

## Knock Control

Knock Control is a feature designed for reducing engine damage caused by detonation. Detonation occurs due to excessive cylinder pressure usually caused by the ignition event happening too early (too much advance), or excessive cylinder pressure. Other factors can cause detonation including excessive engine temperatures, low octane fuels and lean mixtures.

Detonation can cause irreparable damage to an engine, including burnt pistons and broken ring lands. In almost all cases detonation can be avoided by reducing the amount of ignition advance for a given load. The Knock Control function allows the ECU to detect detonation and automatically reduce ignition advance until detonation no longer occurs.

The following adjustments are provided:

- **Knock Mode** - Determines the operating mode of the knock control function.
- **Knock Target Table** - Sets the knock level required before it is decided that the signal is detonation/knock and not engine noise.
- **Knk I-Trim Cyl #X Table** - Shows the amount of ignition retard caused by the Knock Control system for a particular cylinder or group of cylinders.
- **Ign Retard Limit** - The maximum ignition retard that can be applied by the knock control function.
- **Start Point** - The engine position at which the knock window will start relative to the ignition event.
- **Window Length** - The duration in engine degrees of the knock window.
- **Cyl X Knk Detection** - Enables/disabled knock measurement for the designated cylinder.
- **Cyl X Allocation** - Determines which ignition trim table will be used for a particular cylinders ignition retard. Allows multiple cylinders or banks to share a single retard table.
- **Freq Channel** - Sets the frequency response of the internal knock detection circuitry (V88 only).
- **Gain Channel** - Sets the signal gain of the internal knock detection circuitry (V88 only).
- **Retard Gain** - Controls the rate at which ignition is retarded.
- **Advance Delay** - Sets the time that must pass before with no knock events before timing will be reintroduced.
- **Advance Rate** - Controls the rate at which retard is removed.
- **Clear I-Trim Tables** - Determines if retard tables are zeroed at key on or not.
- **RPM Low Lockout** - Knock Control will not operate below this RPM.
- **RPM High Lockout** - Knock Control will not operate above this RPM.
- **TP Low Lockout** - Knock Control will not operate below this throttle position.
- **TP Delta Lockout** - Knock Control will not operate if the rate of change of throttle position is greater than this value.

The following runtime values are provided (found under Knock Control runtime values):

- **Cyl X Knk I-Trim** - The amount the timing has been altered by the knock control system for a particular cylinder.
- **Knock Threshold** - The current engine noise threshold level from the **Knock Target Table**.
- **Knock Level Global** - The general level of the knock signal from all cylinders combined.
- **Knock Count Global** - The total number of times knock level has exceeded the knock target for all cylinders.
- **Knock Level Cyl X** - The individual magnitude of the knock signal for a particular cylinder.
- **Knock Counter Cyl X** - The number of times the knock signal for a particular cylinder has exceeded the knock threshold level.

**Note:** The Knock Control function and knock windowing only operate above 500 RPM.

### Knock Mode

*Knock Mode* selects the operating mode of the Knock Control function. The following modes are available:

- **OFF** - Knock Control is disabled.
- **ON - Knk Internal** - Knock Control is active. The knock signal is measured by the onboard knock detection circuitry. Note that not all ECUs have on board knock detection circuitry.
- **ON - An Knk Interface** - Knock Control is active. The knock signal is measured using an analog voltage input from an external knock detection device.
- **ON - DI Knk Interface** - Knock Control is active. The knock signal is measured using a digital input from an external knock detection device.

### Knock Target Table

The *Knock Target Table* will become visible when Knock Control is activated. This table sets the allowable engine noise for a given RPM/Load. Each engine will have different noise characteristics. Engine noise is generated by mechanical clearances, valve train noise and even valves closing against the seat! Knock Control will reduce ignition advance when the actual measured level of engine noise is above the value in the *Knock Target Table*. This table must be manually filled out for a particular engine. Knock Target values can range from 0 (minimum noise) to 1020 (maximum noise). See the Knock Control setup procedure below for more info on entering values into this table.

Use the [Table Axis Setup](#) menu to adjust the *Knock Target Table* axis parameters and change rows/columns.

### Cyl X Allocation

Each cylinder can have a table assigned to it that will be used to display the amount of ignition retard due to the Knock Control system. The *Cyl X Allocation* setting determines which table is allocated to a particular cylinder. This allows the following combinations to be achieved:

- An individual knock ignition trim table for each cylinder.
- One knock ignition trim table used for all cylinders.
- Separate knock ignition trim tables for groups of cylinders. eg one table for left bank, one table for right bank. eg. One table for front three cylinders and another table for the rear three cylinders.

These settings can cause confusion so are best illustrated with examples.

**Example:** Individual table for each cylinder (4 cyl engine):

- Cyl 1 Allocation = Cyl 1 ITrim Table
- Cyl 2 Allocation = Cyl 2 ITrim Table
- Cyl 3 Allocation = Cyl 3 ITrim Table
- Cyl 4 Allocation = Cyl 4 ITrim Table

**Example:** One table for all cylinders (4 cyl engine):

- Cyl 1 Allocation = Cyl 1 ITrim Table
- Cyl 2 Allocation = Cyl 1 ITrim Table
- Cyl 3 Allocation = Cyl 1 ITrim Table

- Cyl 4 Allocation = Cyl 1 ITrim Table

**Example:** One table for each bank (8 cyl engine odds on left bank, evens on right bank):

- Cyl 1 Allocation = Cyl 1 ITrim Table
- Cyl 2 Allocation = Cyl 2 ITrim Table
- Cyl 3 Allocation = Cyl 1 ITrim Table
- Cyl 4 Allocation = Cyl 2 ITrim Table
- Cyl 5 Allocation = Cyl 1 ITrim Table
- Cyl 6 Allocation = Cyl 2 ITrim Table
- Cyl 7 Allocation = Cyl 1 ITrim Table
- Cyl 8 Allocation = Cyl 2 ITrim Table

**Example:** One table for front cylinders, one table for rear cylinders (6 cyl engine):

- Cyl 1 Allocation = Cyl 1 ITrim Table
- Cyl 2 Allocation = Cyl 1 ITrim Table
- Cyl 3 Allocation = Cyl 1 ITrim Table
- Cyl 4 Allocation = Cyl 2 ITrim Table
- Cyl 5 Allocation = Cyl 2 ITrim Table
- Cyl 6 Allocation = Cyl 2 ITrim Table

### Knk I-Trim Cyl #X Table (Ignition Trim Table)

The *Knk I-Trim Cyl #X Table* shows the amount of ignition retard caused by the Knock Control system for a particular cylinder or group of cylinders. Each time the magnitude of the knock signal exceeds the *Knock Target* value for that particular RPM/Load ignition timing will be decremented from a cell in this table. The *Knk I-Trim Cyl #X Table* can be used to determine where knock has been detected as each cell that has its retard value changed will turn blue (only when this occurs while the ECU is connected to Vi-PEC Tuning Software).

See [Cyl X Allocation](#) for information on setting up which table relates to a particular cylinder.

The *Knk I-Trim Cyl #X Tables* are cleared when the ECU is turned off. Ignition changes made by the Knock Control function are NOT stored permanently. The *Knk I-Trim Cyl #X Tables* can also be cleared by setting *Knock Mode* to OFF, then back to ON.

### Ignition Retard Limit

The *Ign Retard Limit* sets the maximum amount of ignition timing in degrees that will be removed (or maximum amount of ignition retard). This limit avoids the ECU removing too much timing if the value in the *Knock Target Table* is set too low.

### Filtering (Knk Internal mode only)

On ECUs equipped with on board knock detection circuitry, signal filtering is configurable. The following adjustments are available to configure knock signal filtering (Knk Internal mode only):

- **Freq Channel** - This setting sets the sensitivity of the ECU to a particular knock signal frequency range. The following options are available:
  - *LP Only* - Knock input is sensitive to all frequencies below 7 kHz
  - *5.5 kHz* - Knock input is most sensitive to frequencies near 5.5 kHz
  - *7.0 kHz* - Knock input is most sensitive to frequencies near 7.0 kHz
  - *9.0 kHz* - Knock input is most sensitive to frequencies near 9.0 kHz
- **Gain Channel** - This setting adjusts the overall gain of the knock circuitry amplifier. A higher gain number will result in larger *Knock Level* numbers for a particular signal input. Use this adjustment to get a better range of *Knock Level* numbers. If *Knock Level* numbers are reaching full scale then reducing *Gain Channel* will bring them back into range.

The required *Gain Channel* and *Freq Channel* numbers will depend on the engine type, engine capacity, knock sensor type and knock sensor location. A *Freq Channel* setting of *LP Only* is not often used and exists for compatibility with older ECUs.

Late model vehicles (2004 onwards) may have difficulty operating with the Internal knock detection circuitry. This is due to the use of "2nd Harmonic" knock sensors that some manufactures are factory fitting. There are two solutions to this problem:

1. Contact your nearest Vi-PEC dealer for the purchase of an after market knock sensor.
2. Use an external knock detection device compatible with the "2nd Harmonic" knock sensor.

### Cyl X Window

Knock Windowing refers to the measurement of engine noise only during a certain range of engine rotation. This allows the measurement of engine noise for individual cylinders. Knock Windowing can be used on the ECUs internal engine noise measurement circuitry (V88 only) or with an external knock measuring device.

This setting enables the capture of knock level during a specific range of engine position. This allows capture of knock levels for individual cylinders. Turning ON the *Cyl X Window* function will enable knock detection for that cylinder. If *Cyl X Window* is turned OFF for a particular cylinder, knock detection will not be active for that cylinder.

### Start Point

The engine position in degrees after the ignition event at which the knock window signal will start. e.g. If the current ignition timing is 15 degrees BTDC and the start point is set to 10 degrees, the window will become active at 15 - 10 = 5 degrees BTDC.

### Window Length

The duration in engine degrees of the knock window. eg a value of 40 degrees make the window finish 40 degrees after it starts.

### Retard Gain

Controls the rate at which ignition is retarded. The amount of ignition timing removed (retard) is dependent upon the amount by which the *Knock Level* exceeds the *Knock Threshold*. The number entered in the *Retard Gain* setting is the amount of retard that will occur per percent that the *Knock Level* is above the *Knock Threshold*. So the following applies:

- If the *Knock Level* is 1% above the *Knock Threshold* and the *Retard Gain* is 1.0 then 1 degree of timing will be removed per knock event.
- If the *Knock Level* is 20% above the *Knock Threshold* and the *Retard Gain* is 0.5 then 10 degrees of timing will be removed per knock event.

Basically, a higher number in this setting will result in more retard per knock event. A typical value for *Retard Gain* is 0.5.

#### Advance Delay

The ECU will eventually attempt to advance the timing after it has been removed by the Knock Control system. Advance Delay sets the time that must pass before with no knock events before the ECU will attempt to reintroduce timing.

#### Advance Rate

After the *Advance Delay* has passed, the ECU will attempt to reintroduce ignition timing that has been removed by the Knock Control system. *Advance Rate* sets how fast timing will be reintroduced in degrees per second.

#### Clear I-Trim Tables

This settings determines if all used ignition retard tables are cleared at key on or not. When this setting is OFF, tables will retain the values they contained last time a STORE was performed. This setting can be used to permanently store retard values in the retard tables. The ECU will power up and the engine will run retarded until the Knock Control system tries to put timing back into the engine. Ie the engine will start in a safe state and the ECU will advance timing.

**Warning:** If this setting is set to OFF it is essential that the retard tables have the correct values in them when a store is performed!

When this setting is set to ECU Power On, all retard tables will be set to zero at key on. This setting will cause the engine to be run initially in its most advanced state and timing will be removed after detonation is detected. This is the most commonly used setting.

#### Knock Control Runtime Values

The following Runtime values can be observed under in the Knock Control runtime values to monitor the state of the Knock Control system:

- **Cyl X Knk I-Trim** - The amount the timing has been altered by the knock control system for a particular cylinder. This is the value from the [Knock Ign Trim Table](#) allocated for that particular cylinder.
- **Knock Threshold** - The current knock signal threshold level from the [Knock Target Table](#).
- **Knock Level Global** - The general knock signal level of all cylinders combined.
- **Knock Count Global** - The total number of times knock level has exceeded the knock target for all cylinders. This will equal the sum of all the individual Knock Level Cyl X runtime values.
- **Knock Level Cyl X** - The individual knock signal level for a particular cylinder.
- **Knock Counter Cyl X** - The number of times knock signal level for a particular cylinder has exceeded the knock threshold.
- **Knk System Status** - Displays the current activity of the Knock Control system. The following states may be displayed:
  - **Active** - The knock control system is working.
  - **Lockout - RPM Low** - RPM is below the *RPM Low Lockout* setting.
  - **Lockout - RPM High** - RPM is above the *RPM High Lockout* setting.
  - **Lockout - TP Low** - Throttle position is below the *TP Low Lockout* setting.
  - **Lockout - TP Delta** - The throttle has been suddenly opened or closed. Knock Control is disabled during this time.
  - **Lockout < 500 RPM** - RPM is less than 500. Knock Control is disabled during cranking.
  - **No Signal - DI Feedback** - A signal was expected but not received from an external knock detection device that uses a digital signal to communicate with the ECU.

#### Using an External Knock Measurement Device

To use an external knock measurement device the following is required:

1. An Auxiliary Output should be wired to the devices knock window input. Refer to the [Knock Window Auxiliary Output](#) topic for information on configuring an output.
2. (If using a digital signal to ECU) - The knock devices digital output should be wired to an ECU digital input. This input should be configured as [Digital Knock Feedback](#).
3. (If using an analogue signal to ECU) - The knock devices analog output should be wired to an ECU analog input. This input should be configured as *Knock (0-5V)*.
4. [Knock Mode](#) should be selected appropriately
5. The external device must be configured according to the manufactures instructions to suit the application.

#### Typical Settings For Knock Control

The following picture shows settings typically used for knock control on a four cylinder engine. Note that only one *Knk I-Trim Cyl #X Table* is used for all cylinders.

Knock Control		Knock Mode	ON - Knk Internal	Clear I-Trim Tables	ECU Power-On
Gain Channel	x 1.0	Cyl 1 Allocation	Cyl 1 ITrim Table	Window Start	10 °
Freq Channel	7.0kHz	Cyl 2 Allocation	Cyl 1 ITrim Table	Window Length	50 °
Cyl1 Knk Detection	ON	Cyl 3 Allocation	Cyl 1 ITrim Table	Ign Retard Limit	3.0 °
Cyl2 Knk Detection	ON	Cyl 4 Allocation	Cyl 1 ITrim Table	Retard Gain	0.50 degrees/ %
Cyl3 Knk Detection	ON			Advance Delay	2 s
Cyl4 Knk Detection	ON			Advance Rate	1.0 degrees/ sec
				RPM Low Lockout	1000
				RPM High Lockout	6000
				TP Low Lockout	5 %
				TP Delta Lockout	5.0 %