DPI Remote Keyless Entry System

TECHNICAL SPECIFICATION

ORIGINATING CENTER:	**DPI TECHNICAL CENTER**
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TABLE OF CONTENTS

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.

1. INTRODUCTION

This document is the technical specification of the remote keyless entry (RKE) System for the car consisting of DPI (Daewoo Precision Industries,. LTD) receiver (RX), DPI transmitter (TX) and siren.

The purpose of the DPI 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. dream-net communication

1.2 ANTI-THEFT FUNCTION

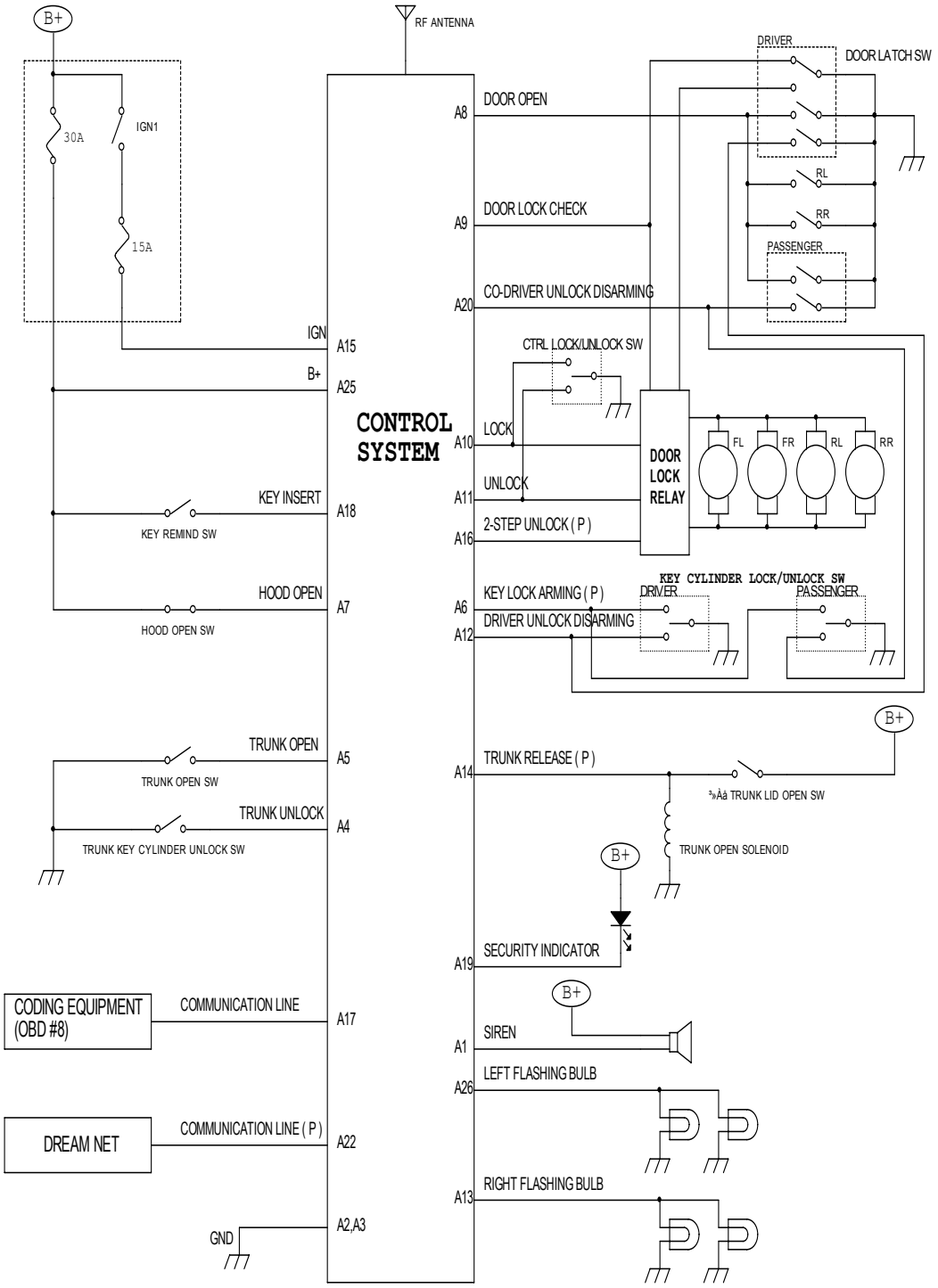
anti theft alarm system occurs the follow function.

a. burglar alarm
b. display the ATAS status using security indicator.
c. safety lock

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 siren for the alarm state
- Receiver control unit with
    - power supply
    - microprocessor
    - EEPROM
    - drivers for the external status led
    - drivers for the external siren, 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 lock / unlock input circuit
    - RF signal receiver
    - RF signal receiving antenna



[Figure 1. SYSTEM BLOCK DIAGRAM]

3. RKE FUNCTION

3.1 DOOR LOCK / UNLOCK USING TRANSMITTER

3.1.1 TRANSMITTER LOCK / UNLOCK

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

[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 siren operates once 0.05sec.
When remote door lock is operated and not in the condition of the arming mode, hazard lamp does not blink and Siren 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).

3.1.2 TRANSMITTER DOOR / 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.

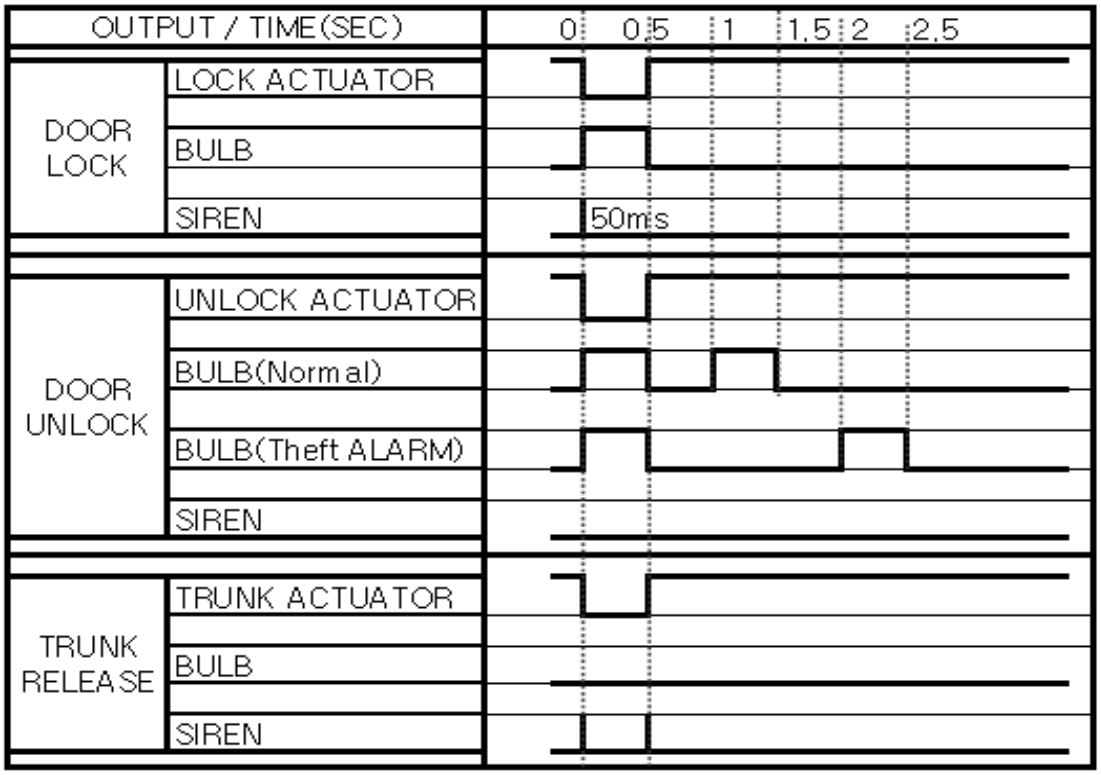
	Status	Button	Function
A	set / unset	"DOOR"	all door lock or unlock according to lock_monitoring status
B	set / unset	"TRUNK"	operating trunk solenoid and chirp operating(0.05sec on / 0.45sec off)

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

When the ignition is off, the key reminder is off, all doors (door / hood / trunk) are closed and the lock_monitoring signal is GND, door lock by the Tx door 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 siren operates once 0.05sec.
When remote door lock is operated and not in the condition of the arming mode, hazard lamp does not blink and Siren does not operation because of not changing Rx status.

When the ignition is off, the key reminder is off and the lock_monitoring signal is open, the Rx drives the door actuator in order to unlock all doors by the Tx door 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. For the information of the remote trunk open, the siren operates twice, the period is 0.5sec (0.05sec on 0.45sec off). But it does not change the Rx status.



[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 (siren) and visible alarm(hazard Lamp)) is activated 8 times 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)

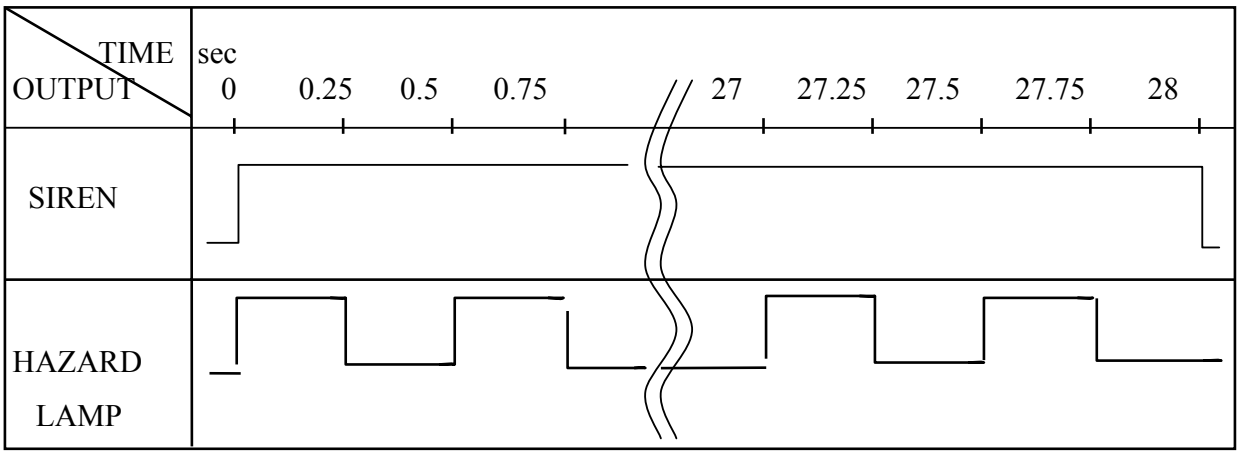
② When the hood open switch input is turned to low(OPEN) (at the moment of opening the hood)

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)

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”, “door” 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” 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 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 (0.12sec ON 0.88sec 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	≥10m : Ignition OFF ≥ 6m : Ignition OB

[Table 4. Active Range]

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.

4. SYSTEM CONFIGRATION

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	315(NA)/433.92(EU)MHz ± 5KHz
operating temperature	-40 ℃ ~ 85℃
Antenna type	pole 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)

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

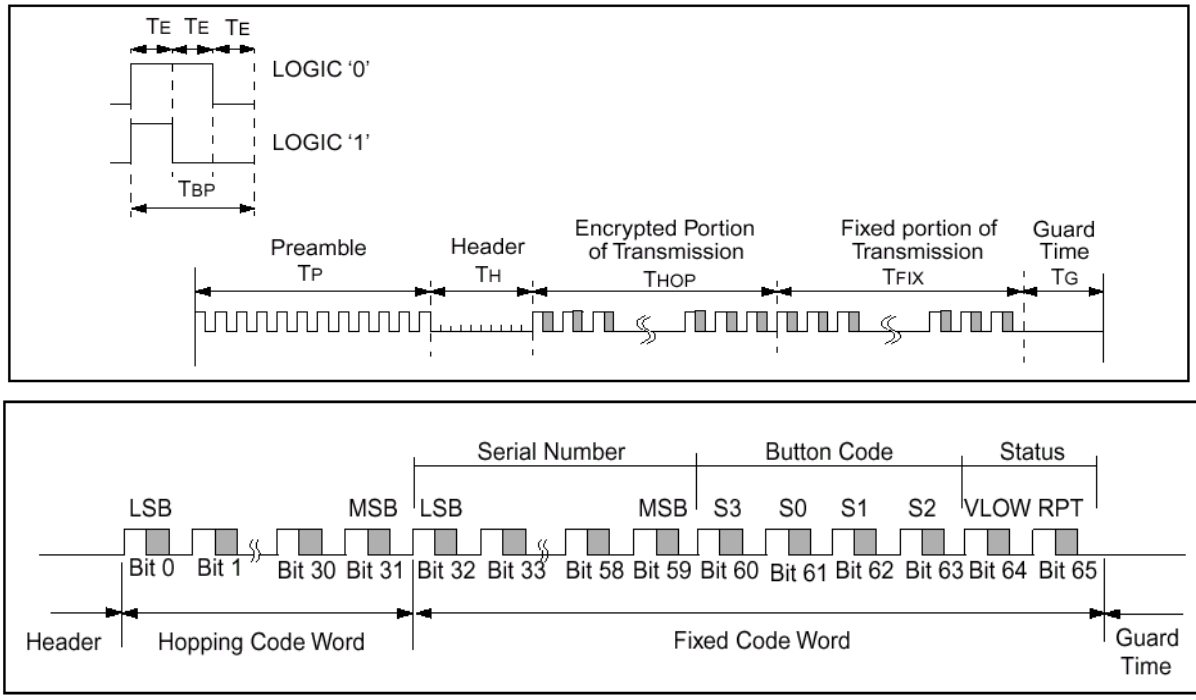
4.2 TRANSMITTER

4.2.1 ELECTRIC SPEC

ITEM	DISCRIPTION
operating voltage	2.5V ~ 3.2V
standby current	MAX 1uA
operating current	Typically 9mA , MAX 14mA
output power	2000uV/m
modulation	FSK
operating frequency	315(NA)/433.92(EU)MHz ± 3KHz
operating temperature	-20℃ ~ +70℃
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]

unit : us

Symbol	Characteristic	Number of TE	ALL		
			Min.	Typ.	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

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. If the supply voltage drops below the low voltage trip point, the led is toggled at approximately 5Hz during the transmission.

5. SYSTEM INPUT/OUTPUT CIRCUIT

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(V23072-C1061-A408)
- 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 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 UNLOCK(A11)

- 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

5.1.2.5 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 SIREN(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

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 : >50kΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND Offset Margin : ±1V

5.1.3.2 DDRIVER KEY CYLINDER LOCK SWITCH INPUT(A6)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – Lock switch is ON
  Switch Open – Lock switch is OFF
- Open Resistance : >50kΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND Offset Margin : ±1V

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 : >50kΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND Offset Margin : ±1V

5.1.3.4 HOOD OPEN SWITCH INPUT(A7)

■ Switch character

- Type : Normally Close Switch to Battery
- Function : Switch Closed – HOOD Open
  Switch Open – HOOD Close
- Open Resistance : >2MKΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND. Offset Margin : ±1V

5.1.3.5 TRUNK(TAIL_GATE) OPEN SWITCH INPUT(A5)

■ Switch character

- Type : Normally Open Switch to Ground
- Function : Switch Closed – TRUNK Open
  Switch Open – TRUNK Close
- Open Resistance : >50KΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND. Offset Margin : ±1V

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 : >50KΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND. Offset Margin : ±1V

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 : >2MΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND. Offset Margin : ±1V

5.1.3.8 KEY REMINDER SWITCH INPUT (A18)

■ Switch Character

- Type : Normally Open Switch to Battery
- Function : Switch Closed – Key Reminder is ON
  Switch Open – Key Reminder is OFF
- Open Resistance : >2MΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND. Offset Margin : ±1V

5.1.3.9 DOOR LOCK MONITORING SWITCH INPUT (A9)

■ Switch character

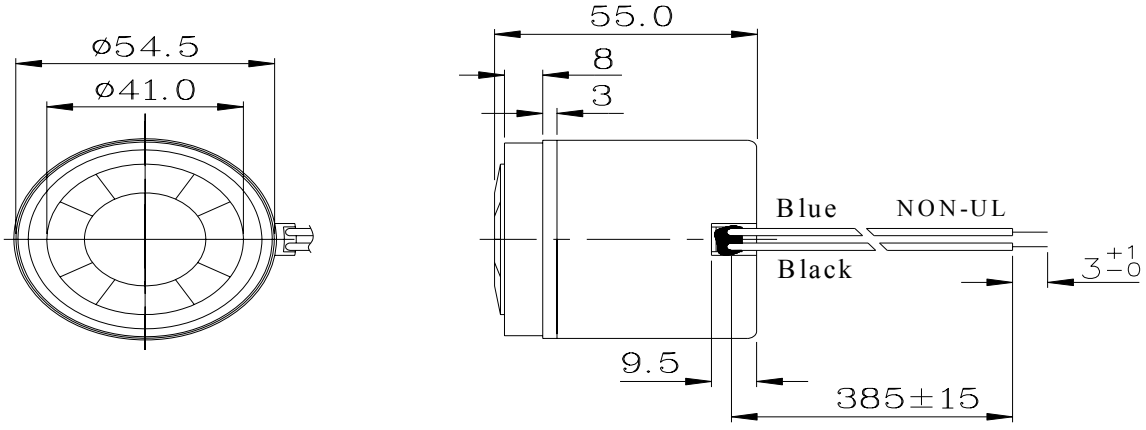
- Type : Normally Open Switch to Ground
- Function : Switch Closed – Lock switch is ON
  Switch Open – Lock switch is OFF
- Open Resistance : >50kΩ
- Closed Resistance : <50Ω
- Open to Close Time : ≤ 5msec
- Close to Open Time : ≤ 5msec
- Noise & GND Offset Margin : ±1V

6. SIREN

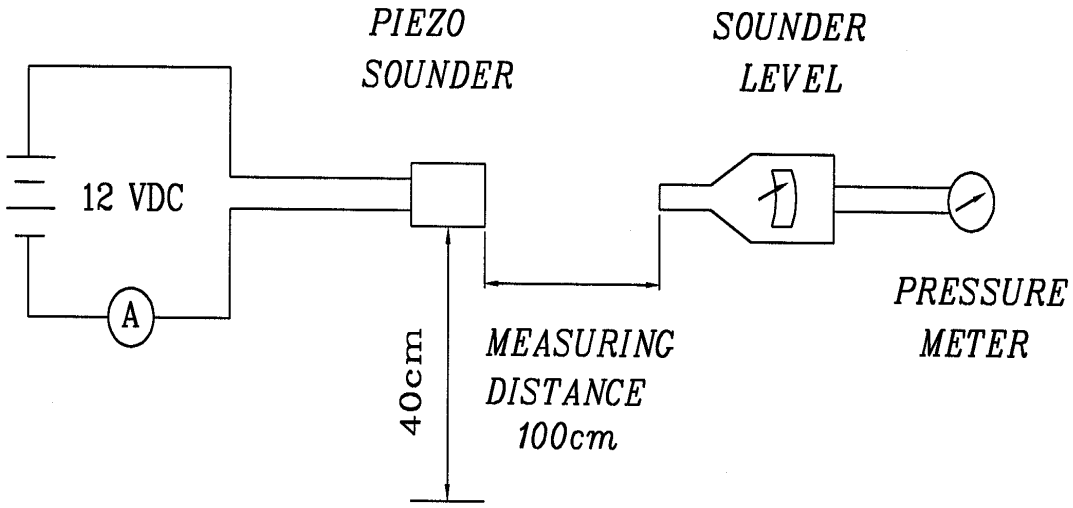
6.1.1 ELECTRIC SPECIFICATION

No.	Item	Unit	Specification	Condition
1	Operating frequency range	KHz	1.5 ~ 4.0	
2	Operating Volt. range	VDC	6 ~ 16	
3	Current Consumption	mA	MAX 260	at 12VDC
4	Inrush current	A	MAX 2	at 12VDC
5	Sound pressure level	dB	MIN 105	at 1 m/12VDC
6	Tone		Siren	
7	Sweep	Hz	2.7 ± 20%	at 12VDC
8	Operating temp.	℃	-30 ~ +100	
9	Storage temp.	℃	-40 ~ +110	
10	Dimension	mm	ϕ 54.5 x H55.0	see appearance drawing
11	Weight (MAX)	gram	107.0	
12	Material		ABS UL-94 1/16" HB HIGH HEAT (ALL BLACK)	

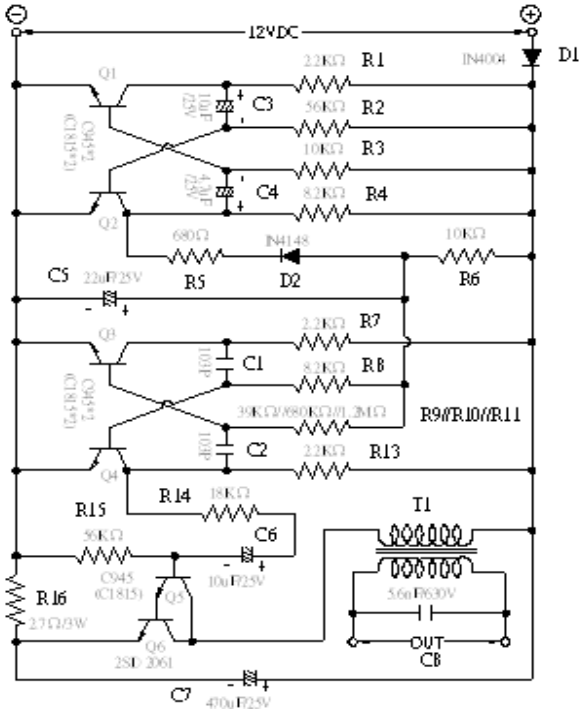
6.1.2 APPEARANCE DRAWING



6.1.3 MEASURING METHOD



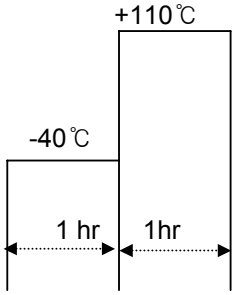
6.1.4 Internal Oscillating Circuit

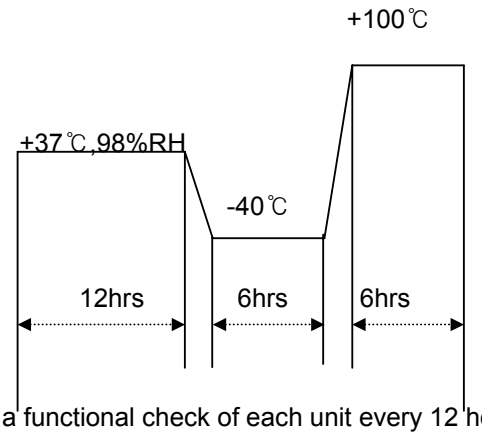


6.1.5 MECHANICAL CHARACTERISTICS

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

6.1.6 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 current consumption should be in ±20% compared with initial ones .The SPL(min.):100dB. The tone should be normal
2	thermal shock	The part shall be subjected to 5 thermal cycles. One cycle shall be consisted of :  Using 2 shuttle chambers with a 2 minutes minimum transition.	
3	storage	The part shall be subjected the uninterrupted storage schedule as below; -40℃:70hours +110℃:118hours	

4	temperature. and humidity cycle test	The part shall be subjected to 5 cycles. One cycle shall be consisted of::  Perform a functional check of each unit every 12 hours	