

Dawnmist UltiMix 5000 Instruction Manual

Computer Radio Control System Upgrade and Mixer

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1 Introduction

UltiMix 5000 adds full microcomputer functionality to a model aircraft (or other model) fitted with a simple, conventional PPM R/C system. Unlike typical computer R/C's which perform most of the processing at the transmitter, UltiMix 5000 places the computer functionality in the model itself, which brings a number of technical advantages. It is only recently that sufficiently powerful microprocessors to do this have become available and affordable — the UltiMix 5000 uses the very latest technology to cram an entire high-reliability real-time microcomputer into a 17-gram package that is smaller than many R/C receivers. UltiMix 5000 is ideally suitable for helicopters as it provides mixing programs for both 90° and 120° swashplates, as well as support for exotic aircraft configurations such as Vee-Tail and Elevons (delta wing) and differential steering as used on tracked vehicles (e.g. tanks) and some water craft.

UltiMix 5000 is also designed to be upgradable. Its on-board operating software can be reprogrammed for a nominal handling cost by Dawnmist Studio, keeping your investment up-to-date with the latest technical innovations and improvements.

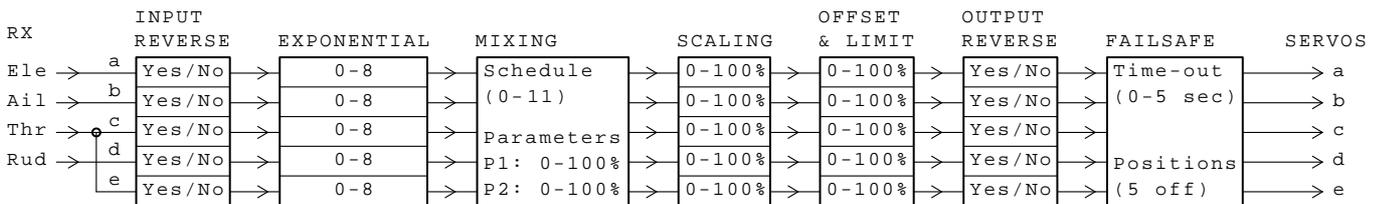


Fig. 1: Block Diagram of UltiMix 5000 Operation

2 How It Works

The UltiMix 5000 contains seven logical sub-units as illustrated in Fig. 1, and with the variable parameters shown. You will see that there are five signal paths through the unit, leading eventually to the five possible servo outputs (a to e). The fifth channel is an 'auxiliary throttle' and its purpose will become clear when discussing collective pitch mixing (CPM) for helicopters. The unit can store and recall up to five independent user programs, where each program has its own user-defined values for all these variables.

It can be seen that each signal path can be independently reversed (before and/or after the mixing process), subjected to varying degrees of exponential (from 0 (linear) to 8 (sharpest exponential)), mixed in various ways, scaled by between 0–100%, offset by an arbitrary distance (and limited to legal limits of travel), and finally output to the servos subject to the unit's failsafe operation. The failsafe is conceptually simple but very powerful in use: for each program, a specific 'failsafe' set of servo positions is memorized, along with a time-out which can vary between zero and five seconds, or can be set never to time out. When the integrity of the incoming signal from the Rx is lost (due to a glitch, equipment failure, interference etc.), the UltiMix initially holds its outputs at their last valid setting. If the time-out period expires before the signal returns, the unit switches its outputs to the remembered failsafe settings. Typically the time-out is set to a second or two, so that momentary glitches do not disturb the aircraft's flight path, but guaranteeing that a failsafe position is rapidly adopted if the signal is lost. As soon as a valid signal reappears, the unit exits failsafe mode and the servos move to their commanded positions.

To summarize, then, UltiMix 5000 can store up to five user programs using non-volatile memory (i.e. memory is retained even in the absence of power). Each program consists of the following settings, and their defaults (in a 'blank' program) are as shown:

- Five input/pre-mix ('stick') reversal settings, one per servo. These are Yes/No settings (default No).
- Five exponential settings, one per servo. These range from 0 (linear) to 8 (strongest exponential). Default is linear (0). The details of the exponential values can be found under **Technical Specifications**.
- An optional mixing schedule (No mixing, CPM1, CPM2, CCPM1, CCPM2, VeeTail, Elevons, HH-CPM, HH-CCPM, DiffSteering, DiffSteering+Elevons, SpecialDiff) and up to two mixing parameters

whose use is explained under each mixing schedule. Default is no mixing; both parameters default to 50%.

- Five scale settings, one per servo. Each is 0–100% (default 100%).
- Five offset settings, one per servo. Each is 0–100% (default 50%).
- Five output/post-mix ('servo') reversal settings, one per servo. These are Yes/No settings (default No).
- A stored 'snapshot' of the 'failsafe' servo positions (one per servo). Default central.
- A time-out value for failsafe operation, 0–5 seconds or Off. Default 1 second.

The 'offset and limit' function works as follows: the offset parameter is expressed as a percentage of full travel, such that 'servo centred' is offset to the specified percentage of full travel — thus 50% means 'no offset' (centred input gives centred output), values less than 50% give negative offset, values greater than 50% give positive offset. After offsetting, the servo travel is limited to legal values (a range of slightly over 90° of servo rotation). This provides a 'clipping' effect which can sometimes be useful: for example, with the offset set to 0% (negative offset of half travel), the servo will not move off the end position until the (processed) stick value reaches almost half-stick. Offset is a relatively rarely-used function: if you don't need it, simply leave the offset set to 50% and it will have no effect. The commonest use of the offset facility is to store trim settings in the UltiMix rather than having to adjust the Tx trims when the R/C is moved between different models. In this application, offset values are typically not far from 50%.

As well as the five non-volatile program stores, the unit has a 'current program' store which is used to alter and experiment with programs before storing them in one of the five non-volatile stores, and also has a preset 'blank program' which can be loaded as a starting point for creating your own programs. Any existing program may also be recalled as a starting point for a new program. All five stored programs, as well as a record of which one is selected, are stored in non-volatile FLASH memory. This memory can be altered whenever you like, but still retains data indefinitely in the absence of power — so the unit cannot 'forget' its programming.

2.1 The Mixing Schedules

The unit's operating software at present provides a choice of 12 different mixing schedules, which are listed here with their Schedule Numbers. There are two *parameters*, P1 and P2, associated with the mixing schedule, though P2 is not used in Schedules 5 and 6 and neither parameter is used in Schedule 0. The schedule number and parameters chosen are stored as part of the user's program.

0 No Mixing. This schedule allows the UltiMix 5000 to be used in a standard airframe with the usual four control axes. This allows the unit to be used to add scaling, reversal, exponentiation and failsafe to a standard aircraft configuration without performing any mixing. In this schedule, the mixer block in Fig. 1 does nothing, so the outputs *a–e* are simply processed versions of the elevator, aileron, throttle, rudder and auxiliary throttle (optional), respectively.

1 CPM1: 90° Swashplate. This schedule performs a typical helicopter mixing operation. P1 sets the relative contribution made to the collective pitch by the Throttle/Collective and Elevator/Aileron controls (50% giving equal weights), while P2 sets the relative contribution made to the tail servo by Throttle/Collective and Rudder controls (again, 50% gives equal weights). Mathematically, the transfer function of the mixer block is thus:

$$\begin{array}{ll} \text{(Swashplate rear)} & a = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ele} \\ \text{(Swashplate left)} & b = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ail} \\ \text{(Swashplate right)} & c = P1\% \times \text{Thr} - (100-P1)\% \times \text{Ail} \\ \text{(Tail servo)} & d = P2\% \times \text{Thr} + (100-P2)\% \times \text{Rud} \\ \text{(Aux throttle)} & e = \textit{unchanged} \end{array}$$

2 CPM2: 90° Swashplate (Reverse Tail). Very similar to Schedule 1, this simply reverses the effect of the Throttle/Collective input on the tail servo without also reversing its effect on the swashplate

servos. This is the only reversal that cannot be covered by the Reverse blocks at the input and output (see Fig. 1) and is therefore provided as a separate schedule. Mathematically:

$$\begin{aligned}
 \text{(Swashplate rear)} & \quad a = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ele} \\
 \text{(Swashplate left)} & \quad b = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ail} \\
 \text{(Swashplate right)} & \quad c = P1\% \times \text{Thr} - (100-P1)\% \times \text{Ail} \\
 \text{(Tail servo)} & \quad d = (100-P2)\% \times \text{Rud} - P2\% \times \text{Thr} \\
 \text{(Aux throttle)} & \quad e = \textit{unchanged}
 \end{aligned}$$

3 CCPM1: 120° Swashplate. This schedule performs helicopter mixing for equi-spaced (120°) swashplates. P1 sets the relative contribution made to the collective pitch by the Throttle/Collective and Elevator/Aileron controls (50% giving equal weights), while P2 sets the relative contribution made to the tail servo by Throttle/Collective and Rudder controls (again, 50% gives equal weights). Due to the 120° spacing of the servos, the transfer function is rather complicated in order to keep the elevator, aileron and collective functions from interacting. Mathematically, the transfer function of the mixer block is thus:

$$\begin{aligned}
 \text{(Swashplate rear)} & \quad a = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ele} \\
 \text{(Swashplate left)} & \quad b = P1\% \times \text{Thr} + 1.154 \times (100-P1)\% \times \text{Ail} - 0.5 \times (100-P1)\% \times \text{Ele} \\
 \text{(Swashplate right)} & \quad c = P1\% \times \text{Thr} - 1.154 \times (100-P1)\% \times \text{Ail} - 0.5 \times (100-P1)\% \times \text{Ele} \\
 \text{(Tail servo)} & \quad d = P2\% \times \text{Thr} + (100-P2)\% \times \text{Rud} \\
 \text{(Aux throttle)} & \quad e = \textit{unchanged}
 \end{aligned}$$

4 CCPM2: 120° Swashplate (Reverse Tail). Very similar to Schedule 3, this simply reverses the effect of the Throttle/Collective input on the tail servo without also reversing its effect on the swashplate servos. This is the only reversal that cannot be covered by the Reverse blocks at the input and output (see Fig. 1) and is therefore provided as a separate schedule. Mathematically:

$$\begin{aligned}
 \text{(Swashplate rear)} & \quad a = P1\% \times \text{Thr} + (100-P1)\% \times \text{Ele} \\
 \text{(Swashplate left)} & \quad b = P1\% \times \text{Thr} + 1.154 \times (100-P1)\% \times \text{Ail} - 0.5 \times (100-P1)\% \times \text{Ele} \\
 \text{(Swashplate right)} & \quad c = P1\% \times \text{Thr} - 1.154 \times (100-P1)\% \times \text{Ail} - 0.5 \times (100-P1)\% \times \text{Ele} \\
 \text{(Tail servo)} & \quad d = (100-P2)\% \times \text{Rud} - P2\% \times \text{Thr} \\
 \text{(Aux throttle)} & \quad e = \textit{unchanged}
 \end{aligned}$$

5 Vee-Tail. A Vee-tailed aeroplane uses two independently-movable diagonally-slanted tailplanes to perform the functions normally provided by rudder and elevators. This mixing schedule combines the rudder and elevator signals in the appropriate way. P1 sets the relative sensitivity to rudder and elevator commands (50% is equal). When the tailplanes are angled 45° from horizontal, equal sensitivity is usually appropriate. For other angles, P1 should be adjusted to give the desired relative sensitivity (higher numbers increase the elevator effect and decrease the rudder effect). Mathematically,

$$\begin{aligned}
 \text{(Tailplane left)} & \quad a = P1\% \times \text{Ele} + (100-P1)\% \times \text{Rud} \\
 \text{(Ailerons)} & \quad b = \textit{unchanged} \\
 \text{(Throttle)} & \quad c = \textit{unchanged} \\
 \text{(Tailplane right)} & \quad d = P1\% \times \text{Ele} - (100-P1)\% \times \text{Rud} \\
 \text{(Aux throttle)} & \quad e = \textit{unchanged}
 \end{aligned}$$

6 Elevons. A delta-winged aeroplane typically uses two independently-movable elevons to perform the functions normally provided by ailerons and elevators. This mixing schedule combines the aileron and elevator signals in the appropriate way. P1 sets the relative sensitivity to aileron and elevator commands (50% is equal). In most cases, equal sensitivity is usually appropriate, but any desired weighting can be chosen: higher values of P1 increase the elevator effect and decrease the aileron effect. Mathematically,

(Left elevon)	$a = P1\% \times Ele + (100-P1)\% \times Ail$
(Right elevon)	$b = P1\% \times Ele - (100-P1)\% \times Ail$
(Throttle)	$c = \textit{unchanged}$
(Rudder)	$d = \textit{unchanged}$
(Aux throttle)	$e = \textit{unchanged}$

7 **HH-CPM: 90° Swashplate.** This schedule performs a variation of Schedule 1 without the tail-mixing function, for use with heading-hold gyros. Since P2 is not needed for tail mixing, it is instead used to allow direct adjustment of the relative sensitivity of the swashplate servos to aileron/elevator. P1 sets the effect of the throttle, while P2 sets the effect of the elevator and ailerons. Mathematically, the transfer function of the mixer block is thus:

(Swashplate rear)	$a = P1\% \times Thr + P2\% \times Ele$
(Swashplate left)	$b = P1\% \times Thr + P2\% \times Ail$
(Swashplate right)	$c = P1\% \times Thr - P2\% \times Ail$
(Rudder)	$d = \textit{unchanged}$
(Aux throttle)	$e = \textit{unchanged}$

8 **HH-CCPM: 120° Swashplate.** Similar to Schedule 7 but for 120° swashplates, this schedule performs a variation of Schedule 3 without the tail-mixing function, for use with heading-hold gyros. Since P2 is not needed for tail mixing, it is instead used to allow direct adjustment of the relative sensitivity of the swashplate servos to aileron/elevator. P1 sets the effect of the throttle, while P2 sets the effect of the elevator and ailerons. Mathematically, the transfer function of the mixer block is thus:

(Swashplate rear)	$a = P1\% \times Thr + P2\% \times Ele$
(Swashplate left)	$b = P1\% \times Thr + 1.154 \times P2\% \times Ail - 0.5 \times P2\% \times Ele$
(Swashplate right)	$c = P1\% \times Thr - 1.154 \times P2\% \times Ail - 0.5 \times P2\% \times Ele$
(Rudder)	$d = \textit{unchanged}$
(Aux throttle)	$e = \textit{unchanged}$

9 **Differential Steering.** Used for models which steer by means of two motors which run at different speeds in lieu of a rudder. The classic example of this type of steering is of course tracked vehicles such as tanks, though differential steering can be found on all sorts of craft. This mixing schedule combines the throttle and rudder signals to derive left and right motor (throttle) signals. P2 defines the action of the throttle relative to the rudder: 50% gives 'true' differential steering where the full range of steering angles is available at any speed, but correspondingly the fastest dead-ahead speed is limited to 'half throttle' — this low a P2 value usually makes for steering which is over-sensitive at high speeds. On the other hand, a P2 of 100% allows full-speed ahead and limits the steering angle at high speeds. Intermediate P2 values give intermediate results; some experimentation will help you choose the best setting for your model. Mathematically,

(Elevator)	$a = \textit{unchanged}$
(Ailerons)	$b = \textit{unchanged}$
(Left Motor)	$c = P2\% \times Thr + 0.5 \times Rud$
(Right Motor)	$d = P2\% \times Thr - 0.5 \times Rud$
(Aux throttle)	$e = \textit{unchanged}$

10 **Differential Steering with Elevons.** Used for models which combine differential steering (see Schedule 9) with Elevons (see Schedule 6), this schedule is simply a combination of Schedules 6 and 9:

(Left elevon)	$a = P1\% \times Ele + (100-P1)\% \times Ail$
(Right elevon)	$b = P1\% \times Ele - (100-P1)\% \times Ail$
(Left Motor)	$c = P2\% \times Thr + 0.5 \times Rud$
(Right Motor)	$d = P2\% \times Thr - 0.5 \times Rud$
(Aux throttle)	$e = \textit{unchanged}$

11 **Differential Steering with Centre Engine.** This schedule is identical to schedule 9 except that it adds special processing to the Aux Throttle output to drive a forward-only centre motor in conjunction

with reversible left and right motors. This configuration is used on some boats. The right and left channels should be set up with reference to schedule 9, while the Aux Throttle function has no parameters to adjust. Its function is to map the upper half of the throttle stick's travel to the *full* range of the output, and leave the output at minimum when the stick is below halfway. This is the correct logic to drive a non-reversible ESC from the Aux Throttle channel while driving reversible ESCs from left and right channels. If the range of outputs provided by the Aux Throttle function needs to be adjusted to match your ESC, the Ultimix's Offset (and possibly also Scale) functions will be found helpful — for example, if the centre ESC does not start until the stick is well above centre, a positive offset should be applied to the Aux Throttle channel. Mathematically,

- (Elevator) $a = \text{unchanged}$
- (Ailerons) $b = \text{unchanged}$
- (Left Motor) $c = P2\% \times \text{Thr} + 0.5 \times \text{Rud}$
- (Right Motor) $d = P2\% \times \text{Thr} - 0.5 \times \text{Rud}$
- (Aux throttle) $e = \text{See Text}$

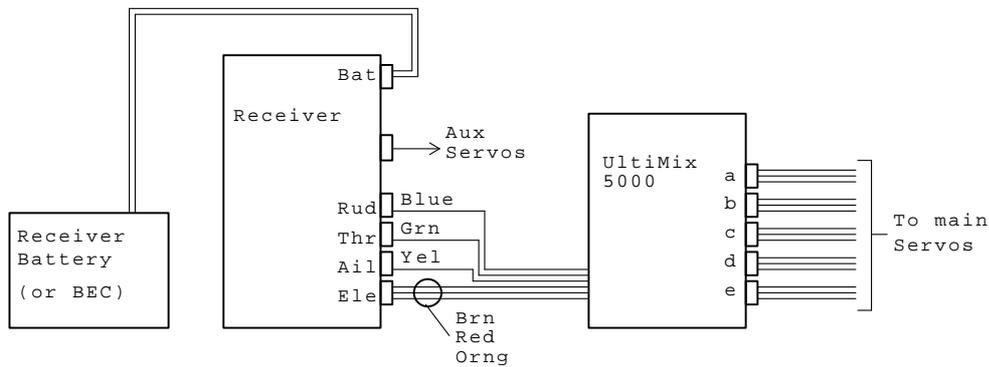


Fig. 2a: Connecting Up (No Gyro)

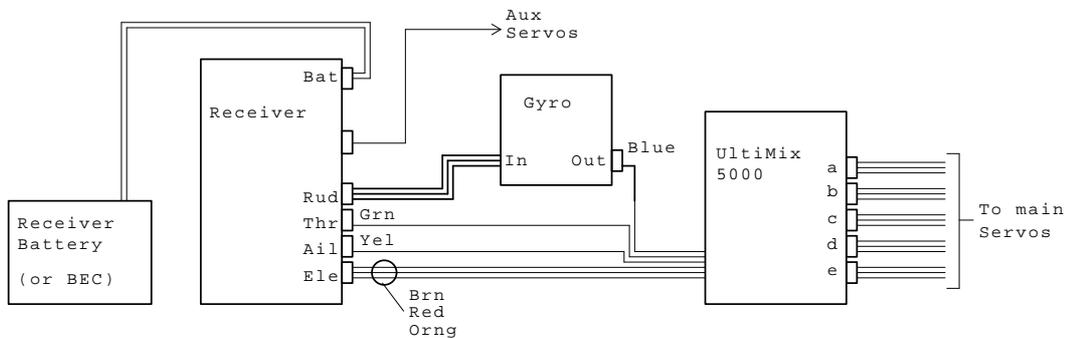


Fig. 2b: Connecting Up (With Rudder Gyro)

2.2 Connecting Up

Referring to Fig. 2a/b (and also Fig. 3), you will see that connecting the Ultimix 5000 into your R/C system is simple: the Ultimix has a ribbon-cable ending in four 3-pin servo-type plugs, and these plug into the primary four channel outputs of the Rx, colours as shown. Please note that the plugs are non-polarized so that they will suit any make of R/C, and therefore it is important to plug them in the right way round. By looking at the Rx's battery socket, you will see that the centre pin is positive (usually red), and one of the side pins is negative (usually black), the remaining pin being unconnected on the battery pack — this becomes the 'data out' pin on a servo socket. Plug the four plugs from the Ultimix in such that the three connectors with only one pin used are orientated so that the used pin corresponds to 'data out' and not battery negative. The remaining (Elevator) plug has all three pins implemented, and this is inserted such

that the brown lead corresponds to battery negative and the orange lead to 'data out' (the UltiMix 5000 obtains its operating power via this connection). Accidental reversal of the plugs is not likely to cause any damage but will prevent the system from working until the mistake is corrected.

In a similar way, up to five main servos (whose precise functions depend upon the mixing schedule selected) are plugged in to the male connectors on the UltiMix 5000. These connectors are again unpolarized for compatibility with all manufacturers, and are oriented such that the negative pin is towards the edge of the board and the 'data out' pin towards the large black microchip visible on the board. Please refer to Fig. 3 to find your way around the UltiMix 5000 board; this also shows which servo output is which.

When a gyro is in use, as in a helicopter rudder application, the gyro should be connected inline between the Rx's Rudder output and the UltiMix 5000's Rudder input, rather than between the UltiMix and the servo (see Fig. 2b). A standard three-conductor lead connects the gyro to the Rx in the usual way, allowing the gyro to obtain its power from the Rx. By connecting the gyro 'before' the UltiMix, the tail mixing function will not 'fight against' the gyro's corrections. Similarly, if a gyro is fitted to another control function (for example, a few modellers use a gyro for aileron stabilization of an aeroplane), then again the gyro(s) should be fitted *between* the Rx and the UltiMix 5000 in order to prevent any conflicts between the gyro corrections and the mixing functions.

As a final point, if your R/C has more than four channels, then whatever auxiliary channels it uses are connected directly to servos, rather than through the UltiMix — again as shown in Fig. 2a/b. This applies to auxiliary functions such as landing gear retracts which do not require processing via the UltiMix.

The physical layout of the UltiMix unit is shown in Fig. 3. Studying this figure in conjunction with the mixing schedules above will help to identify which of the five servo outputs is which. The figure also shows the locations of the buttons and LEDs that are used for setting-up the unit.

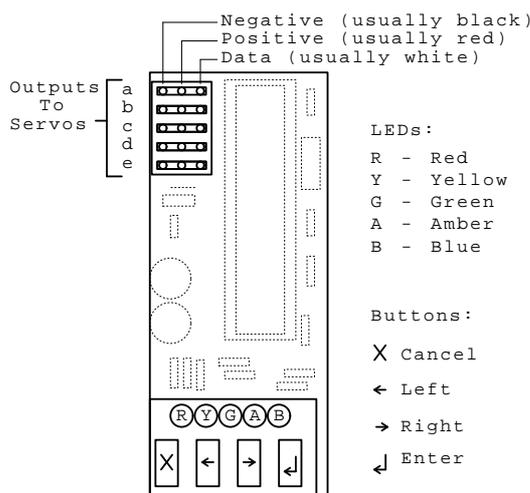


Fig. 3: Layout of UltiMix 5000

2.3 Transmitter Setup

The UltiMix 5000 does not require any complicated transmitter (Tx) setup, being designed to work with transmitters with minimal facilities. Some more elaborate transmitters have some degree of adjustability, most usually this is scaling (adjustment of servo throw, sometimes called ATV) and reversal, in addition to the basic trims that all transmitters have. Scaling, if provided, should be turned off (adjust the control for full-throw operation) as it can upset the exponential function of UltiMix. Scaling can be done at the UltiMix instead, where it takes place after any mixing functions, which is the correct place for it. Servo reversal can be selected at the Tx if desired, but since the UltiMix 5000 also has a channel-by-channel reverse facility it is usually simpler to ignore the reversal switches at the Tx and perform any reversals needed at the UltiMix. This is particularly true if you move your equipment between several models — by keeping the Tx setup fixed and performing all the setup at the UltiMix (with its automatic memories for up to 5 models) a lot of confusion can be avoided.

3 Normal Operation

When first powered-up, the UltiMix 5000 first flashes all five of its LEDs, then flashes out the number of the user program selected the last time it was operated (this is flashed on the blue LED, 1 to 5 flashes corresponding to Programs 1 to 5). If no program has ever been selected (as in the case of a brand-new unit), the blue LED does not flash at all and the 'blank' program is selected by default. As soon as the blue LED has flashed out the program number, the unit enters normal operation.

In normal operation, either the red or green LED is illuminated (and no others): green if the Rx is receiving a valid signal, or red if not. You can see the unit change state by switching the Tx on and off; this will also demonstrate the failsafe function.

In normal operation, the UltiMix 5000 simply obeys the selected program, processing the input signals in accordance with Fig. 1 and outputting them to the servos. In the event of a glitch or signal loss, the time-out procedure begins: the red LED lights instead of green, and the unit initially holds the servos in their last valid position. If a signal is not restored before the pre-set Time-out has expired, the servos move to their programmed failsafe positions. When a signal is finally restored, the LEDs change back from red to green and the servos take up the transmitted positions.

The unit remains in 'normal operation' at all times unless it is sent into Programming Mode by pressing the Cancel button. Even while programs are being edited, the unit still accepts inputs and produces outputs as defined by the current program settings, but the red and green LEDs do not indicate status as they are used as part of the user interface for programming. Thus the basic functions of UltiMix remain in operation all the time.

4 Programming UltiMix 5000

4.1 The User Interface

Referring to Fig. 3, you will see that there are four buttons (designated **Cancel**, **Left**, **Right** and **Enter**) and five coloured LEDs. The software uses these resources to provide a powerful but easy-to-use scheme for setting-up and programming the UltiMix 5000. To keep things simple, the entire user interface is built around just two types of user interaction, called respectively "One of Five" and "Numeric" menus.

To activate the user interface, simply press (and release) **Cancel**. The unit carries on operating normally upon the R/C signals at all times, but this action cancels the usual red/green LED indication and invokes the user interface instead.

One special feature that is worthy of note is the 'one-minute time-out'. At any point in the user interface, if no button is pressed for an entire minute, the unit exits from whichever menu it is in and reverts to normal operation. This makes it simple to recover from any confusion that might occur over which menu the unit is in. After the time-out has occurred, another press on the **Cancel** button is required to re-enter the user interface at the top-level menu.

A graphical 'map' of the user interface is given in Section 9. Referring to this alongside the descriptions given here should make the unit's operation clear.

4.1.1 One-of-Five Menus

In any One-of-Five menu, one out of the five LEDs flashes. The flash rate varies from menu to menu as a reminder of which menu you are in. The flashing LED varies from leftmost (red, representing Option 1) to rightmost (blue, representing Option 5). You can move the selection left and right respectively by using the **Left** and **Right** buttons. Pressing **Cancel** escapes right out of the user interface and reverts to normal operation without performing any menu selection. Pressing **Enter** accepts the current selection and performs the chosen menu function.

4.1.2 Numeric Menus

Numeric menus are used when a numerical parameter is to be displayed and/or amended. Using the menu consists of displaying the current value of the parameter, and then allowing the user to modify the value before re-displaying it. This display–change sequence continues until **Enter** is pressed, or until the one-minute time-out operates if no buttons are pressed.

All numeric parameters used in UltiMix 5000 lie within the range 0–100, and some are restricted to smaller ranges. Numbers are indicated on the LED display by flashing out the ‘tens’ on Amber, then the ‘units’ on Blue (e.g. 54 will be shown as five flashes of Amber followed by four flashes of Blue) — with two exceptions, for zero and 100. Zero is indicated by the Green, Amber and Blue LEDs flashing once, together (otherwise there would be no flashes at all for zero), and 100 is indicated by the Green LED flashing once (as a ‘hundreds’ column, in effect). If any button is pressed while the number is being flashed out, the flashing is stopped immediately and the button acted upon, otherwise a button is awaited after flashing finishes. As soon as any button is pressed, the updated value of the number is flashed out (unless the **Enter** button is pressed to accept the new value).

In numeric input mode, the buttons have the following functions:

- **Cancel.** Forces the numeric value to zero.
- **Left.** For a parameter with a 0–100 range (rather than a single digit), this button increments the ‘tens’ digit by one. If the count is ninety-something, then pressing **Left** raises the number to 100; if the count is already 100, pressing **Left** ‘wraps around’ to zero. For single-digit parameters, **Left** instead decrements the ‘units’ by one, ‘sticking’ at zero¹.
- **Right.** For a parameter with a 0–100 range, increments the ‘units’ digit by one, wrapping round from 9 to zero without incrementing the ‘tens’ digit. For single-digit parameters¹, the count ‘sticks’ at maximum and does not wrap round.
- **Enter.** Accepts the number currently displayed.

This procedure may seem a little complicated at first, but with practice it becomes very simple to use. A little experimentation is helpful to accustom yourself to the way the menu system works. Remember that you can experiment freely with the ‘current program’ without affecting any of the stored programs.

4.2 The Menus

4.2.1 The Main Menu (M0)

The first menu entered upon pressing **Cancel** to start up the user interface is the Main Menu, or M0. This is a One-of-Five menu that selects top-level functions. The table below shows which function corresponds to which LED, and which sub-menu is activated:

Red	Inspect/change per-program parameters (M1)
Yellow	Inspect/change per-servo parameters (M2)
Green	Recall stored program (M3)
Amber	Save current program (M4)
Blue	Null-out current program (—)

It will be seen that all of these functions invoke a lower-level menu of some sort with the exception of the NULL function (Blue). The latter simply clears the current program to a ‘do-nothing’ setting that passes the input signals through unchanged, flickering the Blue led for confirmation. This can be a useful starting point for constructing your own programs. Please note that NULLing the current program does not in itself affect any of the five stored programs. The stored programs can only be altered with the SAVE command, and the selection of which of these is loaded at power-up can only be altered by either the SAVE or RECALL commands.

¹The mixing schedule number is treated as a single digit even though it can exceed 9. This is usually found to be more convenient than treating it as a multi-digit number as it can thus be directly incremented or decremented using the **Left** and **Right** keys.

4.2.2 The Per-Program Parameters Menu (M1)

Following a flicker of the Red LED to confirm M1 Mode, this menu offers a One-of-Five selection of which of the per-program parameters to view/change (this affects only the Current Program, of course). The options are:

Red	Mixing Schedule ² (0–11)
Yellow	Mixing Parameter P1 (0–100)
Green	Mixing Parameter P2 (0–100)
Amber	Time-out Setting (0–100)
Blue	Set Failsafe Values

The first four of these functions use a numerical menu to show/adjust the relevant parameter as explained previously. In all cases, the selection is confirmed by a flicker of the appropriate LED, and likewise, final confirmation of pressing **Enter** causes the same LED to flicker again. After performing any function within M1, the user interface returns to M1 again to allow other parameters to be altered. To exit M1, press **Cancel** which returns to normal operation.

The meanings of the mixing parameters were described previously. The Time-out is expressed as a percentage of maximum (5 seconds), e.g. a value of 20 gives a one-second time-out. Zero means ‘never time out’ — if you require an instantaneous time-out, use 1 instead of zero. If the time-out is set to zero, the unit always holds the last valid position after a signal loss and never goes to the stored failsafe positions.

The final (Blue) function of M1 is slightly different. This is the ‘set failsafe’ option, and sets the failsafe positions of all five servos for the current program. Instead of using some kind of menu input, this option simply ‘takes a snapshot’ of the servo positions being commanded by the Transmitter at the precise moment that **Enter** is pressed to select Blue. These positions are held as the current program’s failsafe positions and may be Saved along with the rest of the program. Therefore it is necessary to have the transmitter switched on and sending a valid signal when this option is selected.

4.2.3 The Per-Servo Parameters Menu (M2)

Following a flicker of the Yellow LED to confirm M2 Mode, this menu offers a One-of-Five selection of which servo’s parameters to view/change. The menu options are as follows, or **Cancel** can be pressed to exit to normal operation without changing anything.

Red	Servo A
Yellow	Servo B
Green	Servo C
Amber	Servo D
Blue	Servo E

When a servo is selected, first of all the corresponding LED flickers to confirm the selection. There is then a sequence of five numerical menu inputs for the servo, as detailed below. Upon completion, the user interface goes back to M2 to allow another servo to be altered if desired (use **Cancel** to escape).

1. Flicker Yellow, then view/change input (pre-mix or ‘stick’) Reverse parameter (0–1; 0 for no reversal).
2. Flicker Green, then view/change Exponential parameter (0–8; 0 for linear).
3. Flicker Red, then view/change Scale parameter (0–100; 100 for no change).
4. Flicker Amber, then view/change Offset parameter (0–100; 50 for no change).
5. Flicker Yellow, then view/change output (post-mix or ‘servo’) Reverse parameter (0–1; 0 for no reversal).
6. Flicker Blue, then return to M2 for another servo.

²The upper limit of this parameter varies according to the version of software installed: future releases of Ultimix with more mixing schedules will have a higher maximum. Even though it can range higher than 9, it is treated as a single-digit parameter as far as numerical menus are concerned, for convenience of adjusting it up or down as well as for logical consistency with earlier software versions in which it could not exceed 9.

4.2.4 The Recall Program Menu (M3)

Following a flicker of the Green LED to confirm Recall Mode, this menu offers a One-of-Five selection of which of the five stored programs to recall. When **Enter** is pressed, the selected program is made current (i.e. copied to the current program store, where it can be modified if desired). Another flicker of the Green LED confirms that the Recall is complete. Recalling a program also causes the unit to 'remember' the recalled program as the power-on default.

4.2.5 The Save Program Menu (M4)

Following a flicker of the Amber LED to confirm Save Mode, this menu offers a One-of-Five selection of which of the five stored programs to overwrite with the current program. When **Enter** is pressed, the current program is copied to the selected program store, overwriting any previous contents of the store. Another flicker of the Amber LED confirms that the Save is complete. Saving a program also causes the unit to 'remember' the saved program as the power-on default.

An example will help to clarify things: let us assume that we wish to create a modified version of Program 3 to make a new Program 4. Start by Recalling Program 3, and then alter parameters as required using the Parameters menus. This will affect only the current program, not the stored Program 3. When satisfied with the changes, save the current program as Program 4. From now on, Program 4 will be loaded as the power-on default (until another program is Recalled or Saved). Any changes made to the current program but not Saved will be lost next time the power is turned off (or if another program is Recalled), so it is simple to undo any mistakes or unintended changes.

Section 10 provides a program recording sheet to enable you to note down the parameters of any programs which you wish to keep permanently for reference.

4.3 Test and Special Modes

There are three special functions of UltiMix 5000 that can be selected by holding down a combination of buttons as the unit is being powered-up. One of these is a Factory Test mode to help Dawnmist Studio to assure the quality of our products, one is used for loading software upgrades, and the other is a 'Factory Reset' that erases all stored programs and settings, restoring the unit to its as-delivered state. None of these functions need be used in normal circumstances.

Please note that to access these special functions, the relevant buttons must be held down right throughout the start-up procedure and then released after the initial LED flashing has finished.

To enter Factory Test mode, hold down the **Cancel** and **Left** buttons during power-up. The unit will then remain in test mode until it is powered-down. Accessing this test mode does not affect any stored user programs in any way and the selected program is still obeyed as in normal operation. The only difference is that the buttons do not perform their usual programming functions, but instead access test functions. The precise functions of Factory Test mode are not explained here as they are only of use to the unit's manufacturer. The test mode is documented here for completeness only.

To enter Software Update mode, hold down the **Cancel** and **Right** buttons during power-up. In this mode, normal operation does not occur, but instead the unit attempts to access an external computer and download a new version of its internal software. This is made possible by the use of advanced 'Flash Memory' in the microprocessor that powers the Ultimix, which can be updated thousands of times. Update mode is generally only used by Dawnmist Studio for installing upgrades. If this mode is entered by accident, simply switch off the unit and it will return to normal operation at next power-up — the software can only be changed by a complex interaction with an external system, and cannot be corrupted by accidentally entering Update mode without a special external "download adaptor" connected to the Ultimix. Upon entry to Update mode, the Blue and Amber LEDs are lit to indicate that the Ultimix is searching for a download adaptor. The Blue extinguishes when such an adaptor is found and downloading starts, then (after a few seconds) Red or Green indicates whether or not the download was successful. If downloading starts but does not complete, the Ultimix 'remembers' this state and thereafter will always power-up straight into Update mode until a successful download is performed, in order to ensure that the Ultimix cannot be put into use with corrupted software. If downloading was successful, the next power-up activates the new

software version. This process is documented here for completeness only, as Dawnmist Studio does not at present support end-user downloads due to the cost of the download hardware. Please note that this electronic update facility only exists on Version 2.00 and later of the Ultimix; earlier versions can still be updated but this requires physical removal of the microprocessor chip from its socket for reprogramming.

The final special function, Factory Reset, may occasionally be of use to the user. To access this mode, hold down the **Cancel** and **Enter** buttons during power-up. When the buttons are subsequently released, the unit wipes all of its program memories, by copying the 'blank' program into each memory in turn and leaving the current program selection 'unset' — this returns the unit to precisely the state in which it was delivered. When this has been done, all five LEDs flicker rapidly as an acknowledgement, and the unit then commences normal operation with a blank program. Please note that performing a Factory Reset erases all previous contents of the unit's program memories, and thereafter there is no way to retrieve the previous settings. This is why this mode has been deliberately made difficult to select, to prevent accidents.

If you wish to clear the current settings without erasing stored programs, please refer to 'Select Blank Program' in the programming instructions (see Main Menu, Blue option). To erase only selected program memories, select the blank program and then Store it in the chosen memory or memories (see Main Menu, Amber function).

5 Upgrades

UltiMix 5000 is designed to be upgradable. Its on-board operating software can be reprogrammed by Dawnmist Studio for a nominal handling cost, keeping your investment up-to-date with the latest technical innovations and improvements. Even new mixing schedules and whole new functional blocks can be added in software!

Dawnmist Studio is committed to continual product development and improvement. We are always interested to hear customers' feedback and suggestions for ways in which our products could be improved — please let us know what features you would like to see in future versions of the UltiMix 5000 software.

The version number of the currently-installed operating software will be found on the printed label on the underside of the unit. Check out the Dawnmist web site for details of any available upgrades (www.dawnmist.org/rcm.htm) and any version-specific information about upgrades. To obtain an upgrade, simply mail the UltiMix 5000 back to Dawnmist Studio with the appropriate upgrade fee (see web site) and your return address, then we will do the rest. Electronic updates (which can be done to any Ultimix with software version 2.00 or later) are inexpensive and are done by return of post. Early units with Version 1.xx software can still be updated to the latest spec, but this requires a chip change and takes a little longer.

Please be aware that the process of upgrading the software will clear all stored programs. Therefore it is prudent to make a note of the parameters of any programs you wish to keep prior to returning the unit to us, so that they can be re-entered when the upgraded unit is returned to you.

6 Technical Specifications

Product Title:	Dawnmist UltiMix 5000
Software Version:	2.30 (July 2009)
Dimensions:	58×24×12 mm
Weight:	17 gram (including cables/connectors)
Power:	4.5–6V at less than 25mA (one LED on)
Inputs:	4 channels from Rx and/or Gyro
Outputs:	1–5 servos
Program Memories:	5 non-volatile, 1 temporary
Memory type:	Non-volatile FLASH memory
Memory life:	40 years typical
Buttons:	Cancel, Left, Right, Enter
LEDs:	Daylight-visible Red, Yellow, Green, Amber and Blue
Failsafe:	Fully configurable, 5 channel
Processor:	20MHz RISC
Approvals:	Meets relevant  specifications

6.1 Exponential Values

For each possible value of the Exponential setting (0–8), this table shows the gain ratio, i.e. the gain at full-stick (fully up or fully down) relative to the gain at mid-stick (neutral). Essentially, 0 is linear, 1 gives the mildest exponential effect, while 8 gives the most pronounced exponential effect.

0	1:1 (linear)	3	2.5:1 (5:2)	6	5:1
1	1.33:1 (4:3)	4	3:1	7	6:1
2	2:1	5	4:1	8	8:1

7 Warranty and Support

The UltiMix 5000 comes with a limited warranty against defects in parts and workmanship for a period of one year after purchase. This does not cover damage caused by overload, misuse, impact or unauthorised modification, and is limited to the repair or replacement of the defective unit. Consequential losses of any sort are not covered, and it is stressed that it is the purchaser's responsibility to ensure that this product is used safely and properly. This does not affect your statutory rights.

Dawnmist products are engineered to a high standard, and we want you to get the best out of them. If you have any difficulties, please email tech@dawnmist.org for fast-response expert help.

Dawnmist Studio, Exwick, Exeter EX4 2LJ, United Kingdom (UK)

<http://www.dawnmist.org>

An online version of this document can be found at <http://www.dawnmist.org/ultimix.pdf>

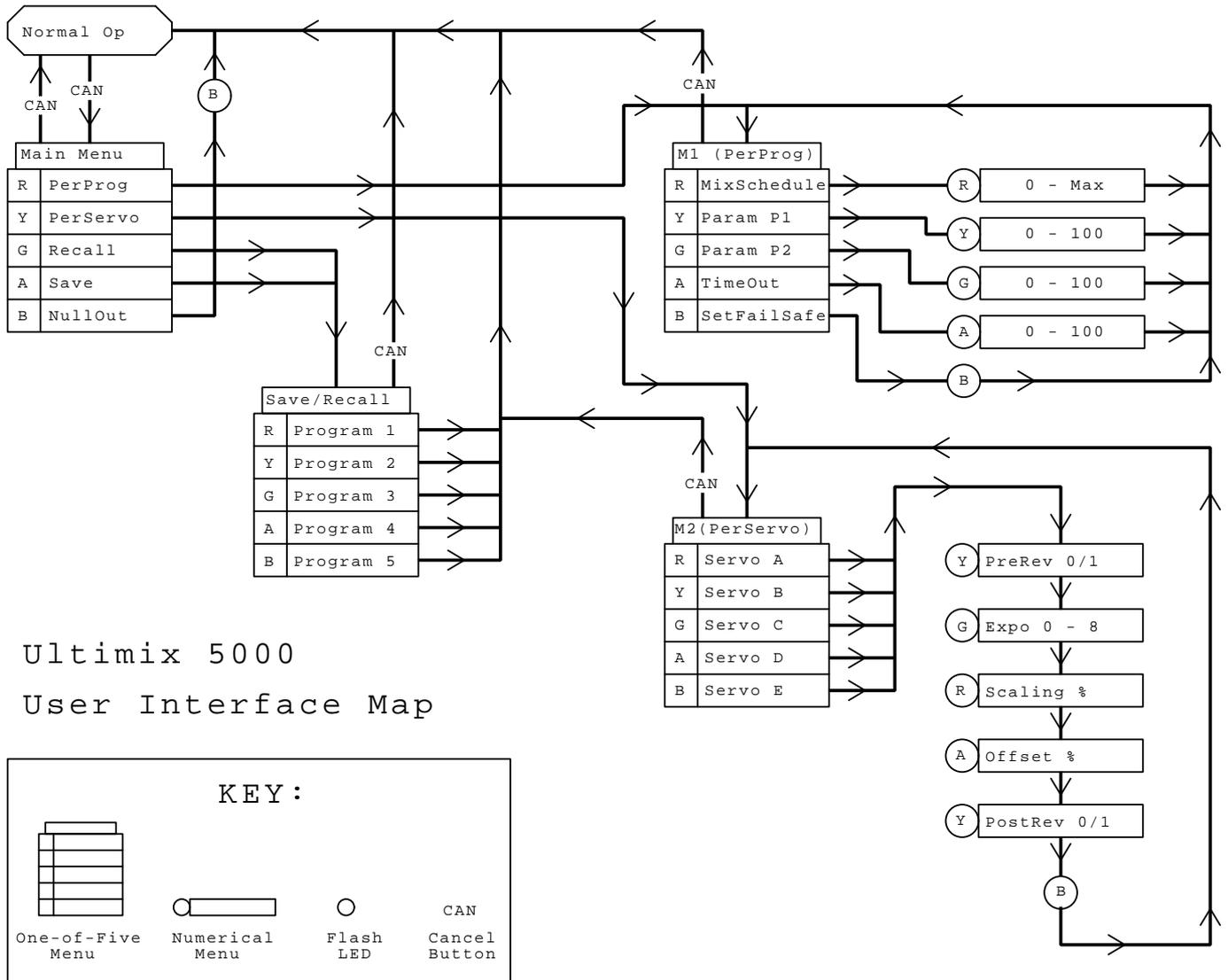
8 Revision History

This document, and the software to which it relates, is carefully maintained and regularly updated by Dawnmist Studio. Updated copies of the manual may be downloaded from the Internet (see above) or obtained by post. While the manual is written to reflect the current (latest) release of software, it is intended also to cover, as far as is possible, the earlier versions. This table describes the revision history of the software, to enable users with older versions to be aware of which features their software lacks and to help you decide upon when or if to upgrade to the latest revision.

V2.30	<i>10-Jul-09.</i> Added mixing schedule 11 (differential steering with centre motor) in response to customer requests.
V2.20	<i>24-Feb-05.</i> Added support for differential steering (mixing schedules 9 and 10), expanded and improved user manual in response to customer feedback.
V2.10	<i>28-Sep-04.</i> Added output (post-mix) reversal block (previous versions had only the pre-mix reversal block) and corresponding per-servo program parameter.
V2.00	<i>01-Aug-04.</i> Major new version, adding mixing schedules 7 and 8 to support heading-hold gyro applications and introducing electronic update facility for easy download of new software versions.
V1.10	<i>24-Apr-04.</i> Added offset-and-limit block for storing trim or offset data (previous version lacked this) and corresponding per-servo program parameter.
V1.00	<i>01-Apr-04.</i> First release with five functional blocks (reverse, exponential, mixing, scaling, failsafe) and mixing schedules 0–6.

9 User Interface Map

The figure below shows a graphical representation of the various components of the user interface (menus, etc.) and how they fit together. This is intended to elucidate the textual description of the user interface given previously and should be studied in conjunction with that description.



10 Program Recording Sheet

For your convenience, the final page of this manual consists of three copies of a write-in table covering all the elements of a complete Ultimix user program. You can use it to record present values of any program which has taken a while to perfect, for example in case you intend to experiment with the values and wish to record the previous settings, or if you are sending your Ultimix back for upgrade and wish to record the program(s). You are welcome to photocopy this table as many times as you like, or to download the Internet (PDF) version of this document from our web site and print out further copies.

Prog No.		Mix Schedule		P1		P2		Time Out	
Servo	Pre-Reverse	Exponential	Scale %	Offset %	Post-Reverse				
A									
B									
C									
D									
E									

Prog No.		Mix Schedule		P1		P2		Time Out	
Servo	Pre-Reverse	Exponential	Scale %	Offset %	Post-Reverse				
A									
B									
C									
D									
E									

Prog No.		Mix Schedule		P1		P2		Time Out	
Servo	Pre-Reverse	Exponential	Scale %	Offset %	Post-Reverse				
A									
B									
C									
D									
E									