KNOCK DETECTIVE

USER MANUAL

(March 18, 2024)

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 while using 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. 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 knock sensor(s) with pigtail(s) and M8x1.25 bolt(s)
FWLRtuning Stickers (worth 6.9 horsepower each)

Knock Detective pin out

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 pin out

Red – Sensor Signal
Black – Sensor Ground

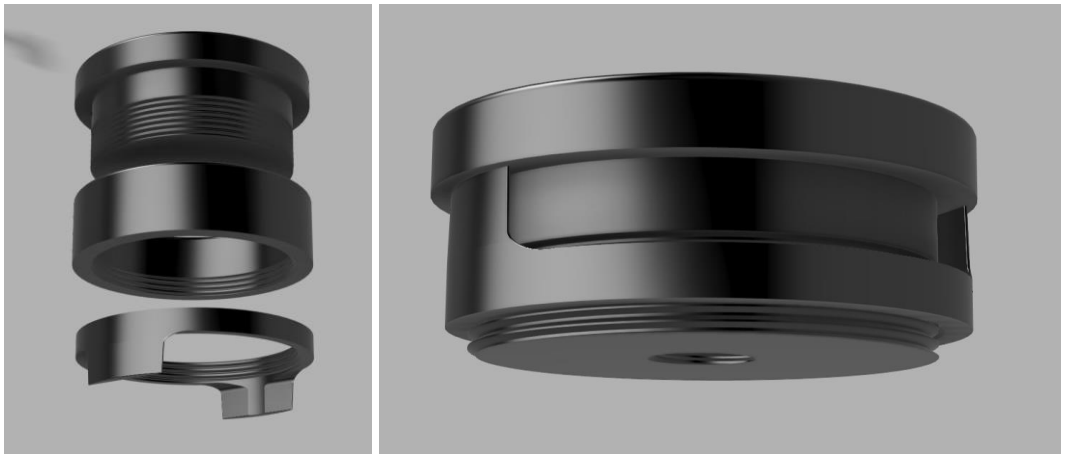
Knock Sensor Installation Process:

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 extremely crucial but the further away from the top of 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:

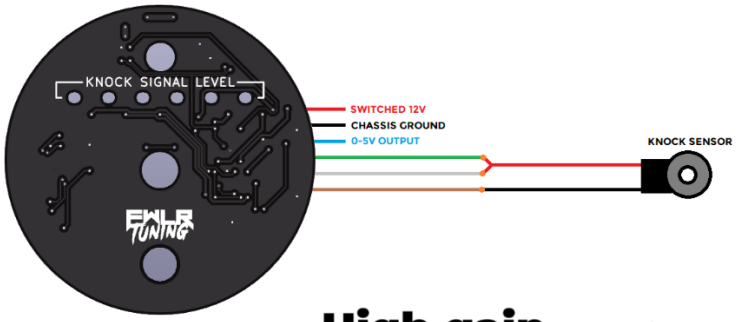
The Knock Detective is a standard 52mm gauge. There are two collars provided. Some gauge holders are tighter than others, so you may need to use the low-profile collar. After removing the two threaded collars from the back of the gauge, slide the gauge into your gauge holder. Chose the collar which fits your gauge holder best and tighten it to secure it. 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. Make sure to slide the wires through the gauge holder and collar before splicing them, or you will have to redo the wiring (ask me how I know).

Here's how to use the low-profile collar to fit the gauge into tight spaces:



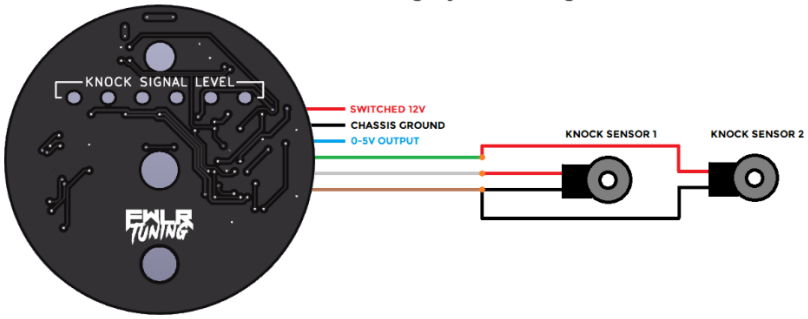
Selecting the gain

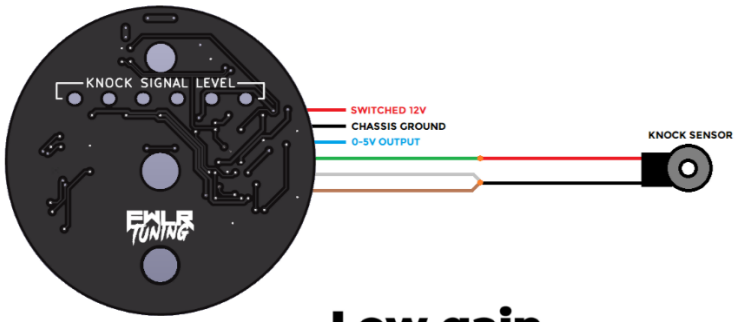
For most applications the high gain wiring will work fine. If you find your audio is sounding distorted at higher RPMs or you are at the very bottom of your sensitivity adjustment, you may want to try switching to the low gain wiring. Basically, the low gain wiring will cut the input signal level in half.



High gain

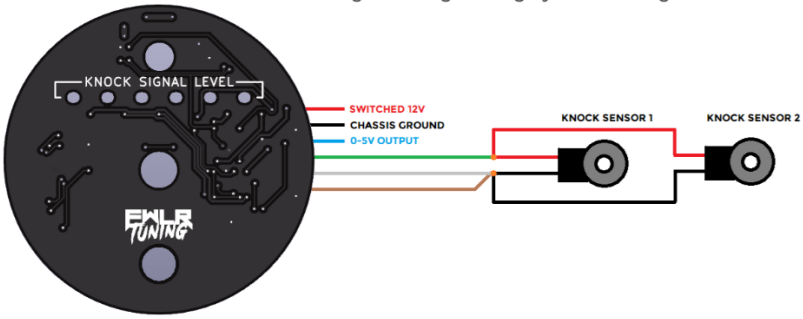
N/A and lightly boosted engines





Low gain

High Revving and highly boosted engines



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Wiring The Knock Detective

- I recommend using crimps and heat shrink to make the connections (Molex 0192939384)
- Connect the **RED** wire through a 5A fuse to a switched 12V supply that receives power only when the key is on. The Knock Detective draws between 7mA and 50mA of current.
- Run the **BLACK** wire to a chassis ground.
- Connect the **WHITE**, **GREEN**, and **BROWN** wires according to the gain you want.
- 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.

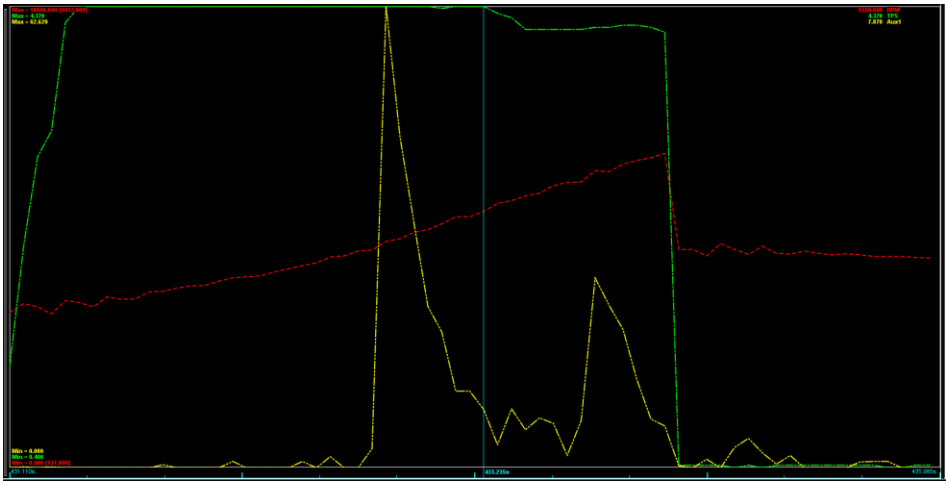
Sensitivity Calibration Process:

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 higher frequencies of the knock sensor signal. 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 light up during the pull. For examples of what knock sounds like, watch the videos at the end of this document. It typically sounds like marbles rattling on glass or sharp snapping sounds like a Geiger counter 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 a few 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!**



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. 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 where the knock threshold is and tune accordingly. 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.
Note: The volume adjustment and sensitivity adjustment have no affect on one another.

Using The Knock Detective Display:

The Knock Detective is **primarily** an audio knock detection system allowing you to listen to your engine while you tune. The LEDs and analog output are great tools to visualize the signal you are listening to. 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. After following the calibration process, seeing more than one or two LEDs spike up indicates a potential knock event. **It's normal to see the level rise 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 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 rise 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.**

Videos:

Full demonstration: https://www.youtube.com/watch?v=yfvrSEdrPU0

Interpreting the output: https://www.youtube.com/watch?v=hL8NYVwk04s

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