ABS - K75, K100, K1 & K1100

How an ABS (Anti-lock Braking System) works: Very simply, when the ABS control unit (a.k.a. ABS brain) senses that one of your wheels is slowed to the point where it is about to stop moving while the other wheel is moving it "modulates" the pressure in the brake line. Modulating is relieving the pressure in the brake system and then reapplying it. This allows the tire to be "locked" (skidding) for only a very short period of time so that it doesn't slide out from under the bike in the case of the front wheel or swing around to the side in the case of the rear wheel.

BMW ABS I & ABS II: BMW was the first motorcycle manufacturer to build bikes with ABS. As a result, the technology is rather crude by today's standards but the important part is that it works and can help you avoid an otherwise inevitable accident. The crudeness of these early ABS systems is evidenced in the rather long cycle times for modulation. When the ABS kicks the wheels will go "clunk, clunk, clunk."

What is the value of ABS? ABS keeps your front and/or rear wheels from locking up (skidding) when the brakes are over-applied for the available traction. Some common scenarios where ABS is useful:

- **Changing traction situations:** For example when you're braking and you ride over some gravel or sand that you didn't see or when you're braking on a wet road and travel over a metal surface such as a manhole cover. In these stuations an ABS system will sense a lockup and release the brakes much more quickly than most, if not all, riders could, thus reducing the risk of the rider crashing.

- **Emergency braking situations:** For example when a car pulls out in front of you unexpectedly or a deer leaps out into the road ahead of you. In theory, a very skilled rider knows where the threshold between maximum braking and locking up a wheel is and can outbrake an ABS-equipped bike. This is true for people like professional racers and people who practice threshold braking frequently. However, in reality, most riders cannot "outbrake" an ABS-equipped bike on a non-ABS bike. They will either overbrake, locking up one or both wheels (and potentially crash) or underbrake for fear of locking up a wheel and their stopping distance will be longer than if they'd been on an ABS-equipped bike. In an emergency braking situation, an ABS system allows the

rider to risk overbraking without locking up one or both of the wheels, thus allowing him/her to stop sooner and in a shorter distance (or at least scrub off more speed before a collision) than on a non-ABS bike.

What does it feel like when the ABS kicks in? The easiest way to find that out is to try it. Find a level clear dry parking lot or section of roadway with no other traffic around. Get the bike up to 25-30 mph and apply a lot of pressure quickly to the rear brake. You'll feel the clunk, clunk, clunk of the rear ABS kicking in. This really is a very safe exercise and I recommend that everybody try this at least once. That way, when it kicks in in real life, you won't be surprised by it but will realize that it's your ABS kicking in and not something failing on your bike. Try the front too if you think you're up to it.

ABS System Components:

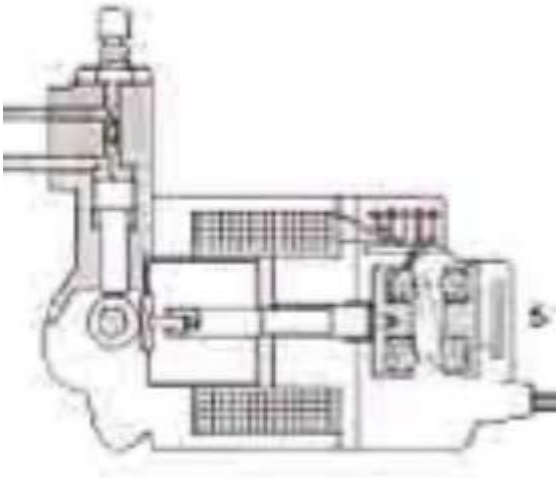
Front master cylinder and reservoir, rear master cylinder and reservoir: These are the same as non-ABS master cylinders and reservoirs and function identically.

Front and rear calipers: These function identically to non-ABS calipers.

Front and rear ABS sensors: These are inductive sensors that pulse as the teeth of the ABS rings go by them when the bike is moving. The rates of the pulses from each sensor tell the ABS brain how fast each wheel is turning, thus allowing it to detect when a wheel is about to, or has, locked up and is skidding.

Front and rear ABS modulators: On ABS I bikes, the front ABS modulator is mounted above the rear of the left side peg plate. (Except for the K1 where it is mounted inside the left front of the fairing.) The rear modulator is mounted above the rear of the right peg plate. The function of the modulators is to let off and then re-apply braking pressure to keep their respective wheels from remaining locked up. They are controlled by the ABS brain.

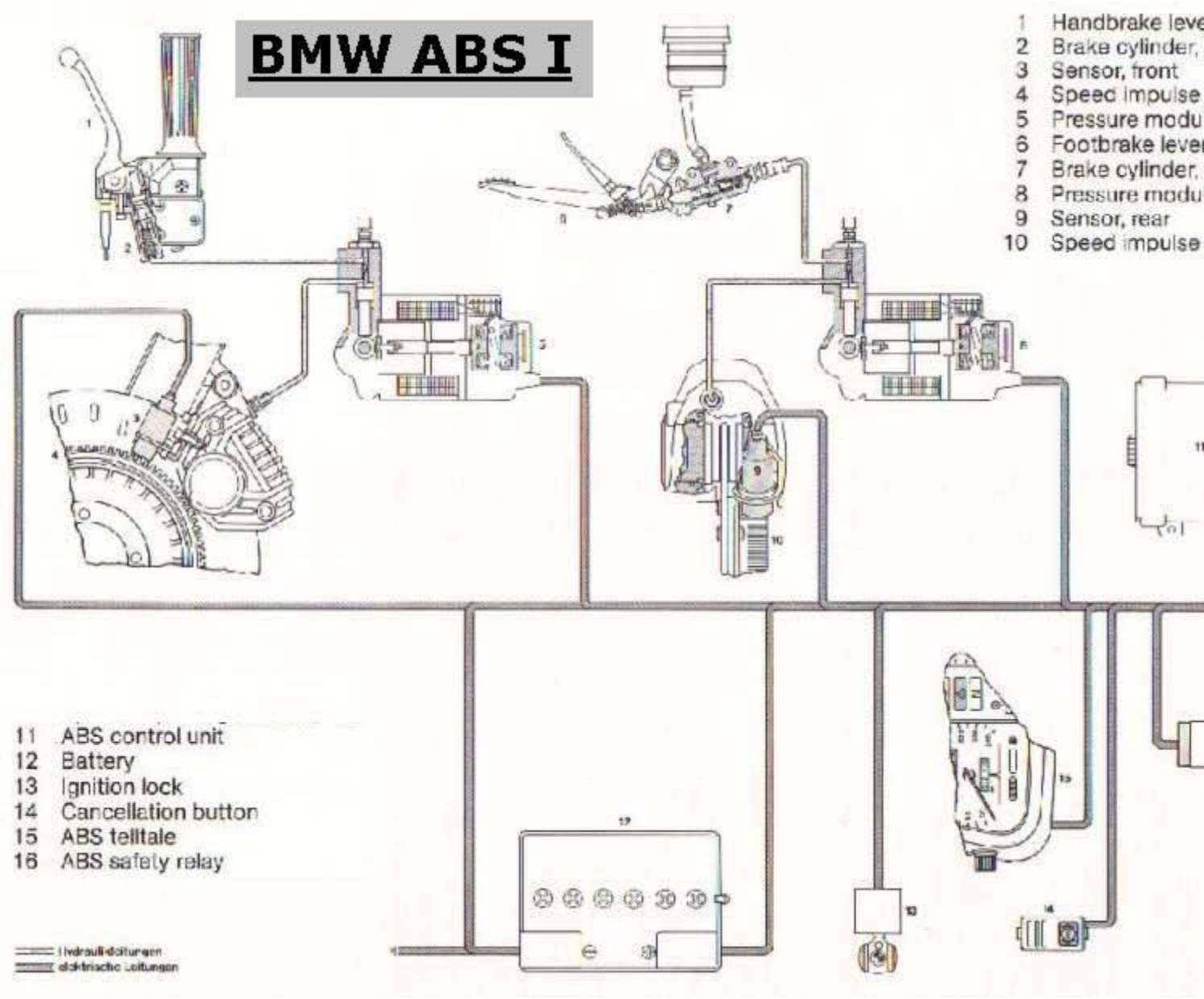
ABS modulator cutaway diagram:



On ABS II bikes (model year 1994 and later K1100 models) both ABS modulators are integrated together with the ABS brain into a single unit under the seat. (The metal housing under the left side of the seat marked FAG.)

ABS control unit (brain): This is a computer of sorts that, based upon input from the front and rear ABS sensors, determines if a wheel is about to, or has, locked up and controls the modulators accordingly. On K75s and 2 valve K100s the ABS brain is located under the roof of the tail cowl. On 4 valve ABS I K bikes the ABS brain is mounted under the seat behind the battery. On an ABS II bike the ABS brain is integrated with the modulators into a single unit as described in the prior paragraph.

ABS System Schematic: (ABS II is conceptually similar)



Flashing ABS warning lights and what they mean:

After the bike has started but before it's moved: The ABS warning lights in your instrument cluster will flash until the bike is under way. The reason for this is that upon startup the ABS brain tests the sensors, modulators and it's own internal functioning to make sure all components of the system are fully operational. Since the ABS brain cannot test the sensors until the bike is moving and it gets inductive pulses from them it will remain in this test mode and the lights will keep flashing until you ride off. Once it has verified that all components are are working as you initially ride off, the ABS warning lights will go out if everything is OK. Your ABS is working and ready to modulate either or both the front and rear brakes should the need arise.

After the bike is moving: If the ABS warning lights remain flashing after the bike is under way then this indicates that the ABS is in fault mode. The lights will keep flashing to remind you that you don't have ABS brakes. When the ABS brain is in fault mode your brakes will keep working though - just as normal non-ABS brakes would. If you press the ABS switch on the dash then the ABS warning lights will go solid for several minutes so they're less obnoxious and distracting but after that several minutes have transpired the ABS warning lights will start flashing again to remind you that your ABS is in fault mode and not operational. Hit the ABS switch to make them go solid again for another few minutes.

How do I "fix" a faulted ABS system?

ABS control units are somewhat sensitive to low voltages. Many times that is the cause of an ABS fault and a simple reset in all that's required to make the ABS system operational again.

Resetting the ABS: The first thing to try is resetting the ABS to clear the fault. Open your seat and look for a blue plastic cap on a three wire connector which is a diagnostic plug for hooking up to a computer at the BMW dealer. If you don't see the blue plastic cap then it may be lost. In that case look for a black plastic connector under the seat that has three wires and is not connected to anything.

Diagnostic plug cap:

Once you've located the diagnostic plug cap, remove the cap and stick the stripped end of a piece of wire into the center terminal of the diagnostic plug. Ground the other end somewhere on the bike. For 93 and earlier K bikes a good place to ground the other end of the wire is where the battery ground is bolted to the left side of the transmission near the shift lever.

Once your wire is grounded, hold down the ABS switch and turn the key all of the way clockwise to turn the bike on while keeping the ABS switch depressed. (You don't need to start the bike, just turn it on.) Count to thirty slowly. Then turn off the bike. Hopefully the ABS fault is now cleared.

Remove the grounded wire from the diagnostic plug, replace the diagnostic plug's protective cap and then go for a short ride. If the ABS brain has been reset successfully then the ABS warning lights should go out after the bike has moved several feet.

Note that sometimes it can take several reset attempts for the reset to take so try it a few times if the first reset doesn't resolve your problem. (Hence the Voodoo nature of it.)

Failing or low battery: BMW ABS brains are sensitive to low voltage so a faulting ABS brain may be a symptom that your battery needs to be replaced. If you suspect that an old or dying batterry may be causing your ABS problems then remove the battery and take it to your nearest auto parts store. Ask them to "load test" the battery for you. They will do it for free.

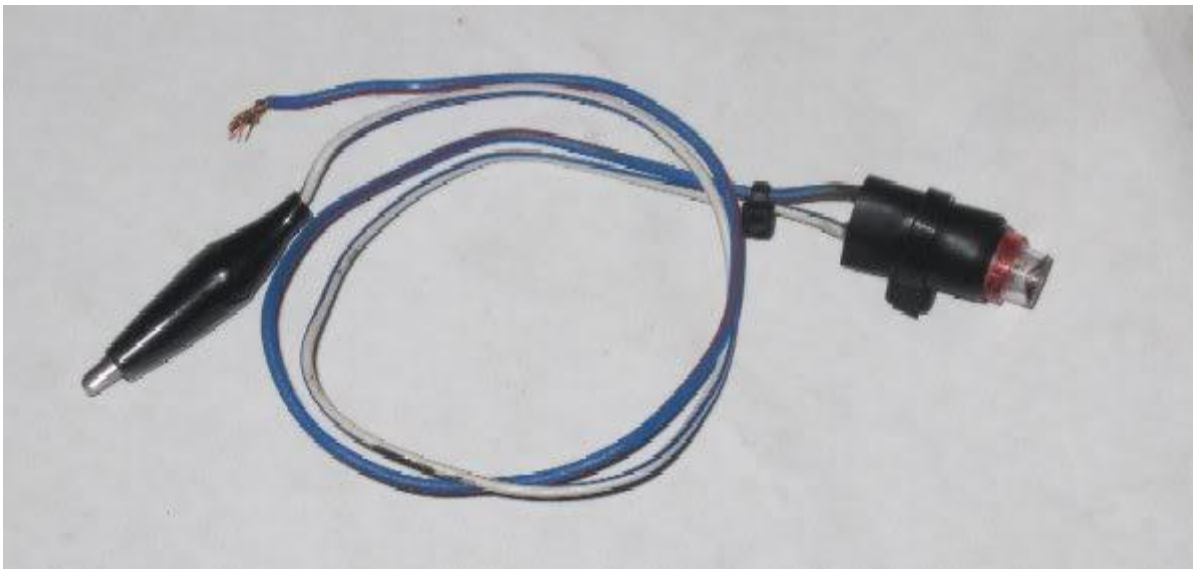
(It gets you in their store to buy other stuff, helps them test the condition of batteries they sold that are still under warranty and, most importantly, it helps them sell batteries.)

Reading ABS fault codes:

If the reset didn't take and your battery doesn't seem to be the issue, then it is possible to use the diagnostic plug to "read" the fault code from the ABS brain to determine what the ABS thinks is wrong. This can be done using either a 12V LED bulb or an analog voltmeter. (You can't use a normal incandescent bulb to read fault codes due to the amount of current they require.) The LED or voltmeter is used to count the dips in voltage at the center terminal on the diagnostic plug.

Reading fault codes with a 12V LED: 12V LEDs are readily available from Radio Shack and on Fleabay. Remove the blue protective cap from the diagnostic plug. Connect the positive terminal of the LED to the center hole of the diagnostic plug and ground the other terminal of the LED. When you turn the bike on (there's no need to start it) the LED should illuminate. Count the number of times the LED flashes OFF to determine the fault code. The ABS brain will keep cycling so if you don't get the count the first time just wait a few seconds and it will be repeated.

Since I play around with K bikes a lot and own several with ABS I built myself a little pre-wired 12V LED-bulb for reading fault codes. It has an alligator clip on the ground lead and a stripped wire at the end of the positive lead:



Reading the fault code with an analog voltmeter: You need to use an analog voltmeter (one with a needle) because digital voltmeters don't react to the drops in voltage quickly ennoug to count them. (Unless you've got a digital voltmeter that costs more than your bike did. :D) Put the positive (red wire) probe of your voltmeter into the center hole of the diagnostic plug and ground the other (black wire) probe somewhere on the bike. Count the number of dips in voltage (needle drops to the left) to determine the fault code.

Fault codes and what is causing the ABS fault:
1 - Front modulator
2 - Rear modulator
3 - Front ABS sensor
4 - Rear ABS sensor
5 - Low battery
6 - ABS relay
7 - ABS control unit (brain)