micron radio control

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Micron MR001 Receiver Programming - v1.9.1

This document is available on-line at http://micronrc.uk/mr001-1.9.1-progtable where you will be able to use the links to access information about the functions that can be programmed.

This page contains programming information for firmware versions shown in the page title, information for other versions can be found via mr6xx_version.

Micron receivers implement a rich set of features with a common programming interface that allows functionality to be changed using most Micron model rail transmitters or a joystick Tx. Each row in the table below describes a 5 number sequence (levels 1 to 5) which is used to modify a feature's behaviour - e.g. change the throttle from centre-off to low-off behaviour; set an auxiliary output as servo, on/off, or auto-direction light. Each row also contains a brief explanation of the function accessed by that row and a link to more detail in the features page.

The value for each level of a programming sequence will be indicated by a repeated flash pattern on a receiver's LED. For example, the value 3 is displayed as a sequence of 3 flashes followed by a pause (this is called a 3-flash in receiver and transmitter user manuals). Where appropriate, a value of zero is displayed as a very short flash followed by a pause.

Many table rows specify how a transmitter control is used to activate the receiver function; the row specifies (usually at level 4) a R/C channel. Transmitters encode each control (throttle, toggle switch, push button, etc.) as a number in the range 0..1024 and transmits them in the radio signal as separate R/C channels. The mapping between transmitter controls and R/C channels is described in the user manual for the transmitter. Throttle is usually channel 1, Selecta (if used) is channel 2, the bind button is channel 5, and so on.

Receiver outputs use the channel value directly to provide a proportional response to transmitter control changes. Switched outputs divide the R/C channel range into 2 or 3 positions: low, mid and high where low is a channel value less than 250, high is greater than 750 and mid is 511 +/- a small delta. The transmitter user manual describes the control positions corresponding to low, mid and high and the programming table shows how these low, mid and high values are used to control the receiver output.

For specific information on how to place a receiver into programming mode, see the receiver's user manual. See the transmitter's user manual or Receiver Programming for information on how to use a transmitter for entering a program sequence.

Programming Table

ESC Configuration | Servo Configuration | On/Off Configuration | General Configuration | Radio Configuration | Input | Power Switch

Menu	Level 2	Level 3	Level 4	Level 5	Information
1 = ESC Configuration (top)	1 = ESC Num	1 = Centre off (1 ch: fwd/rev) esc-centre-off	**Throttle** 1-10 = R/C Channel		Forward and reverse with one control, off at control centre (-100% .. 0 .. +100%) prog: 1,1,1,1 = Menu1, H1, centre-off, R/C chan 1
1	1 = ESC Num	2 = Low off (2 ch: speed & direction) esc-low-off	Throttle R/C Channel 1-10 = R/C Channel	**Direction** 1-10 = R/C Channel	One control for throttle (0 .. 100%) Second control for direction (prog: 1,1,2,1,3 = Menu1, H1, low-off, R/C chan 1, R/C chan 3
1	1 = ESC Num	3 = Low off to Fwd/Rev (2 ch: speed & direction) esc-low2ctr	**Throttle** 1-10 = R/C Channel	**Direction** 1-10 = R/C Channel	One control for throttle (0 .. 100%) and another for direction. Both are combined into a single forward/reverse output, which must be type 'Throttle Servo'. (prog: 1,1,3,1,3 = Menu1, H1, low-off-to-centre, R/C chan 1, R/C chan 3'
1	1 = ESC Num	4 = Motor start power min-power	0-10 = Tens (x10) (0-flash = 0)	0-9 = Units (x1) (0-flash = 0)	Minimum power level, the motor will jump to this power when the throttle is opened. (0% for full power range) (eg: 1,1,4,2,5 = Menu1, H1, min power, 25%)
1	1 = ESC Num	5 = Motor max power max-power	0-10 = Tens (x10) (0-flash = 0)	0-9 = Units (x1) (0-flash = 0)	Maximum power level (100% for full power range) (eg: 1,1,5,8,0 = Menu1, H1, max power, 80%)
1	1 = ESC Num	6 = Motor reverse reverse	1 = Normal 2 = Reversed 3 = Normal (toggle allowed) 4 = Reversed (toggle allowed)		Reverse motor rotation. Options 1 and 2 do not affect directional lighting. Options 3 & 4 allow direction toggle if throttle is at max on startup - this also affects the directional lighting which is useful when consisting DMUs.

Menu	Level 2	Level 3	Level 4	Level 5	Information
1	1 = ESC Num	7 = Not used			PWM program not available
1	1 = ESC Num	8 = Motor soft start/stop - inertia soft-start	**Acceleration** 1 = immediate 2 = 0.25s 3 = 0.5s 4 = 1s 5 = 2s 6 = 4s 7 = 8s	**Deceleration** 1 = same as accel 2 = 0.25s 3 = 0.5s 4 = 1s 5 = 2s 6 = 4s 7 = 8s	Set the rate of throttle change - acceleration and deceleration, which can be set independently or the same. The times are for full range, 0..100% throttle. 1,1,8,1,1 = no inertia, motor speed immediately follows the throttle control 1,1,8,4,1 = accel and decel over 1s The default is immediate; 0.25s or 0.5s will reduce ESC heating for motors with significant BEMF.
1	1 = ESC Num	9 = Direction mode esc-dir-mode	**ESC Behaviour** 1 = direction latching* 2 = stop when neutral	**Direction Output Mode** 1 = immediately follow direction R/C ch* 2 = change only when throttle at stop	This program serves 2 purposes: 1. how changing the Tx direction control affects the ESC in low-off and low-to-centre modes 2: how an output (e.g. servo) mapped to the direction channel responds to changing the Tx direction control
1	1 = ESC Num	10 = Auto light mode auto-lights	1 = on when stopped (default) 2 = off when stopped		Set the auto light behaviour when the motor is stopped. The default is 'on when stopped' and should be changed to 'off when stopped' for road vehicles.
2 = Servo Configuration (top)	1-11 = P1-P11	1 = Normal Servo servo	1-10 = R/C Channel	1 = normal speed 2-6 = slow motion	Servo PPM signal on any 'P' pad. Default is full throw from full stick movement; servo travel and reversing can be adjusted using level3 = 7. Slow motion times are roughly equal to the number of seconds for end to end rotation (for an 'average' servo). **Note:** using this programming row over-rides any offset, toggle or mix settings.
2	1-11 = P1-P11	2 = Offset Servo servo-offset	1 = control low-mid 2 = control mid-high		Full range servo control using half of the transmitter control movement, either from low to mid or from mid to high. **Note:** the output must be first configured as a servo using level3=1; this allows specification of normal or slow speed. If the pin is not currently configured as a servo, the receiver will exit programming mode at level 3 with a rapid LED flash.
2	1-11 = P1-P11	3 = Servo Toggle servo-toggle	1 = start low, toggle chan low 2 = start low, toggle chan high 3 = start high, toggle chan low 4 = start high, toggle chan high		Servo toggles between low and high end points each time the channel is low or high. Use the 'Adjust Servo' and/or 'Expand Servo Range' functions to set the end points' **Note:** the output must be first configured as a servo using level3=1; this allows specification of normal or slow speed. If the pin is not currently configured as a servo, the receiver will exit programming mode at level 3 with a rapid LED flash.
2	1-11 = P1-P11	4 = Differential Servos servo-differential	**2nd Servo** 1-11 = P1-P11	**2nd servo direction** 1 = same direction 2 = opposite direction	Specify a second servo to be used as a differential servo mixed pair. Then, using the following programming row, specify a second R/C channel to be differentially mixed into the 2 servo outputs. **Note:** the first servo must be already configured as a servo using level3=1; this allows specification of normal or slow speed. If the pin is not currently configured as a servo, the receiver will exit programming mode at level 3 with a rapid LED flash.
2	1-11 = P1-P11	5 = Differential Second R/C	**2nd Channel**	**Mix direction**	Specify a 2nd R/C channel plus ratio

Menu	Level 2	Chan Level 3	1-10 = R/C Channel Level 4	normal Level 5	Information
		servo-differential		1 = 25% mix 2 = 50% mix 3 = 75% mix 4 = 100% mix reverse 5 = 25% mix 6 = 50% mix 7 = 75% mix 8 = 100% mix	and direction for mixing into the 2 servo outputs defined in the previous programming row. **Note:** the previous program row must be entered before this one, otherwise programming mode will exit with a rapid LED flash. The level 2 P number must be the main servo - the value entered for level 2 in the previous program row. Example: servos on P1 and P2, master R/C channel = 2, secondary R/C channel = 6 with a mix ratio of 50%: 1,1,1,2,2 (main servo=P1, main R/C=2, speed=1) 1,1,4,2,1 (main servo=P1, second servo=P2, same direction) 1,1,5,6,2 (main servo=P1, second R/C=6, ratio=50%)
2	1-11 = P1-P11	6 = ESC Servo servo-esc	1 = ESC Num		Servo output slaved to a ESC. Only one servo output at a time can be connected to a ESC. If a different servo is attached, the previously connected servo output stops worked and must be reprogrammed for some other function.
2	1-11 = P1-P11	7 = Adjust Servo servo-adjust	1 = Toggle Servo Direction 2 = Adjust Servo Travel 3 = Reset Behaviour		Toggle servo direction, adjust travel using transmitter controls, or reset behaviour back to standard. In the last case, the output will require reprogramming. If the pin is not currently configured as a servo, the receiver will exit programming mode at level 3 with a rapid LED flash.
2	1-11 = P1-P11	8 = Expand or Reduce Servo Range servo-range	expand 1 = normal range (1.1ms..1.9ms) 2 = +25% (1.0ms..2.0ms) 3 = +50% (0.9ms..2.1ms) 4 = +75% (0.8ms..2.2ms) 5 = +100% (0.7ms..2.3ms) 6 = +125% (0.6ms..2.4ms) 7 = +150% (0.5ms..2.5ms) 8 = +200% (0.3ms..2.7ms) reduce 9 = -75% (1.4ms..1.6ms) 10 = -50% (1.3ms..1.7ms) 11 = -25% (1.2ms..1.8ms)		Expand or reduce the servo throw range from the default 1.1ms .. 1.9ms (aka 100%) servo pulse width. The actual pulse width range will depend on the range of your transmitter's control. These fixed scaled values can be fine tuned using servo travel adjustment. If the pin is not currently configured as a servo, the receiver will exit programming mode at level 3 with a rapid LED flash. **Beware:** make sure that your servo can handle an increased range before connecting it.
3 = On/Off Configuration (top)	1-11 = P1-P11	1 = Momentary on/off momentary	1-10 = R/C Channel	Idle off P=0V, F=open 1 = ch low on 2 = ch mid on 3 = ch high on Idle on P=3.3V, F=closed 4 = ch low off 5 = ch mid off 6 = ch high off	1 R/C channel can control up to 3 outputs, momentary = non-latching. eg: 3,4,1,5,1 = P4, On only when Ch5 is low eg: 3,6,1,5,3 = P6, On only when Ch5 is high
3	1-11 = P1-P11	2 = Single Action Latching latch1	1-10 = R/C Channel	Start off P=0V, F=open 1 = ch low toggle 2 = ch high toggle Start on P=3.3V, F=closed 3 = ch low toggle 4 = ch high toggle	1 R/C channel can control 1 or 2 outputs, each control action toggles the output on/off. (eg: 3,4,2,5,1 = P4, Start off, toggle when Ch5 is low) (eg: 3,6,2,5,2 = P6, Start off, toggle when Ch5 is high)
3	1-11 = P1-P11	3 = Dual Action dual-action	1-10 = R/C Channel	Channel high 1 = <1s momentary 2 = <1s toggle 3 = >2s momentary 4 = >2s toggle Channel low 5 = <1s momentary 6 = <1s toggle 7 = >2s momentary	1 R/C channel can control 1 to 8 outputs. Output selection is based on the time that the control is away from mid value (centre). The output can be configured for latching (toggle on/off) or momentary, short press momentary turns the output on for 0.5s; see the MRxxx Features documentation for details. All outputs

Menu	Level 2	Level 3	Level 4	Level 5	Information
3	1-11 = P1-P11	4 = Flash or Latch latch3	1-10 = R/C Channel	8 = >2s toggle Channel high 1 = <1s 0.5s momentary on 2 = <1s 1.0s momentary on 3 = <1s 1.5s momentary on 4 = <1s 2.0s momentary on Channel low 5 = <1s 0.5s momentary on 6 = <1s 1.0s momentary on 7 = <1s 1.5s momentary on 8 = <1s 2.0s momentary on	start off (P=0V, F=open). 1 R/C channel can control 1 or 2 outputs with either momentary with a selection of on times or latching action. Momentary or latching selection is based on the time that the control is away from mid value (centre): <1s gives a momentary on, >2s latches; if the output is latched on the momentary action is disabled. All outputs start off (P=0V, F=open).
3	1-11 = P1-P11	5 = Auto Lights auto-lights	1 = Forward 2 = Reverse 3 = Brake		Link output ports to the speed controller status. See 7,7 for setting brake light on time and 3,x,10 for setting the behaviour of the forward and reverse lights when stopped (default is on when stopped and should be changed to off when stopped for road vehicles).
3	1-11 = P1-P11	6 = Left Indicator & Hazard Light indicator-lights	**Activation** 1-10 = R/C Channel	**Steering** 1-10 = R/C Channel	Indicator and Hazard Lights (level 3 = 5 or 6). A < 1s operation of the activating channel (high/left=left, low/right=right) starts an indicator flashing, movement of the steering channel away from centre cancels the indicator. A > 2s high/left operation of the activating channel starts both indicators flashing together as hazard lights. There may be only one left and one right indicator pin.
3	1-11 = P1-P11	7 = Right Indicator & Hazard Light indicator-lights			See previous. An attempt to set right indicator without first setting a left indicator will result in a rapid CPU LED flash error.
3	1-11 = P1-P11	8 = Output Grouping output-groups	0-9 = Group ID (0-flash = no group)	**Group Behaviour** 1 = Exclusive 2 = Override	Group P or F logic outputs to co-ordinate behaviour. The default is no grouping. The only implemented behaviours are: • **Exclusive**: only one output is on at a time, attempts to set other outputs on are rejected • **Override**: setting an output on turns all other outputs off, turning the over-riding output off turns all outputs that were on back on
3	1-11 = P1-P11	9 = Flashing Light flashing-lights	1-10 = R/C Channel	**toggle when:** 1 = ch low 2 = ch high	Flashing Lights. Simple repeated flashes with configurable on/off times, sequence count and pause times, toggled by a high or low value on the activating channel. The default is a repeated 0.5s on/off flash.
3	1-11 = P1-P11	10 = Flashing Light On and Off Times	**On Time** 1 = 250ms 2 = 500ms* 3 = 750ms 4 = 1s 5 = 1.25s 6 = 1.5s 7 = 1.75s 8 = 2s 9 = 2.25s 10 = 2.5s	**Off Time** 1 = 250ms 2 = 500ms* 3 = 750ms 4 = 1s 5 = 1.25s 6 = 1.5s 7 = 1.75s 8 = 2s 9 = 2.25s 10 = 2.5s	Set the flashing light on/off duty cycle. The pin must already have been configured as flashing type (3,P,8,...). The defaults are marked with '*'.
3	1-11 = P1-P11	11 = Flashing Light Pattern and Repetition Delay	**Flash Count** 1..15	**Repetition Delay** 1 = 0 (immediate)* 2 = 0.5s 3 = 1s	Set the flashing light sequence pattern and repetition delay. The pin must already have been configured as flashing type (3,P,8,...). The

Menu	Level 2	Level 3	Level 4	Level 5	Information
				4 = 1.5s 5 = 2s 6 = 2.5s 7 = 3s	default is marked with '*'
4 = General Configuration (top)	1 = LED2 LED2	1 = LED2 Disabled 2 = LED2 Enabled (not when deselected or in cruise mode) 3 = LED2 Enabled when deselected or cruise 4 = LED2 Always	**LED2 Pin** 1-11 = P1-P11	**On-board LED** 1 = on continuously 2 = shut-off after 10s 3 = shut-off after 30s 4 = shut-off after 60s	**LED2:** Any output can drive a LED to mirror the on-board LED. 1-flash: disabled (LED2 pin choice must be specified but is not used) 2-flash: enabled but not after Rx is deselected (Selecta) or Tx is switched off (Cruise Control) 3-flash: enabled for Selecta and Cruise Control 4-flash: over-rides any other function on this pin (e.g. auto lights). **On-board LED:** 1-flash: on continuously 2-flash: shut-off after specified time from Rx enabled
4	2 = LVC LVC	1 = LVC Disabled 2 = LVC Auto			Enable or disabled low voltage cut-off. 2-flash = LVC enabled with auto threshold, 3-flash = LVC enabled with manually set threshold. Levels 4 & 5 only apply to manual threshold.
		3 = LVC Manual	Manual threshold (volts): 4-20 = 4-20V	Manual threshold (tenths): 0-9 = 0.1-0.9V	
4	3 = Sleep Sleep	Time before sleep: 1-6 = 1-6 hours 7 = never	LVC sleep: 1 = No 2 = Yes (5 minutes)		Inactivity timeout (1-6 hours) LVC sleep is triggered by Low Voltage Cut (if enabled)
4	4 = Failsafe / Cruise Failsafe	**Time to stop after signal loss** 1-4 = 1-4s 5 = sleep time	**Failsafe R/C channels** 1 = No 2 = Restore channel positions saved at bind time 3 = All channels off		Time to kill outputs after signal loss. Use 'Sleep time' (level 3 option 5) for 'cruise control' with transmitter switched off. The default is to stop all ESC and leave other outputs at the current setting. Outputs may optional be restored to the 'at bind' positions (level4 = 2) or turned off = 0V (level4 = 3),
4	5 = Emergency stop EStop	1 = Disabled			Manual trigger stop over radio. (eg: 4,5,2,3,6 stops using ch3 low with 6s delay - i.e. ch3 must be low for at least 6s to trigger.)', The 'not low' option is a good way of implementing a 'dead man's' button. Set 4,5,4,4,1 and connect a button to Tx2 or MT01 input 4. The button must be held down to operate a motor connected to the receiver; release the button and the motor stops. Use this with Cruise disabled (4,4,1) for full fail safe operation.
		2 = ch low to stop 3 = ch high to stop 4 = ch not low to stop 5 = ch not high to stop	1-10 = R/C Channel	Time to stop: 1-6 = 1-6s	
4	6 = ESC Arming Arming	1 = Disabled			Arm the ESC only when the throttle is in the off position. Enabled by default. THINK CAREFULLY before you disable this feature.
		2 = Enabled	1 = H1		
4	7 = Brake On Time auto-lights	1-6 = 1-6s			The time that the brake light stays on after stopping. The default is 1s.
4	8 = Selecta Selecta	1 = Disabled			Enable or disable the loco selection feature which is compatible with all transmitters that have a Select switch. All transmitters stocked by Micron use R/C channel 2 for Selecta. Multi-Select (level 3 = 3) allows a receiver to respond to multiple Selecta switch positions, e.g. for single and consist operation. The transmitter must be correctly calibrated for Multi-Select to work.
		2 = Enabled 3 = Enabled + Multi-Select 4 = Tx Change (not available) 5 = Clear all Selecta data	1-10 = R/C Channel		
4	9 = Deselect Action Selecta	1 = stop 2 = continue			Action when deselected: 'continue' or 'stop': continue - ESC continues at the last throttle setting. stop - throttle smoothly closes the default is 'continue'.
4	10 = Auto-light	1 = Disabled			Enable/disable the auto-direction

Menu	Level 2	Level 3	Level 4	Level 5	Information
	control auto-lights	2 = Enabled	1-10 = R/C Channel	**Start off** 1 = toggle when ch low 2 = toggle when ch high 3 = momentary on when ch high **Start on** 4 = toggle when ch low 5 = toggle when ch high 6 = momentary off when ch high	outputs using an R/C channel. When this control is enabled, the initial state of auto-lights is disabled (i.e. off). Any other function mapping of the R/C channel remains - e.g. output on/off switching.
4	11 = Reset Configuration Reset				Restore backed-up configuration or, if no backup, the factory configuration
4	12 = Backup Configuration Backup				Create configuration backup to be restored with a reset. A backup should be saved whenever the Rx configuration is changed by programming or using a power on jumper.
4	13 = Select Configuration Select Config	1-4 = stored configuration			Select one of the stored configurations, See the receiver documentation for details of each configuration
4	14 = Show Firmware Version Version				Show the firmware version by flashing the LED (and LED2 if enabled). Firmware versions are 2 numbers: major and minor (e.g. 1.2). 0.5s of rapid flashing is shown first, followed by a flash count for the major number, a pause and then a flash count for the minor number. A zero is shown as a very brief flash, much shorter than the normal flash. The pattern is repeated until the receiver is switched off.
5 = Radio Configuration (top)	1 = Binding Bind	1 = DSM2/DSMX Protocol	1 = auto only 2 = manual only 3 = manual then auto 4 = always		Choose auto or manual bind. The pins/pads for manual bind are specified in the receiver manual.
6 = Input (top)	**Input Pin** 1-11 = P1-P11	1 = Buffer Stop Trigger buffer-stop	Time to stop: 1-6 = 1-6 seconds		One P pad can be used as a trigger to stop the vehicle automatically by slowing to a stop. The throttle must be closed to restart. The trigger is enabled after the reactivation delay.
6	**Input Pin** 1-11 = P1-P11	2 = Stop & Reverse Trigger stop-reverse	Time to stop: 1-6 = 1-6 seconds	fixed pause 1-6 = 4,8,15,30,45,60s random pause 7 = 4-8s 8 = 8-15s 9 = 15-30s 10 = 30-45s 11 = 45-60s 12 = 60-120s (1-2m) 13 = 120-300s (2-5m) 14 = 300-600s (5-10m)	One P pad can be used to stop the vehicle automatically by slowing to a stop. The vehicle reverses at the same speed after the pause time. If the vehicle is manually restarted by closing and then opening the throttle during the pause time, the restart is cancelled.
6	**Input Pin** 1-11 = P1-P11	3 = Station Stop Trigger station-stop	Time to stop: 1-6 = 1-6 seconds	pause time as above	One P pad can be used to stop the vehicle automatically by slowing to a stop. The vehicle continues at the same speed and in the same direction after the pause time. If the vehicle is manually restarted by closing and then opening the throttle during the pause time, the restart is cancelled.
6	**Input Pin** 1-11 = P1-P11	4 = Not used			Placeholder for limit switch
6	**Input Pin** 1-11 = P1-P11	5 = Reactivation Delay automation	1-15 = 5 second increments		Set the delay before an input trigger is reactivated after being actioned. The default when setting an input type is 10 seconds (level 5 = 2). This

Menu	Level 2	Level 3	Level 4	Level 5	Information
					program allows the delay to be specified in 5 second increments: 1 = 5 seconds, 4 = 20 seconds, 9 = 45 seconds, 15 = 75 seconds. Resetting the input type (level 3 = 1..3) resets the activation delay to 10 seconds.
6	**Input Pin** 1-11 = P1-P11	6 = Input Enable/Disable automation	1-10 = R/C Channel	0 = disable control Start Enabled 1 = disable when ch low 2 = disable when ch high 3 = toggle when ch low 4 = toggle when ch high Start Disabled 5 = enable when ch low 6 = enable when ch high 7 = toggle when ch low 8 = toggle when ch high	All automation features are enabled by default. This function allows a transmitter control to over-ride this by: - disabling on receiver start - disabling or enabling while running The input type (options 1..4) must be programmed before this function. If the P port is not configured as input, an attempt to enter this program option will result in a rapid flash on the receiver LED. The actuating R/C channel may also be used for other functions - e.g. to light an LED to show the enable/disable state of automation.
6	**Input Pin** 1-11 = P1-P11	7 = Input Enable Indicator automation	0 = disable 1-11 = P1-P11		This function allows a Rx output (F or P) to be used to indicate when the input is manually activated - e..g. to illuminate a LED. The program sequence is available only when the 'Input Enable/Disable' control has been programmed. Set the pin value (level 4) to zero to disable the indicator.
7 = Power Switch (top)	**Pin** 1-11 = P1-P11	1 = Sense power-switch	1 = e-switch disabled 2 = e-switch enabled		The Sense pad is an input used to switch on and off. It must be active low - i.e. connected to negative for switching. The e-switch will be operative as soon as the Sense and Power ports are configured and the e-switch is enabled (7,P,1,2); the receiver will not initialise unless Sense is held low for at least 2s. A power-on-jumper can be used if you want to temporarily disable the e-switch.
7	**Pin** 1-11 = P1-P11	2 = Power power-switch	**Control Channel** 0 = disable 1-10 = R/C Channel	1 = action when ch low 2 = action when ch high	The Power pad is an active high output used to control an external electronic switch. The output is 3.3V when power is on and 0V to switch off. A R/C channel may optionally be used to switch the receiver off. This can be either active low or active high. The control must be held in the active position for at least 3s to switch off.