# PART TIME TRANSFER CASE

## GENERAL

### 1. SPECIFICATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>New Part Time T/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>343 mm</td>
</tr>
<tr>
<td>Mating surface of front flange</td>
<td>40 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>33.8 kg (without oil)</td>
</tr>
<tr>
<td>Oil capacity</td>
<td>1.4 L</td>
</tr>
<tr>
<td>Location</td>
<td>Transfer case</td>
</tr>
<tr>
<td>Major elements</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>Part time &amp; TOD (common)</td>
</tr>
<tr>
<td>Tightening bolt</td>
<td>11 EA, M8 x 1.25</td>
</tr>
<tr>
<td>Input shaft</td>
<td></td>
</tr>
<tr>
<td>A/T: External spline</td>
<td></td>
</tr>
<tr>
<td>M/T: Internal spline</td>
<td></td>
</tr>
<tr>
<td>Ring gear</td>
<td>Inserted into housing groove</td>
</tr>
<tr>
<td>Sun gear</td>
<td>Separated input shaft and sun gear</td>
</tr>
</tbody>
</table>
1. OVERVIEW
By using the planetary gear sets, two-gears shift type part time transfer case achieves direct connection when selecting 4WD "HIGH" and 2.48 of reduction gear ratio when selecting 4WD "LOW". The silent chain in transfer case transfers the output power to front wheels. Simple operation of switches on instrument panel allows to shift to "2H", "4H" and "4L" easily while driving. The warning lamp alarms the driver when the system is defective.

2. OPERATION

<table>
<thead>
<tr>
<th>Application</th>
<th>Mode Position</th>
<th>Operating Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving type</td>
<td>2H</td>
<td>Normal Driving on the normal road and highway, or high speed driving</td>
</tr>
<tr>
<td></td>
<td>4H</td>
<td>Slippery road such as snow, rainy, sand, mud etc.</td>
</tr>
<tr>
<td></td>
<td>4L</td>
<td>Maximum driving force required condition such as towing, rough road. When a vehicle is driven in turning at low speed on the paved road, a vibration and a noise may be occurred by tight corner braking.</td>
</tr>
<tr>
<td>When shifting the mode</td>
<td>2H ↔ 4H</td>
<td>It is possible to shift the mode between 2WD and ↔ 4WD without clutch operation under the vehicle speed is below 70 km/h.</td>
</tr>
<tr>
<td></td>
<td>2H, 4H ↔ 4L</td>
<td>Manual Transmission</td>
</tr>
<tr>
<td></td>
<td>2WD Drive, 4WD Drive (High Speed)</td>
<td>• Before shifting the mode, stop the vehicle and fully depress the clutch pedal.</td>
</tr>
<tr>
<td></td>
<td>2WD Drive ↔ 4WD Drive (High Speed)</td>
<td>Automatic Transmission</td>
</tr>
<tr>
<td></td>
<td>2WD Drive, 4WD Drive (High Speed) ↔ 4WD Drive (Low Speed)</td>
<td>• Before shifting the mode, stop the vehicle and place the selector lever at [N] position.</td>
</tr>
</tbody>
</table>

Note:
To make the mode shift easier, stop the vehicle, depress the brake pedal, select the mode switch, and move the selector lever with the sequence of [N→P→N].
3. SECTIONAL DIAGRAM

- Planetary gear set
- Oil pump
- Magnetic clutch
- Input shaft
- Front output shaft
- 4H-4L Shift fork (Reduction shift fork)
- 2H-4H Shift fork (lockup fork)
- Shift motor

PART TIME TRANSFER CASE
REXTON 2010.01
**Shift Motor**

When selecting a position in 4WD switch, the shift control unit exactly changes the motor position to 2H, 4H and 4L by the position encoder in control unit that monitors motor position.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Position A</td>
</tr>
<tr>
<td>2</td>
<td>Position B</td>
</tr>
<tr>
<td>3</td>
<td>Position C</td>
</tr>
<tr>
<td>4</td>
<td>Position D</td>
</tr>
<tr>
<td>5</td>
<td>Position ground</td>
</tr>
<tr>
<td>6</td>
<td>Control (4L - 4H - 2H)</td>
</tr>
<tr>
<td>7</td>
<td>Control (2H - 4H - 4L)</td>
</tr>
</tbody>
</table>

**Speed Sensor and Clutch Coil**

The rear speed sensor utilizes the hall effect. It generates 0V and 5V of square type digital wave according to the rotation of the wheel with teeth of transfer case rear output shaft. The speed signal from rear propeller shaft is entered into control unit. When the control unit determines that 4WD HIGH operation is available, electric current flows into the clutch coil. The coil magnetized by this electric current pull in the lockup hub to engage into output spline. Accordingly, the power is transferred to front wheels.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clutch coil</td>
</tr>
<tr>
<td>B</td>
<td>Sensor power (5V)</td>
</tr>
<tr>
<td>C</td>
<td>Sensor signal</td>
</tr>
<tr>
<td>D</td>
<td>Sensor ground</td>
</tr>
</tbody>
</table>
4. SYSTEM LAYOUT

4WD switch

Automatic transmission

TCCU

Input

Output

Indicators

4WD CHECK + 4WD CHECK + 4WD CHECK

Input shaft

Planetary gear set

2H-4H shift fork

Front output shaft

Oil pump

Magnet clutch

Drive gear

Shift motor

Shift position

Speed sensor (4L)
5. SYSTEM OPERATION

1) Transfer Case Control Unit (TCCU)

- **4WD Operation**
  TCCU is located under the driver's seat and permits the vehicle to shift from two-wheel drive to four-wheel drive (and back shift) according to drivers switch operation during driving (For the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).

1. **2H → 4H**
   - Change the 4WD switch in instrument panel from 2H to 4H.
   - This shift is available during driving.
   - "4WD HIGH" indicator in meter cluster comes on.

   **When the system is defective**
   - 4WD CHECK* warning lamp comes on

2. **4H → 2H**
   - Change the 4WD switch in instrument panel from 4H to 2H.
   - This shift is available during driving.
   - "4WD HIGH" indicator in meter cluster goes out.
   - "4WD CHECK" warning lamp comes on when the system is defective.
3. 4H → 4H

- This function is only available when the speed signal from speed sensor is about to stop (below 2 km/h).
- This function is only available when clutch pedal is depressed (manual transmission) or selector lever is selected to "N" position (automatic transmission).
  (TCCU must recognize the clutch pedal signal or "N" signal.)
- Change the 4WD switch in instrument panel from 4H to 4L.
- "4WD LOW" warning lamp in meter cluster flickers during this process, then goes out when the shift is completed.
- "4WD CHECK" warning lamp comes on when the system is defective.
2) Transfer Case Block Diagram

- Battery voltage
- Ignition switch ON/OFF
- Position 1
- Position 2
- Position 3
- Position 4
- 2H/4H/4L switch signal
- Rear speed sensor signal
- CAN HIGH
- CAN LOW
- Shift motor output (Motor LO-HI)
- Shift motor output (Motor HI-LO)
- Clutch coil
- Position encoder ground (Return position)
- Speed sensor ground (Return position)
- Rear speed sensor 5 V power supply
- K-Line
- Hub solenoid
<table>
<thead>
<tr>
<th>Section</th>
<th>Pin No.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>12, 25</td>
<td>Ground</td>
<td>Part time TCCU ground</td>
</tr>
<tr>
<td></td>
<td>13, 26</td>
<td>B+</td>
<td>Part time TCCU battery voltage input</td>
</tr>
</tbody>
</table>
| Input side    | 23      | Ignition switch| Ignition switch voltage  
: ON – above 4V, OFF – below 0.9 V                                          |
|               | 18      | Position 1     | Position encoder : recognize shift motor position  
HIGH – above 4 V, LOW – below 0.9 V                                          |
|               | 5       | Position 2     | Same as above                                                               |
|               | 19      | Position 3     | Same as above                                                               |
|               | 17      | Position 4     | Same as above                                                               |
|               | 4, 16   | 2H, 4H, 4L switch| Mode input by 2H, 4H, 4L selection  
HIGH – above 4V, LOW – below 0.9 V                                          |
|               | 7       | Rear speed sensor | Rear speed sensor (Hall effect) signal input                                  |
| Both sides    | 8       | CAN HIGH       | CAN bus HIGH line                                                           |
|               | 9       | CAN LOW        | CAN bus LOW line                                                            |
|               | 21      | K – LINE       | Connected to diagnosis connector                                             |
| Output side   | 10      | Speed sensor voltage | Supply 5V to front and rear speed sensors                                   |
|               | 1, 14   | Motor HI–LO    | Motor output port  
– Connected to battery when shifting to LO from HI  
– Connected to ground when shifting to HI from LO or when braking the motor |
|               | 2, 15   | Motor LO–HI    | Motor output port  
– Connected to battery when shifting to HI from LO  
– Connected to ground when shifting to LO from HI or when braking the motor |
|               | 11      | EMC            | Supply voltage to clutch coil  
– Max. current: 9 A                                                           |
|               | 20      | Position ground (return) | Provide ground to position encoder                                          |
|               | 3       | Speed ground (return) | Provide ground to speed sensor                                              |
|               | 24      | Hub solenoid   | Supply voltage to hub solenoid                                              |
3) TCCU System

(1) Position Encoder

The position encoder is the code that TCCU can determine the shift motor position.

<table>
<thead>
<tr>
<th>Position Code</th>
<th>Motor Position</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 0</td>
<td>Left stop</td>
<td></td>
</tr>
<tr>
<td>1 0 1 0</td>
<td>2 H</td>
<td></td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>Zone 1</td>
<td></td>
</tr>
<tr>
<td>0 1 1 0</td>
<td>Zone 2</td>
<td></td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>Zone 3</td>
<td></td>
</tr>
<tr>
<td>0 0 1 1</td>
<td>4 H</td>
<td></td>
</tr>
<tr>
<td>0 0 0 1</td>
<td>Zone 4</td>
<td></td>
</tr>
<tr>
<td>1 0 0 1</td>
<td>Zone 5</td>
<td></td>
</tr>
<tr>
<td>1 0 0 0</td>
<td>Zone 6</td>
<td></td>
</tr>
<tr>
<td>1 1 0 0</td>
<td>4 L</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0</td>
<td>Right stop</td>
<td></td>
</tr>
<tr>
<td>1 1 1 1</td>
<td>Encoder OFF</td>
<td></td>
</tr>
</tbody>
</table>

(2) Operation

- **TCCU initialization and operation**
  - TCCU sends relevant data to meter cluster via CAN to diagnose and check the indicators when the ignition switch is turned to ON. At this time, the 4WD indicators (4WD LOW and 4WD HIGH) comes on for 0.6 seconds.
  - TCCU starts diagnosis by operating clutch and hub solenoid for 1.5 seconds.
  - If the selector switch position and the shift motor position code does not match when the IG power is turned ON, the shift is controlled to move in the direction of the selector switch position.
  - The shift operation is controlled to move only toward selector switch position if the selector switch position is not met with shift motor position code when the ignition switch is turned to ON.

- **Function of indicating lamp during shifting**
  - As the operation of shift motor starts, the indicator flickers in interval of 0.3 seconds and stops after the shifting operation is completed or cancelled.
  - Operation diagram of "4H" indicator when changing the switch to 4H from 4L.
  - Operation diagram of "4L" indicator when changing the switch to 4L from 2H/4H.
Shift conditions

Shift operation is only allowed when some conditions are satisfied. These shift conditions should be satisfied for 2 seconds before starting motor. The motor has three seconds of delay at its initial operation to do trouble diagnosis.

Once the motor starts, the shift conditions are no longer checked.

Shift conditions are as follows:
- Normal battery voltage and shift motor for all gears
- 2H and 4H shifts has nothing to do with vehicle speed, "N" position in automatic transmission or clutch signal.
- Shift operation between 2H/4H and 4L is only available when the vehicle speed is below 46 km/h.
- No defective speed sensor

Motor controls

- The shift steps have the sequence of 2H → 4H → 4L and 4L → 4H → 2H. TCCU operates the shift motor until it reads required position code. If it detects the faulty code, the system is operated with the compensation mode.
- Once the shift operation is started, it is completed regardless of ignition power. If there are not operating signals from position sensor, the shifting failure due to timeout occurs. This failure appears when the shifting time between 2H and 4H and between 4H and 4L is delayed over 5 seconds compared to normal shift. Once the shifting time exceeds the specified time, TCCU cannot properly supply the voltage to shift motor and is operated in compensation mode.
- Even though the system recognize a fault before motor starts, it is considered as fault.
- Motor stops operation when it reaches at target range.

Synchronization

Synchronization occurs during shifting from 2WD (2H) to 4WD (4H or 4L). The synchronizer clutch and hub solenoid are controlled during synchronization as follows:
- Clutch coil operates when the selector changes from 2H to 4H/4L.
- Shift motor moves in 4H mode.
- Hub solenoid starts its operation 4 seconds after shifted to 4H.
- Clutch coil stops its operation 5 seconds after the hub solenoid is activated.

Compensation

The motor stops when the encoder related troubles are detected during shift operation. It moves toward LOW-HIGH direction for 5 seconds so that the motor is not left in unidentified position.
6. POWER FLOW

- Power Flow

- Switch Transfer
  \[2H, 4H \leftrightarrow 4L\]

- TCCU

- Locking Hub Solenoid

- Vacuum System Operation

- Locking Hub Operation

- Transfer

- Front Propeller Shaft

- Rear Propeller Shaft

- Front Axle

- Rear Axle

- Front Wheel

- Rear Wheel
1) 2H Mode (Rear Wheel Drive)

Power Flow

Transmission Output Shaft → T/C Input Shaft → Rear Propeller Shaft → Rear Axle → Rear Wheel

Transmission → Front Axle (Front Wheel) → Rear Axle (Rear Wheel)
2) 4H Mode (4WD Drive - High Speed)

Power Flow

- TCCU
- Motor
- Transmission Input Shaft
- Shift Cam, Rail, Fork
- Magnetic Clutch
- Output Shaft
- Hub
- Chain
- Front Propeller Shaft
- Rear Propeller Shaft
3) 4L Mode (4WD Drive - Low Speed)

Power Flow

- TCCU
- Motor
- Transmission Input Shaft
- Shift Cam, Rail, Fork
- Planetary Gear (2.483)
- Chain
- Hub
- Output Shaft
- Front Propeller Shaft
- Rear Propeller Shaft
7. CIRCUIT DIAGRAM (DI & 5-SPEED A/T)