

# RayTech Automotive

## SynchroKing 4 Mk2 - Instruction Manual

### Application

The SynchroKing 4S Mk2® is a universal vacuum synchronization/balancing tool for both carburetors and throttle valve bodies. It is suitable for any combustion engine with four intake ports from cars, motorcycles, mopeds, scooters, carts, mowers and outboard engines. The SynchroKing 4S Mk2® is designed to provide a compact, easy to use and economical synchronisation tool for home and workshop use. The SynchroKing 4S® is primarily designed for use with engines with four inlet manifolds but is in principle suitable for any engine with more than one intake. If not all four ports are used, the device will automatically ignore the sensor input from the disconnected ports, making it possible to use the device on 2 and 3 manifold engines. The device comes with a set of 4 of each M5 and M6 nipples, enabling easy connection to the vacuum test ports on most vehicles

This Owner's manual must be read in conjunction with the Workshop manual of the vehicle before using the SynchroKing 4S®. Before proceeding the user should as a minimum be familiar with the test ports in the manifolds, the idle adjuster screws and the balancing adjuster screws.

### Features:

1. Australian designed and manufactured.
2. High quality, robust housing.
3. Digital display for vacuum for four vacuum channels
4. Bar displays for differential vacuum display
5. Push-button operated dampening control
6. No battery required.
7. Reverse polarity protection.
8. Auto calibration function at startup.
9. 1-year limited warranty for the original Purchaser.

### The package includes:

- 1 x SynchroKing 4S Mk2® device, c/w integrated power lead
- 4 x vacuum hoses
- 4 x M5 brass nipples
- 4 x M6 brass nipples
- Detailed and illustrated user manual

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## Device Description:

1. Main displays - The two main displays indicate the vacuum measured in the inlet manifolds in mm of mercury [mmHg].
2. Bar displays - Each bar display indicates the level of vacuum *relative* to the average vacuum in the inlet manifolds.
3. Pushbuttons ' + ' and ' - ' Used to set the desired dampening factor and initiate a manual re-calibration
4. Power cable - Connects to the vehicle's battery to power the device.
5. Hoses - Connect to the nipples in the inlet manifolds.
6. 4 x M6 and 4 x M5 nipples - screw into the test ports of the vehicle's intake manifolds.



Figure 1 - Device Overview

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## Connections

Diagram 2 shows the SynchroKing 4S Mk2® connected to the battery and inlet manifolds

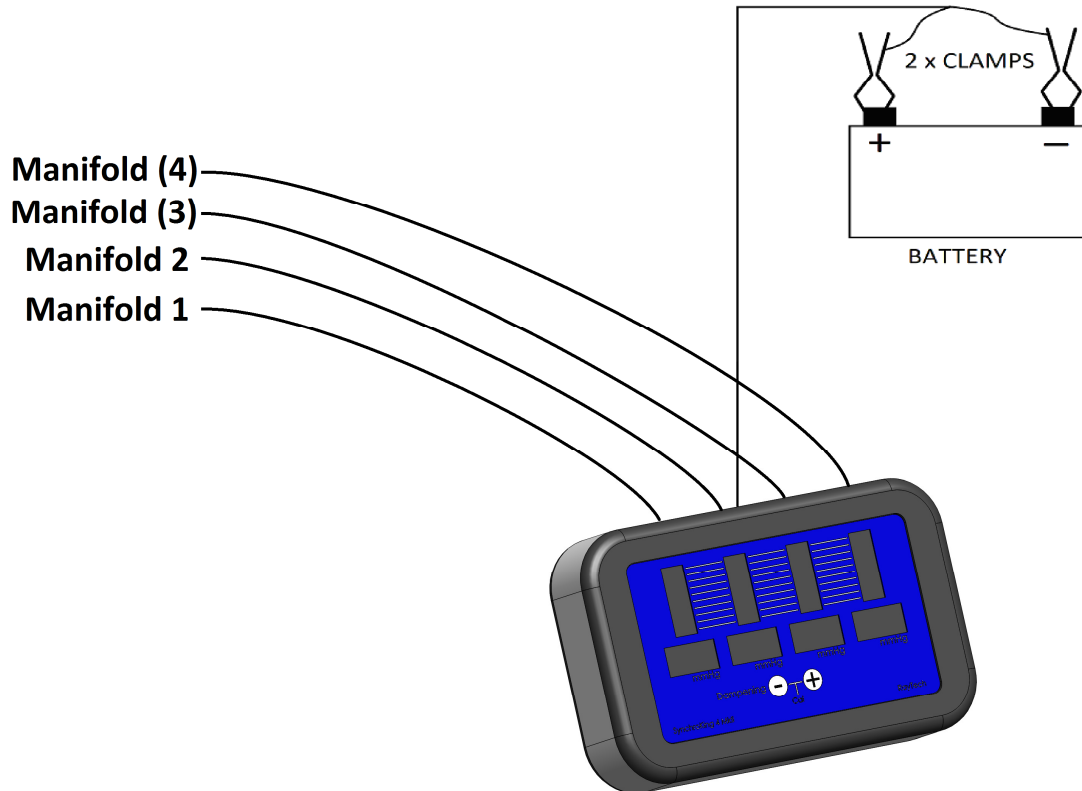


Figure 2 - Connection Diagram

## Function description

### Vacuum measurement

The SynchroKing 4S Mk2® displays the vacuum of each individual channel in mmHg with a resolution of 2mmHg. Values under 20mmHg are suppressed and the device will display ' - - - ' for any suppressed channels. If the channel is suppressed then it will be excluded from the calculation of the average value of all active channels.

### Vacuum differential

The SynchroKing 4S Mk2® calculates the average value of all active channels and compares the individual value of each channel to this average. The deviation from average is displayed on the bar graph of the channel. Each bar represents 20 mmHg vacuum differential, whereas the two middle being lit indicate a pressure differential of less than 20mmHg (i.e the vacuum being practically the same in both manifolds). See Figure 3 for examples.

### Dampening

The SynchroKing 4S Mk2® is equipped with a dampening function to produce a meaningful and readable display of the vacuum level. The vacuum in the inlet manifold of a running engine will fluctuate which will result in a rapidly updating readout which makes it virtually impossible to read the vacuum level. (Equivalent to a rapidly bouncing needle on a conventional gauge).

To overcome this, the dampening function will store the average value of many measurements into the device memory and produce a display value based on these, resulting in a more stable readout (equivalent to a choke valve on a conventional gauge). The dampening factor is

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selectable in 100 increments. A higher dampening factor will result in a more stable display but reduced sensitivity and vice versa. The user should set the dampening factor such that a satisfactory balance is struck between readability and sensitivity.

At startup the device will be set at the default dampening factor of 30.

The dampening factor can be adjusted in increments of 1 by pressing the '+' or '-' button momentarily. The dampening factor can be increased or decreased in increments of 10 by pressing and holding the '+' or '-' button respectively.

Once one of the buttons is pressed, the device will display 'dp' in the No.2 display and the current dampening level in the No.3 display. After setting the desired dampening level and releasing the button, the device will revert to normal operation after 1 second.

### **Calibration**

At startup the SynchroKing 4S Mk2® will perform an automatic calibration, during which the output signal of each sensor unit is baselined at zero. (Note that values below 20 are suppressed thus not showing on the display). This function ensures that each of the four sensors are referencing the same start value.

The device is also equipped with a manual calibration option. In normal operation it is not necessary to execute a manual calibration. Only in the event that the previous (auto) calibration was not successful, manual calibration is needed. Incorrect calibration occurs for instance when the pressure on one or more channels was not atmospheric at the calibration.

The manual calibration function is provided in order not to initiate a reset of the dampening level as is the case with turning the device off and on.

To execute a manual calibration, press both the '+' and '-' buttons at the same time. The No.2 display will show 'CAL'. The No.3 display will show a count down by adding a '-' to the display every one second. Calibration is complete when the No.3 display goes blank. Releasing either button before the cycle is complete will abort the calibration.

*Ensure that at the time of calibration, all channels are at atmospheric pressure. Vacuum or pressure being present at the time of calibration will result in incorrect measurements. It is suggested to turn the engine off and have the throttle wide open when calibrating.*

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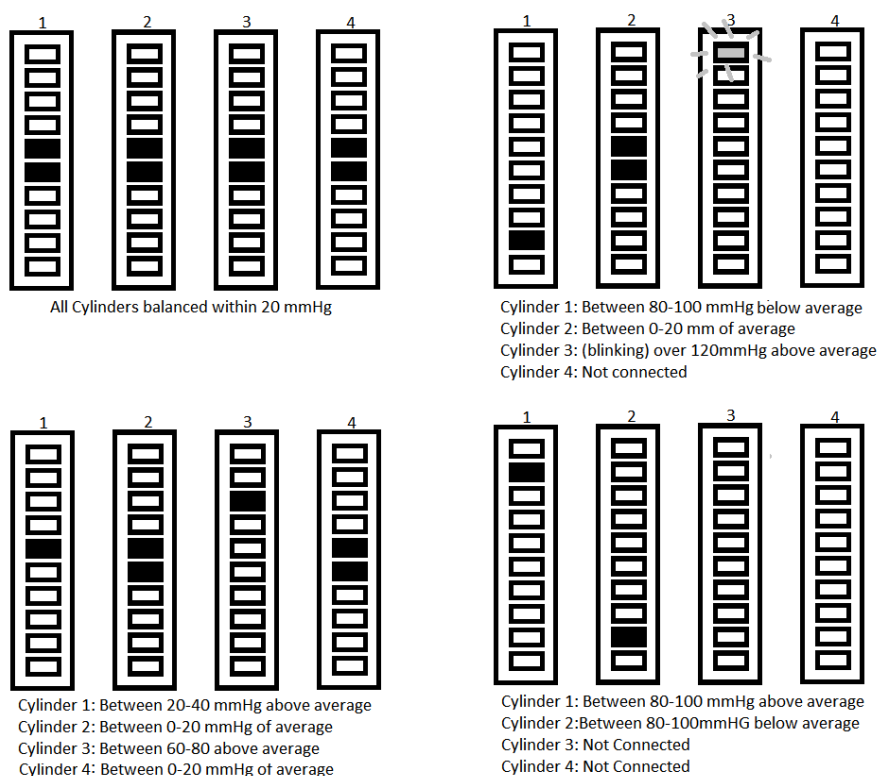
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### Operation

The following paragraphs describe the generic synchronization procedure which will be applicable to most vehicles. The user should read these in conjunction with the vehicle's service manual. Some manufacturers specify specific vacuum levels.

1. Find the test port plugs in the inlet manifold test ports and remove them.
2. Select the correct size of nipple (either M5 or M6) and install them into the manifold's test ports. Apply 'snub tight' torque only, enough to compress the O-rings. Some vehicles are fitted with vacuum test port that accept the 5mm hose to be connected directly; if this is the case the nipples are unnecessary.
3. Push the hoses onto nipples, take note which manifold connects to which port on the SynchroKing 4S Mk2®
4. Connect the alligator clamps to the vehicle's battery. The device will now come on-line and execute to automatic calibration. - CAUTION: Observe correct polarity and take care not to cause a short circuit.
5. The display should now light up and indicate "- - -" on all displays.
6. Start the vehicle and allow the engine to warm up to normal operating temperature.
7. With the throttle fully closed, adjust, as necessary, the stationary adjuster screw on the carburettor or throttle valve body, until the bar displays equal vacuum in both inlet manifolds. (See Figure 3).
8. The dampening factor may be used to reduce the 'bounce' on the display that the engine may produce. Bear in mind that increasing dampening will reduce bounce but reduces sensitivity and vice versa. *Most engines will not achieve a perfect and stable readout, the user should aim for the best practically achievable setting.*
9. After the idle balancing has been completed, proceed by slowly opening the throttle and allow the engine speed to increase to roughly 1/3 of maximum RPM. Repeat the procedure above for idling only using the balancing adjuster screw(s) - refer to the manual.
10. Re-check and re-adjust the idle and balancing screws as required and stop the engine.
11. Remove the hoses.
12. Allow the nipples to cool of and remove them from the manifolds.
13. Reinstall the test port plugs (do not forget any seals or gaskets, observe the instructions in the workshop manual).

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**Figure 3 - Examples of Bar Display indications**

### Specification

Dimensions	160 x 120 x 32	mm
Nipple M5 dimensions	M5, d_barb=6, L=25	mm
Nipple M6 dimensions	M6, d_barb=6, L=25	mm
Supply Voltage Max	15	V
Supply Voltage Min	6	V
Current draw, typical	30	mA
Current draw, max	60	mA
Operating Temp, Max	50	deg C
Operating Temp, Min	-5	deg C
Measurement resolution	2	mmHg
Measurement range	0 - 400	mmHg
Typical maximum deviation between channels at 200mmHg	<2mm	mmHg

#### Limited Warranty-

The SynchroKing 4S Mk2® comes with a limited 1-year warranty for the original purchaser. RayTech will repair, replace or refund any unit found to have defects in material workmanship during this period. Any warranty claims must be submitted to raytechcontact@yahoo.com. Opening of the device will void the Warranty.

The customer is liable for return shipping. RayTech will pay for shipping back to the customer, only if the device has been determined to be defective by RayTech.

RayTech does not guarantee the fitness of its products for any purpose other than described in this manual. RayTech shall not be liable for any loss from use of the product or accidental or consequential damages.