3. POWER WINDOW OPERATIONS

Power Window Auto-down

When the front of the switch is lightly pressed, the window will be lowered while the switch is pressed. When pressed to its end, the window will open automatically until it is fully open. If you want to stop the window while automatic lowering, lightly press the switch again or pull up the switch.

Power window versions in this vehicle: Auto Down, Auto Down/Up

The circuit diagram shows the Auto Down version.
Power Window Auto Up

The Auto Up function only applies to the driver’s window and is operated when pulling the switch up. The following circuit is for the vehicle equipped with the Auto Up function (optional).

The power window motor with the Auto Up function includes the anti-trap function, so the power motor and the anti-trap control ECU is integrated together.
Power Window with Anti-trap Function

Anti-trap Function

- Condition for Auto-Up: Initialization completed, Ignition ON
- Anti-trap operation
  
  If there is resistance of 100 N while the window is operating with the auto up function, the window is lowered approx. 150~180 mm to prevent personal injury.

- There is undetectable area where the space between the top of the glass and the window frame is below 4 mm.

Stop Condition of Anti-trap Power Window While in Operation

The motor stops if any of below conditions is met while auto up/down or manual up/down is operated.

- When the voltage is out of operation range → both the automatic and manual operations are not active
- When the motor is overheated → both the automatic and manual operations are not active
- When anti-trap is operated → this is only operated during auto up
- When initialization is canceled → if an error is detected or erased → the automatic operation is not active
- When power relay OFF (when STICS shuts off the power to the power window relay)
- When a signal from other switch is input while the motor is running
System Overview

The driver’s door is equipped with the auto down, auto up (optional) and anti-trap (if auto up equipped) function. Also, it is equipped with dual rail regulator.

Specifications

1. Electrical Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specified value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>DC 12 V</td>
<td>Operated normally within this range</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>DC 9 V ~ DC 16 V</td>
<td>- Auto up function is inactive within 9 V ~ 10 V</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-35°C ~ +75°C</td>
<td>- Data storage and manual operation is possible within 7 V ~ 9 V</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-40°C ~ +85°C</td>
<td>- Stops motor if exceeding 16 V</td>
</tr>
<tr>
<td>Max. humidity</td>
<td>95% RH</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>33 mA</td>
<td>No load included</td>
</tr>
<tr>
<td>Size and weight</td>
<td>-</td>
<td>Shown in the drawing</td>
</tr>
<tr>
<td>Current in slip mode</td>
<td>Max. 1 mA</td>
<td></td>
</tr>
</tbody>
</table>

2. System Diagram
3. Power Window ECU Motor Connectors

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Operation</th>
<th>I_{max}</th>
<th>I_{normal}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Up (close)</td>
<td>low</td>
<td>15 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td>2</td>
<td>Power relay</td>
<td>high</td>
<td>15 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td>3</td>
<td>Battery</td>
<td>-</td>
<td>25 A</td>
<td>10.6 A</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>-</td>
<td>25 A</td>
<td>10.6 A</td>
</tr>
<tr>
<td>5</td>
<td>Lean comm.</td>
<td>-</td>
<td>15 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td>6</td>
<td>Down (open)</td>
<td>low</td>
<td>15 mA</td>
<td>10 mA</td>
</tr>
</tbody>
</table>

**System Function**

1. **Power Signals of B+ and Power Relay**

The power window motor is integrated with ECU which is supplied with B+ power constantly to memorize the window position and operating speed. The motor runs only when the power is supplied to the switch by STICS. Also, it goes to slip mode to minimize the battery discharge.

2. **Operating Voltage**

- Auto up inactive voltage: when the voltage is within 9 V ~ 10 V, auto up is inactive due to voltage drop
- Limited operation: when the voltage is within 7 V ~ 9 V, data can be stored and the window can be operated manually.
- Motor stop: when the voltage is over 16 V, the motor is stopped
3. Self-diagnosis
The ECU motor diagnoses of itself to stop the motor or reset the hardward if there is malfunction in the system or supply voltage.
- Service person may not know whether the ECU motor is in self-diagnosis or not.
- If there is an error in RAM checksum after wake-up
  → Hardware reset: auto Up deactivated (very unlikely in a real world) → Re-initialization
- If the voltage is low (less than 5V)
  → Hardware reset: motor stops (both auto/manual deactivated) → Reactivated when the voltage is returned to normal
- If the motor rotates more than 10 times to the upper direction after initialization (idling for more than 10 times than the memorized position)
  → Motor stops, initialization erased → No auto up → Reactivated after initialization
- If the motor rotates more than 400 times to the lower direction after initialization
  → Motor stops, initialization erased → No auto up → Reactivated after initialization
- Abnormal program running (very unlikely in a real world)
  → Hardware reset by monitoring program → motor stops (both auto/manual deactivated) → Replace motor

4. Motor Overheat Prevention Function
There is overheat prevention function to prevent motor from overheated (only if ECU operates normally).
- If the system is supplied with power or resetted, the ECU motor initialize the temperature counter which counts the temperature increase as the motor runs.
- 1st limited value:
  The temperature is not measured directly. If the motor runs 8~9 times consecutively, it runs again in 60 seconds after completing the current operation.

⚠️ CAUTION
- If the motor stops due to the 7~8 consecutive operation, it runs again in 3~4 minutes.

- 2nd limited value (not plausible on-board)0
If the value reaches the 2nd limited value due to the consecutive operation, the motor stops immediately and runs again in certain period of time.

5. System Initialization
The top position of the wiper should be recognized again if the wiper motor or regulator is replaced or the initialization is erased due to the error detected.
- The auto up function is deactivated and the window position is not memorized unless the system is initialized.
6. System Re-initialization (For Recognizing the Window Operating Characteristics)

Raise/Lower the window for approx. 5 times after the initialization to recognize the vehicle's window operating characteristics (position, speed etc.). By doing this, the correct resistance (less than 100 N) is applied when anti-trap function is activated.

CAUTION

- The power window ECU motor with the anti-trap function observes the actual lowest position of the power window motor at every 20 cycles to reflect the slight changes in positions of door weather strip, regulator system, motor, etc.

7. Sleep Mode

The ECU goes into the sleep mode to save the battery voltage when the conditions are established.

- Condition: It goes into the sleep mode if the motor overheat prevention heat counter decreased to the initial value and the power relay is OFF for 10 seconds.
- It can go into the sleep mode after 10 minutes from the time when the motor stops by the motor overheat prevention program.

8. Wakeup Mode

It wakes up from the sleep mode when the hardware is reset (including connecting and disconnecting the connector or battery) or ignition switch is turned to ON position.

9. Soft Stop Down Mode

The ECU cuts off the power to the motor when the window is lowered to the 10 mm (approx. 7 revolutions) up from the lowest position to lower the window smoothly. From that position, the window is lowered by the inertia force. To fully lower the window, operate the switch again after the soft stop down.

10. Other Characteristics and Cautions

- The initial values are erased when the error is detected by self-diagnosis.
- The ECU motor stores the window position, intial value, window running direction, operation characteristics in the memory. Normally, the stored values are not erased by initializing the hardware or disconnecting the battery cable. However, the stored value may be erased occasionally in the case when the ECU is down.
- If the stored values are erased unexpectedly, the system should be initialized again.
- The window operation stops when turning the power OFF while it is in operation. However, if the anti-trap function is in operation, it completes its operation.
- Stuck prevention filter for power window switch
  The signal from the switch is overridden if it is continuous for more than 20 seconds with no level change of the window due to the malfunction of the power window switch, short circuit or misoperation by the operator.
- The anti-trap function of the power window may not work properly due to wrong installation of glass run or regulator.