

# april systems design Ltd



[www.aprilsystems.co.uk](http://www.aprilsystems.co.uk)

## **Detonation detection system**

M8 and M6 Stud detector

Nov11

### **Overview**

Detonation is the pre-ignition of fuel in the cylinder and can cause piston damage; a certain level of detonation is good (fuel dependant) to ensure that the engine is running at the optimal level. The detection system allows detonation to be detected and a bright indicator flash indicates a detonation has occurred to warn the rider/driver. With a counter connected into the system, the number of detonations for 1 or each of 2 cylinders can be displayed.

The April systems detonation detection system allows a plug together system that can be simply expanded from a simple single cylinder system to a full dual cylinder system and to other data recording/logging systems.

### **System variations:**

Systems are built from the basic components of:

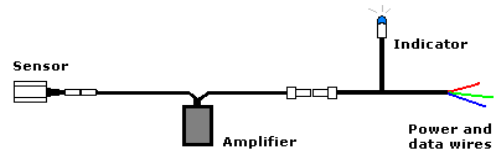
- Sensor and Amplifier
- Power and indicator lead
- Counter unit

The power / data lead can be wire ended or have a connector for datalogger.

### **Single Cylinder**

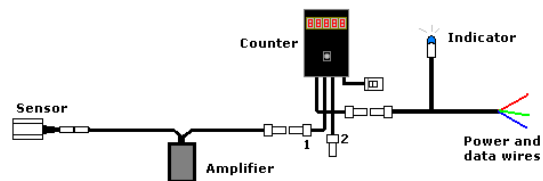
Simple detonation detection

- 1 Sensor and Amplifier
- 1 power and indicator lead



Detonation detection and counter

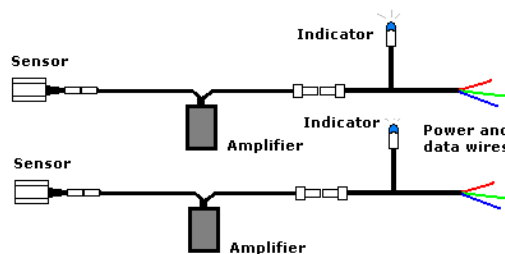
- 1 Sensor and Amplifier
- 1 power and indicator lead
- 1 detonation counter



### **Twin Cylinder**

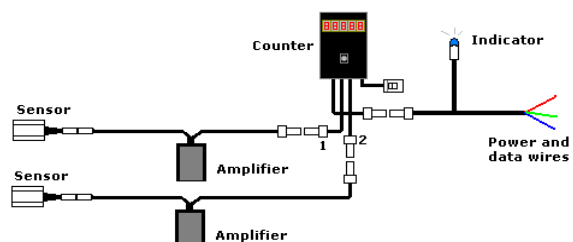
Simple detonation detection

- 2 off Sensor and Amplifier
- 2 off power and indicator lead



Detonation detection and counter

- 2 off Sensor and Amplifier
- 1 off power and indicator lead
- 1 off detonation counter



## **Stud sensor and amplifier unit**

Amplifier unit



M6 and M8 Stud detectors



The detector system comprises of: a M8 or M6 Stud detector sensor and a small amplifier unit. The sensor detects head (or block) deformation and passes this signal to the amplifier. The amplifier produces two output signals:

- (A) A standard detonation profiled pulse
- (B) An indicator drive for the blue indicator or data logger

The (A) output can be coupled to other type of detonation detection systems such as:  
Honda detonation counter and logger  
BPS CDi ignition and engine control systems  
Cougar Data Recording motorcycle logging system

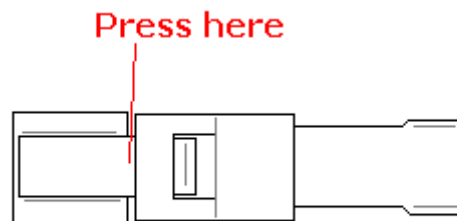
The (B) output can be coupled to loggers with standard 5V analogue or digital inputs  
Aim MyChron Extreme system

If connection to one of the above is required then request a power cable with a logger output connection. Note that the BPS/cougar cylinder pressure cannot be measured by this type of sensor

On powering up the unit will generate a detonation signal and/or flash the indicator this is normal and provides a test for the power and indicator

## **Sensor fitting**

1. To disconnect the White JST connector, push with fingernail at the join



2. When positioning the sensor cable, heat the sensor lead to soften and mold to the required position

## **Options:**

. Longer cables on the amplifier for Karts are optional, this allow the counter and/or the blue indicator flash to be mounted at the front / steering wheel

. Connections to loggers ... please contact office for details / options available

**Counter unit with throttle graph**



The counter unit (for single or dual cylinder) has two detonation detector inputs labelled (1) and (2) a power connection and a data recorder output. The detector amplifier/s plug directly into the counter and are powered by the counter units single power cable.

- . The count values are stored in a non-volatile memory and so are unaffected by having the power removed.
  - . The value normally displayed is the addition of cylinder 1 and cylinder 2 count values
  - . Pressing the button briefly once will cycle through the count values
- The display will show ....

```

1=
{Cylinder 1 count value}
{Cylinder 1 throttle graph}
2=
{Cylinder 2 count value}
{Cylinder 2 throttle graph}
Total
{Addition of cylinder 1 and 2}           the normal display
    
```

- . When cycling through the cylinder counts the counter system will continue to count any detonations
- . 20 seconds after a button is pressed the display will fade to reduce power consumption

**Throttle connection**

On the power and indicator lead connect the yellow/blue wire to the engines throttle , 0-5V input

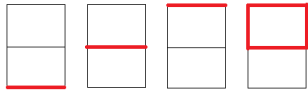
**Reset and throttle monitor**

- . To reset all the values to zero: press and hold the button for 2 seconds
- . After 2 seconds the display will show the throttle position to test the connection and ensure the full throttle range is displayed

<u>Throttle voltage</u>	<u>Area</u>	<u>Display</u>
< 1.35V	Low throttle	^ _____
1.35V – 2.24V	Low mid	— ^ _____
2.24V – 3.00V	Mid	— — ^ _____
3.00V – 4.00V	Upper Mid	— — — ^ _____
>4V	Full	— — — — ^ _____

## Throttle graph

. The throttle graph gives a display of detonation counts for each of the five throttle position areas



75% to 100% of the maximum number of detonations are indicated by a circle at the top of the display

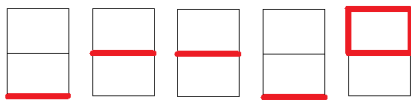
50% - 75% maximum is a line at the top of the display

25% - 50% maximum is a line in the middle

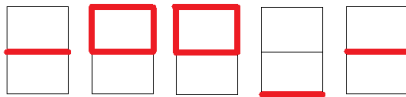
<25% the maximum is a line at the bottom

Examples :

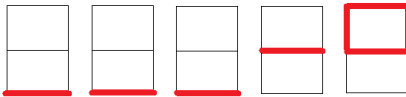
1. Most detonation is on the main jet at full throttle, 25-50% of that maximum is spread over the needle drive area – an even set-up



2. Most detonation is on the needle perhaps too lean in this area



3. All the detonation is on the main jet



## Datalogger connection

. The counter power cable has an indicator output that flashes for either cylinder (1) or cylinder (2). This line can be used for a single logger channel.

The data output connector allows a logger to be easily connected

. The data output connector:

Pin 1 red = power

Pin 2 yellow = cylinder (1) 0-5V data

Pin 3 blue = cylinder (2) 0-5V data

Pin 4 green = gnd

. The Yellow and blue data lines can be joined if only one channel on the logger is available

. The unit can be power from the data output connector if required

. The unit has a Velcro mounting pad

## Reading the count on generator only powered engines

The count values on the counter are retained even without power connected to read on a generator only motorcycle then build a small 9 to 14V battery ( 500mAH or above ) with a connector and power the motorcycle for the short period required to read the display.

## For non power circuit motorcycles

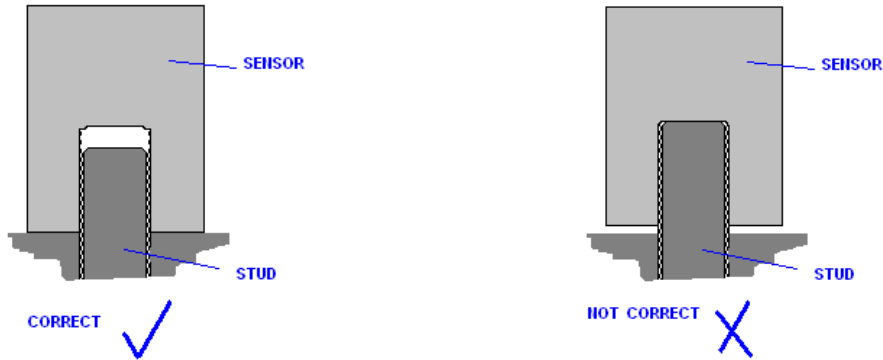
If no power in use is available then use a rechargeable 250mAh PP3 battery and a PP3 holder wired into the power lines, this will power a detonation system (single and twin with or without counter ) for over 2 hours.

## **Installation Procedure for the M6/M8 stud detector**

The mounting position should be on the head bolts or as central as possible and in the top half of the engine. The sensor should be tightened to the normal head nut tightness

**For the M6 :** Use an M6 head bolt or stud, the detector has a maximum of 6mm of internal threads until the head of the internal set screw.

**For the M8 :** Use an M8 head bolt or stud, the detector has a maximum of 8mm of internal threads until the head of the internal set screw.



The sensors outside metal surface must make contact to the head or block or steel washer or nut. The inside surface should not touch the top of the stud. The contact of the sensor should be of high quality and clean to ensure the resonance coupling. The whole of the sensors metal surface needs to be in level contact.

Only use a copper washer between the head and the detector if the washer is required for the water seal such as on a Honda RS125 and Honda RS250, this will require adjustment to the sensitivity of the detection.

If the sensor cable is in a tight location use a heat-gun to warm the heat-shrink and bend the cable to an angle

The detector amplifier unit must be mounted at least 80mm away from the ignition coils. Also route all detector cables away from HT leads or the coil.

**Honda Power connections** - Wire behind the tachometer:  
Red positive power to Honda black  
Green Chassis to Honda green

**Yamaha Power connections** - Wire behind the tachometer:  
Red positive power to Yamaha Brown  
Green Chassis to Yamaha Black

If connecting the unit to an AIM MyChron extreme then the power connection can be via the signal connector

### **NOTE :**

- . Mount the blue indicator in the dash foam pointing towards the rider.
- . Velcro mount the detector amplifier unit to the inside of the chassis: DO NOT MOUNT ON THE SIDE OF THE COIL.
- . Ensure all cables are away from the HT leads, if the HT lead goes right route the detonation lead left.
- . Velcro mount the counter unit in a visible position and ensure that the button cannot be pressed accidentally or pushed by other cables.
- . Use the coloured tie-wraps to indicate which cylinder is which; red=1, blue=2 ensure that the leads are in the correct connectors for cylinders.

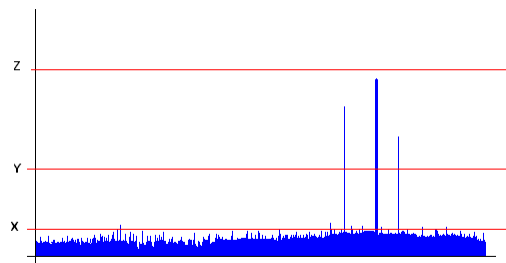
### **Sensitivity Adjustment**

The sensitivity adjustment is by a 15 position switch; 0 is the most sensitive and F is the least.



If there is no data for your engine on the sensitivity level required, set the sensitivity at the most sensitive = 0. This will no doubt show a continuous blue indication while running the engine in normal conditions. Then with the engine running slightly rich, reduce the sensitivity until the light never flashes under load with the RPM in the power band.

A typical detonation signal is shown below. If the unit is too sensitive then engine noise will be detected (shown as X), the unit needs to be set higher than that level. The range that detonation is detectable is wide (level Y).



If the sensitivity is still too high then please contact the office as a suitable washer placed between the cylinder head or block with reduce the detection sensitivity

### **Leaded Fuel**

Please Note; leaded fuel does not detonate as easily at unleaded fuels, the point of increased detonation on leaded fuel will be much leaner than the optimal fuel setting. The setting of the detonation unit will therefore be affected.

### **Excessive Detonation count**

- . The effect that the sensor detects can also be caused by mechanical bangs. Worn bearings in the crank or con rod can easily slap against the cylinder head when a higher revs.
- . Interference can also cause the detector amplifier to detect non existent detonation, the cables and amplifier must be mounted away from the HT coil, HT wire or the LT coil drive wiring.
- . Mid throttle (on the Needle / lean needle) detonation can cause actual detonation to occur that is not damaging to the piston but is still a detonation and will still be detected / counted.

### **Detonation system simple test**

#### **With no counter :**

Power up system – check for short flash on power up

- No flash – Check 4 way binder connections and power feed

Disconnect sensor from engine, plug back into system, Unscrew lid of box and set sensitivity to 0 – check arrow points to zero. With system powered up, hold sensor loosely in hand. Tap end of sensor with the flat of a new 15-17mm spanner so that a crisp audible ‘tink’ can be heard

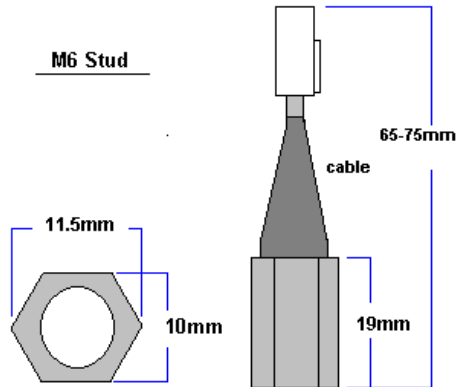
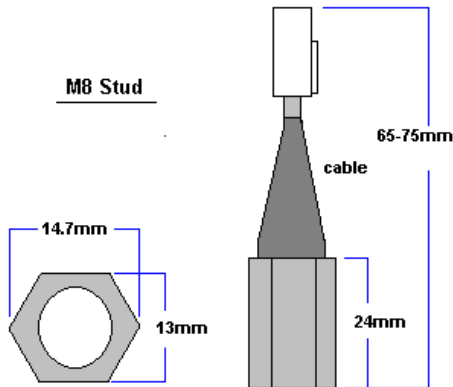
#### **With counter :**

Power up system – check for short flash on power up

- No flash, No count display – Check 4 way binder connections and power feed
- Flash No display – Send counter for testing, test each sensor as above

Disconnect the counter and plug each sensor amplifier into the power lead and test as above

**Specifications:**



Sensor

Sensor temperature range  
Connector

-20degC to +150degC  
JST IP65

Detector amplifier

Voltage range  
Input Current  
Amplifier temperature range  
Size  
Weight  
Water ingress  
Mounting  
Connectors  
Detonation output  
Led / Logger output

9V to 20V  
5mA nominal 20mA peak  
-10degC to +90degC  
46mm x 32mm, 20mm high  
Approx 100g  
Washable with cover on  
Industrial Velcro  
JST / Binder 719  
-40V 1mA 16uS  
+5V 5mA 200mS

Counter

Voltage range  
Input Current  
Temperature range  
Size  
Weight  
Water ingress  
Mounting  
Connectors  
Inputs  
Led output  
Memory  
Max count

9V to 20V  
50mA nominal 150mA peak  
-10degC to +60degC  
72mm x 45mm , 15mm high  
Approx 60g  
Washable  
Industrial Velcro  
Binder 719  
2 off -40V 16uS piezo  
+5V 5mA 200mS  
3 not power dependant, (1),(2), (1)+(2)  
99999

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