OVERVIEW AND OPERATION PROCESS

1. OPERATION PROCESS

1) Overview
Rain sensor wiper system is a wiper operation system that sets wiper operation time to fast or slow automatically without driver’s operation by controlling wiper motor drive when the rain sensing unit on the inner upper central windshield senses rain.

2) System Diagram

3) Principle of Rain Sensor

1. Rain sensing unit detects amount of rains through LED and photodiode.
2. When infrared rays emitted from LED are reflected against rains on the windshield surface, photodiode detects the amount of rains.
3. Rain sensing unit has glass transmitting rate compensation circuit so it can detect rains constantly regardless of transmitting rays.
4. Windshield transmitting rate can be measured at the central point on the glass between LED and photodiode.
2. OPERATION MODE

Rain sensor wiper control system has AUTO mode (on the conventional INT position) in addition to conventional wiper functions of OFF, MIST, LOW and WASHER. When positioned to AUTO, the rain sensor detects rains on the windshield and then controls wiper operation time and wiper operation speed to LOW or HIGH automatically.

<table>
<thead>
<tr>
<th>Wiper Switch Position</th>
<th>Rain Sensor Operation Mode</th>
<th>System Operation Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIST</td>
<td>MIST</td>
<td>As long as the switch is in MIST position, the wiper motor operates in low speed. The wiper blade returns to park position after wiping and does not affect on the sensor.</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>When wiper is not in park position, the wiper motor continues to operate in low speed until the wiper returns to park position.</td>
</tr>
<tr>
<td>AUTO</td>
<td>AUTO</td>
<td>Automatic delay (INT)/automatic speed control in AUTO (can be controlled by driver) position, the sensitivity against rains on windshield can be controlled by wiper switch.</td>
</tr>
<tr>
<td>(Sensitivity of AUTO mode can be controlled to stage 1 ~ 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW</td>
<td>MANUAL</td>
<td>Wiper motor operates continuously in low speed of approx. 45 rev./min.</td>
</tr>
<tr>
<td>HI</td>
<td>MANUAL</td>
<td>Wiper motor operates continuously in high speed of approx. 60 rev./min.</td>
</tr>
<tr>
<td>WASHER (When washer button pressing time is ≥ 0.6)</td>
<td>WASHER</td>
<td>When the washer switch is pressed over 0.6 sec., the wiper operates for 2.5 ~ 3.8 sec.</td>
</tr>
<tr>
<td>WASHER (When washer button pressing time is &lt; 0.6)</td>
<td>WASHER</td>
<td>When the washer switch is pressed for 0.2 ~ 0.6 sec., the wiper operates once.</td>
</tr>
</tbody>
</table>

(1) OFF mode

When wiper switch is in OFF position and ignition switch is in ON position, rain sensor operates in OFF mode. On this mode, the wiper motor does not operate. During OFF mode, rain sensor monitors windshield conditions and then sets the wiper switch sensitivity stage. So the sensor performance can be optimized when turned from OFF mode to AUTO mode. Control algorithim in OFF mode is assumed as set to normal detection.
(2) AUTO mode
When wiper switch is turned to AUTO mode from OFF, wiper operates once immediately to notice the driver wiper system operation. When operated once, the wiper stays on park position to determine whether the wiper parking time is proper for rain volume. However, this operation varies according to driver's set volume. When parking period is completed, rain sensor inputs signal to wiper motor to wipe out rains on windshield.

(3) Automatic intermittent
Under AUTO INT mode, the wiper cleans windshield once and then takes variable parking time on the inner area position.

(4) Automatic low speed
AUTO LO mode operates when rains on windshield exceed critical value of AUTO INT and AUTO LO. This critical value has magnetization characteristics that prevents repeating operation between AUTO INT and AUTO LO while accumulating rain.

(5) Automatic high speed
AUTO HI mode operates when rains on windshield exceed critical value of AUTO LO and AUTO HI. This critical value has magnetization characteristics that prevents repeating operation between AUTO LO and AUTO HI while accumulating rain.

(6) Washer mode
Rain sensor monitors whether the wiper switch has selected washer function. When washer switch on the wiper switch in wiper system is pressed on for over 0.6 sec., wiper operates for 2.5 ~ 3.8 sec. and, if not, operates once only. Under washer mode, wiper motor operates in low speed to clean the windshield.

(7) Manual mode
If the driver operates switch, the wiper motor operates in low or high speed. At this moment, the wiper operation is controlled by direct ground from wiper switch, not by rain sensor controls.

⚠️ CAUTION
- When rain sensor is defective, wiper operates in low/high speed normally.
3. OPERATIONAL CHARACTERISTICS OF RAIN SENSOR

(1) Power stabilization time
When power is supplied, rain sensor outputs OFF signal until there is effective output within 250 msec. Effective output is available after 2 sec. from the power supply.

(2) Control of wiper speed and frequency
Main function of rain sensor is controlling wiping speed and delay time between wiping operations and maintaining level of rains (degree of rains that covering windshield) that driver has selected. According to set sensitivity and level of rains, rain sensor algorism determines operation mode among AUTO INT, AUTO LO and AUTO HI. When sensitivity is set, wiper operation continues without driver's switch operations.

(3) Shifts between modes
Rain sensor algorism shifts among AUTO INT, AUTO LO and AUTO HI at lower so does not make shocks.

(4) Adjustable sensitivity performance
Sensitivity of rain sensor can be set by increasing/decreasing INT on wiper switch. Sensitivity can be set from stage 1 to stage 5 according to actual system. Each stage can be identified so that can satisfy every driver's desire on level of rains. Adjustable ranges are from short delay time (1 ~ 5 sec.) to long delay time (over 20 sec.), so that can meet very small amount of rain. However, if rains heavily, wiper operates continuously in high speed regardless of set sensor sensitivity.

(5) Response characteristics of AUTO LO
If rains and the wiper should be operated from 0 to AUTO LO, rain sensor's high speed demand signal output period does not exceed 9 sec.

(6) Response characteristics of AUTO HI
If rains and the wiper should be operated from 0 to AUTO HI, rain sensor's high speed demand signal output period does not exceed 9 sec.

(7) Response characteristics when shifting from AUTO LO to AUTO HI
If rains and wiper operation changes from AUTO LO to AUTO HI, rain sensor's high speed demand signal output period does not exceed 9 sec.
(8) Response characteristics when shifting from AUTO HI to OFF
If rains and wiper operation changes from AUTO HI to OFF, the system counts wiping times when it is high and low (12-time) and when it is changing from INT to OFF (7-time) not to exceed 19 times in total.

(9) Instant wipe
When wiper system is operated by wiper switch, it wipes windshield once before returning to operation position.
This one-time operation happens every time when wiper switch is operated to increase the sensitivity by changing INT volume from lower state (state 1) to higher stage. However, it does not happen when wiper switch is changed into lower sensitivity. If ignition switch is turned ON when ignition switch is turned off and wiper switch is set to a certain sensitivity, wiper operates once immediately to notice the driver wiper system operation. If rain is too small to operate the wiper system with AUTO mode, rain sensor remains in AUTO INT mode for long time.
4. REAR WIPER CONTROL SYSTEM

1) General

Conventional rear wiper system is controlled when rear wiper relay is operated by operating switch. However, rear wiper system on Rexton is controlled by separate ECU. The reason is that the conventional vehicle has rear wiper brush on the rear glass but the Rexton can open the rear glass so cannot install rear wiper brush on the rear glass. The rear wiper brush is installed on the back panel and the wiper motor is operated in 2 stages.

2) Description on System Operation

- **Wiping mode**
  1. Wiper switch is turned on, relay 1 on CONT turns on to rotate the motor clockwise.
  2. When "W" and "C" points on the CAM switch are connected during revolution, relay 1 on CONT turns off and then relay 2 turns on to rotate the motor counterclockwise.
  3. If "W" and "C" points on the CAM switch are connected during revolution again, relay 2 on CONT turns off and then relay 1 turns on to rotate the motor clockwise. It means by changing motor polarities between 2 and 4 with CAM switch, the wiper operates.

- **Parking mode operation**
  1. Parking while operating clockwise: If turns off wiper switch during wiper operation, "W" and "C" points on the CAM switch are connected during revolution, then relay 1 on CONT turns off to stop the motor. After 1 second, relay 1 on CONT turns on to rotate the motor clockwise and then "P" and "C" grounds on the CAM switch are connected to turn off relay 1 on CONT and to stop motor.
  2. Parking while operating counterclockwise: If turns off wiper switch during wiper operation, "W" and "C" points on the CAM switch are connected with ground during revolution, then relay 2 on CONT turns off to stop the motor. After 1 second, relay 2 on CONT turns on to rotate the motor counterclockwise and then "P" and "C" grounds on the CAM switch are connected to turn off relay 2 on CONT and to stop motor.
**Washer mode operation**
When washer switch is turned on for over 0.5 sec., wiper mode operates 2 times and then performs parking mode operation to stop motor. However, when washer switch is turned on for less than 0.5 sec., wiper motor does not operate.

**Limit switch ON mode operation**
1. Limit switch ON during wiper operation: If turn on limit switch during wiper operation, returns to parking position immediately to stop the motor.
2. Limit switch ON under parking position: Even when the wiper switch or INT switch is turned on, the motor does not operate.

**3) System operation description**

1. If turn on motor operation switch, relay 1 on controller turns on to rotate the motor clockwise (operation order: (1) → (2) → (3) → (4))
2. When "W" and "C" points on the CAM switch are connected during revolution, relay 2 on controller turns off and relay 1 on controller turns on to rotate the motor clockwise. It means by changing motor polarities between wiping ranges with CAM switch, the wiper operates. (operation order: reciprocates (2) → (3) → (4) → (3) → (2))
3. DSP angle means angle between (1) and (2) or (1) and (4).
4. If rotates from (3) to (4) in clockwise, the motor parks in position (1). If rotates from (3) to (2) in counterclockwise, the motor parks in position (1). It means when motor is in park position, "W", "C" and "P" points are in a line as shown in below.
1) Washer coupled mode

1. When wiper switch is turned on for over 0.6 sec. under ignition switch on condition, washer coupled wiper output comes on.
2. When washer switch is turned off, wiper mode operation will be performed 2 times and then return to parking position.
3. Wiper motor output works same as the wiper operation mode.

2) Limit switch ON/OFF mode operation

1. If turn on limit switch while wiper motor is operating under ignition switch on condition, returns to parking position without delay to stop the motor.
2. Under limit switch on condition, wiper motor output control will be stopped.
   (It is to control the wiper blade not to be blocked by rear glass when opened.)
4) Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor</strong></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>DC 12 V ± 0.3 V</td>
</tr>
<tr>
<td>Test voltage</td>
<td>DC 13.5 ± 0.3 V</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>DC 10 ~ 15 V</td>
</tr>
<tr>
<td>Min. operation voltage</td>
<td>Below DC 8 V</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>Over 500 V mega 1 M</td>
</tr>
<tr>
<td>Lock test Torque</td>
<td>Over 1.1 Km</td>
</tr>
<tr>
<td></td>
<td>Current Below 14 A</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>- 40°C ~ + 80°C</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>DC 12 V</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>DC 9 ~ 16 V</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>- 30°C ~ + 80°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>- 40°C ~ + 90°C</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>Over 1 M</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>Below 0.5 V</td>
</tr>
<tr>
<td></td>
<td>(Load current between terminals 5-7, 6-8, 5-8 and 6-7 at 5 A)</td>
</tr>
<tr>
<td>Test voltage</td>
<td>14.0 ± 0.5 A</td>
</tr>
<tr>
<td>Allowable load current</td>
<td>Max. 10 A</td>
</tr>
</tbody>
</table>

5) Circuit Diagram

![Circuit Diagram Image]
5. AUTO LIGHT SYSTEM

1) Overview
Auto light control is a system that turns on/off position lamps and headlamps automatically. Auto light sensor unit on the instrument panel upper (passenger) detects surrounding brightness and then turns on or off position lamps and headlamps automatically if light switch is in AUTO mode even when the driver does not operate light switch. If enters tunnel during day driving or gets dark due to fog, rain or snow, it also operates.

2) Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto light sensor unit</td>
<td>Operating voltage</td>
</tr>
<tr>
<td></td>
<td>Load</td>
</tr>
<tr>
<td></td>
<td>Operating temperature</td>
</tr>
<tr>
<td></td>
<td>Storage temperature</td>
</tr>
<tr>
<td></td>
<td>Installation position</td>
</tr>
</tbody>
</table>

3) Input/Output Diagram

![Input/Output Diagram](image-url)
4) Auto Light Sensor Unit Terminal

1. System power supply
2. Auto light switch
3. Reserved
4. Headlamp relay
5. Position lamp relay
6. System ground

5) Auto Light Operation and Turning on Condition

▶ Switch operations by function
1. Turn on the ignition switch and operate the multi-function switch in the order of OFF → position lamp → headlamp → AUTO → switch.
2. Turn on/off the position lamp, headlamp and switch.
3. Turn on the AUTO switch. At this moment, position lamps and headlamps come on automatically if brightness of light that reflected on the photodiode in the auto light sensor unit is the same as voltage that set by software in CPU.
4. If operate position lamp and headlamp switch manually again, the lamps turn on/off according to switch operations not by brightness of light that detected by sensor.
5. When ignition switch is removed, position lamps and headlamps turn off.

▶ Turning on conditions

<table>
<thead>
<tr>
<th>Brightness</th>
<th>Lamp</th>
<th>Position lamp ON condition</th>
<th>Headlamp ON condition</th>
<th>Operation delay time</th>
</tr>
</thead>
<tbody>
<tr>
<td>For ON</td>
<td></td>
<td>30.5 ± 5 (LUX)</td>
<td>8.9 ± 3 (LUX)</td>
<td>0.5 ± 0.1 sec.</td>
</tr>
<tr>
<td>For OFF</td>
<td></td>
<td>60.5 ± 5 (LUX)</td>
<td>17.2 ± 3 (LUX)</td>
<td>3 ± 1 sec.</td>
</tr>
</tbody>
</table>