The Frequency Hop Spread Spectrum UHF RFID 4 channel Reader system in 800/900 MHz ISM band

KIS900W-4CH
Ver. 2.12

User Manual

June 2005

Federal Communications Commission (FCC) Interference Statement

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

This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operations.

Caution : Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Notice 1

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 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 instruction 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 2

Shielded RS-232 cables are required to be used to ensure compliance with FCC Part 15, and it is the responsibility of the user to provide and use shielded RS-232 cables.

Notice 3

The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

Table of Contents

1. GLOSSARY.

dB   Decibels;
dBi   Antenna gain in dB relative to isotropic antenna;
EIRP   Effective Isotropic Radiated Power;
EPC   Electronic Product Coding;
ERP   Effective Radiated Power;
FH   Frequency Hopping;
RFID   Radio Frequency Identification;
RTF   Reader Talks First (Protocol);
UHF   Upper High Frequency (Band);

2. INTRODUCTION.

This User Manual is destined for studying of the KISCOM Frequency Hop Spread Spectrum UHF RFID Scanner 4 channel System in 800/900 MHz ISM band KIS900W-4CH employment.

The System is designed to read an EM 4222 (EM Marine) and Philips UCODE EPC 1.19 SL3ICS31 01 chips based UHF transponders.
It is equipment for industrial applications especially well suited for large reading distance and multiple Tags with the Random delay Time reply on power Anticollision protocol for EM 4222. System supports OID Radio Frequency Identity Protocol for communications at 860 MHz – 960 MHz Generation 2 Identity Tag (Class 1).

The wide ranges of applications for this equipment includes

• Factory automation
• Electronic toll collection (ETC)
• Railway, car identification and tracking
• Inter modal container identification
• Asset identification and tracking
• Item management for retail, health care, and logistics applications
• Access control
• Animal identification

Typical reading range is between 30 cm to 6 m depending on the Reader model, type of antenna, used transponder and environment.

3. TECHNICAL SPECIFICATION.

3.1. KIS900W-4CH RFID reader system is used for identifying/reading transponders based on EM 4222 chip and Philips Read/write SL3ICS31 01 chip.

3.2. KIS900W-4CH RFID reader system supports multiple tag identification processes using Anticollision protocol.

3.3. KIS900W-4CH RFID reader system supports UCODE EPC Philips Tag's user memory writing protocol.

3.4. KIS900W-4CH reader system have five frequency band modifications:

Korean regulation	910 – 914 MHz (18 channels, 200 kHz spacing Frequency Hope)
USA ISM Frequency band	902 – 928 MHz (63 channels, 400 kHz spacing Frequency Hope);
Singapore Frequency band	923 – 925 MHz (8 channels, 200 kHz spacing);
EUROPE and Far East Frequency band	800 MHz 1 channel inside 869,4 – 869,65 MHz
South Africa	915.3 MHz

3.5. Carrier frequency stability 1×10^{-5}

3.6. Radio power output
- 1 W ERP (Korean Band)
- 4 W EIRP (USA ISM Band)
- 4 W EIRP (Singapore Band)
- 0,5 W ERP (European Band)
- 2 W ERP (South Africa Band)

3.7. Read range (1W)   5 meters (Typically read range depends on Reader environment and the used tag)

3.8. Transponder specification
- based on EM 4222 chip, read only;

Transponder Activation:	Random delay Time reply on power;
Tag ID	64 bit
Tag bit data rate	
Data Rate Operational modes Value 1	64 kbit/s (chip V1, V2)
Value 2	256 kbit/s (chip V3, V4, V5)
Modulation /Coding	AM/time pulse position

- based on SL3ICS31 01 chip, read/write:

Transponder Activation:	RTF (Reader Talks First);
Tag ID	64 and 96 bits EPC number support; 256 bits user memory.

Reader to Tag
    data rate   40 kbps
    Modulation /Coding   AM/Manchester encoding

Tag to Reader
    data rate   40 kbps
                                          160 kbps
    Modulation /Coding   AM/FM0 encoding

3.9. Interfaces:
    Serial RS232 / RS422 optional,
        9600, 19200, 38400 115200 baud; 8 data; no parity; 1 stop bit

    10BaseT Ethernet Port; Optional

3.10. Power Supply Input DC Voltages   5 V / 1,5 A

3.11. Operating Temperature range   -20deg to +50 deg C

3.12. Humidity   5 to 95 % non-condensing

3.13. Dimension   196 (W) x 310 (L) x 42 (H)

3.14. Weight   Approx. 1,0 Kg

3.15. Antenna

KIS900-AE

Frequency band	902-928 MHz
Gain	<6 dBi
Polarization	Horizontal
In band VSWR	< 1,2
Dimension (mm)	420 (L) 215 (w) 55 (H)
Weight	Approx. 1,5 Kg

KIS900-AN-2H02

Frequency band	902-928 MHz
Gain	<6 dBi
Polarization	Horizontal
In band VSWR	< 1,15
Dimension (mm)	454 (L) 215 (w) 55 (H)
Weight	Approx. 1,5 Kg

KIS900-AN-2V02

Frequency band	902-928 MHz
Gain	<6 dBi
Polarization	Vertical
In band VSWR	< 1,15
Dimension (mm)	454 (L) 215 (w) 55 (H)
Weight	Approx. 1,5 Kg

4. SUPPLIED GOODS AND ACCESSORIES.

KIS900W-4CH Reader	1
Antenna	1
KIS 900-AE;	
Or KIS 900-AN-2H02;	
Or KIS 900-AN-2V02	
RF Antenna Cable (length 3m)	2
KIS900W-4CH Test S/W & User Manual CD	1
RS-232 serial interface cable	1(Optional)
Power Supply Block PL-050201	1 (Optional)
AC power supply cable	1 (Optional)
Tag	Optional

5. PUTTING INTO OPERATION

a) Read please this User manual fully before any installation works.

b) Install and fix Reader, Antennas and Power Supply on the wall or another surfaces, where you will to place and to use equipment. Distance between Reader and Antenna must not be more 3 m RF cable length. The Direction of the Antenna front surface must be in direction on the wanted reading area.

There are must be used bolt M4 or M5 for Reader mounting. Mounting Bolts placement and dimension depicted on Figure 1.

There are must be made fore holes for Antenna mounting, as it depicted on Figure 2.

Notice*:* The antenna must be installed by the professional installer to comply with the safety, electrical and radiation standards.

The installer should properly configure the output power of transceiver according to related country regulation requirement and per antenna type.

FCC regulations limit exposure to radio frequency (RF) radiation. To comply with these regulations, operators of this device must maintain a distance of at least 23 cm. (9.1 inches) from the cover on the antenna assembly (The cover on the antenna is the dome shaped surface). While the device is on, the operator's body and parts of the body such as eyes, hands, or head, must be 23 cm. (9.1 inches) or farther from the cover of the antenna assembly.

FCC regulations also require that the antenna assembly of this device be installed in accordance with the installation procedures to allow the operator to comply with the limit.
Use of antennas and accessories not authorized may void the compliance of this product and may result in RF exposures beyond the limits established for this equipment.

Mounting bolts placement for Reader installation.

Reader

100 mm

270 ~ 290 mm

Bolt position
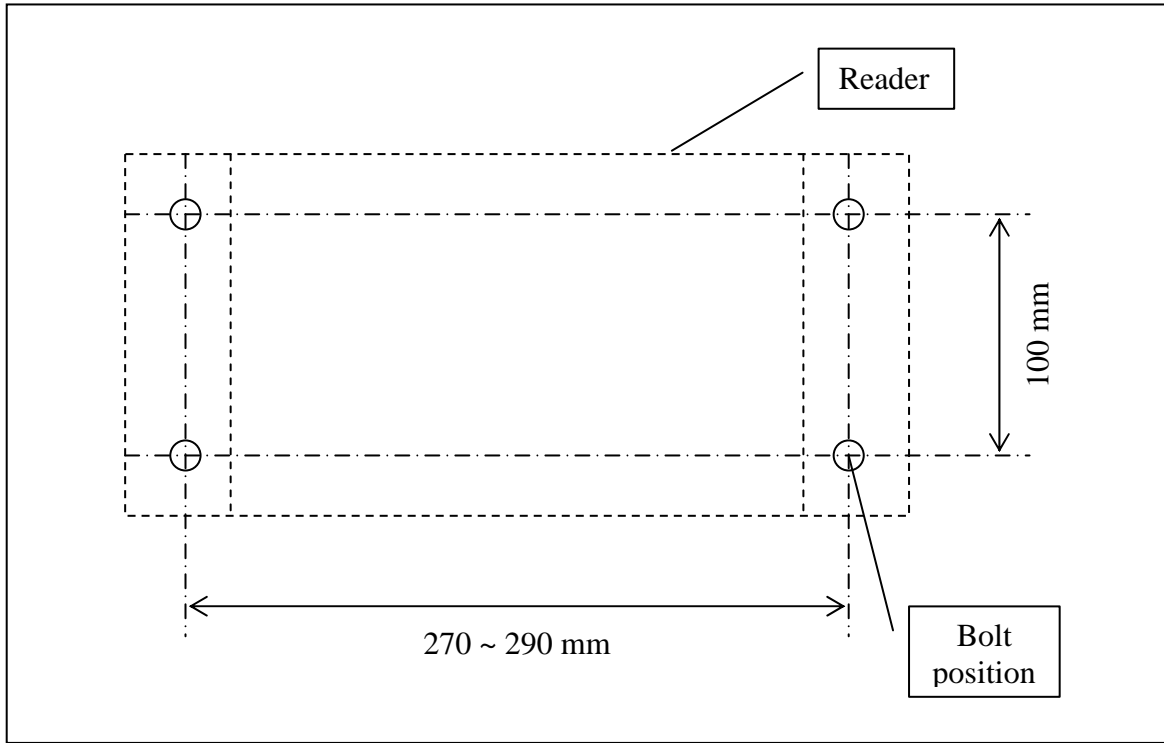
Fig. 1

Mounting Holes placement for Antenna installation.

Antenna

BNC Connector

70 mm

70 mm

Hole position
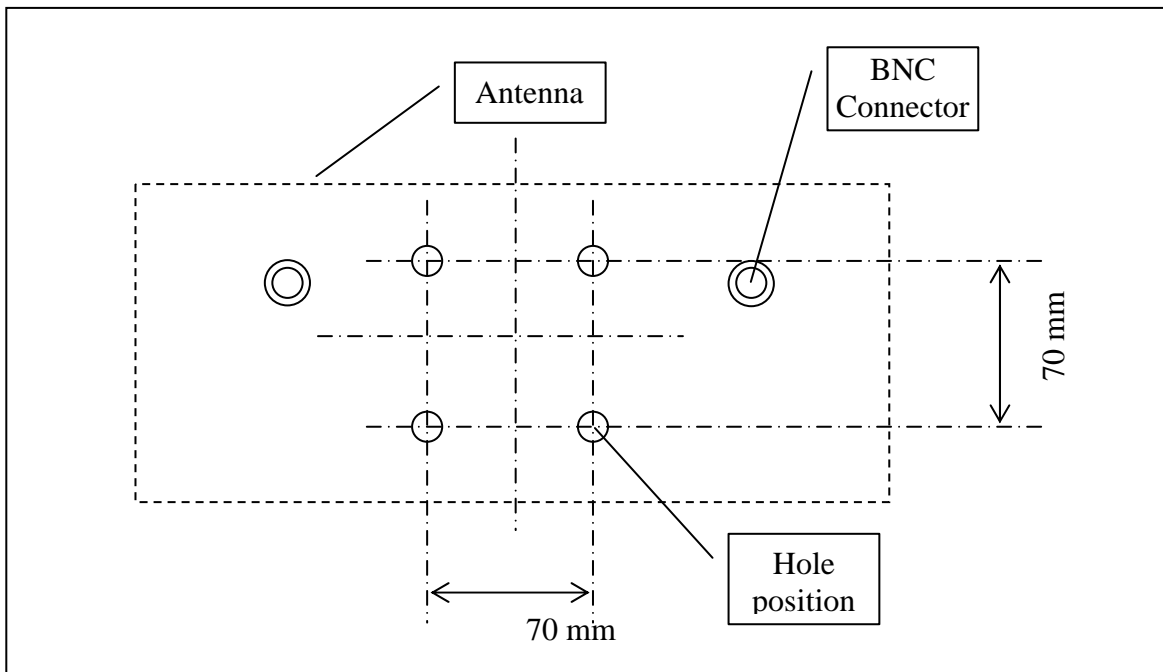
Fig. 2

c) Make next cable connections:

- Reader to Antenna using RF cables from the supplied accessories set;
- Reader to PC according to Fig. 1 in section 6 of this manual;
- Reader to Power Supply Block according to Table 1 in section 6 of this manual;

d) Run appropriate software (for example Windows terminal program) on PC.

Please assure the interface is set to the right baud rate (default Reader port parameter: 38000 baud, 8N1).

Establish a connection to the reader and connect reader power supply to power source.

After power on and successful self-test reader send a message, which must to appear on terminal window (see appendix "KISCOM UHF RFID Controller's COMMANDS"):

<KISCOM Reader 900RE Started><CR><LF>

Default RS232 interface: 38400 baud, 8 data, no parity, 1stop bit

e) Test the reader with the command described in Command Set Manual.

f) After the device is successfully tested as described above, you can set the reader configuration as needed. Details how to change the configuration of the reader are described in appendixes "KISCOM UHF RFID Controller's COMMANDS" and "KISCOM RFID READER CONFIGURATION BYTE LISTING".

Last configuration will be stored automatically in reader and used after power turn off.

6. CABLE CONNECTIONS

RS-232 Connection cable between Reader and PC depicted on Fig. 1

RS-232 Connection cable between Reader and PC

To PC 9pin Female D Type		To Reader DATA 9pin Male D Type	
Pin N	Net	Pin N	Net
1	NC	1	NC
2	Receive Data	2	Transmit Data
3	Transmit Data	3	Receive Data
4	NC	4	NC
5	Signal Ground	5	Signal Ground
6	NC	6	NC
7	NC	7	NC
8	NC	8	NC
9	NC	9	NC

Fig. 1
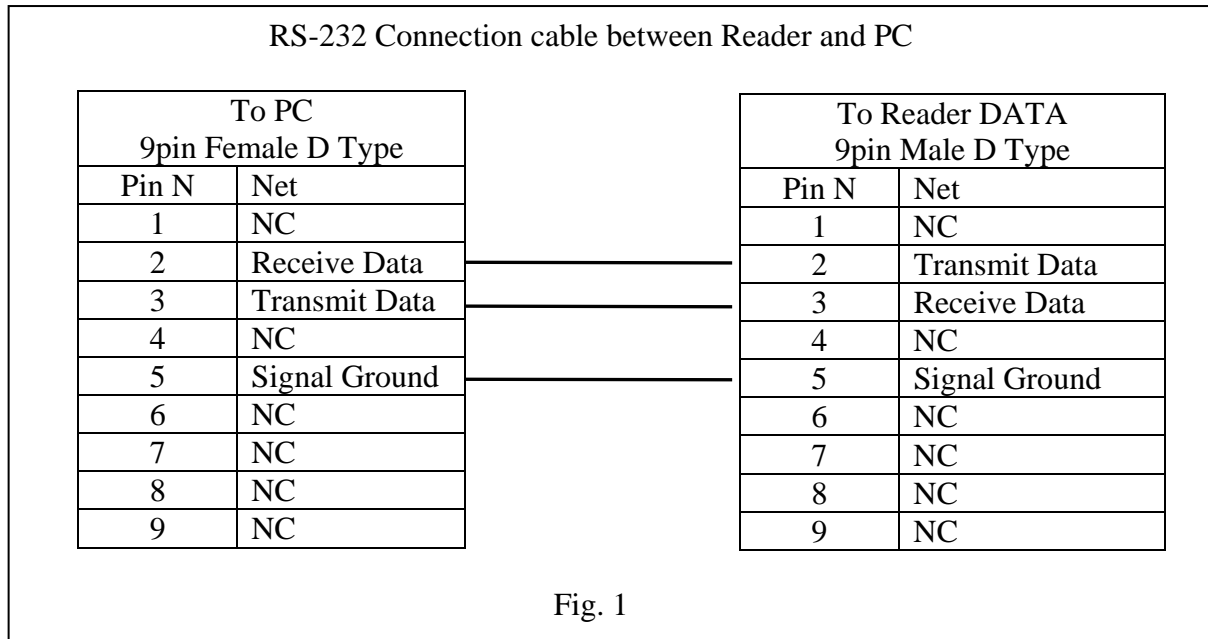
The power supply Connector pins out, current for each voltage line of power connector showed in Table 1.

TABLE 1. The power supply Connector pins out

JR1 Pin N	Supply line Voltage	Current consumption*
1	+ 5 V	1,5 A
2	GND	

Current consumption* - It is average current in the Table 1, real current may be +- 20 %.

7. TROUBLE SHOOTINGS

Should the reader not work as desired, please check the following:

a) Is the configuration of the reader as wanted?

Check with help of the command   W[w].

b) Is the configuration not known, are the baud rates of reader and terminal set different?
Restore the basic setting of the parameters values with command   D[d].
Now all parameter values are set to the default values, the reader will work in normal condition.

c) Is the antenna defect or not properly connected?

d) The transponder is not in the active antenna field. Bring the transponder closer to the antenna.

e) Antenna mounting is wrong (for example behind a metal structure).
In such a case, it can happen that the radiated power is reflected by unwanted plate in nearby metal structures.

Please change antenna position.

f) Although there is no transponder in the active antenna field.

g) Noise from another radio equipment can also reduce the read range. You should try to remove all source of noise causing devices.

Upper High Frequency fields radiated by other devices interfere with the reader communication: - power supplies, electrical motors, etc.

Please remove such devices or remove the radiated interfering field by proper grounding if trouble takes place.

8. NOTICE

a) The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers or have strict marketing control.

b) Installation of this device should be accomplished only by a qualified RF system Installer who is :

- Knowledgeable of the use, Installation and configuration procedures and associated RF components.
- Knowledgeable of each system component's equipment User and Installation Guide.
- Knowledgeable of the installation and configuration procedures for the site's. Infrastructure system and wiring.
- Knowledgeable of the installation procedures, safety, and code requirements for the site's antenna, antenna mast, antenna cabling, and installation. KISCOM highly recommends that the antenna installation be performed by a qualified antenna installation professional.

c) The intended use is generally not for the general public. It is generally for industry/commercial use.

9. WARNINGS AND CAUTIONS

! This reader is an active electrical transmission system and radiates in UHF frequency range of approximately 900 MHz. When connecting a defective or a not suited antenna to the device the radiated power can be higher than 4 dB W. The operator is responsible that the device does not endanger people at risk.

! Do not operate the device with open housing, as otherwise there is a danger, that parts with dangerous voltage can be touched.

! Do not disconnect antenna cable when reader is in operating.

! Do not operate the device with antenna cable disconnected. Operating reader with disconnected antenna can damage reader.

! Never operate the device with defective antenna cables. The antenna cables may conduct dangerous voltages. When disconnecting an antenna cable please assure that the device is turned off and the cable was grounded for a short time before touching it. Otherwise stored energy of the antenna may cause harm.

! The device should only be opened by trained personal when switched off.

! **Caution!** Do not bring another antenna very near at the operated antenna (second antenna operated or not). In both cases there is a risk, that the antenna may be destroyed. Such defects are not covered by the warranty.

10.   ORDERING AND LABEL INFORMATION.

RFID System Model Number   KIS900W-4CH-xx

Note   xx = country/frequency band version

KIS900W-4CH-00 – Korean

KIS900W-4CH-01 – USA

KIS900W-4CH-02 – EU

KIS900W-4CH-03 – South Africa

KIS900W-4CH-04 – Singapore

Antenna Model Number:

KIS900-AE – Horizontal polarization, dimension 420 x 215 x 55 mm;

KIS 900-AN 2H02 Horizontal polarization, dimension 454 x 215 x 55 mm;
Or
KIS 900-AN 2V02 Vertical polarization, dimension 420 x 215 x 55 mm

Power Supply Block PL-050201 – Input AC 100-240V 50-60Hz / Output DC 5V 2A

Reader's Label Information:

10cm

Brand-Name : KIS-SEKO   FCC ID :_____

Model : KIS900W-4CH   S/N : _____

Power : 5V DC   Date: _____

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 Made in Korea

www.kiscom.co.kr   KISCOM Co., Ltd.

4cm
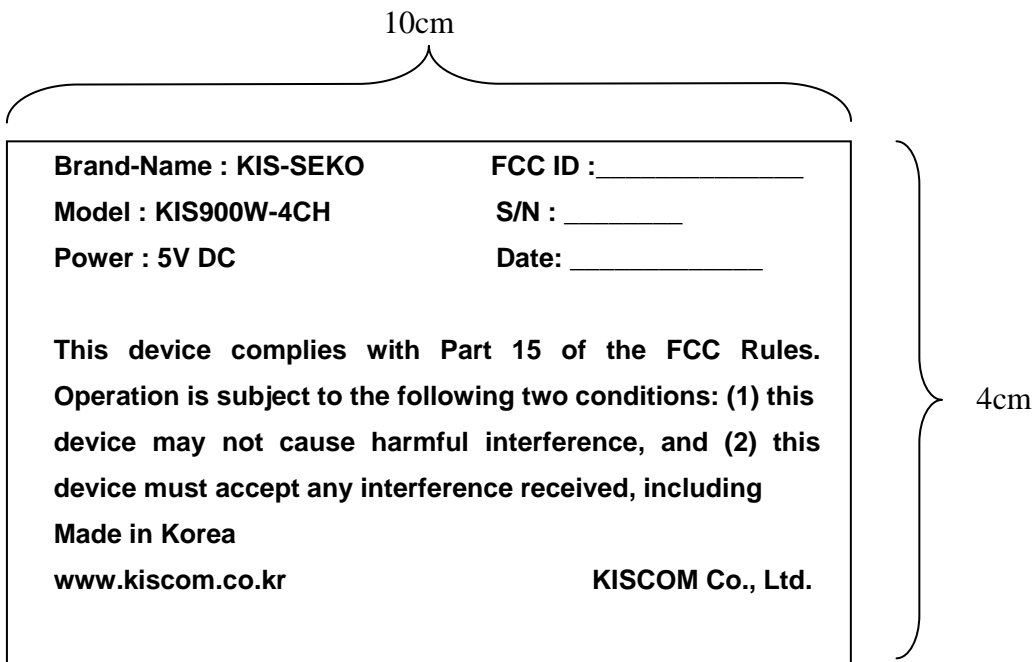
11.   APPENDIX A. KISCOM UHF RFID CONTROLLER'S COMMANDS *

1.1   Abbreviations Used

hh	=	ASCII hex config byte number	
xx	=	ASCII hex value	
iiiiiiiiii	=	tag identification number	
[x]	=	alternative characters	
<cr>	=	Carriage Return	$0D
<lf>	=	Line feed	$0A
<ack>	=	Acknowledge	$06
<nak>	=	Not Acknowledge	$15
<sp>	=	Space	$20
<SNR>	=	8 bytes Serial Number	-xxxxxxxxxxxxxxx
<ByteMask>		1 byte	-xx
BlockData>		4 bytes	-xxxxxxxx
WordData>		8 bytes	-xxxxxxxxxxxxxxx
<Address>		1 byte	-xx
<CRC>		2 byte	-xxxx
<NAnt>		1 byte	-xx

1.2   Base Commands

After power on and successful self-test reader send a message:
 <KISCOM Reader 900RE Started><CR><LF>
 Default RS232 interface: 38400 baud, 8 data, no parity, 1stop bit

1.2.1. Command R[r] <cr> .

Get number Tag from antenna in Continuous mode .
In this mode only data reading adopted without errors

Response
  <NAnt><iiiiiiiiiiiiiiii><CR><LF>

…………………………….
  <iiiiiiiiiiiiiiii><CR><LF>
  <iiiiiiiiiiiiiiii><CR><LF>
  <E>[P]<CR><LF>

Repeating a "R" command during date entry aborts this command

This command can be used in a mode " of single reading tag" and mode "one answer per one time"
For this case it is necessary to record 1 in fourth bit or to record 1 in fifth bit of byte of the
configuration number 4, accordingly.

1.2.2. Command V[w] <cr>.

Firmware testing and check RFID system

Response:

<Korea Integrated Systems><CR><LF>
<MultiProtocol RFID System ><CR><LF>
<Model: USG3><CR><LF>
<Firmware Version X.XX<CR><LF>
<10.03.2005><CR><LF>
<Checksum:____ ><CR><LF>

1.3.   Extended commands.

1.3.1   Command   L[l]hh xx

Set the config byte "hh" in EEPROM to a value   of "xx".
Response
<ack>xx<cr>
Where "xx" is the value the config byte requested.

1.3.2 Command S[s]hh

Get the ASCII hex value of configuration byte "hh" from the   EEPROM.

Response
<ack>XX<cr>
Where "xx" is the value the config byte requested.

1.3.3 Command   D[d]

Load the default ROM config values into RAM.

Response
<ack><Default settings!><cr><lf>
<Air Link Interface: 40Kbit per second><cr><lf>
<COM Interface: 38.4Kbits per second><cr><lf >
<Korean Standard 910-914 MHz><cr><lf >

1.3.4. Command
W[w]<NAnt><SNR><Address><ByteMask><BlockData><cr>.

Records 4 bytes of the data BlockData to the specified Address in a tag with number SNR
The starting address for the WRITE command must be on a 4-byte page boundary.
Executing WRITE, a tag only writes those bytes that are selected be the ByteMask.

Response:
    1   -   <SNR><CRC><cr>
         -   <xx><CRC><cr>
         -   <Ok on write><cr>
         -   <NAnt><BlockData><CRC><cr>

    2   -   <NAK><cr>
    3   -   <Error on synchro><cr>
    4   -   <Error on write><cr>
    5   -   <Error CRC><cr>

1.3.5 Command M[m] <NAnt><SNR><Address><cr>

Reads the 8 byte memory content beginning at the specified Address and sends back its content in
the response in a tag with number SNR

Response:
    1   -   <NAnt><WordData><CRC><cr>
    2   -   <Error on synchro><cr>
    3   -   <NAK><cr>

1.4 Remote Access & Control Commands

All described commands are activated at the installation necessary bits in config
bytes. For application in this mode is necessary the connection of a embedded module LAN
TCP/IP interface. Delivers by the order.

* NOTE

*1. This Command set is in force for KIS900W-4CH Sample S/W Version 28.02.2004. This Version
S/W maybe used to reading EM4222 V3, V4, V5 with data rate 256 kbps.*

2. Use KISCOM Demo software for sending Commands from PC to Reader.

12.   APPENDIX B.   KISCOM RFID READER CONFIGURATION BYTE LISTING

Firmware Version: V1.1
Date: 11/April/2005

Equipment: KIS900W-4CH
Notes:

```
;========================================================================
; Module   : Config
; Purpose  : Due to a lack of configuration switches, we use 5 bytes at the
;            top of the EPROM to add further configuration information to
;            the reader program.
; Mods     :
;======================================================================
;

Config bytes 05
; Control of antennas;
;
; Bit#
;
;   7 6 5 4 3 2 1 0
;   | | | | | | | |
;   | | | | | | | |
;   | | | | | | | |
;   | | | | | | | |
;   | | | | + + + +-- binary code for control of antennas
;   | | | |           1 - atenna ON
;   | | | |           0 - atenna OFF
;   | | | |
;   | | | |           1 - format of the message: number antenna + number tag
;   | | | +---------- 0 - format of the message: only number tag
;   | | |
;   | + + ----------- X NOT USED


         PUBLIC  CfgByte5

  CfgByte05  DB  00010001B      ; DB   11h
```

```
;========================================================================*
; Config bytes 04
; data format and working mode
; <NOT USED>
;   7 6 5 4 3 2 1 0
;   | | | | | | | | |
;   | | | | | | | | +-- 0   - output data format without 2 byte CRC
;   | | | | | | | |    1   - output data format with 2 byte CRC
;   | | | | | | | +---- 00  - 400 ms -time of one frequency hop
;   | | | | | | |      01  - 050 ms ……..
;   | | | | | | |      10  - 200 ms ……..
;   | | | | | +------ 11  - 100  ms ……..
;   | | | | |
;   | | | | +-------- 0   - "continuous" power mode
;   | | | | |          1   - pulse  power mode
;   | | | | |
;   | | | +---------- 0   - multianswer anti-collision mode
;   | | |            1   - reading and sending of number only of one tag
;   | | |               ( "parking mode" )
;   | | |
;   | | +----------- 0   - multianswer anti-collision mode
;   | |             1   - one ansver per one time
;   | |                ( "portable mode" )
;   | |
;   | + ------------ X   NOT USED
;   |
;   |
;   + -------------- 0   - test mode (test mode only for adjustment!)
;                    1   - pulse test mode
;

      PUBLIC  CfgByte4
  CfgByte04:  DB  00000111B    ; DB 07h ;

; CfgByte04:  DB  00001101B    ; DB 0Dh ; For special delivery
; CfgByte04:  DB  00001100B    ; DB 0Ch
; CfgByte04:  DB  00101100B    ; DB 2Dh - For special delivery ( "portable mode" )




;========================================================================*
Config bytes 03
; Control of power
; Bit#
;
;   7 6 5 4 3 2 1 0
;   | | | | | | | | |
;   | | | | | | | | |
;   | | | | | | | | |
;   | | | | | | | | |
;   | | | | + + + + +-- X NOT USED
;   | | | |
;   | | | |
;   | | | +----------- X NOT USED
;   | | |
;   | | |            1      anticollision Philips  mode
;   | | +------------- 0      one tag reading mode for Philips tag
;   | |
;   | |            1      Philips tag reading mode
;   | +--------------- 0      EMarin tag reading mode



          PUBLIC  CfgByte3

  CfgByte03:  DB  10011111B    ; DB  9Fh   ; Philips

; CfgByte03:  DB  00011111B    ; DB  1Fh   ; EMarine
```

```
;========================================================================
;  Config byte 02
;
; Bit#
;
;   7 6 5 4 3 2 1 0
;   | | | | | | | |
;   | | | | | | | | +-- 1  tag ID with data rate 256 000 baud
;   | | | | | | | |     0  tag ID with data rate 64 000 baud
;   | | | | | | | |
;   | | | | | | + +---- 00  Korean   Standard
;   | | | | | |         01  European Standard
;   | | | | | |         10  American Standard
;   | | | | | |         11  Singapore Standard
;   | | | | | |
;   | | | | | |
;   | | | | | |
;   + + +-+-+---------- X NOT USED
;
;
;
;
                PUBLIC  CfgByte2
;
;               76543210
CfgByte02:  DB  00000111B           ; DB   07


; For special delivery
; CfgByte02:  DB  10000000B          ; DB   80h




;==========================================================================*
; Config byte01
; COM port baud
;
;  Bit#
;
;   7 6 5 4 3 2 1 0
;   | | | | | | | |
;   | | | | | | | |
;   | | | | | | | |
;   | | | | | +-+-+-- RESERVED(no parity, 8 bit data)
;   | | | | |
;   | | | | |
;   | | | | |
;   | | | | | +-------- RESERVED (0 dont use RTS/CTS)
;   | | | | |                    (1 use RTS/CTS)
;   | | | | |
;   | | | +-+---------- 00 - 115200 baud; 01 – 9600 baud;
;   | | |              10 - 19200 baud;  11 – 38400 baud
:   | | |
;   | | |
;   | +------------- X NOT USED
;   |
;   +--------------- RESERVED

                PUBLIC  CfgByte1

;               76543210
CfgByte01:  DB  00110000B     ;  DB 30h
; 38400,8,n,1
```