

Standard Read/Write ID Transponder with Anticollision

Description

The TK5551 is a complete programmable R/W transponder which implements all important functions for identification systems, including anticollision (e.g. 10 transponders in < 500 ms dependent on the application). It allows the contactless reading and writing of data which are transmitted bidirectionally between a read/write basestation and the transponder. It is a plastic-cube device which accomodates the IDIC® *) e5551 and also the antenna realized as an LC-circuit. No additional external power supply is necessary for the transponder because it receives power from the RF field generated by the base

station. Data are transmitted by modulating the amplitude of the RF field. The TK5551 can be used to adjust and modify the ID-code or any other stored data, e.g. rolling code systems. The on-chip 264-Bit EEPROM (8 blocks, 33 bits per block) can be read and written blockwise from the base station. The blocks can be protected against overwriting. One block is reserved for setting the operation modes of the IC. Another block can obtain a password to prevent unauthorized writing. For detailed technical information about functions, configurations etc., please refer to the e5551 data sheet.

Features

- Anticollision ID transponder in plastic cube for R/W
- Contactless read/write data transmission
- Inductive coupled power supply at 125 kHz
- Basic component: R/W IDIC® e5551
- Anticollision mode by password request
- E.g. 10 transponders read out in < 500 ms (RF/32; maxblock 2) dependent on the application
- Built-in coil and capacitor for circuit antenna
- Starts with cyclical data read out
- 224-bit EEPROM user programmable in 32-bit blocks
- Typical < 50 ms to write and verify a block

- Write protection by lock bits
- Malprogramming protection
- Options set by EEPROM:
 Bitrate [bit/s]: RF/8, RF/16, RF/32, RF/40,
 RF/50, RF/64, RF/100, RF/128
 Modulation: BIN, FSK, PSK, Manchester,
 Biphase

Application

- Access control
- Process control and automation
- Installation and medical equipment
- Asset management

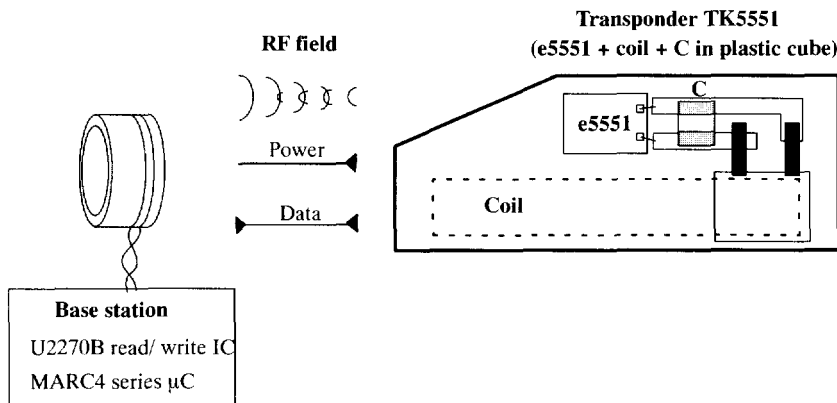


Figure 1. Transponder and base station

*) IDIC® stands for IDentification Integrated Circuit and is a trademark of Atmel Wireless & Microcontrollers.

Ordering Information

Extended Type Number	Package	Remarks
TK5551A-PP	Plastic cube	All kind of modulation; RF/8, RF/16, RF/32, RF/40, RF/50, RF/64, RF/100 and RF/128 *) Default programmed: Manchester Modulation, RF/32, MAXBLK = 2

*) see datasheet e5551

General

The transponder is the mobile part of the closed coupled identification system (see figure 1), whereas the read/ write base station is basing on the U2270B or on discrete solutions, and the read/ write transponder is basing on the IDIC[®] e5551.

The transponder is a plastic-cube device consisting of following parts:

- The transponder antenna, realized as tuned LC-circuit
- Read/ write IDIC[®] (e5551) with EEPROM

The Transponder Antenna

The antenna consists of a coil and a capacitor for tuning the circuit to the nominal carrier frequency of 125 kHz. The coil has a ferrite core for improving the distance of read, write and programming operations.

The Read/ Write IDIC[®] e5551

The read/ write IDIC[®] e5551 is part of the transponder TK5551. The data are transmitted bidirectionally between the base station and the transponder. The transponder receives power via a single coil from the RF signal generated by the base station. The single coil is connected to the chip and also serves as the IC's bidirectional communication interface.

Data are transmitted by modulating the amplitude of the RF signal. Reading of register contents occurs by damping the coil by an internal load. Writing into registers occurs by interrupting the RF field in a specific way. The TK5551 transponder operates at a nominal frequency of 125 kHz. There are different bit rates and encoding schemes.

The on-chip 264-bit EEPROM (8 block, 33 bits each) can be read and written blockwise from the base station. The blocks can be protected against overwriting by using lock bits. One block is reserved for setting the operation modes of the IC. Another block contains a password to prevent unauthorized writing.

See e5551 data sheet for more detailed information of IDIC[®].

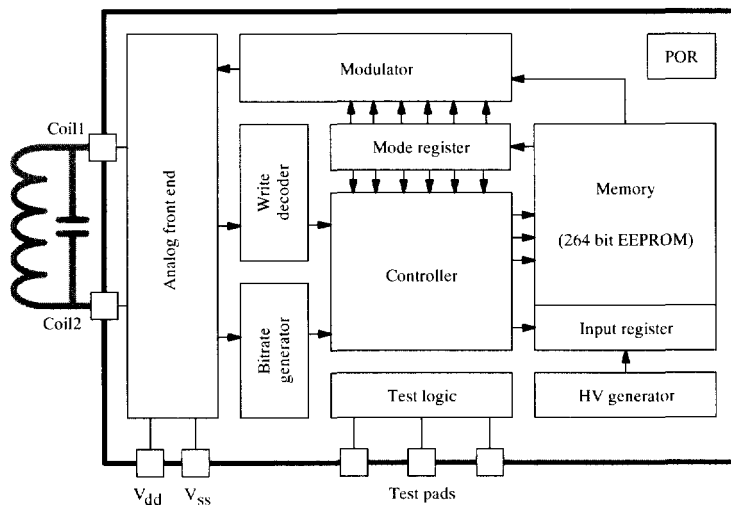


Figure 2. Block diagram e5551

Electrical Characteristics

Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Operating temperature range	T_{amb}	-40 to +85	°C
Storage temperature range	T_{stg}	-40 to +125	°C
Maximum assembly temperature, $t < 5$ min.	T_{ass}	170	°C
Magnetic field strength at 125 kHz	H_{pp}	1000	A/m

Operating Characteristics Transponder

$T_{amb} = 25^{\circ}\text{C}$, $f = 125$ kHz if not otherwise noted

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Inductance		L		3.8		mH
LC circuit, $H_{pp} = 20$ A/m						
Resonance frequency	Room temperature	f_r	120	125	130	kHz
Quality factor		Q_{LC}		13		

Magnetic field strength (H)

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Max. field strength where tag does not modulate	No influence to other transponders in the field	$H_{pp\ not}$		4		A/m
Minimum field strength						
Read mode, write mode	$T_{amb} = -40^{\circ}\text{C}$	$H_{pp\ -40}$		30		A/m
	$T_{amb} = 25^{\circ}\text{C}$	$H_{pp\ 25}$		18		A/m
	$T_{amb} = 85^{\circ}\text{C}$	$H_{pp\ 85}$		17		A/m
Programming mode	$T_{amb} = 25^{\circ}\text{C}$	H_{pp}		50		A/m
Data retention EEPROM	$T = 25^{\circ}\text{C}$	$t_{retention}$	10			Years
Programming cycles EEPROM			100,000			
Programming time / block	RF = 125 kHz	t_p		16		ms
Maximum field strength		$H_{pp\ max}$			600	A/m

Modulation range (see also H-DV curve)

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Modulation range	$H_{pp} = 20$ A/m	DV		4.0		V
	$H_{pp} = 30$ A/m			6.0		
	$H_{pp} = 50$ A/m			8.0		
	$H_{pp} = 100$ A/m			8.0		

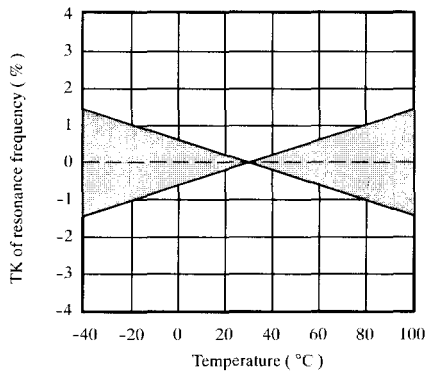


Figure 3. Typical TK-range of resonance frequency

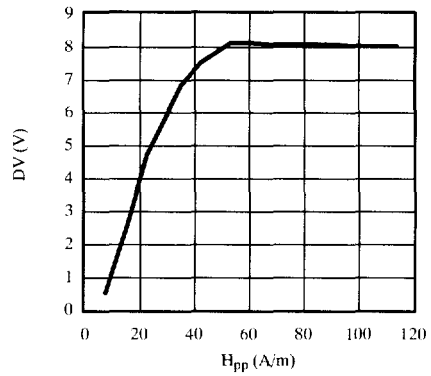
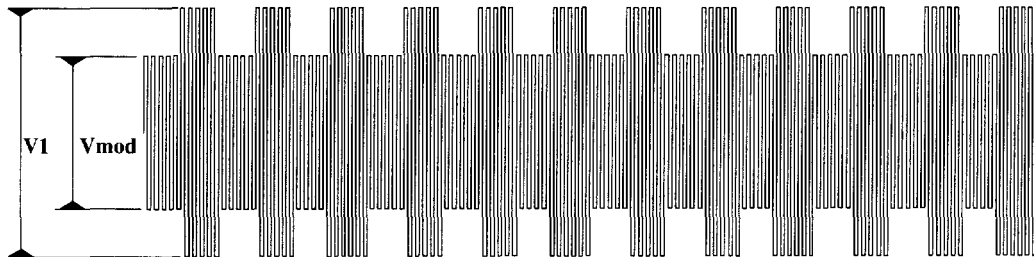


Figure 4. Typical H-DV curve

Output voltage of the testing application



$$DV \equiv V1 - Vmod$$

Figure 5. Measurement of the modulation range DV

Measurement Assembly

All parameters are measured in a Helmholtz-arrangement, which generates a homogenous magnetic field (see figure 6 and 7). A function generator drives the field

generating coils, so the magnetic field can be varied in frequency and field strength.

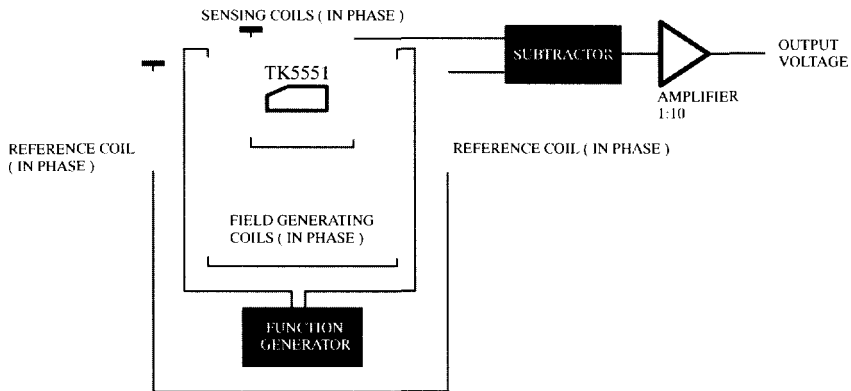


Figure 6. Testing application

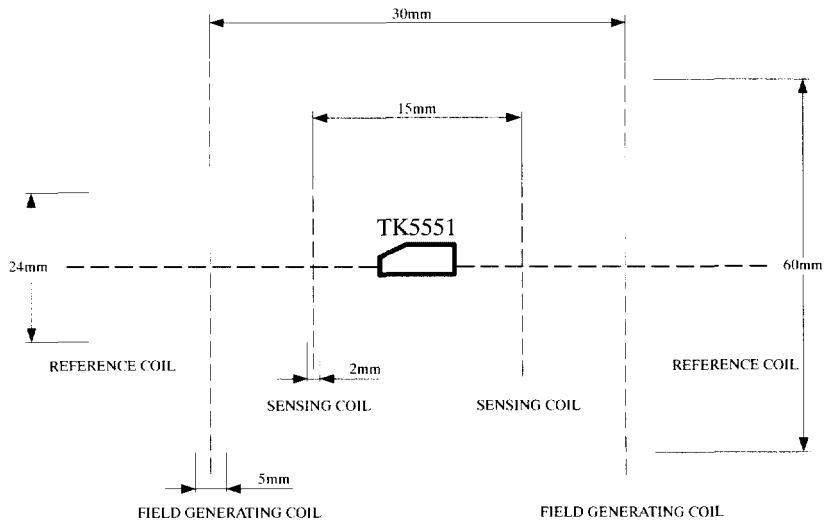


Figure 7. Testing geometry

Writing Data into the TK5551

The write sequence of the TK5551 is shown below. Writing data into the transponder occurs by interrupting the RF field with short gaps. After the start gap the standard write OP-code (10) is followed by the lockbit.

The next 32 bits contain the actual data. The last 3 bits denote the destination block address. If the correct number of bits have been received, the actual data is programmed into the specified memory block.

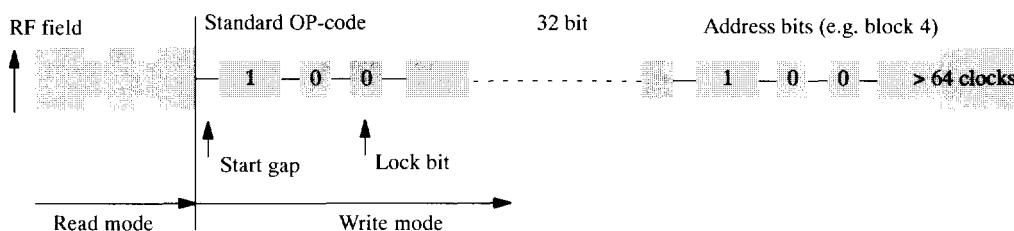
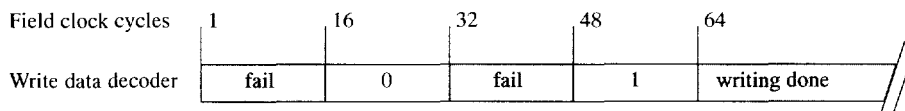


Figure 8. Write protocol

Write Data Decoding

The time elapsing between two detected gaps is used to encode the information. As soon as a gap is detected, a counter starts counting the number of field clock cycles until the next gap will be detected. Depending on how many field clocks elapse, the data is regarded as '0' or '1'. The required number of field clocks is shown in figure 9.

A valid '0' is assumed if the number of counted clock periods is between 16 and 32, for a valid '1' it is 48 or 64 respectively. Any other value being detected results in an error, and the device exits write mode and returns to read mode.



12445

Figure 9. Write data decoding scheme

Behavior of the Real Device

The TK5551 detects a gap if the voltage across the coils decreases below the threshold value of an internal MOS transistor. Until then, the clock pulses are counted. The number given for a valid '0' or '1' (see figure 9) refers to the actual clock pulses counted by the device. However, there are always more clock pulses being counted than were applied by the base station. The reason for this is the fact that an RF field cannot be switched off immediately. The coil voltage decreases exponentially. So although the RF field coming from the base station is switched off, it takes some time until the voltage across the coils reaches the threshold value of an internal MOS transistor and the device detects the gap.

Referring to the following diagram (figure 10), this means

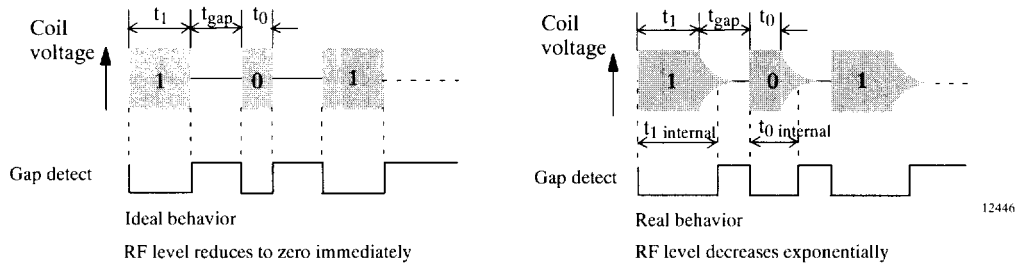


Figure 10. Ideal and real behavior signals

Operating Distance

The maximum distance between the base station and the TK5551 depends mainly on the base station, the coil geometries and the modulation options chosen (see U2270B Antenna Design Hints and the U2270B data sheet). Under laboratory conditions, a distance of up to

9 cm can be reached. For optimized distance, please refer to the application note. When using the Atmel Wireless & Microcontrollers' U2270B demo board, the typical distances in the range of 0 to 5 cm can be achieved.

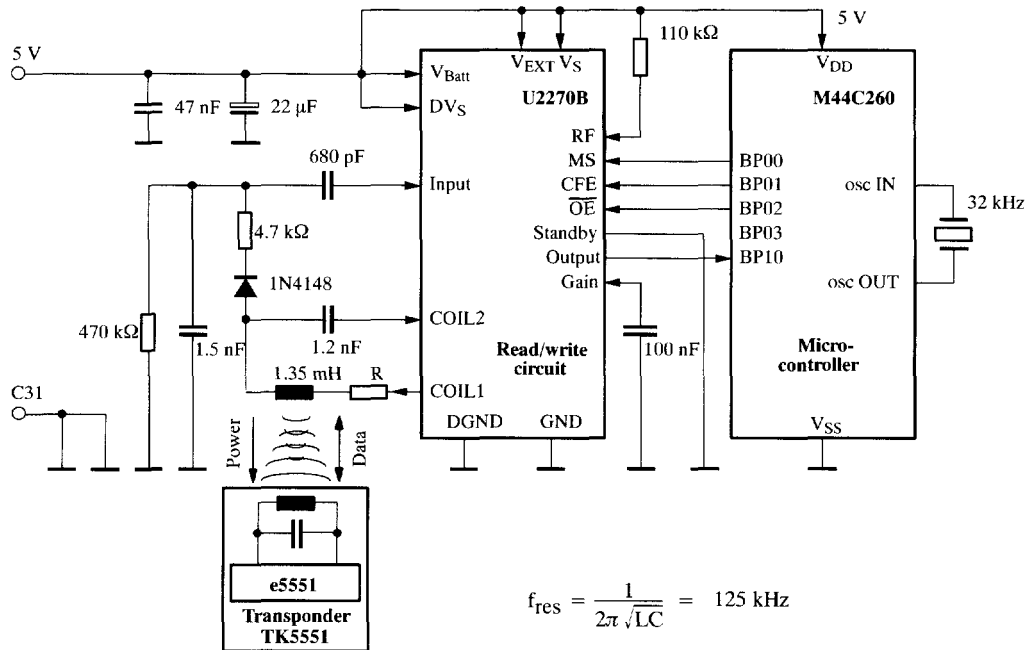
Anticollision Mode by Password Request (AOR = answer on request)

The AOR mode is an anticollision procedure for transponders to read e.g. 10 transponders in the field during 500 ms (RF/32; maxblock 2). The number of transponders and the time to read out are dependent on the application.

If the AOR mode has been configured by AOR bit at block 0, the transponder remains in sleep mode during putting it into the field. If the specified "AOR wake-up" command is sent, the dedicated transponder generates an internal RESET (see e5551 data sheet: OP-code formats). Due to the RESET the transponder is woken up. That

means, the transponder is able to modulate the field (read mode). The "AOR wake-up" command consists of the OP-code and the 32-bit password. The time duration to send the "AOR wake-up" sequence is between 8.7 ms and 27.5 ms according to figure 10. The time duration is dependent on the min./max. values of the measured write-time frames and the content of the password. To select another transponder in the field, it is necessary to send the "stop OP code" to stop the modulation of the transponder.

Application

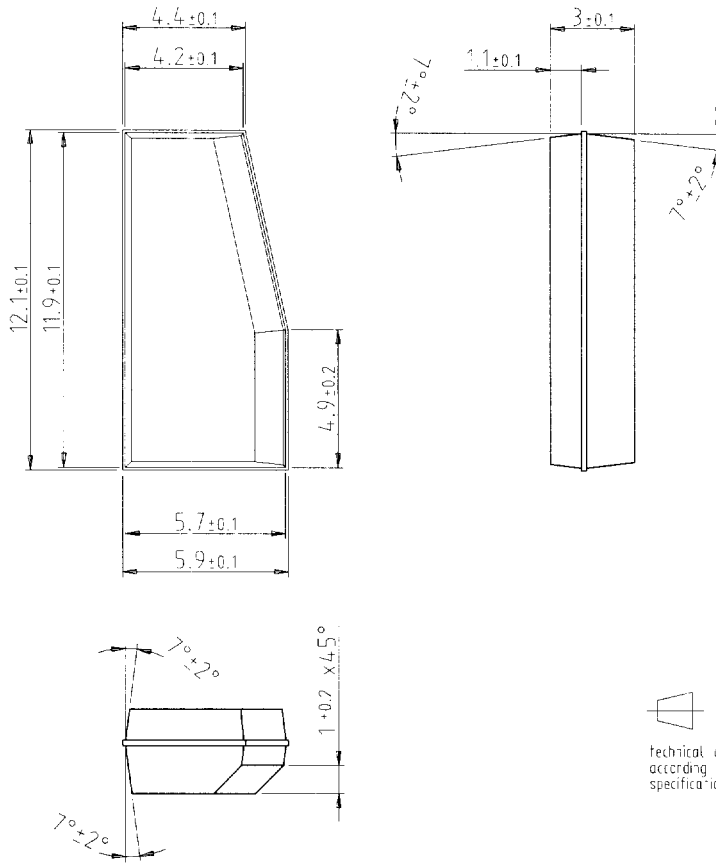


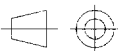
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Figure 11. Complete transponder system with the read/write base station IC U2270B

Package Information

Dimensions in mm




Technical drawings
according to DIN
specifications

