

S&T Remote Keyless Entry System

TECHNICAL SPECIFICATION

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TABLE OF CONTENTS

1.	INTRODUCTION.....	3
1.1	REMOTE KEYLESS ENTRY FUNCTION	3
1.2	ANTI-THEFT FUNCTION	3
2.	SYSTEM DESCRIPTION.....	4
3.	RKE FUNCTION.....	6
3.1	DOOR LOCK / UNLOCK USING TRANSMITTER.....	6
3.1.1	TRANSMITTER LOCK / UNLOCK/PANIC	6
3.1.2	TRANSMITTER UNLOCK/LOCK/ TRUNK	7
3.2	BURGLAR ALARM	9
3.3	DISARMING BY KEY CYLINDER	10
3.4	SAFETY LOCK(AUTO DOOR LOCK AFTER 30SEC)	10
3.5	SECURITY INDICATOR	11
3.6	DIAGNOSTIC	11
3.7	ACTIVE RANGE	11
3.8	IPC SIGNAL CONTROL(ONSTAR FUNCTION)	12
4.	SYSTEM CONFIGURATION	13
4.1	RECEIVER	13
4.1.1	FUNCTION.....	13
4.1.2	ELECTRIC SPEC	13
4.1.3	METHOD OF CODING TRANSMITTER	13
4.2	TRANSMITTER.....	14
4.2.1	ELECTRIC SPEC	14
4.2.2	DATA FORMATION	14
4.2.3	TRANSMITTER FUNCTION.....	15
4.2.4	BATTERY	15
4.2.5	LED	16
5.	SYSTEM INPUT/OUTPUT CIRCUITS.....	17
5.1.1	SERIAL DATA LINK(NO. A17).....	17
5.1.2	ELECTRIC OUTPUT	17
5.1.2.1	HAZARD LAMP (LEFT : A26, RIGHT : A13).....	17
5.1.2.2	SECURITY INDICATOR(A19).....	17
5.1.2.3	DOOR LOCK(A10).....	17
5.1.2.4	DOOR UNLOCK(A11)	17
5.1.2.5	2 STEP UNLOCK (A16, PROVISION).....	18
5.1.2.6	HORN(A1).....	18
5.1.2.7	TRUNK RELEASE(A14).....	18
5.1.3	ELECTRIC INPUT	18
5.1.3.1	TRUNK KEY CYLINDER UNLOCK SWITCH INPUT(A4)	19
5.1.3.2	DRIVER KEY CYLINDER LOCK SWITCH INPUT(A6, PROVISION).....	19
5.1.3.3	PASSENGER KEY CYLINDER UNLOCK SWITCH INPUT(A22)	19
5.1.3.4	HOOD OPEN SWITCH INPUT(A7)	19
5.1.3.5	TRUNK OPEN SWITCH INPUT(A5).....	20
5.1.3.6	DOOR OPEN SWITCH INPUT (A8)	20
5.1.3.7	IGNITION SWITCH INPUT (A15)	21
5.1.3.8	KEY REMINDER SWITCH INPUT (A18)	21
5.1.3.9	DOOR LOCK MONITORING SWITCH INPUT (A9)	21
6.	HORN.....	22
6.1.1	ELECTRIC SPECIFICATION	22
6.1.2	MECHANICAL CHARACTERISTICS	22
6.1.3	Environment Test	22

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	2 / 23

1. INTRODUCTION

This document is the technical specification of the remote keyless entry (RKE) System for the car consisting of S&T (S&T Daewoo Co., LTD) receiver (RX), S&T transmitter (TX) and Horn.

The purpose of the S&T RKE system is to provide the remote control function and the anti-theft function in which it is installed and to prevent it from being driven by unauthorized users. The verification of the user authorization is done by using a remote control operation with the security code.

The diagnosis of the RKE is realized by the ALDL-function modes. They are realized by the ALDL test equipment. To avoid manipulation of the usage of the test equipment, especially the use of the key coding procedure has to be protected against unauthorized use.

1.1 REMOTE KEYLESS ENTRY FUNCTION

remote keyless entry occur the follow function.

- a. Remote door lock / unlock
- b. Remote trunk Release
- c. Vehicle locator
- d. Onstar function

1.2 ANTI-THEFT FUNCTION

anti theft alarm system occurs the follow function.

- a. Burglar alarm
- b. Display the ATAS status using security indicator.
- c. Safety lock

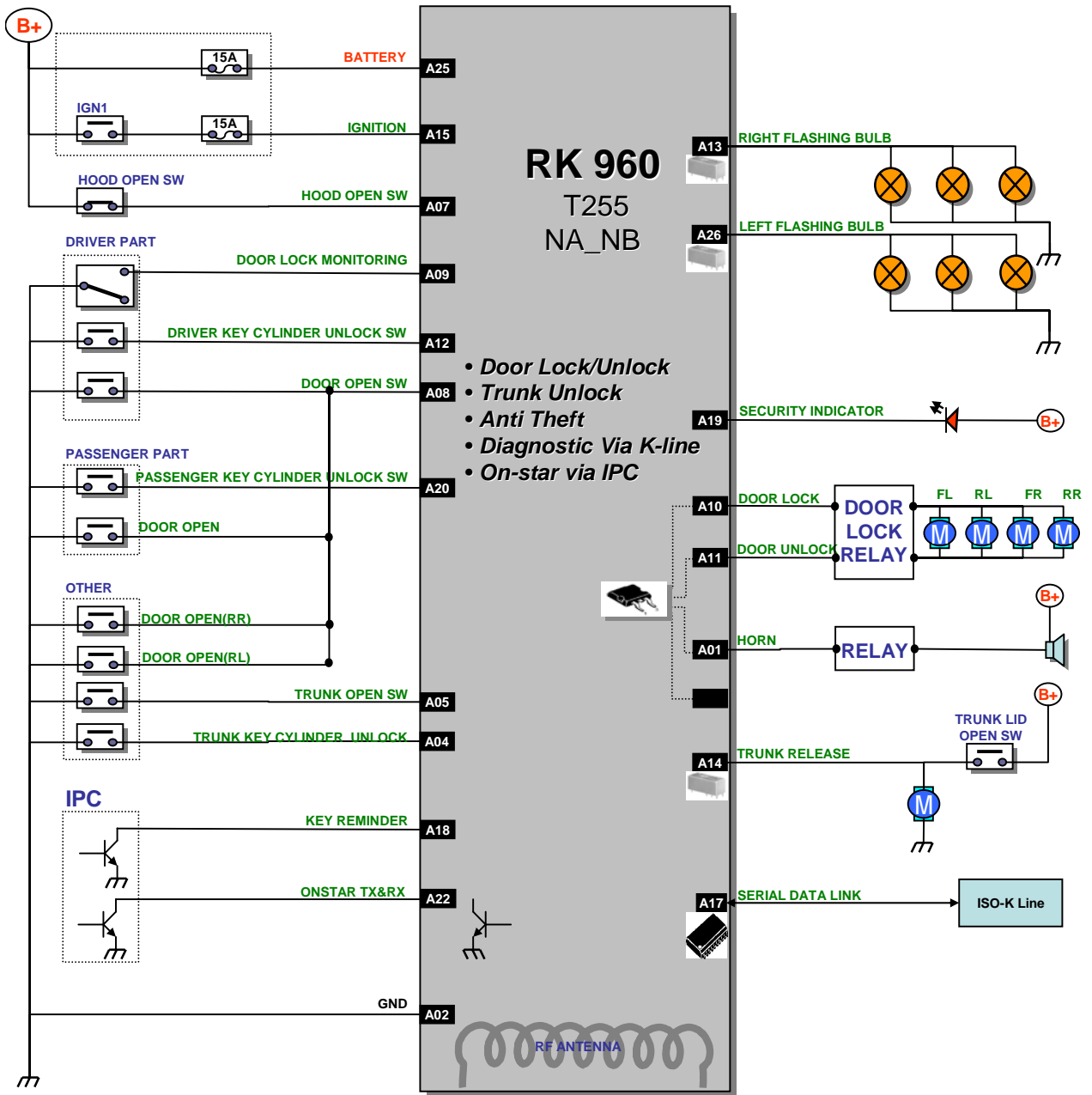
Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	3 / 23

2. SYSTEM DESCRIPTION

The RKE system consist of

- Maximum 5 of in-key type transmitter(TX)
 - A security led for displaying the RKE state
 - A horn for the alarm state
- Receiver control unit with
 - power supply
 - microprocessor
 - EEPROM
 - drivers for the external status led
 - drivers for the external horn, flashing bulb and door lock relay unit
 - drivers for the external trunk open actuator
 - serial data link for communication with the test equipment
 - ignition signal input circuit
 - theft detection input circuit(door open, hood open, trunk open)
 - key cylinder unlock input circuit
 - RF signal receiver
 - RF signal receiving antenna

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	4 / 23



[Figure 1. SYSTEM BLOCK DIAGRAM]

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	5 / 23

3. RKE FUNCTION

3.1 DOOR LOCK / UNLOCK USING TRANSMITTER

3.1.1 TRANSMITTER LOCK / UNLOCK/PANIC

This system function by using two buttons of the valid Tx is shown at Table 1. Now we define the “VALID Tx” as the ID code (Fixed code + Crypto code) of the Tx is memorized by the Control Unit.

	Status	Button	Function
A	Unset	"UNLOCK"	All door unlock, Hazard lamp blink twice, Disarming Mode
B	Set	"LOCK"	All door lock, Hazard lamp blink once, Arming Mode
C	Set/unset	"PANIC"	Horn and Hazard lamp blink 28sec

[Table 1. System Function by Using Two Buttons of the Valid Tx]

When the ignition is off, the key reminder is off and all doors(door / hood / trunk) are closed, door lock by the Tx lock button. The Rx status goes to the arming mode in the condition of the arming mode. For the information of the remote door lock, the hazard lamp blinks once for 0.5sec and the horn operates once 0.03sec.

When remote door lock is operated and not in the condition of the arming mode, hazard lamp does not blink and horn does not operation because of not changing Rx status.

When the ignition is off and the key reminder is off, the Rx drives the door actuator in order to unlock all doors by the Tx unlock button. The Rx status goes to the disarming mode. For the information of the remote door unlock, the hazard lamp blinks twice, the period is 1sec and the duty ratio is 0.5sec. But if there was the burglar alarm, the hazard lamp blinking period is 2s (0.5sec On and 1.5sec Off).

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	6 / 23

When the ignition is off and the key reminder is off, the Rx drives panic function by the Tx panic button. But it does not change the Rx status. For the information of the remote panic, the hazard lamp blinks 28sec, the period is 0.5sec and duty ratio is 0.25sec, the horn operates 28sec, the period is 1sec and the duty ratio is 0.5sec

3.1.2 TRANSMITTER UNLOCK/LOCK/ TRUNK

This system function by using two buttons of the valid Tx is shown at Table 2. Now we define the "VALID Tx" as the ID code (Fixed code + Crypto code) of the Tx is memorized by the Control Unit.

	Status	Button	Function
A	Unset	"UNLOCK"	All door unlock, Hazard lamp blink twice, Disarming Mode
B	Set	"LOCK"	All door lock, Hazard lamp blink once, Arming Mode
C	set / unset	"TRUNK"	Operating trunk solenoid

[Table 2. System Function by Using Two Buttons of the Valid Tx]

When the ignition is off, the key reminder is off and all doors(door / hood / trunk) are closed, door lock by the Tx lock button. The Rx status goes to the arming mode in the condition of the arming mode. For the information of the remote door lock, the hazard lamp blinks once for 0.5sec and the horn operates once 0.03sec.

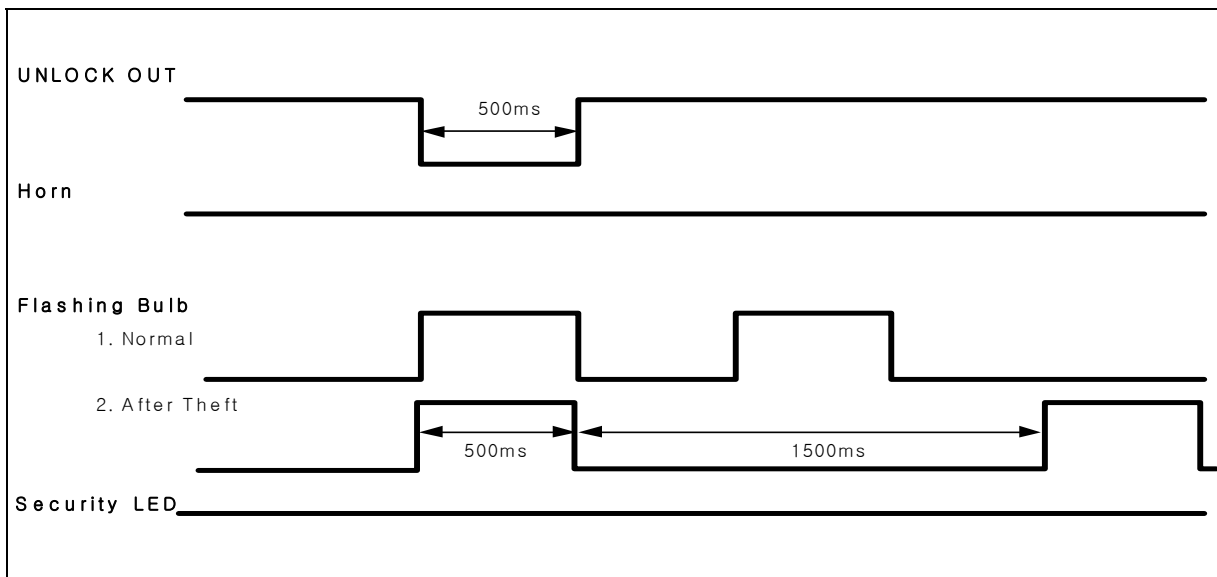
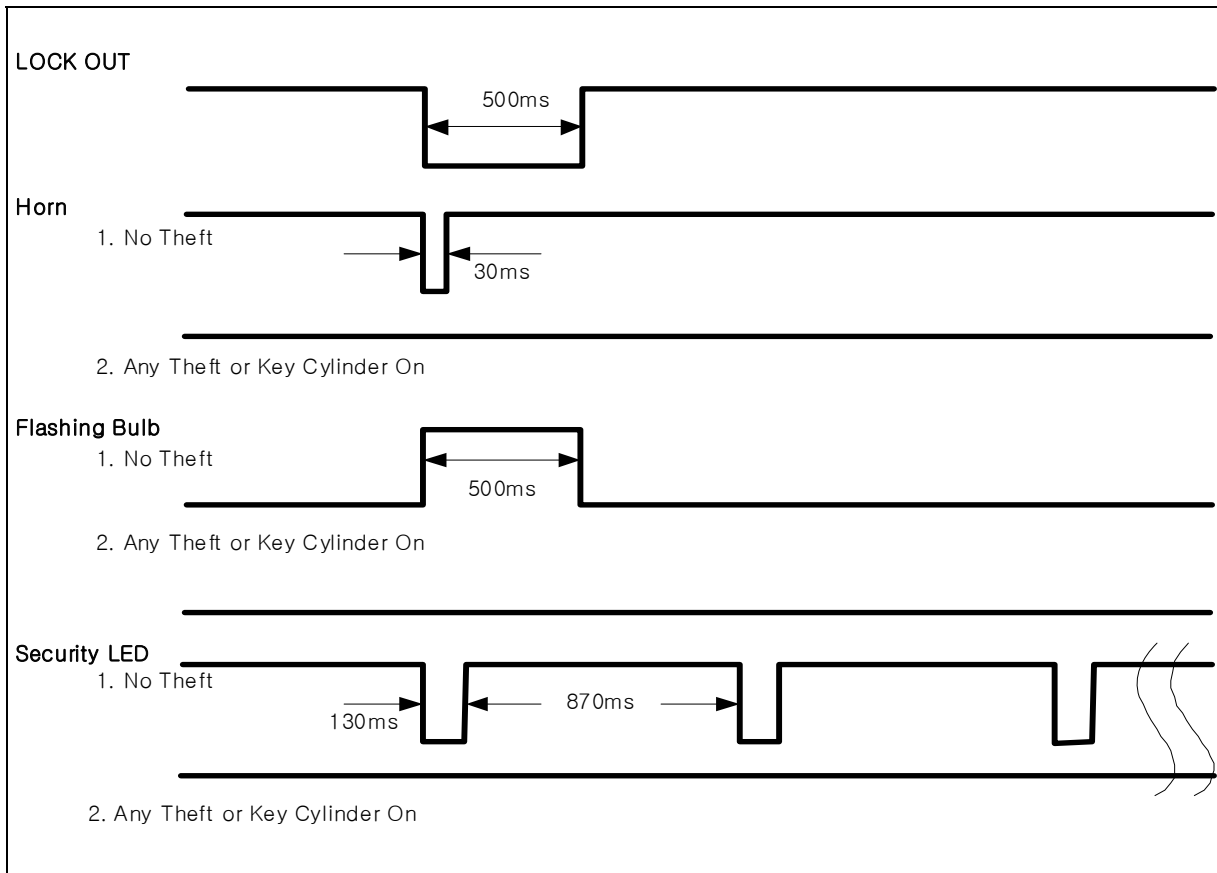
When remote door lock is operated and not in the condition of the arming mode, hazard lamp does not blink and horn does not operation because of not changing Rx status.

When the ignition is off and the key reminder is off, the Rx drives the door actuator in order to unlock all doors by the Tx unlock button. The Rx status goes to the disarming mode. For the information of the remote door unlock, the hazard lamp blinks twice, the period is 1sec and the duty ratio is 0.5sec. But if there was the burglar alarm, the hazard lamp blinking period is 2s (0.5sec On and 1.5sec Off).

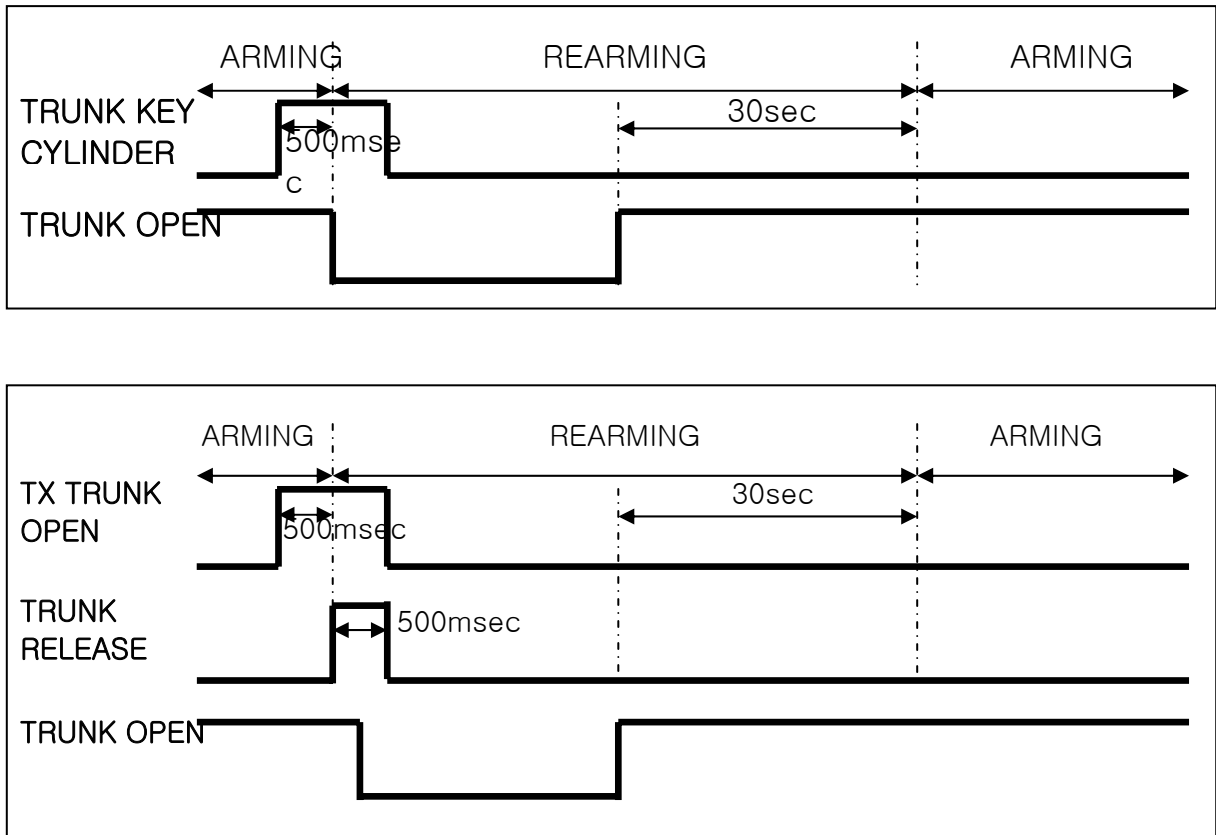
When the trunk function by the Tx trunk button operates, trunk solenoid is actuated for 500ms.

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	7 / 23

For the information of the remote trunk open. But it does not change the Rx status.



Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	8 / 23



[Figure 2. FUNCTION FLOW]

3.2 BURGLAR ALARM

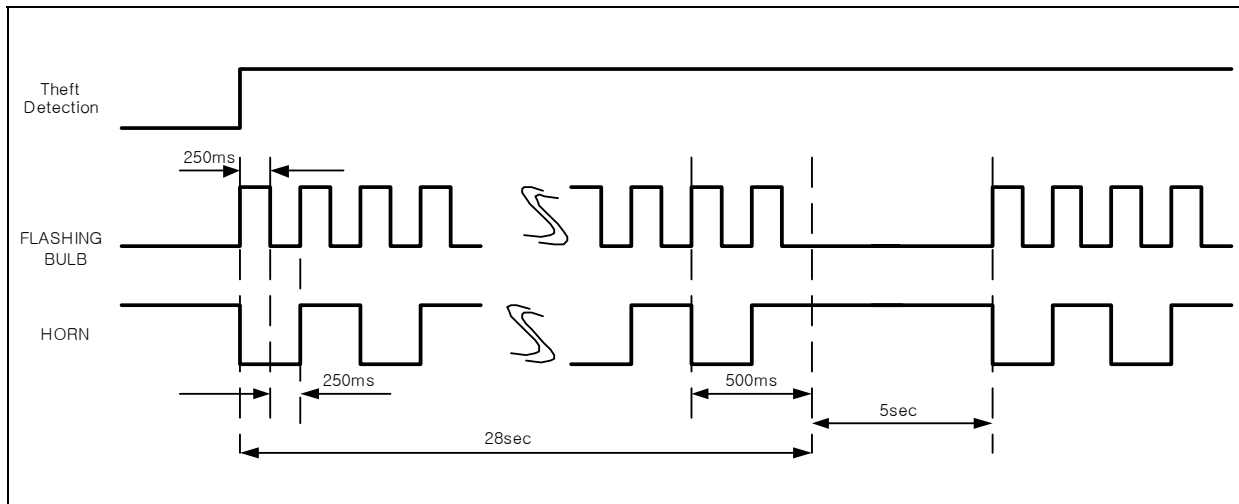
At the arming mode, if below signal input is recognized by the Rx, the burglar alarm (audible alarm (horn) and visible alarm(hazard Lamp)) is during 28 seconds operated and 5 seconds paused. The alarm activating count is the option by customer.

- ① When the door open switch input is turned to low(GND) (at the moment of opening the door)
- ② When the hood open switch input is turned to low(OPEN) (at the moment of opening the hood)
- ③ When the trunk open switch input is turned to low(GND) (at the moment of opening the trunk)
- ④ When the ignition switch input is turned to high(BAT) (at the moment of IGN on)

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	9 / 23

If the above theft detection input is received at the arming mode, the type of theft is memorized at the Rx EEPROM. But the alarm duration is not prolonged even if theft detection signal is recognized during the alarm mode. That is, the Rx ignores the theft detection input until the alarm is finished.

During the alarm is activated, if the “lock”, “unlock”, “trunk”, “panic” function code is received, the Rx performs the function according to be received code and the burglar alarm (audible alarm and visible alarm) is deactivated. If the “trunk” and “panic” function code is received, the Rx does not perform the function and the burglar alarm is deactivated. And if the tamper switch (passenger unlock disarming / driver unlock disarming / trunk unlock disarming) is ON, the Rx stops the burglar alarm and goes to the disarming mode.



[Figure 3. Timing Chart for Burglar Alarm]

3.3 DISARMING BY KEY CYLINDER

If the tamper switch (passenger unlock disarming / driver unlock disarming / trunk unlock disarming) is ON, the Rx stops the burglar alarm and goes to the disarming mode.

3.4 SAFETY LOCK(AUTO DOOR LOCK AFTER 30SEC)

At the arming mode, if the door / trunk / hood open and the ignition on is not occurred during 30

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	10 / 23

seconds after all door is unlocked by the Tx unlock button or the Tx door button, then all door is locked again and the Rx also goes to the arming mode. At the case of the safety lock, even though the Rx goes to the arming mode, the EEPROM data of the Rx about alarm is not changed. If the remote door unlock is actuated again during the waiting time (30 seconds), the safety lock process is restarted.

3.5 SECURITY INDICATOR

If the Rx status enters to the arming mode, the security indicator is blinking period 1sec (0.13sec ON 0.87sec OFF).

Security Indicator	RKE & ATAS Status
Blinking(f=1Hz) Duty cycle 1:7(ON/OFF)	Arming, Trunk Rearming State
OFF	Disarming Status

[Table 3. Security Indicator Operating timing Chart]

3.6 DIAGNOSTIC

Communication between the ECU and the diagnostic tester takes place in accordance with ISO9141-2, with line K only but without line L. Line K is a bidirectional data line used to convey request messages from the diagnostic tester to the ECU and response messages from the ECU to the diagnostic tester. Additional DIAGNOSTIC function refers to the document SPECIFICATION #DPE-AE-RK509603S Keyless Entry System Diagnostic Specification.

3.7 ACTIVE RANGE

Active functions of the receiver shall be operable when the Tx is with in the specified range of the vehicle, as follows:

FUNCTION	RANGE
All functions	≥20m : Ignition OFF ≥ 6m : Ignition ON

[Table 4. Active Range]

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	11 / 23

Active range requirements shall be met with the receiver mounted in the vehicle in its production intent mounting location and orientation. Range requirements are specified for open, flat, paved terrain, with fair weather (no rain or snow), temperatures between 0°C and 80°C, and fob height between 0.5 and 1.5 meters above the ground surface. Range shall be measured from the center of the vehicle, and is independent of fob orientation.

'remote function' and 'ignition ON' range shall be determined with the engine running, and all applicable vehicle functions (radio, rear defog, alarm, etc) in operation.

3.8 IPC SIGNAL CONTROL(ONSTAR FUNCTION)

When RKE receive specified signal time from IPC, It executes functions such as LOCK, UNLOCK, Alert. Specified signal time is as follows.

■ Signal Time for function

Function	Signal Time	IPC	RKE
1) LOCK	20ms	Transmit	Receive
2) UNLOCK	30ms	Transmit	Receive
3) Alert Audible & Visible(5min.)	40ms	Transmit	Receive
4) Alert Stop	50ms	Transmit	Receive

Alert function is performed during 5min. (Bulb 250ms ON / 250ms OFF, Horn : 500ms ON / 500ms OFF) by receiving Alert Audible & Visible signal and Alert function is stopped by receiving Alert Stop signal.

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	12 / 23

4. SYSTEM CONFIGURATION

4.1 RECEIVER

4.1.1 FUNCTION

The control unit is operating the section “3. RKE FUNCTION”

4.1.2 ELECTRIC SPEC

ITEM	DISCRIPTION
operating voltage	8V ~ 16V(Test Voltage : 12.6V)
standby current	MAX 5mA
sensitivity	-100dBm(Min)
operating frequency	315MHz \pm 5KHz
operating temperature	-40 °C ~ 85 °C
Antenna type	Internal Herical antenna
PCB thickness	16mm
PCB material	FR - 4

[Table 5. Electric specification for Receiver]

4.1.3 METHOD OF CODING TRANSMITTER

The receiver is able to save 5EA transmitter security key (fixed code + hopping code)

Method for Tx coding (save the transmitter)

- connect diagnostic connector and ALDL diagnostic device(SCAN-100 for GMDAT)
- ALDL diagnostic device selects the coding mode
- It is pressing the transmitter button 2 or 3 times.
- confirm the message for coding ok of ALDL diagnostic device.
- disconnect diagnostic connector and ALDL diagnostic device

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	13 / 23

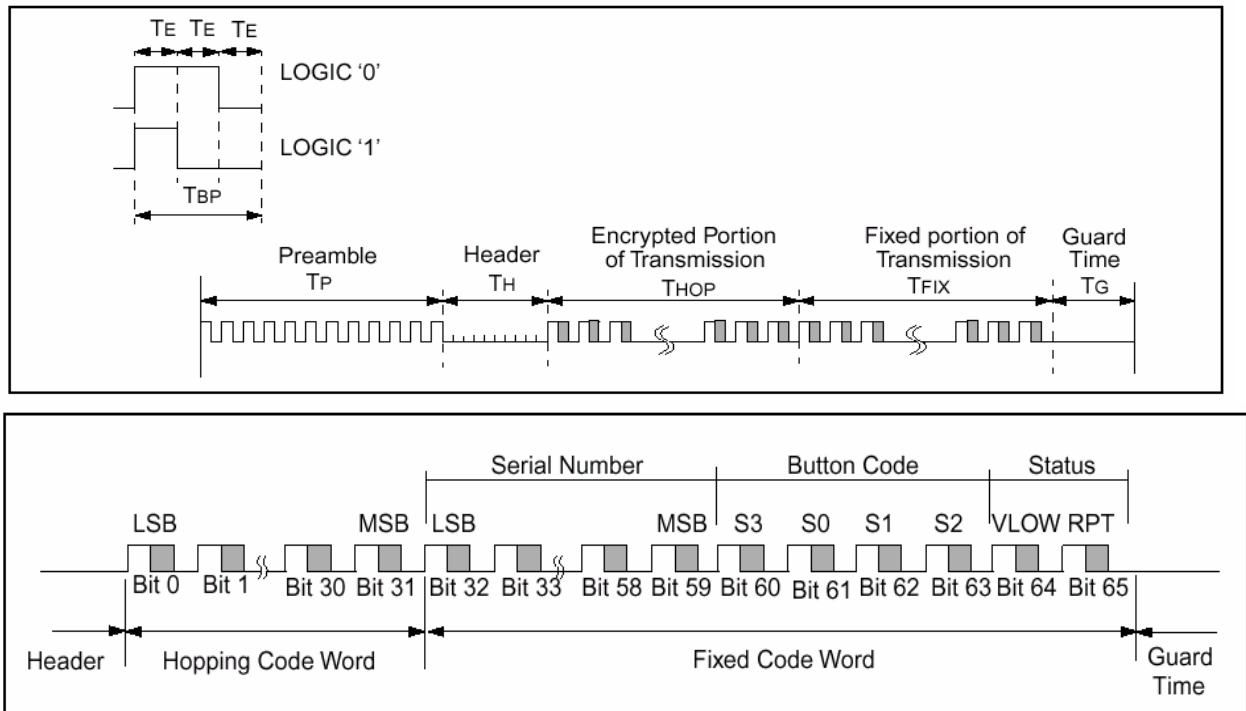
4.2 TRANSMITTER

4.2.1 ELECTRIC SPEC

ITEM	DISCRIPTION
operating voltage	2.5V ~ 3.2V
standby current	MAX 1uA
operating current	MAX 10mA
output power	10mW
modulation	FSK
operating frequency	315MHz \pm 5KHz
operating temperature	-10℃ ~ +60℃
Antenna type	PCB Pattern ANTENNA
PCB thickness	8mm
PCB material	FR-4

[Table 6. Electric specification for Transmitter]

4.2.2 DATA FORMATION



[Figure 4. Data Code Formation]

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	14 / 23

unit : us					
Symbol	Characteristic	Number of TE	ALL		
			Min.	Type	Max
TE	Basic pulse element	1	260	400	660
TBP	PQM bit pulse width	3	780	1200	1980
TP	Preamble duration	23	6.0	9.2	15.2
TH	Header duration	10	2.6	4.0	6.6
THOP	Hopping Code duration	96	25.0	38.4	63.4
TFIX	Fixed Code duration	102	26.5	40.8	67.3
TG	Guard Time	39	10.1	15.6	25.7
	Total Transmit Time	270	70.2	108.0	178.2
	PWM data rate		1282	833	505

[Table 7. Data Bit Timing Table]

4.2.3 TRANSMITTER FUNCTION

The transmitter trans the high frequency signal using the PWM (Pulse Width Modulation) method. The synchronization information, fixed information and switch information will be encrypted to form the hopping code. The encrypted or hopping code portion of the transmission will change every time a button is pressed, even if the same button is pushed again. Keeping a button pressed for a long time will result in the same code word being transmitted until the button is released or time-out occurs. If in the transmit process, it is detected that a new button is pressed, the current code word will be aborted. A new code word will be transmitted and the time-out counter will reset. If all the buttons are released, the minimum code words will be completed.

4.2.4 BATTERY

Battery removal shall be able to be performed without specialized tools. Average time to replace a battery shall be less than 5 minutes. No damage to the transmitter shall result if the batteries

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	15 / 23

are installed backwards. Battery replacement shall not require the customer to handle any loose components (i.e. circuit boards, battery clips, etc.).

Battery life shall exceed 2 years at 25°C based on usage specified in section 3.1.1, with transmission time corresponding to 1 second duration button press activations.

4.2.5 LED

During the normal transmission the led operating is ON. The transmitter button continuously ON, during about 3.2sec blinking(25ms ON, 500ms OFF) consecutively, after LED becomes OFF

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	16 / 23

5. SYSTEM INPUT/OUTPUT CIRCUITS

5.1.1 SERIAL DATA LINK(NO. A17)

It is the line for communicate receiver and diagnostic device. It defines RKE diagnostic protocol regulation(#DPE-AE-RK509603S)

5.1.2 ELECTRIC OUTPUT

5.1.2.1 HAZARD LAMP (LEFT : A26, RIGHT : A13)

- Type : Normal open Relay(TWIN,JJM2W-12V-2A)
- Output Level : Battery voltage to GND
- Max. switching current : 2 x 60 A
- Max. continuous current : 2 x 10 A @ +23℃
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request: No
- Over Current Protection Request : No
- RIGHT LOAD : 21W x 2EA, 5W x 1EA
- LEFT LOAD : 21W x 2EA, 5W x 1EA

5.1.2.2 SECURITY INDICATOR(A19)

- Type : Low Side Drive
- Output Level : 1V to GND
- Max. Output Current : 100mA
- Min./Max. Duty Cycle : 0 / 100 %
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request: No
- Over Current Protection Request : Yes

5.1.2.3 DOOR LOCK(A10)

- Type : Low Side Drive
- Max. Low Output Level : 1V to GND
- Max. Output Current : 500mA
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request : Yes
- Over Current Protection Request : Yes

5.1.2.4 DOOR UNLOCK(A11)

- Type : Low Side Drive

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	17 / 23

- Max. Low Output Level : 1V to GND
- Max. Output Current : 500mA
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request : Yes
- Over Current Protection Request : Yes

5.1.2.5 2 STEP UNLOCK (A16, PROVISION)

- Type : Low Side Drive
- Max. Low Output Level : 1V to GND
- Max. Output Current : 500mA
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request : Yes
- Over Current Protection Req'd : Yes

5.1.2.6 HORN(A1)

- Type : Low Side Drive
- Max. Low Output Level : 1V to GND
- Max. Output Current : 500mA
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request : No
- Over Current Protection Request : No

5.1.2.7 TRUNK RELEASE(A14)

- Type : Normal Open Relay
- Output Level : Battery Voltage to GND
- Max. Switching Current : 60 A
- Max. Continuous current : 10 A @ +23℃
- Fault Diagnostic Request : No
- State During Reset : Off
- Short Circuit Protection Request : No
- Over Current Protection Request : No

5.1.3 ELECTRIC INPUT

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	18 / 23

5.1.3.1 TRUNK KEY CYLINDER UNLOCK SWITCH INPUT(A4)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Unlock switch is ON
Switch Open – Unlock switch is OFF
- Open Resistance : $>50k\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND Offset Margin : $\pm 1\text{V}$

5.1.3.2 DRIVER KEY CYLINDER LOCK SWITCH INPUT(A6, PROVISION)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Lock switch is ON
Switch Open – Lock switch is OFF
- Open Resistance : $>50k\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND Offset Margin : $\pm 1\text{V}$

5.1.3.3 PASSENGER KEY CYLINDER UNLOCK SWITCH INPUT(A22)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Unlock switch is ON
Switch Open – Unlock switch is OFF
- Open Resistance : $>50k\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND Offset Margin : $\pm 1\text{V}$

5.1.3.4 HOOD OPEN SWITCH INPUT(A7)

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	19 / 23

■ Switch character

- Type : Normally Close Switch to Battery
- Function : Switch Closed – HOOD Open
Switch Open – HOOD Close
- Open Resistance : $>2\text{MK}\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND. Offset Margin : $\pm 1\text{V}$

5.1.3.5 TRUNK OPEN SWITCH INPUT(A5)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – TRUNK Open
Switch Open – TRUNK Close
- Open Resistance : $>50\text{K}\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND. Offset Margin : $\pm 1\text{V}$

5.1.3.6 DOOR OPEN SWITCH INPUT (A8)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – DOOR Open
Switch Open – DOOR Close
- Open Resistance : $>50\text{K}\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND. Offset Margin : $\pm 1\text{V}$

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	20 / 23

5.1.3.7 IGNITION SWITCH INPUT (A15)

■ Switch character

- Type : Normally Open Switch to Battery
- Function : Switch Closed – IGNITION is ON
Switch Open – IGNITION is OFF
- Open Resistance : $>2M\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND. Offset Margin : $\pm 1V$

5.1.3.8 KEY REMINDER SWITCH INPUT (A18)

■ Switch Character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Key Reminder is ON
Switch Open – Key Reminder is OFF
- Open Resistance : $>2M\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND. Offset Margin : $\pm 1V$

5.1.3.9 DOOR LOCK MONITORING SWITCH INPUT (A9)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Lock switch is ON
Switch Open – Lock switch is OFF
- Open Resistance : $>50k\Omega$
- Closed Resistance : $<50\Omega$
- Open to Close Time : $\leq 5\text{msec}$
- Close to Open Time : $\leq 5\text{msec}$
- Noise & GND Offset Margin : $\pm 1V$

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	21 / 23

6. HORN

6.1.1 ELECTRIC SPECIFICATION

Make	FIAMM
Frequency	415±20Hz(High)
Rated voltage	12V
Power consumption	Max 3.5A(@12V)
Pressure of sound	110±5dB(@13V,2m)
Operation voltage range	10~14.5V

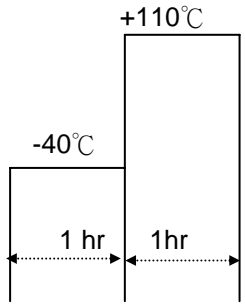
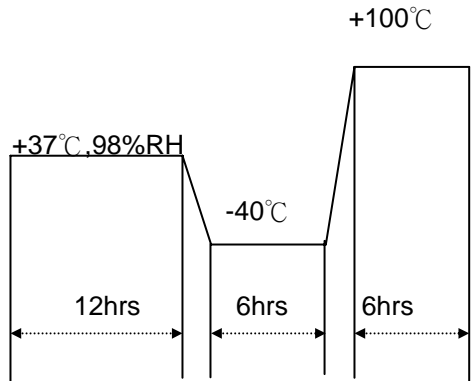
6.1.2 MECHANICAL CHARACTERISTICS

No.	Item	Test Condition	Evaluation standard
1	solder ability	Stripped wires of lead wires are immersed in rosin for 5 seconds and then immersed in solder bath of +230±5℃ for 3±0.5 seconds.	90% min. stripped wires shall be wet with solder.(except the edge of terminal)
2	soldering heat resistance	Stripped wires are immersed up to 1.5mm from insulation in solder bath of +300±5℃ for 3±0.5 seconds or +260±5℃ for 10±1 seconds, and then sounder shall be measured after being placed in natural condition for 4 hours.	no interference in operation
3	lead wire pull strength	The pull force shall be applied to lead wire : horizontal 3.0N vertical 2.0N	no damage and cutting off.
4	vibration	The test shall last 4 hours and be performed in 3 primary axis with a RMS G level=3.2G from 10 to 2000Hz..	operation shall be checked at the end of each axis test. Maintain the tolerance of ±4dB

6.1.3 Environment Test

No.	Item	Test Condition	Evaluation standard
1	frost	Placed at -40 ℃ for 8 hours and removed to at +38 ℃ ,95%RH.Device testing will be done when an uniform frost coating is observed on the device	Being placed for 2 hours at +25℃, buzzer shall be measured. The value of

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	22 / 23

2	thermal shock	<p>The part shall be subjected to 5 thermal cycles. One cycle shall be consisted of :</p>  <p>Using 2 shuttle chambers with a 2 minutes minimum transition.</p>	<p>current consumption should be in $\pm 20\%$ compared with initial ones .The SPL(min.):100dB. The tone should be normal</p>
3	storage	<p>The part shall be subjected the uninterrupted storage schedule as below; -40°C:70hours +110°C:118hours</p>	
4	temperature. and humidity cycle test	<p>The part shall be subjected to 5 cycles. One cycle shall be consisted of::</p>  <p>Perform a functional check of each unit every 12 hours</p>	

FCC__Compliance Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES

Operating is subject to the following two conditions; (1) this device may not cause harmful interference, and (2) this device must accept ant interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

Title	Remote Keyless Entry System Specification	Spec. No.	DPE-AE-RK019912S
Written by		Rev. No.	A0
Date	24 . July. 2007	Page	23 / 23