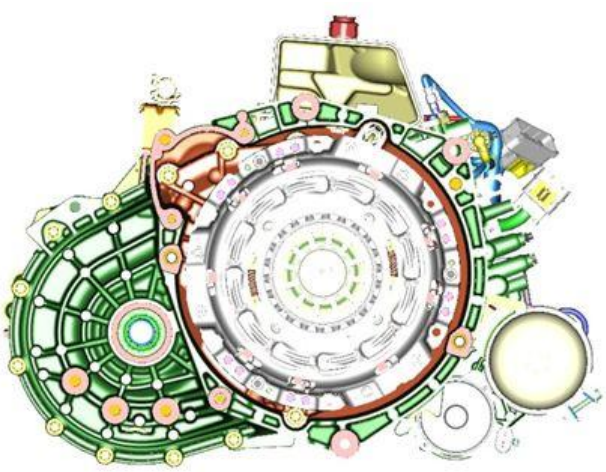
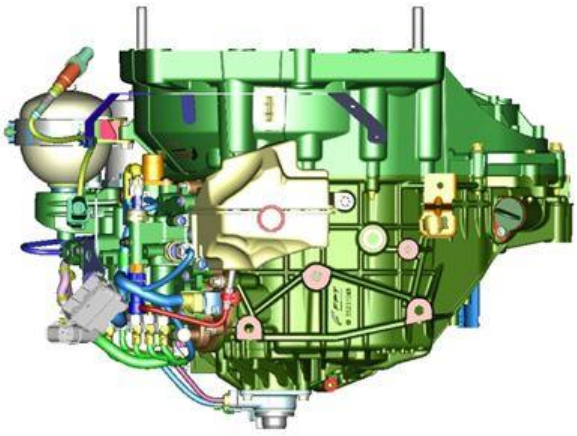
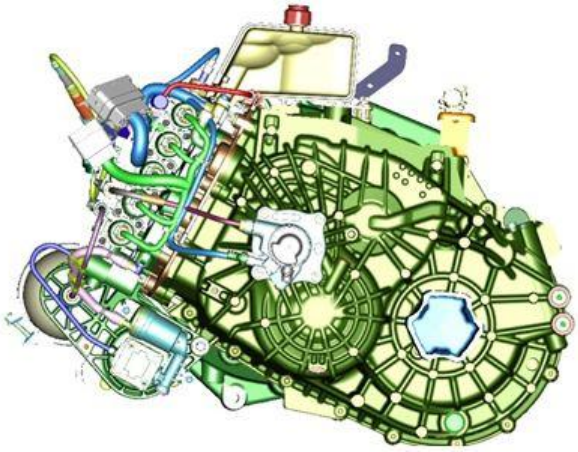
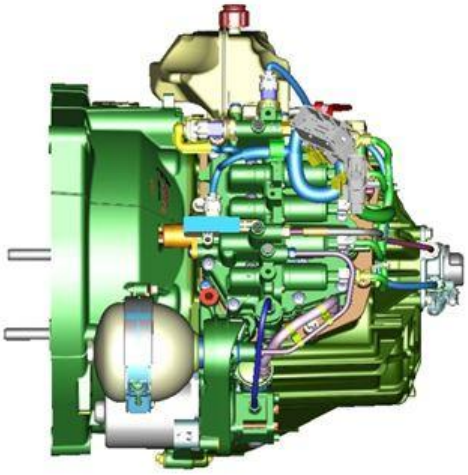
ALFA TCT









The Fiat Powertrain Technologies Alfa TCT is a three-shaft transmission capable of transmitting a maximum torque of 350 Nm. It uses innovative technology that allows driving comfort to be combined with an automatic transmission, with lower running costs than for manual gearboxes.
The Alfa TCT transmission is made by combining two aluminium alloy half-casings. It can be installed in front wheel drive, transverse engine layout arrangements. The Alfa TCT has a typical three-shaft layout for additional compactness. A particularity is that the main shaft actually consists of two mutually coaxial driveshafts. Two dry clutches operated by two separate hydraulic actuators are used to transmit torque to the main shaft:

- a traditional one located under the transmission casing (traditional) to manage the even gear clutch;
- the second one located on the transmission casing to manage the odd gear clutch.

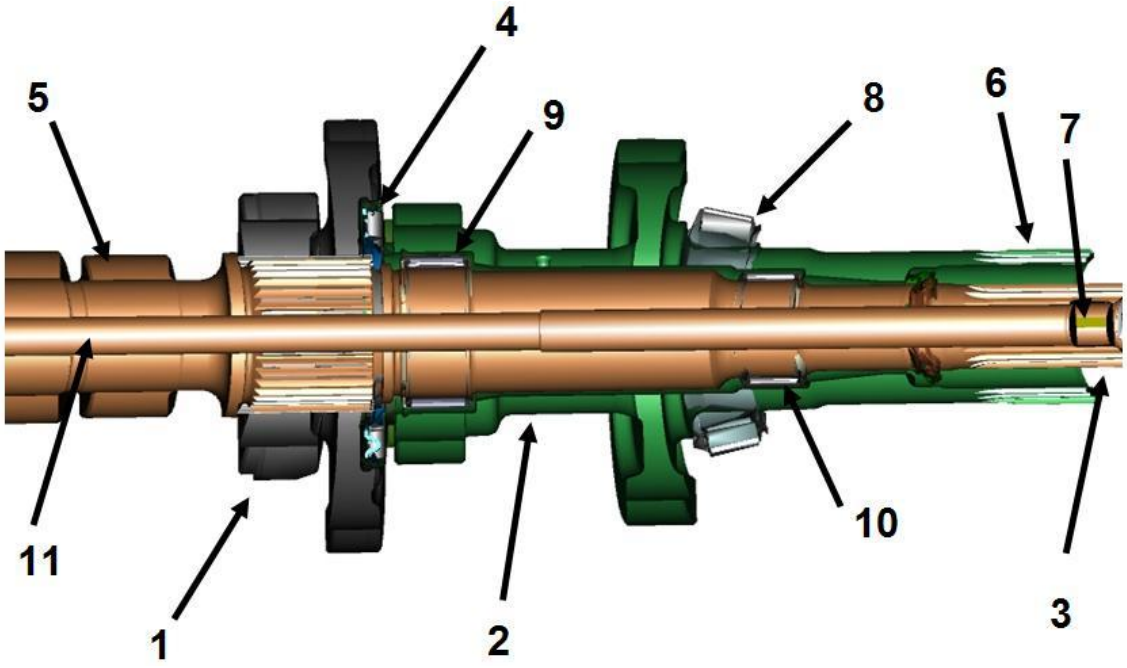
Gears are engaged and the clutches are managed by an electro-hydraulic robot, controlled in turn by a specific transmission control unit (NCR). The electro-hydraulic robot is positioned directly on the transmission casing.

The specific features are:

- 6 synchronised gears
- Max. torque that can be transmitted: 350 Nm
- Three shafts, one input (main) shaft plus two layshafts (upper and lower);
- Main shaft comprising two coaxial shafts
- Double dry clutch
- Double hydraulic actuator for the clutches.
- Fixed idler mechanical gearbox
- Synchronised reverse
- Free wheel for reverse engagement
- Helical tooth gears (straight teeth reverse gear)
- Specific differential integrated in the transmission casing;
- Brake on differential for "Parking" function
- Designed for coupling to specific flywheel
- Transmission housing split in two aluminium half casings
- Electro-hydraulic robot for clutch and gear shift control
- Dedicated TCU

ALFA TCT operating principles - Mechanical part

FPT engineers have designed solutions to allow continuous motion transmission using the C633 manual gearbox. Firstly, the main shaft of the Alfa TCT consists of two mutually coaxial shafts, called outer main shaft and inner main shaft. The junction area houses an axial bearing allowing reciprocal rotation. Both shafts are made of steel. The inner main shaft has a grooved profile for splining 3rd and 5th speed drive gears, while the outer main shaft is made in one piece.
Section view:



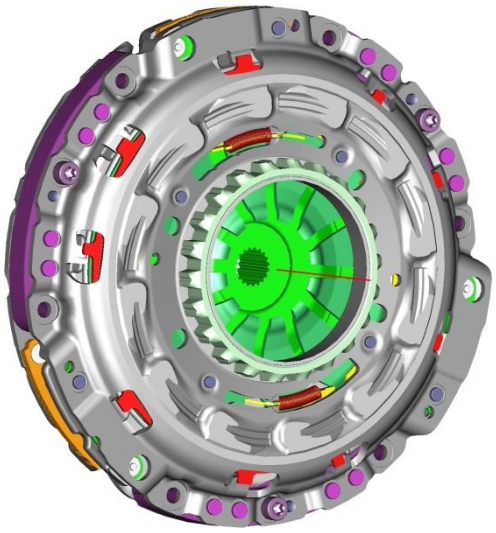
1. 3rd speed drive gear
2. outer main shaft (coupled to clutch K2 – even gears)
3. inner shaft odd gear clutch grooved profile
4. axial bearing
5. inner main shaft (coupled to clutch K1 – odd gears)
6. outer main shaft even gear clutch grooved profile
7. clutch rod bushing
8. outer main shaft bearing
9. roller cage
10. inner main shaft roller cage
11. inner main shaft hole for introducing odd gear clutch rod

The need for two main shafts derives from the fact that two pairs of gears must be meshed to allow continuous motion transmission. Therefore, two clutches are needed to obtain this without causing mechanical damage, one for odd gears (called K1) and one for even gears (called K2). While travelling, one of the two clutches is closed to transmit motion from only one pair of gears and the other clutch is open to prevent transmission using the other gear pair. During both upshifting and downshifting, both clutches work together, so that one opens while the other closes and vice versa.

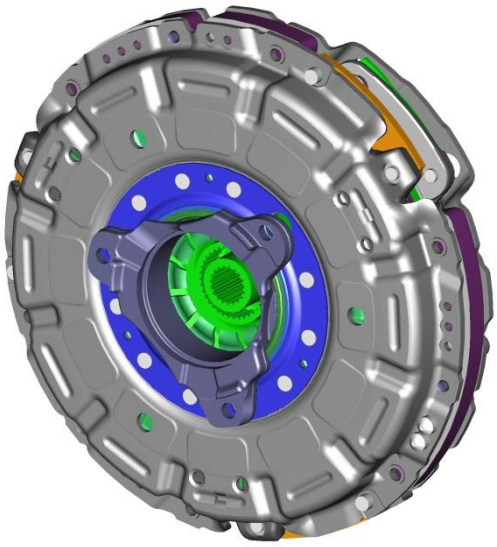
- The even drive gears (2nd, 4th and 6th) are obtained on the outer shaft (coupled to clutch K2), along with the groove for splining the even gear clutch.

- The odd driven gears (1st, 3rd, 5th, reverse) are splined on the inner main shaft (connected to the clutch K1), along with the grooved profile for splining the odd gear clutch.

Clutches

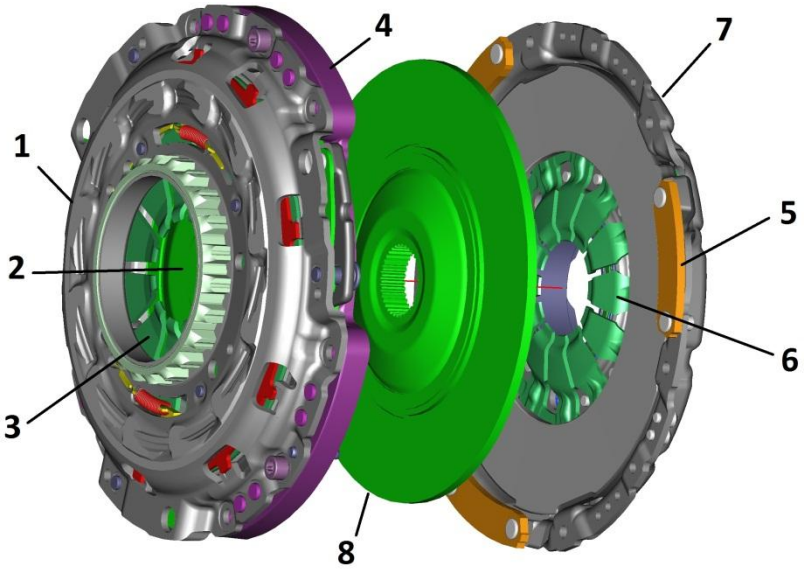


Clutch kit – view from engine side



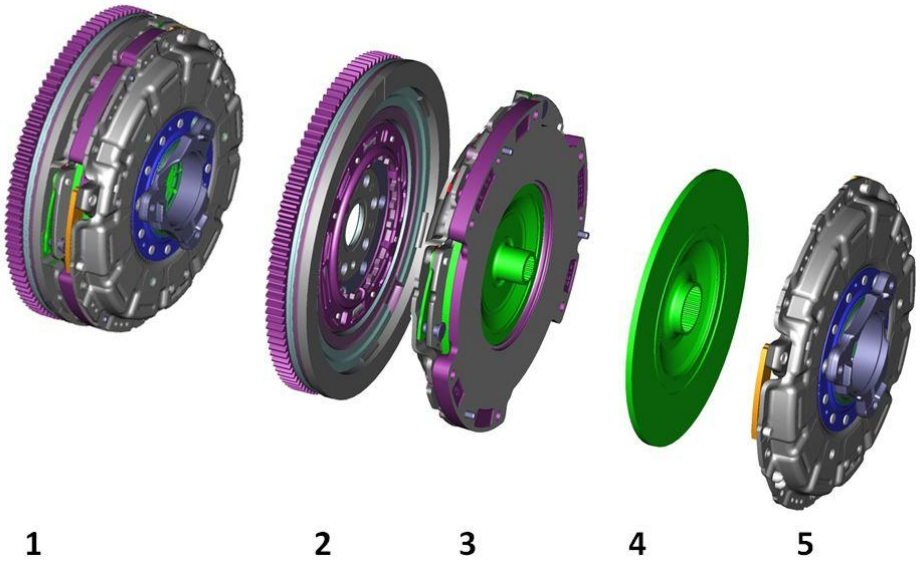
Clutch kit – view from transmission side

The clutch kit is made by LuK and consists of a single body with two clutch plates and retaining mechanisms of the two clutches, such as pressure plate with diaphragm springs and pressure plate retaining springs.
The kit must be coupled to a specific flywheel which is provided with locking grooves visible on the clutch mechanism facing outside (engine side). Disassembling the clutch kit, we can see that odd gear driven plate K1 (normally closed) is positioned facing engine side and differs from the even gear driven plate clutch K2 (normally open) because of the visibly smaller diameter of the main shaft splining grooved profile. The two clutches cannot be replaced individually. The entire unit needs to be replaced in the case of problems to either clutch.



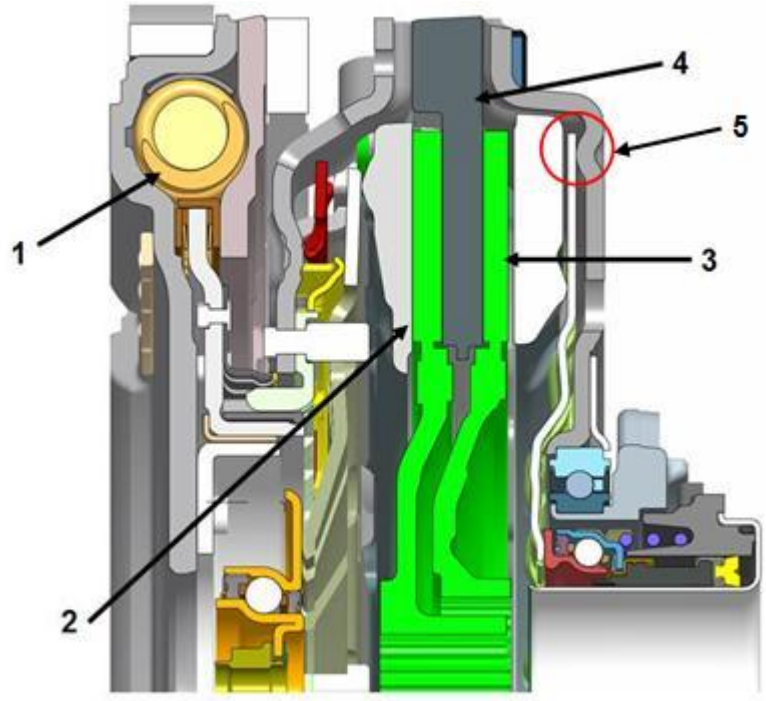
1. odd gear clutch K1 mechanism lid
2. odd gear clutch K1 driven plate
3. odd gear clutch K1 pressure plate spring
4. intermediate flywheel
5. even gear clutch K2 pressure plate retaining spring
6. even gear clutch K2 pressure plate spring
7. even gear clutch K2 mechanism lid
8. even gear clutch K2 driven plate

Flywheel assembly exploded view - Clutch kit



1. Flywheel assembly - Clutch kit
2. Flywheel
3. Odd gear clutch K1 kit
4. Even gear clutch K2 plate
5. Clutch K2 lid-pressure plate assembly

Clutch unit section view:

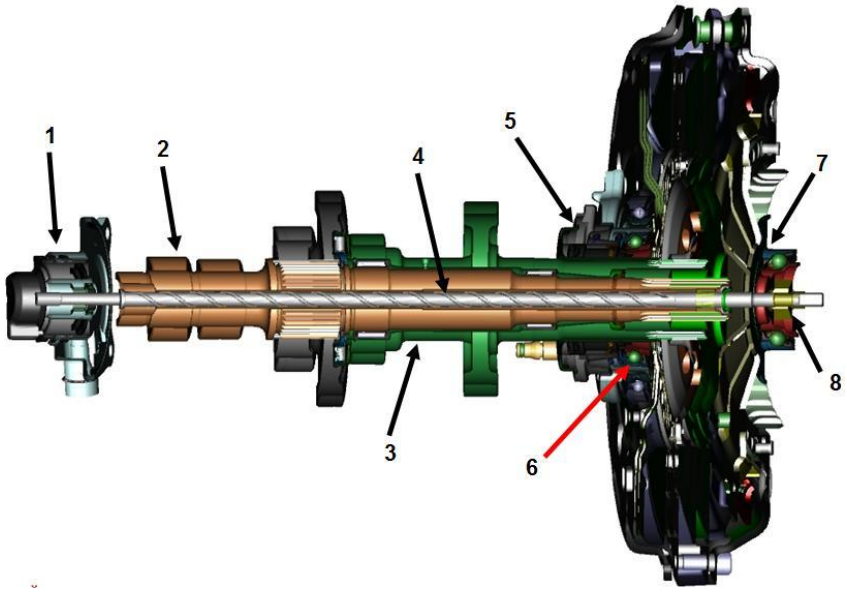


1. Dual mass engine flywheel assembly
2. Odd gear clutch K1
3. Even gear clutch K2
4. Intermediate flywheel
5. Fulcrum point for clutch K2 diaphragm spring

Neither clutch plate K1 nor K2 (Fig. 11) is pressed on the dual mass flywheel surface. On the contrary, they are pressed on the surface of an intermediate flywheel mass between the two plates K1 and K2 and integral with the dual mass flywheel. The odd gear clutch K1 (engine side) operates on one side of the intermediate flywheel mass; the even gear clutch K2 (transmission side) works on the other side. Clutch K1 is normally closed and provided with automatic clearance recovery mechanism. Clutch K2 is normally open and not provided with clearance recovery mechanism. The diaphragm spring of clutch K2 has a different layout and a different pivoting point than clutch K1: consequently, clutch K2 is normally open.

Clutch control

There are two clutch controls, usually called CSC, which work in tandem. When one clutch is released, the other one is engaged. CSC movement is entirely controlled by the NCR which, by means of the robot on the transmission, can engage or release the clutches. The oil supply circuit to both CSCs is not separate from the oil circuit used by the robot to actuate the gear engagement and selection actuators. The same hydraulic oil is used.



1. odd gear clutch K1 CSC
2. inner main shaft
3. outer main shaft
4. odd gear clutch K1 thrush bearing control rod
5. even gear clutch K2 CSC
6. even gear clutch K2 thrust plate bearing
7. odd gear K1 clutch thrust bearing
8. odd gear clutch K1 bearing plug

Functional characteristics

The following pictures illustrate the operating characteristics of the clutch during a normal Powershift type gear shift.
We will take shifting from 1st gear to 2nd gear as an example. Remember that:

- The 1st speed drive gear is on the inner main shaft and is connected to odd gear clutch K1.
- The 2nd speed drive gear is on the outer main shaft and is connected to even gear clutch K2.