YAMAHA 2010

SERVICE MANUAL

XT1200Z(Z)

SUPER TÉNÉRÉ

23P-28197-E0

EAS20110

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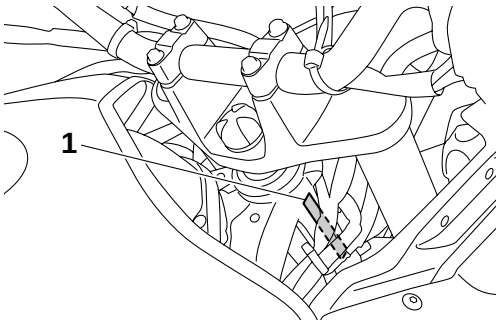
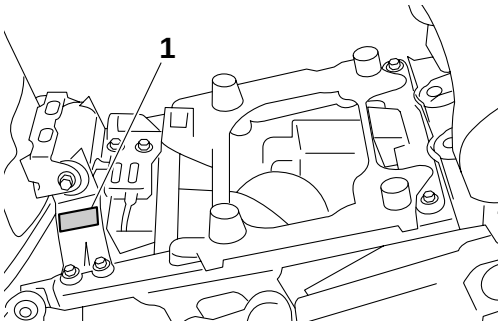
GENERAL INFORMATION

EAS20130
IDENTIFICATION

EAS20140
VEHICLE IDENTIFICATION NUMBER
The vehicle identification number “1” is stamped into the right side of the frame.



EAS20150
MODEL LABEL
The model label “1” is affixed to the frame under the rider seat. This information will be needed to order spare parts.



EAS20170
FEATURES

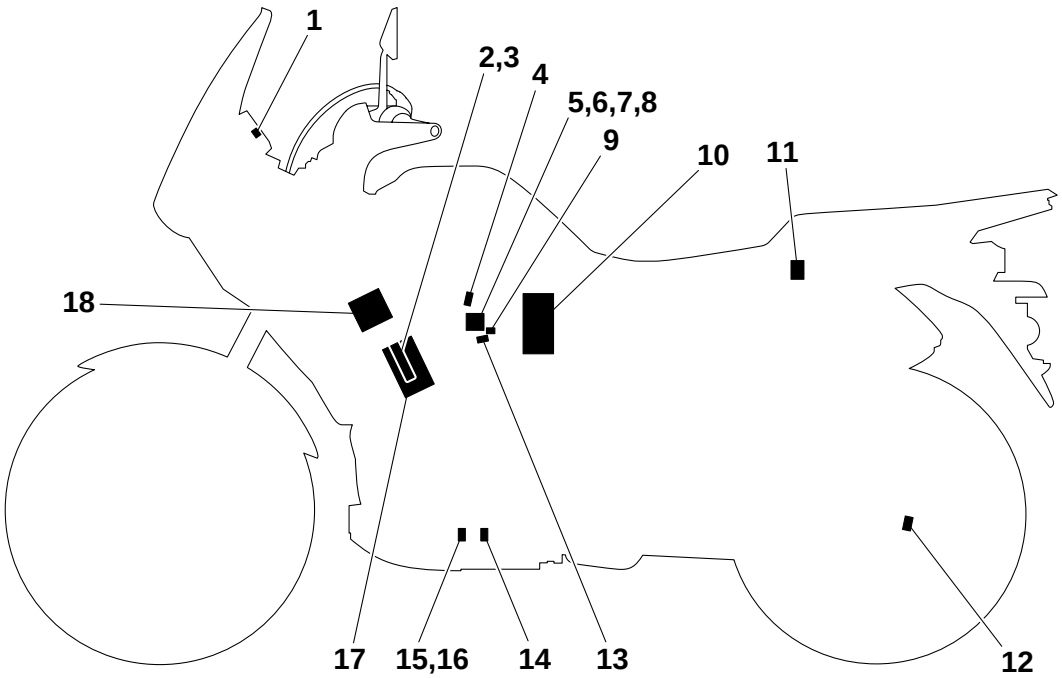
EAS30340
OUTLINE OF THE FI SYSTEM

The main function of a fuel supply system is to provide fuel to the combustion chamber at the optimum air-fuel ratio in accordance with the engine operating conditions and the atmospheric temperature. In the conventional carburetor system, the air-fuel ratio of the mixture that is supplied to the combustion chamber is created by the volume of the intake air and the fuel that is metered by the jet used in the respective carburetor.

Despite the same volume of intake air, the fuel volume requirement varies by the engine operating conditions, such as acceleration, deceleration, or operating under a heavy load. Carburetors that meter the fuel through the use of jets have been provided with various auxiliary devices, so that an optimum air-fuel ratio can be achieved to accommodate the constant changes in the operating conditions of the engine.

As the requirements for the engine to deliver more performance and cleaner exhaust gases increase, it becomes necessary to control the air-fuel ratio in a more precise and finely tuned manner. To accommodate this need, this model has adopted an electronically controlled fuel injection (FI) system, in place of the conventional carburetor system. This system can achieve an optimum air-fuel ratio required by the engine at all times by using a microprocessor that regulates the fuel injection volume according to the engine operating conditions detected by various sensors.

The adoption of the FI system has resulted in a highly precise fuel supply, improved engine response, better fuel economy, and reduced exhaust emissions.

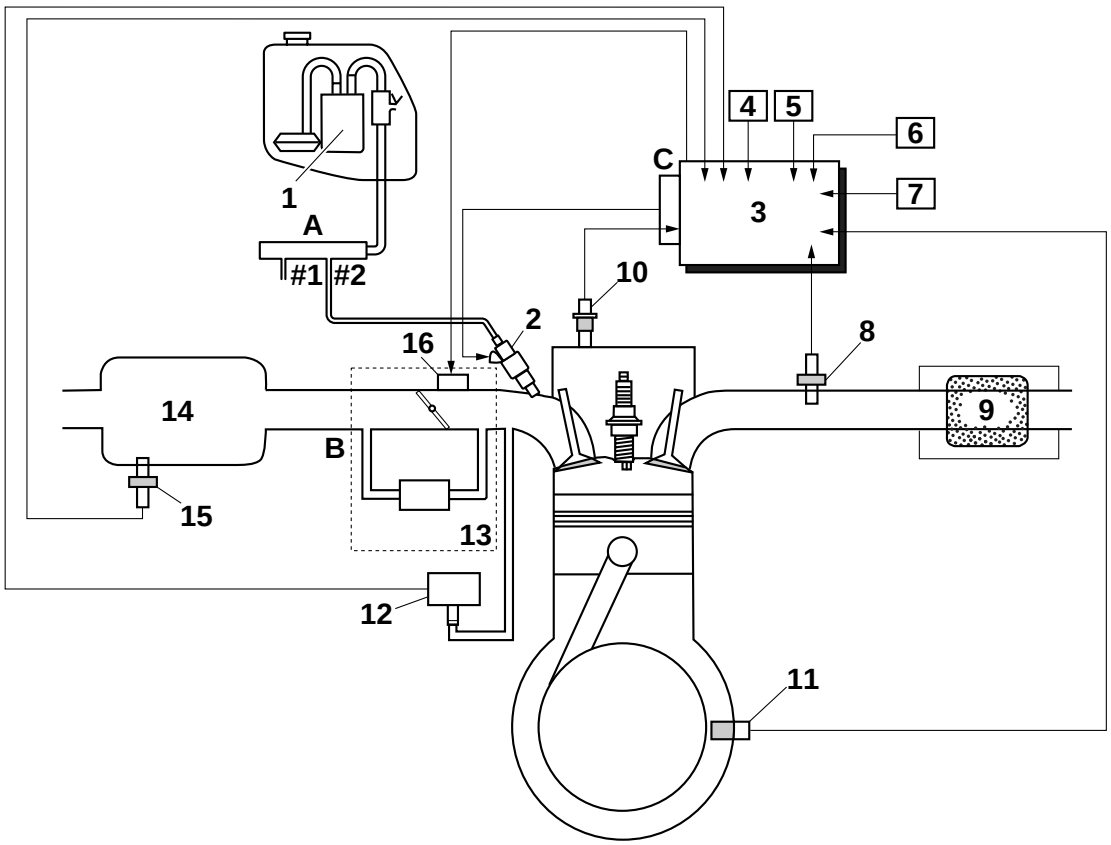


1. Engine trouble warning light
2. Ignition coils
3. Spark plugs
4. Intake air temperature sensor
5. Throttle position sensor
6. Accelerator position sensor
7. Intake air pressure sensor
8. Throttle servo motor
9. Fuel injectors
10. Fuel pump
11. Lean angle sensor
12. Rear wheel sensor
13. Coolant temperature sensor
14. Crankshaft position sensor
15. O_2 sensor #1
16. O_2 sensor #2
17. Battery
18. ECU (engine control unit)

EAS23P1100
FI SYSTEM

The fuel pump delivers fuel to the fuel injector via the fuel filter. The pressure regulator maintains the fuel pressure that is applied to the fuel injector at 324 kPa (3.24 kgf/cm², 47.0 psi). Accordingly, when the energizing signal from the ECU energizes the fuel injector, the fuel passage opens, causing the fuel to be injected into the intake manifold only during the time the passage remains open. Therefore, the longer the length of time the fuel injector is energized (injection duration), the greater the volume of fuel that is supplied. Conversely, the shorter the length of time the fuel injector is energized (injection duration), the lesser the volume of fuel that is supplied.

The injection duration and the injection timing are controlled by the ECU. Signals that are input from the throttle position sensor, accelerator position sensor, coolant temperature sensor, lean angle sensor, crankshaft position sensor, intake air pressure sensor, intake air temperature sensor, rear wheel sensor and O_2 sensors enable the ECU to determine the injection duration. The injection timing is determined through the signals from the crankshaft position sensor. As a result, the volume of fuel that is required by the engine can be supplied at all times in accordance with the driving conditions.



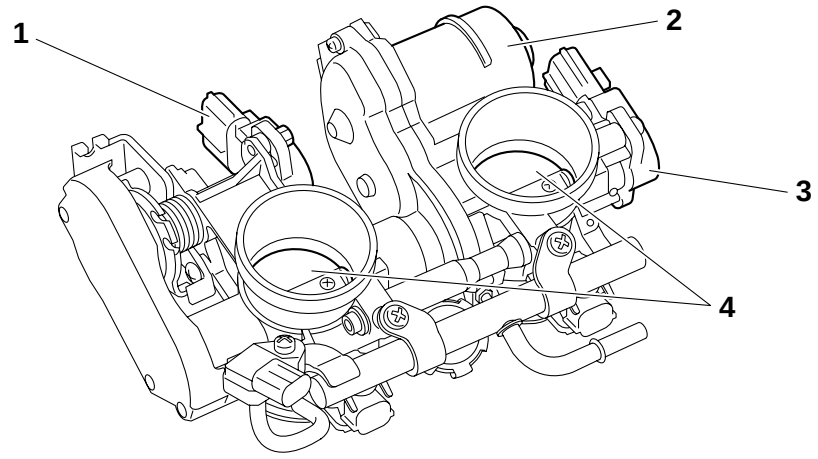
1. Fuel pump
2. Injector
3. ECU (engine control unit)
4. Throttle position sensor
5. Accelerator position sensor
6. Rear wheel sensor
7. Lean angle sensor
8. O_2 sensor
9. Catalytic converter
10. Coolant temperature sensor
11. Crankshaft position sensor
12. Intake air pressure sensor
13. Throttle body
14. Air filter case
15. Intake air temperature sensor
16. Throttle servo motor

A. Fuel system
B. Air system
C. Control system

EAS23P1098
YCC-T (Yamaha Chip Controlled Throttle)

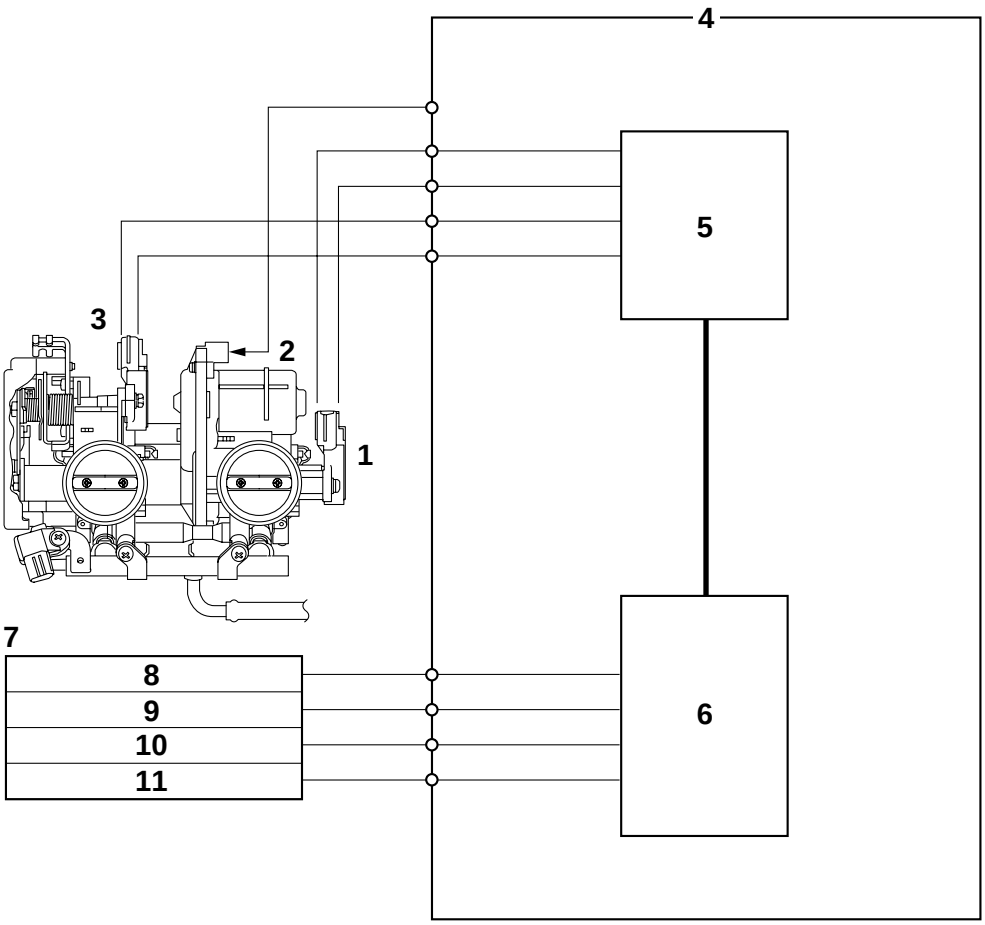
Mechanism characteristics
Yamaha developed the YCC-T system employing the most advanced electronic control technologies. Electronic control throttle systems have been used on automobiles, but Yamaha has developed a faster, more compact system specifically for the needs of a sports motorcycle. The Yamaha-developed system has a high-speed calculating capacity that produces computations of running conditions every 1/1000th of a second.
The YCC-T system is designed to respond to the throttle action of the rider by having the ECU instantaneously calculate the ideal throttle valve opening and generate signals to operate the motor-driven throttle valves and thus actively control the intake air volume.
The ECU contains two CPUs with a capacity about five times that of conventional units, making it possible for the system to respond extremely quickly to the slightest adjustments made by the rider. In particular, optimized control of the throttle valve opening provides the optimum volume of intake air for easy-to-use torque, even in a high-revving engine.

Aims and advantages of using YCC-T
- Increased engine power
  By shortening the air intake path, higher engine speed is possible → Increased engine power.
- Improved driveability
  Air intake volume is controlled according to the operating conditions → Improved throttle response to meet engine requirement.
  Driving force is controlled at the optimal level according to the transmission gear position and engine speed → Improved throttle control.
- Engine braking control
  Due to the throttle control, optimal engine braking is made possible.
- Simplified idle speed control (ISC) mechanism
  The bypass mechanism and ISC actuator are eliminated → A simple mechanism is used to maintain a steady idle speed.
- Reduced weight
  Compared to using a sub-throttle mechanism, weight is reduced.



1. Accelerator position sensor
2. Throttle servo motor
3. Throttle position sensor
4. Throttle valves

YCC-T system outline



1. Throttle position sensor
2. Throttle servo motor
3. Accelerator position sensor
4. ECU (engine control unit)
5. YCC-T CPU
6. FI CPU
7. Sensor input
8. Neutral switch
9. Crankshaft position sensor
10. Rear wheel sensor
11. Coolant temperature sensor

EAS23P1060
OUTLINE OF THE UBS

This model is equipped with a unified brake system (UBS) that operates the rear brake when the brake lever is squeezed.
When the brake lever is squeezed, the rear brake force is controlled electronically according to the brake lever input (hydraulic pressure) and vehicle speed (deceleration). During tandem riding or when the vehicle is carrying a heavy load, the rear brake force generated by the UBS is higher to increase vehicle stability.
If the brake pedal is operated before the brake lever, the UBS will not operate. However, if the brake pedal is operated while the UBS is operating, the UBS will continue to operate until the brake pedal input exceeds the rear brake force generated by the UBS. Then, the rear braking will switch to rider control.

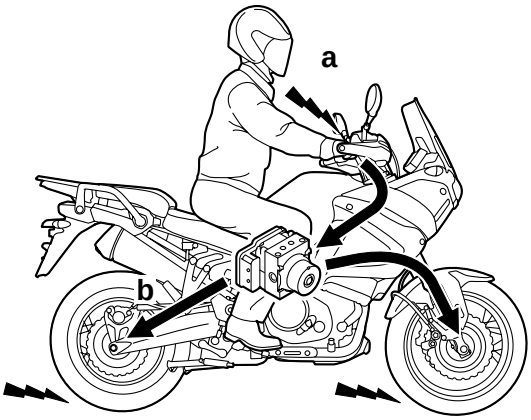
TIP

If the brakes are operated while the vehicle is traveling at low speeds, the UBS will only generate a small brake force.

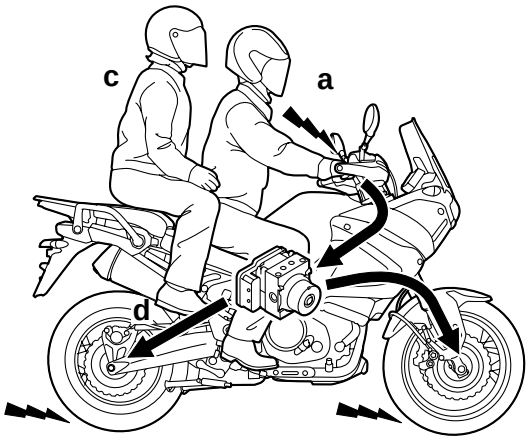
UBS operation

• Brake lever input only: Front braking and rear braking with hydraulic pump (with UBS operation)

Brake lever only operated (UBS operation)



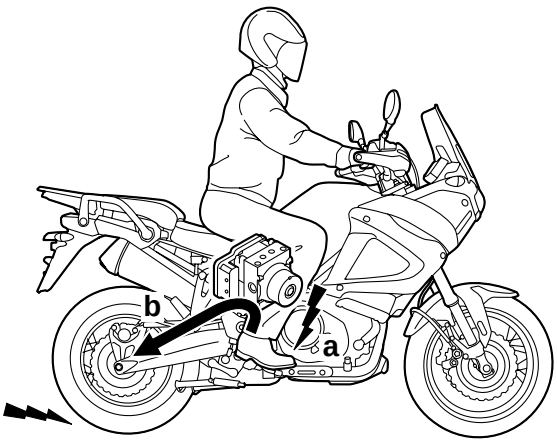
a. Input
b. Automatic pressurization (normal)



a. Input
c. During tandem riding or when carrying a load
d. Automatic pressurization (high)

• Brake pedal input only: Rear braking (without UBS operation)

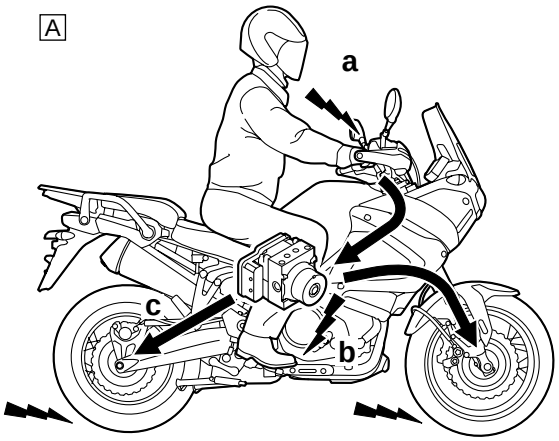
Brake pedal only operated



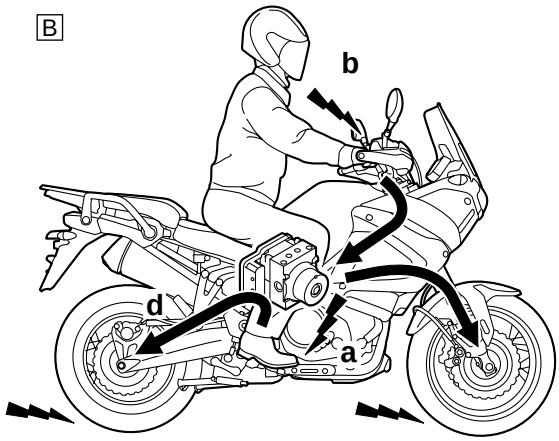
a. Input
b. No automatic pressurization

• Brake lever input and brake pedal input: Front braking and rear braking (with and without UBS operation)

Brake lever and brake pedal both operated

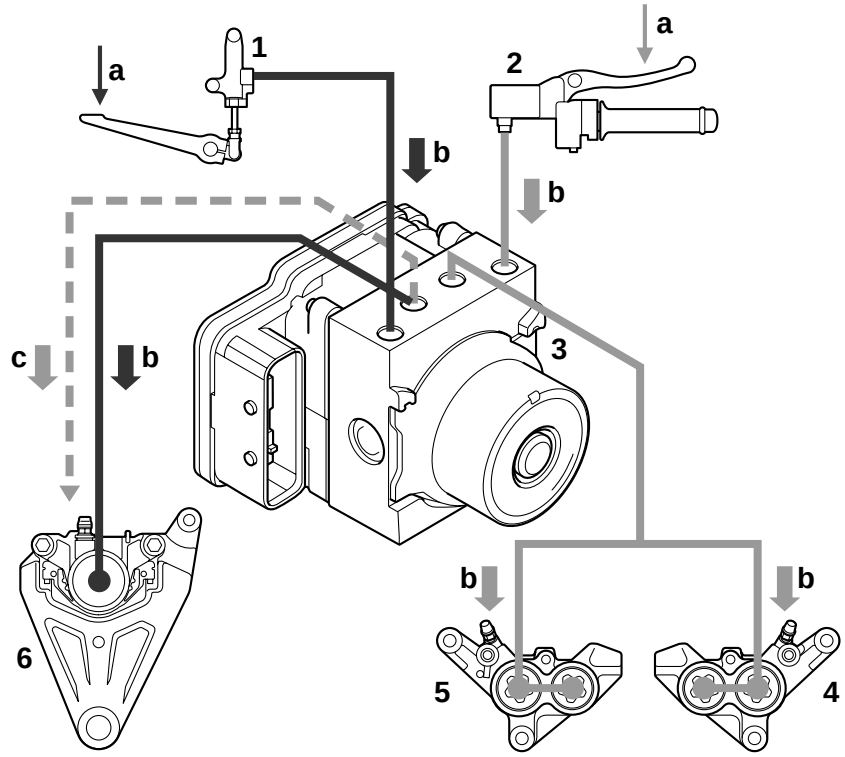


A. Brake lever is operated before brake pedal
a. First input
b. Second input
c. Brake fluid is automatically pressurized until the second input exceeds the automatic pressurization



B. Brake pedal is operated before brake lever
a. First input
b. Second input
d. No automatic pressurization

UBS diagram



1. Rear brake master cylinder
2. Front brake master cylinder
3. Hydraulic unit assembly (ABS ECU)
4. Right front brake caliper
5. Left front brake caliper
6. Rear brake caliper

a. Input
b. Pressurization
c. Pressurization (hydraulic pump pressurization by UBS)

When the brake lever is squeezed, the front brake master cylinder pressure sensor in the hydraulic unit detects the hydraulic pressure. The ABS ECU calculates the appropriate rear brake force according to the detected hydraulic pressure and sends a signal to the rear brake hydraulic pump. The hydraulic pump pressurizes the rear brake caliper using electronic control to operate the rear brake.

TIP

- If the brake pedal is depressed while the brake lever is being squeezed, the brake pedal may feel hard due to the operation of the UBS, but this does not indicate a malfunction.
- If the rider squeezes the brake lever while resting their foot on the brake pedal, a vibration can be felt at the brake pedal due to the operation of the UBS, but this does not indicate a malfunction.

ECA23P1054

NOTICE

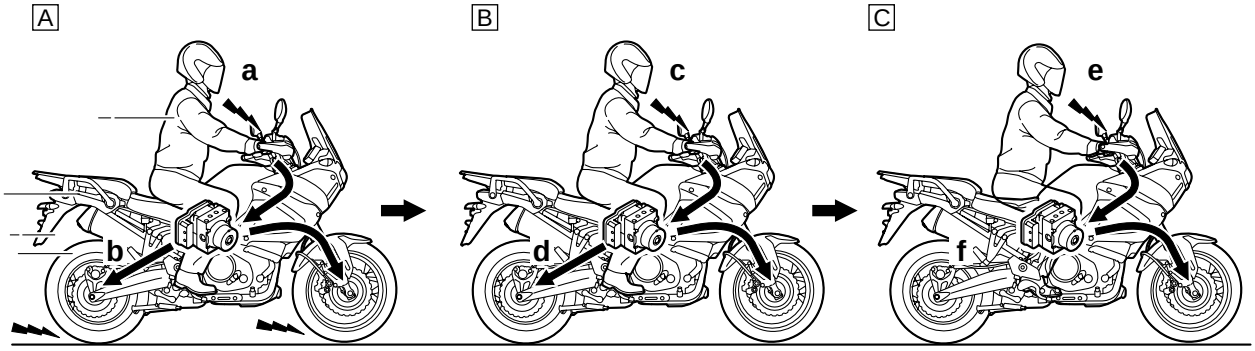
- **The UBS does not operate before the vehicle starts off.**
- **If the vehicle is stopped by operating the brake lever only, the brake force due to the operation of the UBS will be maintained while the brake lever is squeezed. However, if the brake lever is released, then squeezed again, the UBS will not operate.**

ECA23P1055

NOTICE

- **The unified brake system is a system to assist the brake operation. However, both the brake lever and the brake pedal must be operated for maximum braking effect.**
- **Because the balance between the front brake calipers and the rear brake caliper in the unified brake system is determined electronically, be sure to use the specified brake pads.**
- **Each set of brake pads should be checked individually and replaced if necessary.**

When vehicle is stopped using brake lever only



A. Deceleration
a. Input
b. Automatic pressurization

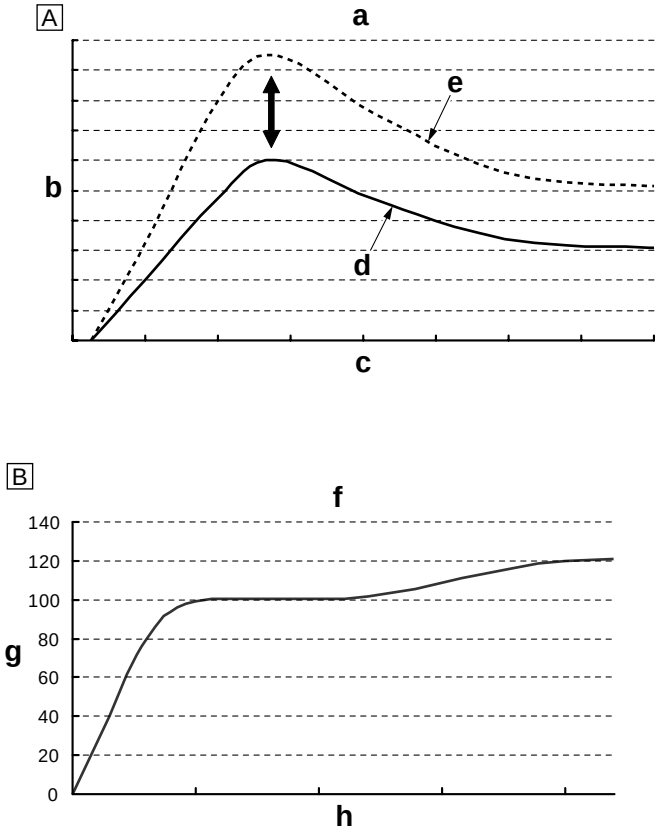
B. Vehicle stopped
c. Input maintained
d. Pressurization maintained

C. Brake lever released, then squeezed again, after vehicle stops
e. Brake lever released, then squeezed again
f. No automatic pressurization

UBS hydraulic pressure map

The appropriate hydraulic pressure is distributed according to the load being carried by the vehicle. See figure “A”.

The coefficient is set according to the vehicle speed when the brake input starts and remains constant until the brake input stops. When the brakes are operated continuously to slow the vehicle, the coefficient (UBS brake force) does not decrease together with the vehicle speed. See figure “B”.

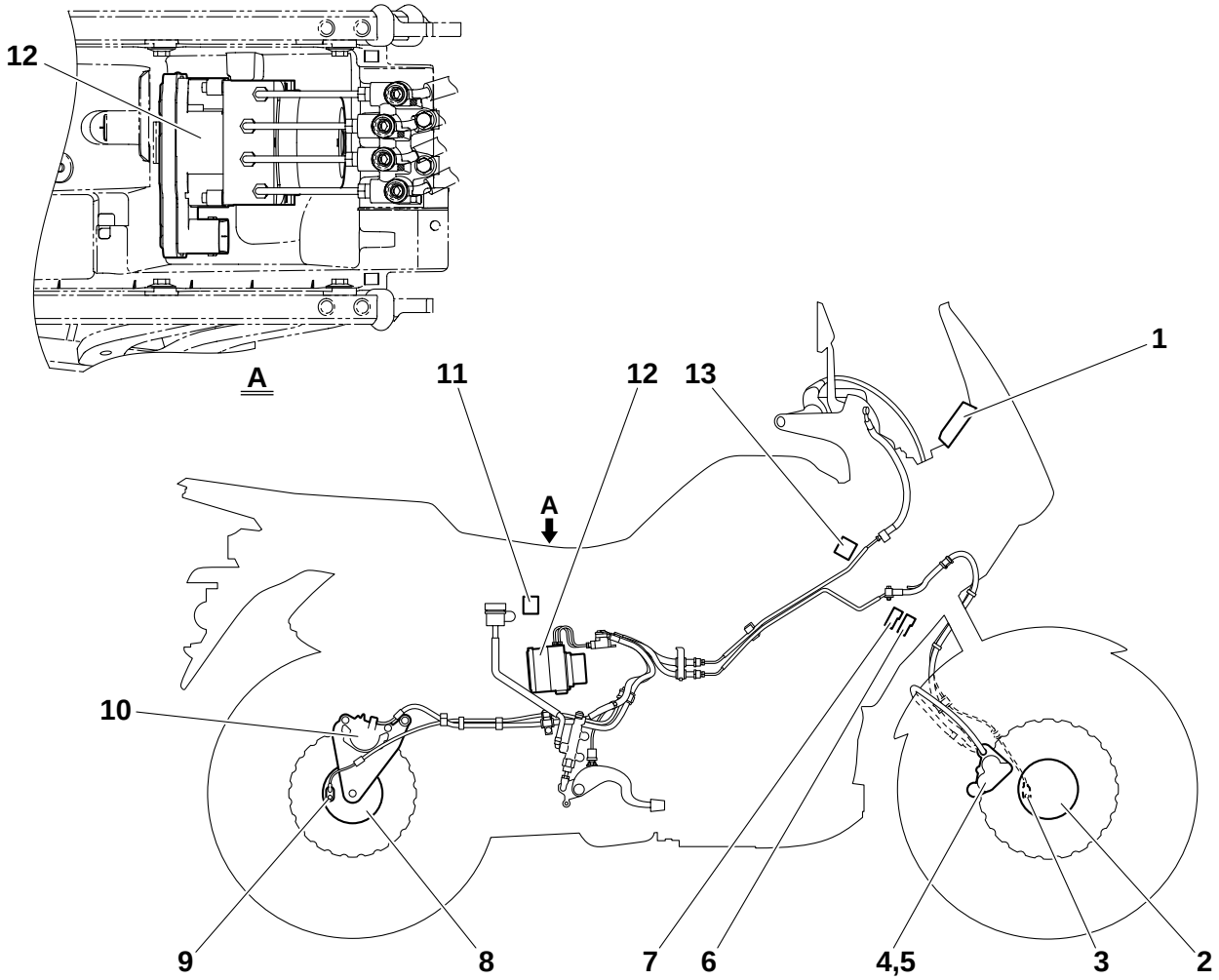


a. Hydraulic pressure distribution
b. Rear brake output (bars)
c. Front brake input (bars)
d. Rider only
e. When carrying the maximum load
f. Vehicle speed coefficient
g. Coefficient (%)
h. Speed (km/h)

EAS23P1061
OUTLINE OF THE ABS

1. This model is equipped with the latest, advanced type of ABS, which has improved feeling during operation and smoother braking than previous ABS brakes. The ABS ECU detects the hydraulic pressure using the pressure sensors and controls the pressure linearly using continuously variable adjustments to obtain the appropriate pressure when the wheels have a tendency to lock or according to the operation input (hydraulic pressure) from the brake lever or brake pedal.
2. If the wheels have a tendency to lock during brake lever input, brake pedal input, or UBS control, the ABS will operate.
3. The hydraulic unit assembly, which is the main component of the ABS, is centrally located on the vehicle to increase mass centralization.

ABS layout



1. ABS warning light
2. Front wheel sensor rotor
3. Front wheel sensor
4. Right front brake caliper
5. Left front brake caliper
6. ABS ECU fuse
7. ABS solenoid fuse
8. Rear wheel sensor rotor
9. Rear wheel sensor
10. Rear brake caliper
11. ABS test coupler
12. Hydraulic unit assembly
13. ABS motor fuse

Useful terms

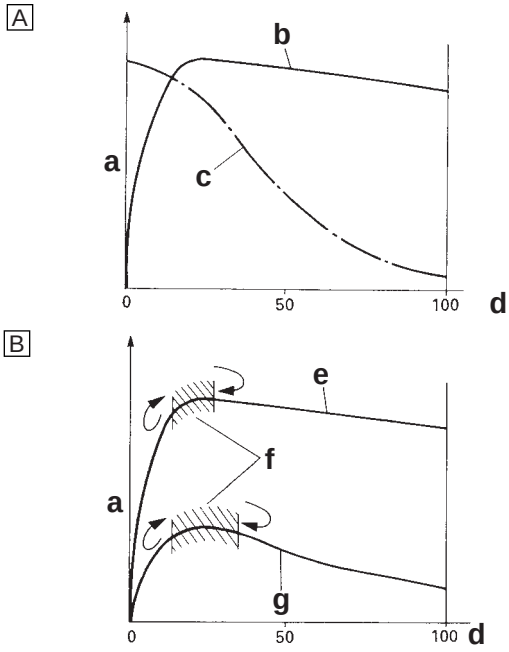
- Wheel speed:
  The rotation speed of the front and rear wheels.
- Chassis speed:
  The speed of the chassis.
  When the brakes are applied, wheel speed and chassis speed are reduced. However, the chassis travels forward by its inertia even though the wheel speed is reduced.
- Brake force:
  The force applied by braking to reduce the wheel speed.
- Wheel lock:
  A condition that occurs when the rotation of one or both of the wheels has stopped, but the vehicle continues to travel.
- Side force:
  The force on the tires which supports the vehicle when cornering.
- Slip ratio:
  When the brakes are applied, slipping occurs between the tires and the road surface. This causes a difference between the wheel speed and the chassis speed.
  Slip ratio is the value that shows the rate of wheel slippage and is defined by the following formula.

$$\text{Slip ratio} = \frac{\text{Chassis speed} - \text{Wheel speed}}{\text{Chassis speed}} \times 100\ (\%)$$

  0%: There is no slipping between the wheel and the road surface. The chassis speed is equal to the wheel speed.
  100%: The wheel speed is “0”, but the chassis is moving (i.e., wheel lock).

Brake force and vehicle stability

When the brake pressure is increased, wheel speed is reduced. Slipping occurs between the tire and the road surface and brake force is generated. The limit of this brake force is determined by the friction force between the tire and the road surface and is closely related to wheel slippage. Wheel slippage is represented by the slip ratio.
Side force is also closely related to wheel slippage. See figure “A”. If the brakes are applied while keeping the proper slip ratio, it is possible to obtain the maximum brake force without losing much side force. ABS allows full use of the tires’ capabilities even on slippery road surfaces or less slippery road surfaces. See figure “B”.



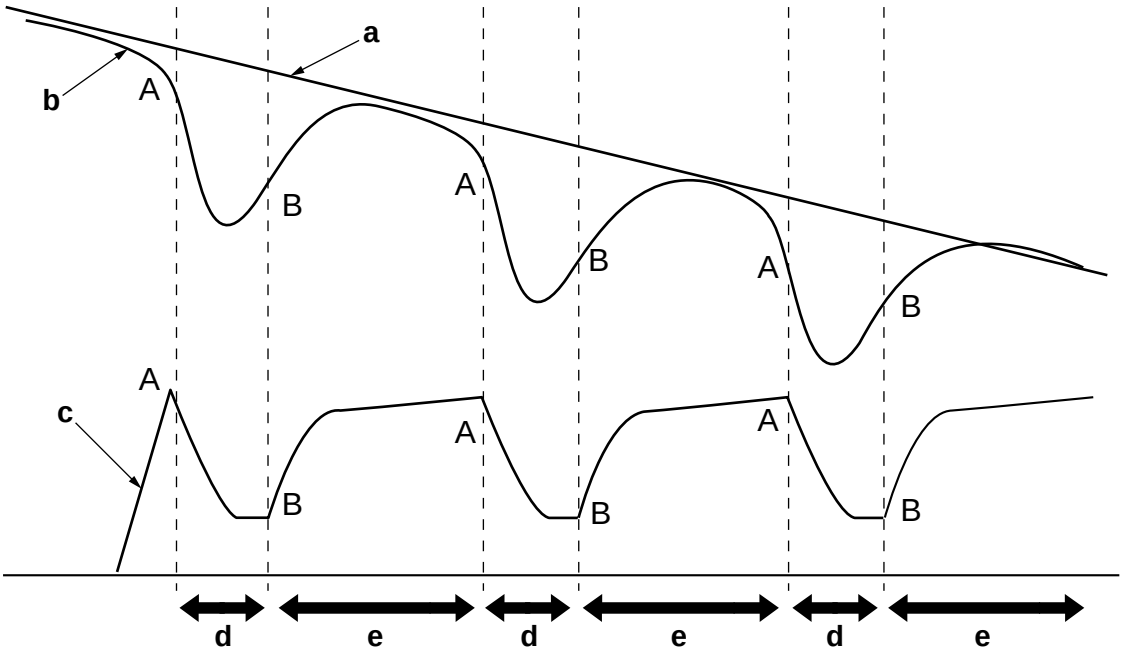
a. Friction force between the tire and road surface
b. Brake force
c. Side force
d. Slip ratio (%)
e. Less slippery road surface
f. Controlling zone
g. Slippery road surface

Wheel slip and hydraulic control

The ABS ECU calculates the wheel speed of each wheel according to the rotation signal received from the front and rear wheel sensors. In addition, the ABS ECU calculates the vehicle chassis speed and the rate of speed reduction based on the wheel speed values.

The difference between the chassis speed and the wheel speed calculated in the slip ratio formula is equal to the wheel slip. When the wheel speed is suddenly reduced, the wheel has a tendency to lock. When the wheel slip and the wheel speed reduction rate exceed the preset values, the ABS ECU determines that the wheel has a tendency to lock.

If the slip is large and the wheel has a tendency to lock (point “A” in the following figure), the ABS ECU reduces the hydraulic pressure in the brake caliper. Once the ABS ECU determines that the tendency of the wheel to lock has diminished after the hydraulic pressure is reduced, it increases the hydraulic pressure (point “B” in the following figure). The hydraulic pressure is initially increased quickly, and then it is increased gradually.



a. Chassis speed
b. Wheel speed
c. Brake force
d. Depressurizing phase
e. Pressurizing phase

ABS operation and vehicle control

If the ABS starts operating, there is a tendency of the wheel to lock, and the vehicle is approaching the limit of control. To make the rider aware of this condition, the ABS has been designed to generate a reaction-force pulsating action in the brake lever and brake pedal independently.

TIP

When the ABS is activated, a pulsating action may be felt at the brake lever or brake pedal, but this does not indicate a malfunction.

The higher the side force on a tire, the less traction there is available for braking. This is true whether the vehicle is equipped with ABS or not. Therefore, sudden braking while cornering is not recommended. Excessive side force, which ABS cannot prevent, could cause the tire to slip sideways.

EWA23P1023

⚠ WARNING

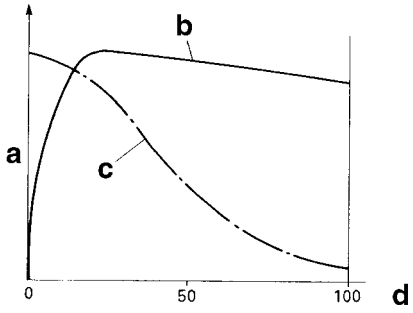
The braking of the vehicle, even in the worst case, is principally executed when the vehicle is advancing straight ahead. During a turn, sudden braking is liable to cause a loss of traction of the tires. Even vehicles equipped with ABS cannot be prevented from falling over if braked suddenly.

The ABS functions to prevent the tendency of the wheel to lock by controlling the hydraulic pressure. However, if there is a tendency of the wheel to lock on a slippery road surface, due to engine braking, the ABS may not be able to prevent the wheel from locking.

EWA23P1024

⚠ WARNING

The ABS controls only the tendency of the wheel to lock caused by applying the brakes. The ABS cannot prevent wheel lock on slippery surfaces, such as ice, when it is caused by engine braking, even if the ABS is operating.



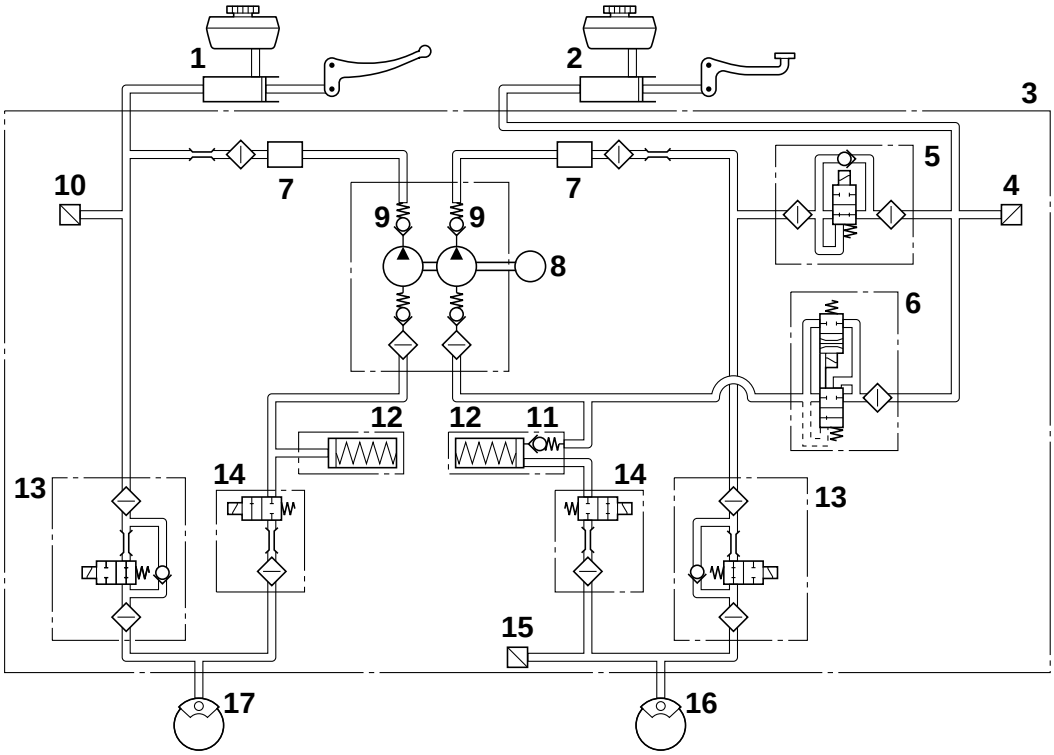
a. Friction force between the tire and road surface
b. Brake force
c. Side force
d. Slip ratio (%)

Electronic ABS features

The Yamaha ABS (anti-lock brake system) has been developed with the most advanced electronic technology.

The ABS also includes a highly developed self-diagnosis function. The ABS has been designed to operate as a conventional brake system if the ABS malfunctions. Also, there may be little or no additional rear brake force provided by the UBS. If the UBS does not operate, the front and rear brakes will operate independently according to the rider input, and the respective brake force will be the same as during normal braking. When the brake lever is squeezed, only the front brakes will operate and when the brake pedal is depressed, only the rear brake will operate.

ABS block diagram

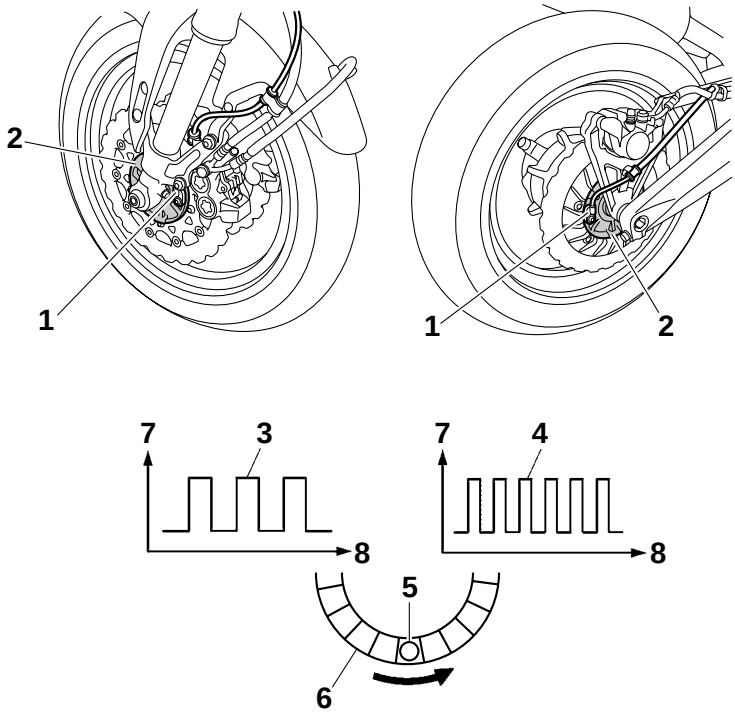


1. Front brake master cylinder
2. Rear brake master cylinder
3. Hydraulic unit assembly
4. Rear brake master cylinder pressure sensor
5. Separation solenoid valve
6. Shuttle solenoid valve
7. Damping chamber
8. ABS motor
9. Hydraulic pump
10. Front brake master cylinder pressure sensor
11. Check valve
12. Buffer chamber
13. Inlet solenoid valve
14. Outlet solenoid valve
15. Rear brake caliper pressure sensor
16. Rear brake caliper
17. Front brake calipers

EAS23P1062
ABS COMPONENT FUNCTIONS

Wheel sensors and wheel sensor rotors

Wheel sensors “1” detect the wheel rotation speed and transmit the wheel rotation signal to the ABS ECU.
Each wheel sensor contains an MR sensor. The wheel sensors are installed in the sensor housing for each wheel.
Sensor rotors “2” are installed on the inner side of the front and rear wheel hubs and rotate with the wheels.
The front and rear sensor rotors each have 92 magnetic poles (46 pairs) and are installed close to the wheel sensors. As the sensor rotor rotates, the MR element in the MR sensor installed in the wheel sensor generates the voltage which is proportional to the magnetic flux density, and the generated voltage is processed for waveform shaping in the MR sensor to output.
The ABS ECU calculates the wheel rotation speed by detecting the pulse frequency.



3. At low speed
4. At high speed
5. Wheel sensor
6. Wheel sensor rotor
7. Voltage
8. Time

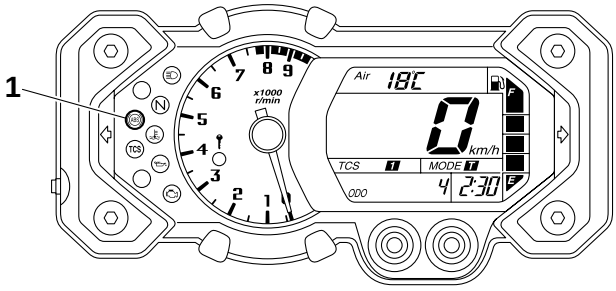
ABS warning light

The ABS warning light “1” comes on to warn the rider if a malfunction in the ABS occurs.
When the main switch is set to “ON”, the ABS warning light comes on for 2 seconds, then goes off, so that the rider can check if the ABS warning light is disconnected and check if the ABS is operating properly.

ECA23P1056

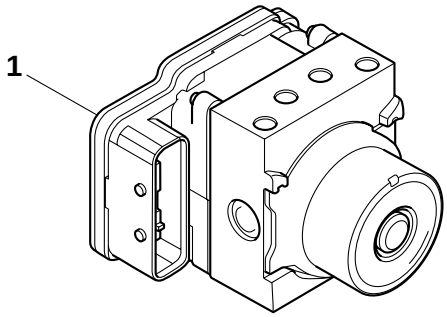
NOTICE

If the rear wheel is raced with the vehicle on the centerstand, the ABS warning light may flash or come on. If this occurs, set the main switch to “OFF”, then back to “ON”. Start the engine. Gently ride the XT1200Z up to 20 km/h (12 mi/h) on straight road without a hard acceleration. The reset will start and the ABS indicator light will be turned off.



Hydraulic unit assembly

The hydraulic unit assembly “1” is composed of hydraulic control valves (outlet solenoid valves, inlet solenoid valves, a shuttle solenoid valve, and a separation solenoid valve), buffer chambers, damping chambers, hydraulic pumps, an ABS motor, hydraulic pressure sensors (front brake master cylinder pressure sensor, rear brake master cylinder pressure sensor, and rear brake caliper pressure sensor), and an ABS ECU. The hydraulic unit adjusts the front and rear wheel hydraulic pressure to control the wheel speed according to signals transmitted from the ABS ECU.



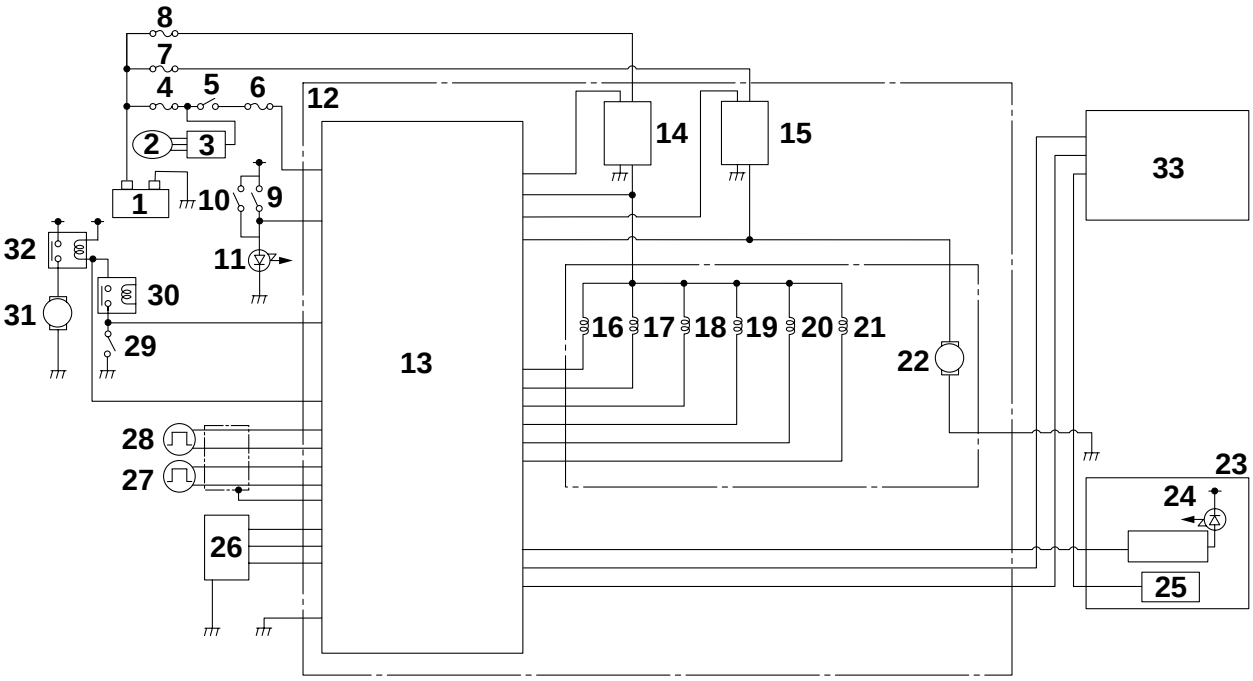
Hydraulic control valves

There are four types of hydraulic control valves: inlet solenoid valve, outlet solenoid valve, shuttle solenoid valve, and separation solenoid valve. The electromagnetic force generated in the inlet solenoid valve varies proportionally with the duty cycle control voltage that is supplied to it. Since this voltage is continuously variable, the solenoid valve moves smoothly and the hydraulic pressure is adjusted linearly.

1. Inlet solenoid valve
   This valve is open during normal braking and UBS operation.
   The valve opens and closes during ABS operation to adjust the hydraulic pressure input from the brake lever or brake pedal.
2. Outlet solenoid valve
   This valve is closed during normal braking and UBS operation.
   The valve opens during ABS operation to reduce the hydraulic pressure.
3. Separation solenoid valve
   This valve is open when the brake pedal is depressed, but the valve opens and closes during UBS operation to adjust the hydraulic pressure.
   The valve opens if the ABS operates when the brake pedal is depressed, but the valve opens and closes to adjust the hydraulic pressure if the ABS operates during UBS operation.
4. Shuttle solenoid valve
   This valve is closed when the brake pedal is depressed, but the valve opens during UBS operation to pressurize the rear brake caliper.
   The valve closes if the ABS operates when the brake pedal is depressed, but the valve opens and closes to adjust the hydraulic pressure if the ABS operates during UBS operation.

ABS ECU

The ABS ECU is integrated with the hydraulic unit to achieve a compact and lightweight design. As shown in the following block diagram, the ABS ECU receives wheel sensor signals from the front and rear wheels and also receives signals from other monitor circuits.



1. Battery
2. AC magneto
3. Rectifier/regulator
4. Main fuse
5. Main switch
6. ABS ECU fuse
7. ABS motor fuse
8. ABS solenoid fuse
9. Front brake light switch
10. Rear brake light switch
11. Tail/brake light
12. Hydraulic unit assembly
13. ABS ECU
14. Solenoid relay
15. ABS motor relay
16. Front brake inlet solenoid
17. Front brake outlet solenoid
18. Rear brake inlet solenoid
19. Rear brake outlet solenoid
20. Separation solenoid valve
21. Shuttle solenoid valve
22. ABS motor
23. Meter assembly
24. ABS warning light
25. Speedometer
26. ABS test coupler
27. Rear wheel sensor
28. Front wheel sensor
29. Start switch
30. Starting circuit cut-off relay
31. Starter motor
32. Starter relay
33. ECU (engine control unit)

The necessary actions are confirmed using the monitor circuit and control signals are transmitted to the hydraulic unit assembly.

ABS control operation

The ABS control operation performed in the ABS ECU is divided into the following two parts.

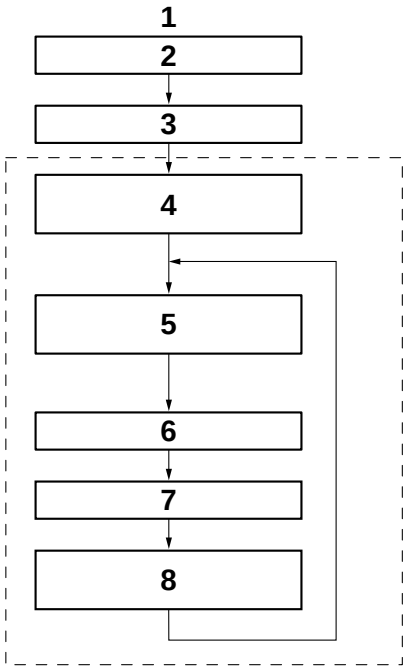
- Hydraulic control
- Self-diagnosis

When a malfunction is detected in the ABS, a fault code is stored in the memory of the ABS ECU for easy problem identification and troubleshooting.

TIP

- Some types of malfunctions are not recorded in the memory of the ABS ECU (e.g., a blown ABS solenoid fuse).

- The ABS performs a self-diagnosis test for a few seconds each time the vehicle first starts off after the main switch was set to “ON”. During this test, a “clicking” noise can be heard from under the seat, and if the brake lever or brake pedal is even slightly operated, a vibration can be felt at the lever and pedal, but these do not indicate a malfunction.



1. Software operation flow
2. Main switch “ON”
3. Initialize
4. Self-diagnosis (when static)
5. Self-diagnosis (when riding)
6. Receive signals
7. Control operation
8. Depressurize/pressurize

EAS23P1063
UBS AND ABS OPERATION

The ABS hydraulic circuit consists of two systems: one for the front wheel and one for the rear wheel.

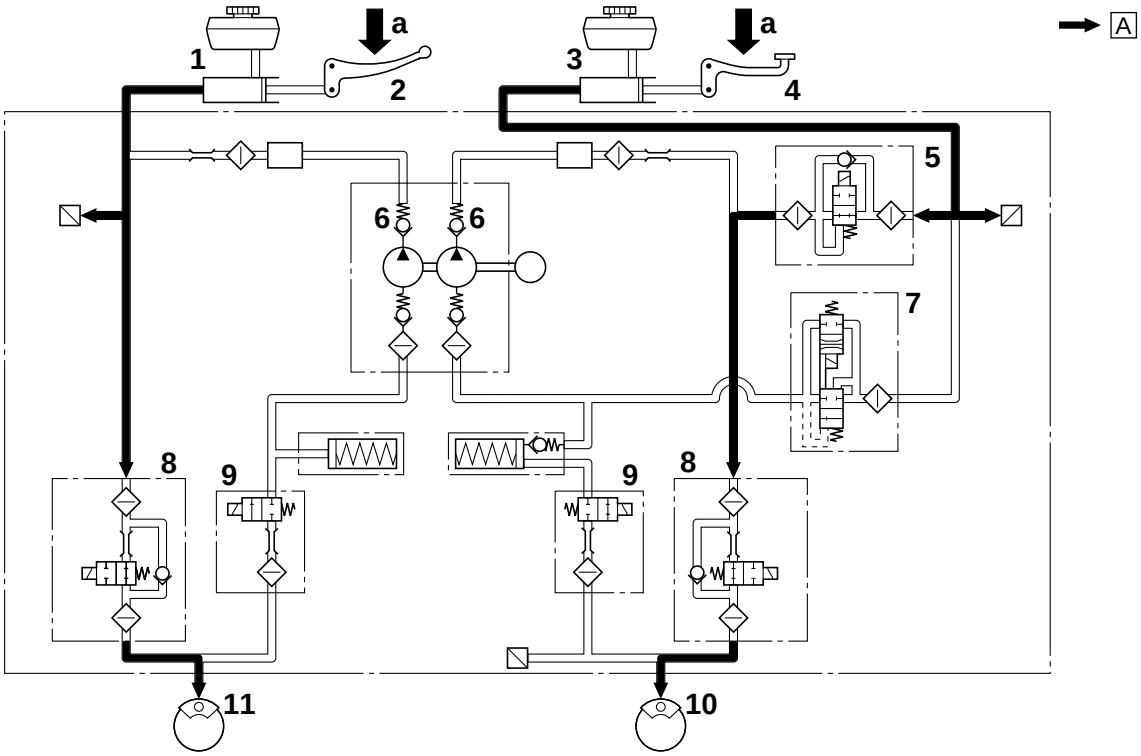
Normal braking (ABS not activated and UBS not activated)

Front brakes:

When the ABS is not activated, the inlet solenoid valve is open and the outlet solenoid valve is closed because a control signal has not been transmitted from the ABS ECU. Therefore, when the brake lever is squeezed, the hydraulic pressure in the front brake master cylinder increases and the brake fluid is sent to the front brake calipers. At this time, the hydraulic pump check valve is closed. The front brake master cylinder directly pressurizes the front brake calipers during normal braking. When the brake lever is released, the brake fluid in the front brake calipers returns to the front brake master cylinder.

Rear brake:

When the ABS is not activated, the inlet solenoid valve and separation solenoid valve are open and the outlet solenoid valve and shuttle solenoid valve are closed because a control signal has not been transmitted from the ABS ECU. Therefore, when the brake pedal is depressed, the hydraulic pressure in the rear brake master cylinder increases and the brake fluid is sent to the rear brake caliper. At this time, the hydraulic pump check valve is closed. The rear brake master cylinder directly pressurizes the rear brake caliper during normal braking. When the brake pedal is released, the brake fluid in the rear brake caliper returns to the rear brake master cylinder.



1. Front brake master cylinder
2. Brake lever
3. Rear brake master cylinder
4. Brake pedal
5. Separation solenoid valve
6. Hydraulic pump
7. Shuttle solenoid valve
8. Inlet solenoid valve
9. Outlet solenoid valve
10. Rear brake caliper
11. Front brake calipers

A. Pressurize
a. Input

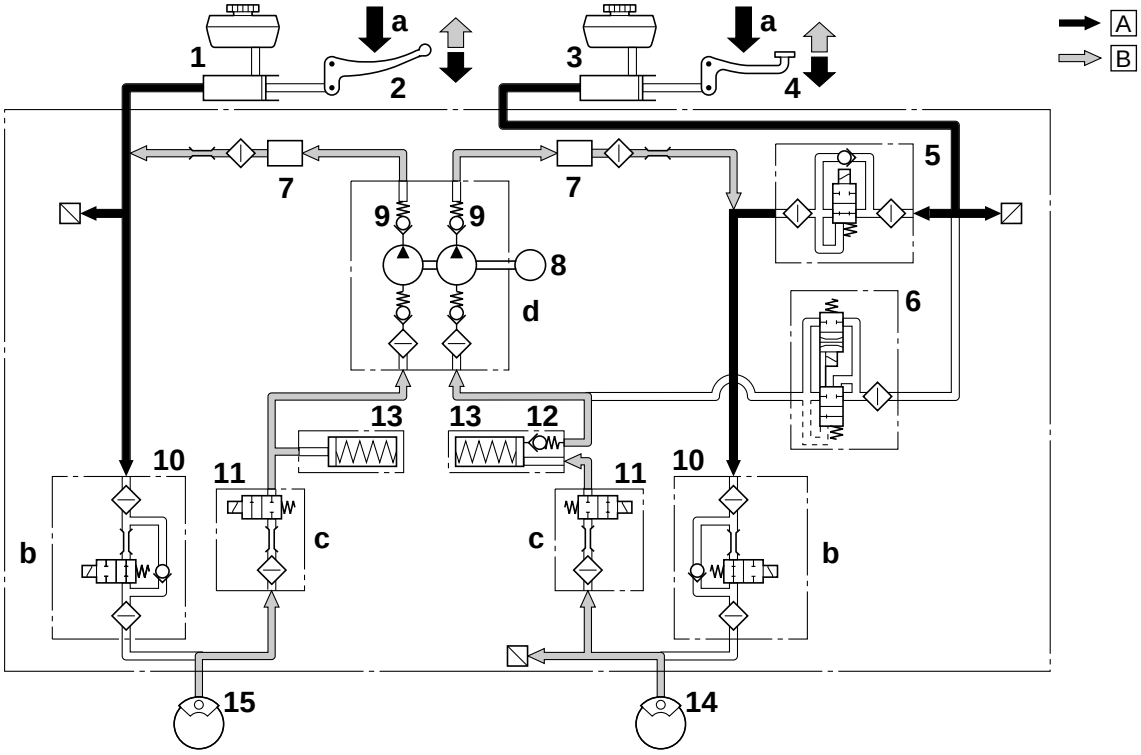
Emergency braking (ABS activated and UBS not activated)

Depressurizing phase:

When the front wheel (or the rear wheel) is about to lock, the outlet solenoid valve is opened by the "depressurization" signal transmitted from the ABS ECU. When this occurs, the inlet solenoid valve closes the brake line from the brake master cylinder. Because the outlet solenoid valve is open, the brake fluid is sent to the buffer chamber. As a result, the hydraulic pressure in the brake caliper is reduced. The brake fluid stored in the buffer chamber is pumped back to the brake master cylinder by the hydraulic pump linked to the ABS motor.

Pressurizing phase:

The outlet solenoid valve is closed by the "pressurization" signal transmitted from the ABS ECU. At this time, the ABS ECU controls the opening of the inlet solenoid valve. As the inlet solenoid valve opens, the brake line from the brake master cylinder opens, allowing the brake fluid to be sent to the brake caliper.



1. Front brake master cylinder
2. Brake lever
3. Rear brake master cylinder
4. Brake pedal
5. Separation solenoid valve
6. Shuttle solenoid valve
7. Damping chamber
8. ABS motor
9. Hydraulic pump
10. Inlet solenoid valve
11. Outlet solenoid valve
12. Check valve
13. Buffer chamber
14. Rear brake caliper
15. Front brake calipers

A. Pressurize
B. Depressurize
a. Input
b. Inlet solenoid valve is closed
c. Outlet solenoid valve is open
d. Hydraulic pump is operating

UBS (ABS not activated and UBS activated)

Brake lever input only

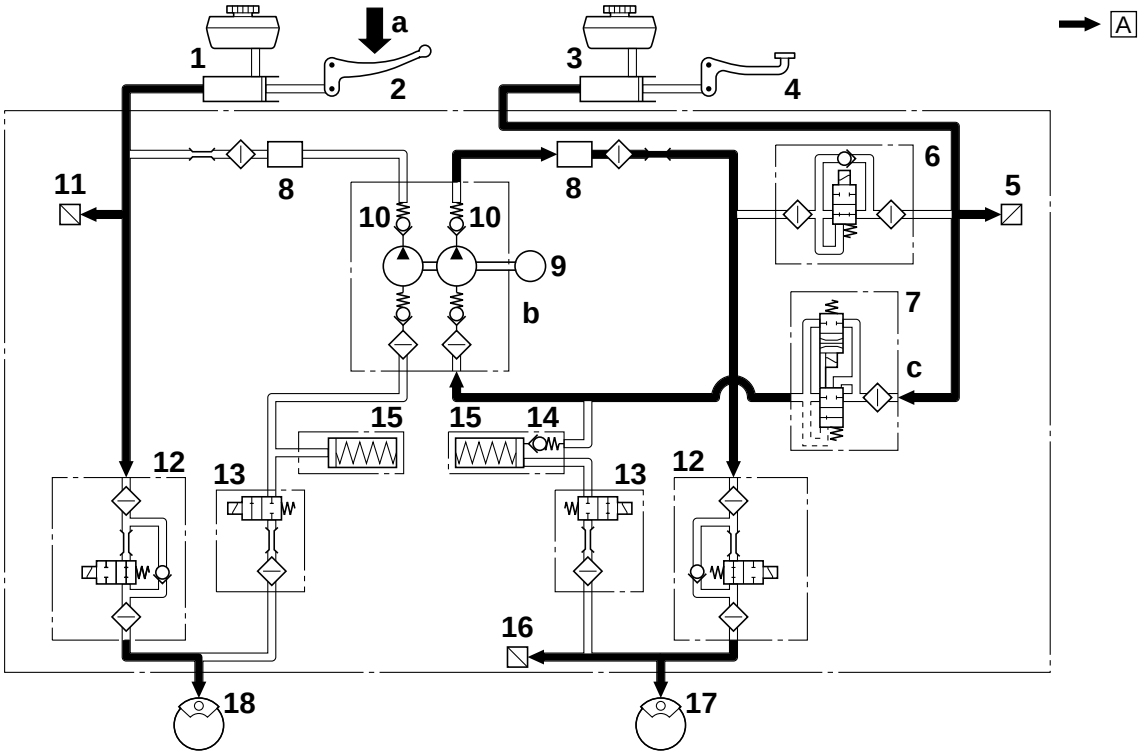
Front brakes:

When the ABS is not activated, the inlet solenoid valve is open and the outlet solenoid valve is closed because a control signal has not been transmitted from the ABS ECU. Therefore, when the brake lever is squeezed, the hydraulic pressure in the front brake master cylinder increases and the brake fluid is sent to the front brake calipers. At this time, the hydraulic pump check valve is closed. The front brake master cylinder directly pressurizes the front brake calipers during normal braking. When the brake lever is released, the brake fluid in the front brake calipers returns to the front brake master cylinder.

Rear brake:

When the brake lever is squeezed, the ABS ECU detects the hydraulic pressure using the front brake master cylinder pressure sensor and operates the hydraulic pump. At this time, the ABS is not activated, the inlet solenoid valve is open, and the outlet solenoid valve is closed because a control signal has not been transmitted from the ABS ECU. The shuttle solenoid valve opens and closes according to the UBS control signals from the ABS ECU. The hydraulic pump draws in the brake fluid from the rear brake master cylinder and automatically pressurizes the rear brake caliper.

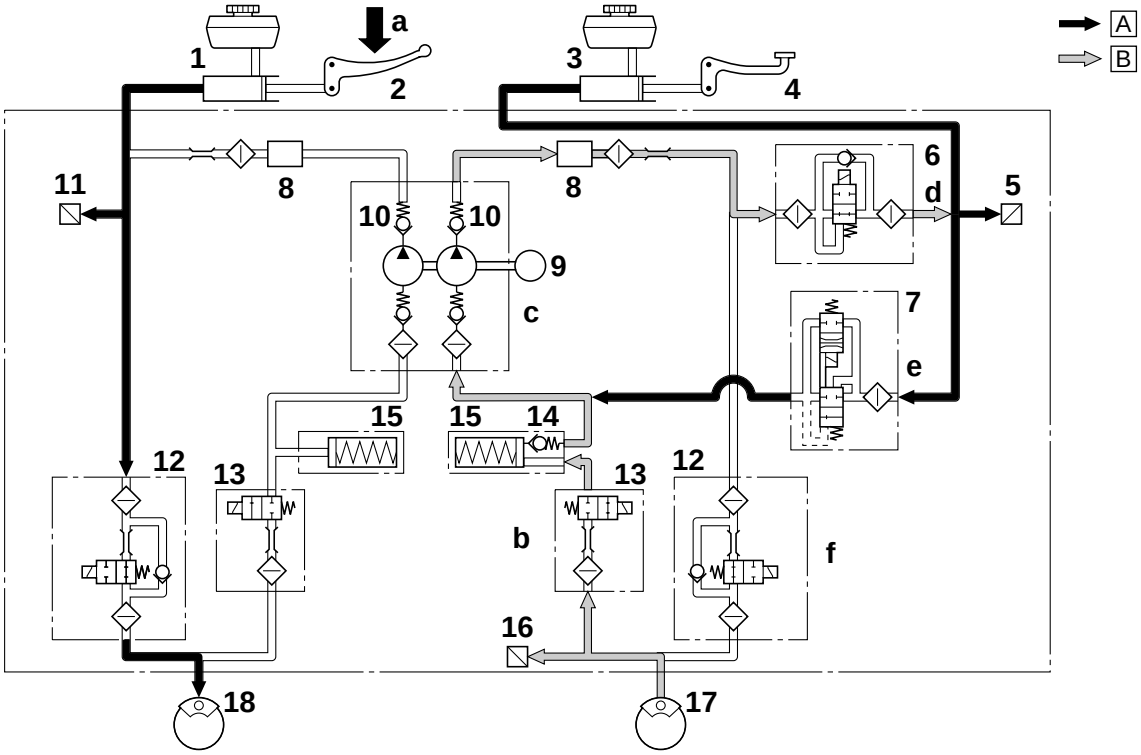
If the brake pedal is depressed, the UBS automatic pressurization stops. The ABS ECU detects and controls the hydraulic pressure in the rear brake caliper using the front brake master cylinder pressure sensor, rear brake master cylinder pressure sensor, and rear brake caliper pressure sensor.



1. Front brake master cylinder
2. Brake lever
3. Rear brake master cylinder
4. Brake pedal
5. Rear brake master cylinder pressure sensor
6. Separation solenoid valve
7. Shuttle solenoid valve
8. Damping chamber
9. ABS motor
10. Hydraulic pump
11. Front brake master cylinder pressure sensor
12. Inlet solenoid valve
13. Outlet solenoid valve
14. Check valve
15. Buffer chamber
16. Rear brake caliper pressure sensor
17. Rear brake caliper
18. Front brake calipers

A. Pressurize
a. Input
b. Hydraulic pump is operating
c. Shuttle solenoid valve is open

UBS (ABS activated and UBS activated)
Brake lever input only
Front brakes:
Refer to “Emergency braking (ABS activated and UBS not activated)”.
Rear brake:
When the rear wheel is about to lock, the outlet solenoid valve is opened by the “depressurization” signal transmitted from the ABS ECU. When this occurs, the inlet solenoid valve closes the brake line from the rear brake master cylinder. Because the outlet solenoid valve is open, the brake fluid is sent to the buffer chamber. As a result, the hydraulic pressure in the rear brake caliper is reduced.
In order to control the hydraulic pressure at the pressure required for UBS control at this time, the hydraulic pressure is detected using the rear brake master cylinder pressure sensor and rear brake caliper pressure sensor, and the separation solenoid valve and shuttle solenoid valve open and close.
The brake fluid stored in the buffer chamber is pumped back to the rear brake master cylinder by the hydraulic pump linked to the ABS motor.

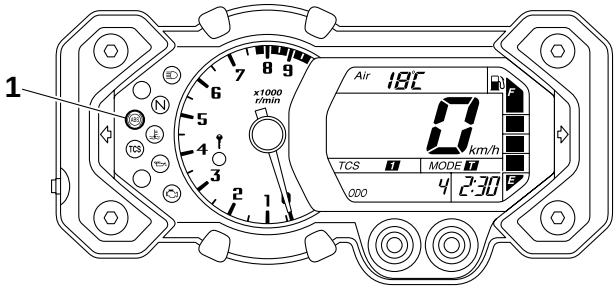


1. Front brake master cylinder
2. Brake lever
3. Rear brake master cylinder
4. Brake pedal
5. Rear brake master cylinder pressure sensor
6. Separation solenoid valve
7. Shuttle solenoid valve
8. Damping chamber
9. ABS motor
10. Hydraulic pump
11. Front brake master cylinder pressure sensor
12. Inlet solenoid valve
13. Outlet solenoid valve
14. Check valve
15. Buffer chamber
16. Rear brake caliper pressure sensor
17. Rear brake caliper
18. Front brake calipers

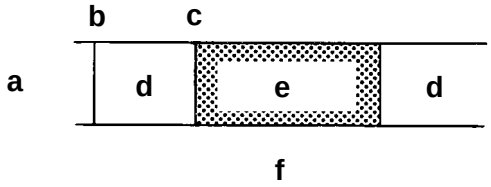
A. Pressurize
B. Depressurize
a. Input
b. Outlet solenoid valve is open
c. Hydraulic pump is operating
d. Separation solenoid valve is open or closed
e. Shuttle solenoid valve is open or closed
f. Inlet solenoid valve is closed

EAS23P1064
ABS SELF-DIAGNOSIS FUNCTION

ABS warning light
The ABS warning light “1” comes on when a malfunction is detected by the ABS self-diagnosis. The ABS warning light is located on the meter assembly.

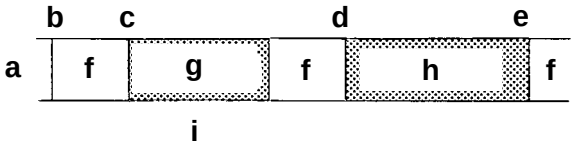


Instances when the ABS warning light comes on
1. The ABS warning light comes on when the main switch is set to “ON”.
   The ABS warning light comes on for 2 seconds while the ABS is performing a self-diagnosis, then goes off if there are no problems.



a. ABS warning light
b. Main switch “OFF”
c. Main switch “ON”
d. Goes off
e. Comes on for 2 seconds
f. ABS self-diagnosis

2. The ABS warning light comes on while the start switch is being pushed.
   When the engine is being started, the ABS warning light comes on while the start switch is being pushed. (Refer to “ELECTRIC STARTING SYSTEM” on page 8-7.)



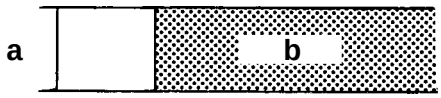
a. ABS warning light
b. Main switch “OFF”
c. Main switch “ON”
d. Start switch “ON”
e. Start switch “OFF”
f. Goes off
g. Comes on for 2 seconds
h. Comes on while the start switch is being pushed
i. ABS self-diagnosis

3. The ABS warning light comes on while riding.
   If the ABS warning light comes on while riding, a malfunction has been detected in the ABS or UBS. The ABS hydraulic control will not be performed. The ABS will have recourse to manual braking if this occurs.

ECA23P1057

NOTICE

There may be little or no additional rear brake force provided by the UBS if the ABS warning light comes on while riding. If the UBS does not operate, the front and rear brakes will operate independently according to the rider input. When the brake lever is squeezed, only the front brakes will operate and when the brake pedal is depressed, only the rear brake will operate.

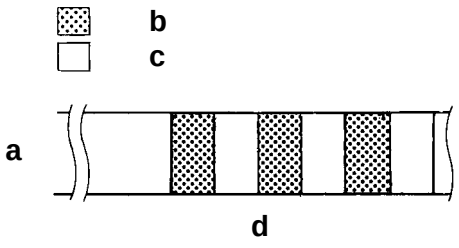


a. ABS warning light
b. Comes on

4. The ABS warning light flashes while riding.
   If the ABS warning light flashes while riding, there is no problem with the function of the ABS and UBS. However, the ABS ECU input has unstable factors. (For details, refer to "ABS TROUBLE-SHOOTING OUTLINE" on page 8-95.)

TIP

The ABS warning light comes on or flashes if the vehicle is ridden with the test coupler adapter connected to the ABS test coupler.



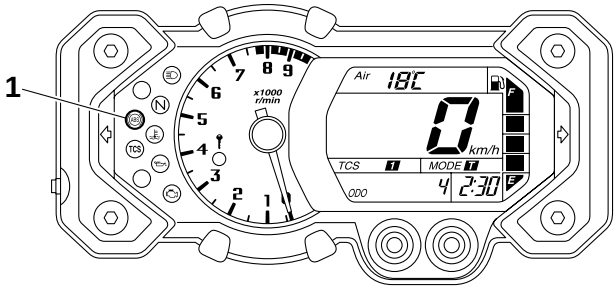
a. ABS warning light
b. Comes on
c. Goes off
d. Unstable ABS ECU input

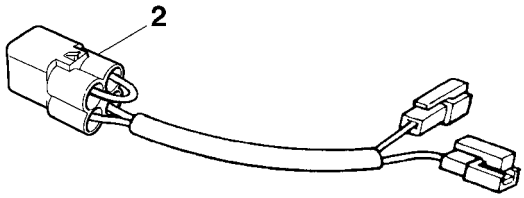
5. The ABS warning light "1" flashes when the test coupler adapter "2" is connected to the ABS test coupler "3" for troubleshooting the ABS. The ABS test coupler can be accessed by removing the rider seat.
   When the test coupler adapter is connected to the ABS test coupler, the ABS warning light starts flashing and the ABS warning light flash pattern indicates all the fault codes recorded in the ABS ECU.

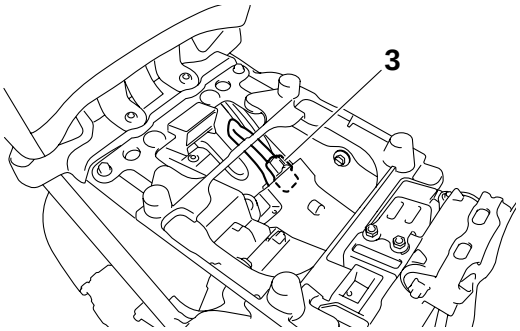
	**Test coupler adapter** **90890-03149**

TIP

The ABS warning light comes on or flashes if the vehicle is ridden with the test coupler adapter connected to the ABS test coupler.







EAS23P1065

ABS WARNING LIGHT AND OPERATION

ABS warning light

- When the main switch is set to “ON”, the ABS warning light comes on for 2 seconds, then goes off.
- The ABS warning light comes on while the start switch is being pushed.
- If the ABS warning light comes on while riding, stop the vehicle, and then set the main switch to “OFF”, then back to “ON”. The ABS operation is normal if the ABS warning light comes on for 2 seconds, then goes off.
- If the rear wheel is raced with the vehicle on the centerstand, the ABS warning light may flash or come on. If this occurs, set the main switch to “OFF”, then back to “ON”. The ABS operation is normal if the ABS warning light goes off when the vehicle first starts off after the main switch was set back to “ON”.
- The ABS operation is normal if the ABS warning light flashes.
- If the ABS warning light comes on or flashes while riding, the ABS and UBS will not work correctly. There may be little or no additional rear brake force provided by the UBS. If the UBS does not operate, the front and rear brakes will operate independently according to the rider input. When the brake lever is squeezed, only the front brakes will operate and when the brake pedal is depressed, only the rear brake will operate.

ABS and UBS function

EWA23P1038

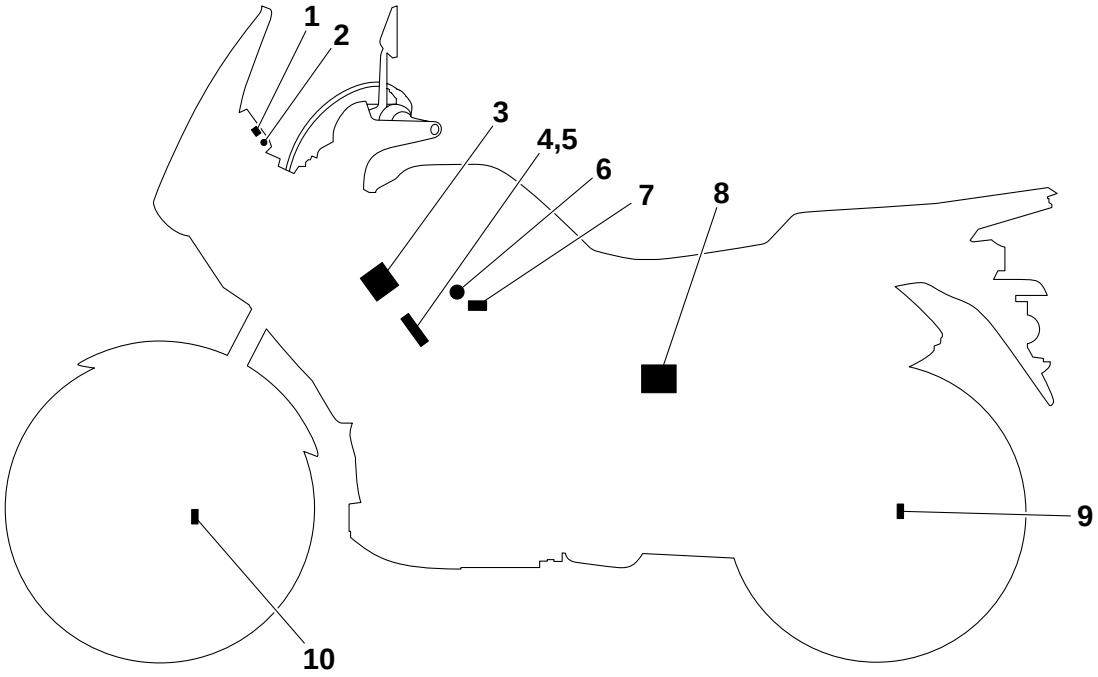
WARNING

- **When hydraulic control is performed by the ABS, the brake system alerts the rider that the wheels have a tendency to lock by generating a reaction-force pulsating action in the brake lever or brake pedal. When the ABS is activated, the grip between the road surface and tires is close to the limit. The ABS cannot prevent wheel lock* on slippery surfaces, such as ice, when it is caused by engine braking, even if the ABS is activated.**
- **The ABS and UBS is not designed to shorten the braking distance or improve the cornering performance.**
- **Depending on the road conditions, the braking distance may be longer compared to that of vehicles not equipped with ABS. Therefore, ride at a safe speed and keep a safe distance between yourself and other vehicles.**
- **The braking of the vehicle, even in the worst case, is principally executed when the vehicle is advancing straight ahead. During a turn, sudden braking is liable to cause a loss of traction of the tires. Even vehicles equipped with ABS cannot be prevented from falling over if braked suddenly.**
- **The ABS and UBS do not work when the main switch is set to "OFF". The conventional braking function can be used.**

*** Wheel lock: A condition that occurs when the rotation of one or both of the wheels has stopped, but the vehicle continues to travel.**

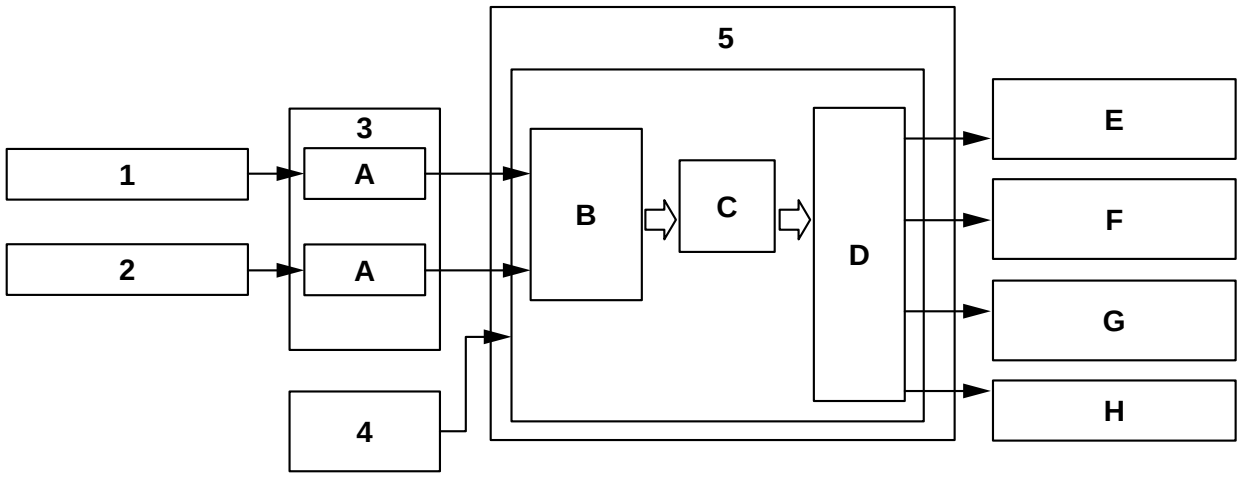
EAS23P1099
OUTLINE OF THE TCS (Traction Control System)
The traction control system controls excessive spinning (slipping) of the rear wheel when accelerating on slippery surfaces, such as unpaved or wet roads.
The ECU monitors the front and rear wheel speeds using the signals from the front and rear wheel sensors, and detects rear wheel slipping according to the difference between the wheel speeds. If the slipping exceeds the preset value, the ECU controls the slipping using integrated control of the ignition timing, fuel cut-off, and throttle valve opening of the YCC-T system.
The traction control system can be set to one of two operation modes or turned off.

TCS (Traction control system) layout



1. Traction control system indicator light
2. Traction control system switch
3. ECU (engine control unit)
4. Ignition coils
5. Spark plugs
6. Throttle servo motor
7. Fuel injector
8. ABS ECU (electronic control unit)
9. Rear wheel sensor
10. Front wheel sensor

TCS (Traction control system) block diagram
The signals from the front and rear wheel sensors are sent to the ECU through the ABS ECU, and the ECU calculates the amount of slip according to the difference between the detected front and rear wheel speeds.
If the amount of slip exceeds the preset value, the ECU controls the ignition timing, fuel cut-off, and throttle valve opening of the YCC-T system so that the amount of slip is less than the preset value. The traction control system indicator light in the meter assembly flashes when the traction control system has activated.



1. Front wheel sensor
2. Rear wheel sensor
3. ABS ECU (electronic control unit)
4. Traction control system switch
5. ECU (engine control unit)
A. Signal conversion
B. Slip amount calculation
C. Exceeds preset value
D. Actuator control
E. Fuel cut-off
F. Ignition timing (retarded)
G. Traction control system indicator light (flashes)
H. YCC-T motor throttle valve opening (decreased)

TCS (Traction control system) function

The traction control system helps maintain traction when accelerating on slippery surfaces, such as unpaved or wet roads. If sensors detect that the rear wheel is starting to slip (uncontrolled spinning), the traction control system assists by regulating engine power as needed until traction is restored. The traction control system indicator light flashes to let the rider know that traction control has engaged.

TIP

The rider may also notice slight changes in engine and exhaust sounds when the traction control system is engaged.

EWA23P1039

WARNING

The traction control system is not a substitute for riding appropriately for the conditions. Traction control cannot prevent loss of traction due to excessive speed when entering turns, when accelerating hard at a sharp lean angle, or while braking, and cannot prevent front wheel slipping. As with any motorcycle, approach surfaces that may be slippery with caution and avoid especially slippery surfaces.

There are two traction control system modes. The traction control system can also be turned off:
- "TCS" mode "1": Default mode
- "TCS" mode "2": Sporty mode
  This mode decreases traction control system assist, allowing the rear wheel to spin more freely than "TCS" mode "1".

• “TCS” “Off”: The traction control system is turned off. The system may also be automatically disabled in some riding conditions (Refer to “Resetting”).

When the key is turned to “ON”, the traction control system is enabled and “TCS” “1” displays in the multi-function meter.

The traction control system mode can be changed and the system can be turned off only when the key is in the “ON” position and the vehicle is not moving.

TIP

Turn the traction control system “Off” to help free the rear wheel if the motorcycle gets stuck in mud, sand, or other soft surfaces.

ECA23P1085

NOTICE

Use only the specified tires. Using different sized tires will prevent the traction control system from controlling tire rotation accurately.

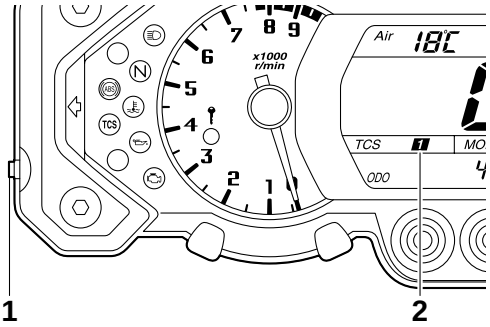
Setting the traction control system

EWA23P1040

⚠ WARNING

Be sure to stop the vehicle before making any setting changes to the traction control system. Changing settings while riding can distract the operator and increase the risk of an accident.

Push the traction control system switch on the multi-function meter for less than one second to change between “TCS” modes “1” and “2”. Push the switch for at least two seconds to select “TCS” “Off” and turn the traction control system off. Push the switch again to return to the previously selected mode “1” or “2”.



1. Traction control system switch
2. Traction control system mode display

Resetting

The traction control system will be disabled in the following condition:

• The rear wheel is rotated with the centerstand down and the key in the “ON” position.

If the traction control system has been disabled, both the traction control system indicator light and the engine trouble warning light come on.

To reset the traction control system:

Turn the key to “OFF”. Wait at least one second, then turn the key back to “ON”. The traction control system indicator light should go off and the system will be enabled. The engine trouble warning light should go off after the motorcycle reaches at least 20 km/h (12 mi/h). If the traction control system indicator light and/or engine trouble warning light still remain on after resetting, check the fuel injection system (Refer to “FUEL INJECTION SYSTEM”).

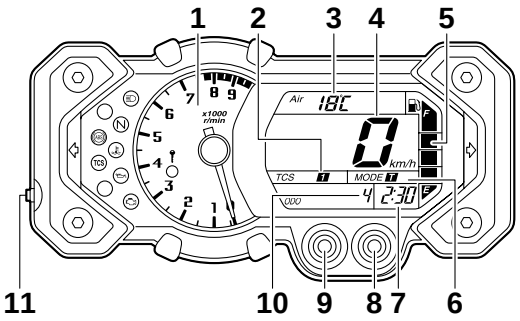
EAS23P1106
INSTRUMENT FUNCTIONS

Multi-function meter unit

EWA23P1041

⚠ WARNING

Be sure to stop the vehicle before making any setting changes to the multi-function meter unit. Changing settings while riding can distract the operator and increase the risk of an accident.



1. Tachometer
2. Traction control system mode display
3. Coolant temperature display/air intake temperature display/instantaneous fuel consumption display/average fuel consumption display
4. Speedometer
5. Fuel meter
6. Drive mode display
7. Clock
8. Right set button
9. Left set button
10. Odometer/tripmeter/fuel reserve tripmeter
11. Traction control system switch

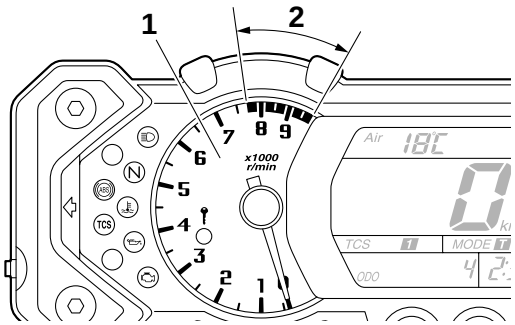
The multi-function meter unit is equipped with the following:
- a speedometer
- a tachometer
- an odometer
- two tripmeters (which show the distance traveled since they were last set to zero)
- a fuel reserve tripmeter (which shows the distance traveled since the last segment of the fuel meter started flashing)
- a clock
- a fuel meter
- an air intake temperature display
- a coolant temperature display
- a fuel consumption display (instantaneous and average consumption functions)
- a drive mode display (which shows the selected drive mode)
- a traction control system mode display (which shows the selected traction control system mode)
- a self-diagnosis device
- an LCD and tachometer brightness control mode

The left and right set buttons, located under the display, allow you to control or change the settings in the multi-function meter unit.

TIP

- To use the left and right buttons, the key must be turned to “ON”, except for the brightness mode.
- For the U.K. only: To switch the speedometer and odometer/tripmeter/fuel consumption displays between kilometers and miles, press the left button for at least two seconds.

Tachometer



1. Tachometer
2. Tachometer red zone

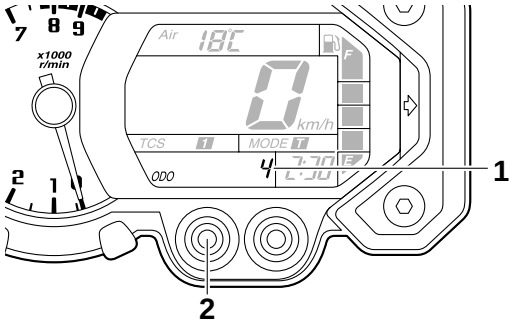
The electric tachometer allows the rider to monitor the engine speed and keep it within the ideal power range.
When the key is turned to “ON”, the tachometer needle sweeps once across the r/min range and then returns to zero r/min in order to test the electrical circuit.

ECA23P1086

NOTICE

Do not operate the engine in the tachometer red zone.
Red zone: 7750 r/min and above

Odometer and tripmeter modes



1. Odometer/tripmeter/fuel reserve tripmeter
2. Left set button

Pushing the left button switches the display between the odometer mode “ODO” and the tripmeter modes “TRIP 1” and “TRIP 2” in the following order:
ODO → TRIP 1 → TRIP 2 → ODO

TIP

When selecting “TRIP 1” or “TRIP 2”, the display flashes for five seconds.

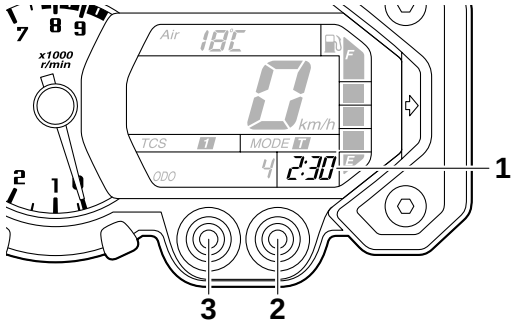
When approximately 3.9 L (1.03 US gal, 0.86 Imp.gal) of fuel remains in the fuel tank, the display automatically changes to the fuel reserve tripmeter mode “TRIP F” and starts counting the distance traveled from that point. In that case, pushing the left button switches the display between the various tripmeter and odometer modes in the following order:
TRIP F → ODO → TRIP 1 → TRIP 2 → TRIP F

TIP

When selecting “TRIP 1”, “TRIP 2” or “TRIP F”, the display flashes for five seconds.

To reset a tripmeter, select it by pushing the left button, and then push this button for at least one second while the display is flashing. If you do not reset the fuel reserve tripmeter manually, it resets itself automatically and the display returns to the prior mode after refueling and traveling 5 km (3 mi).

Clock

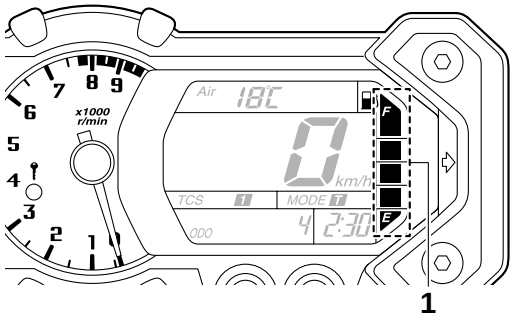


1. Clock
2. Right set button
3. Left set button

The clock displays when the key is turned to “ON”. In addition, the clock can be displayed for 10 seconds by pushing the left button when the main switch is in the “OFF”, “LOCK” or “Parking” position.
To set the clock:

1. Push the left button and right button together for at least three seconds.
2. When the hour digits start flashing, push the right button to set the hours.
3. Push the left button; the minute digits start flashing.
4. Push the right button to set the minutes.
5. Push the left button; the clock starts after the button is released.

Fuel meter



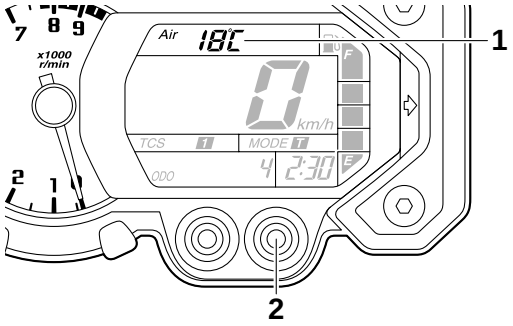
1. Fuel meter

The fuel meter indicates the amount of fuel in the fuel tank. The display segments of the fuel meter disappear towards “E” (Empty) as the fuel level decreases. When the last segment starts flashing, refuel as soon as possible.
When the key is turned to “ON”, all display segments come on once in order to test the electrical circuit.

TIP

This fuel meter is equipped with a self-diagnosis system. If a problem is detected in the electrical circuit, all display segments start flashing. If this occurs, check the electrical circuit.
Refer to “SIGNALING SYSTEM” on page 8-21.

Air intake temperature, coolant temperature, instantaneous fuel consumption and average fuel consumption modes



1. Coolant temperature display/air intake temperature display/instantaneous fuel consumption display/average fuel consumption display
2. Right set button

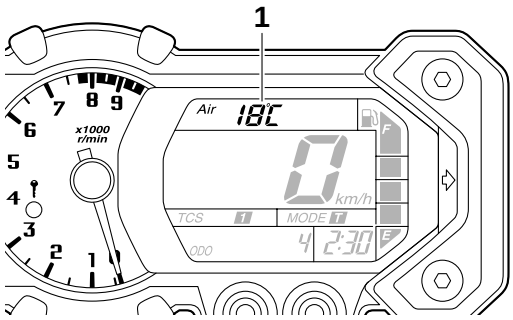
Push the right button to switch the display between the air intake temperature mode, the coolant temperature mode, the instantaneous fuel consumption mode “km/L” or “L/100 km”, and the average fuel consumption mode “AVE_ _._ km/L” or “AVE_ _._ L/100 km” in the following order:

air intake temperature → coolant temperature → km/L or L/100 km → AVE_ _._ km/L or AVE_ _._ L/100 km → air intake temperature

For the UK only:
Push the right button to switch the display between the air intake temperature mode, the coolant temperature mode, the instantaneous fuel consumption mode “km/L”, “L/100 km” or “MPG”, and the average fuel consumption mode “AVE_ _._ km/L”, “AVE_ _._ L/100 km” or “AVE_ _._ MPG” in the following order:

air intake temperature → coolant temperature → km/L, L/100 km or MPG → AVE_ _._ km/L, AVE_ _._ L/100 km or AVE_ _._ MPG → air intake temperature

Air intake temperature mode



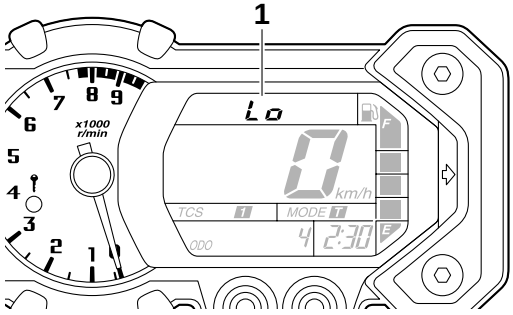
1. Air intake temperature display

The air intake temperature display indicates the temperature of the air drawn into the air filter case.

TIP

Even if the air intake temperature is set to be displayed, the coolant temperature warning light comes on if the engine overheats.

Coolant temperature mode



1. Coolant temperature display

The coolant temperature display indicates the temperature of the coolant.

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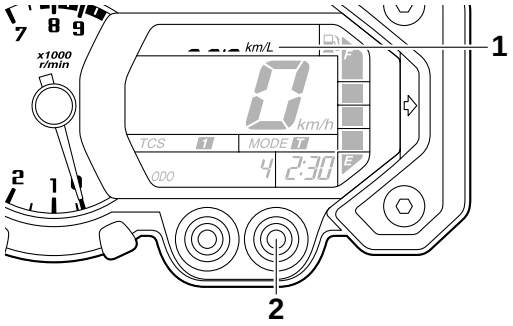
NOTICE

Do not continue to operate the engine if it is overheating.

Instantaneous fuel consumption mode



The instantaneous fuel consumption display modes “km/L”, “L/100 km” or “MPG” (for the UK only) show the fuel consumption under the current riding conditions.

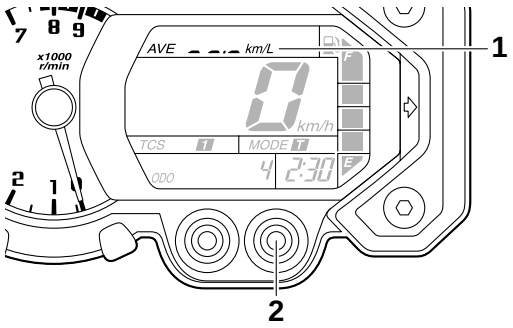
- The “km/L” display shows the distance that can be traveled on 1.0 L of fuel.
- The “L/100 km” display shows the amount of fuel necessary to travel 100 km.
- For the UK only: The “MPG” display shows the distance that can be traveled on 1.0 Imp.gal of fuel.

To switch between the instantaneous fuel consumption displays, push the right button when one of the displays is shown.

TIP

The instantaneous fuel consumption displays when the vehicle speed reaches 20 km/h (12 mi/h).

Average fuel consumption mode



The average fuel consumption display modes “AVE_ _._ km/L”, “AVE_ _._ L/100 km” or “AVE_ _._ MPG” (for the UK only) show the average fuel consumption since the display was last reset.

- The “AVE_ _._ km/L” display shows the average distance that can be traveled on 1.0 L of fuel.
- The “AVE_ _._ L/100 km” display shows the average amount of fuel necessary to travel 100 km.
- For the UK only: The “AVE_ _._ MPG” display shows the average distance that can be traveled on 1.0 Imp.gal of fuel.

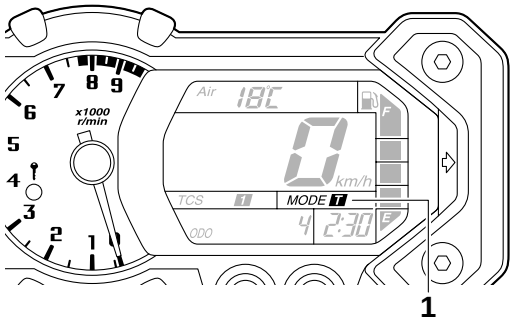
To switch between the average fuel consumption displays, push the right button when one of the displays is shown.

To reset the average fuel consumption display, select it by pushing the right button, and then push the right button for at least one second while the display is flashing.

TIP

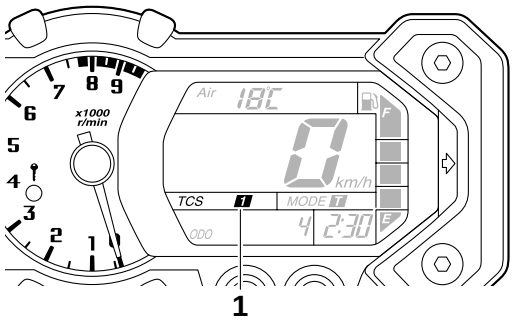
After the display is reset, the average fuel consumption is not displayed until the vehicle has traveled 1 km (0.6 mi).

Drive mode display



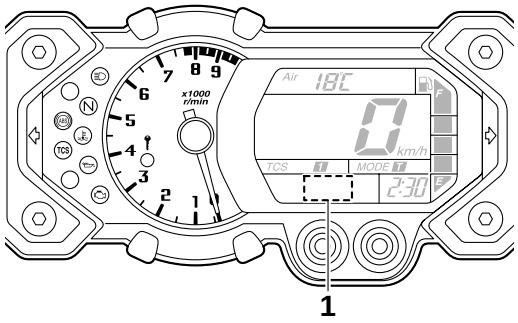
This display indicates which drive mode has been selected: Touring mode “T” or sports mode “S”. For more details on the modes and on how to select them, refer to “D-mode (drive mode)”.

Traction control system mode display



This display indicates which traction control system mode has been selected: “1”, “2” or “Off”. For more details on the modes and on how to select them, refer to “TCS (Traction Control System) function”.

Self-diagnosis device



1. Fault code display

This model is equipped with a self-diagnosis device for various electrical circuits.
If a problem is detected in the immobilizer system circuits, the immobilizer system indicator light flashes and the display indicates a fault code.
If a problem is detected in any other circuit, the engine trouble warning light comes on and the display indicates a fault code.

TIP

If the display indicates immobilizer system circuit fault code 52, this could be caused by transponder interference. If this fault code appears, try following the procedure below.

1. Use the code re-registering key to start the engine.

TIP

Make sure there are no other immobilizer keys close to the main switch, and do not keep more than one immobilizer key on the same key ring! Immobilizer system keys may cause signal interference, which may prevent the engine from starting.

2. If the engine starts, turn it off and try starting the engine with the standard keys.
3. If one or both of the standard keys do not start the engine, take the vehicle, the code re-registering key and both standard keys.

If the display indicates any fault codes, note the code number, and then check the vehicle.

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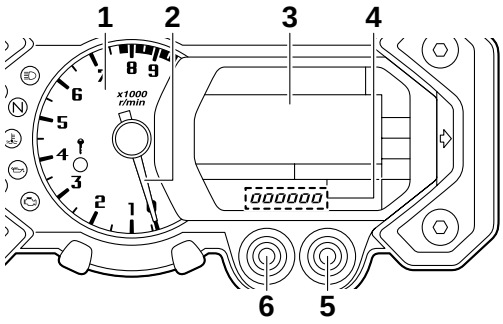
NOTICE

If the display indicates a fault code, the vehicle should be checked as soon as possible in order to avoid engine damage.

LCD and tachometer brightness control mode



1. Tachometer panel
2. Tachometer needle
3. LCD
4. Brightness level display
5. Right set button
6. Left set button

This function allows you to adjust the brightness of the LCD, and the tachometer panel and needle to suit the outside lighting conditions.
To set the brightness
1. Turn the key to “OFF”.
2. Push and hold the left button.
3. Turn the key to “ON”, and then release the left button after five seconds.
4. Push the right button to select the desired brightness level.
5. Push the left button to confirm the selected brightness level. The display returns to the odometer or tripmeter mode.

D-mode (drive mode)

D-mode is an electronically controlled engine performance system with two mode selections (touring mode “T” and sports mode “S”).
Push the drive mode switch “MODE” to switch between modes.