MultiTag Rfid System

RFID READER
KIT33039

13.56 MHz 'R' version
FW version 1.15F

Preface

SOLTEC Soluzioni Tecnologiche S.r.l. (SOLTEC) reserves the right to make changes to its products or services or to discontinue any product or service at any time without notice. SOLTEC provides customer assistance in various technical areas, but does not have full access to data concerning the use and applications of customer's products. Therefore, SOLTEC assumes no liability and is not responsible for customer applications or product or software design or performance relating to systems or applications incorporating SOLTEC products. In addition, SOLTEC assumes no liability and is not responsible for infringement of patents and/or any other intellectual or industrial property rights of third parties, which may result from assistance provided by SOLTEC. SOLTEC products are not designed, intended, authorized or warranted to be suitable for life support applications or any other life critical applications that could involve potential risk of death, personal injury or severe property or environmental damage. With the edition of this document, all previous editions become void. Indications made in this manual may be changed without previous notice. Composition of the information in this manual has been done to the best of our knowledge. SOLTEC does not guarantee the correctness and completeness of the details given in this manual and may not be held liable for damages ensuing from incorrect or incomplete information. Since, despite all our efforts, errors may not be completely avoided, we are always grateful for your useful tips. The installation instructions given in this manual are based on advantageous boundary conditions. SOLTEC does not give any guarantee promise for perfect function in cross environments. The companies or products mentioned in this document might be brands or brand names of the different suppliers or their subsidaries in any country. This document may be downloaded onto a computer, stored and duplicated as necessary to support the use of the related SOLTEC products. Any other type of duplication, circulation or storage on data carriers in any manner not authorized by SOLTEC represents a violation of the applicable copyright laws and shall be prosecuted.

Safety Instructions / Warning - Read before start-up!

- **The device may only be used for the intended purpose designed by the manufacturer. The operation manual should be conveniently kept available at all times for each user.**
- **Unauthorized changes and the use of spare parts and additional devices that have not been sold or recommended by the manufacturer may cause fire, electric shocks or injuries. Such unauthorized measures shall exclude any liability by the manufacturer.**
- **The liability-prescriptions of the manufacturer in the issue valid at the time of purchase are valid for the device. The manufacturer shall not be held legally responsible for inaccuracies, errors, or omissions in the**

manual or automatically set parameters for a device or for an incorrect application of a device.

- **Repairs may be executed by the manufacturer only.**
- **Only qualified personnel should carry out installation, operation, and maintenance procedures.**
- **Use of the device and its installation must be in accordance with national legal requirements and local electrical codes.**
- **When working on devices the valid safety regulations must be observed.**

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant top art 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the I nstruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTICE:
This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

NOTICE:
This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:

(3) this device may not cause harmful interference, and
(4) this device must accept any interference received, including interference that may cause undesired operation.

Table of contents

1. Introduction

The reader of the KIT33039 is a read/write RFID device for industrial application, operationg at 13.56 MHz, that communicates with a 'host' system (typically a PC or a PLC) through a RS232/RS485 serial line and acts as a joint through a set of commands between the host system and rfid tags (or transponders) presents near the antenna. The same 'master/slave' protocol is used for the communication between the host system ('master') and the reader ('slave'), independently of the kind of connection (point to point, multidrop net). Through these communication channels, it is also possible to configure the functional parameters and to upgrade the firmware. For the KIT33039 the reader works with a dedicated external rf antenna. The reader is equipped with useful removable screw terminal blocks in order to facilitate the electrical wiring in order to allow an easy installation.

2. Technical specifications

Board dimensions	**67mm x 94mm**
Power supply	**10Vdc ... 27Vdc**
Current consumption	**Max 100mA @ 12 Vdc**
Operating frequency	**13.56MHz ± 7kHz**
Supported tags	**ICODE2 (Philips) TAG-IT HF-I (TI) EM4135 (MEM) LRI 64 (ST) LRI 512 (ST) MB89R118 (FUJITSU)**
Antenna	**dedicated external**
Communication interface	**RS232 / RS485**
Signalling	**3 leds, buzzer**
Operating temperature	**0°C ... +55°C**
Connections	**Removable screw terminal blocks (cable section: 0.5 ... 1.5mm^2)**

3. Operating features

Features of the supported transponders:

Manufacturer	Part	Standard	User memory	Notes
Philips	SL2 IC S20	15693 -2 -3	896 bits (28x32) à 112 bytes	ICODE2 UID 64 bits
TI	TAG-IT HF-I	15693 -2 -3	2048 bits (64x32) à 256 bytes	TAG-IT HF-I UID 64 bits
MEM	EM4135	15693 -2 -3	2432 bits (38x64) à 304 bytes	EM4135 UID 64 bits
STM	LRI 64	15693 -2 -3	-	LRI 64 UID 64 bits 56 bits OTP
STM	LRI 512	15693 -2 -3	512 bits (16x32) à 64 bytes	LRI 512 UID 64 bits
FUJITSU	MB89R118	15693 –2-3	16000 bits (250x64) à 2000 bytes	MB89R118 UID 64 bits

Working description:

The version 'R' of the reader's firmware is characterised by the coexistence of 2 'parallel' and asynchronous activities: the transponder identification (UID code of ISO 15693 transponders) and the communication with the 'host' system. The 'continuous' identification activity, based on an anticollision loop sequence (max 16 transponders can be detected and identified), interacts with the communication activity through a buffer that contains the UID code of the last identified transponders. Due to synchronization and filtering reasons, the buffer is handled by a parameter defined as 'hold time' (fixed value of 1 second) and allows to extend 'artificially' the presence of the transponders after they leave the antenna's influence area (the hold time is applied individually for each present transponder); this behaviour is observable looking at the yellow led status that is 'on' indicating the presence of transponder/s. Through the command 'inventory' it is possible to get the data contained in the buffer.

The reader allows the execution of 'on request' functions. During the execution of these functions, the 'continuous' identification activity will be suspended temporarily. The involved commands concern read/write specific activities relative to the supported transponders.

List of configurable parameters:

parameter	range values / choices	default
network address	000 ... 255	255
baud rate	1200, 2400, 4800, 9600, 19200, 38400	19200
data bits	7, 8	8
stop bit/s	1, 2	1
parity bit	none, even, odd	none
buzzer	disabled, enabled	abilitato

4. Communication features

The 'master/slave' protocol expects that the reader (as 'slave') after the reception of a message send to him by the 'host' (as 'master'), transmits a response message after a minimum time of about 10 ms. By default, the reader will apply the following parameters: address 255, baud rate 19200, 8 data bits, parity none and 1 stop bit. These parameters can be modified as specified in the 'Parameters programming' protocol command.

To simplify the explanations, the following conventions will be used:

SOH	Character 01h (0x01)
STX	Character 02h (0x02)
ETX	Character 03h (0x03)
EOT	Character 04h (0x04)
ENQ	Character 05h (0x05)
ACK	Character 06h (0x06)
NAK	Character 15h (0x15)
SYN	Character 16h (0x16)
CR	Character 0Dh (0x0D)
'0'…'9'	Character 30h ...39h (0x30 ... 0x39)
'A'...'F'	Character 41h ...46h (0x41 ... 0x46)
<..>	Character 30h ...39h (0x30 ... 0x39), 41h ...46h (0x41 ... 0x46)
<bcc>	Checksum

This is the general structure of a message:

SOH <add h> <add l> ... <bcc> CR

SOH is the opening character, CR is the final character, <bcc> is the checking character or checksum and it is calculated as 'xor' of the previous characters starting from SOH and applying the following rule: if <bcc> = SOH or <bcc> = CR or <bcc> = EOT , then <bcc> := <bcc>+1 (must be incremented of 1).

The reader's address is expressed with a byte (0...255 in decimal, 0x00 ... 0xFF in hexadecimal) transformed into two ASCII characters: the first ASCII character <add h> represents the ASCII coding of the high nibble of the byte, while the second ASCII character <add l> represents the ASCII coding of the low nibble of the byte. Example: 255 à 0xFF à 'F' 'F'. This rule is also valid for coding a generic byte value.

The following is the structure of a generic data (data = one or more binary bytes) message is:

SOH <add h> <add l> STX <data 0> … <data n> ETX <bcc> CR

For easy comprehension, the original data bytes are expressed in hexadecimal notation (hex or 0x..). Every original data byte is transformed into two ASCII characters: the first one represents the ASCII coding of the high nibble of the byte and the second one represents the ASCII coding of the low nibble of the byte. The obtained string of ASCII characters has to replace the sting <data 0> … <data n> in the message.

Example: the 'FW version reading' command is composed by one data byte (value 0x34); the message for a reader with address 0x01 will be: SOH '0' '1' STX '3' '4' ETX ACK CR (in hexadecimal: 0x01, 0x30, 0x31, 0x02, 0x33, 0x34, 0x03 , 0x06, 0x0D).

4.1. Protocol commands – Parameters programming

This command is used to set the communication and operating parameters of the reader that are: address (0 … 255), baud rate (1200, 2400, 4800, 9600, 19200, 38400), data bits (7, 8), parity bit (none, even, odd), stop bits (1, 2), hold time (00 … 99 seconds), and flag for 'automatic' buzzer managment (disabled, enabled).

The 'master' sends the following command:

SOH <adda h> <adda l> STX '2' 'F' <addn h> <addn l> <bdr> <bit> <stop> <par> <man t> <man u> '0' '0' <filt h> <filt l> <flag h> <flag l> ETX <bcc> CR

Where:

<adda h> <adda l>	actual address	byte encoded in ASCII
<addn h> <addn l>	new address to be set	byte encoded in ASCII 0 ... 255
<bdr>	baud rate	'0' for 1200 '1' for 2400 '2' for 4800 '3' for 9600 '4' for 19200 '5' for 38400
<bit>	data bits	'7' or '8'
<stop>	stop bits	'1' or '2'
<par>	parity bit	'0' for none '1' for even '2' for odd
<man t> <man u>	hold time	'0' '0' ... '9' '9' seconds not applicable à set '0' '1'
<filt h> <filt l>	filter time	byte with decimal value encoded in ASCII 0 ... 99 for time in seconds 100 ... 199 for time in minutes (0 ... 99) not applicable à set '0' '1'
<flag h> <flag l>	flags	byte encoded in ASCII where the bits are dedicated for disabling (value 0) or enabling (value 1) specific func.: bit 7 buzzer 'automatic' managment bit 6 output relay 1 'automatic' man. not applicable à set 0 bit 5 ... bit 1 t.b.d. (must be set to 0)

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <add h> <add l> ACK <bcc> CR

Note: after the command execution, the reader applies the new parameters.

4.2. Protocol commands – Default parameters programming

This command is used to set the default values of the communication and operating parameters of the reader: address (255), baud rate (19200), data bit (8), parity bit (none), stop bit (1), flag for 'automatic' buzzer management (enabled).

The 'master' sends the following command:

SOH <adda h> <adda l> STX '3' '1' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <adda h> <adda l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <adda h> <adda l> ACK <bcc> CR

Note: after the command execution, the reader applies the new parameters.

4.3. Protocol commands – FW version reading

The 'master' sends the following command:

SOH <add h> <add l> STX '3' '4' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <add h> <add l> STX '3' '4' <vf 01 h> <vf 01 l> <vf 02 h> <vf 02 l> … <vf 15 h> <vf 15 l> <vf 16 h> <vf 16 l> ETX <bcc> CR

Where:

<vf 01 h> <vf 01 l>	ASCII coding of the byte 1 of the string
…	…
<vf 16 h> <vf 16 l>	ASCII coding of the byte 16 of the string

In this case the 16 bytes are represented by a string of 16 ASCII characters that define the version. Example '__BLUEBOX_HF_1.12f__' indicates that this is a BLUEBOX in HF configuration (High Frequency 13.56 MHz) with firmware version 1.12f.

4.4. Protocol commands – Status reading

The reader will answer to this command with a series of information about the current status.

The 'master' sends the following command:

SOH <add h> <add l> STX '3' '6' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <add h> <add l> STX '3' '6' <sta hh> <sta hl> <sta lh> <sta ll> ETX <bcc> CR

Where:

<sta hh> <sta hl> <sta lh> <sta ll>	**ASCII coding of a word (in order the nibble coding that gathers the bits from 15 to 12, the nibble coding that gathers the bits from 11 to 8, ...), with the following bit meaning:** **bit 15 not used** **bit 14 serial line interface selected (0=RS232, 1=RS485)** **bit 13 RF status (0=off, 1=on)** **bit 12...10 not used** **bit 9 relay 2 status (1=activated) not applicable** **bit 8 relay 1 status (1=activated) not applicable** **bit 7 Dip SW1 switch 4 position (1=off)** **bit 6 Dip SW1 switch 3 position (1=off)** **bit 5 Dip SW1 switch 2 position (1=off)** **bit 4 Dip SW1 switch 1 position (1=off)** **bit 3...2 not used** **bit 1 input 2 status (1=activated) not applicable** **bit 0 input 1 status (1=activated) not applicable**

4.5. Protocol commands – RF deactivation

With this command, it is possible to deactivate the reader's rf field and to suspend the transponder 'continuous' reading; this function is useful for example when 2 readers may have interferences due to their reciprocal proximity, and permits the alternative activation of the readers (see also 'RF activation' command).

The 'master' sends the following command:

SOH <add h> <add l> STX '3' '8' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <add h> <add l> ACK <bcc> CR

4.6. Protocol commands – RF activation

With this command, it is possible to reactivate the reader's rf field (see also 'RF deactivation' command) and to start again the transponder 'continuous' reading.

The 'master' sends the following command:

SOH <add h> <add l> STX '3' '9' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

SOH <add h> <add l> ACK <bcc> CR

4.7. Protocol commands – ISO 15963 transponders inventory

With this command, it is possible to get the buffer that contains the UID code of the identified ISO 15693 transponders that are present near the antenna.

The 'master' sends the following command:

SOH <add h> <add l> STX '1' '0' ETX <bcc> CR

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

a) if at least one transponder is present

SOH <add h> <add l> STX '1' '0' '0' '0' <uid 1 0 h> <uid 1 0 l>... <uid 1 i h> <uid 1 i l>... <uid 1 7 h> <uid 1 7 l> ... <uid j 0 h> <uid j 0 l>... <uid j i h> <uid j i l>... <uid j 7 h> <uid j 7 l> ... <uid n 0 h> <uid n 0 l>... <uid n i h> <uid n i l>... <uid n 7 h> <uid n 7 l> ETX <bcc> CR

Where:

i	i = 0 ... 7
j	j = 1 ... n
n	number of detected transponders
<uid j i h> <uid j i l>	ASCII coding of the byte i of UID j

b) if no transponder is present

SOH <add h> <add l> STX '1' '0' '0' '1' ETX <bcc> CR

4.8. Protocol commands – Reading a data block of an ISO 15693 transponder

With this 'on request' command, it is possible to get a data block of a known (UID) ISO 15693 transponder. Note that the number of bytes of a block depends on the transponder type; for example, the ICODE2 transponder is organized in blocks of 4 bytes, the MB89R118 transponder is organized in blocks of 8 bytes, for more details see the specific transponder data sheet.

The 'master' sends the following command:

SOH <add h<add l> STX '1' '1' <uid 0 h> <uid 0 l>... <uid i h> <uid i l>... <uid 7 h> <uid 7 l> <blk h> <blk l> ETX <bcc> CR

Where:

i	i = 0 ... 7
<uid i h> <uid i l>	ASCII coding of the byte i of the UID
<blk h> <blk l>	ASCII coding of the block (0x00 ... 0xFF)

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

a) if the addressed transponder is present

SOH <add h> <add l> STX '1' '1' '0' '0' <data 0 h> <data 0 l>... <data i h> <data i l>... <data n h> <data n l> ETX <bcc> CR

Where:

i	i = 0 ... n
n	number - 1 of bytes in the block
<data i h> <data i l>	ASCII coding the i data byte

b) if the addressed transponder do not support the requested block or if some error is occurred during the transaction

SOH <add h> <add l> STX '1' '1' '0' '2' ETX <bcc> CR

c) if the addressed transponder is not present

SOH <add h> <add l> STX '1' '1' '0' '1' ETX <bcc> CR

4.9. Protocol commands – Writing a data block of an ISO 15693 transponder

With this 'on request' command, it is possible to write a data block of a known (UID) ISO 15693 transponder. Note that the number of bytes of a block depends on the transponder type; for example, the ICODE2 transponder is organized in blocks of 4 bytes, the MB89R118 transponder is organized in blocks of 8 bytes, for more details see the specific transponder data sheet.

The 'master' sends the following command:

SOH <add h> <add l> STX '1' '2' <uid 0 h> <uid 0 l>... <uid i h> <uid i l>... <uid 7 h> <uid 7 l> <blk h> <blk l> <data 0 h> <data 0 l>... <data j h> <data j l>... <data n h> <data n l> ETX <bcc> CR

Where:

i	i = 0 ... 7
<uid i h> <uid i l>	ASCII coding of the byte i of the UID
<blk h> <blk l>	ASCII coding of the block (0x00 ... 0xFF)
j	j = 0 ... n
n	number - 1 of bytes in the block
<data j h> <data j l>	ASCII coding of the j data byte

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

a) if the addressed transponder is present and the block has been correctly written

SOH <add h> <add l> STX '1' '2' '0' '0' ETX <bcc> CR

b) if the addressed transponder do not support the requested block or if some error is occurred during the transaction

SOH <add h> <add l> STX '1' '2' '0' '2' ETX <bcc> CR

c) if the addressed transponder is not present

SOH <add h> <add l> STX '1' '2' '0' '1' ETX <bcc> CR

4.10. Protocol commands – Locking a data block of an ISO 15693 transponder

With this 'on request' command, it is possible to lock a data block of a known (UID) ISO 15693 transponder.

The 'master' sends the following command:

SOH <add h> <add l> STX '1' '3' <uid 0 h> <uid 0 l>... <uid i h> <uid i l>... <uid 7 h> <uid 7 l> <blk h> <blk l> ETX <bcc> CR

Where:

i	i = 0 ... 7
<uid i h> <uid i l>	ASCII coding of the byte i of the UID
<blk h> <blk l>	pagina (byte) codificato in ASCII (0x00 ... 0xFF)

If the addressed reader is not able to execute the command, it answers with:

SOH <add h> <add l> NAK <bcc> CR

Otherwise (the reader is able to execute the command), it answers with:

a) if the addressed transponder is present and the lock has been correctly executed

SOH <add h> <add l> STX '1' '3' '0' '0' ETX <bcc> CR

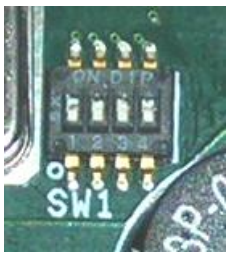
b) if the addressed transponder do not support the requested block or if some error is occurred during the transaction

SOH <add h> <add l> STX '1' '3' '0' '2' ETX <bcc> CR

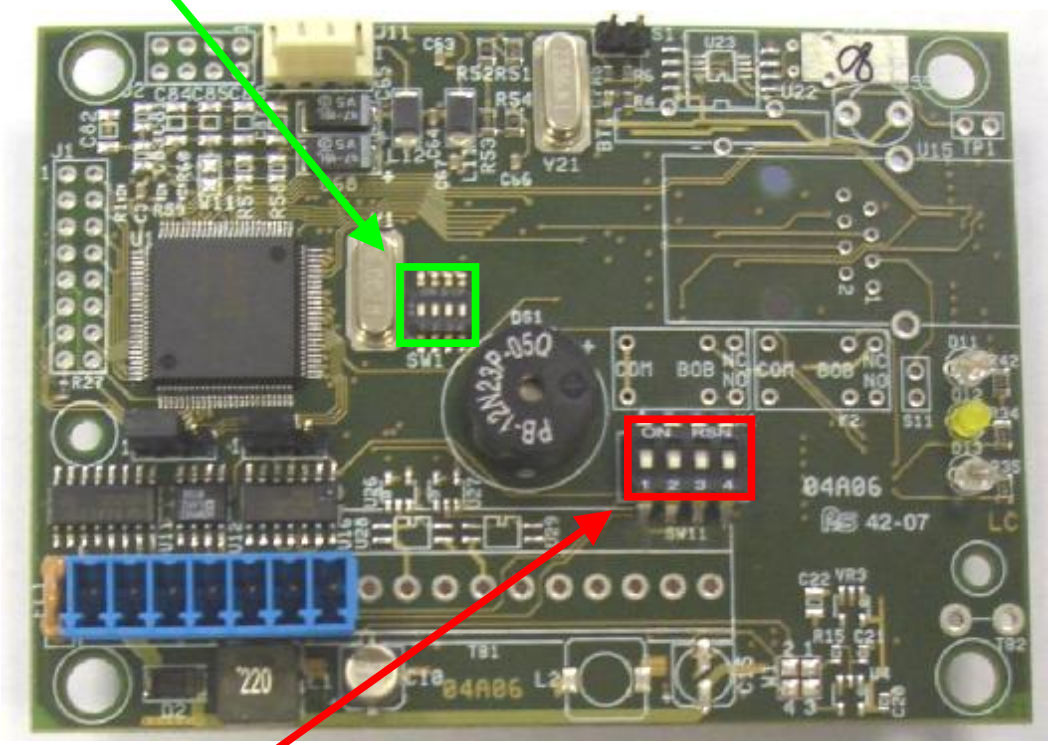
c) if the addressed transponder is not present

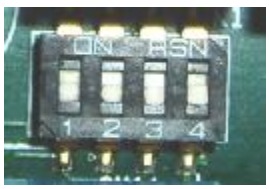
SOH <add h> <add l> STX '1' '3' '0' '1' ETX <bcc> CR

5. Hardware settings: SW1 e SW11 DIP switches



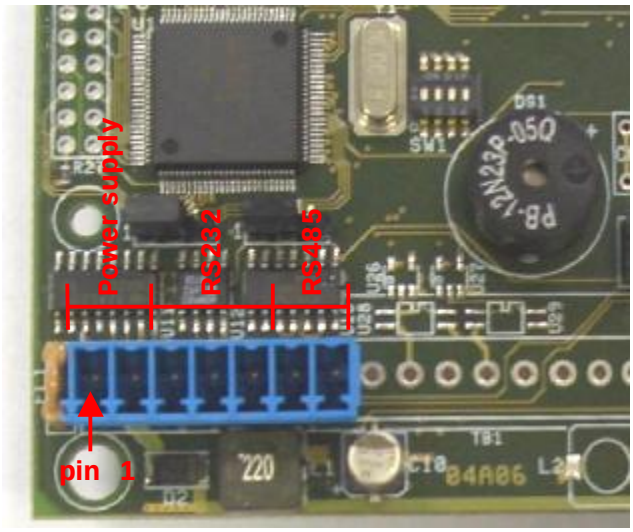
SW1	
Dip 1	forces address 255 (19200, 8,n,1)
Dip 2	-
Dip 3	-
Dip 4	-





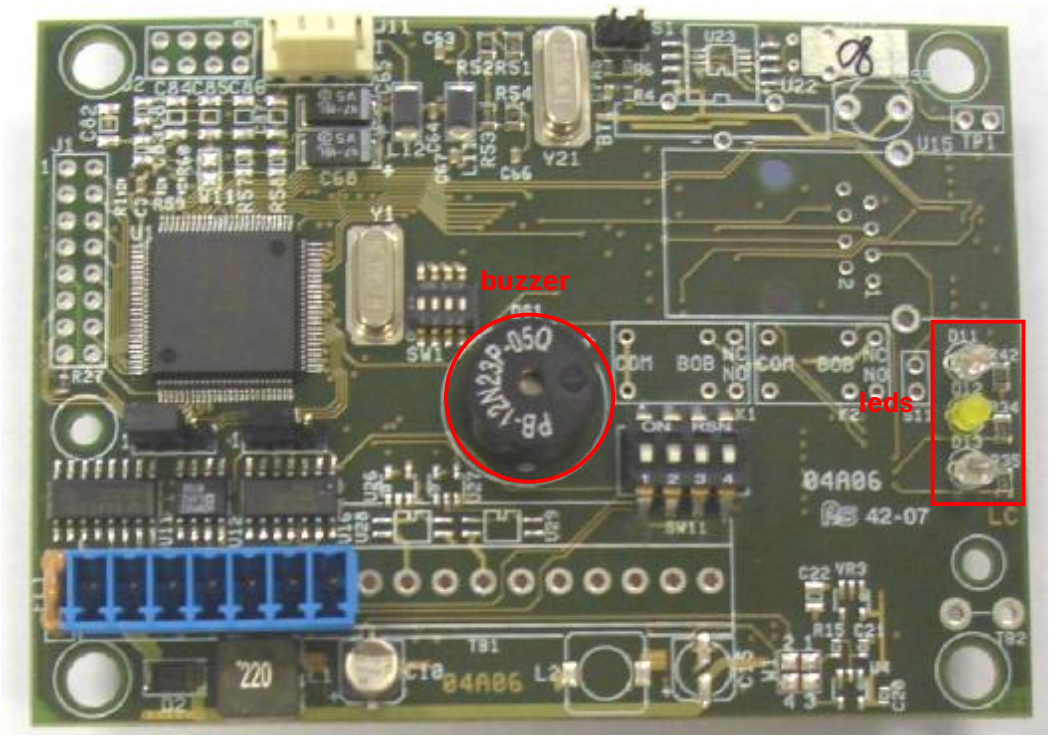
SW11	
Dip 1	On: RS485 fail-safe resistor connected to +5V
Dip 2	On: On: RS485 fail-safe resistor connected to gnd
Dip 3	On: RS485 120Ω termination resistor connected
Dip 4	Serial interface selection: On: RS485 Off: RS232

6. External connections



Pin	No	Min	Typical	Max	Description
+ PWR	1	10Vdc	12Vdc/24Vdc	27Vdc	DC power supply
- PWR (Gnd)	2				DC power supply return
RS232 Tx	3				RS232 connection (output to host)
RS232 Rx	4				RS232 connection (input from host)
RS232 Gnd	5				RS232 connection (reference)
RS485 RT+	6				RS485 connection (positive)
RS485 RT-	7				RS485 connection (negative)

7. Status indication: leds and buzzer



Leds: the following table specifies the meaning of leds status

led	state	description
green	on	power ok
yellow	flashing on	transponder absent transponder present
red	on	missing parameters / SW1-1 switched on

Buzzer: if the 'automatic' management of the buzzer is enabled by the flag defined in the parameters, the buzzer will be activated for 0.5 seconds when one or more 'new' (not already present) transponders are identified.

Leds and buzzer behaviour during reader start up: leds will be switched on during the whole initialisation phase (about 1 second), at the end of the initialisation phase, the buzzer will be switched on for 0.5 seconds, afterwards the leds and the buzzer will work as described above.

8. Antenna

The KIT33039 is provided with a specific antenna and specific cable for the connection to the reader.

9. Installation

The reader must be fixed on a support using the four holes near the corners of the board. A minimum distance of 5 mm must be respected between the board and the support. Its important to avoid contacts of metallic parts with the board: use rather plastic fixing components (scews, nuts, washers, spacers).

Connect the cable wires (section: 0.5 ... 1.5mm^2) to the removable screw terminal blocks using suitable end terminals. In order to simplify this operation, remove the screw terminal blocks, cable them and then reinsert them when wiring is completed.

The antenna must be fixed using the four holes near the corners of the board. The antenna is adjusted to work at a distance of 50 mm of a metallic plane with its LS side oriented toward the metallic plane.