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Installing and Operating the CSC-1/G Constant Speed Controller

Smart Avionics Ltd.

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Smart Avionics Limited reserves the right to change or improve its products at any time without obligation to upgrade or modify existing products.

Unless indicated otherwise, the contents of this document applies to any revision of the product's software.

The CSC-1 software revision number format has changed from X.Y to X. The last old-style revision was 1.163 and the first new-style revision is 455. The revision numbers always increase in value but are not necessarily consecutive.

Document Revision History

Revision	Date	Author	Remarks
683	June 2009	MB	Added takeoff mode.
638	July 2008	MB	Added FF Time and FUF Time.
619	July 2008	MB	Added Current Show and CurSense mOhms.
607	June 2008	MB	Updated description of Sampling Time parameter.
580	January 2008	MB	Various additions/changes.
547	February 2007	MB	Updated PWM parameters.
510	January 2007	MB	Fixed feather input pin error.
500	November 2006	MB	Now covers feathering Woodcomp SR3000.
476	October 2006	MB	Jabiru %power display + minor changes.
1.13	May 2006	MB	Added Woodcomp SR3000 Appendix.
1.12	January 2006	MB	Additions for ignition lead tacho pickup, fuel injected engines and PWM parameters. Updated MAP parameters.
1.10	June 2005	MB	Added Current Min and Inactive Time parameters. Added Jabiru Appendix.
1.9	February 2005	MB	Minor update to Idle Diff parameter section
1.8	August 2004	MB	Minor updates
1.7	March 2004	MB	Various updates
1.6	October 2003	MB	Both PV50 and generic variants now documented
1.5	June 2003	MB	Now describes effect of altitude on power display
1.4	May 2003	MB	Parameter additions & installation clarifications
1.3	February 2003	MB	MAP parameter changes & general fixes
1.2	January 2003	MB	First public revision
1.1	November 2002	MB	Initial draft

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Chapter 1

Introduction

This document describes how to install and use the Smart Avionics CSC-1/G constant speed controller. The CSC-1/G is a generic product designed to work with electrically operated variable pitch propellers typically fitted to homebuilt aircraft. The CSC-1/G will work with propellers fitted with limit switches and also propellers that rely on the controller detecting the current increase that occurs when a mechanical limit is reached.

The CSC-1/G is particularly suitable for use with a Rotax 912, 912S or 914 engine but it may also be used with other engine types as long as a suitable tachometer signal is available.

As the CSC-1/G continuously displays engine RPM, it may either replace, or work alongside, an existing tachometer.

Important

The CSC-1/G is intended to be installed only in homebuilt or experimental category aircraft. Use in any other category aircraft is not approved by Smart Avionics.

For safe and reliable operation and to ensure that you get the maximum benefit from the CSC-1/G, it is important that you understand and comply with the installation and operating instructions contained in this document.

1.1 Controller Capabilities

The controller provides the following capabilities:

Multi-mode constant speed controller
: Operates as an intelligent propeller pitch control system that maximises aircraft performance and reduces pilot workload.

Tachometer
: Displays engine revolutions to the nearest 10 RPM.

Manifold pressure display
: When combined with an external manifold pressure sensor[1], the CSC-1/G displays manifold pressure as either inches of mercury (”Hg) or as an approximate percentage engine power.[2]

Engine hours meter
: When the engine is not running, the controller displays total tachometer time.

Highly configurable
: Many of the controller’s operational parameters can be adjusted from a simple to use ‘setup mode’.

1.2 Overview of Operation

Electric variable pitch propellers have been around for a long time but it is only fairly recently that they have become popular with homebuilt aircraft constructors. As the engines fitted to most homebuilt aircraft are relatively small, using a variable pitch propeller can radically improve the aircraft’s takeoff performance. The best results are obtained when the variable

[1] Such as the Smart Avionics MPS-1. Unless indicated otherwise, the remainder of this document assumes that a manifold pressure sensor is fitted.

[2] Currently, the approximate percentage engine power display is only available when using a Rotax 4-stroke, Jabiru or fuel injected engine.

pitch propeller is used in conjunction with a constant speed controller.

A constant speed controller ensures that, for a given throttle setting, the engine RPM is constant irrespective of the aircraft's airspeed. This is achieved by altering the pitch of the propeller. If the RPM is less than the desired value (the target RPM), the propeller pitch is reduced and this will cause the RPM to increase. Conversely, if the RPM is greater than the target RPM, the propeller pitch will be increased and this will cause the RPM to reduce. In practice, the controller allows the RPM to vary slightly from the target RPM before making an adjustment to avoid continuously making very small propeller pitch changes. This variation is specified as a 'dead band' around the target RPM. So, if the target RPM is, say, 5300 and the dead band is 100 RPM, the pitch will be reduced if the measured RPM falls below 5200 and the pitch will be increased if the RPM is 5400 or greater.

The main benefit of using a constant speed controller is obtained at takeoff. At takeoff, the propeller pitch will be controlled such that the engine will deliver maximum power without exceeding the maximum allowed engine RPM. By contrast, if the aircraft is fitted with a variable pitch propeller alone, the pilot has to adjust the propeller pitch manually during takeoff to avoid reaching the 'red line'. As the pilot is also flying the aircraft and keeping an exemplary lookout, the actual propeller pitch used (and, therefore, performance) only approximates the ideal profile. Generally, the pilot will set the propeller pitch somewhat coarser than optimal to ensure that the engine does not exceed the maximum allowed RPM.

Using a constant speed controller, therefore, provides a dual benefit – it not only maximises the takeoff power by ensuring that the RPM is maintained just below the red line but it also reduces pilot workload during one of the most important phases of flight.

1.3 Controller Display and Switches

The CSC-1/G has been designed to be very simple to use; in flight, the pilot only has to operate one push button and one toggle switch. Figure 1.1 shows the Pilot's view of the CSC-1/G.

Figure 1.1: Pilot's View of the Controller

The pilot's view of the controller consists of:

LCD display

This continuously displays (clockwise from top left):

Actual engine RPM

The RPM value is rounded to the nearest 10.

Operating mode

The current operating mode is displayed (`OFF`, `MAN`, `CRS`, `CLM` or `TKO`).

Propeller pitch limit indicator

When the propeller pitch becomes fully fine, `--` is displayed below the last two characters of the operating mode. When the pitch becomes fully coarse, `++` is displayed. At other times, the pitch limit indicator is blank.

Propeller pitch change indicator

While the propeller pitch is being increased by the controller, + is displayed below the first character of the operating mode. While the pitch is being decreased, - is displayed. If in cruise mode and the throttle has been closed, T is displayed.

Manifold pressure / engine power level

The Manifold Absolute Pressure (MAP) may be displayed either as a pressure (in inches of mercury) or as an approximate percentage power (suffixed with a % character)[3].

When takeoff, climb or cruise modes are selected, or whenever the target RPM is being adjusted, the target RPM is displayed for a short time in place of the manifold pressure.

RPM! indicator

This is a warning indicator to alert the pilot to consider the RPM. The indicator may light up either red or yellow as follows:

Continuous red

This indicates that the RPM has reached the 'red line' (maximum allowed RPM).

Continuous yellow

This indicates that the RPM has reached the 'yellow line' (maximum continuous RPM).

Continuous yellow with red flashes

If the RPM is maintained above the maximum continuous RPM for more than 4 minutes[4], the indicator flashes red to alert the pilot to the need to reduce the RPM.

Flashing red

This indicates that the RPM has fallen below 4000[5] and that cruise mode is still selected. The idea here is

[3]For some installations, an estimated fuel flow can be displayed here instead of percentage power.

[4]Time period configurable.

[5]RPM configurable.

to alert the pilot of the need to select another mode (takeoff, climb or even manual) as it is likely that the throttle has been closed for descent.

OK/DISABLE switch

Enables/disables the automatic control functionality. In the DISABLE position, the computer is completely disconnected and the +/− switch can be used to change the propeller pitch manually. In normal operation, the OK/DISABLE switch can always be left in the OK position.

+/− switch

Depending on the mode of the controller, this switch either directly controls the propeller pitch or adjusts the target RPM. Pushing the switch up reduces the propeller pitch (increases RPM) and pushing the switch down increases the propeller pitch (decreases RPM).

MODE button

Pressing the MODE button changes the controller's mode of operation (assuming the OK/DISABLE switch is in the OK position).

Pitch motor active indicator (optional)

An optional panel mounted indicator can be installed that illuminates when the propeller pitch motor is active and has not reached a limit stop.

External switches (optional)

If required, external switches can be connected to duplicate the MODE button and +/− switch.

When power is applied to the controller, it flashes the RPM! indicator and briefly displays a banner and the software revision number. The total engine hours run is then displayed until either the MODE button or the +/− switch is pressed or the engine is started.

1.4 Controller Modes

The following modes of operation are provided:

1.4.1 Disabled mode

The controller is in disabled mode when the OK/DISABLE switch is in the DISABLE position. Propeller pitch control is via the +/– switch. All automatic control is disabled and the mode display will show `OFF`. The current RPM, propeller pitch and manifold pressure will continue to be updated on the display.

1.4.2 Manual mode

Propeller pitch control is manually adjusted using the +/– switch. Automatic RPM limiting is enabled. This means that if the RPM reaches the preset limit RPM, the pitch will be automatically coarsened to avoid exceeding the engine's maximum allowed RPM. The mode display will show `MAN` when the controller is in manual mode.

When power is applied to the controller, it always starts in manual mode (assuming the OK/DISABLE switch is in the OK position). It is not possible to change to another mode until the engine is started. Once the engine is running, if the MODE button is pressed briefly, the mode changes to cruise. If the MODE button is pressed for at least 1/2 a second but less than 1 second, the mode changes to climb and if the MODE button is pressed for at least 1 second the mode changes to takeoff.

1.4.3 Cruise mode

The controller endeavours to keep the RPM within a 'dead band' around the target RPM by adjusting the propeller pitch. The default value of the cruise mode target RPM is 5000. The target RPM may be adjusted in steps of 50 RPM using the +/–

switch[6]. On leaving cruise mode, the current target RPM is remembered and when, subsequently, cruise mode is entered again, that RPM value is reinstated. The mode display will show `CRS` when the controller is in cruise mode.

Pressing the MODE button briefly, reverts the mode to manual. Pressing the MODE button for more than 1/2 a second but less than 1 second selects climb mode and pressing the MODE button for at least 1 second selects takeoff mode.

If the RPM is less than half of the target RPM, the constant speed function is inhibited.

1.4.4 Climb mode

Similar to cruise mode, except that on entering climb mode, the target RPM is set to the preset 'Climb RPM' and the mode display will show `CLM`. The target RPM may be adjusted in steps of 50 RPM using the +/− switch[7] but, unlike cruise mode, the current target RPM value is not remembered when climb mode is exited. This means that the next time climb mode is entered, the target RPM will again be set to the preset climb mode target RPM value (which can be altered using setup mode). The preset target RPM value is always used when climb mode is entered to reduce pilot workload by removing the need for the pilot to check (and possibly adjust) the target RPM.

Pushing the MODE button for more than 1/2 a second and less than 1 second always selects climb mode (assuming the controller is not disabled using the OK/DISABLE switch) and pressing the MODE button for at least 1 second selects takeoff mode. Pushing the MODE button briefly while in climb mode, reverts the controller to cruise mode.

If the RPM is less than half of the target RPM, the constant speed function is inhibited.

[6] Software versions 1.155 onwards constrain the cruise mode target RPM to be no less than the value of the **Low RPM** parameter and no more than the value of the **Limit RPM** parameter.

[7] Software versions 1.155 onwards constrain the climb mode target RPM to be no less than the cruise mode target RPM and no more than the value of the **Limit RPM** parameter.

1.4.5 Takeoff mode

Identical behaviour to climb mode, except that on entering takeoff mode, the target RPM is set to the preset 'TKO RPM' and the mode display will show TKO.

Pushing the MODE button for more than 1 second always selects takeoff mode (assuming the controller is not disabled using the OK/DISABLE switch). Pushing the MODE button briefly while in takeoff mode, reverts the controller to climb mode.

Note

If the takeoff mode target RPM is (erroneously) configured to be less than or equal to the climb mode target RPM, the controller will select climb mode in preference to takeoff mode to ensure that the higher target RPM is used.

If the RPM is less than half of the target RPM, the constant speed function is inhibited.

The following table summarises how to change between the modes using the MODE button.

Table 1.1: Mode Change Procedure Summary

From	To Manual	To Cruise	To Climb	To Takeoff
Manual		Briefly × 1	> 1/2 a second	> 1 second
Cruise	Briefly × 1		> 1/2 a second	> 1 second
Climb	Briefly × 2	Briefly × 1		> 1 second
Takeoff	Briefly × 3	Briefly × 2	Briefly × 1	

1.5 Engine Power Display

For some engine types, the CSC-1/G can display the engine power level as a percentage of the maximum achievable power. Alternatively, if the engine is fuel injected or a MPS-1D differential MAP sensor is being used, the power level can be displayed as an estimated fuel flow.

1.5.1 Rotax 4-stroke engine power display

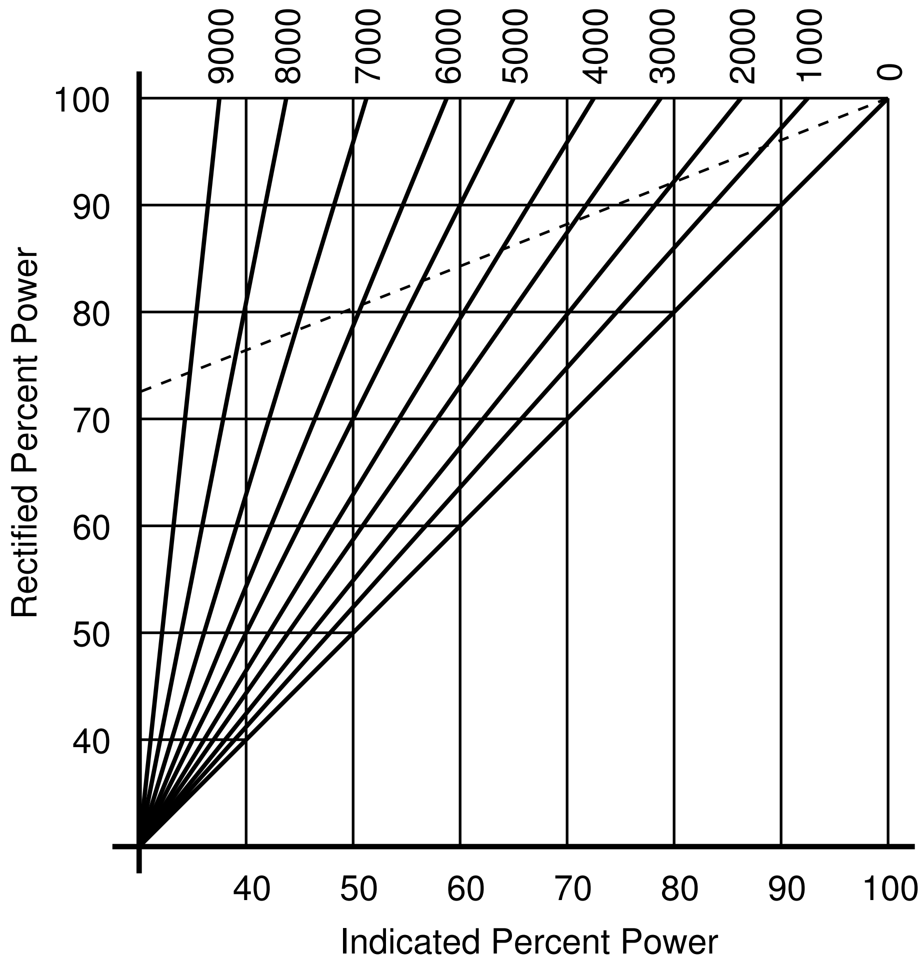
The displayed values are calculated from the current manifold pressure and RPM. The relationship between RPM, manifold pressure and engine power level is complex and so the controller derives the power level from the measured values using a set of profiles that approximate the real relationship. To account for the different characteristics of the Rotax 912, 912S and 914 engines, a different set of power level profiles is required for each engine and the correct engine type must be selected for the results to be valid (default is 912).

Although the percentage power values displayed are consistent inasmuch that the same value is always shown for a given combination of RPM and manifold pressure, it should be remembered that the displayed values are only an approximation to the actual engine power level.

In particular, for non-turbo engines (912 and 912S), as altitude is gained, the power display progressively undereads when using a manifold pressure sensor that measures absolute pressure. The amount the display undereads is dependent on both the altitude (relative to the 1013mB level) and the throttle setting. For low power settings (around 40%) the display undereads by approximately 1 per 1000 feet of altitude. At high power settings (around 80%) the display undereads by approximately 5 per 1000 feet. For power settings between 40% and 80% the deficit scales linearly between 1 and 5. For example, when flying with a high power setting at FL30 (3000' above the 1013mB level), the power display will be undereading by $3 \times 5 = 15$.

Figure 1.2 on the next page can be used to quickly determine the 'rectified percent power' from an 'indicated percent power' and altitude (relative to 1013mB). Simply follow the indicated power up to the appropriate altitude line and read the rectified percent power on the left. The sloping dashed line indicates the maximum possible power achievable for each altitude.

Figure 1.2: Power Display Altitude Correction for 912/912S



When using the MPS-1/D differential pressure sensor, the percentage power display is not affected to any great extent by the altitude.

1.5.2 Jabiru engine power display

The displayed values are calculated from the current manifold pressure and RPM. One profile (called Jab) is currently available and this is based on data for the 3300 engine. It is likely that the profile will also give reasonable results with the smaller 2200 engine.

Although the percentage power values displayed are consistent inasmuch that the same value is always shown for a given combination of RPM and manifold pressure, it should be remembered that the displayed values are only an approximation to the actual engine power level. In particular, as altitude is gained, the power display progressively undereads.

1.5.3 Fuel injected engine power display

The displayed values are calculated from the current RPM and fuel injector pulse width. For the CSC-1/G to be able to do this, its tachometer input must be connected to one of the fuel injector drive signals and a configuration parameter (**WOT Inj Time**) must be set to the correct value for your engine.

1.6 Safety Features

The CSC-1/G's hardware and software has been carefully designed to provide reliable and safe operation. Safety related features of the design are:

- A front panel switch that completely isolates the computer control from the pitch motor drive circuitry. In the unlikely event of a hardware or software failure, the computer control can be disabled and manual control used instead.
- Software is designed to reduce pilot workload to a minimum.
- Utilises a single-chip microcontroller that is specifically designed for embedded control applications. By using a single-chip solution, the controller is more reliable and less likely to either produce or be affected by electrical noise.
- On powering up, the microcontroller verifies the integrity of its program memory to ensure that it has not become corrupted.
- A built in 'watchdog timer' resets the microcontroller to a safe known state within a fraction of a second if the software fails to operate correctly.
- The CSC-1/G's software can easily be upgraded should a safety critical problem be identified or the product is significantly enhanced.

1.7 Product Support

Product support information (including the latest version of this document) is available from the Smart Avionics web site, www.smartavionics.com.

If you have a problem installing or operating the CSC-1/G that is not covered by this document, please send email to support@smartavionics.com.

Smart Avionics is committed to providing high quality, good value products. To that end, we would very much like to receive your feedback. If you have any comments or suggestions for product improvements please send them to us at the above email address.

Chapter 2

Installation & Setup

This chapter describes how the controller should be installed in your aircraft and how to set up the controller to match your particular propeller. The installation is not difficult and should not present any problems as long as the recommendations below are observed.

For details of the installation of the propeller and the associated wiring, please refer to the documentation supplied with the propeller.

Please read all of this chapter before proceeding.

2.1 Mechanical Considerations

The controller is designed to fit in a standard 57mm instrument panel cutout. Four M4 screws (supplied) attach the controller's enclosure to the instrument panel. No other support is required.

The length of the M4 screws should not be greater than 10mm + the thickness of the instrument panel.

2.2 Environmental Considerations

The controller is robust but should be protected against excessive vibration.

In use, the controller enclosure will become warm if the propeller pitch motor requires a large amount of current to operate and the pitch motor is activated very frequently. For propellers with high current requirements, the controller should be mounted such that the air flow around its enclosure is unimpeded so that the heat is convected away. Little heat is generated when the propeller pitch motor is not operating.

2.3 Electrical Considerations

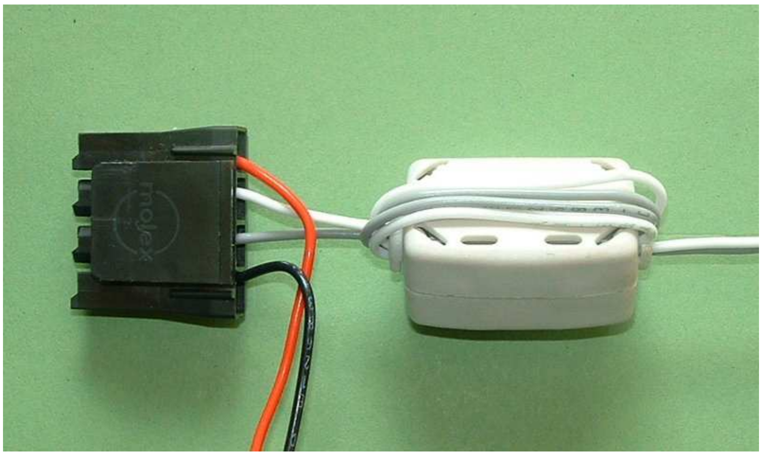
Please refer to Appendix B (*Connections*) for a full list of the controller's external connections and a connection diagram.

To ensure trouble free operation of the controller, it is important that the following points are observed:

1. Preferably, fuses should be used to protect the CSC-1/G and its associated wiring. Alternatively, circuit breakers can be used but they do not provide as good protection as fuses and the voltage drop across them can be twice that of a fuse.

2. The two wires that supply the power to the propeller's pitch motor are connected to pins 2 and 3 (`Pitch Motor A` and `Pitch Motor B`) of the 4 Way connector. The gauge of wire used for both of these connections is determined by the current requirements of the propeller pitch motor. This information could be specified in the documentation supplied with the propeller. If not, use wire no thinner than 18 AWG. To suppress high frequency electrical noise, these wires should be passed through a ferrite ring or tube located as near to the controller as possible. Ideally, the wires should make two complete turns through the centre of the ferrite as shown in Figure 2.1 on the facing page.

Figure 2.1: Ferrite Installation



The controller switches `Pitch Motor A` (pin 2) to +12V and `Pitch Motor B` (pin 3) to ground when it wants to decrease the propeller pitch and, conversely, it switches `Pitch Motor B` (pin 3) to +12V and `Pitch Motor A` (pin 2) to ground when it wants to increase the pitch. If the pitch motor operates in the wrong sense, you need to swap over these connections!

If the propeller is fitted with limit switches, it is most important to follow the propeller manufacturer's installation instructions to ensure that the drive current is interrupted when the pitch limits are reached.

3. The pitch motor ground (pin 1 of the 4 Way connector) must be connected to a good ground connection and the pitch motor power supply (pin 4 of the 4 Way connector) must be connected to +12V via a fuse of not more than 15A rating. The best protection is provided by a quick blow (F type) fuse. Use similar gauge wire as used for the pitch motor outputs (at least 18 AWG).

Important

> The pitch motor outputs are not short-circuit protected so it is vital that the pitch motor power supply is fitted with a suitable fuse or circuit breaker to avoid damaging the CSC-1/G in the event of the outputs being shorted together or to ground.

4. The controller's logic ground connection (pin 14 of the D-type connector) must be connected to a high quality ground using wire no thinner than 20 AWG. If the instrument panel is fitted with a ground bus-bar or common ground connection, that would be a suitable ground.

5. The controller's logic power supply (pin 8 of the D-type connector) should be connected to +12V via a fuse. As the amount of current drawn from this supply by the controller is quite small (< 100 mA), the fuse rating (and the wire gauge) is not critical. A fuse of 1A to 3A would be adequate as the fuse is really there to protect the wiring.

   The controller's logic and pitch motor power supplies can be combined and connected to +12V via a single fuse. The advantage of doing this is simply that only one fuse is required. The disadvantage is that, if the fuse failed, the controller will not function at all.

6. **Rotax engine**

   The tachometer input (pin 4 of the D-type connector) should be connected to one side of the Rotax tachometer pickup. The other side of the tachometer pickup is connected to ground. If you wish to use an additional tachometer instrument (for example, the Rotax analogue unit), simply connect the tachometer pickup signal to both units. If you find that connecting an additional tachometer stops the controller from measuring RPM, it is most likely that the additional tachometer is loading the signal excessively. To compensate for this, you will need to adjust the controller's tachometer sensitivity as described in Section 2.5.3 on page 26. Connecting a Rotax analogue tachometer does not require the sensitivity to be adjusted.

   Non-Rotax engine

   The tachometer input (pin 4 of the D-type connector) should be connected to a suitable signal that provides one or more pulses per revolution of the engine. Please consult the documentation provided by the engine manufacturer to determine the correct signal to use. If your engine is fuel injected, one of the fuel injector drive signals can be used and this will allow the

CSC-1/G to calculate percentage power.

If a suitable signal is not available, you can generate a tachometer signal by wrapping a few (3-6) turns of insulated solid core copper wire around an ignition lead and then connecting one end to the CSC-1/G's tachometer input. In this case, it is likely that the **Tacho Div** parameter will need to be set to 0 to multiply the RPM by 2.

Important

Do not connect the tachometer input directly to any high voltage signal (such as an ignition lead!)

By default, the controller's tachometer sensitivity is set for use with a Rotax tacho signal. You will almost certainly need to change the sensitivity (as described in Section 2.5.3 on page 26) to obtain correct operation. For 12V tachometer signals, set the tachometer sensitivity value to 55.

If the signal pulses more than once per revolution of the engine, the **Tacho Div** parameter must be set to the appropriate divisor value to ensure the RPM measurement is correct.

7. If external switches are to be connected to the `Pitch -`, `Pitch +` or `Mode` inputs (pins 11, 12 and 13 respectively of the D-type connector), these must be good quality, normally open switches that connect the respective input to ground when pressed. To stop the controller being affected by electrical noise it is important that shielded cable is used to connect the switches (the shield being connected to ground).

8. **MAP sensor fitted**

   The manifold pressure sensor output should be connected to `MAP Sensor In` (pin 10 of the D-type connector). Power for the MAP sensor can be taken from `Auxiliary Supply Out` (pin 3). For your convenience, pin 9 (`MAP Sensor Ground`) is internally connected to ground and can be used as the ground for the MAP sensor.

   For software revisions 1.157 onwards, the **MAP Type** parameter must be set appropriately to match the type of MAP sensor fitted. For software revisions 1.143 onwards, the **Have Map** parameter must be set to 1 to enable the MAP display.

No MAP sensor fitted

For software revisions 1.157 onwards, the **MAP Type** parameter must be set to `None` to disable the MAP display. For software revisions 1.143 onwards, the **Have Map** parameter must be set to 0 to disable the MAP display. For software revisions before 1.143, `MAP Sensor In` must be connected to `MAP Sensor Ground` (pin 9 to pin 10) to disable the MAP display.

9. If a pitch motor active indicator is to be fitted, it must be wired between +12V and the `Pitch Changing` connection (pin 15) of the D-type connector. The indicator should not consume more than 250mA. If you use a LED indicator, make sure that either the indicator is rated for 12V operation or that an external resistor is wired in series to limit the current (typically, a value between 470 and 1000 ohms is suitable). To protect the wiring and the controller, it is recommended that the positive side of the indicator should be connected to either +12V via a quick blow fuse of not more than 1A rating or directly to the `Auxiliary Supply Out` (pin 3).

10. Pin 3 of the D-type connector (`Auxiliary Supply Out`) provides an auxiliary power output that can be used to supply +12V for both the pitch motor active indicator and the manifold pressure sensor. This output is internally connected to the logic power supply (pin 8) via a protection device that limits the current that it can supply to less than 250mA.

11. If the D-type plug used is of the solder type (as supplied), make sure that the soldered connections are of good quality and that the individual connections are sleeved (heat-shrink sleeving supplied).

12. A D-type connector shell (supplied) must be used to provide mechanical protection and cable strain relief. Furthermore, it is important that the screws that hold the D-Type plug

in its socket are tightened. This will ensure that the plug is securely attached.

2.4 Installation Approval

Before the aircraft can be flown with the CSC-1/G installed, the installation has to be approved. Exactly how this is achieved differs from country to country.

In the UK, the installation must be inspected and approved by your LAA inspector, entries made in the airframe, engine and propeller log books and a new Flight Release Certificate issued before the aircraft is flown with the CSC-1/G installed.

Appendix C (*LAA Inspection Checklist*) lists the items the inspector should check before approving your installation.

If yours is the first installation of a particular combination of propeller type, engine type , aircraft type and controller, the LAA may require you to carry out an initial evaluation to ensure the controller works satisfactorily before approving the usage of the controller in that aircraft. If problems arise, please contact Smart Avionics.

2.5 Controller Setup

Important

Once the controller has been satisfactorily installed in the aircraft, the controller parameters must be checked and, if necessary, adjusted to the correct values before the aircraft is flown. See Section 3.1 on page 29 for directions on how to set controller parameters.

- The default values for the various RPM parameters are suitable for Rotax engines and must be changed if you are using another type of engine.
- The current sensing parameters must be adjusted to be suitable for the propeller you are using.
- If you have fitted a MAP sensor and you wish to display percentage engine power, you will need to select the correct engine type.

The following sections provide detailed information on specific aspects of controller setup

2.5.1 Current limit adjustment

The pitch motor current limits must be set to an appropriate value for the propeller you are using. The CSC-1/G monitors the current supplied to the pitch motor and if the current exceeds preset limits, the current is switched off. This capability is absolutely essential for propellers that rely on 'stall current sensing' to determine when they have reached the end of their travel.

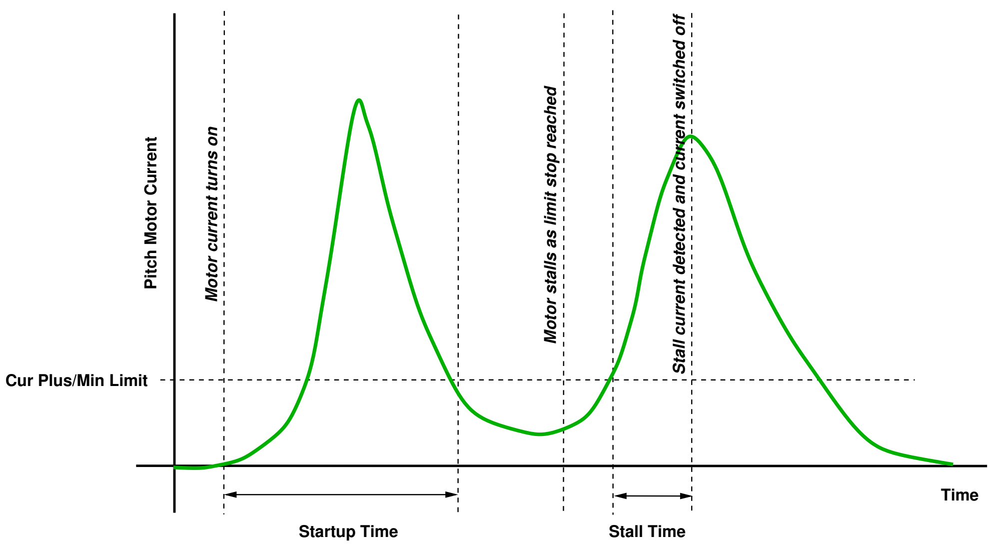
For propellers that have limit switches that interrupt the current when the mechanical limit is reached, the values of these parameters are not critical. They simply need to be high enough to allow normal operation of the propeller at all engine power levels.

The propeller manufacturer should be able to provide you with the necessary information regarding the pitch change motor's current requirements. If you don't have that information, the current limits can still be set correctly but it will require a little bit of trial and error to find the optimum values.

To minimise the stress on the propeller motor and the controller, the controller uses a sophisticated algorithm to detect the stall current as quickly as possible. Figure 2.2 shows how the pitch motor current varies when power is applied to the pitch motor and, subsequently, the pitch motor stalls on reaching a limit. The figure also shows the relationship between the motor current and the relevant controller parameters. Looking at this curve from left to right (time increasing) you can see the following:

1. Initially, the motor takes a large amount of current when accelerating from stationary.
2. Once the pitch motor has accelerated, the current then reduces to a fairly constant value that is dependant on the loading on the pitch change motor.
3. When the propeller reaches either the coarse or fine limit stops, the motor stalls and so the current rises to the 'stall current' value.
4. When the controller has determined that the motor has stalled, it switches off the current.

Figure 2.2: Pitch Motor Stall Current Sensing



The parameters that characterise the controller's current limit behaviour are:

Startup Time

This is the amount of time (in mS) that must elapse after the pitch motor current is turned on before the direction specific current limits (**CurLimit +** and **CurLimit –**) are enabled. When power is applied to a stationary pitch motor, the initial current surge is quite large. This parameter tells the controller how long to wait before assuming that the initial current surge has diminished. The default value is 300mS (just under 1/3 second) which should be suitable for most propellers.

Ideally, this parameter should be small to minimise the time taken to detect the stall current in the situation where the propeller has already reached a limit and the current is re-applied to drive the propeller in the same direction. However, if the **Startup Time** value is too small, the big initial current surge will not be ignored and this will cause the stall current sensing to trigger erroneously. The optimal value can only be found after the direction specific parameters (described next) have been determined. Once that has been done, the value of **Startup Time** can be progressively reduced until the controller starts detecting the fine and coarse limits immediately the current is applied to the pitch change motor and then the value is increased by 50 or 100 mS to provide some margin.

CurLimit + (CurLimit –)

This is the maximum amount of current (in units of 100 mA) that the controller will supply to the pitch change motor when increasing (decreasing) the propeller pitch. If this current is exceeded for a period greater than or equal to **Stall Time**, the current is turned off and the controller assumes that the coarse (fine) pitch limit stop has been reached.

The default value for **CurLimit +** and **CurLimit –** is 100 which equals 10A. If you find that the current limit trips before the propeller reaches the mechanical limit, you must increase the value of the appropriate parameter. Conversely, if these parameters are set to too high a value then the pitch change motor will be subject to increased mechanical and electrical stress when it stalls and its life may be shortened.

Commonly, increasing the propeller pitch takes more current than reducing the pitch and that is why two parameters are specified rather than one. You may be able to reduce the value of either or both of these parameters without the controller spuriously indicating that a limit has been reached. It should be noted that the current required to drive the pitch motor varies with the engine power setting. Generally, as engine power is increased, the current required to change pitch increases. For this reason, when adjusting the current limits, the new parameter value must be tested at a high engine power level to determine if it is correct.

Stall Time

This is the maximum amount of time (in mS) that the output current can be greater than **CurLimit +** (**CurLimit –**), while increasing (decreasing) the propeller pitch before the current is switched off. The default value is 100 which should be suitable for all propellers.

Important

Please note that when the controller is in disabled mode, the stall current sensing is also disabled. This means that when a limit is reached due to the pilot operating the +/– switch, the current will not be automatically switched off and the pitch activity indicator will stay illuminated. So to avoid overheating the pitch change motor, do not operate the +/– switch for extended periods when the controller is in disabled mode.

2.5.2 Throttle closed sensing

If a MAP sensor is fitted, the CSC-1/G can detect when the throttle has been closed (or nearly closed) and it will inhibit the propeller pitch change that would otherwise occur in a futile attempt to maintain the target RPM. If this was not done, the propeller pitch would be reduced all the way to the fine limit and then the throttle would have to be opened with care to avoid exceeding the red line RPM. This feature is only active in cruise mode and is most useful when descending from the overhead to circuit height. The pitch indicator displays a `T` when this feature is active.

The throttle has to be reduced quite quickly for the controller to detect the change. Don't slam the throttle shut, but don't take too long either. In practice, when the throttle is closed, the RPM decreases and for a short while the propeller pitch is reduced. However, after a very short delay, the controller detects the throttle closure and inhibits any further pitch reduction. Subsequently, when the throttle is opened again (or climb mode is selected) the propeller pitch changes again.

For this feature to work correctly, the **Idle MAP Diff** parameter must be set to an appropriate value for the type of engine you are using. This parameter specifies the maximum amount the MAP can reduce from the current value before the controller detects that the throttle has been closed. Put another way, if the MAP reduces more than the value of **Idle MAP Diff** then the controller considers the throttle to have been closed and it inhibits the pitch drive. If the value of this parameter is set too low, the pitch change will be inhibited too often, i.e. when the power level is being reduced in the cruise. If, on the other hand, the value of this parameter is too high, the pitch change will not be inhibited even when the throttle is smartly closed.

For Rotax 912, 912S and 914 engines, setting **Idle MAP Diff** to a value of 3.0 works well. By default, this parameter is set to 0.0 which disables the throttle closed sensing.

2.5.3 Tachometer sensitivity adjustment

The tachometer input sensitivity is preset to a value that should be suitable for most installations (Rotax engines). However, if necessary, the sensitivity can be adjusted to cater for tachometer signals that are either smaller than average or suffering from electrical noise. The adjustment is best carried out with the engine running so that the result of the adjustment can immediately be tested. Please observe ground running safety precautions.

The tachometer sensitivity is adjusted as follows:

1. Enter setup mode (see Section 3.1 on page 29 for instructions on how to do this) and cycle through the options (using the MODE button) until the **Tacho Level** option is displayed.

2. To make the tachometer input more sensitive (perhaps because the RPM display is 'dropping out' at low RPM), decrease the value of the **Tacho Level** parameter using the +/− switch.

   Conversely, to make the tachometer input less sensitive (perhaps because the RPM display is being affected by electrical noise), increase the value of the **Tacho Level** parameter using the +/− switch.

   To have much effect, you will probably have to change the parameter value by quite a large amount.

3. Leave setup mode by moving the OK/DISABLE switch to DISABLE and then back to OK again.

4. Check that the RPM display is indicating correctly across the full RPM range and that the displayed value does not vary when the RPM is steady. If necessary, repeat the adjustment process.

Chapter 3

Adjusting Controller Parameters

The controller's behaviour can be modified by altering the values of various parameters. The controller is supplied with sensible default values for these parameters and so it is unlikely that you will need to change many of them.

3.1 Entering Setup Mode

The controller's parameters are changed via a 'setup mode'. To enter setup mode do the following:

1. Ensure the OK/DISABLE switch is in the OK position.
2. Ensure manual mode is selected (`MAN` displayed).
3. If the engine is running, ensure the RPM is less than half of the red line RPM.
4. Hold the +/− switch either up or down and while doing so, press the MODE button and then release both switches.

The controller will now enter setup mode and the screen will display the name of a parameter and its current value.

When the controller is in setup mode, pressing the MODE button will cycle to the next parameter and operating the +/− switch will adjust the displayed parameter value. The parameter value will be either incremented or decremented depending on the direction the +/− switch is operated.

When adjusting a numeric parameter, its value will be continuously adjusted as long as the +/− switch is held up or down (and the parameter has not reached its maximum or minimum allowed value).

If, when entering setup mode, you held the +/− switch down (+), you will cycle forwards through the parameters and if you held that switch up (−) you will cycle backwards through the parameters. While in setup mode, you can change the parameter cycling direction by holding the MODE button and pressing the +/− switch in the desired direction.

To leave setup mode, simply move the OK/DISABLE switch to the DISABLE position and then back to the OK position again.

Unless the power to the controller is removed, it will remember which parameter is currently being adjusted so that, when setup mode is entered again, the same parameter is displayed.

It is not recommended that you use setup mode in flight.

Important

The default values for engine related parameters are suitable for Rotax engines. If you are not using a Rotax engine you will almost certainly need to change these values.

3.2 Parameter Descriptions

TKO RPM

[Revision 683 or later] This is the initial target RPM that is always used when takeoff mode is selected (default 5700). The value should be greater than the value of **CLM RPM**. In takeoff mode, the target RPM may be adjusted using the +/− switch.

CLM RPM

This is the initial target RPM that is always used when climb mode is selected (default 5400). In climb mode, the target RPM may be adjusted using the +/− switch.

If this parameter is set to a value that is less than the stored value of the cruise mode target RPM (default value 5000), the cruise mode target RPM will be reduced to make it the same as the climb mode target RPM[1].

CLM Dead Band

This is the dead band that will be used when climb or takeoff mode is selected. Using too low a value will make the controller ‘nervous’ and it will tend to adjust the propeller pitch too often. Using too high a value will make the controller unresponsive.

If the climb/takeoff mode target RPM is near to the red line RPM (e.g. using a target RPM of, say, 5700 with a red line RPM of 5800), a small dead band will be required to ensure that the RPM is kept below the red line RPM. Using a small dead band will make the controller work a bit harder in the climb but as this phase of flight does not last for a long time it’s unlikely to be a problem.

CRS Dead Band

This is the dead band that will be used when cruise mode is selected. Using too low a value will make the controller ‘nervous’ and it will tend to adjust the propeller pitch too often. Using too high a value will make the controller unresponsive.

Startup Time

CurLimit +

CurLimit –

Stall Time

See Section 2.5.1 on page 22 for detailed information about adjusting these parameters.

Current Min

[Revision 1.154 and later] The minimum current (default 500 mA) that the pitch motor will take when active. If the

[1] The cruise mode target RPM can be altered using the +/− switch while flying in cruise mode.

current is less than this value, the controller considers the pitch motor inactive.

Current Show

[Revision 618 and later] When this parameter is set to 1, the amount of current being delivered to the pitch motor will be displayed (in 100mA units) instead of the mode name. If the current is zero, the mode name is displayed as normal. This facility is intended to be used as a diagnostic aid rather than as a permanently enabled feature.

CurSense mOhms

[Revision 618 and later] This is the value (in milli-ohms) of the current sensing resistor. For CSC-1/G units with serial numbers < 38 this should be set to 10. For units with serial numbers ≥ 38, this should be set to 20.

Inactive Time

[Revision 1.154 and later] If no pitch motor activity is detected for this amount of time (default 200 mS), the controller assumes that the propeller has reached one of the limit stops.

PWMSpeed +

This is the PWM[2] duty cycle (as a percentage) used when increasing the propeller pitch. The lower the PWM duty cycle, the slower the propeller's pitch motor will operate.

PWMSpeed –

This is the PWM duty cycle (as a percentage) used when reducing the propeller pitch. The lower the PWM duty cycle, the slower the propeller's pitch motor will operate.

PWM Accel

This parameter determines whether the PWM speed will be automatically increased during the pitch change operation. It can be set to these values:

[2] Pulse Width Modulation

0 Acceleration disabled.
1 Enable acceleration when increasing pitch.
2 Enable acceleration when decreasing pitch.
3 Enable acceleration when increasing & decreasing pitch (default).

The primary reason for having this feature is to ensure that the propeller will always be able to coarsen even when the aerodynamic loading on the propeller blades is very high. By automatically increasing the PWM speed, more power is applied to the pitch motor and this will overcome the heavy aerodynamic load. When the aerodynamic load is small, the pitch will change rapidly and so the PWM speed will hardly have time to increase much.

Feather

[Revision 488 and later] If a feathering propeller (such as the Woodcomp SR3000) is fitted, this parameter can be set to non-zero to enable the feathering function.

Fth Max RPM

[Revision 576 and later] Feathering is only enabled when the engine RPM is less than this value. The default value is such that feathering is only allowed when the engine is stopped. For engines that can windmill when stopped, this value must be set to be above the windmill RPM so that the propeller can be feathered.

FF Time (Fast Feather Time)

[Revision 635 and later] The amount of time (in seconds) that the feathering function should drive the pitch motor at full speed. After this time has elapsed, the pitch motor is slowed to the speed set by **PWMSpeed +**.

Some propellers allow full speed feathering all the way to the limit switch, in which case, the value of **FF Time** just needs to be larger than the time taken to feather the propeller. For propellers that should not be feathered at full speed all the way to the limit switch, use a value such that the pitch motor decelerates a few seconds before the limit switch is reached.

FUF Time (Fast Un-Feather Time)

[Revision 635 and later] The amount of time (in seconds) that the un-feathering function should drive the pitch motor at full speed. After this time has elapsed, the pitch motor is slowed to the speed set by **PWMSpeed -**. Use a value such that the pitch motor decelerates a few seconds before the limit switch is reached.

MAP Type

[Revision 1.157 and later] This parameter sets the type of MAP sensor fitted. The +/− switch selects between the following options:

None	Select this option when no MAP sensor is fitted. All other MAP parameters are hidden.
MPS-1A	A Smart Avionics MPS-1A sensor is fitted.
MPS-1D	A Smart Avionics MPS-1D differential sensor is fitted.
GR	A Grand Rapids MAP sensor is fitted.
*	Select this option for all other MAP sensor types. For this option, the **MAP1**, **MAP2**, **MAP3** and **MAP4** parameters must also be set to match the sensor's characteristics. Please contact Smart Avionics for help in setting these values.

Have MAP

[Revisions 1.143 to 1.156] This parameter should be 1 (the default value) if a MAP sensor is fitted. If you do not have a MAP sensor, you must set this parameter to 0 to disable the MAP portion of the display. Setting this parameter to 0 will hide all the other MAP parameters.

MAP 1

[Before revision 1.157 or when MAP Type = *] This is 1/4 of the ADC (Analogue Digital Converter) value that will be produced when the MAP sensor is sensing the smallest pressure it can handle. Each ADC count is equivalent to 5V/1024 = 4.8828 mV.

MAP 2

[Before revision 1.157 or when MAP Type = *] This is 1/4 of the ADC value that will be produced when the MAP sensor is sensing the largest pressure it can handle.

MAP 3

[Before revision 1.157 or when MAP Type = *] This is the smallest pressure the MAP sensor can handle in units of 1/5” Hg.

[Before revision 1.157] If necessary, this parameter can be adjusted to remove any offset between the ambient air pressure and the manifold pressure displayed when the engine is not running. Increasing the value of the parameter, increases the displayed manifold pressure. For example, if the real ambient pressure is 29.8 and the MAP display shows 29.4 then **MAP 3** needs to be increased by (29.8 - 29.4) $\times$ 5 = 2.

MAP 4

[Before revision 1.157 or when MAP Type = *] This is the largest pressure the MAP sensor can handle in units of 1/5” Hg.

MAP 5 [Before revision 1.157]

MAP Smoothing [Revision 1.157 and later]

This sets the level of smoothing applied to the MAP sensor readings. Small changes to this parameter have a big effect on the smoothing. Increasing the value by 1 doubles the amount of smoothing. If you increase the smoothing, the MAP display is less jittery but takes longer to reach its final value.

MAP Offset [Revision 1.157 and later]

If necessary, this parameter can be set to remove any offset between the ambient air pressure and the manifold pressure displayed when the engine is not running. This parameter is in units of 1/10” Hg and it can be either positive or negative. Positive values will increase the displayed pressure, negative values will decrease the displayed pressure. For example, if the real ambient pressure is 29.8 and the MAP display shows 29.4 then **MAP Offset** needs to be set to (29.8 - 29.4) $\times$ 10 = 4.

If you have a Smart Avionics differential sensor (MPS-1D), do not match the displayed value to the ambient pressure. Instead, a value of 29.0 should be displayed when the engine is not running (irrespective of the ambient pressure). If the value is not 29.0, adjust **MAP Offset** accordingly.

MAN MAP

CRS MAP

CLM MAP

TKO MAP [Revision 683 or later]

Specifies the MAP display style to be used in manual, cruise, climb and takeoff modes. The +/− switch selects between the following options:

Pressure
Displays pressure in inches of mercury (default).

% Power
Displays approximate percentage power.

Toggle
Toggles between the Pressure and % Power display styles every 6 seconds.

Irrespective of the selected MAP display style, if the engine is not running, the MAP will be displayed as a pressure.

Engine Type

Specifies the engine profile to be used when displaying MAP as percentage power. The +/− switch selects between the following options:

912	Selects the Rotax 912 profile (default).
912S	Selects the Rotax 912S profile.
914	Selects the Rotax 914 profile.
Jab	[Revision 468 and later] Selects the Jabiru profile.

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Inj	[Revision 1.157 and later] Specifies that the engine is fuel injected. The percentage power will be calculated from the tacho signal duty cycle.
*	[Revision 1.153 and later] Specifies that the engine is not a Rotax or Jabiru and, therefore, the percent power display is not available.

WOT Inj Time

[Revision 1.157 and later] For fuel injected engines, this is the duration of the fuel injector pulse when the throttle is wide open. It is in units of 100 μS and the default value is 80 which equates to 8 mS.

Max Fuel Flow

[Revision 1.157 and later] For fuel injected engines or when using a MPS-1D differential MAP sensor, this can be set to the full power fuel flow rate per hour. By setting this parameter to a non-zero value, the percentage power display will be replaced with an estimated fuel flow of the form `x/H` where `x` is the calculated fuel flow.

Idle MAP Diff

This is the maximum amount that the MAP can be reduced (” Hg) without the controller assuming that the throttle has been closed. If the MAP is reduced by more than this amount and the controller is in cruise mode, the propeller pitch will not be reduced in an attempt to achieve the target RPM. Setting the value to 0 (the default value) disables this feature. See Section 2.5.2 on page 25 for more information.

RPM Warn Time

This is the amount of time the RPM can be above the maximum continuous RPM (yellow line) before the RPM! indicator display flashes red. The default is 240 seconds which is 60 seconds less than the maximum time allowed by Rotax.

[Revision 1.153 and later] Setting this parameter to 0 disables the warning feature.

Yellow RPM

This is the yellow line RPM (default 5500, which is suitable for Rotax 912/912S/914). This only determines when the RPM! indicator displays yellow and has no effect on the automatic pitch control.

Red RPM

This is the red line RPM (default 5800, which is suitable for Rotax 912/912S/914). This only determines when the RPM! indicator displays red and has no effect on the automatic pitch control.

Limit RPM

This is the RPM at which rev limiting (automatic pitch coarsening) is activated when manual mode is being used (default 5700, which is suitable for Rotax 912/912S/914).

Low RPM

This is the threshold RPM below which the RPM! indicator will flash red when cruise mode is selected (default 4000). The purpose of this is to alert the pilot to the fact that cruise mode is still selected but they have closed the throttle.

TT Mins

The number of minutes the engine has run (Tacho Time) since this parameter was last set to 0. This is automatically advanced once a minute when the engine is running. When the value gets to 60, it is reset to 0 and the **TT Hours x1** parameter is advanced.

TT Hours x1

The number of hours the engine has run since this parameter was last set to 0. This is automatically advanced when each hour of engine time is accumulated. When the value gets to 100, it is reset to 0 and the **TT Hours x100** parameter is advanced.

TT Hours x100

The number of hundreds of hours the engine has run since this parameter was last set to 0. This is automatically advanced when each hundred hours of engine time is accumulated.

Sampling Time

This is the amount of time (in mS) needed to capture each RPM measurement. Larger values produce a more stable RPM reading but also increase the controller's response time which has the effect of reducing the accuracy of the pitch adjustments and can lead to hunting (pitch cycles back and forth).

For revisions ≥ 601, a value of 0 automatically adjusts the sampling time to achieve the best results. 0 is now the default, for earlier revisions, the default is 100.

Important

The automatic adjustment of **Sampling Time** requires that the controller can reliably detect when the pitch motor has stopped due to reaching either the coarse or fine pitch limits. If, for some reason, the pitch limit detection is not working correctly, do not set **Sampling Time** to 0.

Contrast

This sets the contrast of the LCD display (default 30). Smaller values increase contrast, larger values decrease contrast.

Tacho Level

This is the sensitivity level of the tachometer input (default 100). Smaller values increase the sensitivity. See Section 2.5.3 on page 26 for information on adjusting the tachometer level.

[Revision 1.153 and later] For non-Rotax engines, you should also set the **Engine Type** parameter to `Jab`, `Inj` or `*` to inhibit the automatic tacho level adjustment function that matches the controller's response to the characteristics of the Rotax tacho signal.

Tacho Div

This is the tachometer input divider. The CSC-1/G divides the incoming tachometer signal frequency by this value. The default value is 1 which is suitable for Rotax engines as they produce one pulse per revolution.

Setting this parameter to `0` multiplies the tachometer signal frequency by 2 which may be required when the tachometer signal is being generated by wrapping a pickup wire around an ignition lead.

Table 3.1 lists the controller's parameters along with their minimum, maximum and default values. If a parameter is not supported in all revisions of the controller's software, the revisions that support it are noted.

Table 3.1: Controller Parameters

Parameter Name	Default	Minimum	Maximum	Increment	Revision
TKO RPM	5700	50	9950	50 RPM	$\geq$ 683
CLM RPM	5400	50	9950	50 RPM	
CLM Dead Band	50	10	990	10 RPM	
CRS Dead Band	100	10	990	10 RPM	
Startup Time	300	1	5000	25 mS	
CurLimit +	100	1	180	1 (100mA)	
CurLimit –	100	1	180	1 (100mA)	
Stall Time	100	1	5000	25 mS	
Current Min	5	1	150	1 (100 mA)	
Current Show	0	0	1	1	$\geq$ 618
CurSense mOhms	10/20	1	250	1	$\geq$ 618
Inactive Time	200	10	2550	10 mS	$\geq$ 1.154
PWMSpeed +	100	20	100	1%	
PWMSpeed –	100	20	100	1%	$\geq$ 525
PWM Accel	3	0	3	1	$\geq$ 576
Feather	0	0	1	1	$\geq$ 488
Fth Max RPM	50	50	9950	50	$\geq$ 576
FF Time	20	0	255	1	$\geq$ 635
FUF Time	0	0	255	1	$\geq$ 635
MAP Type	MPS-1A	None, MPS-1A, MPS-1D, GR or *			$\geq$ 1.157
Have MAP	1	0	1	1	$<$ 1.157
MAP 1	1	0	255	1	

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Table 3.1: Controller Parameters (cont.)

Parameter Name	Default	Minimum	Maximum	Increment	Revision
MAP 2	162	0	255	1	
MAP 3	15	0	255	1	
MAP 4	250	0	255	1	
MAP 5	5	1	255	1	$<$ 1.157
MAP Smoothing	5	1	255	1	$\geq$ 1.157
MAP Offset	0	-127	127	1	$\geq$ 1.157
MAN MAP	Pressure	Pressure, % Power or Toggle			
CRS MAP	Pressure	Pressure, % Power or Toggle			
CLM MAP	Pressure	Pressure, % Power or Toggle			
TKO MAP	Pressure	Pressure, % Power or Toggle			$\geq$ 683
Engine Type	912	912, 912S, 914, Jab, Inj or *			
WOT Inj Time	80	0	255	100μS	$\geq$ 1.157
Max Fuel Flow	0	0	255	1	$\geq$ 1.157
Idle MAP Diff	0.0	0.0	25.0	0.5 ”Hg	$\geq$ 1.148
RPM Warn Time	240	0	500	5 seconds	
Yellow RPM	5500	50	9950	50 RPM	
Red RPM	5800	50	9950	50 RPM	
Limit RPM	5700	50	9950	50 RPM	
Low RPM	4000	50	9950	50 RPM	
TT Mins	0	0	59	1	$\geq$ 1.143
TT Hours x1	0	0	99	1	$\geq$ 1.143
TT Hours x100	0	0	255	1	$\geq$ 1.143
Sampling Time	0	0	500	25 mS	
Contrast	30	0	255	1	
Tacho Level	100	0	255	1	
Tacho Div	1	0	255	1	$\geq$ 1.148

Chapter 4

Pilot's Notes

Please read all of these notes before you try using the CSC-1/G in flight. If you are not familiar with the controller's features and modes of operation, please read Chapter 1 (*Introduction*) first.

Important

These notes assume that the pilot already has some experience of operating a variable pitch propeller manually. If you are not familiar with how your propeller is operated in flight manually, it is strongly recommended that you gain some experience of manual operation before using the CSC-1/G's constant speed modes.

Some countries (including the UK) require pilots to undergo 'differences training' before they are allowed to operate aircraft with variable pitch propellers.

Caution

If the controller is configured to use PWM to slow down the propeller pitch motor, be aware that when the controller is disabled, the PWM is also disabled and so the propeller pitch will change at the full speed the pitch motor is capable of when the +/− switch is operated. When the pitch changes at full speed, it is very likely that the pitch will overrun when the limit switch is activated due to the inertia in the pitch motor and gearbox. If that happens, the propeller pitch can end up either too coarse or, potentially more seriously, too fine (with the attendant risk of over-revving the engine.

To avoid the possibility of over-revving the engine when PWM is being used and the OK/DISABLE switch is in the DISABLE position, do not reduce the propeller pitch using the +/− switch without first ensuring that the throttle is mostly closed. After the propeller pitch has been reduced, **cautiously** increase the throttle setting. If the RPM is too high, you must coarsen the pitch again before the throttle is opened further.

4.1 Coping with Malfunctions

4.1.1 Coping with a controller malfunction

In the unlikely event that the controller suffers a hardware or software failure and you believe it to be untrustworthy, disable the computer control by setting the OK/DISABLE switch to the DISABLE position and use the +/− switch to manually adjust the propeller pitch.

4.1.2 Coping with an engine malfunction

If an engine malfunction causes the RPM to fluctuate, the controller will continuously change the propeller pitch in a futile attempt to keep the RPM constant. If this occurs, select manual mode and use the +/− switch to manually adjust the pitch to a suitable setting.

4.2 Recommended Usage of Controller

The following sections suggest how the controller should be used in various phases of flight. Remember, at any time, manual mode can be selected and the pitch controlled manually. This would be appropriate when carrying out manoeuvres that involve rapidly changing airspeed e.g. stalls or flying in very rough air.

The RPMs mentioned in the following notes are suitable for a Rotax engine. If you do not have a Rotax engine, you will need to substitute the correct values for your engine type.

4.2.1 Engine start

When starting the engine, the OK/DISABLE switch can be in either position. Until the engine is running, pressing the MODE button will not change the controller's mode but it will make the controller display the current mode, pitch and manifold pressure instead of the total engine hours.

Before you start the engine, it is a good idea to make sure that the propeller pitch is not particularly coarse. This will reduce the load on the engine while starting and idling. If necessary, reduce the pitch using the +/− switch. However, unless the pitch has been manually changed, it is likely to be still fine from the previous landing. As soon as the engine runs, the current RPM will be displayed.

4.2.2 Runup

For the engine runup, the propeller pitch should be fairly fine. This can be achieved either by selecting manual mode and adjusting the pitch using the +/− switch or by selecting climb or takeoff mode. It is likely that the propeller pitch will still be fine from the previous landing. For taildragger aircraft (Europa mono-wheels etc), take extreme care when using large amounts of throttle with fine pitch on the ground as it is possible for the tail to rise unexpectedly (especially if the wind is strong and gusty). For all aircraft, make sure the brakes are applied or the aircraft is chocked.

4.2.3 Takeoff

For takeoff, select takeoff mode (by pressing the MODE button for at least 1 second) as part of the pre-takeoff checklist and verify that the pitch display indicates that fully fine pitch has been achieved. When takeoff mode is selected, the takeoff mode target RPM is set to the preset value and displayed for a few seconds. If desired, use the +/− switch to adjust the target RPM.

When the throttle is opened, check that the static RPM rises to a sensible value. The exact figure will depend on the position of the propeller's limit stop but should be around 5000 RPM.

The RPM should quickly rise as the aircraft accelerates. When the RPM exceeds the takeoff mode target RPM (+ dead band), the pitch will automatically be coarsened to bring the RPM back into the dead band. This automatic 'gear changing' can be slightly unsettling at first because the pilot may not be used to hearing the RPM changing quickly without their intervention.

If there is a strong wind gradient, the RPM may increase quickly as the aircraft flies through the gradient. In this situation it is possible that the maximum allowed RPM will momentarily be exceeded if the target RPM is high (say 5700). To avoid this, reduce the target RPM by 100 using the +/− switch before taking off into a strong wind gradient. Strong gusts and turbulence can have the same effect.

Once a safe height has been achieved, climb mode can be selected with a brief press of the MODE button. Alternatively, the target RPM may be altered at any time in the climb using the +/− switch.

If the target RPM is greater than the maximum continuous RPM, care must be taken not to exceed the high RPM time limit specified by Rotax. To alert the pilot to the possibility of the time limit being exceeded, the controller flashes the RPM! indicator red when the RPM has been above the yellow line RPM for more than 4 minutes (the time limit is configurable). **It is the pilot's responsibility to ensure that the recommended time limit is not exceeded.**

Throughout the takeoff and climb out, the pilot should concentrate on airmanship and accurate flying; very little thought has to be given to the controller.

4.2.4 Climb

To enter a climb while cruising, the following sequence of actions should be carried out:

1. raise the nose to start the climb
2. as the airspeed reduces, engage climb mode
3. progressively open the throttle to the desired setting

The amount of time between raising the nose and engaging climb mode depends on how fast the aircraft was cruising. If the cruise airspeed is low, engage climb mode at the same time as the nose is raised and start opening the throttle immediately afterwards. To reduce the chance of over-revving the engine, avoid quickly opening the throttle whenever the airspeed is high.

The target RPM in the climb may be adjusted using the +/− switch.

Note

Although the switch actually adjusts the target RPM, it is labelled in terms of propeller pitch adjustment, so pressing it towards **+** increases the pitch and reduces the RPM (and vice versa). This may seem confusing but it is consistent with how the +/− switch is used to adjust the pitch in manual mode.

4.2.5 Cruise

When the aircraft, in climb mode, reaches the required cruising level, select cruise mode by pressing the MODE button briefly. Simultaneously, adjust the throttle to the desired power level. The airspeed is then controlled by the throttle. The target RPM can be adjusted using the +/− switch as described above.

Gentle climbs and descents can easily be made in cruise mode without adjusting the throttle as the controller will adjust the pitch appropriately when the airspeed changes.

As a climb is steepened, the propeller pitch will be reduced to maintain the RPM.

As a descent is steepened, the propeller pitch will be increased to limit the RPM. At some point, the propeller will become fully coarse and the RPM will continue to rise if the airspeed is not reduced. The pilot can either reduce the throttle setting or reduce the rate of descent.

If the air is very turbulent, the controller may adjust the propeller pitch a lot more frequently than normal. In this situation, it is better to select manual mode and suffer the RPM changes rather than overworking the propeller pitch change mechanism.

4.2.6 Descent

When descending, reduce the throttle as normal and, if necessary, change the controller mode. For example, when descending from the overhead to circuit height, you can keep cruise mode selected as this is appropriate for the downwind leg. When descending on base leg, select takeoff mode so that you will be ready for a possible go-around.

4.2.7 Approach

Ensure that takeoff mode has been selected by the time the approach starts and check, with a couple of glances at the LCD display, that within a few seconds the propeller has gone fully fine and that the RPM is reasonable given the airspeed and the throttle setting.

4.2.8 Engine shutdown

The controller can be in any mode and the OK/DISABLE switch can be in either position when the engine is shutdown.

4.3 Limitations

The pilot should be aware of the following limitation of the controller:

Electrically operated variable pitch propellers cannot react quickly enough to stop the red line RPM being exceeded if the propeller pitch is too fine for the current airspeed and the throttle is opened quickly.

To reduce the chance of this occurring, avoid quickly opening the throttle, especially when the airspeed is high and the propeller pitch is fine.

Chapter 5

Troubleshooting

This chapter provides answers to problems you may encounter when installing and operating the CSC-1/G.

5.1 Installation and Hardware Problems

5.1.1 Controller completely dead

This is most likely caused by either a wiring problem or a blown fuse. When power is applied to the controller, the RPM! indicator flashes a couple of times and the LCD display shows a banner and the software revision number for a few seconds. If, when power is turned on, absolutely nothing happens, check the supply fuse, wiring and the D-type plug connections.

5.1.2 Pitch motor does not operate

There are various reasons why the pitch motor does not operate: one or both of the pitch motor outputs may have been shorted to ground, the pitch motor outputs could be open-circuit or the pitch motor supply fuse could have blown or even that the pitch motor or the slip-ring mechanism is faulty or that the limit switches (if fitted) are incorrectly adjusted.

5.1.3 Pitch motor operates in the wrong sense

If the pitch motor operates in the wrong sense, i.e. the propeller pitch increases when it should decrease and vice-versa, it indicates that the two wires from the controller to the propeller need to be transposed.

5.1.4 +/− switch always makes the pitch go fine

If the +/− switch always makes the propeller pitch reduce no matter which direction it is pressed, this indicates that the `Pitch -` and the `Pitch +` connections have been shorted together. This can be due to either a wiring fault or through the use of an external +/− switch that (erroneously) connects those wires together when it is not being activated.

5.1.5 Controller produces radio interference

If, when the pitch motor is being driven by the controller, interference is heard on the radio (or some other instrument is affected) it is likely that a wiring problem may exist. Check that both the controller and the radio (or affected instrument) have adequate power supply and ground wiring,

5.1.6 Controller affected by other equipment

The controller could be affected by other equipment in several ways. In the most severe case, operating other equipment causes the controller to be reset. This could indicate a problem in either the controller's ground or supply wires or even a more general problem with the aircraft's +12V supply or ground connections.

Another possible problem is that operating other equipment has an effect similar to the MODE button or the +/− switch being pressed. This could happen if the optional external switches have been connected using inadequately shielded wires.

5.1.7 Spurious MAP display with no MAP sensor fitted

If you find that spurious MAP values are displayed even though you have not fitted a manifold pressure sensor, it is likely that you omitted to connect the MAP sensor input to ground when you installed the controller. Please see Section 2.3 on page 16 for details. For software revisions 1.143 and later, the **Have MAP** parameter must be set to 0 when a MAP sensor is not fitted. Alternatively, for software revisions 1.157 and later, the **MAP Type** parameter must be set to `None` when a MAP sensor is not fitted.

5.2 Operational Problems

5.2.1 Display goes blank with engine running

If the display (RPM, MAP etc.) momentarily blanks, or drops out completely and, instead, shows the total tachometer time, this indicates that the tachometer input needs to be adjusted to make it more sensitive. Section 2.5.3 on page 26 describes how to do this. If the sensitivity is slightly too low, you may find that the display is OK at low RPM but starts blanking at higher RPM.

5.2.2 Controller drops out of cruise/climb/takeoff modes

When the RPM becomes zero, the controller automatically drops out of cruise/climb/takeoff modes and returns to manual mode. If this happens in flight it indicates that the RPM measurement is not completely reliable. If this occurs, it is likely that the tachometer input needs to be adjusted to make it more sensitive. Section 2.5.3 on page 26 describes how to do this.

5.2.3 Wrong RPM displayed for non-Rotax engine

If you are not using a Rotax engine and the displayed RPM is a multiple (×2, ×3, etc.) or 1/2 of the real RPM then you should set the **Tacho Div** parameter to the correct divider value. For example, if the tachometer signal you are using pulses twice per revolution, set the value to 2. If you are using an ignition lead pickup or the tachometer signal pulses only every other revolution, you must set the value to 0. You may also need to adjust the tacho sensitivity value. Section 2.5.3 on page 26 describes how to do this.

5.2.4 RPM display over-reads or is unsteady

If, as the throttle is increased, the RPM display jumps from a reasonable value to a value that is much too high, this indicates either that the tachometer sensitivity is too high or that the RPM measurement circuitry is being affected by electrical noise. Electrical noise can also make the RPM display unsteady. Section 2.5.3 on page 26 describes how to adjust the tachometer sensitivity level.

If electrical noise is badly affecting the tachometer signal, it may not be possible to adjust the tachometer sensitivity such that the RPM measurement does not over read at high RPM and the RPM measurement does not drop out at low RPM. If this is the case, you should investigate the routing of the tachometer pickup wiring and whether it should be shielded.

5.2.5 RPM is less than target RPM

A reason for not achieving the target RPM could be that the propeller has reached the fine pitch limit stop (or microswitch, if fitted). If this is the case, consider adjusting the position of the fine pitch limit (if this is possible) to allow the pitch to be reduced further. Please consult the propeller manufacturer's documentation for details of how to do this and observe any limitations regarding the minimum pitch setting allowed for your propeller/engine/aircraft combination.

Other reasons for the achieved RPM being less than you expect could be that either the airspeed is very low or the engine is not producing full power.

5.2.6 RPM is greater than target RPM

If the controller cannot reduce the RPM to the target RPM, this indicates that the propeller has reached the coarse pitch limit stop (or microswitch, if fitted). When this happens, the controller will continuously display a + next to the pitch value. This may happen because either the coarse pitch limit is too fine or one or both of the throttle setting or the airspeed are too high. It may be possible to increase the coarse pitch limit to allow the propeller pitch to become coarser. Please consult the propeller manufacturer's documentation for details of how to do this and observe any limitations regarding the maximum pitch setting allowed for your propeller/engine/aircraft combination.

5.2.7 Controller changes pitch too often

If during automatic operation (climb, cruise or takeoff modes), the controller adjusts the propeller pitch more often than appears necessary, it is possible that the respective dead band is too small. The dead band values are adjustable via setup mode (see Section 3.1 on page 29).

It is also possible that the pitch change motor is very fast or it has a lot of inertia and this may cause the pitch to overshoot the correct value. Reducing the values of the **PWMSpeed +** and **PWMSpeed -**parameters will reduce the speed of the pitch motor.

Another reason could be that the RPM measurement is being affected by some electrical or mechanical problem. Try selecting manual mode and see if the RPM still varies. If it does, the problem is probably not with the controller.

Remember, the RPM will vary because of airspeed changes and turbulence. If the air is very rough it is better to use manual mode rather than the constant speed modes.

5.2.8 Controller does not change pitch often enough

If during automatic operation (climb, cruise or takeoff modes) the controller adjusts the propeller pitch less often than appears necessary, this most likely indicates that the dead band is too large. The dead band is adjustable via setup mode (see Section 3.1 on page 29).

If the pitch is not being reduced when the throttle is reduced in cruise mode and a MAP sensor is fitted it is possible that the value of the **Idle MAP Diff** parameter is too small. See Section 2.5.2 on page 25 for more information.

5.2.9 MAP display does not match ambient pressure

Due to variations in the MPX4250 pressure sensor device used in the MPS-1, it is possible that the manifold pressure displayed when the engine is not running is different from the ambient air pressure. You can remove this error by adjusting the value of the **MAP Offset** or **MAP 3** (depending on the CSC-1/G software revision) parameter (for details of how to do this, see Section 3.1 on page 29).

5.2.10 MAP display very unsteady

If the MAP display (or the percentage power display) is very unsteady, adding a restriction to the tube that connects the MPS-1 to the manifold can be beneficial. The hole in the restriction should not be larger than 1mm diameter. Furthermore, if the restriction is situated close to the manifold, it will provide protection in the case of a leak in the tube.

If adding a restriction does not steady the display, you can increase the value of the **MAP Smoothing** or **MAP 5** (depending on the CSC-1/G software revision) parameter to increase the amount of smoothing applied to the MAP readings.

Another possible cause of a jittery MAP display is electrical interference. Check that the wiring from the MAP sensor to the CSC-1/G is not routed near to sources of electrical noise (ignition wires, etc.) Shielding the MAP sensor wires will be beneficial.

5.2.11 Controller shows - - or ++ too often

If the controller shows - - or ++ even though the propeller has not actually reached the fine or coarse limit it means that the controller is erroneously detecting the limit. The controller believes that a limit has been reached if (a) the pitch motor current falls to zero or (b) if the pitch motor current exceeds the preset limit.

If your propeller's pitch motor consumes less than 300mA when running, adding a power resistor in parallel across the pitch motor terminals to increase the current drawn to at least 500 mA will stop the controller erroneously detecting the zero current situation. Please contact Smart Avionics for help if you are not sure how to achieve this.

If the pitch motor current is exceeding the preset limit then the current limit parameters need adjusting. Section 2.5.1 on page 22 describes how to do this.

5.2.12 Controller display shows 'BAD MEM'

This indicates that the controller has failed the program memory integrity test that is carried out each time power is applied. In the unlikely event of this occurring, please contact Smart Avionics. However, if you need to use the aircraft before the controller can be repaired and you have an alternative means of displaying the engine RPM, it is acceptable to disable the computer using the OK/DISABLE switch and then use the +/− switch to control the pitch manually .

Appendix A

Specifications

Table A.1: Mechanical Specifications

Parameter	Value	Units
Weight	320	gm
Width	63	mm
Height	63 (ex screw heads)	mm
Depth behind panel	106 (ex connector)	mm
Panel hole diameter	57.5	mm
Mounting screw hole diameter	4.5	mm
Mounting screw pitch diameter	66.7	mm
Max length of mounting screw	10 + panel thickness	mm

Table A.2: Display Specifications

Quantity	Min	Max	Resolution	Units
RPM	0	9990	10	RPM
MAP	3–6[1]	50	0.1	”Hg

Table A.3: Environmental Specifications

Parameter	Min	Max	Units
Operating temperature range	0	+50	°C

[1] Actual value determined by the MPS-1 sensor.

The operational temperature range is limited by the specification of the LCD display. The colder the display becomes, the slower it reacts. In testing, the display was found to be still usable at ambient temperatures below 0 °C. The controller itself will operate over a range of –40 to +70 °C.

Table A.4: Electrical Characteristics

Characteristic	**Min**	**Max**	**Units**
Logic supply voltage	10	15	V
Logic supply current	75	85 [2]	mA
Pitch drive supply current	0	< 10 continuous, < 18 peak[3]	A

[2]To this must be added any current drawn by the Auxiliary Supply Output (250 mA max)

[3]Determined by propeller motor.

Appendix B

Connections

The following table and Figure B.1 on page 63 specify how the 15 way D-type connector on the rear of the controller is wired.

Table B.1: CSC-1/G D-Type Connections

Pin	Name	In/Out	Connected To	Notes
1	N/C			
2	N/C			
3	Auxiliary Supply Out	Out	+12V power to MAP sensor and pitch drive LED	Maximum available current 250mA (internally protected)
4	Tacho	In	Tacho signal	For Rotax, connect to one side of tacho pickup, ground other side of pickup
5	Feather	In	Switch to ground	Optional (only for SR3000 feathering)
6	N/C			
7	Ground	–	Can be left unconnected	Internally connected to pins 9 &14
8	Controller Supply	In	+12V supply	Protect with fuse (3A or less)
9	MAP Sensor Ground	–	MAP sensor ground	Internally connected to pins 7 &14

(continued on next page)

Table B.1: CSC-1/G D-Type Connections (cont.)

Pin	Name	In/Out	Connected To	Notes
10	MAP Sensor In	In	MAP sensor output	If MAP sensor not fitted and revision before 1.143, connect to ground (pin 9)
11	Pitch −	In	Switch to ground	Optional (use shielded wire)
12	Pitch +	In	Switch to ground	Optional (use shielded wire)
13	Mode	In	Switch to ground	Optional (use shielded wire)
14	Ground	–	Ground	Internally connected to pins 7 & 9
15	Pitch Changing	Out[1]	Ground end of pitch changing indicator	Max sink current 250mA

The following table and Figure B.1 on the next page specify how the 4 way connector on the rear of the controller is wired.

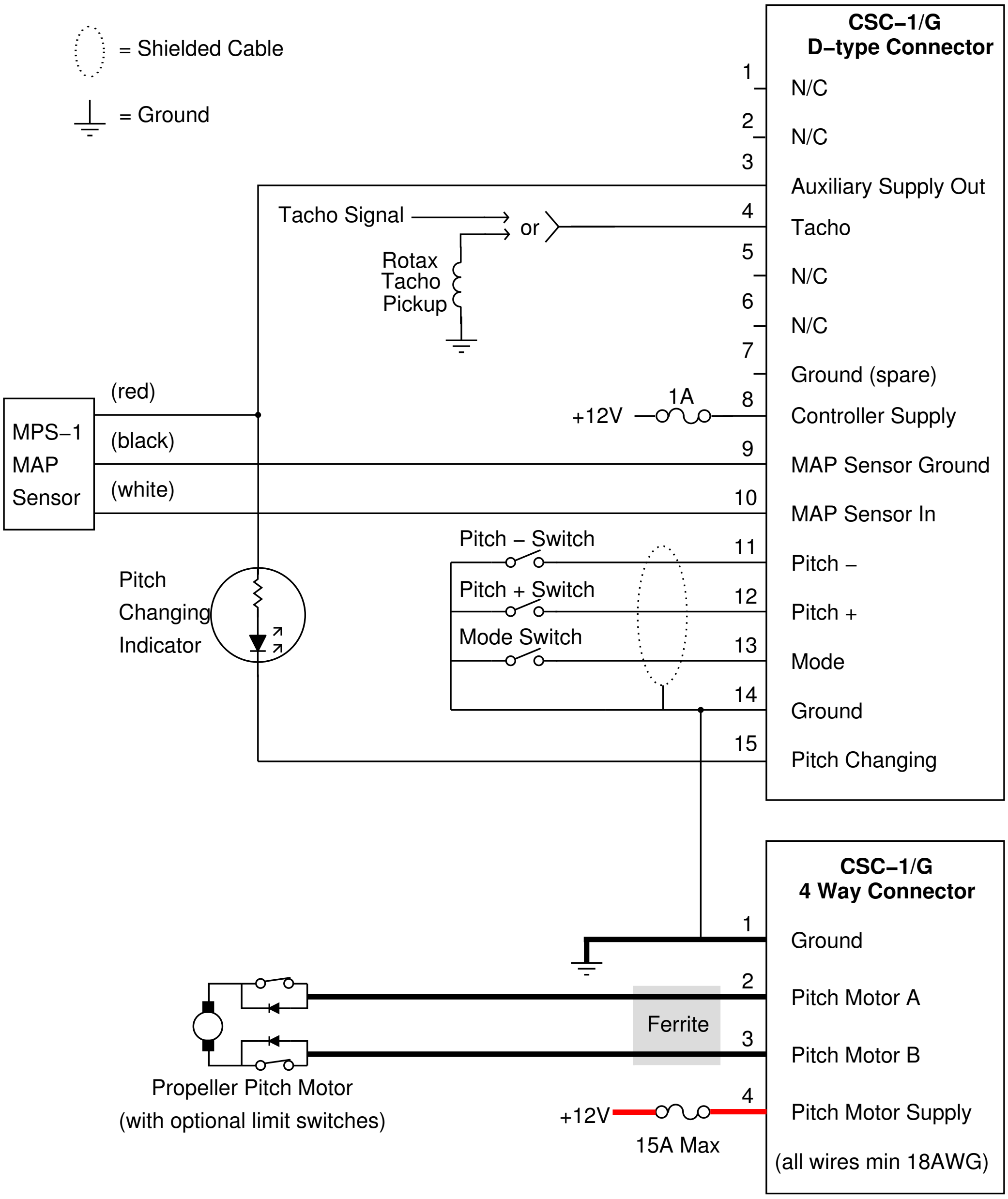
Table B.2: CSC-1/G Propeller Connections

Pin	Name	Connected To	Notes
1	Pitch Motor Ground	Ground	Connect to same ground as pin 14 of the D-type is connected to
2	Pitch Motor A	To propeller motor	Positive to reduce pitch
3	Pitch Motor B	To propeller motor	Positive to increase pitch
4	Pitch Motor Supply	+12V supply	Protect with 15A or smaller fuse

For connection to a Woodcomp SR3000 fitted with the feathering option, please see Figure E.1 on page 71.

[1]Technically, it's an open-collector type output.

Figure B.1: CSC-1/G Connection Diagram



Appendix C

LAA Inspection Checklist

Your LAA inspector should check the following items before approving the CSC-1/G installation:

1. The propeller has been installed in accordance with the manufacturers instructions.
2. The controller is securely mounted in the instrument panel in a position that allows the pilot to easily view the display and operate the switches.
3. If external switches have been fitted, they should be labelled so that their purpose is clear. If an external +/− switch is fitted, it should be oriented such that pushing the switch forward or up (depending on the orientation of the switch) reduces the propeller pitch (increases RPM).
4. All wiring has been carried out to an acceptable standard for a permit aircraft.
5. If a MPS-1 manifold pressure sensor has been fitted, it must be securely mounted in a sensible position inside the engine compartment. The tube that connects the sensor to the manifold[1] must be adequately restrained and should not be able to flex so much as to strain the connection on the MPS-1.

[1] The MAP take-off is normally fitted to the balance tube between the carburettors.

Appendix D

Use with a Jabiru Engine

This Appendix lists the parameter values to be used when the controller is used with a Jabiru 2200 or 3300 engine.

To detect the engine RPM, the controller's tacho input (pin 4 of the D-Type connector) should be connected to either of the Jabiru engine's permanent magnet generator outputs.

Important

To ensure reliable RPM detection, the Jabiru regulator must be suppling power to some load. When the regulator's output current is very low, the displayed RPM will become erratic or not be displayed at all.

Table D.1 on the next page lists the recommended parameter values to be used with Jabiru 2200 and 3300 engines. All other parameters can be set to their default values (listed in Table 3.1 on page 40).

If the throttle closed sensing as described in Section 2.5.2 on page 25 is to be used, set the **Idle MAP Diff** parameter to 3.

Table D.1: Jabiru Engine Parameter Values

Parameter	Value
TKO RPM	3200
CLM RPM	3000
Engine Type	`Jab`
RPM Warn Time	0
Yellow RPM	3000
Red RPM	3300
Limit RPM	3200
Low RPM	2000
Tacho Level	70
Tacho Div	5 for 2200, 6 for 3300

Appendix E

Use with a Woodcomp SR3000 Propeller

The CSC-1/G can be directly connected to the Woodcomp SR3000 hub without using the Woodcomp speed control box. Figure E.1 on page 71 shows the wiring diagram. Basically, the CSC-1/G pitch motor outputs go straight to the SR3000 slipring brushes. If the SR3000 has the feathering option, the inner slipring brush can be connected via an external feather switch to control the feathering. If the SR3000 does not have the feathering option, the inner slipring (if fitted) is not connected. To suppress high frequency electrical noise, the wires to the sliprings should be passed through a ferrite ring or tube located as near to the controller as possible. Ideally, the wires should make two complete turns through the centre of the ferrite as shown in Figure 2.1 on page 17. Woodcomp recommend using a 10A fuse in the main +12V supply to the controller.

If your SR3000 is fitted with either the feathering or the reversing option, it is beneficial to connect a large valued capacitor between pins 1 and 4 of the 4-way connector. The capacitor will reduce the chance of the controller introducing electrical noise into other avionic systems and also improve the drive current delivered to the propeller pitch motor. The critical parameters for this capacitor are that its voltage rating is at least 25V and that it must be capable of handling a ripple current of at least 8A or more (the higher the ripple current rating, the better). The actual capacitance value is not critical but it is likely to be at least 10,000μF. If you require help obtaining a suitable capacitor, please contact Smart Avionics. To obtain the maximum benefit, the wires from the capacitor to the controller's connector should be as short as possible.

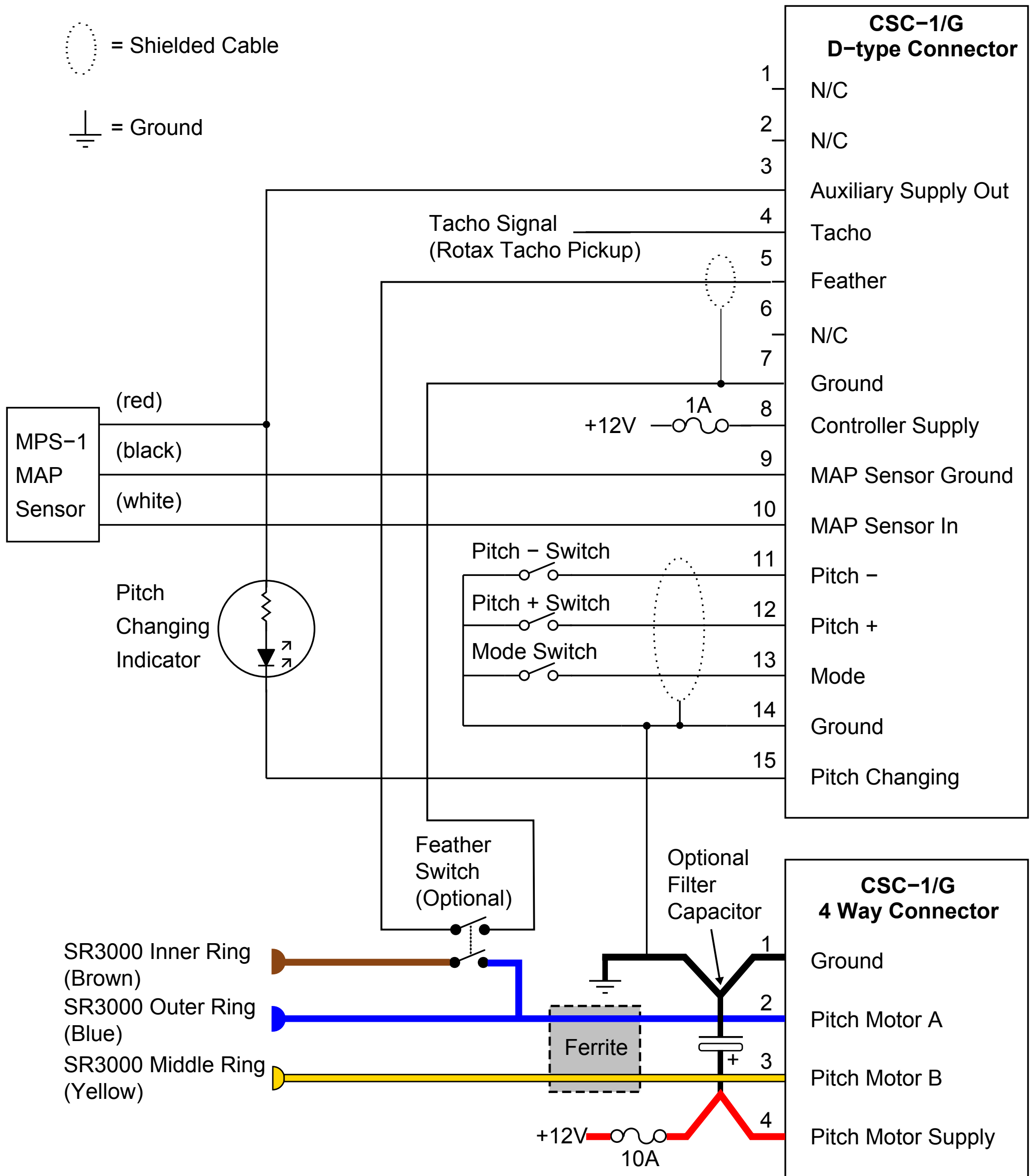
Important

Please note that large value capacitors are nearly always polarised and they will be destroyed (explode) if the connections are reversed so please take extra care to ensure that the capacitor is connected the right way around before applying power.

Important

The feathering and reversing versions of this propeller are fitted with a very fast pitch motor and so to stop the pitch 'hunting' during constant speed operation, the controller must be configured to use PWM to reduce the pitch motor speed. See Section E.2 on page 73 for details of the parameters that need to be set for use with a feathering or reversing SR3000. Also, please read the caution on Page 43 regarding the usage of the +/− switch when the OK/DISABLE switch is in the DISABLE position.

Figure E.1: CSC-1/G Connection Diagram for SR3000



E.1 SR3000 Feathering

If the SR3000 is capable of feathering, the CSC-1/G can drive the propeller to and from the feathered position through the use of an external feathering switch. This switch should be a high quality double-pole, single-throw, toggle type with a rating of 5A or more. Preferably, the switch should have a locking mechanism that stops the pilot operating it inadvertently. The switch should be mounted near to the CSC-1/G and it's positions should be labelled 'VP/CS' and 'Feather'. For normal (constant speed) operation, the feather switch is in the VP/CS (open) position. The switch is only closed when the propeller is to be feathered.

Important

The propeller can only be feathered when the engine RPM is less than the value of **Fth Max RPM**. If the feather switch is operated while the RPM is greater than or equal to this value, the blade pitch will not change and the controller's display will show 'FTH' in the top right hand side of the display and the LED will flash red.

E.1.1 Feathering the propeller

To feather the propeller, the engine must be switched off and the RPM less than **Fth Max RPM**. When the feather switch is closed, the propeller blades will move to the feathered position and they will stay there as long as the feather switch is closed.

While the propeller is feathering (and also when it is fully feathered), the CSC-1/G's display will show a scrolling message: '++ FEATHERING ++'.

If you have fitted an activity LED, it will illuminate while the pitch is changing and go out when the propeller is fully feathered.

E.1.2 Un-feathering the propeller

To un-feather the propeller, return the feather switch to the open (VP/CS) position and the blades will return to the fully fine position.

While the propeller is being un-feathered (and also when it has reached the fully fine position), the display will show a scrolling message: '— UNFEATHERING —'.

If you have fitted an activity LED, it will illuminate while the pitch is changing and go out when the propeller is fully fine.

Once the pitch is fine enough to start the engine, you can stop the un-feathering (and return to manual mode) by pressing the MODE button. The un-feathering will also stop if the RPM becomes greater than or equal to the value of **Fth Max RPM**.

Important

After the propeller has un-feathered, the blades are likely to be in the fully fine position. When the engine is re-started in flight, take care to avoid over-revving the engine. You may wish to manually coarsen the blade pitch a little before starting the engine.

E.1.3 Powering down the CSC-1/G while feathered

Once the propeller has been feathered, the power to the CSC-1/G may be switched off until the time when the propeller is to be un-feathered.

Keep the feathering switch in the feather position while the power is switched off.

If you move the feather switch to the CS/VP position, the CSC-1/G will not know that the propeller is feathered when the power is switched on again. If you do move the switch to the CS/VP position, the propeller can be un-feathered by either moving the switch to the feather position and then back to the CS/VP position or by manually reducing the pitch using the +/− switch.

E.2 Woodcomp SR3000 Parameter Values

Table E.1 on the next page lists the recommended parameter values to be used with a Woodcomp SR3000 propeller. All other parameters can be set to their default values (listed in Table 3.1 on page 40).

Table E.1: Woodcomp SR3000 Parameter Values

Parameter	Value	Rational
CurLimit +	150	Current limit for increasing pitch needs to be increased
PWMSpeed +	45 or 100	If SR3000 is fitted with a fast pitch motor, reduce the pitch motor speed to avoid hunting in CS modes, otherwise, set to 100
PWMSpeed –	25 or 100	If SR3000 is fitted with a fast pitch motor, reduce the pitch motor speed to avoid hunting in CS modes, otherwise, set to 100
PWM Accel	3	Enable acceleration in both directions.
Sampling Time	0 or 50	Faster RPM sampling to avoid hunting in CS modes - for revisions $\geq$ 601 set to 0, otherwise set to 50
Feather	0 or 1	0 if propeller doesn't feather, otherwise 1.
Fth Max RPM	50	If propeller can't windmill, set to 50. Otherwise, use a value greater than the max RPM that will occur when the propeller is windmilling.
FF Time	10	The SR3000 can feather at full speed all the way to the limit switch.
FUF Time	2	The SR3000 should not be unfeathered at full speed all the way to the limit switch as it will overshoot and the pitch will become very fine.

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