RevLock 40: Takes helicopter governors to the ultimate with **G-Sensitive Collective Management** – another innovative performance-enhancing idea from CSM.

RL40 has all the accuracy, ease of installation and flexibility for which RevLocks are renowned. But now, when you reach the limits of the power output of the engine, RL40 automatically modulates the maximum collective pitch available to prevent the engine becoming bogged down.

With RL40 your can use more collective pitch range than with a conventional governor. You get higher flight speeds and snappier transient high g manoeuvrability. In sustained high g and high cyclic situations RL40 almost imperceptibly regulates the maximum collective pitch to keep your engine in the power band leaving you to concentrate on the flying. RL40 uses its accelerometer to distinguish high-g flight situations, where head speed maintenance is paramount to retain g-pulling capability and cyclic response, from the low-g situations (vertical climb and fast flight) where the blades are not required to produce as much lift and optimum performance involves trading some head speed for even higher collective pitch.

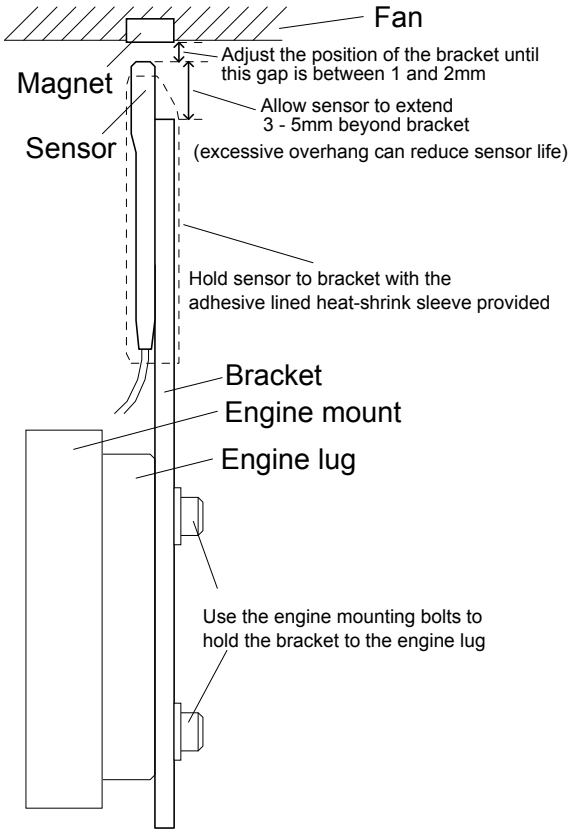
CCPM is no problem – the on-board CCPM mixing provided by a CSM CycLock unit will allow the full RL40 Collective Management feature to be used on this type of helicopter.

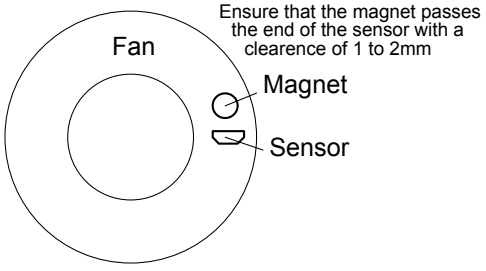
Installing RevLock RL40

Mounting the magnet
Unlike simple hall switch systems, the sensor employed by RevLock allows not only accurate timing of the engine rotation but also signal strength testing. RevLock automatically tests that the sensor signal has a good safety margin every time before you fly. This facility also greatly simplifies the magnet-to-sensor gap adjustment.

A 4mm diameter magnet is supplied with RevLock. This should be located in a drilling in the back face of the fan. Many helicopter fans are supplied pre-drilled for this size of magnet. If so, simply press the magnet into the pre-drilled hole and use thin super glue or two-part epoxy to secure it. The magnet may be mounted either North or South face out - RevLock copes with either polarity. Please note that only one magnet should be fitted -
Do not use two magnets unless you have a low-revving petrol (gas) engine - see Appendix 1

If your fan is pre-drilled with two opposing holes you may wish to fit a counter weight into the second hole. These are available as Part No. CSMRL16 from your CSM stockist.



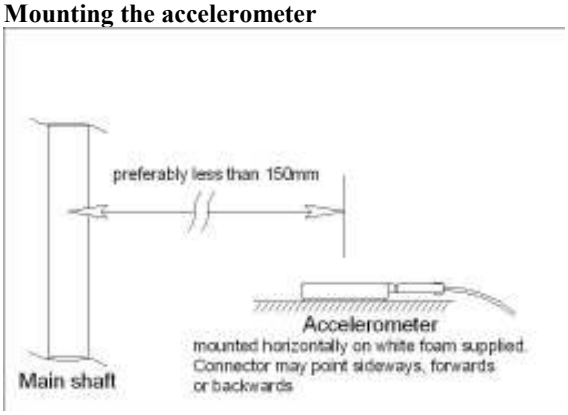


If your fan is not pre-drilled for the magnet you should assemble the sensor onto the engine first and then mark and drill the fan where the magnet will pass the end of the sensor (not off to one side). If possible bolt the fan to the engine with the magnet furthest from the piston.

Mounting the sensor.
Three sizes of sensor mounting bracket to suit 30, 50, and 60 - 90 size engines are included with RevLock.
Mount the sensor oriented as shown so that the magnet passes the end of the sensor with a gap of about 1 to 2mm. The unit has an automatic sensor signal test which allows you to check that the sensor is close enough to the magnet for correct operation.

When routing the sensor cable to the main RevLock unit take care that the wire will not come into contact with the exhaust.

Mounting the accelerometer



The accelerometer requires a mounting site in the helicopter that is horizontal and not too far from the centre of gravity. A location within 150mm of the main shaft is ideal. Avoid locations likely to be subject to high vibration (i.e. close to engine mountings).

Installing the RevLock Unit
You may find the quick reference guide on the 'At a glance' card useful to identify the RevLock connectors. Your RevLock 20 unit is capable of operating in 'Manual' or 'Remote' RPM control modes. In 'Manual' RPM mode the required engine RPM is set entirely from the controls on the RevLock unit. In 'Remote' RPM mode the required RPM can be set from the transmitter via any available auxialiary channle. Use the 'Manual' mode only when no suitable auxiliary channel is available on your receiver.

Connect the throttle servo to the "TS" output of the main RL40 unit

Connect the engine sensor to the "SEN" input of the main RL40 unit

Connect the accelerometer to the "ACC" input of the main RL40 unit.

Using one of the supplied cables connect the throttle output of the receiver to ‘TH’ of the main RL40 unit.

Connect the collective servo or CCPM mixer to “COL OUT”

Connect the collective output of the receiver to “COL IN”

Optionally use the third supplied cable to connect the ‘REM’ input of RL40 to a suitable auxiliary channel of the receiver.

Position the unit where the LEDs can be seen, and attach using the adhesive pads supplied.

Radio Set-up
RevLock does not have any special requirements as regards pitch and throttle curves. It has also been designed to give excellent results with servos of modest speed (0.19s/60deg.) A model that has already been flown satisfactorily without a governor will not usually require any adjustment. However if the model has not been flown before installing RevLock you should adjust the throttle linkage and ATV values to

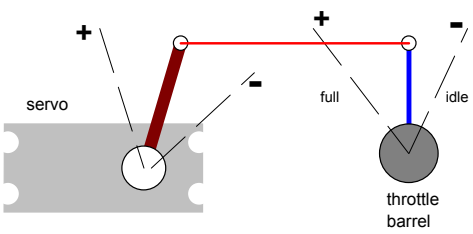


Diagram of suggested Servo arm offset.

ensure that the throttle movement covers the fully shut to fully open position without binding of the linkage or stalling the servo. Select a servo arm length that avoids throttle ATV values greater than 115% or less than 85%. Some engines have very non-linear throttling characteristics with small throttle movements at light loads causing large changes in power while large movements are required to produces significant power changes near full throttle. You should adjust the throttle trim until the correct idle is obtained with the stick in the fully closed position with the idle-up switch in the normal position. A linear throttle curve taking the throttle from idle at bottom stick to full throttle at top stick is ideal. Any Idle up state should have its lowest throttle value at least 25% above the idle point to ensure that the governor remains engaged at all collective positions. A fully aerobatic idle up pitch range (with equal positive and negative pitch ranges) should have the normal V shaped throttle curve. RevLock will tend to mask carburation problems with the engine so we strongly recommend that you check the mixture settings of the engine with the governor disabled. This is easily gone by pressing 'SET' during the Sensor Test routine. This will prevent RevLock from engaging. RevLock will simply pass the throttle signal from the receiver directly to the servo. RevLock's Fail-safe will remain active.

The throttle hold should put the throttle to the idle position.

Built-in PPM Fail-safe
RevLock includes a fail-safe feature to improve safety when used with a PPM radio system. If RevLock is not sent throttle pulses from the receiver for over 1 second it will force the throttle servo to the stored idle position until throttle data from the receiver is restored. This fail-safe cannot operate when used with a PCM receiver. **It is vitally important that with PCM radios the throttle channel fail-safe is set to the idle point or below to ensure that the governor will disengage on radio failure.**

Basic set-up procedure

This procedure tells RevLock about your throttle idle and throttle full positions and servo type.

When a new RevLock is first turned on the Speed LEDs will 'ripple' to show that it has no set-up data stored. This condition may also occur if the set-up process was not completed successfully. If the LEDs are not rippling then some earlier basic setup data is stored and you should force RevLock into the basic setup routine by holding 'SET' down during power up to erase all previous data. (see 'Re-entering the setup procedure' below)

Hold down 'SET'. All the LEDs will light as a 'lamp test'.

Release 'SET'. RevLock will enter basic set-up mode.

One Speed LED will light - you are at step 1 of the set-up. (**Idle set**)

Put the throttle to the normal Idle position (NOT the throttle fully shut position)

Press 'SET'.

Two Speed LEDs will light - you are at step 2 of the set-up. (**Full throttle set**)

Put the throttle to the fully open position.

Press 'SET'.

Three Speed LEDs will light - you are at step 3 of the set-up. (**Digital/Normal Servo set**)

With a normal servo put the throttle to the Idle position, check that both Mode A and Mode B LEDs are off and press 'SET'.

With a digital servo put the throttle to the full position, check that both Mode A and Mode B LEDs are on and press 'SET'.

Four Speed LEDs will light indicating set-up is complete. If digital servo support is ON then the two mode lights will also be on. RevLock now holds at the Idle position.

Check that the throttle is at idle and then turn off.

Re-entering the set-up procedure
Once the unit has received its initial setting up it will boot up using its stored data. If at any time you wish to change the set-up data (for example if you have changed the throttle linkage or the type of throttle servo) you may re-enter the set-up procedure by holding down the 'SET' while powering up the receiver. The unit will acknowledge entry of the procedure by turning on all the LEDs and ALL data will be erased.

Setting the Target RPM

RevLock monitors and controls engine RPM. To obtain a desired head RPM you should multiply the figure required by the engine to main gear ratio (eg 8.5 for a Raptor 50).
On power up all the LEDs will turn on briefly.

Accelerometer test

On power up, if the accelerometer signal is seen then (after the LED test) the main unit briefly flickers the Mode A and Mode B LEDs. If this does not occur, check the Accelerometer is plugged in correctly.

Sensor Test

Next, the "Sensor OK" LED will flash to show that the test is being done. With the throttle fully shut and with any glow drive disconnected, turn the engine over a few revolutions by hand or starter in the normal running direction. If the magnet-to-sensor distance is satisfactory the "Sensor OK" LED will light solidly. If not, you should re-adjust the sensor position as outlined above. After the sensor test you can set and target RPM values.

Sensor Test abort/engine set-up feature

The sensor test can be aborted by pressing 'SET'. This will turn the Sensor LED off and allow you proceed to speed setting. This feature is useful when you are setting speeds on the bench and your starter is not handy. It also allows the governor to be quickly disabled for carburettor setting engine runs. Mixture setting is much easier with the governor disabled as the action of the governor will tend to mask engine set-up problems.

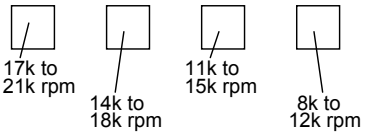
Target RPM setting in 'Manual' mode.

If the RevLock unit is not connected to a remote channel, the 'Manual' LED will be ON and only one target RPM value can be set. To set this RPM proceed as follows:-

Put the throttle to idle. 

Ensure that the "Sensor OK" LED is on (see sensor test above).

Pressing 'SET' will cycle the unit through the five speed range options. The currently selected speed range will be indicated on the Speed LEDs as illustrated below. If no Speed LED is lit then the unit is in Range 0 and is inactive.

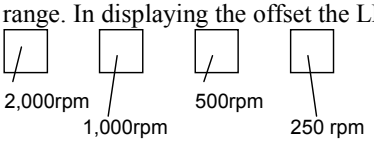


Press 'SET' until the required RPM range is indicated.

Put the throttle to fully open. 

Observe that the "ARMED" LED comes on.

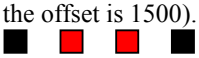
The function of the Speed LEDs now changes to show the RPM Offset. The offset is how far the target RPM is above the bottom of the range. In displaying the offset the LEDS have the following values:-



Turn the ADJUST control clockwise to increase the offset RPM and anticlockwise to decrease it. To set the adjuster to the right RPM either add up the value of each LED lit or refer to the RPM selector chart on the 'At a glance' card for the required light pattern.

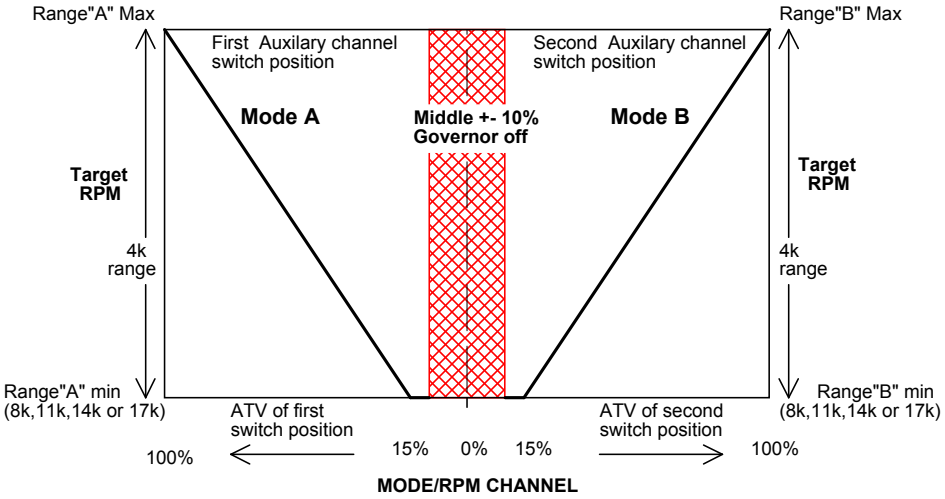
Example:-

If you wish to set the target RPM to 15,500 rpm you should set the throttle to Idle and press 'SET' till the 14k+ (14,000 to 18,000) range LED is lit like this:- 

The required rpm of 15,500 is 1,500 rpm above the bottom of the selected range (i.e. the offset is 1500). You set this by raising the throttle to full and rotating the ADJUST control until the 1,000 and 500 LEDs are lit like this:- 

Target RPM setting in 'Remote' mode.

In the 'Remote' mode an auxiliary channel is used to control the target RPM. This should be a switch controlled channel with ATV adjustment of the throw in both positions. RevLock allocates independent RPM ranges to the two switch positions as illustrated below.



Set the two target RPM values as follows:-

Power up the radio. Go through the Sensor test or abort the test as described before.

Put the throttle to idle. 

The unit will turn on either the Mode A or Mode B LED. Move the switch of the Mode/Speed channel between its two positions and check that the Mode LEDs change. Make a note of which switch position corresponds to which mode.

With the switch in the Mode A position and the throttle at the Idle position press 'SET' repaeatedly to increment the Mode A RPM Range which will be shown on the Speed LEDs. Note that Range 0 (no LEDs on) ensures that the unit will be inactive in that mode.

Put the throttle to full. 

Set the RPM channel switch to Mode A

Setting the RPM offset for Mode A is done using the ATV of the Mode/Speed channel. The resulting offset into the range will be displayed on the speed LEDs. Increasing the ATV will increase the RPM and vice versa. Start with a low ATV value increase the ATV until the Speed LEDs just show the correct pattern for the speed required. The RPM selector chart on the 'At a Glance' card shows the display pattern for all engine RPM values. Although the display only shows engine RPM in 250 RPM steps RevLock measures the Remote channel value to an accuracy of about 6rpm and typically a 1% change in Remote channel ATV corresponds to about a 50 RPM change in target engine RPM.

Switch to Mode B, put the throttle to idle and set the desired RPM range for mode B using 'SET'. Then put the throttle to full and set the RPM offset for the mode B target speed.

Setting the ATV for either Mode below 10% will inhibit the unit from engaging. The unit shows that the ATV is in this state by flashing the Mode LED.

Fine tuning of the target RPM can be made in flight by changing the Remote channel ATV or by mixing other inputs into the Remote channel (see also Appendix 2).

Note that the Range is locked once the engine RPM reach about 3500rpm.

Where the Remote channel for the governor is controlled by the Idle-up switch (for example when using the JR code 44 feature) you may be unable to reduce the throttle to the low position to set the range for either Mode A or Mode B. In this case select idle up and then press 'SET'. This will switch the display briefly to show the current range value (the 'Armed' LED will go off to show the change in display mode). While the range is being displayed in this way further pressing of 'SET' will change the range for the current Mode. After a short pause the display will revert to the offset value and the Armed LED will come on again.

Collective set-up

The Collective management system works on both positive and negative pitch and is intended for use with symmetrical (eg +12 deg. to -12 deg.) collective pitch ranges. The g-sensitivity of RL40 considerably simplifies the setup of the collective and allows significantly more collective pitch range to be used compared to a conventional governor. RL40 will limit the collective pitch in high-g situations where blade

speed is critical to providing enough lift and cyclic authority while allowing full collective in climb and forward flight where some trade off of head speed for more pitch gives better performance (because lower blade speed means less power used in overcoming blade drag leaving more power to climb the model). With most helicopters it is simply a case of adjusting the linkages and collective pitch curve in the transmitter to allow the collective to cover the largest travel possible subject to not causing any binding at the extremes of collective and cyclic controls and allowing RL40's collective management system to adjust how much of this range to employ in all flight conditions. During early flight tests try sustained vertical climbs and reduce the collective pitch range only in situations where the engine bogs down excessively in the climbs. Generally the best climb and forward flight performance is achieved with some loss of head speed and the engine operating towards the lower end of its power band. Note that in assessing the engine speed in the climb the Doppler shift makes it difficult to do this by ear alone as the shift lowers the apparent engine note as the model moves away from you. This effect can be reduced by doing the climbs some distance away and starting from head height. This also gives a better chance of assessing the climb rate visually.

As an aid to set-up an optional external 'Collective Management Active' LED is available. When connected to the CMA connector of the unit, this will light when the RL40 is reducing the collective pitch, so is best mounted so that it can be seen during climb-out.

Pre-Flight Checks.

At turn on observe that after the brief 'LED test ' flash of all the lights, the Mode A & B LEDs will flicker briefly to indicate the accelerometer is connected and the sensor OK LED will start flashing. Turn the engine by hand or with the starter for several revolutions in the normal direction of rotation. If the sensor position is OK the "Sensor OK" LED will come on solidly. If the Sensor OK LED remains flashing check that the Sensor is correctly plugged into the unit. Then check that the magnet is not passing off to one side of the sensor or that the sensor is too far from the magnet.

With the throttle low ensure that the Mode LEDs respond to the Tx Mode/Speed channel switch and that the correct RPM ranges are being displayed for each mode.

Now check that the "Armed" LED comes on when the throttle is raised to 25% above the Idle point and goes off if the throttle is lowered below 15%.

Fail-safe check

Before flying the model ensure that the failsafe system works. With a PCM radio you will need to set the throttle channel fail-safe to idle for this to operate. For PPM systems RevLock's internal fail-safe system is active. Turn on the model. Turn over the engine to complete the Sensor test but do not start the engine. Put the throttle to high and observe the Armed LED come on. Now turn off the transmitter and check that the Armed LED goes out and the throttle goes to idle after about 1 second when the fail-safe cuts in. Beware that low-quality PPM receivers that lack a 'squelch' facility and cause servos to dither continually while the transmitter is off can defeat RevLocks internal fail-safe. Do not use such receivers for helicopter use.

Responsivity control

When the unit is operating in 'Remote' mode the ADJUST control is used as a responsivity control. A good initial setting is with the control in the middle of its range. Correct adjustment is done by test flying. If the governor responsivity is too low then the engine speed will slow for a short period when the load is increased and will rise noticeably when the load is decreased. Too high a responsivity is indicated if the engine has any tendency to hunt or 'warble' when subjected to sudden load changes. This may be most noticeable in windy turbulent conditions.

Normal operation of RevLock

The unit engages when the following conditions are met:-

1. The Throttle is raised above 25% from Idle
2. The Sensor signal is OK
3. The engine RPM are above 75% of the target governor RPM.

Once engaged, the unit will disengage if any of the following occur:-

1. The throttle is brought below 15% above Idle.
2. The RPM drop below 50% of the target governor RPM.
3. The sensor signal is lost.
4. Uf the throttle signal from the receiver is lost (fail-safe)

When the unit is not engaged the throttle signal from the Rx is passed directly to the servo.

The unit will be inactive if:-

1. The current range is set to zero (all Speed LEDs off in Range display) This may be in 'Manual' mode, mode A or mode B.

2. Either Mode A or Mode B LED flashing. (control channel ATV too low)

3. The Sensor OK LED is OFF (test aborted by user) or flashing (the unit has not seen a big enough sensor swing to ensure correct RPM measurement).

Soft Engage facility
The unit includes a soft engage facility that ensures that on engaging the unit smoothly ramps the RPM from the current RPM to the governor target RPM. On changing the mode the unit smoothly ramps the RPM to the new governed RPM.

Appendix 1
Use with low reving petrol (gas) engines
When using a petrol (gas) engine that needs to operate below the 8000 RPM lower limit for RevLock you can use two magnets located accurately 180 degrees apart on the fan. It is important that these magnets be fitted facing the same way around (e.g. both magnets with their North poles towards the sensor). To do this place one of the magnets flat on a steel plate. Mark the exposed face of the magnet with an indelible marker pen or nail varnish. When the ink/varnish is dry place the second magnet on top of the first. Mark the exposed face of this magnet as before.

Now fit the two magnets to the fan with the mark outermost. Note that the Sensor OK test will fail if the two magnets are not the same way around.
RevLock will now see twice the actual engine rpm so you will need to set RevLock to twice your actual target rpm.
Additional magnets are available as a CSM spare part no. CSMRL11

Appendix 2
Pirouette climb/fall correction
In critical hovering there is a minor effect on rotor lift from pirouetting. Because the rotor speed is fixed relative to the body of the helicopter when you pirouette in the direction of the rotor, the speed of the blades through the air increases and the helicopter will tend to climb. Conversely pirouetting opposite to the rotor direction will reduce the blade speed through the air and cause the helicopter to fall. Because RevLock converts ATV values to a high accuracy (6 engine RPM) it is possible for RevLock to make the fine adjustments to the target RPM required by mixing the rudder channel of your transmitter to the governor control channel. For a clockwise rotor head the correct sense of mix is when a left rudder command increases the target rpm. The degree of mix will depend on the gear ratio of the model and the RC system in use but a 10% mix will generally be a good starting point. Adjust the degree of mixing until the tendency to climb and fall in porouettes is minimised. When using this technique avoid running close to the top or bottom of a RevLock RPM range. Because the ranges have a 1000 RPM overlap this is generally easy to arrange. Ensure that at full rudder deflection the Mode LEDs stay on solid and **do not flash** (which would indicat too low an ATV)

Appendix 3
The following spares & accessories are available for your RevLock

CSMRL11	Magnet
CSMRL12	Hall effect engine sensor
CSMRL13	30 size sensor mounting bracket
CSMRL14	50 size sensor mounting bracket
CSMRL15	60 - 90 size sensor mounting bracket
CSMRL16	Counter weight
CSMRL17	Adhesive heat shrink sleeve 10cm
CSMRL31	Collective Management Active LED
CSM0029	Mounting foams
CSM0032	Pair of 100mm input leads
CSM0033	Pair of 200mm input leads
CSM0034	Pair of 300mm input leads
CSM0035	Pair of 400mm input leads
CSM0035	Pair of 500 mm input leads
CSM0015	LPT/parallel port PC interface
CSM0049	USB PC adapter

Ratings
Main unit: Weight: 9g Dimensions : 30mm x 35mm x 4mm
Accelerometer head 2g, 18 x 26 x 4 mm

Supply voltage range: 4.1 - 7.2v**
** Warning: Check your RC system voltage limits as these may be more restrictive.
Typical current draw: 10mA

Manufactured in the UK by CSM Design Consultancy Ltd

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