KNOCK DETECTIVE

USER MANUAL

(March 28, 2023)

DISCLAIMER! READ THIS BEFORE INSTALLATION:

The installation of this device requires some basic wiring skills. If you aren't confident in this area, please consult a professional to ensure safety and reliability when installing. The use of this device also caries some risk as it is up to you to interpret the signals and modify your calibration accordingly. FWLRtuning holds no responsibility for any damage, or personal harm caused by the misuse of this device.

The Knock Detective is a device which helps monitor knock levels to ensure engine safety while driving, as well as aid in tuning. This device requires calibration to each vehicle which will be outlined in this document. The logging feature is extremely useful in setting up your timing tables and determining when and where the engine is experiencing knock or pre-detonation. Although there is no replacement for a dynamometer, in most knock-limited fuel applications you can set up your whole tune based on the readings of a high-quality wideband oxygen sensor and the Knock Detective. Another benefit to hearing the exact sound your engine is making is being able to determine if your ECU's knock readings are real knock or some other sound made by things such as a rattly exhaust or loose bolt. Besides engine use, you can also bolt the knock sensor to drivetrain components, suspension components or anything that vibrates and be able to listen directly to it like an electronic stethoscope. I hope you enjoy this product which I have designed and hand built in Saint John, NB, Canada.

Parts Included in the box:

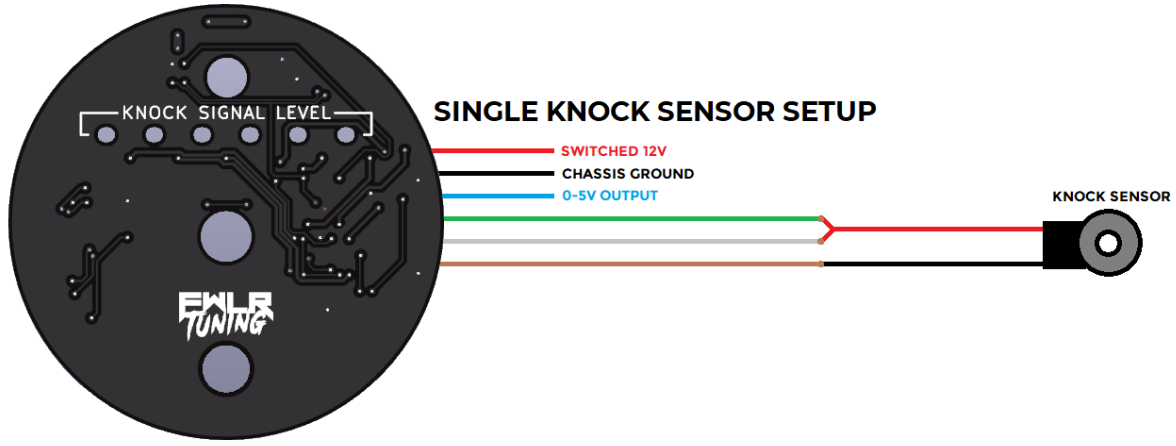
Knock Detective gauge
Normal installation collar
Low-profile installation collar
Bosch wideband knock sensor(s) with pigtail(s) and M8x1.25 bolt(s)
FWLRtuning Stickers (worth 6.9 horsepower each)

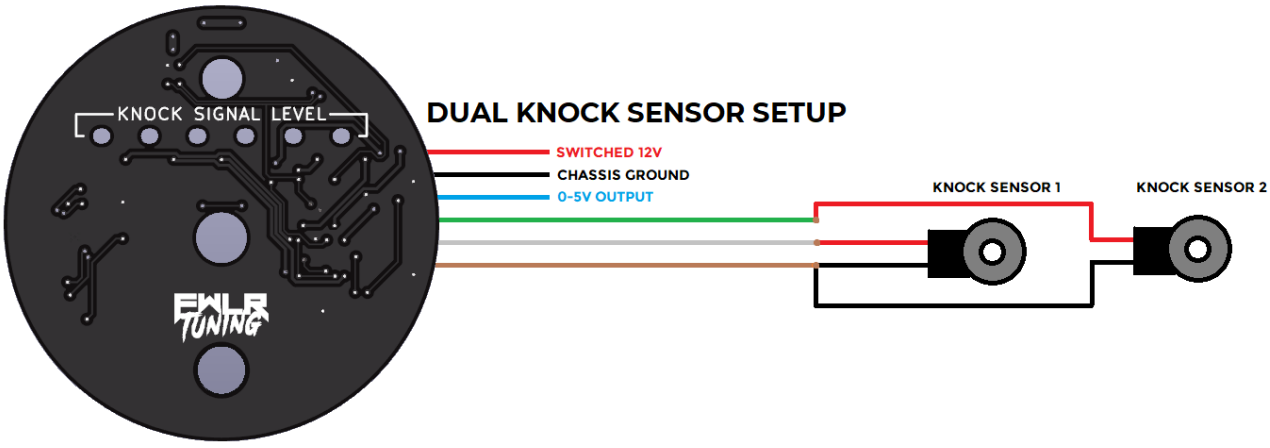
Knock Detective wiring

Red – Switched 12V Supply (through a 10A fuse)
Black – Chassis Ground
Brown – Sensor Ground
Green / **White** – Knock Sensor Inputs
Blue – Knock Level Output (0-5V)

Knock Sensor wiring

Red – Sensor Signal
Black – Sensor Ground





Website: http://FWLRtuning.com
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Knock Sensor Installation Process:

If installing on an inline engine, locate an unused bolt hole on the engine as close to the top of the cylinders and as close to the middle of all cylinders as possible to mount the Bosch Knock Sensor. If installing on a V-style engine, place one knock sensor on each bank as close to the top of the cylinder and as centered as possible. The placement isn't incredibly crucial but the further away from the cylinders you place the sensor(s), the more background noise from things such as the power steering pump or transmission will be present. Torque the knock sensor(s) down to approximately 15 ft-lb.

Knock Detective Gauge Installation Process:

The Knock Detective is a standard 52mm gauge. After removing the threaded collar from the back of the gauge, slide the gauge into your gauge holder. Tighten the collar back on to secure it. There are two collars provided. Some gauge holders are tighter than others, so you may need to use the low-profile collar. Make sure you are able to run a headphone cord comfortably from your seat, you are able to clearly see the 6 LEDs and are able to get a small Philips screwdriver in the calibration hole to set the sensitivity. If you want to disable the LEDs, simply turn the sensitivity all the way down.

Wiring The Knock Detective

- Connect the **RED** wire through a 10A fuse to a switched 12V supply that receives power only when the key is on.
- Run the **BLACK** wire to a chassis ground.
- Connect the **BROWN** wire to the ground(s) on the knock sensor(s).
- If you are running only one knock sensor connect both the **GREEN** and **WHITE** wires together to the signal wire from the knock sensor. If you are running two knock sensors connect the **GREEN** wire to one sensor's signal wire and the **WHITE** wire to the other.
- If you want to datalog the signal, connect the **BLUE** wire to your 0-5V analog input. It's generally good practice to run a ground straight from the Knock Detective to your datalogging device's ground to ensure a proper reference. The output should only be connected a high impedance input such as a datalogger or an ECU input pin.
- If you are not using the output to log, cover the blue wire in heat shrink or electrical tape to avoid it shorting out on something.
- The shielding on the knock sensor cable is tied to ground at the sensor itself, so if you need to lengthen or shorten the cable leave the shield disconnected at the gauge end.

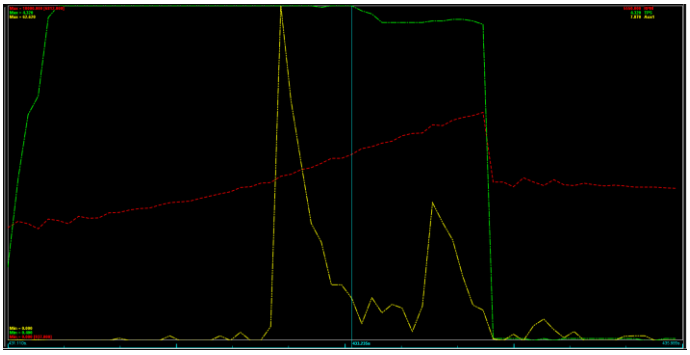
Sensitivity Calibration Process:

The sensitivity is something that must be calibrated by the user for each car, but can provide very useful visual feedback once calibrated. The LEDs display the amplitude of the signal above 5000Hz. Increased load and RPM will cause this signal level to rise fairly smoothly, however knock will cause it to spike up considerably higher and faster. The goal of calibrating the sensitivity knob is to have it only light up one or two LEDs during normal engine operation, leaving the rest of the LEDs to indicate spikes in knock. Once you hear knock and see how the LEDs react, you can watch for that same behavior. The calibration process is as much about calibrating the device as it is learning how the LEDs react to normal engine operation versus knock events.

After installing the Knock Detective, plug in a set of headphones. Use the volume control (knob in the middle) to set your headphone level appropriately. Next, with the car in neutral hold it at 4000-5000 RPM and adjust the sensitivity pot (recessed in the top of the gauge) with a small Philips screw driver. Take care to not push or turn the knob too hard. Start with the sensitivity turned all the way down (fully counter-clockwise) and slowly turn it up until only the first LED is blinking while you hold the engine at 4000-5000 RPM. Take note of what your engine sounds like while you are doing this. The sensitivity is now roughly set.

Next, if you are able to retard the timing and turn down boost levels to ensure no knock will occur, have someone safely do a pull to redline while you are in the passenger seat listening for knock. If the pull was clean and no knock was heard, adjust the sensitivity until only the first couple LED lights up during the pull. For examples of what knock sounds like, visit my website. It typically sounds like marbles rattling on glass or sharp snapping sounds that are much louder than the normal engine operation sound. The goal is to set the sensitivity adjustment so that the sound of your engine under load but NOT knocking only lights up one or two LEDs, leaving the other LEDs to display knock activity.

The next step needs to be done carefully as it involves inducing some light knock and taking note of how the LEDs react. Dial in some extra timing in the low RPM range of your timing map. I typically add 5-10 degrees in the 3000RPM range for this test. Get into some *light* load until you hear the engine begin to knock. Observe the LED activity as well as the sound. If you're datalogging you should see spikes in level as seen below. Short bits of light knock will not hurt your engine, however don't allow the engine to knock for long periods of time. ***DO THIS AT YOUR OWN RISK***



How The Knock Detective Works:

I would encourage anyone who is using this device to do as much research as possible into what knock actually is, what causes it, and how to avoid it. The shockwaves from knock cause massive cylinder pressures which can melt pistons, sparkplugs and destroy bearings. The pressures also translate into large vibrations that spread throughout the engine block. These vibrations are then picked up by the knock sensor and converted into a voltage which is interpreted by the Knock Detective.

Under normal conditions the vibrations picked up by the knock sensor are smooth and relatively low in amplitude. When knock occurs however the spike in cylinder pressure will cause the voltage from the sensor to spike up and thus light up more LEDs, generate a larger sound in your headphones, and output a larger voltage on the output signal.

Using The Knock Detective Display:

There are 6 LEDs on the front of the Knock Detective. Make sure that these LEDs are in clear view when in the driver's seat. The main purpose of these LEDs is to alert the driver to the possibility of knock so that they can abort the pull and avoid damaging the engine. Seeing more than the single LED quickly flash should indicate that there is a potential knock event occurring. **It's normal to see the average level to raise with increased Load and/or RPM. The trick is that the increased Load and/or RPM causes the signal to raise fairly slowly and smoothly, where a knock event will cause a sudden and sharp spike in voltage. Use this difference to determine when knock has occurred.**

Using The Knock Detective Headphone Output:

The headphone output is the most powerful feature of this device. It can be used to distinguish between real knock and false knock. Maybe that loose exhaust hanger, or large piston to wall clearance is causing the knock signal to jump up similar to how knock would. The *sound* of these things would be vastly different than real knock though. Modern ECU's DSP and knock control strategies are very complex, but still pale in comparison to your ears and brain. Visit my website for a library of Knock Detective recordings to familiarize yourself with what knock sounds like. I like to push the engine into some short-term, low load detonation in a controlled environment each time I'm tuning a car in order to learn what that specific engine sounds like. Do this at your own risk and avoid causing knock for sustained periods as this will beat your bearings out and potentially cause more serious engine damage.

Using The Knock Detective Output Signal:

The ability to log the knock sensor level is one of the most useful features of this device. The Knock Detective's output signal (**BLUE** wire) will range from 0-5V. Setting the sensitivity correctly is important as it will affect the output voltage. When you datalog this signal, you should scan through your logs and look for any moment where the output voltage spikes up in a quick manner. This would

indicate a knock event. Tracing these events to certain cells in your timing/fuel tables will help identify problem areas. If you're able to create a custom value in your logging software, try looking at the delta of the knock signal to get a better view of when knock occurs. If you use MegaLogViewer HD create a custom field and use this formula: abs([KNOCK]-(([KNOCK-1]+[KNOCK-2])/2 where KNOCK is the logged Knock Detective voltage.

***Remembe*r - It's normal to see the average level to raise with increased Load and/or RPM. The trick is that the increased Load and/or RPM causes the signal to raise fairly slowly and smoothly, where a knock event will cause a sudden and sharp spike in voltage. Use this difference to determine when knock has occurred.**