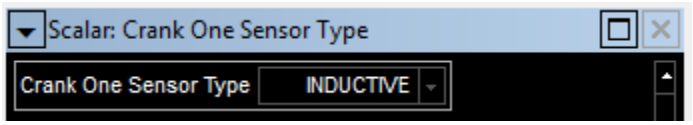
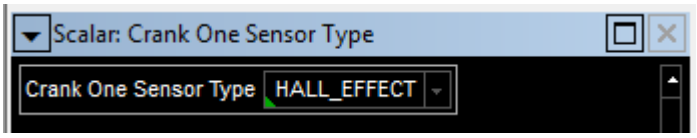
Groups/ANALOG SENSOR SETUP/CRANK AND CAM SENSOR SETUP:

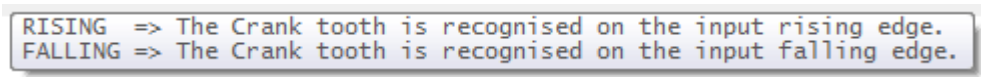
Crank One Sensor Type: The Harley CPS is inductive as is our DC motor powered mechanical 32-2 timing test stand. The two wire CPS produces a sine wave that the SQ6M interprets.




Note: When using the Arduino UNO 32-2 crank pattern generator the software must be set to Hall Effect as the Arduino produces a square wave.

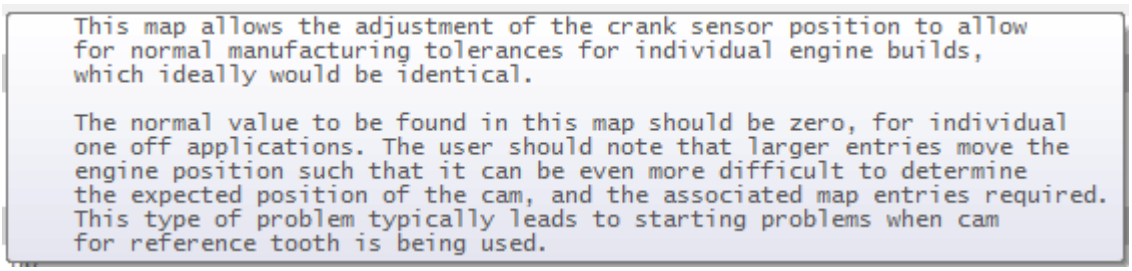


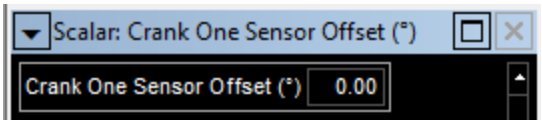

Crank One Edge: Apex had it rising…changed it to falling per Harley practice.





Crank One Sensor Offset:



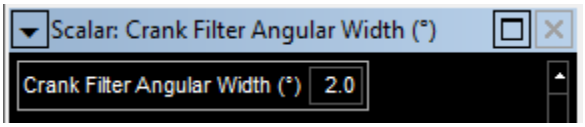

Cam Crank Output To Injectors: Disabled

Groups/ANALOG SENSOR SETUP/CRANK AND CAM SENSOR SETUP/CRANK FILTER

Crank Filter Angular Width:

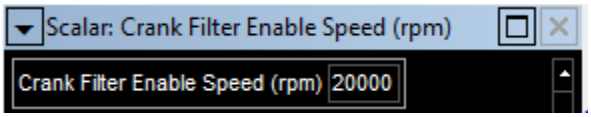
This map allows the adjustment of the crank sensor position to allow for normal manufacturing tolerances for individual engine builds, which ideally would be identical.

The normal value to be found in this map should be zero, for individual one off applications. The user should note that larger entries move the engine position such that it can be even more difficult to determine the expected position of the cam, and the associated map entries required. This type of problem typically leads to starting problems when cam for reference tooth is being used.



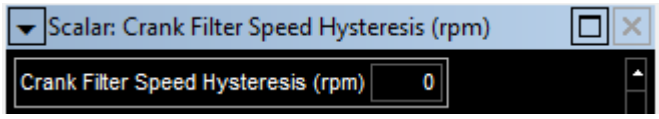

Crank Filter Enable Speed: 0 to 20000 rpm. This effectively disables the filtering.

This map defines the engine speed above which the filtering of the crank signal is applied. See the help for 'Crank Filter Angular Width' for details.




Crank Filtering Speed Hysteresis:

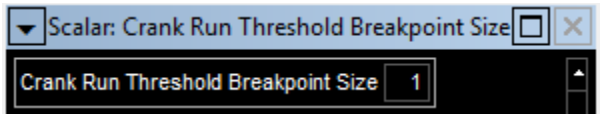
This map in conjunction with 'Crank Filter Enable Speed' defines the engine speed below which the filtering of the crank signal is disabled. See the help for 'Crank Filter Angular Width' for details.




Groups/STANDARD MAPPING/CRANK AND CAM SENSOR SETUP/USER DEFINED SETUP/CRANK ONE SENSOR:

Crank Run Threshold Breakpoint Size: 1 to 11

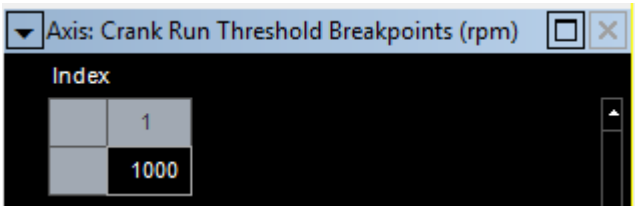
This is the number of engine speed sites used in the map "Crank Run Threshold Breakpoints".



Crank Run Threshold Breakpoints:

```
These breakpoints are used for the following maps:
"Crank One Lower Run Threshold"
"Crank One Upper Run Threshold"
"Crank Two Lower Run Threshold"
"Crank Two Upper Run Threshold"

Standard error checking is carried out between pairs of thresholds at each
breakpoint.
```

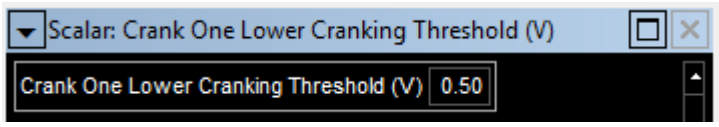



Crank One Lower Cranking Threshold:

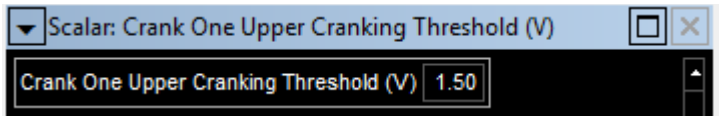
```
#line 37610 "desc.c"
These maps select the input voltage upper and lower thresholds.

Two sets of maps are provided, so that different thresholds ( usually lower ),
can be used during engine cranking, than are used when the engine is running
normally.

NOTE: There must be 0.1v difference between upper and lower threshold voltages
and the upper threshold must be higher than the lower threshold, otherwise
an error will be reported and the engine will not start.
```




Crank One Upper Cranking Threshold:

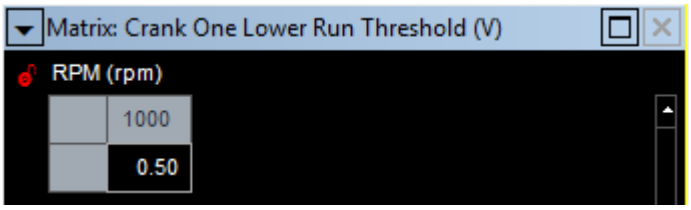


Crank One Lower Run Threshold:

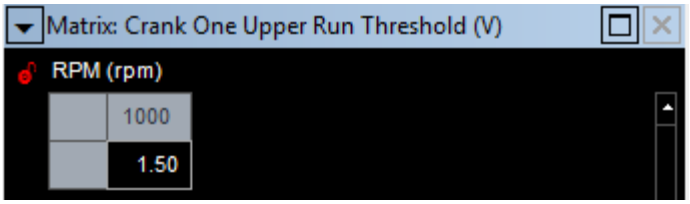
```
#line 37610 "desc.c"
These maps select the input voltage upper and lower thresholds.

Two sets of maps are provided, so that different thresholds ( usually lower ),
can be used during engine cranking, than are used when the engine is running
normally.

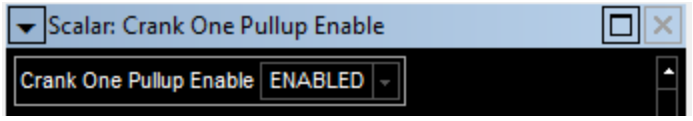
NOTE: There must be 0.1v difference between upper and lower threshold voltages
and the upper threshold must be higher than the lower threshold, otherwise
an error will be reported and the engine will not start.
```




Crank One Upper Run Threshold:




Crank One Pullup Enable:




Groups/STANDARD MAPPING/CRANK AND CAM SENSOR SETUP/USER DEFINED SETUP/CAM SENSOR:
There is no cam sensor in this initial setup. It may be added in EVO configurations later.

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/

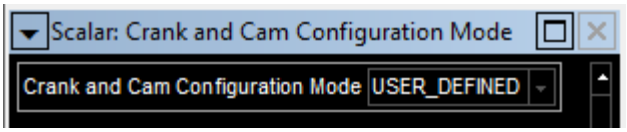
Crank and Cam Configuration Mode:

```
    This map allows the user to select whether the standard
    N minus M crank wheel configuration is to be used, or the more
    complex but vastly more flexible full configuration.

    The N-M crank configuration is suitable for all crank wheel types,
    such as 36-1, where there are missing teeth on the crank, or wheels
    with no missing teeth. Additionally it is possible to use cam for
    reference tooth, in this case, it is not necessary for the cam
    to be positioned in the gap.

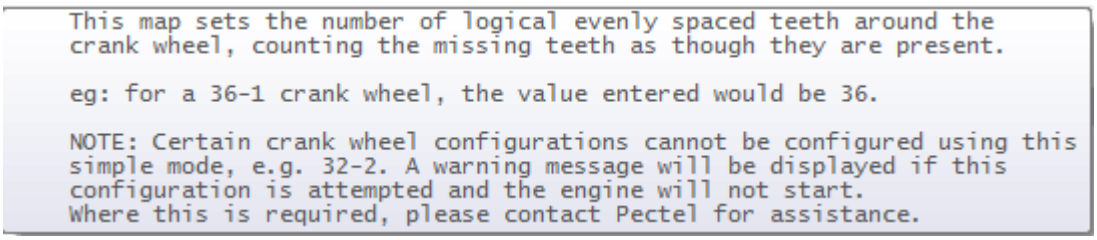
    The full configuration offers the ability to configure a wide variety
    of cam and crank wheel tooth variations, including extra crank teeth,
    multiple crank teeth gaps and multiple cam teeth. If this type of
    configuration is necessary, please contact Pectel for advice on how
    to populate the settings.
```

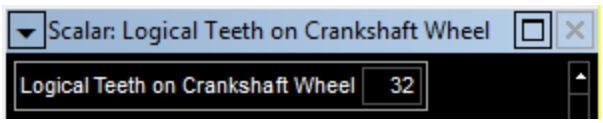
NOTE: We use “USER_DEFINED” as Pectel precludes us using the “ N_MINUS_M” choice



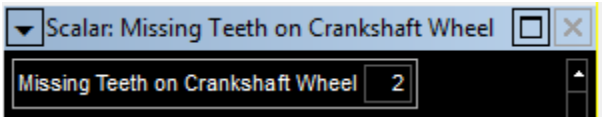

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/
N MINUS M CRANK WHEEL SETUP:

Logical Teeth on Crankshaft Wheel

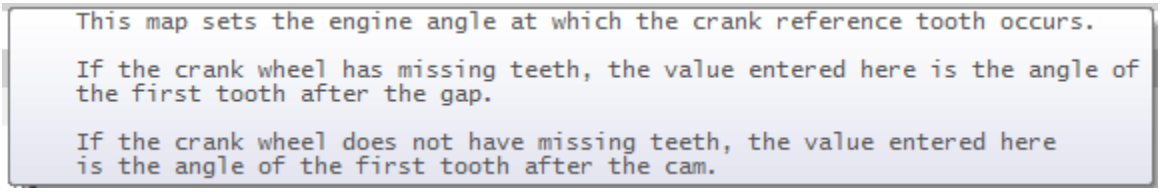


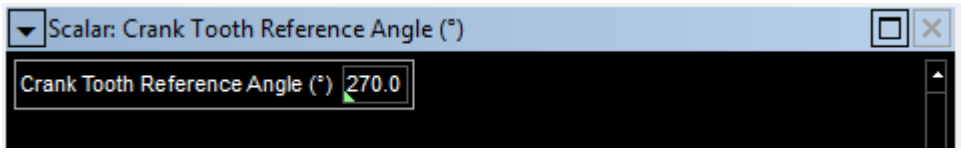

Missing Teeth on Crankshaft Wheel




Crank Tooth Reference Angle




720 degrees / 32 = 11.25 degrees. Two blank teeth plus 6 teeth until first TDC event. 8 * 11.25 equals 90 degrees. 360 degrees minus 90 degrees equals 270 degrees until it returns to this point. This is the crank Tooth Reference Angle. Note: Gaps are 7.78 Deg; Teeth are 3.47 Deg.




Cam Position

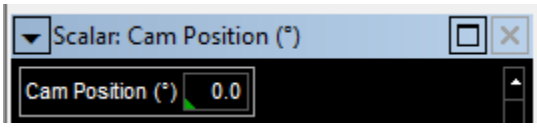
This map sets the engine angle at which the cam tooth occurs.

The accuracy needed for this information is dependent upon how the cam is being used.

If it is only being used to indicate the engine phase then it is less critical, but its relationship to the crank tooth reference angle will affect the phase.

If it is being used as a cam for crank tooth reference, then clearly it is essential that the absolute position entered here is accurate. Referencing the wrong crank tooth, when the crank has missing teeth, will result in engine mapping problems which can be very difficult to spot, it is usually highlighted by incorrect ignition changes.

When using cam for reference tooth detection, the cam does not need to be in the missing crank wheel teeth gap.



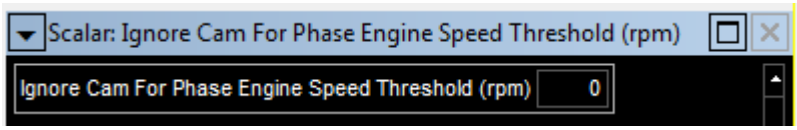

Ignore Cam For Phase Engine Speed Threshold

This feature is used to disregard the cam sensor input, once 720 sync mode has been obtained, above a configurable engine speed. This ensures that any noise on the cam sensor input will not affect the sync state of the engine, once it is above this threshold.

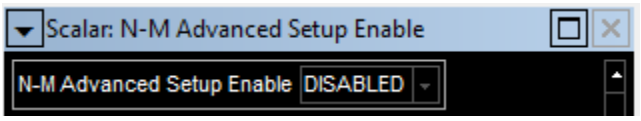
When the engine speed falls below the value in this map, or there are any other loss of engine position errors on the crank sensor, then the cam input is checked once again for correct phase indication.

A threshold value of zero is used to disable this feature.

This feature can be used with crank wheels with and without missing teeth.




N-M Advanced Setup Enabled




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/
N MINUS M CRANK WHEEL SETUP/ADVANCED SETUP: Seven sub categories NOT USED as it is DISABLED

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/SYNC EVENTS:

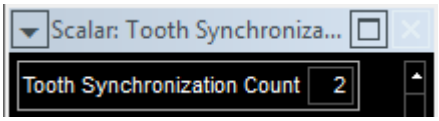
Tooth Synchronization Count:

```
This map determines the number of tooth events which must be seen
consecutively before the tooth sync state is reported.

A tooth event is a maximum measurable time between teeth.

Setting this map too low affects each of the next higher states in
allowing them to incorrectly trigger their status before the engine
speed has stabilised.

Having a higher value delays recognition of this and the next higher
states.
```



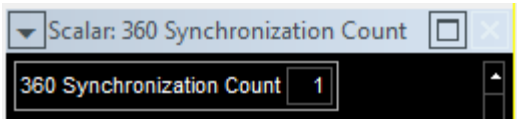

360 Synchronization Count

```
This map determines the number of 360 sync events which must be seen
consecutively before the 360 sync state is reported.

A 360 sync event is typically obtained from either missing tooth
detection on the crank wheel, or cam for reference tooth detection.

Setting this map too low affects the next higher state in allowing
it to incorrectly trigger its status before this state has stabilised.
It may also result in immediate loss of sync again with immediate
increases and/or decreases in speed with the first few ignition events.

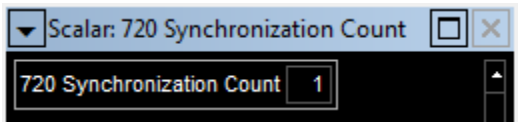
Having a higher value delays recognition of this and the next higher
states. In this case, it may cause unnecessary extended cranking durations.
```




720 Synchronization Count

```
This map determines the number of 720 sync events which must be seen
consecutively before the 720 sync state is reported.

Having too high a value in this map could extend the duration of 360 sync
fuelling and ignition unnecessarily. With applications which use cam for
reference tooth during starting, this would extend the cranking duration.
```




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION:

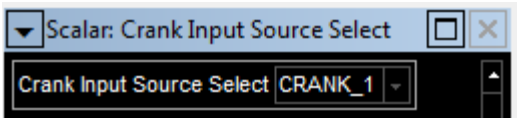
Crank Input Source Select

```
This map selects which input is to be used for the crank position sensor.

The options available are :

    CRANK_1
    CRANK_2
    CAM

The CAM option allows a configuration where there is a single trigger wheel
connected to the Cam input, but which can also be used to determine angular
position over each engine revolution.
```

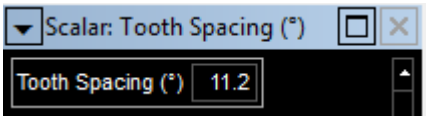



Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/CRANK WHEEL PATTERNS

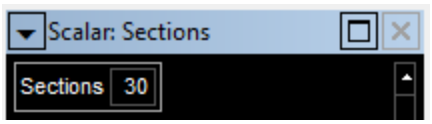
Tooth Spacing

```
The Default Synchronization Tooth Angle, in angle-clocks.
This value is used by the synchronizing Bresenham circuit to generate a signal that
reflects the relative time of incoming teeth.   The size of this value will depend on
the number of teeth on the Crank wheel and the maximum engine speed.   It is important
that this value be less than the minimum tooth spacing time period, measured in multiples
of the BclkEn period (125 ns ).
```

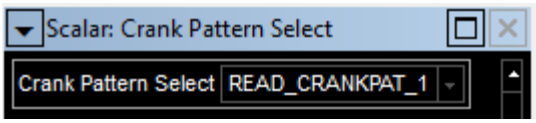
In this case the Harley crank teeth are 3.47 degrees wide and the gap is 7.78 degrees wide. 3.47 + 7.78 = 11.25 degrees total. Entry is 11.2 degrees.




Sections: 1 to 32 maximum




Crank Pattern Select



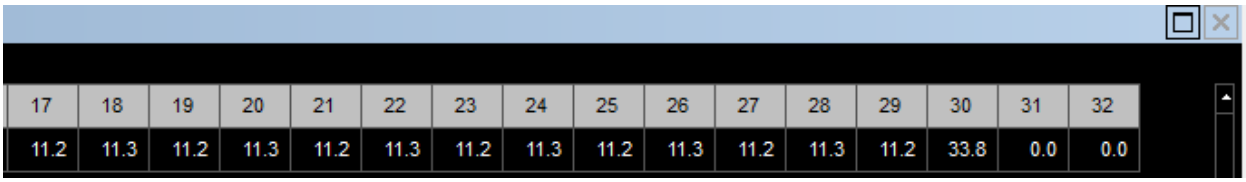

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/CRANK WHEEL PATTERNS/CRANK PATTERN ONE/ANGLE SPACING

Section Number

Matrix: Section Number (°)

Section

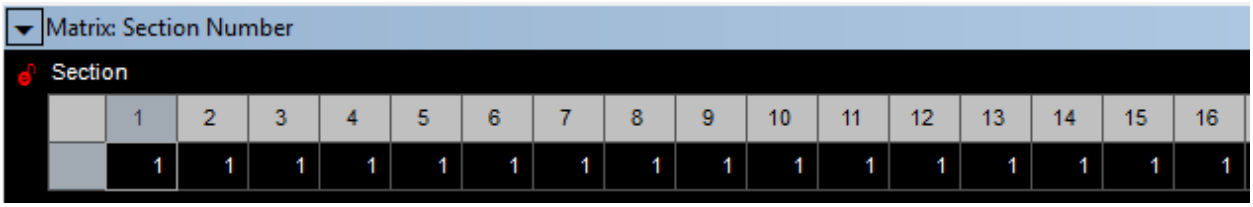
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 |



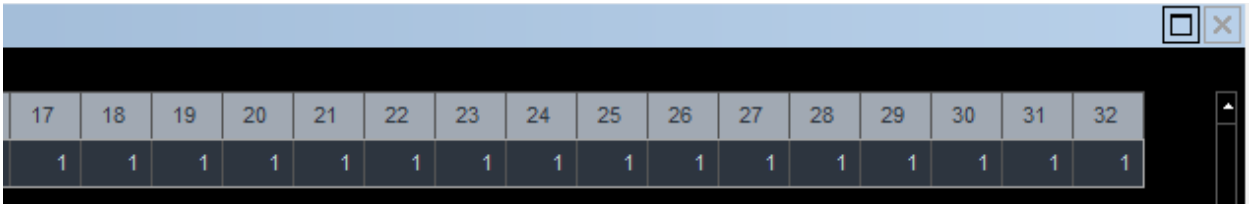
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 11.3 | 11.2 | 33.8 | 0.0 | 0.0 |

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/CRANK WHEEL PATTERNS/CRANK PATTERN ONE/NUMBER OF TEETH

Section Number




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

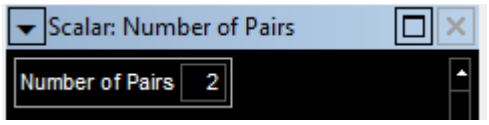


| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/CRANK WHEEL PATTERNS/CRANK PATTERN TWO (NOT USED)

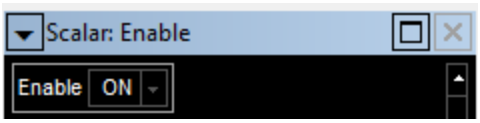
Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/ANOMALIES/USER CRANK ONE

Number of Pairs: 1 to 8 Decimal

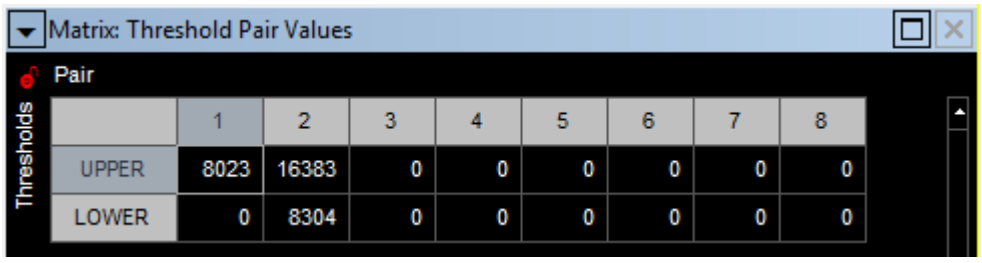



Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/ANOMALIES/USER CRANK ONE/ALTERNATIVE ONE

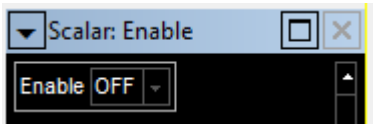
Enable




Threshold Pair Values: 0 to 16383 (?)




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/ANOMALIES/USER CRANK ONE/ALTERNATIVE TWO / THREE / FOUR




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/ANOMALIES/USER [CRANK TWO/ CRANK THREE]…Not Used

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CRANK CONFIGURATION/ANOMALIES/CRANK EDGE ANOMALIES

Crank Rising:

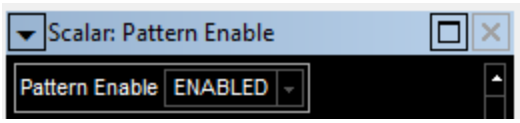

Crank Falling:


Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/CAM CONFUIGURATION…..(Not Used as there is no cam sensor)

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE

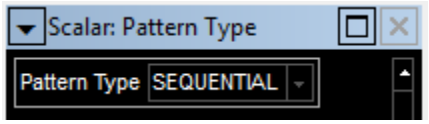
Pattern Enable

Up to 8 patterns of anomalies can be concurrently searched for by the FPGA, in order to gain or verify 360_ or 720_ synchronization. These patterns are individually enabled by the SyncPatEn bits.




Pattern Type

The synchronizing patterns can be of one of two types: Sequential or Counted.



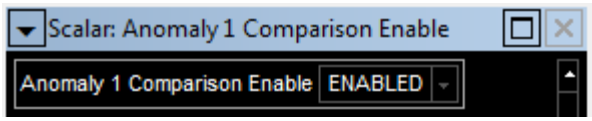

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SEQUENTIAL PATTERN/ANOMOLY ENABLE

Anomoly 1 Comparison Enable

A pattern sequence used to obtain and maintain engine synchronisation is described here as a sequence of anomolies which make up that pattern.

For an anomoly to be used in a pattern, it must be ENABLED in this map, and the corresponding anomoly chosen in the matching ANOMOLY SELECT group.

NOTE: The sequence matching for the pattern is always applied starting at the highest numbered ENABLED anomoly first.




Note: 2-8 anomalies DISABLED

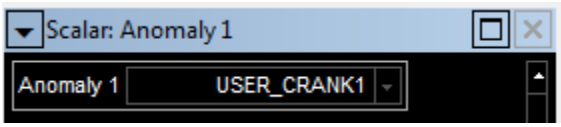
Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SEQUENTIAL PATTERN/ANOMOLY SELECT/ Anomaly 1-8

A pattern sequence used to obtain and maintain engine synchronisation is described here as a sequence of anomolies which make up that pattern.

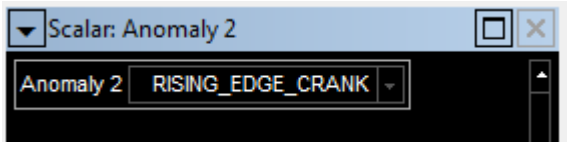
For an anomoly to be used in a pattern, it must be selected in this map and the corresponding enable map set to ENABLED in ANOMOLY ENABLE group.

NOTE: The sequence matching for the pattern is always applied starting at the highest numbered ENABLED anomoly first.

Anomaly 1




Anomaly 2-8




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/COUNTED PATTERN…(Not Used)

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SYNCHRONIZATION

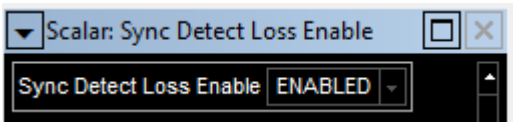
Sync Detect Loss Enable

This map should normally be set to ENABLED for 360 synchronisation patterns and DISABLED for simple cam for phase 720 synchronisation patterns.

The map determines whether a synchronisation error will occur if the pattern is not detected, within the engine revolution or cycle in which it is expected.

eg: Missing crank tooth detection would be ENABLED. This means that the missing tooth must be detected every engine revolution.

eg: Cam for phase indication would be DISABLED. This means that if the cam sensor failed, the engine would continue to run without generating a synchronisation error.

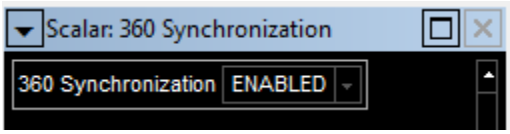



Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SYNCHRONIZATION/360 SYNCHRONIZATION

360 Synchronization

Set this map to ENABLED if the pattern is capable of obtaining and maintaining 360 synchronisation.

If ENABLED, the following maps are used to determine the engine position.

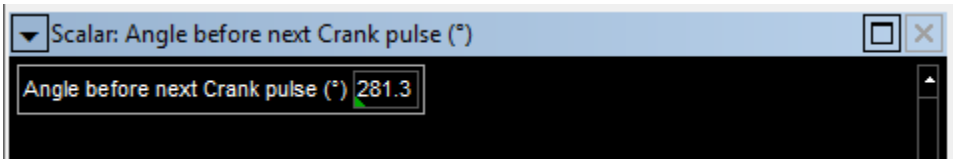



Angle before next Crank pulse

When a pattern is seen, this map is used to set the position of the crank wheel one tooth later. The interpretation of this depends on what anomolies are being used for the pattern, but the typical examples are described below.

Missing crank tooth detection, will be the second crank tooth after the gap.
Cam for reference tooth detection will be the immediate crank tooth after the cam.

270 degrees plus 11.25 degrees

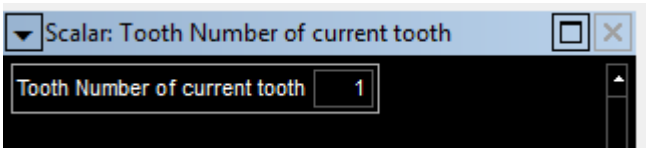



Tooth Number of current tooth

When a pattern is seen, this map is used to set the position of the crank wheel one tooth later. The interpretation of this depends on what anomolies are being used for the pattern, but the typical examples are described below.

Missing crank tooth detection, will be the second crank tooth after the gap.
Cam for reference tooth detection will be the immediate crank tooth after the cam.

The tooth number is qualified by the "Section number of current tooth".

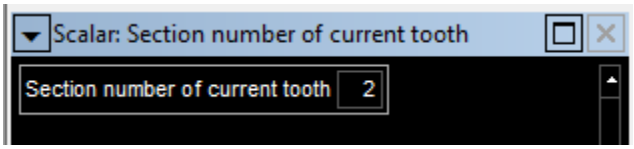



Section number of current tooth: 1 to 32 decimal

When a pattern is seen, this map is used to set the position of the crank wheel one tooth later. The interpretation of this depends on what anomolies are being used for the pattern, but the typical examples are described below.

Missing crank tooth detection, will be the second crank tooth after the gap. Cam for reference tooth detection will be the immediate crank tooth after the cam.

The section number is qualified by the "Tooth number of current tooth".



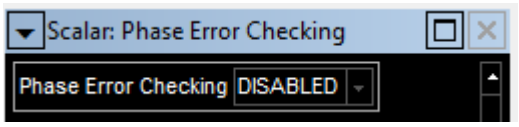

Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SYNCHRONIZATION/360 SYNCHRONIZATION/ERROR CHECKING

Phase Error Checking

When the pattern used to obtain and maintain 360 synchronisation occurs every engine revolution, this map must be set to DISABLED, eg missing crank tooth detection.

When the pattern used to obtain and maintain 360 synchronisation occurs only once per cycle, this map must be set to ENABLED, eg using cam for reference tooth.

When ENABLED, the phase in which the 360 synchronisation pattern is detected is compared against the phase set in the "Phase of Tooth" map. If they do not match, then a pattern error is generated.




Phase of Tooth

```
When a pattern is being used to obtain 360 synchronisation, and that pattern
occurs only once per engine cycle, this map determines the phase to be set
once the pattern has been seen.

The phase is asserted on the crank tooth immediately following the recognition
of the pattern sequence. On subsequent engine revolutions, the phase is tested
and an error generated if they don't match.


If the pattern is seen every engine revolution, then there is no phase information
present in the pattern, so map "Phase Error Checking" must be set to DISABLED
and this map is ignored.
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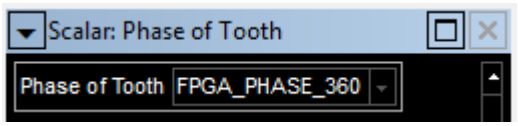
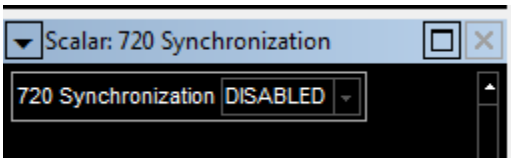



Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERN ONE/SYNCHRONIZATION/720 SYNCHRONIZATION/..not used




Groups/STANDARD MAPPING/HARDWARE SETUP/CRANK AND CAM POSITION CONFIGURATION/USER DEFINED CRANK WHEEL SETUP/POSITION OF PATTERN OUTPUT/PATTERNS 2/3/4/5/6/7/8(DISABLED)