JTEKT®

ITCC

Intelligent Torque-controlled Coupling

Active on-demand AWD system

JTEKT

JTEKT CORPORATION

Stable, Smooth and Highly Efficient Transmission of Power Expanding the possibilities of AWD

Weather conditions, vehicle use, driver's intentions… Calculating every element to ensure that all four tires are firmly hugging the road under ever-changing conditions.
Expanding the ability of more and more vehicles to give the driver that true feeling of confidence and driving pleasure. Our goal is to deliver that experience to everyone!
With this in mind, JTEKT has reduced size and weight while simultaneously improving reliability in the production of ITCC*: electronically controlled coupling for AWD vehicles.

Continuing the Evolution of JTEKT ITCC

Excellent response and powerful torque drawing the maximum potential of all four wheels

The continuous evolution of active on-demand AWD is based on a quest with a single theme: consideration of every aspect to deliver optimum torque to each of the four wheels, front and back, left and right.
At the core of this torque management is JTEKT's electronically controlled AWD coupling, ITCC.※1
Capable of responding instantaneously, safe and controllable, ITCC offers continuous control of the driving force delivered to the front and rear wheels, from 100:0 (front:rear) to 50:50 (front:rear).
As a result of the unparalleled results achieved for both high fuel efficiency and traction performance, ITCC is now installed in many AWD vehicles, and holds No. 1 market share in the world.※2 Its superior installation ease, drive force transfer efficiency and wide-ranging load capacity are key factors supporting the development of AWD systems.

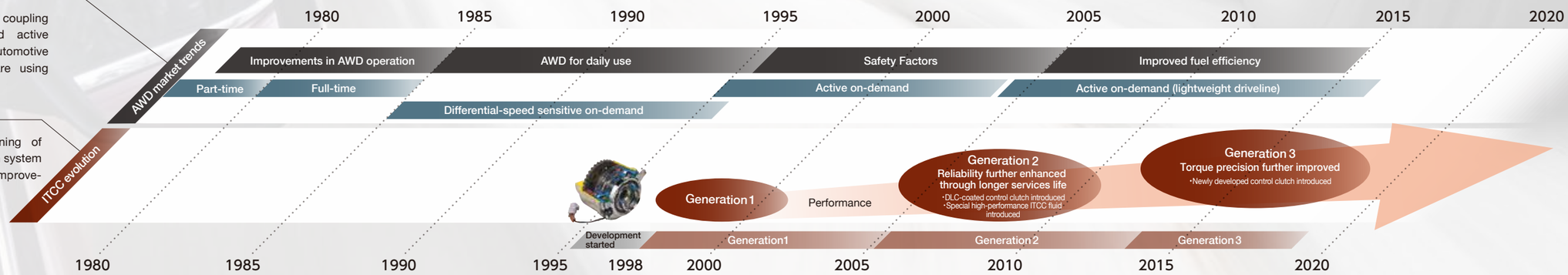
AWD market trends

ITCC History

From differential sensitive on-demand coupling (RBC) to the recently developed active on-demand AWD system (ITCC), automotive manufacturers around the world are using JTEKT AWD systems

ITCC Evolution

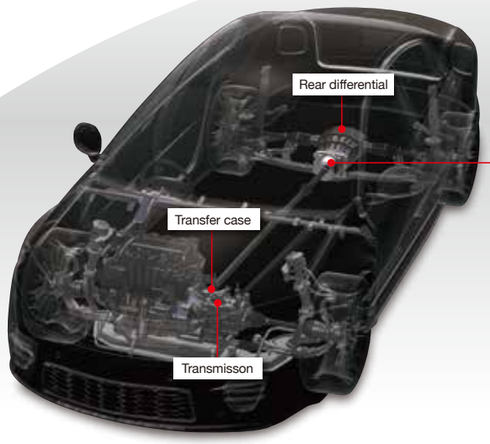
Continuously evolving since beginning of mass-production, the third-generation system (Gen 3) introduces epoch-making improvements in performance and durability.



※1) ITCC:Intelligent Torque Controlled Coupling . ITCC is a registered trademark of JTEKT Corporation.
※2) As of Jan. 2014, in-house study

ITCC Installation Layout

In vehicles with a FWD configuration, the ITCC is installed in front of the rear differential; the active on-demand (active torque split) AWD system providing optimum torque distribution to the front and rear wheels. This contributes to ensuring both high fuel efficiency and superior driving performance.



Sensors for four wheel speeds, throttle position, etc.

↓

ECU

↓

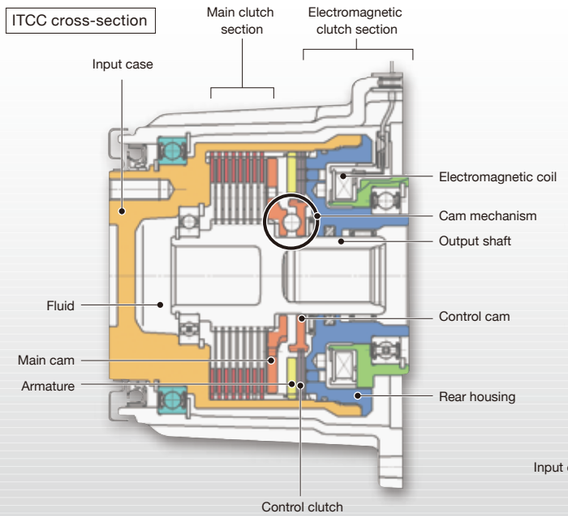
ITCC

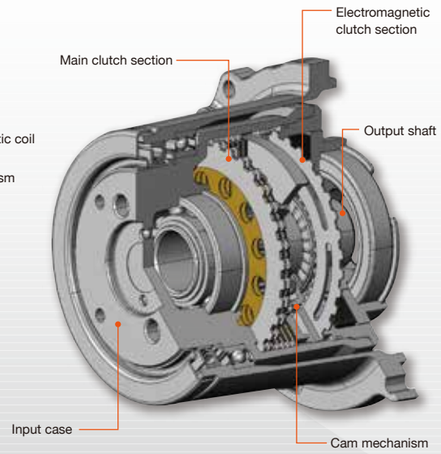
ECU automatically analyzes signals from wheel speeds and other sensors, and continuously adjusts the driving force (e.g., 100:0~50:50) to the front and rear wheels according to driver operation and road surface conditions.

ITCC structure

- Electromagnetic clutch adopted, realizing reductions in size and weight.
- Components broadly divided into five sections: Input case, main clutch, electromagnetic clutch, cam mechanism and output shaft.

ITCC cross-section



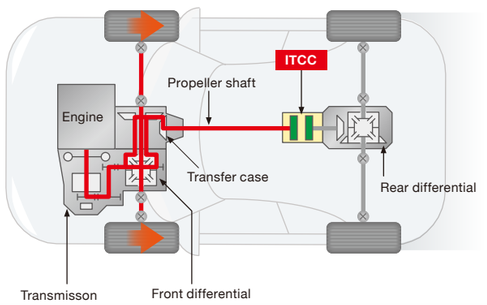


ITCC Operating Principle

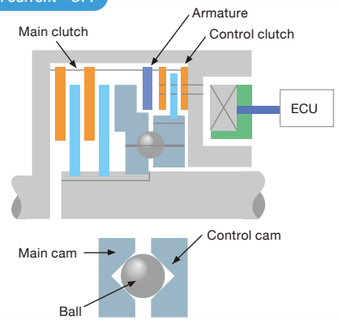
Based on signals from each sensor in the vehicle, such as wheel speed sensors, etc., the ECU analyzes driver operation and road surface conditions, and then ITCC transfers the appropriate torque to the output shaft according to the electrical current from the ECU.

Example of on-demand AWD mounted in FWD configuration
In this mounting example, the ITCC is located in front of the rear differential and the vehicle normally runs with the front-wheel-drive. The ECU receives signals from each sensor, analyzes driving and road surface conditions, and controls the electrical current sent to the ITCC, which then transfers the optimal torque to the rear wheels based on various conditions.

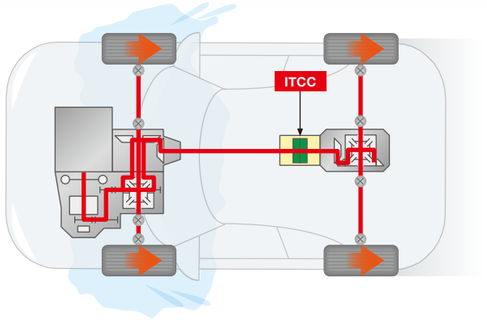
When in 2WD (normal driving)



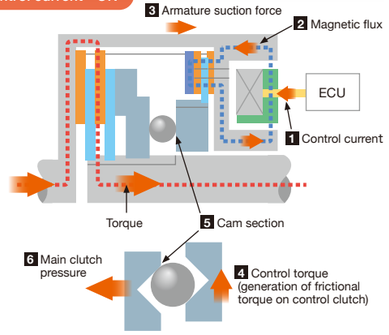
Control current=OFF



When in AWD (front wheels slip)

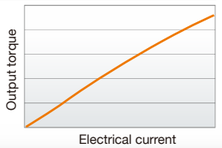


Control current=ON



●Electrical current to torque (I-T) characteristics

Output torque acquired is approximately proportional to the electrical current.



●Torque transmission flow

1 Current applied to coil
↓
2 Generate magnetic flux
↓
3 Armature suction
↓
4 Generate control torque
↓
5 Cam actuated
↓
6 Pressure on main clutch
↓
Torque transmitted from input case to output shaft

ITCC Features

- Optimum driving force distributed based on road surface and driving conditions
- Compact, lightweight system

→ Superior traction and maneuverability

→ Lighter driveline and improved fuel efficiency

→ Excellent compatibility with ABS and stability control systems

※1)As of Jan. 2014, in-house study

Lightweight/Compact size contributes to higher fuel efficiency

Introduction of an electromagnetic clutch enabled reductions in weight, size and electricity consumption, contributing to improved fuel efficiency.

■Newly developed control clutch introduced

Newly developed control clutch, further improved torque precision and lighter driveline contribute to higher fuel efficiency.

●Newly developed control clutch

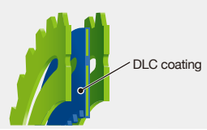
Superior durability and quietness have been realized, contributing to a confident, comfortable drive.

Remarkable anti-shudder performance contributes further to quietness.

■Control clutch coated with diamond-like carbon (DLC) introduced

ITCC can be used in large-sized vehicles where the clutch is subjected to large load, and the amorphous carbon film contributes to both reducing size and increasing service life.

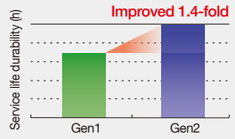
●DLC-coated control clutch



■Special high-performance ITCC fluid introduced

Aiming to improve durability, a special fluid has been introduced that makes it possible to reduce the number of clutch plates to lighten the weight. Additionally, compared to conventional automatic transmission fluid (ATF), AWD coupling performance has been improved, thereby contributing to quietness of eco-cars.

●Durability results using special high-performance ITCC fluid



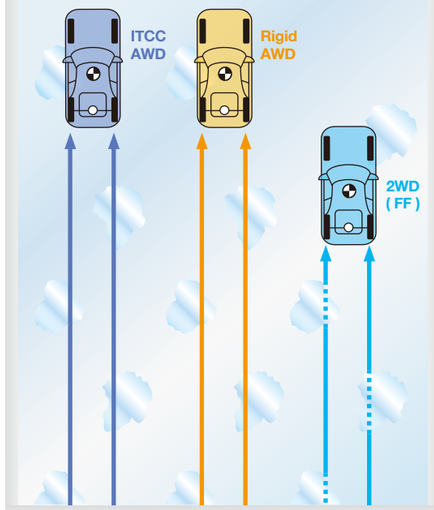
Based on extensive experience, ITCC control contributes to reducing abnormal noises (e.g., driveline torsional vibration, driveline chattering, etc.) generated by the vehicle.

Driving Performance with ITCC

Traction performance

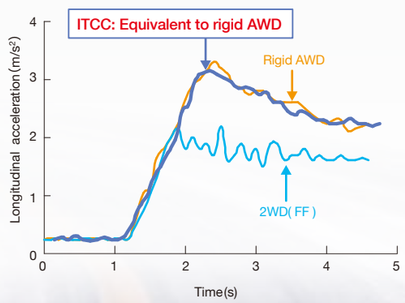
Vehicles equipped with ITCC exhibit a standing-start acceleration performance equivalent to that of rigid AWD.

Standing-start full-throttle acceleration on ice floe



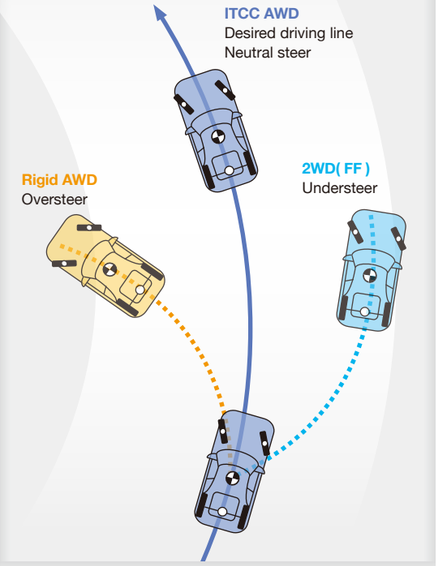
■Launch performance

・Ice surface
・Acceleration: Stop→WOT(wide open throttle)



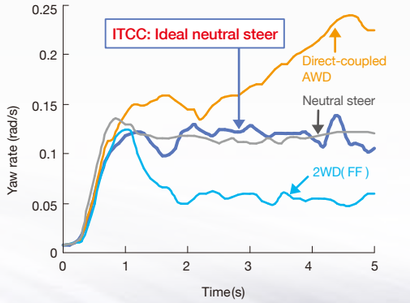
Handling performance/Stability

Vehicles equipped with ITCC exhibit brilliant handling stability even on a slippery surface.



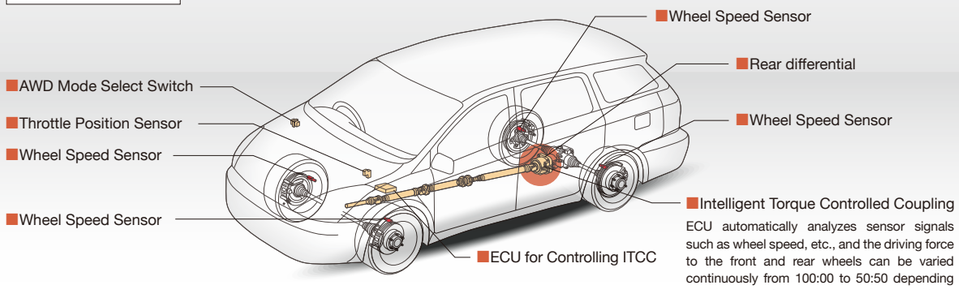
■Cornering performance

・Ice surface
・Accelerate from 30km/h



ITCC Control System Features

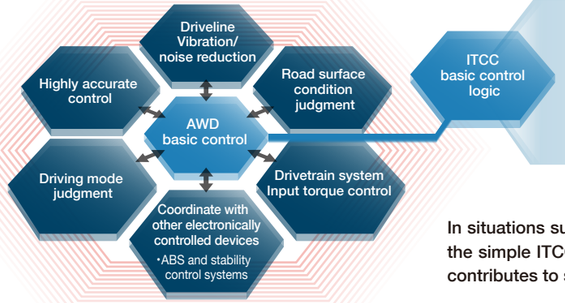
ITCC system layout



ECU automatically analyzes sensor signals such as wheel speed, etc., and the driving force to the front and rear wheels can be varied continuously from 100:00 to 50:50 depending on driver operation and road surface conditions

■Easily coordinate control with other control systems

The ITCC electromagnetic clutch is highly responsive, making it easy to coordinate control with various vehicle control systems (ABS and stability control systems), etc.



ITCC basic control logic

Using wheel speed signal, throttle position signal, etc. that come as standard equipment in the vehicle, ITCC basic control logic compatible with traction performance and tight corner binding avoidance is developed

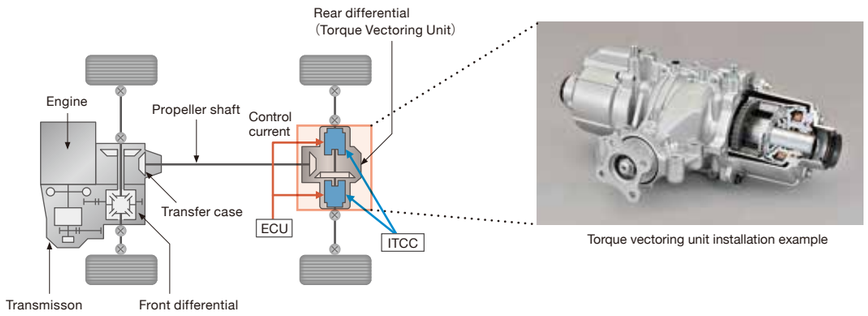
Optional control including driveline lightening and improving vehicle vibration/noise performance is available

In situations such as driving in the city and on snowy roads, the simple ITCC system improves vehicle controllability and contributes to safe, confident driving.

Extended Use Example Based on ITCC

Torque Vectoring Unit Adaptation

In addition to the function that distributes optimum torque to the rear wheels depending on vehicle operation and driving conditions, the system can also freely distribute torque to the right and left rear wheels. When cornering, large torque can be distributed to the outer rear wheel to produce yaw moment that suppresses understeer, thereby enabling the vehicle to hold the desired cornering line. Quick response to steering operation realizes sporty handling performance.



Torque vectoring unit installation example