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DATA SHEET

hitag

HTRM440 family HITAG proximity reader module hardware

Product specification
Supersedes data of 1999 Feb 01
File under Integrated Circuits, IC11

2001 Oct 04

HITAG proximity reader module hardware

HTRM440 family

CONTENTS	8	ELECTRICAL SPECIFICATIONS
1	9	MECHANICAL SPECIFICATIONS
2	10	APPLICATION INFORMATION
3	10.1	Metallic environment, interferences
4	10.2	Distance between two antennas
5	10.3	Possible sources of errors by connecting the HTRM440
6	11	SURVEY OF REFERENCED DOCUMENTS
6.1	12	DATA SHEET STATUS
6.2	13	DEFINITIONS
6.3	14	DISCLAIMERS
6.4		
7		
7.1		
7.1.1		
7.1.2		
7.1.3		
7.1.4		
7.1.5		
7.2		
7.3		
7.3.1		
7.3.2		
7.3.3		
7.4		
7.5		
7.5.1		
7.5.2		
7.5.3		
7.5.4		
7.6		
7.6.1		
7.6.2		
7.6.3		

HITAG proximity reader module hardware

HTRM440 family

hitag

1 FEATURES

- Compact size
- Communication with all HITAG transponders and various other 125 kHz transponders
- Proximity communication distances up to 200 mm
- Data encryption and key handling
- Fast and easy system integration
- Three interface options
- Standard connectors
- Simple antenna design
- DC power supply from 9 to 16 V
- Switches and LEDs connectable
- Meets all requirements for CE and EMI approval.

2 APPLICATIONS

- Universal and flexible reader module for proximity systems.

3 GENERAL DESCRIPTION

HITAG⁽¹⁾ is the name of one of the universal and powerful product lines of our 125 kHz family. The contactless proximity read and write system that works with passive transponders is suitable for various applications. Inductive coupling helps you to achieve reading ranges up to 200 mm and the use of cryptography guarantees highest data security.

The HTRM440 provides you with a universal, cost-effective, small and complete reader module. It enables communication with the 125 kHz transponders HITAG 1 and HITAG 2.

Easy integration and application of the HTRM440 is due to small size and uncomplicated interfaces.

(1) HITAG - is a trademark of Philips Semiconductors Gratkorn GmbH.

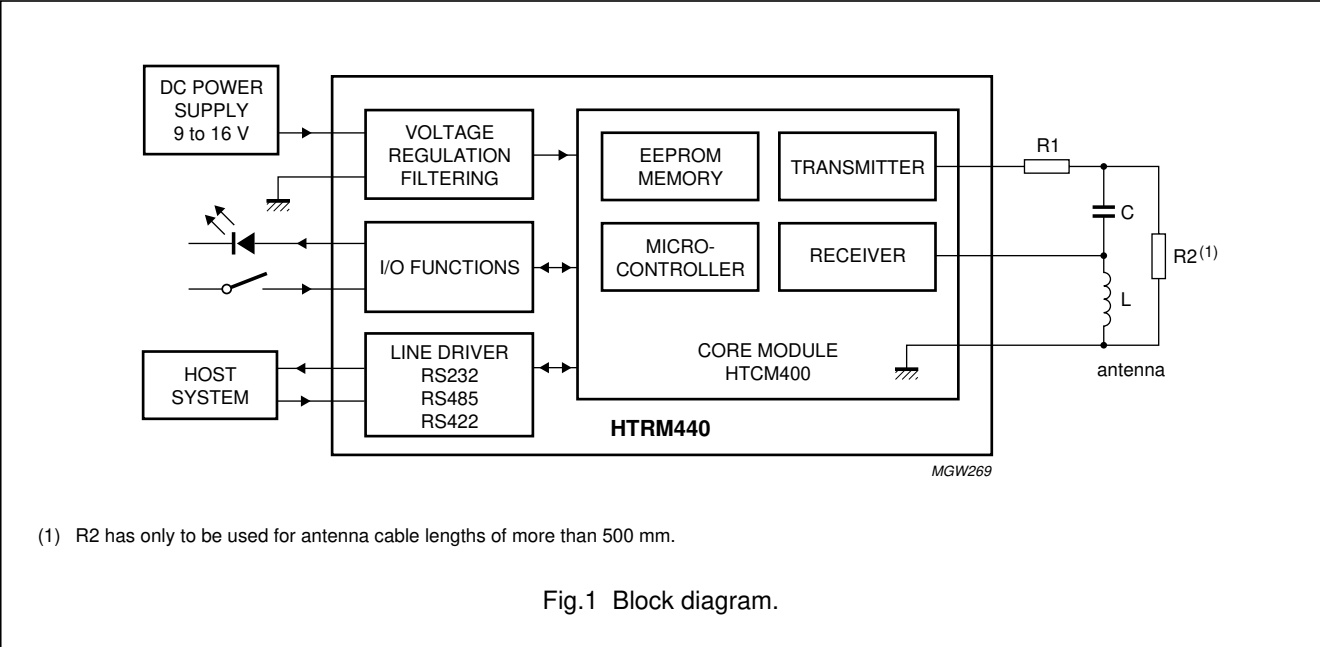
4 ORDERING INFORMATION

PART NUMBER	NAME	ORDER CODE (12NC)
HTRM440/AIE	HITAG proximity reader module RS232	9352 338 70122
HTRM440/BIE	HITAG proximity reader module RS422	9352 338 80122
HTRM440/CIE	HITAG proximity reader module RS485	9352 338 90122

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HTRM440 family

5 BLOCK DIAGRAM



6 PINNING

6.1 Input and output pins

The pins for all inputs, outputs and antenna connections are shown in Fig.2.

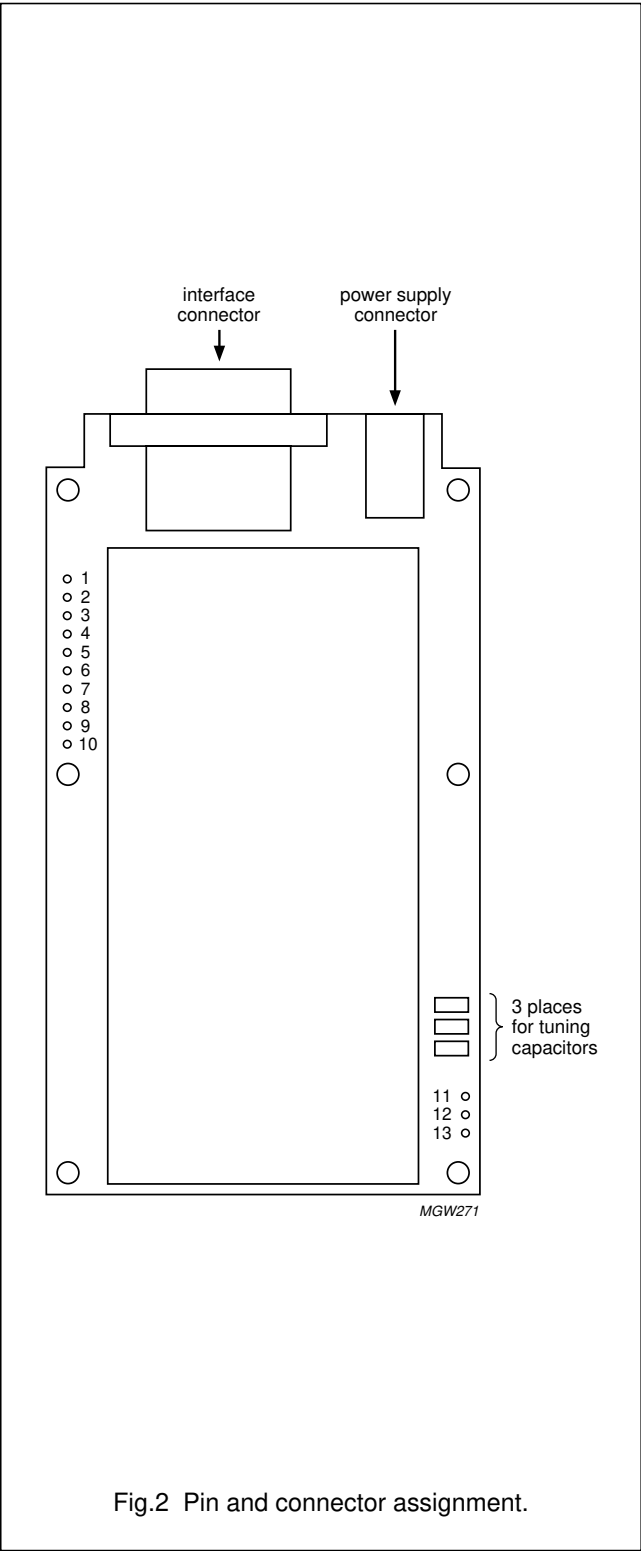
SYMBOL	PIN	TYPE ⁽¹⁾	DESCRIPTION
D1 cathode	1	P	these pins can be used to connect a power LED1
D1 anode	2	O	
D2 cathode	3	P	these pins can be used to connect LED2 and LED3 which are driven by the output pins of the core module
D2 anode	4	O	
D3 cathode	5	P	
D3 anode	6	O	
SW1 a	7	I	these pins can be used as inputs for switch SW1 and SW2 and are internally connected to pins 17 and 18 of the HITAG core module
SW1 b	8	GND	
SW2 a	9	I	
SW2 b	10	GND	
RX	11	I	receiver input; this antenna signal input has to be connected to the input line of the antenna
TX1	12	O	transmitter output; this antenna signal output has to be connected to the output line of the antenna
TX2	13	GND	antenna ground; the ground line of the antenna has to be connected to this pin

Note

1. P = power supply pin, O = output pin, I = input pin and GND = ground supply pin.

HITAG proximity reader module hardware

HTRM440 family

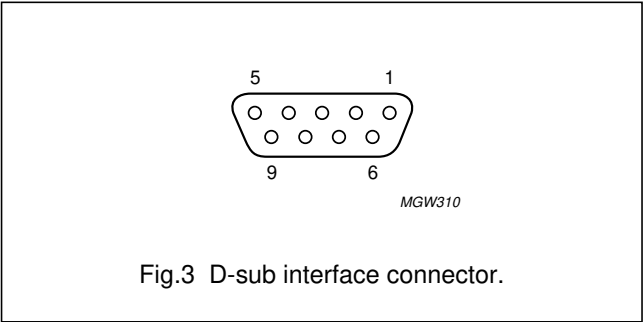


6.2 Antenna tuning connections

Three spare places for antenna tuning capacitors are available on the PCB (see Fig.2).

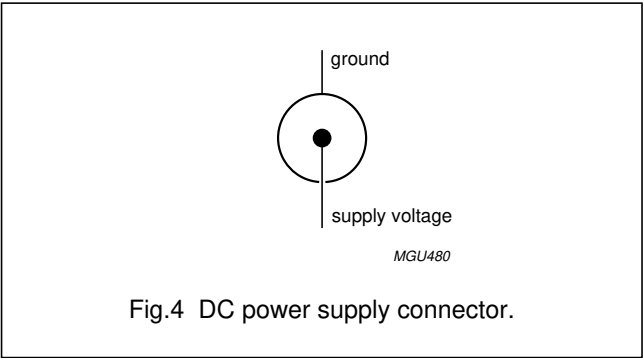
6.3 Interface connector

PIN	INTERFACE TYPE		
	RS232	RS485	RS422
1	n.c.	n.c.	n.c.
2	RxD	A-	A-
3	TxD	A+	A+
4	n.c.	n.c.	n.c.
5	ground	ground	ground
6	n.c.	n.c.	n.c.
7	i.c.	i.c.	B+
8	i.c.	i.c.	B-
9	n.c.	n.c.	n.c.



6.4 Power supply connector

The inner pin of the DC supply connector (see Fig.4) has to be connected to positive voltage and the outer one has to be connected to ground. The connection is fail safe.



HITAG proximity reader module hardware

HTRM440 family

7 FUNCTIONAL DESCRIPTION

7.1 System overview

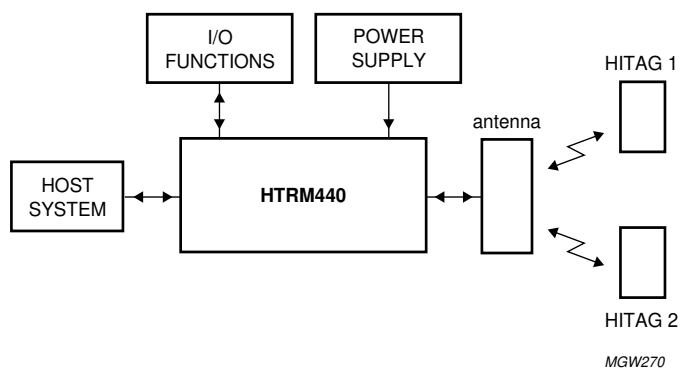


Fig.5 System overview.

The HITAG proximity reader module HTRM440 (see Fig.5) is a part of a complete Radio Frequency Identification (RFID) system:

- Transponders
- Antenna
- Host system
- I/O functions
- Power supply.

7.1.1 TRANSPONDERS

The HTRM440 communicates with HITAG 1 and HITAG 2 transponders. Software commands are used to switch between the different transponder modes.

If several HITAG transponders arrive simultaneously within the communication field of the antenna of a HTRM440, the 'stronger' transponder (the nearer one) takes over or - under special circumstances - no communication takes place. If the transponders arrive into the field one after the other, communication is established with the first one, all the other transponders are ignored. Nevertheless it is possible to mute transponders, so that several HITAG transponders can be accessed sequentially. This ensures that no two (or several) HITAG transponders will ever be processed (above all written to!) accidentally at the same time.

7.1.2 ANTENNA

Capacitor C (see Fig.1) is used for tuning the antenna. There is space reserved on the HTRM440 for tuning capacitors to tune the antenna in case there is no tuning capacitor used on the antenna itself.

7.1.3 HOST SYSTEM

The connection to the host system (e.g. microcontroller or PC) is a serial interface on RS232 level for data transmission (version HTRM440/AIE). Optionally wired interface drivers for CMOS (version HTRM440/BIE) and RS485 (version HTRM440/CIE) are integrated on the reader module.

7.1.4 INPUT AND OUTPUT FUNCTIONS

Two lines of the HTRM440 are wired as inputs from e.g. switches and two lines as outputs to drive LEDs. On the PCB space is reserved to connect three LEDs as well as to connect e.g. two switches.

7.1.5 POWER SUPPLY

The HTRM440 must be supplied by an external DC power supply (9 to 16 V).

HITAG proximity reader module hardware

HTRM440 family

7.2 Reader module software

Software commands mentioned in this data sheet are fully described in document *"HTCM400, HTRM440 Family, HTRM800 Family Interface Protocol Reader - Host"*.

7.3 Reader module hardware

7.3.1 CORE MODULE

The EEPROM on the core module HTCM400 (see Fig.1) is used to store non-volatile data such as personalization data, keys, passwords, configurations and status information.

The microcontroller processes the protocol for the communication between the transponders and the reader module. The interface signals are converted in such a way that HITAG 1 and HITAG 2 transponders are able to process them and the outgoing signals from the transponder are converted into interface-compatible signals. The second essential microcontroller function is its control function. The microcontroller activates and deactivates the transmitter, switches the receiver between the modes for the different transponders reception and selects the EEPROM.

The transmitter receives data from the microcontroller and modulates the carrier.

The receiver demodulates the received data and passes on the data to the microcontroller for further processing.

7.3.2 INTERFACE MICROCONTROLLER TO HOST

The device communicates with the host (e.g. microcontroller or PC) via a serial interface using a baud rate of 9600 baud. Data transfer details are: 1 start bit, 8 data bits, 1 stop bit, no parity bit and the least significant bit is sent first.

7.3.3 VOLTAGE REGULATION FILTERING

Disturbances on the supply pins may reduce the performance of the system. For that reason the supply voltage is filtered but also to limit the spurious emissions at the supply connections caused by the digital parts of the module.

7.4 Postal approval

The postal approval can only be granted for final products, not just for modules like the HTRM440. But the reader module is designed in a way that it is possible to get the postal approval for a system including the HTRM440.

Electromagnetic emissions comply with the guidelines in FTZ 17 TR 2100 and ETS 300 683 and electromagnetic immunity complies with the guidelines in ETS 300 683.

7.5 Security considerations

Developing the HTRM440 special consideration was given to aspects of security. The following items represent the fundamental framework of the security concept:

- Cryptography
- Mutual authentication
- Password verification
- Cyclic Redundancy Check (CRC).

7.5.1 DATA STREAM BETWEEN READER MODULE AND HITAG 1 TRANSPONDERS

All the commands and data transferred from the reader module to the transponder are secured by Cyclic Redundancy Check (CRC). This check is carried out on the transponder.

Every data stream sent (commands, addresses, user data) from the proximity reader module to the transponder is first checked for data errors by the transponder by means of an integrated 8-bit CRC generator and then executed. Normally the transponder responds to each data stream from the proximity reader module with an acknowledgement signal or with a data block. The CRC is formed over commands and addresses or the plain data respectively and in case of crypto mode it is also encrypted. The generator polynomial of the transponder CRC generator reads: $u^8 + u^4 + u^3 + u^2 + 1 = 0x1D$.

The CRC pre assignment is 0xFF.

Detailed instructions how to use and calculate CRC are available at Philips in the following application note *"HT1 (resp. HT2) Transponder family, reliability and integrity of data transmission"*.

7.5.2 DATA STREAM BETWEEN READER MODULE AND HITAG 2 TRANSPONDERS

Every command sent from the reader module to the transponder is checked for data errors by the transponder.

Standard commands transferred from the reader module to the transponder are divided into two bit streams. The second bit stream is generated by inverting the bits of the first bit stream. This redundancy increases data security.

HITAG proximity reader module hardware

HTRM440 family

7.5.3 CHECKING USER DATA

This check is carried out on the HTRM440.

Security of the data read from the transponder by the reader module remains with the user for reasons of flexibility. Therefore, you can choose flexible check sums and store them in the transponder memory together with the data. You can protect sensitive data better than less sensitive data, thus permitting optimized operation times.

7.5.4 DATA PRIVACY

The use of cryptography (stream cypher), mutual authentication, and password verification prevents monitoring and copying the data channel. Therefore, the area of the transponder that only can be accessed enciphered is called 'secret area'.

To make use of cryptography for HITAG 1 transponders you need:

- Keys to be used for initializing of the crypto block
- Logdata to be used for mutual authentication.

To make use of cryptography for HITAG 2 transponders you need:

- A key which is used to initialize the crypto block using HITAG 2 in crypto mode
- Passwords which are used for authentication for HITAG 2 in password mode.

The transponders and the HTRM440 are provided with identical transport keys and transport logdata so that you can start operating them right away (see Table 1).

In order to offer our OEM clients high flexibility, the configuration of the transponder memory, password, keys and logdata can be changed. We strictly recommend to rigorously restrict these possibilities for the end customers (by setting the configuration page to read only, setting password, keys and logdata to neither read nor write).

7.6 Operating security

The following mechanisms ensure the operating security of the HITAG system:

- Anticollision mode
- Monitoring the supply voltage
- Detection of antenna rupture and antenna short-circuit.

7.6.1 ANTICOLLISION

In proximity reader applications using HITAG 1 or HITAG 2 transponders, only one transponder is handled even if there are several transponders within the communication field of the antenna. In this case either no communication takes place or the 'stronger' or closer transponder takes over. By muting a selected transponder (HALT mode) another transponder that is to be found in the communication field of the antenna can be recognised.

7.6.2 MONITORING THE SUPPLY VOLTAGE

The supply voltage is controlled by a watchdog circuit which triggers a system reset if the supply voltage drops below 4.75 V or if the microcontroller fails.

7.6.3 DETECTION OF ANTENNA RUPTURE AND ANTENNA SHORT-CIRCUIT

The HTRM440 does not get permanently damaged in case of an antenna rupture or a brief antenna short-circuit.

Table 1 Transport values predefined by Philips.

SYSTEM	PARAMETER	VALUE
HITAG 1	keyinit password	0x00000000
	keys	0x00000000
	logdata	0x00000000
HITAG 2	keyinit password	0x00000000
	key	0x4D494B524F4E
	password TAG	0xAA4854
	password RWD	0x4D494B52

HITAG proximity reader module hardware

HTRM440 family

8 ELECTRICAL SPECIFICATIONS

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
External power supply						
V_P	DC supply voltage		9	–	16	V
I_P	DC supply current		–	–	150	mA
Modulation						
m_{TX}	modulation ratio of reader module to transponder	Amplitude Shift Keying (ASK)	–	100	–	%
m_{RX}	modulation ratio of transponder to reader module	Amplitude Shift Keying (ASK); note 1	–	–	–	%
Interface to host						
f_t	transmission speed		–	9600	–	baud
Antenna						
d	operating distance	note 2	–	200	–	mm
Temperature						
T_{oper}	operating temperature		–25	–	+85	°C
T_{stg}	storage temperature		–40	–	+85	°C

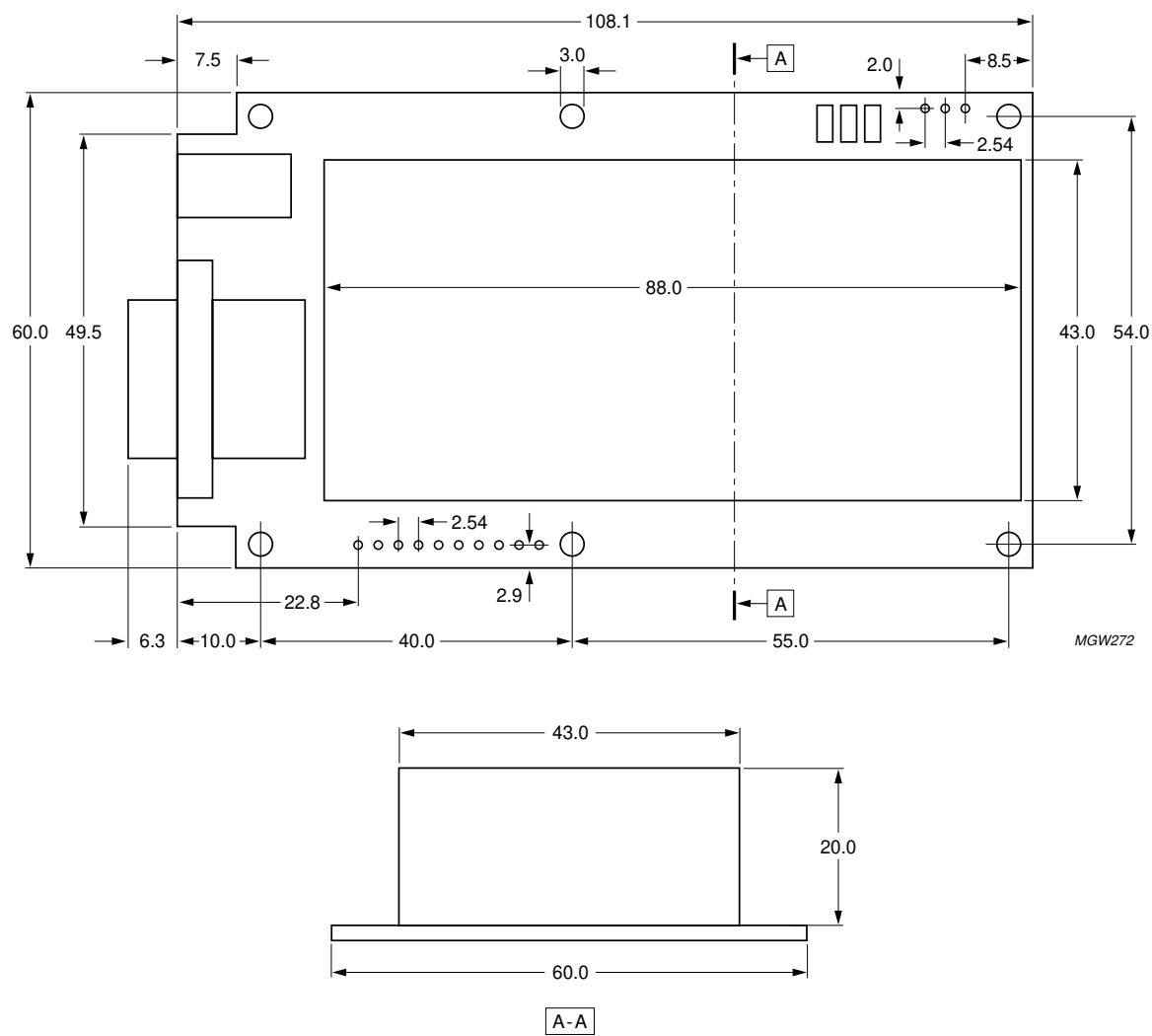
Notes

1. Modulation ratio depending on the distance between transponder and reader module.
2. Depending on antenna and type of transponder; three-wire cable, shielded.

HITAG proximity reader module
hardware

HTRM440 family

9 MECHANICAL SPECIFICATIONS



Dimensions in mm.

Fig.6 Proximity reader module.

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HTRM440 family

10 APPLICATION INFORMATION

10.1 Metallic environment, interferences

The communication range is impaired by metallic environment and electromagnetic interferences (e.g. monitors and keyboards). Therefore, you should keep a distance of at least the antenna's diameter to metallic surfaces or loops as well as to electromagnetic interferences. If this is not possible, you have to take preventive measures such as using ferrites or shielding for transponder and antenna.

10.2 Distance between two antennas

In order to be able to operate two systems side by side without negative influence on communication ranges, you must place the antennas at a minimum distance of four times the antenna diameter. If you place them at a closer distance be sure to use suitable shielding or synchronisation.

10.3 Possible sources of errors by connecting the HTRM440

The following error list should be checked if any error (e.g. read or write distances that do not reach the specified values) occurs:

- Power supply cable not mounted correctly
- DC power supply voltage not in the specified range from 9 to 16 V
- Serial interface not connected correctly

- Interference received by the antenna because of an external noise source (e.g. monitor, keyboards); the remedial measure is to remove the antenna from the interfering area
- Connecting cables of the antenna changed by mistake
- Antenna is mounted in metal environment; the remedial measure is to mount a non-metal space keeper between the antenna and the metal
- Antenna is not designed following the design instructions
- Inductance of the antenna is too high
- Quality factor of the antenna is too high ($Q > 40$)
- Antenna current is too high
- Antenna voltage is too high.

11 SURVEY OF REFERENCED DOCUMENTS

CATEGORY	TITLE
Data sheet	"HTCM400, HTRM440 Family, HTRM800 Family Interface Protocol Reader - Host"
Application note	"HT1 (resp. HT2) Transponder family, reliability and integrity of data transmission"

HITAG proximity reader module hardware

HTRM440 family

12 DATA SHEET STATUS

DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾	DEFINITIONS
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

13 DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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HITAG proximity reader module
hardware

HTRM440 family

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HITAG proximity reader module hardware	HTRM440 family
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