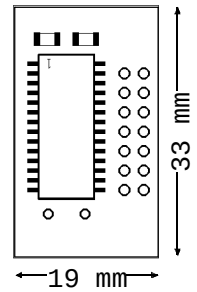
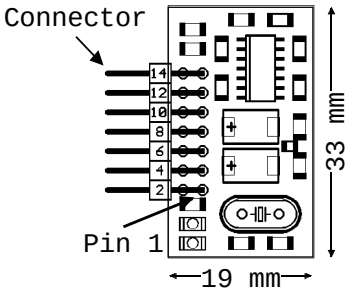
SynLock-Pico-Module

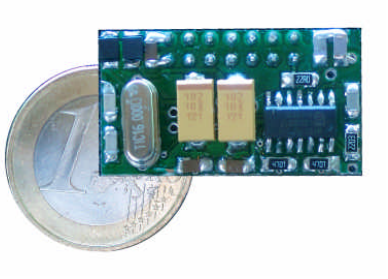
Data Sheet



Bottom View



Top View



1 Scope

The SynLock-Pico-Module provides an easy-to-use facility for accessing a Philips Semiconductors HITAG 1/S (2048 bit) RF transponder. It allows read and write accesses to the transponder without knowing or caring for the complex details of the wireless transmission (e.g. analogue modulation) between SynLock-Pico-Module and HITAG 1/S (2048 bit) RF transponder. After adding only a simple air coil antenna and a 5V DC power supply the SynLock-Pico-Module is ready for use. A so called host (e.g. a microcontroller or a PC via voltage level shifter) can control all functions of the HITAG 1/S (2048 bit) RF transponder and the SynLock-Pico-Module via an integrated serial interface, so the SynLock-Pico-Module can easily be used in own applications for various purposes. Security requirements are fulfilled by using crypto algorithms, which ensure that transponder data can only be read or written correctly if a 32 bit crypto parameter is known. The SynLock-Pico-Module is highly performance optimised, which ensures very short communication response times. The enables the application using the SynLock-Pico-Module to access and process transponder data with a minimum delay.

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2 Pin Description

The SynLock-Pico-Module is connected to the application circuit via 14 pins. The functions of these pins are listed in the following table.

Number	Name	Direction	Description
1	GND	Supply	Ground
2	VCC	Supply	Supply voltage DC +5V ± 5%, 50mA
3	LED1	Out	LED red (5mA)
4	LED1	Out	LED green (5mA)
5	TXD	Out	Serial interface, transmit (TTL)
6	RXD	In	Serial interface, receive (TTL)
7	RESET/	In	Reset, normally not connected
8	PROG/	In	Program mode, normally not connected
9	EXT1		Port pin for further extensions, normally not connected
10	EXT2		Port pin for further extensions, normally not connected
11	n.c.		not connected
12	n.c.		not connected
13	ANT1		Antenna (driver)
14	ANT2		Antenna (driver and sense)

2.1 Supply

The SynLock-Pico-Module needs a regulated power supply with an output voltage DC 5V ± 5% capable of delivering a minimum current of 50mA with a low ripple voltage.

2.2 LEDs

Two LEDs can be connected to the SynLock-Pico-Module. LED1 (normally red) is turned on by the SynLock-Pico-Module if no transponder is in range, while LED2 (normally green) is switched on, if a transponder is detected. Only low current LEDs with a current of less than 5mA should be connected to the SynLock-Pico-Module. A practical and good solution is the use of a two colour LED (red/green)

2.3 Serial Interface

The serial interface of the SynLock-Pico-Module consists of two lines, one for transmitting and one line for receiving data. It uses no additional lines for handshaking.

2.4 RESET/ and PROG/

These two pins of the SynLock-Pico-Module are used for are firmware upgrade if necessary or useful. Pulling the RESET/ pin to low will reset the SynLock-Pico-Module and will switch the LED pins, the serial interface pins, the PROG/ pin and the EXT pins to input. Pulling the PROG/ pin to low while a reset condition occurs will enter the program mode for a firmware upgrade. Both pins are normally not connected.

2.5 Port Pins for Extensions

The SynLock-Pico-Module provides these two pins for further extensions or for special customer requirements. The usage of these two pins requires a special firmware which controls these pins. In normal standard applications both pins are not connected.

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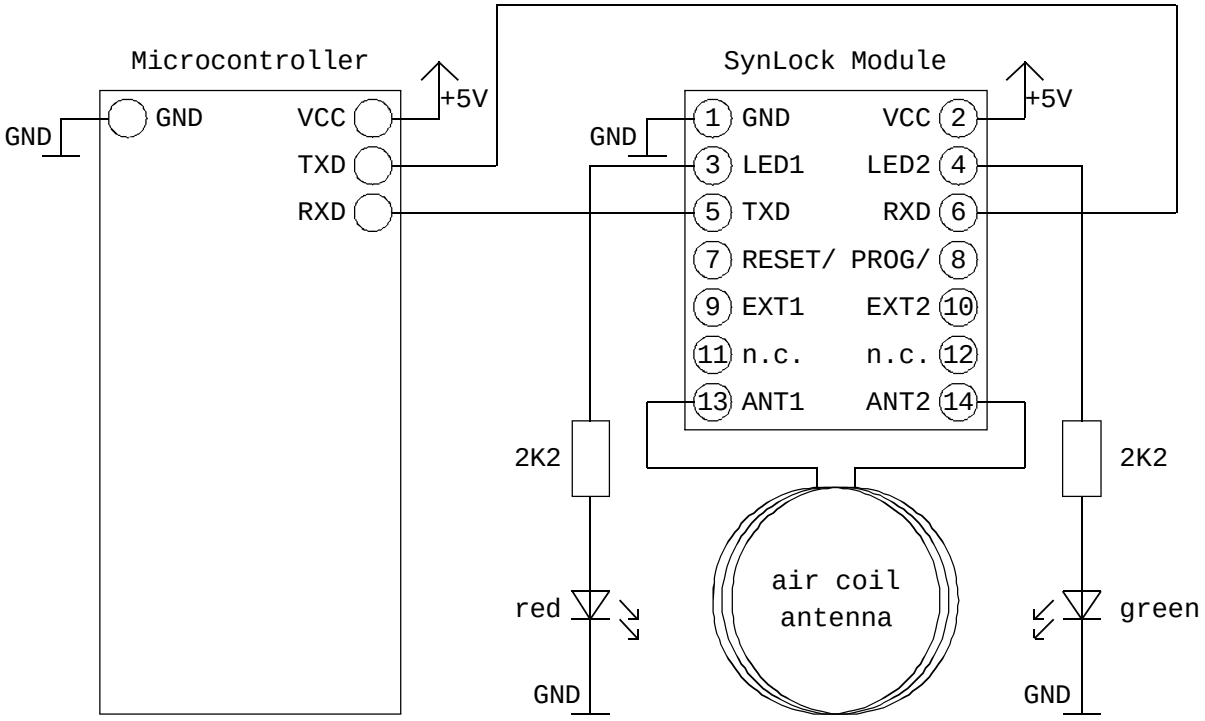
2.6 Antenna

A simple air coil with a specific inductance has to be connected directly to these pins of the SynLock-Pico-Module. Other electronic components like capacitors or resistors are not required. The antenna connector should be placed nearby these two pins.

3 Typical Application

The following illustration shows a typical application including the SynLock-Pico-Module with a minimum of additional external components. A microcontroller caries out the role of the host which controls the SynLock-Pico-Module. The SynLock-Pico-Module needs only a power supply and the air coil antenna for its function. The LEDs and the resistors are not mandatory. If a PC takes the role of the host a voltage level shifter (e.g. MAX232) which converts the different voltage levels between TTL (0,+5V) and V24 (+12V, -12V) will be required.



4 Antenna

The antenna is simply an air coil which represents in conjunction with a capacitor and a resistor (both assembled on the SynLock-Pico-Module) a series RLC oscillator with an resonance frequency of 125kHz. To archive this resonance frequency the antenna coil must have an inductance of 700µH to 800µH and a low Q (10 to 20). To check and if necessary adjust the inductance of the antenna coil an easy and reliable method is available. Without a transponder in range the voltage (peak to peak) measured with an oscilloscope at the ANT2 pin (pin 14) should be greater than 100V and should show a small spike every half wave. In ideal case with a well tuned antenna this spike will appear at every minimum and every maximum of the sine wave. A typical curve plot is shown in the following illustration.

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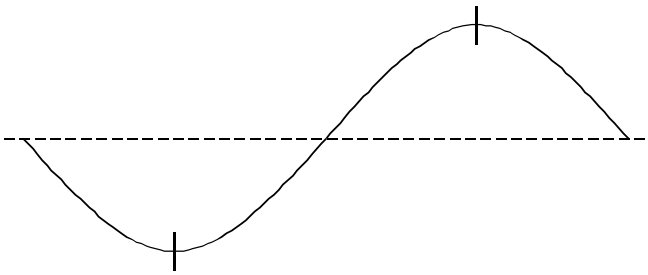
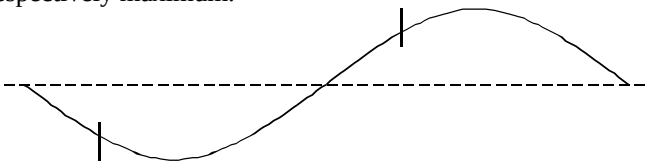
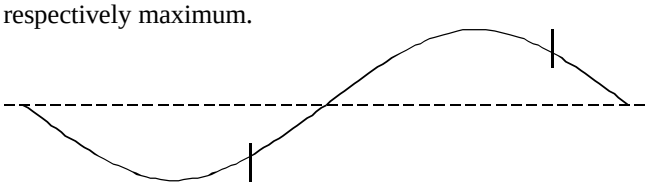


If the inductance of the antenna coil is too high, the voltage will be decreased an the spike is shifted to a position in front of the minimum respectively maximum.



In case of a inductance, which is too low, the voltage will be decreased as well, but the spike is shifted to a position behind minimum respectively maximum.



The SynLock-Pico-Module will check the antenna und detect a broken antenna, a shorted antenna and a detuned antenna. It reports the antenna status via the serial interface to the host.

Parameters for example antennas:

? Material: Cu, 0,3 mm, isolated
Diameter: 15 cm
Turns: 27

? Material: Cu, 0,3 mm, isolated
Diameter: 10 cm
Turns: 40

? Material: Cu, 0,3 mm, isolated
Diameter: 4,5 cm
Turns: 90

5 Serial Interface

The SynLock-Pico-Module uses a bi-directional serial interface for data exchange. Further details and the transmission protocol including interface parameters and special timing requests are described in /1/.

6 Cryption

The SynLock-Pico-Module provides the possibility to crypt the transponder user data based on a special four byte parameter to avoid inspection of user data by non authorised persons. This parameter influences the data crypting decisively and represents the so called crypto seed, which is the base for all crypto actions. The crypto algorithm also includes the fixed and therefore unchangeable serial number of the transponder which prevents cloning and copying of transponders. Changing the seed or cloning a transponder results in reading incorrect, meaningless and “random” data because of the transponder was crypted with another seed respectively serial

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number. That means only transponder user data is correct readable by the SynLock-Pico-Module if it was written by using the same seed and if the transponder was not cloned. If all four bytes of the crypto seed are set to zero the crypting will be disabled.
All for reading and writing necessary crypto actions are performed by the SynLock-Pico-Module self sufficiently without additional control or calculations by the host, that means complete transparent to the host.
Each application class, customer or user should fix a own crypto seed to avoid interferences and data inconsistency with other SynLock-Pico-Modules. For applications with higher security requirements an implementation of additional crypto algorithms in the host is possible.
Only the upper 192 byte of the HITAG 1/S (2048 bit) transponder EEPROM, representing the user data, are affected by the crypto algorithms. The lower 64 byte contain the serial number, configuration bytes and reserved data and therefore they are not influenced by the crypto algorithm.

7 HITAG 1/S (2048 bit) RF Transponder

The HITAG 1/S (2048 bit) transponder provides 2048 bit of EEPROM memory. These 256 byte are organized into four byte pages representing the smallest unit which can be read or written by one access. Four pages or 32 byte are put together to a block representing the biggest unit which can be read or written by one access. The upper 192 byte of the EEPROM memory are dedicated for storing user data. The following table shows the memory map of a HITAG 1/S (2048 bit) RF transponder.

Address	Page	Block	Function
0x00..0x03	0x00	0x00	serial number
0x04..0x07	0x01	0x00	configuration bytes
0x08..0x0b	0x02	0x00	reserved
0x0c..0x0f	0x03	0x00	reserved
0x10..0x13	0x04	0x01	reserved
0x14..0x17	0x05	0x01	reserved
0x18..0x1b	0x06	0x01	reserved
0x1c..0x1f	0x07	0x01	reserved
0x20..0x23	0x08	0x02	reserved
0x24..0x27	0x09	0x02	reserved
0x28..0x2b	0x0a	0x02	reserved
0x2c..0x2f	0x0b	0x02	reserved
0x30..0x33	0x0c	0x03	reserved
0x34..0x37	0x0d	0x03	reserved
0x38..0x3b	0x0e	0x03	reserved
0x3c..0x3f	0x0f	0x03	reserved
0x40..0x43	0x10	0x04	user data
0x44..0x47	0x11	0x04	user data
0x48..0x4b	0x12	0x04	user data
0x4c..0x4f	0x13	0x04	user data
0x50..0x53	0x14	0x05	user data
0x54..0x57	0x15	0x05	user data
0x58..0x5b	0x16	0x05	user data
0x5c..0x5f	0x17	0x05	user data
0x60..0x63	0x18	0x06	user data
0x64..0x67	0x19	0x06	user data
0x68..0x6b	0x1a	0x06	user data
0x6c..0x6f	0x1b	0x06	user data
0x70..0x73	0x1c	0x07	user data
0x74..0x77	0x1d	0x07	user data
0x78..0x7b	0x1e	0x07	user data
0x7c..0x7f	0x1f	0x07	user data
0x80..0x83	0x20	0x08	user data

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0x84..0x87	0x21	0x08	user data
0x88..0x8b	0x22	0x08	user data
0x8c..0x8f	0x23	0x08	user data
0x90..0x93	0x24	0x09	user data
0x94..0x97	0x25	0x09	user data
0x98..0x9b	0x26	0x09	user data
0x9c..0x9f	0x27	0x09	user data
0xa0..0xa3	0x28	0x0a	user data
0xa4..0xa7	0x29	0x0a	user data
0xa8..0xab	0x2a	0x0a	user data
0xac..0xaf	0x2b	0x0a	user data
0xb0..0xb3	0x2c	0x0b	user data
0xb4..0xb7	0x2d	0x0b	user data
0xb8..0xbb	0x2e	0x0b	user data
0xbc..0xbf	0x2f	0x0b	user data
0xc0..0xc3	0x30	0x0c	user data
0xc4..0xc7	0x31	0x0c	user data
0xc8..0xcb	0x32	0x0c	user data
0xcc..0xcf	0x33	0x0c	user data
0xd0..0xd3	0x34	0x0d	user data
0xd4..0xd7	0x35	0x0d	user data
0xd8..0xdb	0x36	0x0d	user data
0xdc..0xdf	0x37	0x0d	user data
0xe0..0xe3	0x38	0x0e	user data
0xe4..0xe7	0x39	0x0e	user data
0xe8..0xeb	0x3a	0x0e	user data
0xec..0xef	0x3b	0x0e	user data
0xf0..0xf3	0x3c	0x0f	user data
0xf4..0xf7	0x3d	0x0f	user data
0xf8..0xfb	0x3e	0x0f	user data
0xfc..0xff	0x3f	0x0f	user data

Page 0 contains the unique 32 bit serial number, while page 1 holds four configuration byte. The upper two byte (address 0x06 and 0x07) of these configuration bytes are currently not used and are therefore available for user purposes. By clearing a bit in the lower two byte (address 0x04 and 0x05) it is possible to protect the corresponding page against write accesses. The function of these bits is shown more detailed in the following tables.

Configuration Byte 0 (Address 0x00)		
Bit	Function	
Bit 7	1	must be 1
Bit 6	1	must be 1
Bit 5	0 1	Block 2 read only Block 2 read/write
Bit 4	0 1	Block 3 read only Block 3 read/write
Bit 3	0 1	Block 4 read only Block 4 read/write
Bit 2	0 1	Block 5 read only Block 5 read/write
Bit 1	0 1	Block 6 read only Block 6 read/write
Bit 0	0 1	Block 7 read only Block 7 read/write

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Configuration Byte 1 (Address 0x01)	
Bit	Function
Bit 7	reserved, must not be changed
Bit 6	reserved, must not be changed
Bit 5	reserved, must not be changed
Bit 4	0 Configuration Page read only/locked 1 Configuration Page read/write **Attention:** Clearing this bit is irreversible.
Bit 3	reserved, must not be changed
Bit 2	reserved, must not be changed
Bit 1	reserved, must not be changed
Bit 0	1 must be 1

Attention:
After clearing bit 4 of configuration byte 1 the configuration page of HITAG 1/S (2048 bit) RF Transponder is irrevocable protected by hardware and cannot be altered. Because of this it is crucial to write firstly the correct value to configuration byte 0 before locking irreversible the complete configuration page by clearing bit 4 of configuration byte 1.

8 Characteristics

- Dimensions: 33mm x 19mm
- Connector: 14 pin, 2 rows, 2,54mm grid
- Supply voltage: DC 5V ± 5%
- Serial interface voltage: 5V (TTL)
- Supply current: max. 50mA
- Power consumption: max. 250mW
- Read/Write access time max. 200ms

9 Additional Information

The SynLock-Pico-Module uses the HITAG Read/Write IC HTRC110. Additional inside information (e.g. antenna design and tuning) are available in /2/

10 References

/1/ SynLock Serial Interface Protocol Specification
(SynLock Serial Interface.pdf)
heddier electronic GmbH
September2003

/2/ Application Note AN 98080
Read/Write Devices base on the HITAG Read/Write IC HTRC110
Philips Semiconductors
September 1998

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12 Manufacturer

Manufacturer of the SynLock-Pico-Module is

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