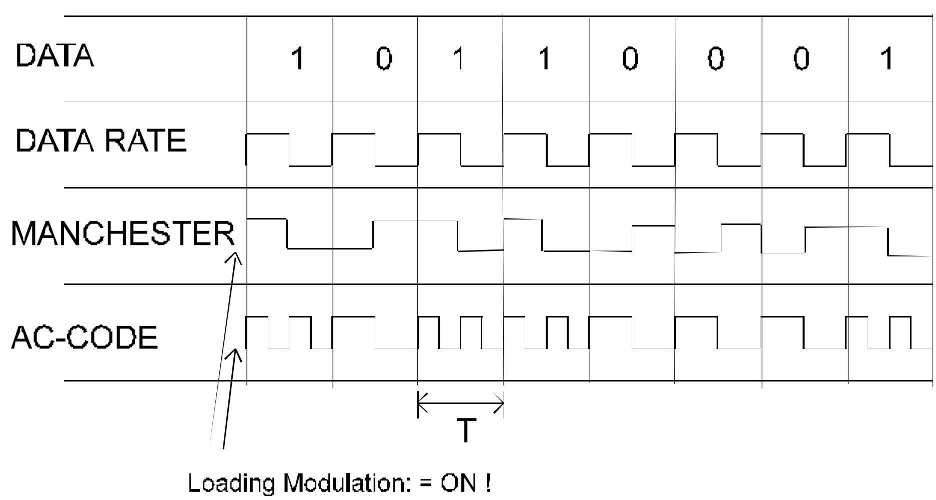


Fig 8. Data coding: transponder → RWD

The first bit of the transmitted data always starts with the Modulator ON (loaded) state.

AC-Coding realizes the lower baudrate, which is used for anticollision mode. The main part of communication uses the SELECT Mode of the transponder IC.

9.3.2.2 Modulation

Figure 9 shows the voltage at the antenna coil of the transponder IC which is measured by using an additional coil fixed on the transponder.

The minimum modulation ratio depends on the coupling factor of the configuration (RWD antenna, transponder antenna size).

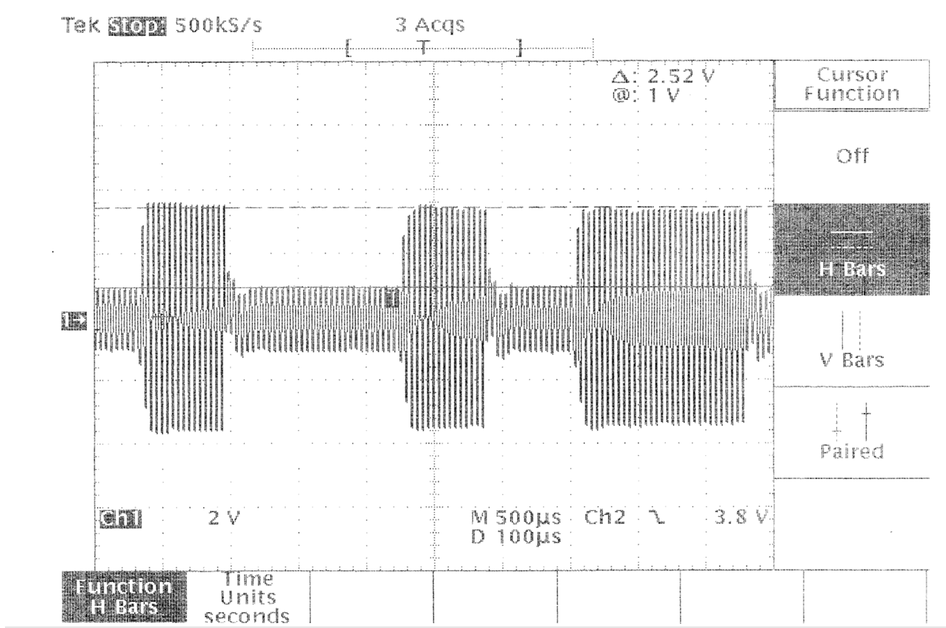


Fig 9. Transponder antenna coil voltage

9.3.3 Data transmission RWD → transponder

9.3.3.1 Coding

Data are transmitted from the RWD to the transponder by switching the current through the RWD antenna on/off. When the current is switched off, the physical state is named low field, otherwise high field.

Binary puls length modulation (BPLM) is used to encode the data stream.

All coded data bits and the stop condition, start with a low field of length t_{low}. Afterwards the field is switched on:

- '0' and '1' can be distinguished by the duration of T[0] and T[1].
- The end of the data transmission is characterized by a stop condition.

The following figure shows the data transmission from the RWD to the transponder.

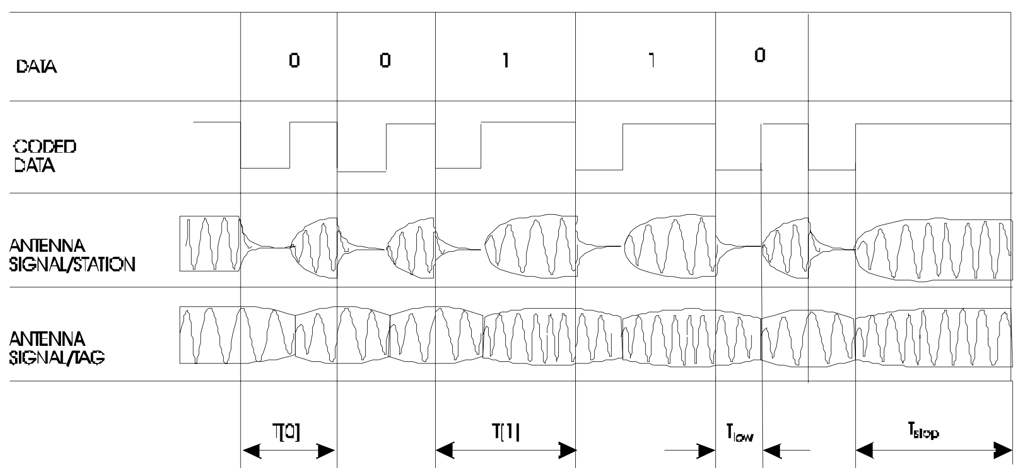


Fig 10. Data coding: RWD → transponder

Table 7. Timing RWD→ transponder

Symbol	Description	Duration	Unit[2]
t_{low}	low field time	4 to 10	T_0[1]
T[0]	logic 0 pulse length	18 to 22	T_0
T[1]	logic 1 pulse length	26 to 32	T_0
t_{stop}	high field for stop condition	> 36	T_0

[1] This application specific value will be within this frame, but has to be optimized for each application depending on antenna current and quality factor!

[2] T_0 Carrier period time ($^1/_{125}$ kHz = 8 μsec nominal)

The average bit rate from the RWD to transponder is:

$$Bitrate = \frac{2}{T\lceil 0 \rceil + T\lceil 1 \rceil} = \ddot{5}, 2kB/s \quad (1)$$

Remark: The end of each data sequence from RWD to transponder has to be a stop condition.

Depending on transient and decay times caused by different RWDs the timing for T[0], T[1] and t_{low} has to be adapted.

The following two examples show the timing for two RWDs from NXP Semiconductors.

Used timing values with Proximity Reader Modul are:

Table 8. Timing values with Proximity Reader Modul

Symbol	Description	Duration	Unit
t_{low}	low field time	6	T_0
T[0]	logic 0 pulse length	22	T_0
T[1}	logic 1 pulse length	28	T_0

Used timing values with Long Range Reader Modul are:

Table 9. Timing values with Long Reader Modul

Symbol	Description	Duration	Unit
t_{low}	low field time	8	T_0
T[0]	logic 0 pulse length	22	T_0
T[1}	logic 1 pulse length	28	T_0

Remark: These application specific values have to be optimized for each application!

9.3.3.2 Modulation

Figure 11 shows the antenna voltage of the RWD.

The minimum modulation depends on the quality factor of the antennas (transponder and RWD) and on the coupling between the antennas. A recommended value for the quality factor of the RWD antenna is approx. 40.

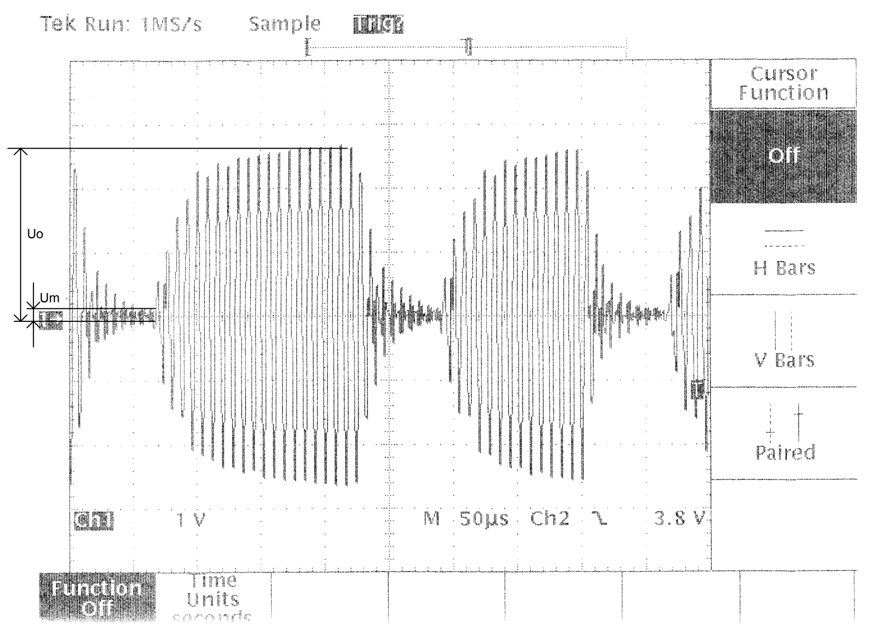


Fig 11. RWD antenna coil voltage

9.3.3.3 Switching the transmission direction

When switching between receiving and sending, the RWD has to consider time frames, in which transmission of data is not allowed:

- t_{WAIT1}: When receiving the last bit from the RWD, the transponder waits before answering.
- t_{WAIT2}: After receiving the last bit from the transponder, the RWD has to wait before sending data. Data transmitted to the transponder within twait, will not be recognized by the transponder.

Table 10. Timing - transmission direction switching

Symbol	Description	Duration		Unit
		Min	Max	
t_{WAIT1}	transponder switching from receive to transmit, wait time after end of data	204	213	T_0
t_{WAIT2}	transponder switching from transmit to receive, wait time after end of data	128[1][2]	-	T_0
		96[1][3]	-	T_0

[1] t_{WAIT2} must not exceed 5000 T_0!

[2] in AC Coding

[3] in Manchester Coding

10. Modes

10.1 Standard Protocol Modes

10.1.1 General comments

The Standard Protocol Mode also allows operation with transponders based on the transponder IC HT1ICS3001x.

(HT1ICS3001x is the predecessor version of the transponder IC HT1ICS3002x.)

The response time of the transponder starts with the detection of the last pause of the carrier signal in a RWD command.

10.1.2 Anticollision Mode

The command to read the serial numbers of all transponders presently located in the field of the read/write antenna uses Anticollision Mode. As the serial number (SN) is 32 bits long, theoretically up to 2^{32} transponders can be in this mode.

Use the SELECT command to exit AC-Mode.

10.1.2.1 Commands

SET_CC:

After transmitting this command from the RWD, all transponders presently located in the field of the RWD antenna respond with a ’1’ (Start bit) followed by the corresponding 32 bit serial number. The response of the transponder is transmitted in AC coding.

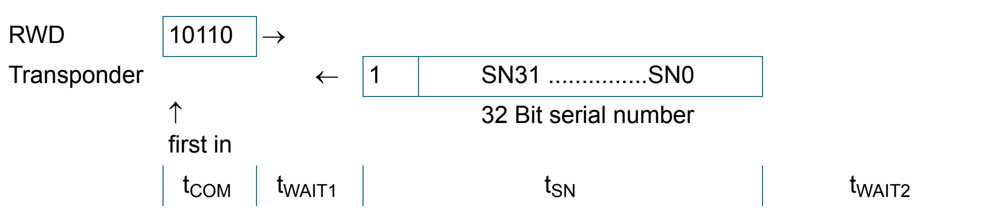


Table 11. Timing - SET_CC

Symbol	Min	Typ	Max	Unit
t_{COM}	119.5	122	124.5	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{SN}	-	2112	-	T_0
t_{WAIT2}	128	-	5000	T_0
Total	-	**2570**	-	**T0**

READ_ID:

If more than one transponder is in the field of the RWD antenna a special designed RWD can recognize a collision at the bit position n after sending the command SET_CC. As a result the RWD sends the command READ_ID.

This command consists of the first (n-1) bits of the recognized serial number and the bit at the position, where the collision occurred. This bit is replaced by a ’1’ (or ’0’).

In advance the RWD informs the transponders in a 5 bit number (n4 to n0) about the number of the sent serial number bits. An 8 bit CRC is also sent to the transponders.

After transmitting this command, all transponders which first n bits of the serial number match the n bits sent in the Read_ID command, answer with the start sequence and the rest of their serial number.

If a collision occurs again the described cycle has to be repeated until one serial number is determined.

RWD	n4 n3 n2 n1 n0	SN31.......SN(31-n+1)	CRC7.....CRC0 →				
	↑	n Bit SN Part					
Transponder	first in			←	1	SN(31-n).......SN0	
						32 -n Bit SN-Rest	
		t_{COM}		t_{WAIT1}		t_{SNPART}	t_{WAIT2}

Table 12. Timing - READ_ID

	Standard protocol mode			Advanced protocol mode			
Symbol	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit[1]**
t_{COM}	327	770,5	1214	327	770,5	1214	T_0
t_{WAIT1}	204	204.5	205	204	204.5	205	T_0
t_{SNPART}	128	1088	2048	256	1216	2176	T_0
t_{WAIT2}	128	-	5000	128	-	5000	T_0
Total		**2191**			**2319**		**T0**

[1] T_0 Carrier period time ($^1/_{125}$ kHz = 8 µsec nominal)

10.1.2.2 SELECT

The command SELECT consists of 5 Zero-bits followed by the determined 32 bit serial number and an 8 bit CRC. The selected transponder then responds with a ’1’ (Start bit), followed by 32 bits representing the Configuration Page. The transponder response is already done in Manchester Code not in Anticollision Code.

RWD	00000	SN31...SN0	CRC7.....CRC0 →					
	↑							
Transponder	first in			←	1	OTP07 OTP00	....	OTP37..OTP30
				OTP-Byte		0		
	t_{COM}			t_{WAIT1}	t_{OTP}			t_{WAIT2}

Table 13. Timing - SELECT

Symbol	Min	Typ	Max	Unit
t_{COM}[1]	-	1110	-	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{OTP}	-	1056	-	T_0
t_{WAIT2}	96	-	5000	T_0
Total		**2500**		**T0**

[1] depends on the data sent to the transponder (intervals for logic 0 and logic 1 are different)

10.1.3 SELECT Mode

The SELECT Mode is used to read data from and write data to a transponder. This mode can be operated encrypted or plain (see Section 10.1.5 “Authentication”).

A transponder can be read or written or muted after processing.

Command set-up in SELECT_MODE

COMMAND CMD3 .... CMD0	ADDRESS	CRC

COMMAND:	Command (4 bits)
ADDRESS:	Address (8 bits, MSB first), indicates the start of a page or block respectively. A7 and A6 must be 0 (highest page number is 63, see also Section 9.1 “Memory map”)
CRC:	Check byte (8 bits, MSB first)

The following commands are supported:

Table 14. Commands in SELECT Mode

COMMAND	CODE CMD3..CMD0	Read	Write	Block CMD	Encrypted	Plain	Notes
WRPPAGE	1 0 0 0	no	yes	no	no	yes	Writes a page plain
WRPBLK	1 0 0 1	no	yes	yes	no	yes	Writes a block plain
WRCPAGE	1 0 1 0	no	yes	no	yes	no	Writes a page encrypted
WRCBLK	1 0 1 1	no	yes	yes	yes	no	Writes a block encrypted
RDPPAGE	1 1 0 0	yes	no	no	no	yes	Reads a page plain
RDPBLK	1 1 0 1	yes	no	yes	no	yes	Reads a block plain
RDCPAGE	1 1 1 0	yes	no	no	yes	no	Reads a page encrypted
RDCBLK	1 1 1 1	yes	no	yes	yes	no	Reads a block encrypted
HALT	0 1 1 1	no	no	no	-	-	Turns into HALT Mode

10.1.3.1 Command length

Length [Bits]	= L {COMMAND}	+	L {ADDRESS}	+ L {CRC}	=		
	4	+	8	+ 8	= 20 bits		

The number of bits for a command is always 20 bits, no matter which command.

10.1.3.2 Order of a Read Sequence

After transmitting a READ command, the address and the 8 bit CRC, the transponder responds with a ’1’ (Start bit) and 32, 64, 96 or 128 bits data. It depends on whether the command was a READ Page or a READ Block command.
In case of a READ Block command where the specified address is not the starting address of the block, but a page address within the block, all pages starting from this address to the end of the block will be sent to the RWD.

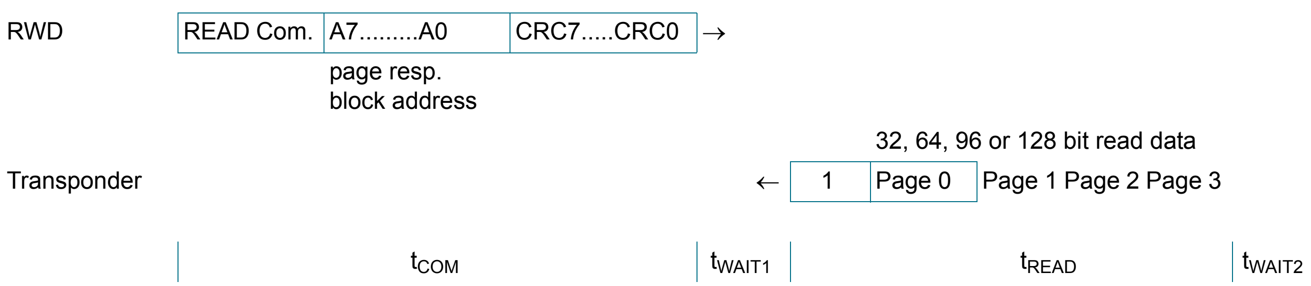


Table 15. Timing - Read sequence

Symbol	Min	Typ	Max	Unit
t_{COM} [1]	440	500	550	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{READ} [2]	1056	-	4128	T_0
t_{WAIT2}	96	-	5000	T_0
Total [3]	-	**1857**	-	**T0**
Total [4]	-	**4929**	-	**T0**

[1] depends on the data (read command, address, CRC)

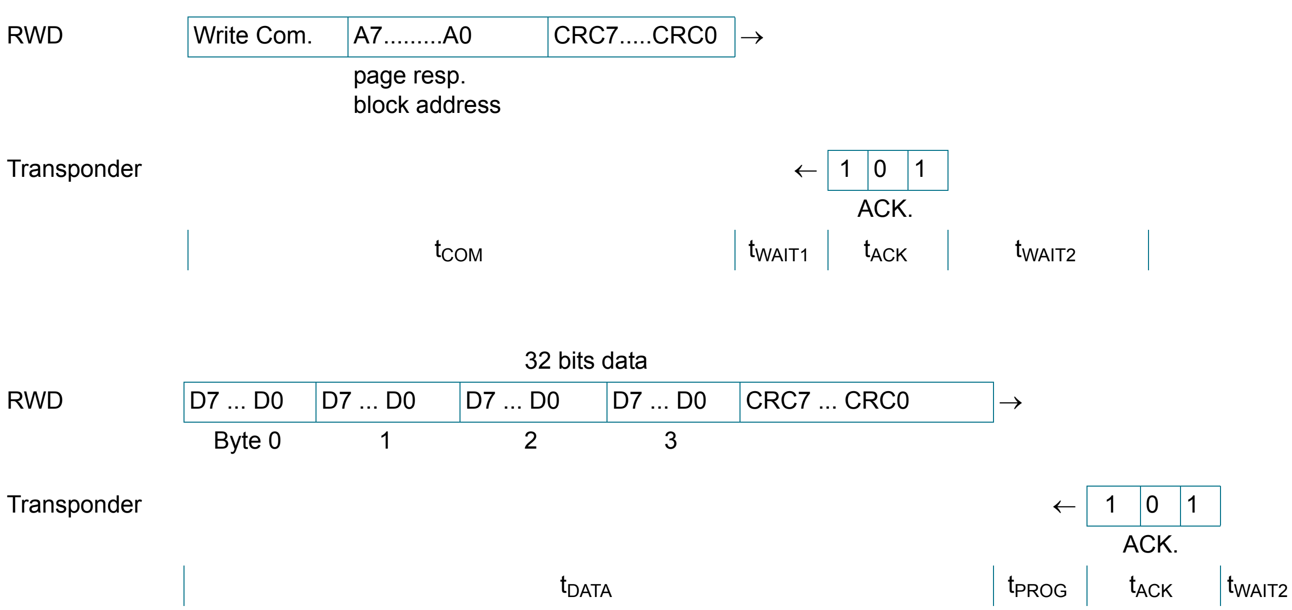
[2] depends on page- or block access

[3] page access

[4] block access

10.1.3.3 Order of a Write Sequence

The memory is organized bytewise. However, the protocol from the RWD to the transponder supports only access to a page or a complete block. To avoid temporary storage of a block in the transponder (before programming takes place) data is transmitted to the transponder only pagewise with a check byte. The transponder confirms the correct programming with an acknowledge which is always sent in plain.



For a Write Page command the acknowledge is sent once, whereas for a Write Block command the acknowledge is executed one to four times, depending on whether the address indicates the beginning of a block or the beginning of one of the three remaining pages within that block.

Table 16. Timing - Write sequence

Symbol		Min	Typ	Max	Unit
t_{COM}	[1]	440	500	550	T_0
t_{WAIT1}		204	208.5	213	T_0
t_{ACK}		-	96	-	T_0
t_{WAIT2}		96	-	5000	T_0
t_{DATA}	[2]	-	1000	-	T_0
t_{PROG}		716	721	726[3]	T_0
Total	[4]	-	**2800**	-	**T0**
Total	[5]	-	**8550**	-	**T0**

[1] depends on the data (write command, address, CRC)

[2] depends on page- or block access and on the data

[3] for flexibility reasons (perhaps the use of future EEPROM blocks with different timing) we recommend to calculate with t_{PROG} of max. 1250 T_0.

[4] page access

[5] block access

Attention: For transponders based on HT1ICS3001x t_{PROG} must be max. 1250 T_0!

10.1.4 HALT Mode

The HALT Mode is used to disable a selected transponder in the field of the RWD. By bringing a selected transponder in HALT Mode, another transponder that is also in the communication field, can be recognized.

This mode will be used mainly in multi-transponder long-range applications, but might be also an useful mode in proximity applications.

A transponder, once switched to HALT Mode, can be enabled again only with a power on reset. This means either the power supply (magnetic field) of the transponder must be interrupted for about 10 ms or the transponder must be moved out of the RWD antenna field.

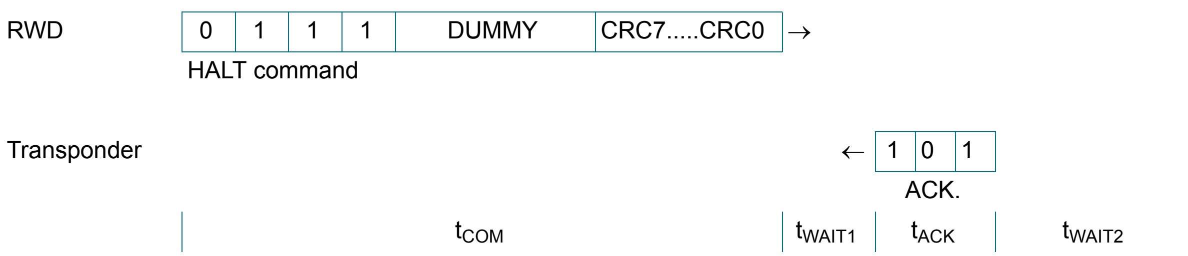


Table 17. Timing - Halt mode

Symbol	Min	Typ	Max	Unit
t_{COM}	448	500	564	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{ACK}	-	96	-	T_0
t_{WAIT2}	96	-	5000	T_0
Total	-	**900**	-	**T0**

DUMMY

This parameter (8 bit) must be sent for command length reasons only. CRC must be valid although the transponder does not process this data. As the HALT command is a plain command, the dummy data must be a valid address of the plain memory area and therefore greater than or equal to 0010 0000. (A7 and A6 have to be ’0’).

10.1.5 Authentication

In order to be able to operate HITAG 1 transponder IC in encrypted mode an authentication protocol has to be processed. Within this protocol it is checked if the Keys and Logdata of the RWD and the transponder match.
Encrypted communication is only possible after a successful authentication.

The authentication process is started by using the WRCPAGE command, followed by 8 bit Key information (see table below), indicating which key with the respective Logdata is used, and the 8 bit CRC. The transponder responds with an acknowledge.

In the next step a 32 bit random number is sent to the transponder.

Up to this point the protocol uses plain text whereas the following communication is in encrypted form.

The transponder responds to the random number with the Start bit and the 32 bit Logdata (0A or 0B), then the RWD sends 32 bit Logdata (1A or 1B to) to the transponder. The transponder responds with an acknowledge.

The authentication protocol contains the information, which of the two sets of Key and Logdata (A or B) are used (see Section 9.2.2 “Definition of the Logdata”).

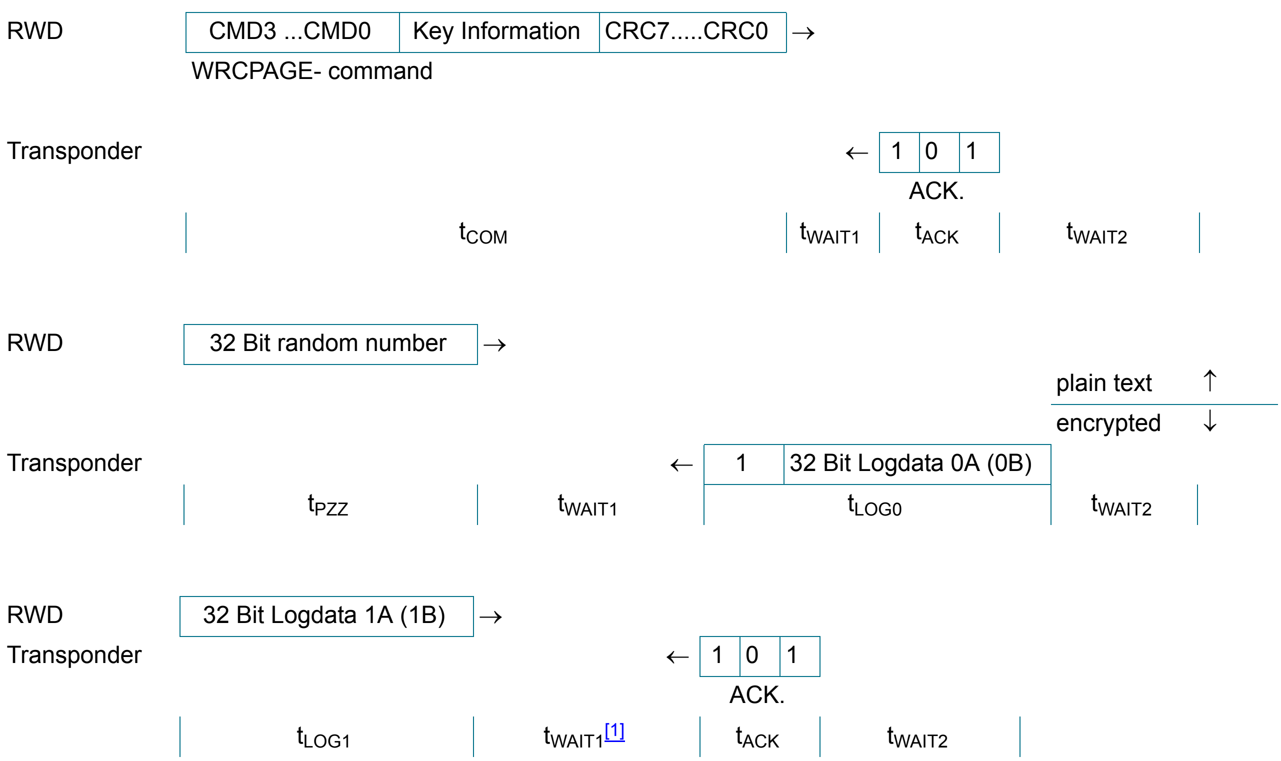
The following table shows the connection between Key information and set of Key and Logdata:

Table 18. Connection between Key set and Logdata

Key information	Logdata transponder → RWD	Logdata RWD → transponder
0 0 0 0 0 0 0 0	Logdata 0A	Logdata 1A
0 0 0 0 0 0 1 0	Logdata 0B	Logdata 1B

The RWD has to use the according Key for encoding and decoding of the data.

10.1.5.1 Authentication protocol



[1] Attention: For transponders based on the TAG ASIC HT1ICS3001x this t_{WAIT1} only is 72 ± 1/2 T_0.

Table 19. Timing - Authentication protocol

Symbol	Min	Typ	Max	Unit
t_{COM}	470	473	476	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{ACK}	-	96	-	T_0
t_{WAIT2}	96	-	5000	T_0
t_{PZZ}	704	800	896	T_0
t_{LOG0}	-	1056	-	T_0
t_{LOG1}	704	800	896	T_0
Total	-	**4220**	-	**T0**

After the authentication process the protocol for the selected transponder runs in encrypted mode. However, acknowledge is sent in plain text.

To return to plain text mode a Plain Command has to be sent. As the transponder is still in Encrypted Mode the plain command has is sent in encrypted whereas the response is already in plain. (e.g. for a READ command the response is already sent in plain text)

10.2 Advanced Protocol Modes

10.2.1 General comments

The Advanced Protocol Mode works compared to the Standard Protocol Mode with an increased number of Startbits and a 8 bit CRC sent by the transponder IC.

This communication protocol is not supported by transponders based on HT1ICS3001x transponder ICs.

The response time of the transponder IC starts with the detection of the last pause of the carrier signal in a RWD command.

10.2.2 Anticollision Mode

The command to read the serial numbers of all transponders presently located in the field of the RWD antenna uses Anticollision Mode. As the serial number (SN) is 32 bits, theoretically up to 2^{32} transponders can be in this mode.

The SELECT command is used to exit AC-Mode.

10.2.2.1 Commands

SET_CCNEW:

After transmitting this command from the RWD, all transponders presently located in the field of the RWD antenna respond with three ’1’ (Start bits) followed by the corresponding 32 bit serial number. The response of the transponder is transmitted in AC coding.

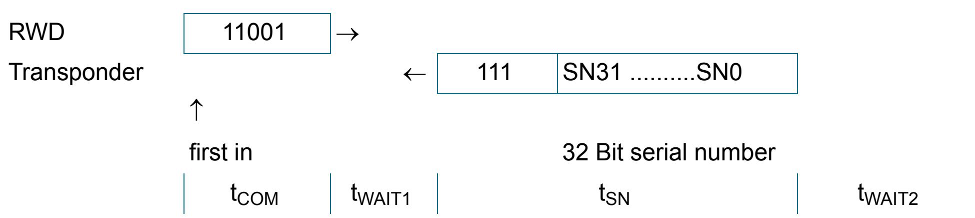


Table 20. Timing - SET_CCNEW

Symbol	Min	Typ	Max	Unit
t_{COM}	125	128	131	T_0
t_{WAIT1}	204	208,5	213	T_0
t_{SN}	-	2240	-	T_0
t_{WAIT2}	128	-	5000	T_0
Total	-	**2635**	-	**T0**

The command SET_CCNEW can be repeated as long as the transponder is in AC Mode.

PLEASE NOTE:
If the command SET_CCNEW is transmitted once the transponder stays in the Advanced Protocol Mode, even if a SET_CC command (Standard Protocol Mode) is transmitted. With a power on reset (supply interrupted for about 10 ms) the transponder IC can be reset.

READ_ID:

If more than one transponder is in the field of the RWD antenna a special designed RWD can recognizes a collision at the bit position n after sending the command SET_CC. As a result the RWD sends the command READ_ID.

This command consists of the first (n-1) bits of the recognized serial number (SN) and the bit at the position, where the collision occurred. This bit is replaced by a '1' (or '0').

The RWD sends to the transponders a 5 bit number (n4 through n0) indicating the number of sent SN bits, the SN bits itself and a 8 bit CRC.

After transmitting this command, all transponders which first n bits of the serial number match the n sent Bits in the Read_ID command, answer with the start sequence and the rest of their serial number.

If a collision occurs again the described cycle has to be repeated until one serial number is determined.

RWD	n4 n3 n2 n1 n0	SN31...SN(31-n+1)	CRC7.....CRC0 →			
	↑	n Bit SN Part				
Transponder	first in			←	111111	SN(31-n).......SN0
						32-n Bit SN-Rest
	t_{COM}			t_{WAIT1}	t_{SNPART}	t_{WAIT2}

Table 21. Timing READ_ID

	Standard protocol mode			Advanced protocol mode			
Symbol	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**[1]
t_{COM}	327	770,5	1214	327	770.5	1214	T_0
t_{WAIT1}	204	204.5	205	204	204,5	205	T_0
t_{SNPART}	128	1088	2048	256	1216	2176	T_0
t_{WAIT2}	128	-	5000	128	-	5000	T_0
Total		**2191**			**2319**		**T0**

[1] T_0 Carrier period time ($^1/_{125}$ kHz = 8 μsec nominal)

SELECT:

The command SELECT consists of 5 Zero-Bits followed by the determined 32 bit serial number and an 8 bit CRC. The selected transponder then responds with the start sequence (6 ones) followed by 32 bits representing the Configuration Page and 8 bits CRC. The transponder response is not carried in Manchester Code.

RWD | 00000 | SN31..SN0 | CRC7..CRC0 | →

↑

Transponder first in

← | 1 1 1 1 1 1 | OTP07.. OTP00 | ... | OTP37..OTP30 | CRC7..0 |

OTP-Byte 0 1,2 3

| t_{COM} | t_{WAIT1} | t_{OTP} | t_{WAIT2} |

Table 22. Timing - SELECT

Symbol	Min	Typ	Max	Unit
t_{COM}[1]	967	1125	1253	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{OTP}	-	1472	-	T_0
t_{WAIT2}	96	-	5000	T_0
Total		**2900**		**T0**

[1] depends on the data sent to the transponder (intervals for logic 0 and logic 1 are different)

10.2.3 SELECT Mode

The SELECT Mode is used to read data from and write data to a transponder. This mode can be operated encrypted or plain (see Section 10.1.5 “Authentication”). A transponder can be read or written or muted after processing.

Command set-up in SELECT_MODE

COMMAND CMD3 .... CMD0	ADDRESS	CRC

COMMAND:	Command (4 bits)
ADDRESS:	Address (8 bits, MSB first), indicates the start of a page or block respectively. A7 and A6 must be 0 (highest page number is 63, see also Section 9.1 “Memory map”)
CRC:	Check byte (8 bits, MSB first)

The following commands are supported:

Table 23. Commands in SELECT Mode

COMMAND	CODE CMD3..CMD0	Read	Write	Block CMD	Encrypted	Plain	Notes
WRPPAGE	1 0 0 0	no	yes	no	no	yes	Writes a page plain
WRPBLK	1 0 0 1	no	yes	yes	no	yes	Writes a block plain
WRCPAGE	1 0 1 0	no	yes	no	yes	no	Writes a page encrypted
WRCBLK	1 0 1 1	no	yes	yes	yes	no	Writes a block encrypted
RDPPAGE	1 1 0 0	yes	no	no	no	yes	Reads a page plain
RDPBLK	1 1 0 1	yes	no	yes	no	yes	Reads a block plain
RDCPAGE	1 1 1 0	yes	no	no	yes	no	Reads a page encrypted
RDCBLK	1 1 1 1	yes	no	yes	yes	no	Reads a block encrypted
HALT	0 1 1 1	no	no	no	-	-	Turns into HALT Mode

10.2.3.1 Command length

Length [Bits]	= L {COMMAND}	+	L {ADDRESS}	+ L {CRC}	=	
	4	+	8	+ 8	= 20 bits	

The number of bits for a command is always 20, no matter which command.

10.2.3.2 Order of a Read Sequence

After transmitting a READ command, the address and the 8 bit CRC, the transponder responds with the start sequence (6 ones) and 32, 64, 96 or 128 bits data depending on whether the command was a READ Page or a READ Block command.
In case of a READ Block command where the specified address is not the starting address of the block, but a page address within the block, all pages starting from this address to the end of the block will be sent to the RWD.

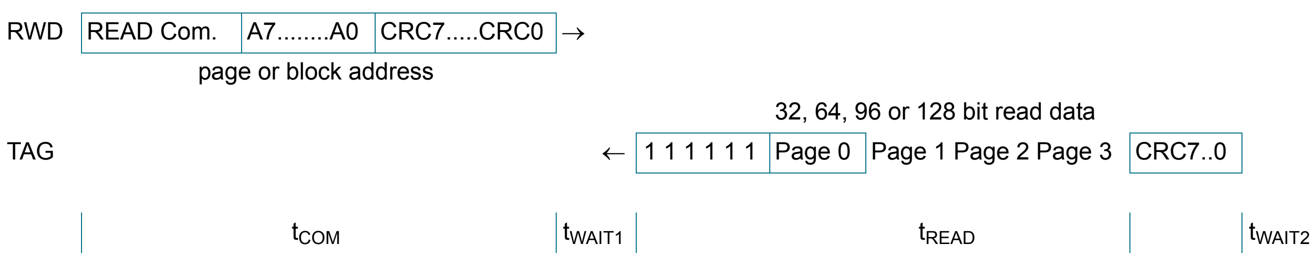


Table 24. Timing - Read Sequence

Symbol		Min	Typ	Max	Unit
t_{COM}	[1]	442	500	564	T_0
t_{WAIT1}		204	208.5	213	T_0
t_{READ}	[2]	1472	-	4544	T_0
t_{WAIT2}		96	-	5000	T_0
Total	[3]	-	**2280**	-	**T0**
Total	[4]	-	**5346**	-	**T0**

[1] depends on the data (read command, address, CRC)

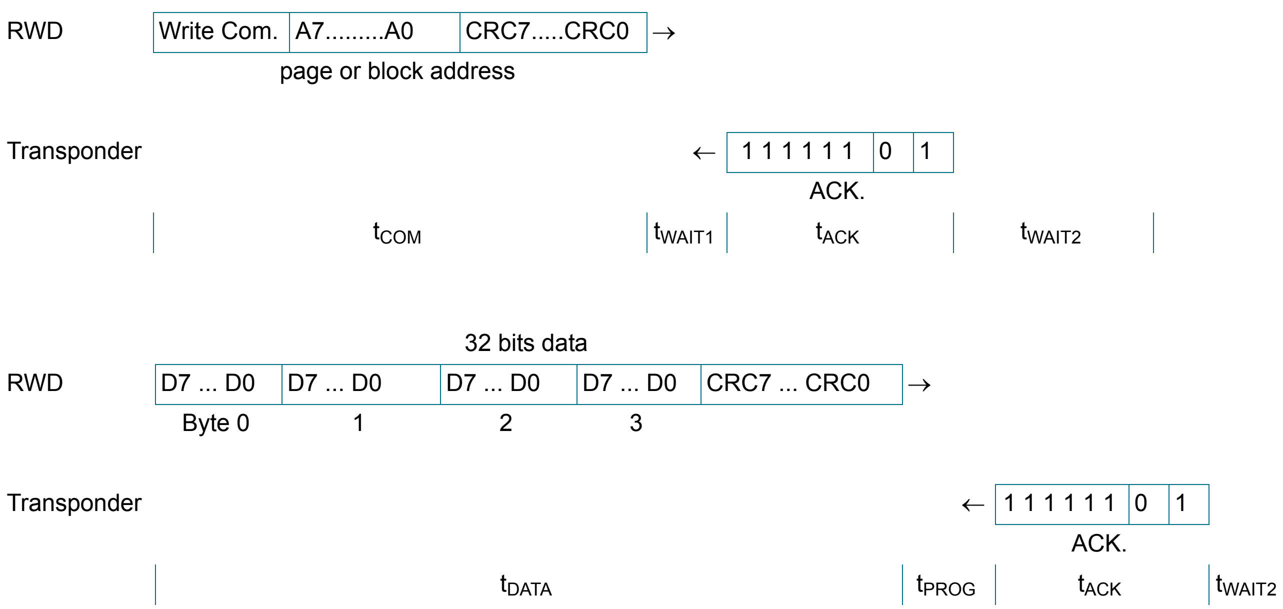
[2] depends on page- or block access

[3] page access

[4] block access

10.2.3.3 Order of a Write Sequence

The memory is organized bytewise. However, the protocol from the RWD to the transponder supports only access to a page or a complete block. To avoid temporary storage of a block in the transponder (before programming takes place) data is transmitted to the transponder only pagewise with a check byte. The transponder confirms the correct programming with an acknowledge which is always sent in plain.



For a Write Page command the acknowledge is sent once, whereas for a Write Block command the acknowledge is executed one to four times, depending on whether the address indicates the beginning of a block or the beginning of one of the three remaining pages within that block.

Table 25. Timing - Write sequence

Symbol		Min	Typ	Max	Unit
t_{COM}	[1]	442	500	564	T_0
t_{WAIT1}		204	208,5	213	T_0
t_{ACK}		-	256	-	T_0
t_{WAIT2}		96	-	5000	T_0
t_{DATA}	[2]	-	1000	-	T_0
t_{PROG}		716	721	726[3]	T_0
Total	[4]	-	**3125**	-	**T0**
Total	[5]	-	**9330**	-	**T0**

[1] depends on the data (write command, address, CRC)

[2] depends on page- or block access and on the data

[3] for flexibility reasons (perhaps the use of future EEPROM blocks with different timing) we recommend to calculate with t_{PROG} of max. 1250 T_0.

[4] page access

[5] block access

10.2.4 HALT Mode

The HALT Mode is used to disable a selected transponder in the field of the RWD. By bringing a selected transponder in HALT Mode, another transponder that is also in the communication field, can be recognized.

This mode will be used mainly in multi-transponder long-range applications, but might be also an useful mode in proximity applications.

A transponder, once switched to HALT Mode, can be enabled again only with a power on reset. This means either the power supply of the transponder (magnetic field) must be interrupted for about 10 ms or the transponder must be moved out of the RWD antenna field.

RWD

0	1	1	1	DUMMY	CRC7.....CRC0	→

HALT command

TAG

←	1 1 1 1 1 1	0	1

ACK.

t_{COM}	t_{WAIT1}	t_{ACK}	t_{WAIT2}

Table 26. Timing - Halt

Symbol	Min	Typ	Max	Unit
t_{COM}	448	500	564	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{ACK}	-	256	-	T_0
t_{WAIT2}	96	-	5000	T_0
Total	-	**1060**	-	**T0**

DUMMY

This parameter (8 bit) must be sent for command length reasons only. CRC must be valid although the transponder does not process this data. As the HALT command is a plain command, the dummy data must be a valid address of the plain memory area and therefore greater than or equal to 0010 0000. (A7 and A6 have to be ’0’).

10.2.5 Authentication

In order to be able to operate HITAG 1 transponder IC in encrypted mode an authentication protocol has to be processed. Within this protocol it is checked if the Keys and Logdata of the RWD and the transponder match. Encrypted communication is only possible after a successful authentication.

The authentication process is started by using the WRCPAGE command, followed by some 8 Bit Key information (see table below), indicating which Key with the respective Logdata is used, and the 8 bit CRC. The transponder responds with an acknowledge.

In the next step a 32 bit random number is sent to the transponder.

Up to this point the protocol uses plain text where as the following protocol is encrypted.

The transponder responds to the random number with the Start bit (6 ones) and the 32 Bit Logdata (0A or 0B), then the RWD sends 32 Bit Logdata (1A or 1B to) to the transponder. The transponder responds with an acknowledge.

The authentication protocol contains the information, which of the two sets of Key and Logdata (A or B) are used (see Section 9.2.2 "Definition of the Logdata").

The following table shows the connection between Key information and set of Key and Logdata:

Table 27. Connection between Key set and Logdata

Key information	Logdata transponder → RWD	Logdata RWD → transponder
0 0 0 0 0 0 0 0	Logdata 0A	Logdata 1A
0 0 0 0 0 0 1 0	Logdata 0B	Logdata 1B

The RWD has to use the according Key for encoding and decoding of the data.

10.2.5.1 Authentication protocol

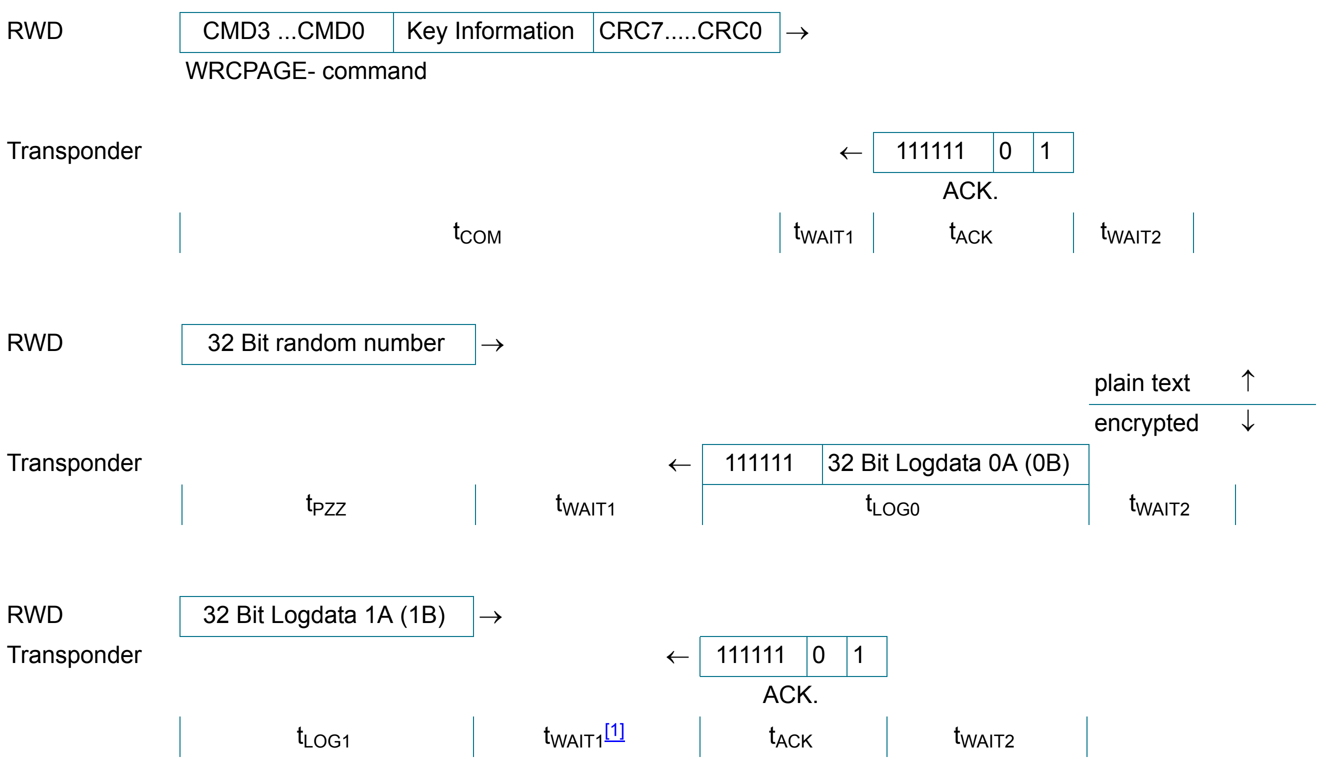


Table 28. Timing - Authentication

Symbol	Min	Typ	Max	Unit
t_{COM}	470	473	476	T_0
t_{WAIT1}	204	208.5	213	T_0
t_{ACK}	-	256	-	T_0
t_{WAIT2}	96	-	5000	T_0
t_{PZZ}	704	800	896	T_0
t_{LOG0}	-	1216	-	T_0
t_{LOG1}	704	800	896	T_0
Total	-	**4710**	-	**T0**

After authentication process the protocol for the selected transponder runs in encrypted mode. However, acknowledge is sent in plain text.

To return to plain text mode a Plain command has to be sent. As the transponder is still in Encrypted Mode this Plain command is sent in encrypted form. If e.g. a READ command is applied the response is already sent in plain.

11. Flow Chart

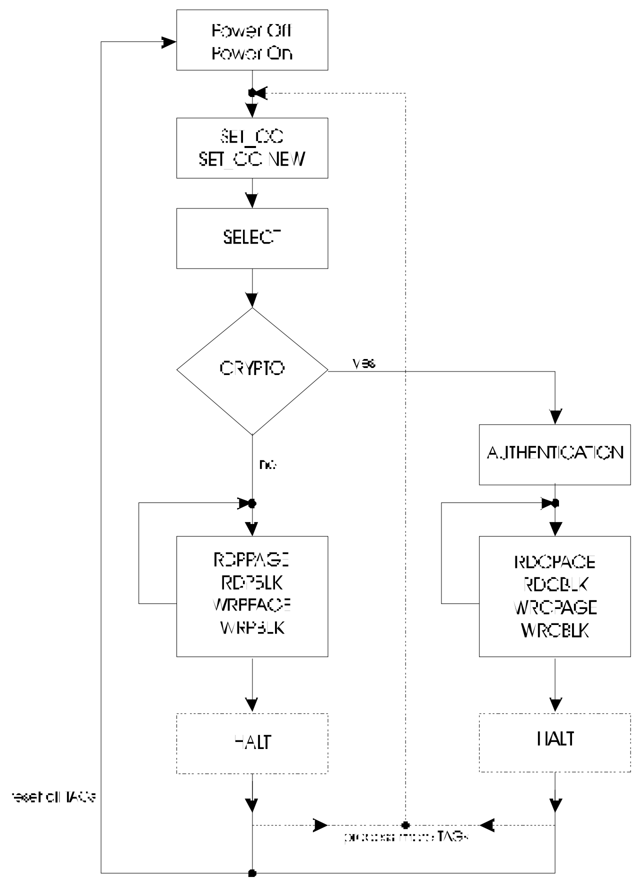


Fig 12. Flow chart

Table 29. Commands

Command	Description
POWER OFF	The RWD turns off the field to put the transponder in its initial (reset) state.
POWER ON	The RWD activates the field to supply the transponder with energy (transponder IC power up time ~ 3 ms).
SET_CC, SET_CC NEW	After receiving the SET_CC (SET_CC NEW) command the transponder responds with its serial number.
SELECT	The transponder is selected by its serial number and responds with its configuration (Configuration Page).
AUTHENTICATION	Authentication procedure is carried out to enter the Encrypted Mode.
HALT	The transponder is deactivated (not necessary for single transponder operation).

12. Data Integrity/Calculation of CRC

12.1 Basic concept for data reliability

The following explanations show the features of the HITAG system to protect read and write access to transponders from undetected errors. It is sufficient to investigate the plain read and write operations because the encryption does not effect the data integrity of the transmission.

12.2 Transmission RWD to transponder

Every data stream (commands, addresses, user data) sent to the transponder includes an 8 bit CRC calculated by the RWD. The data stream is first checked for data errors by the transponder IC and then executed.

The CRC is formed over commands and addresses or the plain data respectively and in case of Encrypted Mode it is also encrypted.

The generator polynomial for the CRC reads:

$u^8 + u^4 + u^3 + u^2 + 1 =$ 1Dh

and the CRD pre-assignment is FFh

For better understanding the protocols for read and write are outlined.

12.2.1 Read sequence

RWD	CMD	ADDR	CRC	→	
Transponder				←	DATA

Table 30. Read sequence

Abbreviation	Description
RWD	RWD
CMD	Command, 4 bits (read page, read block, read page encrypted, read block encrypted)
ADDR	Address, 8 bits (page or block address for page or block read)
CRC	Cyclic redundancy check, 8 bits (check sum of CMD and ADDR)
DATA	Read data, 32 bits to 128 bits (one to four pages for page or block read)

12.2.2 Write sequence

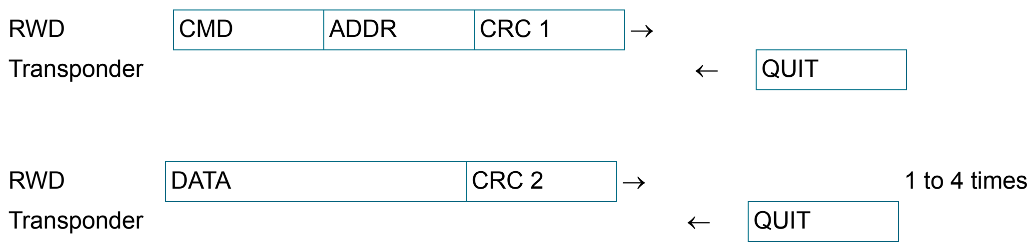


Table 31. Write sequence

Abbreviation	Description
CMD	Command, 4 bits (write page, write block, write page encrypted, write block encrypted)
ADDR	Address, 8 bits (page or block address for page or block write)
CRC 1	Cyclic redundancy check, 8 bits (check sum of CMD and ADDR)
QUIT	Static confirmation, 3 bits
DATA	Write data, 32 bits (one page data)
CRC 2	Cyclic redundancy check, 8 bits (check sum of write data)

The write block command transmits one to four pages and the transponder confirms (QUIT) each of the blocks.

12.3 Transmission transponder to RWD

12.3.1 Standard protocol mode

The parts of protocol transmitted by the transponder to the RWD do not include any check sum because of flexibility reasons. To get the data integrity required by the application, check sums have to be calculated by the user software and stored together with the information in the transponder memory. This seems inconvenient because the check sums allocate parts of the memory in the transponder. The advantage of this solution is the flexibility to choose large checksums for applications requiring high data integrity and smaller check sums for applications requiring short access times, which means short protocols.

12.3.2 Advanced protocol mode

In Advanced Protocol Mode the parts of the selected command, the Read Rage command and the Read Block command, transmitted by the transponder to the RWD, include a check sum.

The generator polynomial for the CRC reads:

$u^8 + u^4 + u^3 + u^2 + 1 =$ 1Dh

and the CRC pre-assignment is FFh

The following explanation shows the feature of this protocol mode to provide a CRC in those commands.

RWD	CMD	DATA 1	CRC 1	→				
Transponder					←	STARTSEQ	DATA 2	CRC 2

Abbreviation	Description
RWD	RWD
CMD	Command, 4 bits (read page, read block, read page ciphered, read block ciphered) or 5 bits (select)
DATA 1	32 bit serial number for select, 8 bits address for page or block read (ciphered or plain)
CRC 1	Cyclic redundancy check, 8 bits (check sum of CMD and DATA 1), calculated by the RWD, checked by the transponder
STARTSEQ	Start sequence of the transponder (six Ones)
DATA 2	Read data, 32 bits to 128 bits (one to four pages for page or block read)
CRC 2	Cyclic redundancy check, 8 bits (check sum of DATA 2, excluding STARTSEQ), calculated by the transponder, checked by the RWD.

12.4 Source Code for CRC-Checksum

The following lines of C-Code show an example for a CRC-Calculation.

```
#include <stdio.h>

#define CRC_PRESET  0xFF
#define CRC_POLYNOM 0x1D

void calc_crc(unsigned char * crc,
unsigned char data,
unsigned char bitcount)
{
*crc ^= data;                        // crc = crc (exor) data
do
{
  if( *crc & 0x80 )                  // if (MSB-CRC == 1)
  {
  *crc<<=1;                          // CRC = CRC bit-shift left
  *crc ^= CRC_POLYNOM;               // CRC = CRC (exor) CRC_POLYNOM
  }
  else
  {
  *crc<<=1;                          // CRC = CRC bit-shift left
  }

  printf("CRC: %02X ", *crc);        // output result step by step
} while(--bitcount);
  printf("\n");
}

void main(void)
{
const cmd=0x00;                      /* 5 bit command, aligned to MSB */
const ident[4]={0x2C, 0x68, 0x0D, 0xB4 };

unsigned char crc;
int i;

crc = CRC_PRESET;                    /* initialize crc algorithm */

calc_crc(&crc, cmd, 5);              /* compute 5 crc bits only */

for(i=0; i<4; i++)
calc_crc(&crc, ident[i], 8);

/* crc = 0x9E at this point */
printf("%02X\n",crc);

getch();

}
```


13. Limiting values

Table 32. Limiting values - HT1ICS3002[1]

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage		-0.5	6.5	V
V_{ESD}	electrostatic discharge voltage	MIL-STD 883D, Method 3015.7, Human Body	2	-	kV
I_{lu}	latch-up current	MIL-STD 883D, Method 3023	100	-	mA
$I_{i(max)}$	maximum input current	IN1-IN2	-	30	mA_{peak}
Tj	junction temperature		–55	+140	°C

[1] Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any conditions other than those described in the Operating Conditions and Electrical Characteristics section of this specification is not implied.

Table 33. Limiting values - HT1MOA2S30[1]

Symbol	Parameter	Conditions	Min	Max	Unit
T_{stg}	storage temperature		–55	+125	°C
T_A	operation temperature	$R_{ThJunctionAmbient} \leq 30K/W$ @ I_{IN}=30mA	–25	+85	°C

[1] Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any conditions other than those described in the Operating Conditions and Electrical Characteristics section of this specification is not implied.

14. Characteristics

Table 34. Electrical specifications - HT1ICS3002[1][2]

Symbol	Parameter	Conditions	Min	Max	Unit
Operating range					
T_A	temperature	$R_{ThJunctionAmbient} \leq 30K/W$ @ I_{IN}=30mA	–40	85	°C
VDD	supply voltage		2.8	5.5	V
Power consumption					
I_{VDDQ}	quiescent current	VDD=3.5V, Limiter off	-	4	µA
I_{VDDI}	idle current	VDD=3.5V, V_{IN}=100mV @ 125 kHz, Limiter off	-	9	µA
Clock recovery					
V_{CLK}	sensitivity	VDD=3.5V	-	100	mV
f_{CLK}	frequency	V_{IN}=100mV, VDD=3.5V	-	250	kHz
Demodulator					
V_{DEMOD}	sensitivity	V_{INHigh} - V_{INLow} @ V_{INHigh}=5Vp, T_0=8µs, T_{MOD}=6*T_0	-	2	V
T_{DEMOD}	response time	V_{INHigh}=5V, V_{INLow}=2.5V, T_0=8µs, T_{MOD}=6*T_0	4	24	µs
Modulator					
R_{IN1L}	R_IN1 linear	VDD=3.5V, V_{IN1}=0.5V, V_{IN2}=0V	1.6	3.0	kΩ

Table 34. Electrical specifications - HT1ICS3002[1][2]

Symbol	Parameter	Conditions	Min	Max	Unit
R_{IN1NL}	R_IN1 nonlinear	VDD=3.5V, V_{IN1}=1.5V, V_{IN2}=0V	0.48	1.46	kΩ
R_{IN2L}	R_IN2 linear	VDD=3.5V, V_{IN1}=0V, V_{IN2}=0.5V	3.4	6.4	kΩ
Voltage limiter					
$V_{LimitMin}$	minimum voltage	VDD @ I_{IN} ±10 µA	2.7	-	V
$V_{LimitMax}$	maximum voltage	VDD @ I_{IN} ±30 µA	-	5.5	V
Resonance capacitor					
$C_{ResInit}$		VDD=3.5V	189	231	pF
Power on reset					
V_{POR}	static power on reset level		1.3	2.3	V
VDD capacitor					
CVDD	VDD capacitor value	VDD=3.5V	1.4	2.6	nF
EEPROM characteristics					
	write current	VDD=2.8V	-	25	µA
	read current	VDD=2.8V	-	9	µA
t_{ret}	retention time	@ 55 °C	10	-	year
$N_{endu(W)}$	write endurance		100000	-	cycle

[1] In normal operation supply voltage is generated by on chip rectification and limitation of the AC voltage applied via antenna to pins IN1 and IN2, and can be measured at pins VDD and VSS.

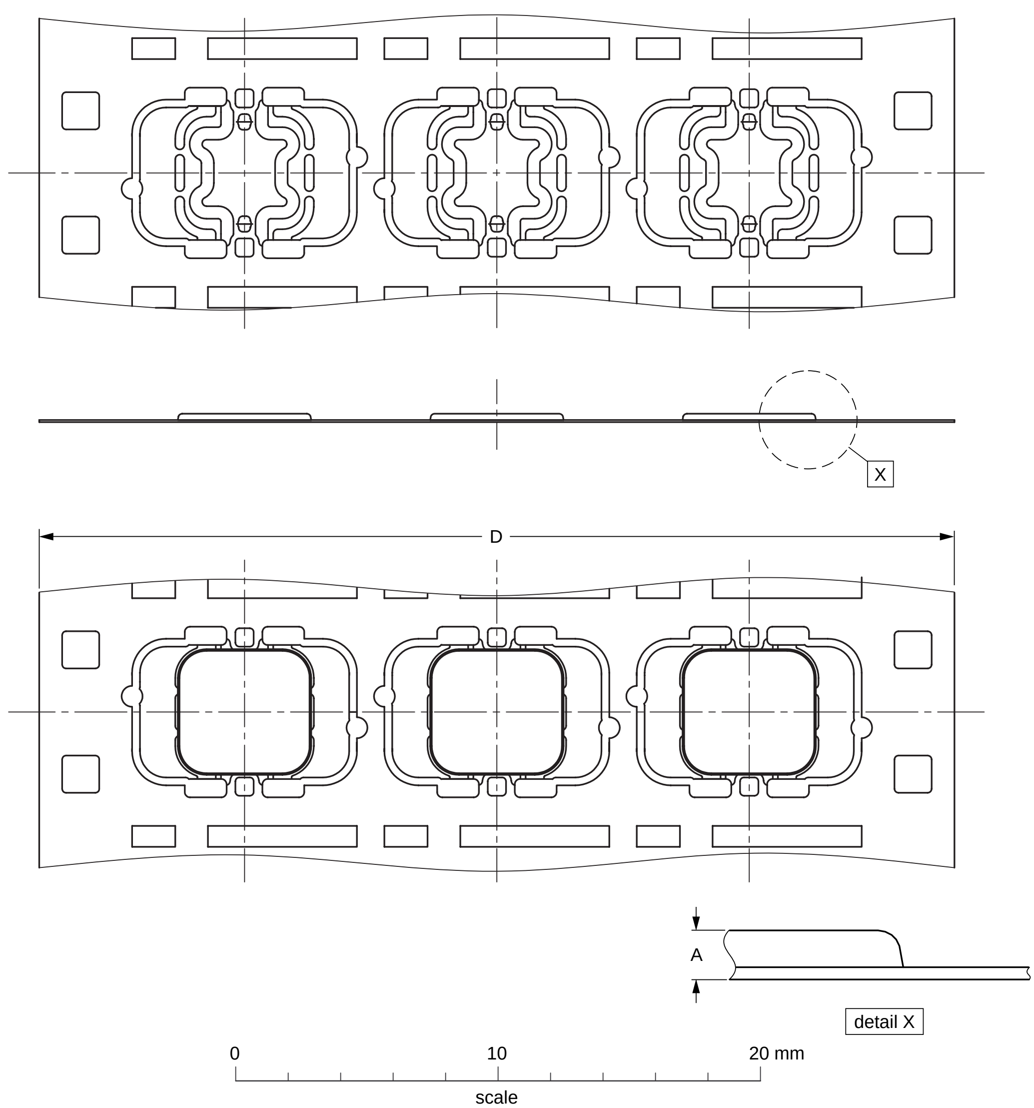
[2] Pins VDD and VSS are not connected for normal operation but can be used for forcing supply voltages during test.

Table 35. Electrical specifications - HT1MOA2S30 (SOT500-2)

Symbol	Parameter	Conditions	Min	Max	Unit
Operating range					
$V_{i,TH}$	input threshold voltage	start modulation after SETCC	2.8	3.9	V_P
$V_{i,RD}$	input read voltage	read E²PROM	3.5	4.5	V_P
$V_{i,WR}$	input write voltage	write E²PROM	3.7	4.7	V_P
Modulator					
R_{MODL}	R_MOD linear	$V_{INLow} \leq 2.0V_P$		4.0	kΩ
R_{MODNL}	R_MOD nonlinear	$V_{INLow} \geq 2.0V_P$		3.6	kΩ
Resonance capacitor					
$C_{ResInit}$		V_i=4.0V	189	231	pF

15. Package outline

PLLMC: plastic leadless module carrier package; 35 mm wide tape **SOT500-2**



DIMENSIONS (mm are the original dimensions)

UNIT	A [(1)] max.	D	
mm	0.33	35.05 34.95	For unspecified dimensions see PLLMC-drawing given in the subpackage code.

Note

1. Total package thickness, exclusive punching burr.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT500-2	- - -	- - -	- - -			~~03-09-17~~ 06-05-22

Fig 13. Package outline SOT500-2 (HT1MOA2S30)

16. Abbreviations

Table 36. Abbreviations

Abbreviation	Definition
AC	Anticollision Code
BPLM	Binary Pulse Length Modulation
CRC	Cyclic Redundancy Check
EEPROM	Electrically Erasable Programmable Memory
IC	Integrated Circuit
RO	Read Only
R/W	Read/Write
RWD	Read Write Device
SN	Serial Number
WO	Write Only

17. References

[1] **Application note —** AN10214, HITAG Coil Design Guide, Transponder IC BL-ID Doc.No.: 0814**[1]

[2] **General specification for 8” wafer on UV-tape —** Delivery type description, BL-ID Doc.No.: 1005**[1]

1. ** ... document version number

18. Revision history

Table 37. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
187530	20100226	Product data sheet	-	-

19. Legal information

19.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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Date of release: 26 February 2010
187530