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ShockWave[®] 3 Sound Module

Version **5.0.2** Hardware Reference Manual

Date: July 20, 2019

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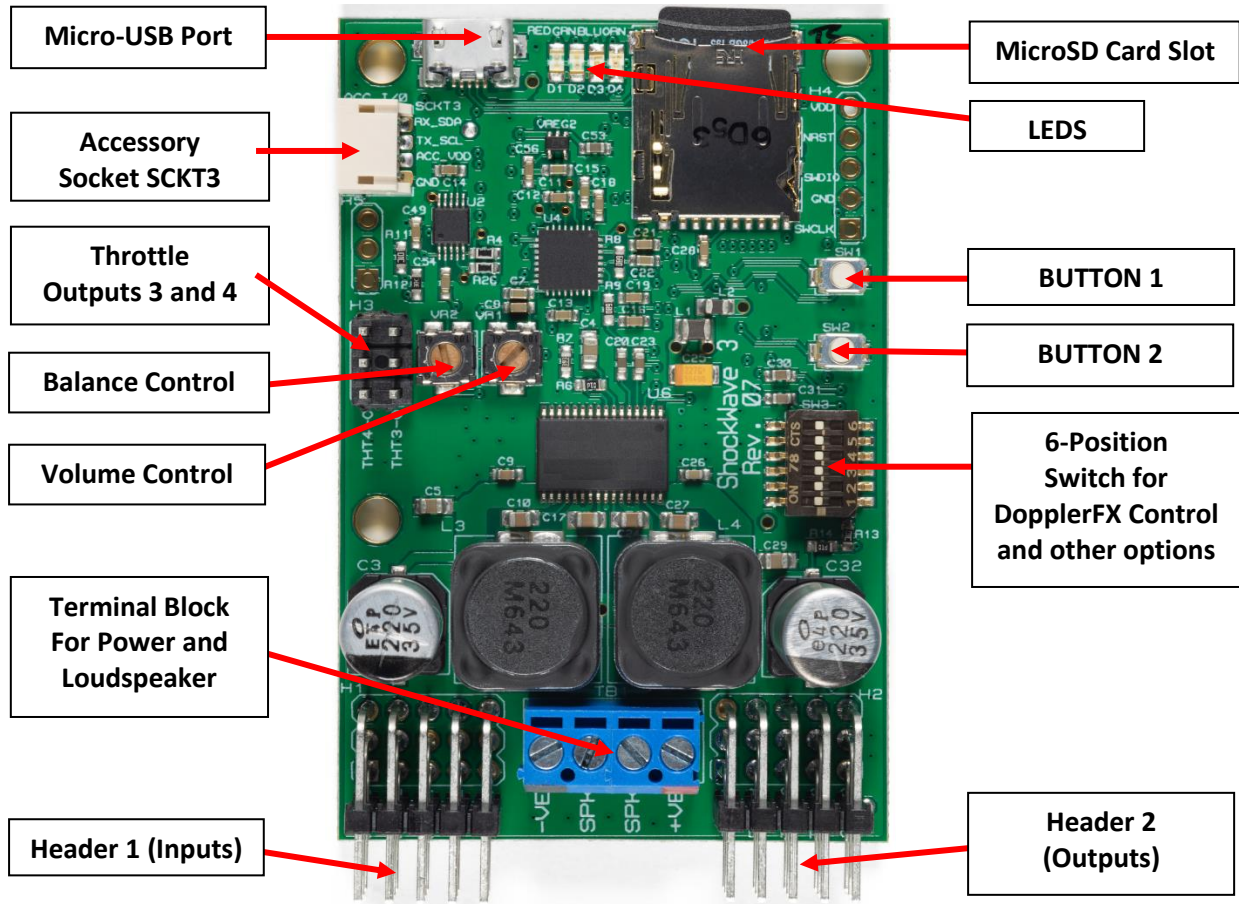
MAKE A BACKUP OF THE ENTIRE CONTENTS OF THE MICROSD CARD USING THE INCLUDED MICROSD TO STANDARD SD ADAPTOR, OR A USB MICROSD CARD READER ON YOUR COMPUTER BEFORE YOU DO ANYTHING!

MAKING A BACKUP SIMPLY MEANS COPYING ALL THE FILES AND FOLDERS ON THE MICROSD CARD TO PREFERABLY TWO STORAGE DEVICES. REMEMBER WHERE YOU PUT THE BACKUPS!



CHAPTER 1 – THE BASICS – GETTING STARTED

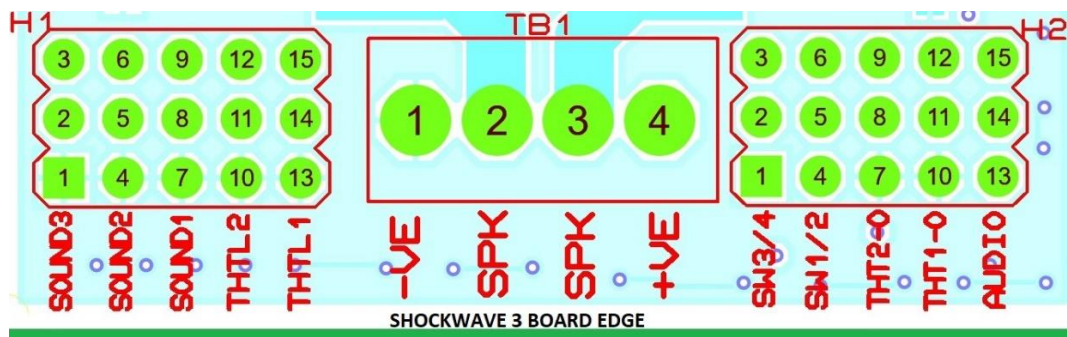
Figure 1: ShockWave 3 Sound Module Layout



Power supply input and loudspeaker connections are made through the blue terminal block TB1. All R/C receiver inputs for throttles and sound select are at Header 1. Optional throttle outputs, Switched Outputs and audio line outputs are at Header 2. In order to hear sound from the loudspeaker, 4.5 – 26 Volts power must be on the main terminal block terminals 1 and 4.

Recommended gauge for loudspeaker and battery wire is 22AWG solid core.

TERMINAL BLOCK AND CONNECTORS H1/H2/H3 DETAIL



HEADER 1 Detail – Use Male-Male or Male-Male-Female Servo Leads

Pin Numbers	Board Legend	Function	Notes
1, 2, 3	SOUND3	Sound Select3 signal in from receiver. Pin 1 is GND, 2 is receiver power, 3 is Sound Select3 signal.	Receiver power is on pin 2
4, 5, 6	SOUND2	Sound Select2 signal in from receiver. Pin 4 is GND, 5 is receiver power, 6 is Sound Select2 signal.	Receiver power is on pin 5
7, 8, 9	SOUND1	Sound Select1 signal in from receiver. Pin 7 is GND, 8 is receiver power, 9 is Sound Select1 signal.	Receiver power is on pin 8
10, 11, 12	THTTL2	Throttle2 signal input from receiver. Pin 10 is GND, 11 is receiver power, 12 is Throttle2 signal.	Receiver power is on pin 11
13, 14, 15	THTTL1	Throttle1 signal input from receiver. Pin 13 is GND, 14 is receiver power, 15 is Throttle1 signal.	Receiver power is on pin 14

Terminal Block TB1 Detail – Use 22AWG solid core wire

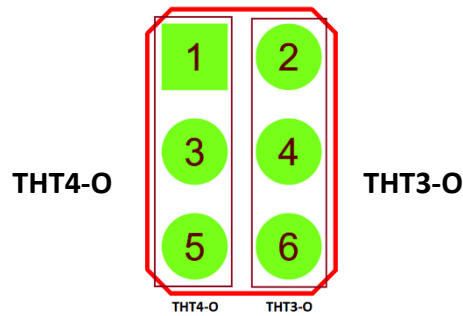
Pin Numbers	Board Legend	Function	Notes
1	--VE	Main Battery negative 4.5 Volts – 26 Volts	Do NOT reverse Battery leads!!
2,3	SPKR	Loudspeaker - Do NOT use less than 8 Ohms on voltages above 14.4 Volts. 4 Ohms is OK on 4.5 - 14.4 Volts.	Loudspeaker leads are reversible.
4	++VE	Main Battery positive 4.5 Volts – 26 Volts	Do NOT reverse Battery leads!!

HEADER 2 Detail

Pin Numbers	Board Legend	Function	Notes
1, 2, 3	SW 3/4	Switched Outputs 3/4. Pin 1 is SWITCH4, 2 is RECEIVER POWER , 3 is SWITCH3.	Receiver power is on pin 2.
4, 5, 6	SW 1/2	Switched Outputs 1/2. Pin 4 is SWITCH2, 5 is RECEIVER POWER , 6 is SWITCH1.	Receiver power is on pin 5.
7, 8, 9	THT2_O	Throttle2 signal output. Pin 7 is GND, 8 is receiver power, 9 is THT2_O signal.	Receiver power is on pin 8. Used for Multi-Sync feature.
10, 11, 12	THT1_O	Throttle1 signal output. Pin 10 is GND, 11 is receiver power, 12 is THT1_O signal.	Receiver power is on pin 11. Used for Multi-Sync feature.
13, 14, 15	AUDIO	Line level Audio Out signals – 1.0V RMS. 13 is GND, 14, is Left Signal, 15 is Right Signal.	Used to feed external amplifier(s).



HEADER 3 Detail



Pin Numbers	Board Legend	Function	Notes
1, 3, 5	THT4-O	Throttle Output 4. Pin 5 is GND, 3 is receiver power, 1 is THT4-O Output.	Receiver power is on pin 3. Used for Multi-Sync feature.
2, 4, 6	THT3-O	Throttle Output 3. Pin 6 is GND, 4 is receiver power, 2 is THT3-O Output.	Receiver power is on pin 4. Used for Multi-Sync feature.

NOTES :

- LEDs for guns or other switched loads can be connected between their Switch 1/2 terminals 4, 6 or Switch 3/4 terminals 1, 3 and **any secondary positive power supply up to a maximum of 30 Volts. DO NOT connect the external LED battery +VE supply to any pin on the sound module. DO NOT exceed 1A on each output or 4 Amps total for all switched outputs.**
- The supplied male – male – female Y servo leads for Throttle and male – male Sound Select inputs are Futaba style colours (black, red, white), but with JR style male plugs for maximum flexibility. **The black wire is always the GND, 0V or –VE connection and should always be inserted towards the outside of the receiver case and towards the board of the sound module.**
- The SPKR terminals **MUST NOT** be connected to anything other than the appropriate loudspeaker for the supply voltage used.
- The ShockWave 3 sound module receives its power from the receiver battery through the **THTTL1/2** or **SOUND1/2/3** servo leads. The ESC(s) should be connected to the receiver throttle output(s) using the supplied male-male-female Y servo lead.

The H2 THT1_O/THT2_O and H3 THT3_O/THT4_O pins are outputs and can optionally be used for the Multi-Engine Sync. feature. These outputs are internally generated and are processed for special effects, in particular, synchronizing these throttle outputs with engine startup and shutdown sounds.

MOUNTING THE MODULE

Mount the module using screws through the three mounting holes and the attached spacers on the underside of the board. **Do not screw down the board if any of the three spacers are missing. There are parts underneath the boards and the board may crack if you apply screw pressure without the spacers present.**

Mount the module where good air circulation can take place, especially when operating it above 18 Volts. The module will get warm on 12 Volts and quite hot on 24 Volts if operated continuously when playing sounds. Do not be overly concerned. The output amplifier is thermally protected and will shut down if it gets too hot.

APPLYING POWER TO THE SHOCKWAVE 3

The **ShockWave 3** module's low-level circuitry can be powered using two methods.

1. From the R/C receiver through the THTTL1/2 or SOUND1/2/3 cables.
2. From the USB port when connected to a PC.

In addition, the audio power amplifier is powered from the Blue terminal block on the module.

Either of the first two methods will power the low-level circuitry and make the sound module functional. Audio line output signals are available through the line output pins on Header 2. However, if you want to hear sound from the sound module's internal power amplifier you must have power applied to the Blue terminal block as well as low-level power from methods 1 or 2.

If USB power is not connected, you must have receiver power applied through the THTTL1/2 or SOUND1/2/3 cables, in addition to power supplied to the Blue terminal block.

REMOVING POWER FROM/TO THE SHOCKWAVE 3

Because of large storage capacitors on-board the **ShockWave 3** sound module, when power is removed from the blue terminal block it may take as long as 20 seconds for the voltage at the terminals to discharge to close to zero. Be careful not to short the power leads when they are disconnected from the battery.

SUPPLY VOLTAGE CONSIDERATIONS

The minimum supply voltage for the power amplifier is 4.5 Volts. The 26 Volts maximum must not be exceeded. A 6S LiPo flight pack will give out a nominal voltage of $6 \times 3.7V = 22.2$ Volts, but close to 26 Volts when fully charged. Be aware that output power changes with the square of the supply voltage, so 1/2 the supply voltage results in 1/4 the output power for any given loudspeaker impedance. At lower supply voltages the volume control should be turned down to avoid distortion due to overdriving the audio amplifier.

The single channel audio amplifier to drive the loudspeaker is powered from the main terminal block terminals 1 and 4. It will play a mix of the left and right audio channels.

WHY DO I HAVE TO WAIT SO LONG FOR THE LEDS TO STOP FLASHING?

During the initialization period when the red/green LEDs are flashing rapidly alternately, the sound module is waiting for the receiver to stabilize and produce valid output signals. The default wait period is 6 seconds but can be set to between 3 and 20 seconds using the **ShockWave 3 PC Control Panel->Hardware Tab** or the new **HardwareSettings.txt** file. This is because some receivers can take a long time to stabilize. If your receiver stabilizes much faster, you can reduce this wait time down to as short as 3 seconds. Also, the wait period is to allow the accessory GNSS receiver supporting the DopplerFX feature, if used, to power up and start outputting valid signals.

CORRECT SWITCH-ON SEQUENCE FOR TRANSMITTER/RECEIVER/SOUND MODULE

The radio transmitter should **ALWAYS** be switched on before the receiver. Some receivers give out invalid signals when the transmitter is not switched on. If the sound module is connected to the receiver and is switched on before the transmitter, some sounds may start playing.

In this case, switch off the receiver and sound module, switch on the transmitter **FIRST** and **THEN** power up the receiver and sound module.

CHAPTER 2 – THE MICROSD CARD AND .SFX8 FILES

THE SHOCKWAVE 3 SOUND MODULE'S MICROSD CARD

The **ShockWave 3** microSD Card connector is a push-push type, i.e. you push the card in to insert and lock it and push it again to release the card for removal. When inserting the microSD Card, make sure it is pushed fully home so that the latching mechanism prevents it from accidentally being removed. To remove the card, push it again and it will spring out so that it can be removed fully.

During installation in your model, or other testing, it is possible to accidentally push the card in without noticing and it may then fall out and get lost. It is therefore advisable to put a piece of adhesive tape over the card and its connector to make sure this does not happen.

The **ShockWave 3** sound module uses the microSD Card to store its digitized sounds, as well as various configuration and hardware settings. It is therefore very easy to add or change the sounds on a **ShockWave 3** sound module by simply plugging in a different microSD Card with new files.

When the **ShockWave 3** sound module has its microSD Card inserted and it is connected to a Windows PC through its USB port, it will appear as a “USB Mass Storage Device”, i.e. a removable “external drive” will appear in Windows Explorer. The name of this drive, or its disk label, is **ALWAYS SHOCKWAVE3**.

DO NOT re-label the **ShockWave 3** microSD Card as any other name. This specific disk label is searched for by the **ShockWave 3 PC** Software to detect the necessary files on the module.

However, the **ShockWave 3** sound module can be connected to the PC with, or without, its microSD Card. When launching the **ShockWave 3 PC** Software, if the microSD Card is missing, you will get a warning dialogue box, but this is for information only. The dialogue box can be closed and the **ShockWave 3** sound module will still be detected. However, the Red LED will flash quickly to indicate the microSD Card is missing.

WHAT IS A .SFX8 FILE?

The **ShockWave 3** sound module uses files on its microSD card with a **.sfx8** file extension. Some users may not see any file extension as Microsoft, in their infinite wisdom, have deemed that ordinary users do not need to see file extensions as a default setting in Windows Explorer. You can see file extensions by changing the Folder View settings in Windows Explorer.

A **.sfx8** file is a composite sound file containing all of the sound clips for a particular model plus important configuration and addressing data to enable the sound module to correctly access each individual sound clip when it needs to. A **.sfx8** file is sometimes called a **sound set** file.

FILE STRUCTURE ON THE MICROSD CARD

The files on the **ShockWave 3** microSD Card must be in a certain format and folder structure. In the microSD Card Root Folder there is the following file :

SELECT_YOUR_SOUNSET_HERE.txt. This file must contain its first two lines as follows:

First line naming the **folder** containing the **.sfx8** file(s) you wish to use.

Second line naming the **.sfx8** file in that folder that you want the **ShockWave 3** sound module to use.

Example:

ShockWaveSoundSets44\Aircraft

SpitfireMerlinSoundSet.sfx8

In this example, when powered up, the **ShockWave 3** module will expect there to be a file named "**SpitfireMerlinSoundSet.sfx8**" in the ShockWaveSoundSets44\Aircraft folder on the microSD Card.

In this way you can have many **.sfx8** sound files on the microSD Card and they can be changed at will by simply editing the **SELECT_YOUR_SOUNSET_HERE.txt**. Each time this information is changed the module should be powered down and then powered up again.

Further lines may appear in the file after the first two lines, but these additional lines will be ignored by the sound module.

In the microSD Card System folder, there will also be a System Sounds file called **SystemSounds44.sfx8**. This file should not be removed or renamed.

CHAPTER 3 – RADIO COMPATIBILITY

The **ShockWave 3** sound module is compatible with any R/C industry standard transmitter and receiver that outputs 1- 2ms PWM (Pulse Width Modulated) pulses. Any R/C radio can be used on any transmission frequency. It cannot be used with receivers that output only proprietary serial bus signals such as Futaba S-Bus, Spektrum X-Bus , FlySky IBus etc.

We **DO NOT** recommend the use of pistol grip style radios which are popular with some model boaters. The extremely small range of throttle trigger movements on this type of radio make it very difficult to start up and shutdown the engine sound unless you are using a separate switched radio channel for engine sound startup and shutdown.

If you want to use the throttle control to startup and shutdown the engine sound, it is recommended to use an airplane style stick radio instead.

CHAPTER 4 – WHAT ARE SYSTEM SOUNDS AND THE SYSTEM SOUNDS FILES

System sounds are those sounds used by the **ShockWave 3** sound module itself as prompts, status indicators or for voice guided instructions.

System Sounds are stored in in the **System** Folder on the microSD card in a **SystemSounds44.sfx8** file. These files are supplied by Model Sounds Inc. and should not be renamed or deleted.

ASSOCIATING SYSTEM EVENTS WITH SYSTEM SOUNDS

The association of system trigger events with the various System Sound clips is defined in the relevant section of our **ShockWave 3 PC** Windows software application and is documented in the reference manual for that software.

SWITCHING SYSTEM SOUNDS ON AND OFF

The ShockWave 3 sound module will come delivered with the system sounds enabled by default. If you wish to switch off **ALL** System Sounds announcements you can do so using **BUTTON1** on the sound module board.

Wait until the red and green LEDs have stopped flashing for the initialization sequence, then press **BUTTON1** and release it quickly within 1.5 seconds. The System Sounds will then **ALL** be turned **OFF**.

If you wish to switch them on again, press **BUTTON1** down and **hold it there** for longer than 1.5 seconds, then release it. The System Sounds will be turned ON.

System sounds can be individually enabled and disabled by editing the **SystemSounds44.sfx8** using our **ShockWave 3 PC** Windows software application.

ADJUSTING THE VOLUME OF SYSTEM SOUNDS

You can adjust the volume of the System Sounds using **BUTTON2**. Follow these steps.

1. Whilst a system sound is playing, adjust the on-board rotary volume control until you get the sound volume you want.
2. Now press and release **BUTTON2**. When the button2 is released it will store the volume setting you have just set in the sound module's non-volatile memory. This value will be remembered subsequently when you power on the sound module again.

This will adjust the volume of System Sounds **relative** to the volume of the main sounds since the main volume control is a master volume control that adjusts the volume of ALL sounds played back on the module. If you alter the volume control position in this way, remember to return it to its original position in order to restore the main sounds volume to its correct level.

CHAPTER 5 – CONNECTING THE SHOCKWAVE 3 MODULE TO YOUR PC

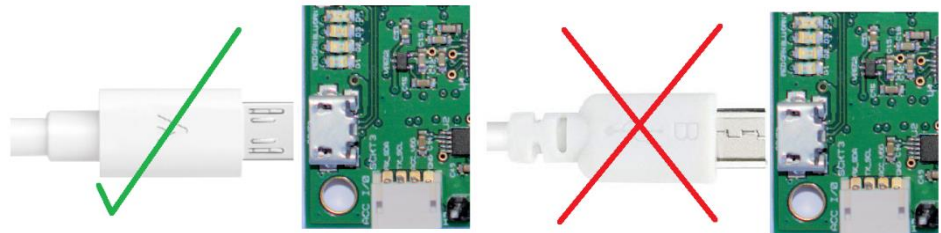
You **DO NOT** need to connect the **ShockWave 3** sound module to a PC in order to use it or set it up.

It is fully configured and ready to use when you receive it. If you want to change any of its many configurable settings or change the sounds, then you will need to connect it to a PC and install the optional **ShockWave 3 PC** Windows software application. Alternatively, you can simply plug in another microSD Card that you purchase from us with the new sounds and configuration settings already installed.

HOW TO CORRECTLY INSERT THE MICRO-USB PLUG INTO THE MICRO-USB CONNECTOR

The USB connector on the **ShockWave 3** sound module is a micro-USB 2.0 type, which is very common on cell-phones and other mobile devices, so you may already have a micro-USB 2.0 to standard USB A-type cable. USB A-type is the end of the cable that plugs into a USB port on your computer. The micro-USB plug on the cable is also compatible with the micro-USB 2.0 portion of a micro-USB 3.0 connector.

The correct orientation of the micro-USB plug on the cable is with the curved corners of the plug facing downwards as shown here:



POWER UP THE TRANSMITTER AND RECEIVER FIRST

Whilst the module will connect to the PC and be powered by the USB connection without the transmitter and receiver being connected and powered on, you will not be able to perform any R/C related activity in the **ShockWave 3 PC** application.

The **ShockWave 3** sound module waits for a 3 to 20 second (default is 6 seconds) initialization period when in both regular and USB modes.

This is to make sure the sound module has stored the correct values for the various R/C pulse widths whichever mode it is in. Therefore, please make sure your **transmitter is switched on before the receiver is powered up** when it is connected to the sound module.

If you use a **throttle cut-off switch** that changes the throttle pulse width once it is armed, then that switch must be armed **BEFORE** the sound module's initialization period is complete. Otherwise, if it is armed afterwards, the sound module will think there is a step change in the throttle pulse width and will likely immediately play the engine sound at full speed as a result.

When connected to a PC USB port, the blue LED will flash whenever there is USB bus activity. In particular, the Windows operating system will issue a request once per second to query the status of the mass storage device to see if it is still ready or has been disconnected. Therefore, the blue LED will flash on and off at least once per second.

The **ShockWave 3** USB interface requires no special USB drivers – the USB drivers it requires are already part of any Windows 10, Windows 8/8.1, or Windows 7 Operating System. When you connect the **ShockWave 3** sound module to the PC for the first time, you will see a message indicating that the required USB drivers are being installed. Shortly afterwards it will say “Your New Hardware is ready to use”.

The **ShockWave 3 PC** Windows software application is available as a separate purchase for download only. This software is not required by everyone so, by not including it with the sound module, we are able to keep the price of the sound module lower for everyone. The manual for the Software Application is in the Manuals folder in the ZIP file that is downloaded. The software can be ordered on-line from our web site.

TRANSFERRING FILES BETWEEN THE PC AND THE SHOCKWAVE 3 SOUND MODULE

If you want to transfer files and configuration data between the PC and the **ShockWave 3** module, it is necessary to remove the microSD Card from the **ShockWave 3** module and insert it into the supplied microSD to standard SD card adapter and insert that into an SD card reader slot on your computer. If your PC does not have an SD card reader, and you do not have a USB microSD card reader, we can supply a USB microSD Card reader as an optional extra. Insert the microSD Card into the USB reader and plug the reader into any spare USB port. **Be careful not to lose the microSD Card!!**

The **ShockWave 3** module conforms to the USB 2.0 Full Speed (12MBits/sec) specification. If you save files to the microSD Card whilst it is in the **ShockWave 3** module, it will be much slower than when the microSD Card is in the USB card reader which conforms to USB 2.0 High Speed (480MBits/sec) specification which is 40 times faster than USB 2.0 Full Speed.

Launch the **ShockWave 3 PC** application **AFTER** the microSD to SD Card reader has been plugged in.

The **ShockWave 3 PC** application will search all disk drives, internal and external, for one that has the disk label "**SHOCKWAVE3**". Be patient – it may take 5 seconds or so for the **ShockWave 3** sound module to be fully recognized by the operating system and the **ShockWave 3 PC** software.



CHAPTER 6 – HOW TO WIRE THE SHOCKWAVE 3 MODULE

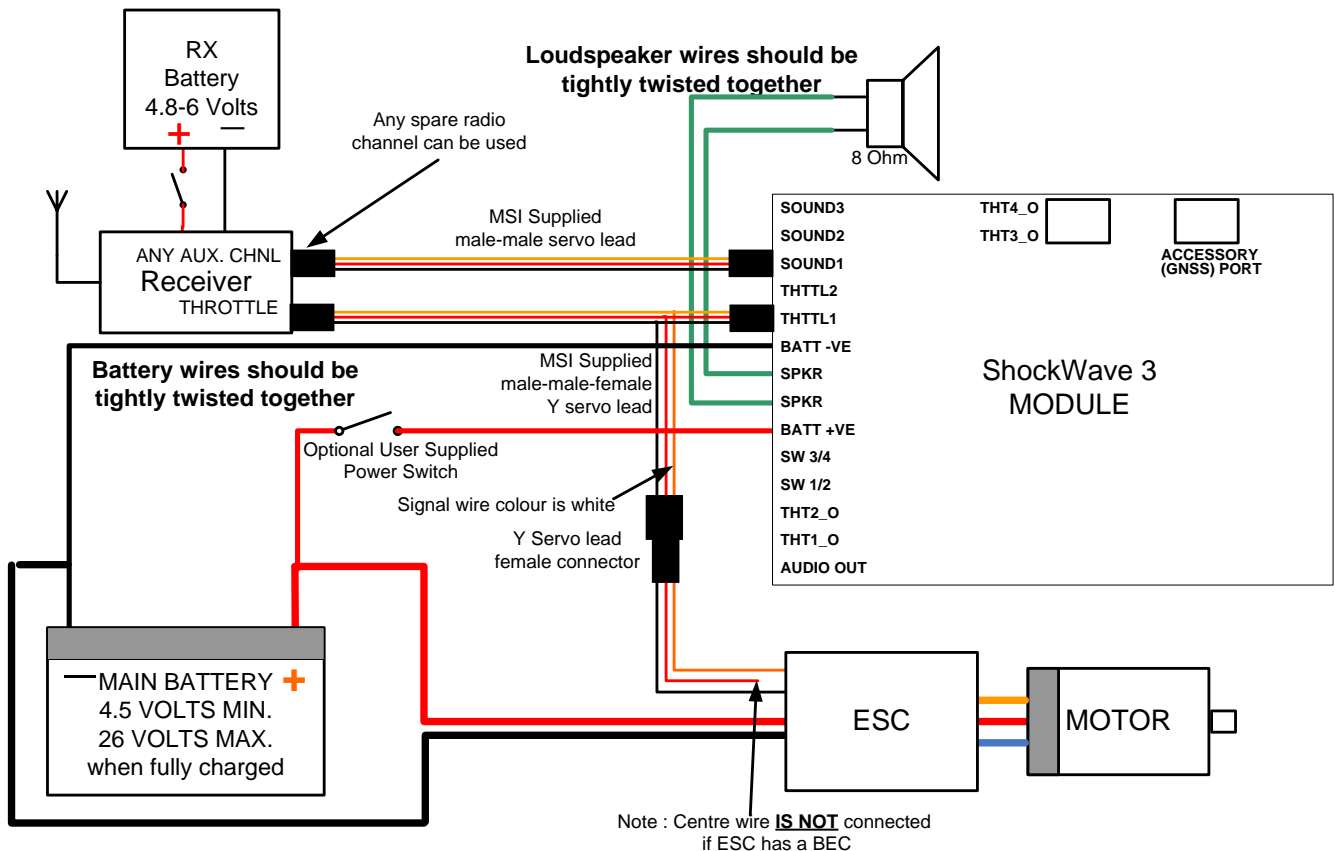
WIRING FOR ONE THROTTLE WITH RECEIVER BATTERY

Although some modellers favour using their ESC BEC (**Battery Eliminator Circuit**) to power their receiver, we do not recommend that set-up for high power systems. Depending upon the wiring, currents involved, and the quality of the ESC BEC, it can introduce radio interference on the receiver power leads. For this reason, we recommend using a separate battery to power the receiver, as shown in the next diagram.

Note : When using a separate battery for the receiver, if the ESC has an active BEC (Battery Eliminator Circuit), the centre wire of the servo lead **MUST BE CUT**. This avoids the receiver battery and the ESC BEC “fighting each other”, which will likely damage the ESC.

When installing, be sure to run separate power lines to the battery just for your sound module. If the power lines are shared with motor or ESC lines, the electrical noise generated by them may interfere with the sound module.

Figure 2: Wiring for Single Throttle with Separate Receiver Battery



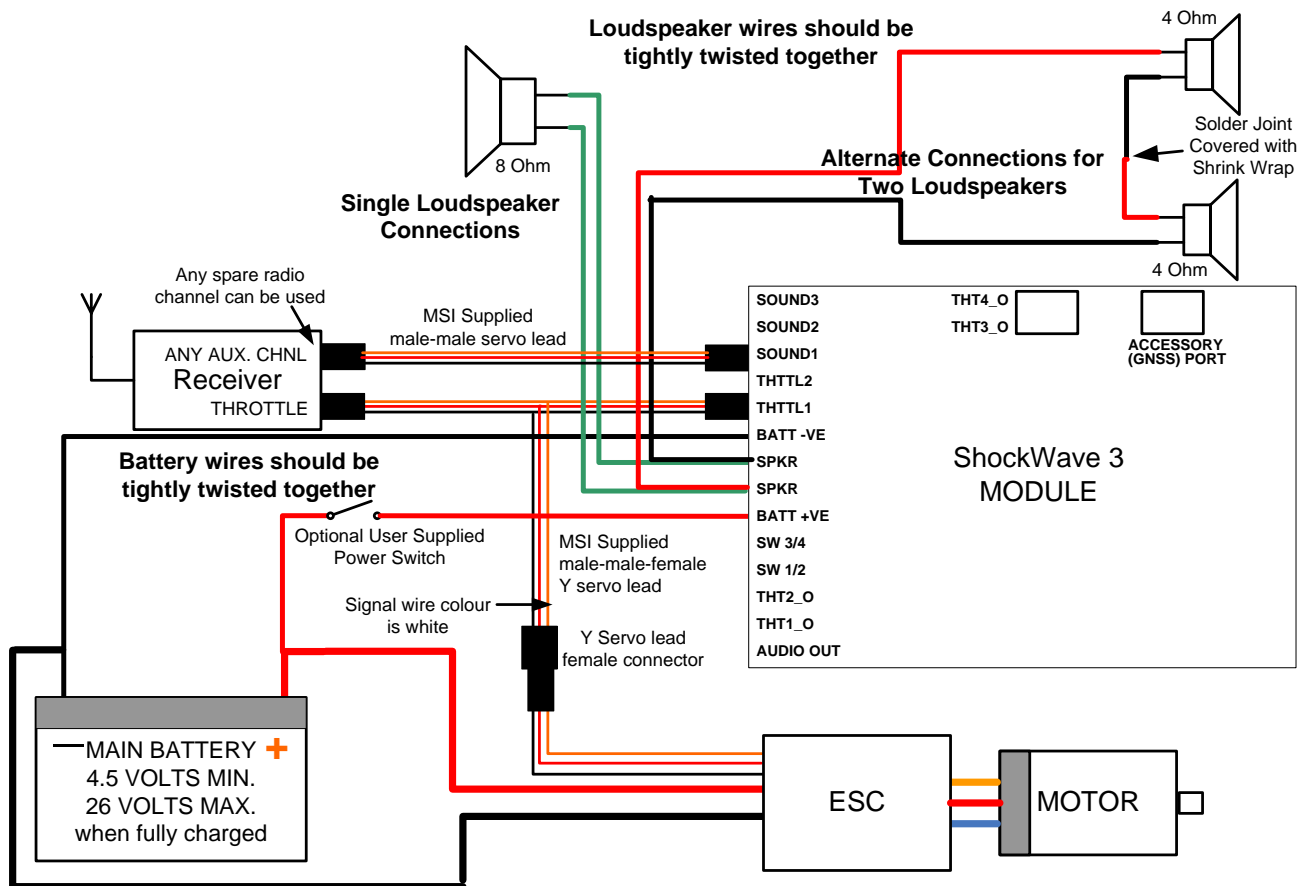


See wiring diagram next for alternate loudspeaker wiring using two loudspeakers in series.

WIRING FOR ONE THROTTLE WITHOUT RECEIVER BATTERY

If you must use the ESC BEC to power the receiver, then the wiring is as follows:

Figure 3: Wiring for Single Throttle Using ESC BEC



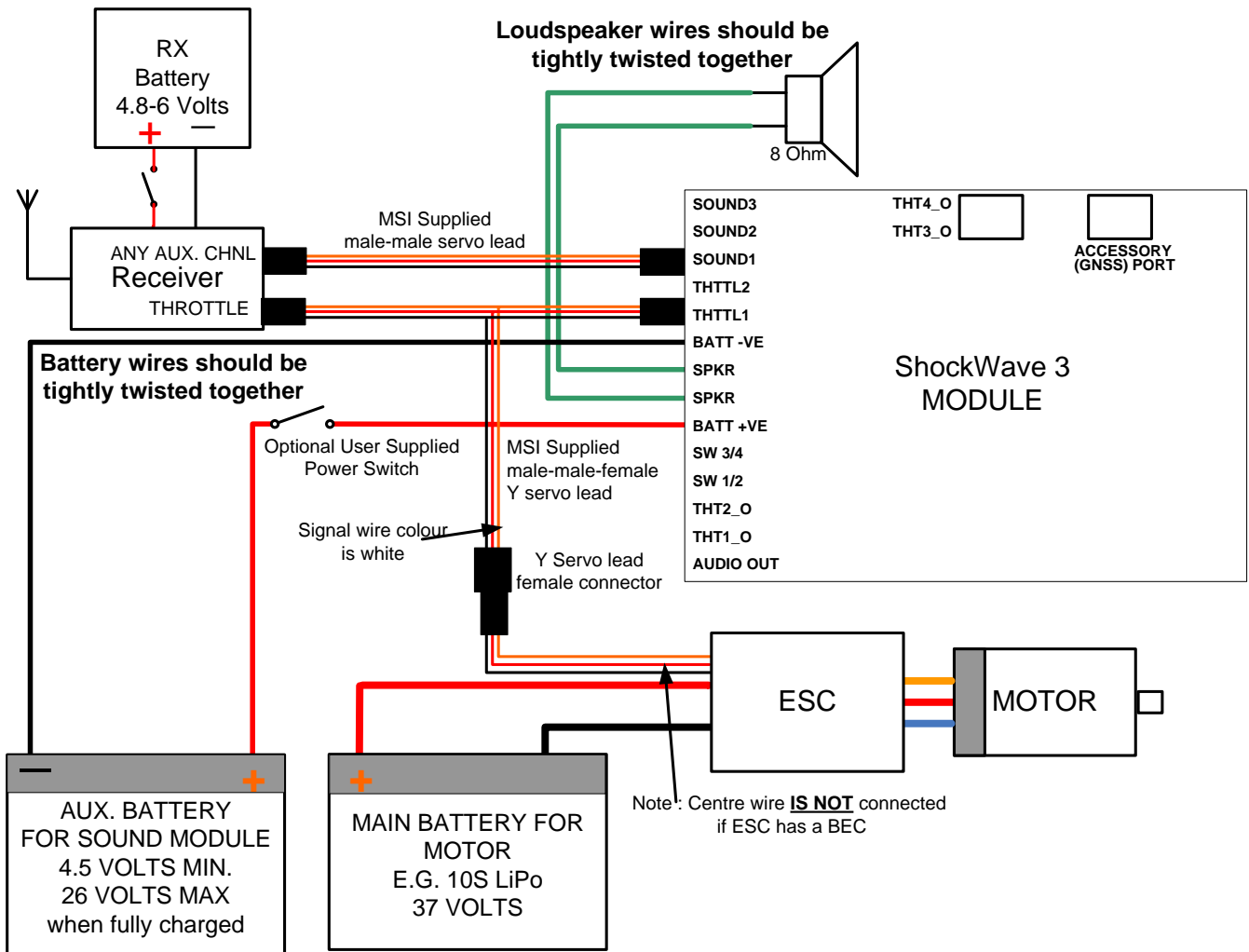
WIRING FOR ONE THROTTLE WITH AUXILIARY BATTERY FOR SOUND MODULE

If your main battery, e.g. your flight pack, exceeds 26 Volts then you are recommended to use a separate battery for the sound module. A small 6S LiPo 1000mAH pack would serve well. You could use a voltage regulator to drop the flight pack voltage down to 26 Volts, but these are generally inefficient and may require heatsinking. The wiring for a separate auxiliary battery is shown here. Usually high voltage, high current, ESCs don't have BECs, but if it does, cut the servo lead centre wire, as before.

Wiring diagram on next page ...



Figure 4: Wiring for Separate Receiver Battery and Separate Sound Module Battery

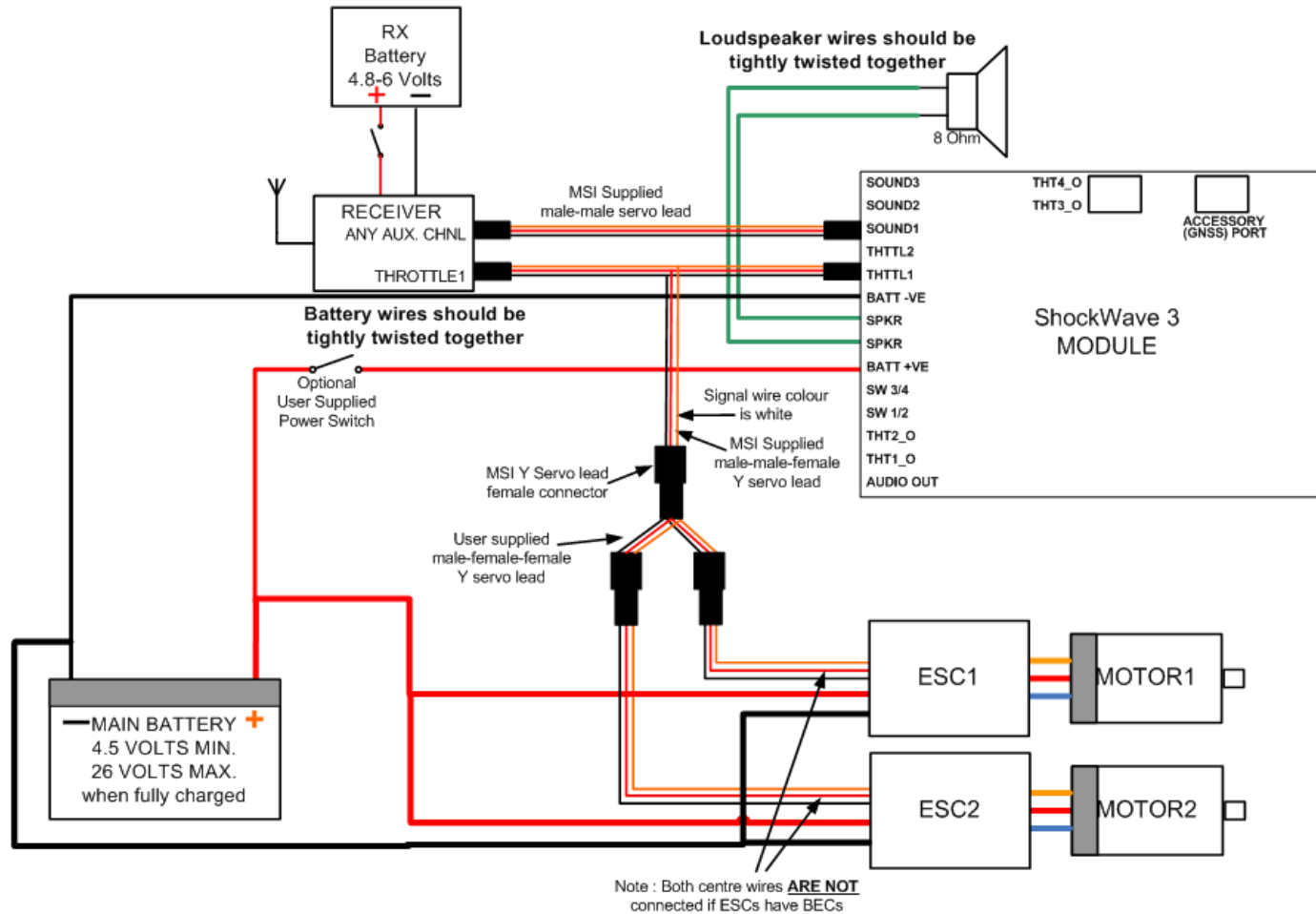


In this diagram you have the main motor battery feeding the **ESC ONLY** and the separate sound module battery feeding the **SOUND MODULE ONLY**, through a switch.

This arrangement is also recommended whenever the motor has a very high current draw so as to isolate the sound system from the spiky, interference prone, motor wiring.

WIRING FOR TWIN MOTORS/ESCS WITH ONE THROTTLE CHANNEL

Figure 5: Wiring for Twin Motors/ESCs With One Throttle Channel



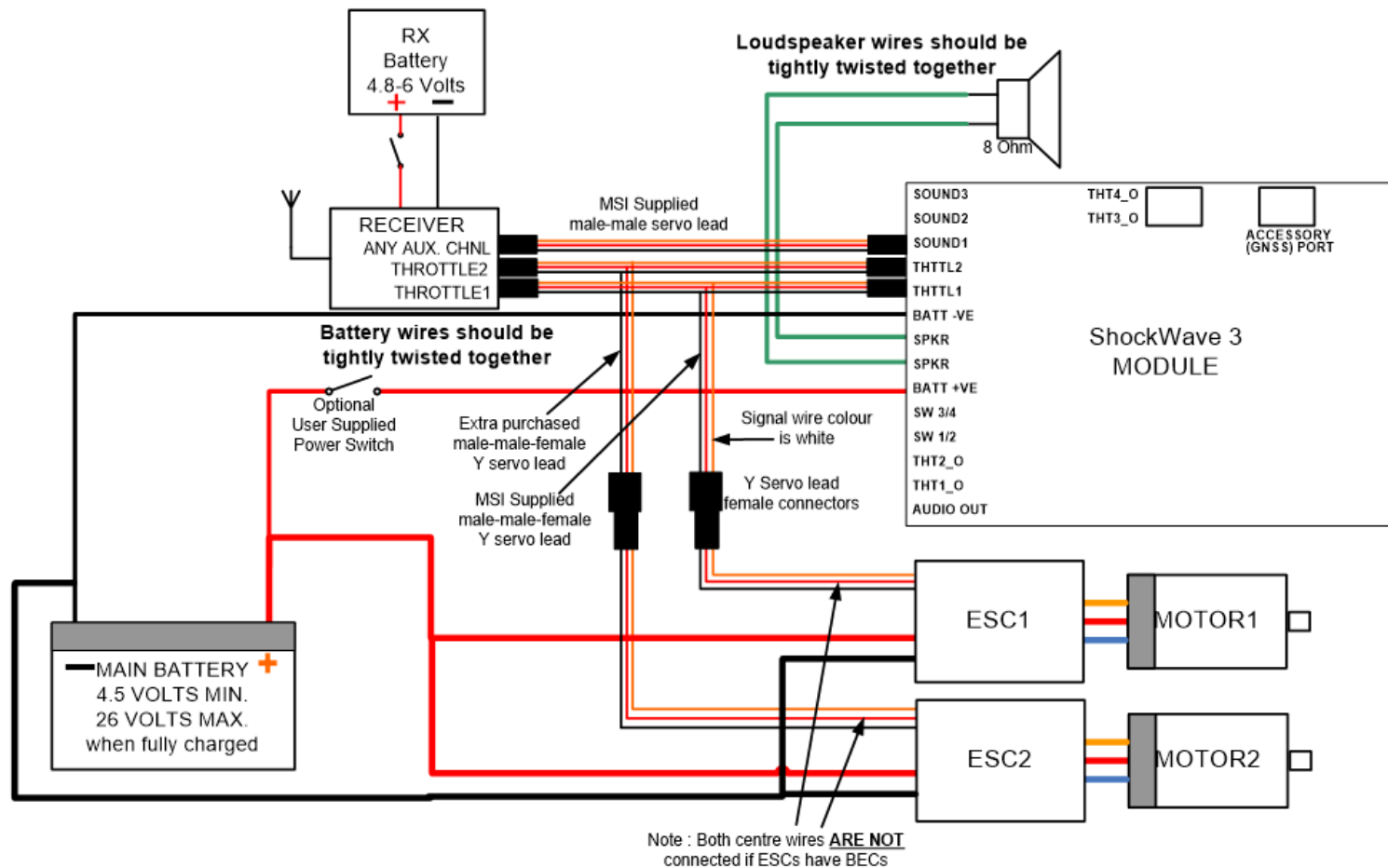
The wiring shown here is where you have one throttle-controlled radio channel on your receiver, as you will for model airplanes and helicopters.

You will require a normal male-female-female Y servo lead which can be purchased from your usual R/C hobby supplier.



WIRING FOR TWIN MOTORS/ESCS WITH TWO THROTTLE CHANNELS

Figure 6: Wiring for Twin Motors/ESCs With Two Throttle Channels



The wiring shown here is where you have two throttle-controlled radio channels on your receiver, as you might for some twin motored model boats and tanks.

This wiring for two motors is very similar to that for one motor, just duplicated.

You will require a second custom male-male-female Y servo lead which can be purchased as an extra from Model Sounds Inc.

CHAPTER 7 – VOLUME/BALANCE CONTROLS AND EXTERNAL AMPLIFIERS

VOLUME CONTROL

The audio volume can be set using the on-board rotary volume control, turning it using a small flat-bladed screwdriver. When playing two or more sounds simultaneously you may have to reduce the volume control to avoid overload and/or distortion if both signals peak at the same time. The signal levels are such that, at full volume setting, full power output can be obtained when powered at 26 Volts. The actual volume and balance settings can be seen in the **ShockWave 3 PC** Main Window. The volume and balance controls also change the signal levels at the Audio Line Outputs.

When powered at lower voltages, e.g. 5-12V, you should reduce the volume control to avoid overdriving the amplifier and causing distortion. When powered at the highest voltage (26 Volts) you can increase the volume control to its maximum setting, but the speaker must then be able to handle 40 Watts. If your speaker can handle only 20 Watts, proceed as follows.

1. Reduce the volume to a very low-level.
2. Gradually increase the volume to the point at which the speaker starts to sound distorted.
3. Back off the volume until the distortion stops.

BALANCE CONTROL

The balance control adjusts the ratio of left/right audio signals. At the centre position, both channels are delivering their maximum signal levels. If the balance control is turned towards the left, it cannot increase the left signal any further, so it reduces the right signal. Conversely, turning the control to the right will reduce the left signal.

REMOTE VOLUME CONTROL – R/C OR WIRED

Using the **ShockWave 3 PC Control Panel->Hardware Tab**, it is possible to configure the **SOUND1** input as an **R/C Remote Volume** control or the **SOUND2** input as a **Wired Remote Volume** control.

The RC Remote Volume mode will make the volume minimum with a 1ms pulse input and maximum with a 2ms pulse input on the **SOUND1** Input pins.

If you want to use an external volume control on the model itself, **SOUND2** input should be configured for **Wired Remote Volume**. This mode requires a variable input voltage on the **SOUND2** signal pins from 0 – +2.5 Volts. You can connect an external potentiometer to the **SOUND2** signal pins to supply a variable 0 – +2.5 Volts with respect to GND or the –VE battery connection.

CONNECTING TO AN EXTERNAL AMPLIFIER

The **ShockWave 3** module has “Line-Out” Audio outputs that permit one or two external single channel amplifiers or one two channel audio power amplifier to be connected. This would allow a high voltage, high power, amplifier to be used.

The left/right line audio output signals on Header 2 pins 14/15 are 1.0 Volts RMS at maximum volume setting for sounds which are stored at their maximum amplitude. These audio outputs should not be loaded with less than 10KOhms in order to preserve good low frequency response.

The setup and assignment of sounds to the left and right channels is done using the **ShockWave 3 PC software** application.

Something you have to watch for, and take care of, when using an external amplifier is the overall phasing of the external amplifier's stereo channels, and its loudspeakers, compared to that of the ShockWave 2 module and its loudspeakers. This means that you need all four loudspeakers to be pushing or pulling air at the same time. It would not help if the **ShockWave 3** speakers (or exciters) were pushing air while the external amplifier speakers were pulling air, as they would be fighting against each other to produce the sound.

The easiest way to test this is to experiment with reversing the polarity of the loudspeaker connections on the **ShockWave 3** blue terminal block and see if it makes any difference to the overall sound output when you are using an external amplifier.

It is possible, using the **ShockWave 3 PC** Windows software, to assign any sound to both the left and right channels. The two channels are mixed internally using subtraction in the differential inputs of the single channel on-board audio power amplifier. They are not additive. This is of no consequence for unrelated sounds such as an engine sound and a weapons firing sound, but you if you attempt to use identical sounds on both left and right channels and play them simultaneously they will subtract, not add.

The ability to have a single sound played on left and right channels is only applicable when you are using an external two channel audio power amplifier instead of the internal one.

CHAPTER 8 – CALIBRATING THE SHOCKWAVE 3 THROTTLE INPUTS

AUTOMATIC THROTTLE SETUP

In order to startup, shutdown and increase and decrease the engine sound speed, the **ShockWave 3** module must know what the corresponding throttle channel pulse widths are at its OFF, maximum forwards and maximum reverse throttle stick positions.

The **ShockWave 3** module makes this job easy for the average user by measuring the incoming throttle pulse width at the time the red/green LEDs stop flashing and using that as the neutral or OFF throttle pulse. It then assumes the maximum forward and reverse values are 1000us for a forwards only control or +/-500us for forwards and reverse throttle controls.

For most users these assumptions are adequate. However, if you want precision control over the full range of sounds and the full throttle stick range, you should consider using the "[Precision Button Throttle Setup](#)" described next.

The [six-position mini DIP switch, switch number 6](#), is used to set whether the module uses the Automatic or Precision Manual throttle setup modes.

PRECISION MANUAL BUTTON THROTTLE SETUP

More precise control over throttle ranges and which engine sounds are selected at each throttle position and other advanced throttle dependent features rely on the sound module accurately knowing what the minimum, maximum and neutral/off throttle pulse widths are.

This can be achieved using the optional precision button setup procedure. You only need do this once for each transmitter/receiver and throttle settings such as mixes, trim tabs etc. If you subsequently alter any throttle setting or change throttle channels, radios or receivers, you should repeat this process. Progress is indicated by the red and green LEDs and, optionally, by system sound announcements.

To setup the Throttle Settings using the Setup Buttons, follow these steps for the **THHTL1** input:

- 1) With power OFF, select the Precision Button Throttle Setup mode using the 6-Position Switch, button # 6. Switch it to the **OFF** position (i.e. nearest the board edge).
- 2) Switch on your transmitter with the throttle controls in their **OFF positions** for model aircraft and helicopters **or NEUTRAL positions** for model boats or tanks, **then** switch on your receiver and sound module. The red and green LEDs should flash alternately for about six seconds, or whatever initial delay period has been configured in the **ShockWave 3 PC Control Panel->Hardware Tab**.

- 3) While the red and green LEDs are flashing alternately, push **BUTTON 1** once and release it quickly. This enters the **THROTTLE1 SETUP** mode. The **RED LED will light for about 1 second** until it captures a valid Throttle1 R/C signal and the **GREEN LED then stays on** - this indicates the Throttle1 and the Sound Select inputs **neutral or off positions** have been captured.
- 4) Move the transmitter **THHTL1** control **FIRST** to the maximum forward position, **then back to the neutral or off position**. The **GREEN LED will go out and the RED LED will come on** to indicate the maximum forwards value has been captured.
- 5) If the **Throttle1** has a reverse mode (model boats or tanks), **without delay**, move the **Throttle1** control to the maximum reverse position and back to neutral again. The **RED LED will go out and the GREEN LED will start flashing** to indicate the maximum reverse value has been captured and the **Throttle1** calibration is complete. The **GREEN LED** flashes briefly every few seconds to indicate that the signals are OK. If the **THHTL1** or **SOUND1** signals are not present, or not valid, the **RED LED** will flash every few seconds instead.
- 6) If the **THHTL1** is forwards only mode (model aircraft or helicopters), the **RED LED will go out after a period of about 1 second** by itself and the **GREEN LED will start flashing** to indicate the **THHTL1** calibration is complete. The **GREEN LED flashes for three times to indicate it is forwards only**. The **GREEN LED** continues to flash briefly every few seconds to indicate that the signals are OK. If the **THHTL1** or **SOUND1** signals are not present, or not valid, the **RED LED** will flash every few seconds.
- 7) If you are using a second **THHTL2** throttle input (optional), then repeat steps 2-5 but use **BUTTON 2** and the transmitter **THHTL2** stick instead. The **GREEN LED** will flash **TWICE** to indicate that **THHTL2** neutral or OFF position has been captured.

CHAPTER 9 – HOW TO CONTROL THE SOUNDS

CONTROLLING “REGULAR” (NON-ENGINE) SOUNDS

There are several ways of controlling the Regular (non-engine) sounds. The default method is to use a single two position switch on the transmitter to control the sounds – this is called “**Switched R/C 1xN**” mode since **ONE** Transmitter switch is used to control many (**N**) sounds. A spring-loaded switch is preferred, if it is available.

Alternatively, if you have a four-channel transmitter and are controlling a land-based vehicle, or a model boat, you can use one of the unused proportional stick channels to simulate a switch, or to select four sounds based on its stick position.

3-Position switches are also supported.

The different modes are selected in the **ShockWave 3 PC Control Panel->Hardware Tab** and work like this :

“Switched R/C1xN” Mode: One transmitter ON/OFF channel is used to switch N sounds

1. Toggle the switch for the SOUND1 input **from OFF to ON and back to OFF N times** quickly to select sound **N**. After a timeout of about 1 second (adjustable), Sound N will start playing. This is “**Latched**” action. Repeat to switch Sound N Off.

OR

2. Toggle the switch for the SOUND1 input **from OFF to ON and back to OFF N-1 times** and then move to on position **and HOLD IT THERE** – Sound **N** will play for as long as the switch is in that **ON** position. Release the switch to the **OFF** position to switch Sound **N** OFF. This is “**Momentary**” action.

It is best to not use the **Latched** mode unless you really need to. That mode is meant for long playing sounds such as sonar pings, music etc. where you would not want to hold the switch/stick in the on position for too long.

But for all other sounds such as guns, horns, Morse code etc. it is best to use the momentary mode by holding the switch in the on position for as long as you want that sound to play.

That way you will be sure that when you release the switch/stick to the off position, that sound will stop playing. Then you won't have to worry about counting the correct number of times to switch it off again and possibly using the incorrect number which then starts playing a different sound instead of switching the first one off.



“Switched R/C 1x1” Mode : One transmitter ON/OFF channel is used to switch 1 sound

If you need only one other non-engine sound such as a single gunfire or horn sound, you can configure the module to simply use one ON/OFF Switch to switch that one sound. I.E. move the switch from its **OFF** to **ON** position to switch sound clip N On. Move it back to its **OFF** position to switch sound clip N OFF. You set which sound is assigned to that switch using the **ShockWave 3 PC Control Panel->Hardware Tab** – see the Software manual.

In the “**Switched R/C 1 x 1**” Mode you can also set the related sound clip to “**Play Once**” in the **ShockWave 3 PC** application. In that case you can simply toggle the transmitter switch used for this channel and the sound will continue to play when the switch is released back to its **OFF** position. When the sound clip reaches its end, it will switch off. This is useful for model tanks where the transmitter switch may be a simple push button and the same radio channel is also used to operate a recoil solenoid for the main gun barrel. The transmitter button may be pushed briefly to both initiate the barrel recoil and play the gun sound, to its end.

“Proportional R/C” Mode: One proportional channel is used to switch four sounds on/off”

This sound selection mode is for use with a centre off spring loaded proportional transmitter stick.

1. Move Tx stick half-forward for more than 1 second = Sound 1 ON;
2. Move stick quickly full forward = Sound 2 ON;
3. Move Tx stick half-backwards for more than 1 second = Sound 3 ON;
4. Move stick quickly full backwards = Sound 4 ON;
5. Which specific sounds are played for Sound 1/2/3/4 is programmable using **ShockWave 3 PC** Software.
6. Proportional R/C mode can have either latched or momentary action as follows:

For Latched Mode : Once the selected sound has started playing, immediately return the stick to its centre position. The sound will stay on until the same action is used to switch it off again.

For Momentary Mode : Once the selected sound has started playing, hold the stick in that position. Once the stick is returned to its centre off position, the sound will switch off.

7. Depending on the particular radio channel you use, the stick may be a left/right channel. instead of a forward/backwards channel.

3-Position Switch

A 3-position switch should be in its centre OFF position when the transmitter and receiver are switched on. The sound module detects the resulting R/C channel's pulse width and uses that as a centre OFF reference value. You move the switch in one direction to switch on one sound clip and in the opposite direction to switch on another sound clip. Returning the switch to its centre OFF position will switch the selected sound off.

Which particular sound clips are selected by the 3-position switch is set using the **ShockWave 3 PC Control Panel->Hardware Tab**.

Using SOUND1/2/3 Inputs and The Offset

The SOUND1, SOUND2 or SOUND3 inputs can be used to switch regular sounds using the methods above.

All sound select inputs have an offset number associated with them. The default value for SOUND1 input is Offset = 0, default for SOUND2 input is Offset = 2, default for SOUND3 input is Offset = 4. The Offset # is added to the number of toggles when these inputs are use in **Switched R/C 1xN** or **Logic Level 1xN** modes. This means that if you toggle SOUND1 input once you get sound clip # 1. If you toggle SOUND2 input once you get sound clip # 3 (if there is one) etc. These offset numbers are adjustable up or down using the **ShockWave 3 PC Control Panel->Hardware Tab**.

If using **Switched R/C 1x1** or **Logic Level 1x1** modes, the offset determines which sound is played when the switch is moved to its ON position in a similar manner, so for SOUND1, by default Sound Clip # 1 will play, for SOUND2 input Sound Clip # 3 (if any) will play.

USING MECHANICAL SWITCHES OR LOGIC LEVEL VOLTAGE INPUTS

When in any of the R/C modes, the SOUND1, SOUND2 and SOUND3 inputs are expected to be from a standard R/C receiver output.

For either of the **Logic Level "1 x N"** or **"1 x 1"** modes, you can also use 2.7 – 12 Volt logic levels or mechanical switches to create logic levels instead of R/C signals. This is also setup in the **ShockWave 3 PC Control Panel->Hardware Tab** – see the Software manual. This is useful for static displays that do not have radio control equipment.

When in Logic Level mode, the respective input is expected to be either a switch connected from the signal terminals (e.g. pin 12 for SOUND1) to the **receiver battery +VE** or a positive voltage with respect to battery –VE that is close to 0 Volts (OFF) or between +2.7 Volts and +12.0 Volts (ON). You can also configure the Logic Level inputs for –VE Logic, I.E. the OFF Logic level is High and the ON logic Level is low.

PLAYING MULTIPLE SOUNDS SIMULTANEOUSLY

Playing up to four sounds simultaneously is supported. Typically this would mean one or two engine sounds and one or two non-engine sounds. However, only two sound clips can be played simultaneously on each of the two internal left and right channels. More than two would overload the internal data values and severe distortion or weird noises may result. In practice, this is not an issue since playing more than two of any non-related sounds at the same time usually results in a muddying of the sounds so that none of them can be heard clearly, so this is usually avoided.

CONTROLLING THE ENGINE SOUNDS

By default, the Engine Sounds are switched on and off by the throttle controls only. The engine sound increases in up to 16 steps of increasing pitch. These sound steps are usually generated automatically by the **ShockWave 3 PC** software.

With some models, e.g. model tanks and some model aircraft and most helicopters, it is preferable to control the engine start-up and shutdown sounds using a switch instead of the throttle position.

To do this, the Engine Sound Mode has to be set to "**Switched with Sound Clip #**" in the **ShockWave 3 PC Control Panel->Hardware Tab**. Then, typically, you would add an EMPTY sound clip to be associated with the engine sound.

Then, when that sound is switched on, the engine start-up sound will play and continue to idle and when that sound is switched off, the engine shut-down sound (if any) will play, then stop. In this case, you usually make the EMPTY sound clip the first one in the Regular Sounds (i.e. sound clip #1).

The sound module has five R/C inputs - two THRTL1/2 and three SOUND1/2/3 inputs. The THRTL1/2 inputs are used to control the speed of the Engine1/Engine2 sounds respectively and may also be used to initiate the start-up and shut-down sounds. The SOUND1/2/3 inputs are used to control the sounds in the Regular Sound Clip List **ONLY**, i.e. non-engine sounds. There are also many different possible control modes used for the SOUND1/2/3 inputs.

If you want to use a switched R/C channel to start-up and shut-down the engine sounds, then that receiver channel must be connected to any of the SOUND1/2/3 inputs and thereby control one of the sounds in the regular sound clip list. Then, in the **ShockWave 3 PC Control Panel->Hardware Tab**, you select the Engine1 mode to be "Switched As Sound Clip # xx" where xx is selected in the adjacent spin number box. When this mode is selected, when the Regular Sound Clip # xx is selected using any of the SOUND1/2/3 inputs the corresponding engine start-up or shut-down is played **INSTEAD** of the EMPTY sound clip.

The EMPTY sound clip does not have to be at position 1 in the Regular Sound Clip List as long as the Engine1/2 mode "Switched As sound Clip # xx" xx is the same as its actual position. But to keep things simple it is usually placed at position # 1.

In either mode the engine sound increases in pitch, from neutral to maximum forwards and from neutral to maximum reverse (if there is a reverse). If the throttle is forwards only, different behaviour is required since there is no reverse.

For both types of throttle (forwards or forwards/reverse), nudge the throttle control forwards a little (to step 1) and the corresponding engine sound will start playing. If there is a separate engine start-up sound, that sound will play and then continue to loop from its loop point. As you move the throttle stick forwards the engine sound will increase in pitch.

Stopping The Engine Sounds

By default, for Forwards Only throttles, as the throttle is brought back towards neutral (off) and from step 1 to OFF, if there is an engine shutdown sound, it will play once, then stop.

By default, for Forwards/Reverse throttles, if the throttle is moved back to the neutral position the engine sound will continue to play in idle indefinitely. This is good for model boats and tanks.

To switch off the engine sound, nudge it into reverse very slightly and **hold it there for about 1.5 seconds**. If you move it too far, the engine sound will continue to play with its increasing speed.

If there is a separate engine shutdown sound, it will play then stop. If there is not a separate engine shutdown sound, the engine sound will stop after the 1.5 second delay.

If you do not want this default behaviour, you can set an "Idle Off Delay" time in the **ShockWave 3 PC Control Panel->Hardware Tab**. If this time is set to anything greater than zero, the engine sound will idle for the stated delay time, and then the engine shutdown sound will play once, then stop.

This is great for model airplanes when, sometimes, the throttle stick has to be returned to full off in flight in order to allow the motor to idle and then quickly moved to a higher setting. It is also useful for an automatic shutoff for model boats and tanks when, after the set time delay, the engine idle sound will stop, then the engine will shut down without further attention from the operator.

CONTROLLING ENGINE SOUNDS WITH AN ANALOG INPUT

Sometimes it is more appropriate to control the engine sounds using an Analog voltage input instead of an R/C receiver pulse. In this case, the Throttle Input Mode for TH TTL1 or TH TTL2 can be set to "Analog" using the **ShockWave 3 PC Control Panel->Hardware Tab** (see the Software Manual). The Analog input voltage should be between 0 and + 3.3Volts relative to GND, or battery negative.

The Analog input is connected between pins 9 or 6 for Throttle1 and Throttle2 respectively and their ground pins 7 and 4.

When the sound module is first switched on, the Analog input voltage must be at its "neutral or OFF equivalent" level. I.E. if the Analog voltage represents a forwards only type of throttle, the voltage should be at 0 volts.

If the Analog voltage represents a forwards/reverse throttle, the voltage should be at the mid-level value of approximately 1.65 Volts when entering the throttle setup sequence. This represents the Neutral throttle setting.

During the "[Precision Button Throttle Setup Procedure](#)", the voltage should be increased to +3.3Volts for maximum forwards, then reduced to 0 Volts (for maximum reverse), and then back to +1.65Volts, for neutral, to indicate it is a forwards/reverse type of throttle.

Once setup correctly as above, the changing voltage level can be used to switch the engine sound on/off and vary its speed, as though it were a regular throttle control.

The Analog input voltage should not exceed 3.3V as that voltage is mapped to an "equivalent maximum pulse width" of 2000 μ s.

STARTING UP JET/TURBOFAN/TURBOPROP/HELICOPTER SOUNDS

All our jet, turbo-prop and helicopter sound sets are configured by default to operate differently from the default piston engine sound sets such as the Spitfire. For all jets and other engines that have long turbine spool-up and spool down times, we configure them to use a separate switched R/C channel connected to the SOUND1 input to startup and shutdown the engine sound.

This is so that you can use a switch to startup the turbine sound while leaving the throttle stick in the off position so that the EDF unit does not startup before the turbine sound blends into the jet exhaust idle sound.

Similarly, on shutdown - the throttle stick can be returned to its off position to make the plane stationary and have the jet turbine sound still idling until you throw the switch back again, whereupon the turbine spool down sound starts, plays once, then stops.

CHAPTER 10 – SPECIAL PROVISIONS FOR MODEL TANKS AND HELICOPTERS

SPECIAL PROVISIONS FOR MODEL TANKS

Most model tanks have gun turrets that can rotate via servo control, or other motorized mechanism, under control of a stick or knob on the R/C transmitter. In this case, instead of being an engine sound, the second "throttle" controlled sound can be turret turning sounds. In this case, what would normally be the engine 2 startup and idle sound, would be a turret start rotation sound and the engine 2 shutdown sound would be a turret stop rotation sound. Furthermore, if you set the loop start and loop stop times appropriately so as to exclude the turret start rotation segment, but include the remainder of the first turret sound, you can use the Engine Sound Control to generate 8 steps of increasing turret rotation pitch so that the further you move the turret control stick/knob, the faster the turret rotation sound will be. 8 steps is quite sufficient for this purpose and going higher than this may cause problems.

Also, because the turret turning motor on real tanks does not vary much in speed, the maximum/base ratio for turret turning sounds is usually very low i.e. about 1.25 compared to the normal 2.0 – 3.0 used for proportional engine sounds.

If you want to use the second engine channel in this way you should set it up as a "Forwards Only" channel when you do the throttle 2 setup procedure.

You do this using the **ShockWave 3 PC Control Panel->Hardware Tab** by checking the **"Force Forwards Only"** check box for the Engine2 sound.

If this channel were setup as a forwards and reverse channel, then when the turret control stick was returned to the centre (off position), the turret turning sound would continue playing as the sound module would think that it is an engine idling sound. By making it a forwards only channel, when the turret control stick is returned to the centre position, the turret stop rotation sound will be played once and then stop.

SPECIAL PROVISIONS FOR MODEL HELICOPTERS

Helicopters (either real or model ones) do not generally change their engine speed much once they are in flight. Instead, other flight controls determine the speed of the aircraft. Therefore, when used in model helicopters, the engine sound set is usually setup such that the maximum speed to the idle speed ratio is relatively low e.g. 1.5 – 1.75. Also, since turbine helicopters have a very long engine spool-up time to full speed, the engine sounds are usually started up using a spare switch on the Transmitter instead of nudging the throttle stick forward a notch or two.

The **ShockWave 3 PC Control Panel->Hardware Tab** is used to set the Engine1 Sound Mode to “Switched with Sound Clip # 1”. We set this up before we ship the sound module out to a model helicopter customer.

Then, an EMPTY sound clip should be used as regular sound clip # 1. Then the radio channel switch used for the regular sounds would operate as follows :

1. Flip the switch from its OFF position to ON, and back to OFF again. After a short 1 second delay, the engine start-up sound will begin and will spin up to idle power and continue looping at idle power. The throttle stick can then be used independently of the engine sound to start the rotors turning at any suitable time during the engine spin-up time.
2. Flip the switch from its OFF position to ON, and back to OFF again. After a short 1.5 second delay, the engine shutdown sound will play once only, and then stop. Again the throttle stick can be moved independently to shut down the model's rotors.

Potential Additional Helicopter Rotor Wash Sounds Using The Second Engine Sound

It is also potentially possible to add rotor wash sounds separately as the Engine2 sounds and use the collective radio channel to feed the THTTL2 input. In this way you would get extra rotor wash sound only when the helicopter is taking off, in flight and landing.

However, this depends upon the availability of obtaining a suitable rotor wash sound that is loud enough to mask the underlying engine sound so that the engine sound is not also added as well.

Such suitable rotor wash sound clips are very rarely obtainable so, in practice, this effect is not easily achievable.

CHAPTER 11 – SYNCING ENGINE STARTUP/SHUTDOWN SOUNDS TO PROPELLER ROTATION

E-Z-SYNC™ FEATURE

E-Z-Sync is a new feature in **ShockWave 3** that allows easy setup and synchronization of the engine start-up and shutdown sounds with the propeller rotation on a model airplane. This feature is relevant only to propeller driven airplanes since jets, and model boats and tanks do not have visible propeller or rotating engine transmission parts. One exception to this is a model air-boat where the rear air pusher propeller is clearly visible.

There are two modes of operation for the E-Z-Sync feature:

1. **MODE 1** – synchronizing engine start-up sound to start of propeller rotation. This is used where the engine sound is started up using the throttle stick only. It is used when the throttle stick movement causes the propeller to start turning and you want to synchronize the engine sound start-up to that throttle position.
2. **MODE 2** - synchronizing start of propeller rotation to engine start-up sound. This is the reverse to **MODE 1**. It is used when a separate switched radio channel is used to start-up the engine sound. In this case, the engine sound track starts first and then, at some later time, you want the propeller to start turning so you need to move the throttle stick to start that motor turning.

This is essentially a manual synchronization process because the R/C operator moves the stick to start the motor at the desired time.

How to use E-Z-Sync MODE 1 (using throttle stick movement to start engine sound)

For Engine 1 and THRTL1 input:

1. Nudge the throttle stick whose radio channel is connected to the THRTL1 input forward until the propeller starts turning or until you want the engine sound to start playing.

You may possibly want the engine sound to start playing before the propeller starts turning if, for example, there are oil pump noises or starter cranking sounds before the motor starts turning the prop. There maybe other sound effects such as “Contact” or Mags are hot” that are in the engine sound track that appear before an actual engine turning over sound occurs.

2. Then **press and release BUTTON1** quickly, within 1.5 seconds. The engine sound will restart from that point and that setting will be stored in the currently active **.sfx8** file on the microSD card.

3. Move the throttle stick to the position where you want the engine shutdown sound to start playing.
4. Then **press and hold BUTTON1** down for longer than 1.5 seconds. The engine 1 shutdown sound plays from that point and that setting will be stored in the currently active **.sfx8** file on the microSD card.

For Engine 2 sound/THTTL2 input channel, perform the same steps as above but using **BUTTON2** instead of **BUTTON1**.

Any activities involving the pressing of the on-board buttons is much easier done on the bench **BEFORE** installing the sound module in any model, simply because of better physical access to the buttons.

How to use E-Z-Sync MODE 2 (using separate switched R/C channel to start engine sound)

1. Flip the radio switch corresponding to the SOUND1 input, or whichever input you have configured to start-up the Engine1 sound track. The engine sound starts up. At the time in the sound track when you want the motor to start turning the propeller, move the throttle stick to start turning the motor to the speed you want.
2. If you want to control this manually every time you start-up the engine sound, there is nothing more to do.
3. However, if you prefer this motor and propeller rotation start-up to happen automatically at the same time, every time, then, without moving the throttle stick any more, **press and release BUTTON1** quickly, within 1.5 seconds.

This will store the current time point and throttle position (i.e. throttle channel pulse width) in the current **.sfx8** file on the microSD card.

4. Subsequently, once the system is powered down, you remove the ESC input connector cable from the supplied male-male-female Y servo lead and instead connect the ESC input connector cable to the **TH1_O** output pins on header H2.

Although these throttle outputs support the **Multi-Engine-Sync** feature, they can also support just one engine and motor startup.

5. Next time you power up the system, and you initiate the engine sound track using the switched R/C radio channel, the motor whose ESC is connected to the **THT1_O output** will start turning at the same speed as it was originally when you pressed **BUTTON1**, even if the throttle stick is in the OFF position.

Then, as you gradually move the throttle stick upwards towards its original start position, once it moves past that start position the throttle stick will take over and the motor speed will track the throttle stick position accurately.

CHAPTER 12 – HOW TO SYNC MULTIPLE MOTORS TO THEIR STARTUP SOUNDS

Multi-Engine-Sync™ feature is not yet available in ShockWave 3 firmware release 5.0.2.

The **ShockWave 3** sound module features a brand-new **Multi-Engine-Sync™** feature which allows multi-engined models to have up to four multiple motors automatically start-up in synchronism with their respective engine start-up sounds.

The idea is that a single throttle-controlled engine sound track will have multiple engine sounds starting up in sequence, as they do in real life for planes such as the B17 and Lancaster four-engined bombers.

In this case, that sound track would be “Engine1” and would be controlled by the THTTL1 input pins.

You use this feature as follows:

Making Your Multiple ESC input connections

1. Connect the first ESC input cable connector to the **THT1_O** output pins on header H2.
2. Connect the second ESC input cable connector to the **THT2_O** output pins on header H2.
3. If you have a third or fourth motor, connect their ESC input cable connectors to the **THT3_O** and **THT4_O** output pins on header H3.

Setting up the Multi-Engine-Sync Feature

1. Press and release the **BUTTON1** quickly, twice in succession, within 1.5 seconds. This will enter Multi-Engine-Sync setup mode.
2. Initiate the start-up of the Engine1 sound track using either the throttle stick, if it is configured for that mode, or whichever switched radio channel is used instead. At the exact time that you want the first motor to start turning in sync. with the sound track's first engine start-up sound, press and release **BUTTON1** quickly within 1.5 seconds.

CHAPTER 13 – WHICH LOUDSPEAKERS TO USE

LOUDSPEAKER SELECTION

An **8 Ohm or higher impedance loudspeaker should be used** for safe operation of the module when operating it at or above 14.4 Volts. If the supply voltage is less than 14.4 Volts, you can safely use a 4 Ohm speaker – this will result in twice the output power being delivered to the loudspeaker – about 18 Watts maximum on a 12 Volt supply. Surplus loudspeakers may have unknown impedance, performance and power handling, so it is recommended to only use one of the loudspeakers we supply.

Failure of the module due to using a speaker less than **8 Ohms, on supply voltages of 14.4 Volts or higher, voids the warranty.**

The biggest challenge in obtaining a realistic sound in models is the size, weight and location of the loudspeaker, and for model boats, a waterproof location. For best results, a speaker enclosure should be used to help reduce the unwanted rear sound pressure wave from cancelling out the wanted forward sound pressure wave, hence reducing the sensitivity and giving poor low frequency response.

However, be aware of making the speaker enclosure too small as the back pressure created when the speaker cone moves will decrease its sensitivity.

In model boats, mounting the speaker in the deck, which acts as a sound baffle, can be very effective. The water around the hull serves to dampen the hull sound vibrations, thus providing very good isolation between the front and rear sound pressure waves. Do not use the loudspeaker in a very small confined space, or one where the sound would be muffled by lack of venting to the outside - the results will be very disappointing.

In model aircraft, mounting the speaker efficiently is important as it is needed to get maximum loudness since model airplanes are much further away than model boats. Also mount the speaker as close as possible to the airplane's centre of gravity. Again, be aware of making the enclosure too small. It is best to try it first without an internal enclosure and use the entire fuselage or wing as the enclosure.

It is permissible to use to **use two 4 Ohm speakers in series only, not in parallel.** This will allow the **ShockWave 3** sound module to be used on a 6S LiPo where it will be able to deliver its maximum output power. In model aircraft where two 4 Ohm speakers are installed, you can try one in each wing.

CHAPTER 14 – HOW TO USE THE SWITCHED OUTPUTS

The **ShockWave 3** module has four switched outputs that can be used to flash LEDs in synchronization with any sound such as gunfire, engine sounds or a Morse code signal. They can also be configured to just be on with any sound clip (including an EMPTY sound clip) so they can be used to switch navigation lights etc., as well. These outputs behave as though they were a switch connected to ground – i.e. the negative battery terminal.

You connect the LED or other load to flash or switch on between a battery positive supply and the switched output pin, as shown below. The centre pins for the switched outputs on Header 2 pins 2 and 5 are internally connected to the **receiver battery supply** from Header 1 pins 2, 5, 8, 11 and 14. For low current LEDs, drawing less than 50mA, you can then use these centre pins (H2 2, 5) to supply power for the LEDs. If you do this, be aware of the additional current draw from the receiver battery while the LEDs are on.

Higher current LEDs should be powered by a separate battery to avoid voltage drop losses along the servo leads.

The LEDs may be supplied by the same receiver power that supplies the **ShockWave 3** module, or another positive voltage up to the maximum 30 Volt rating. These switched outputs are rated at 1 Amp maximum each or 4 Amps for all switched outputs together.

DO NOT SWITCH INDUCTIVE LOADS

The switched outputs are designed to switch LEDs or other electronic circuits, **NOT INDUCTIVE LOADS**. An inductive load is anything that contains a coil of wire such as a motor, relay, solenoid, or “electronic” valve – which usually contains a small solenoid.

If you want to switch an inductive load using the **ShockWave 3** module, then you should use an external Power MOSFET transistor as described later –

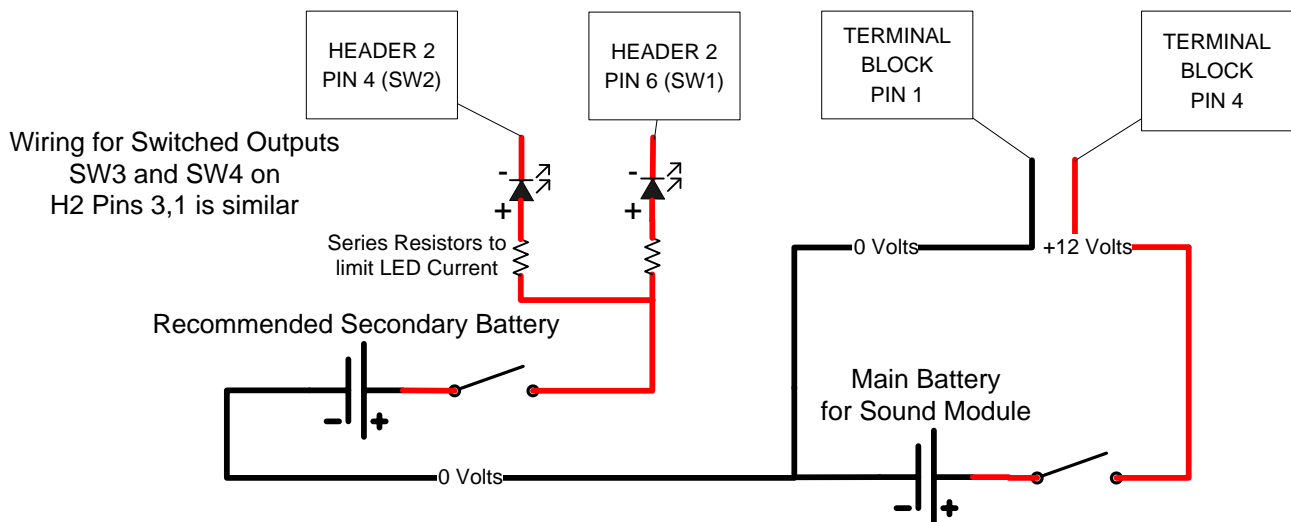
see “[Use external transistors for INDUCTIVE LOADS OR high currents](#)”.

CAUTION – Do Not Use These Outputs to Drive a Motor Directly!

RECOMMENDED SEPARATE BATTERY FOR HIGH CURRENT LEDs OR OTHER LOADS

Figure 7: Example Wiring for Switched Outputs

ShockWave 3 Wiring for LEDs
Using recommended secondary battery for the LEDs



If using the same battery as the receiver to power the LEDs, connect the LED +VE leads, **with their series resistors**, to H2 pin 2 or 5 on the sound module which carries the receiver battery voltage. This is recommended **ONLY** for low current LEDs, i.e. 50mA current or less.

If you are using high power ultra-bright LEDs that draw higher than 50mA current, **DO NOT** use the receiver battery voltage on H2 pins 2 and 5 to power the LEDs. Those pins carry the receiver voltage as a convenience only for low current LED applications. If you attempt to use that voltage supply for high power LEDs, the wire resistance along the various servo leads from the battery, through the receiver and to the sound module can cause a large enough voltage drop such that the sound module and/or the receiver itself may lock up and crash.

When using high power LEDs, **ALWAYS** use a separate battery to power the LEDs, as shown above.

The LEDs MUST HAVE A SERIES RESISTOR (EACH) TO LIMIT THEIR CURRENT – see the article [LEDSeriesResistors.pdf](#) in the Articles folder on the **ShockWave 3** microSD Card. If using a separate battery, connect the LEDs and battery as above.

The sound clip that each LED Switched output flashes with, and the signal threshold level at which the LEDs switch on, is configurable in the **ShockWave 3 PC Control Panel->Switches Tab**. See the **ShockWave 3 PC** manual for details on how to configure them.

The defaults are **SW 1** output flashes with sound clip 1, **SW 2** output flashes with sound clip 2 and both threshold levels are set to 50% of maximum amplitude. This has been found by experience to be optimum for many gunfire sounds.

If you wish to switch LEDs, but have no sound playing such as switching on navigation lights, you can install an **EMPTY (empty)** sound clip as one of the sounds. An EMPTY sound clip is provided on the microSD Card in the “**Sample Sound Files**” folder.

Each switched output can switch 30 Volts / 1 Amp to the battery –VE terminal or 4 Amps maximum for all switched outputs. **DO NOT EXCEED THESE RATINGS!!**

SWITCHED OUTPUTS FOR SMOKER FAN CONTROL

These same switched outputs can be used to generate a variable PULSE WIDTH MODULATED (PWM) Power drive for a smoker unit fan control. The fan motor **MUST** be switched using an external power transistor as shown in Figure 8 below. The PWM frequency is 31.25KHz and the width of the pulse varies and tracks with the throttle setting. Thus, as the motor is driven faster, more smoke will be blown out of the smoker unit by the fan. It is also possible to setup a burst of smoke at a higher level when the engine starts up, to produce a “belch” of smoke at the exhaust pipe/stack.

USE EXTERNAL TRANSISTORS FOR INDUCTIVE LOADS OR HIGH CURRENTS

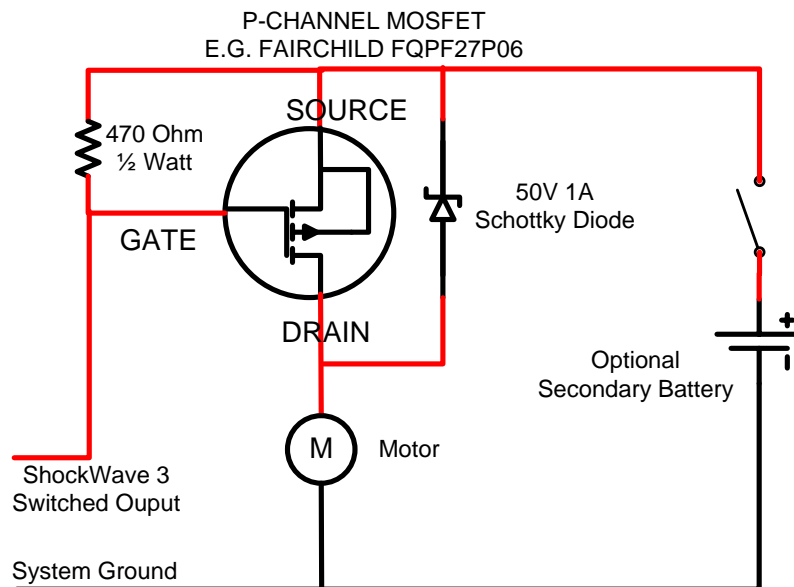
These outputs are controlled by tiny surface mount transistors which are not designed to switch heavy loads. In particular if an electric motor is used, the start-up current spike is many times greater than the rated running current. In these cases, the switched output MOSFET transistors on the sound module could be fried, causing them to become permanently short circuited.

Never connect a motor directly to the switched outputs. The warranty does not cover switched outputs that fail because of over-current in these circumstances.

If you need to switch motors of any size, you **MUST** use an external power MOSFET (Metal Oxide Semiconductor Field Effect Transistor) in a large package and use the sound module switched output to drive the gate (input) of that external MOSFET. The external MOSFET should be a P-channel type and have both a high voltage and a high current rating. They are available very inexpensively from many electronic component suppliers. E.G. device part number FQPF27P06FS-ND from Digikey.com is available at around USD\$2.00 each. It is rated at 60 Volts and 17 Amps and comes in an insulated TO220 package. A typical wiring diagram is shown next :-

Figure 8: External P-Channel MOSFET Transistor For Switching Inductive Loads Or High Currents

ShockWave 3 Wiring for External P-Channel MOSFET for switching heavy currents.



If using an external MOSFET such as this, **DO NOT** exceed the 30Volts maximum rating of the on-board switched output transistors. This means that the positive supply voltage shown above should not exceed 30Volts.

CHAPTER 15 – THE DOPPLERFX FEATURE

The **DopplerFX™** enhanced Doppler shift feature is enabled when an external Model Sounds Inc. **DopplerFX** accessory board is connected to the Accessory Port (SCKT3). The accessory board contains a **GNSS (Global Navigation Satellite System)** receiver.

Because this feature is so extensive, it warrants a reference manual all its own. That document is called **DopplerFXFeatureManual.pdf** and is located in the same folder as this hardware manual.

ORIENTATION OF THE 4-WIRE CABLE CONNECTOR

Correct Orientation of 4-Wire Connector



Incorrect Orientation of 4-Wire Connector



When connecting the supplied 4-wire accessory cable to the **DopplerFX** board, make sure the connector on the cable is inserted into the board connector the right way up. The white wire always goes to the top edge of the board connector as shown here. The connector is quite stiff, so make sure it is inserted all the way in.

If you need to remove it, do so very carefully by teasing the plug from its socket with a finger or thumbnail. Do not pull on the wires to remove it as they will be pulled out of the plug.

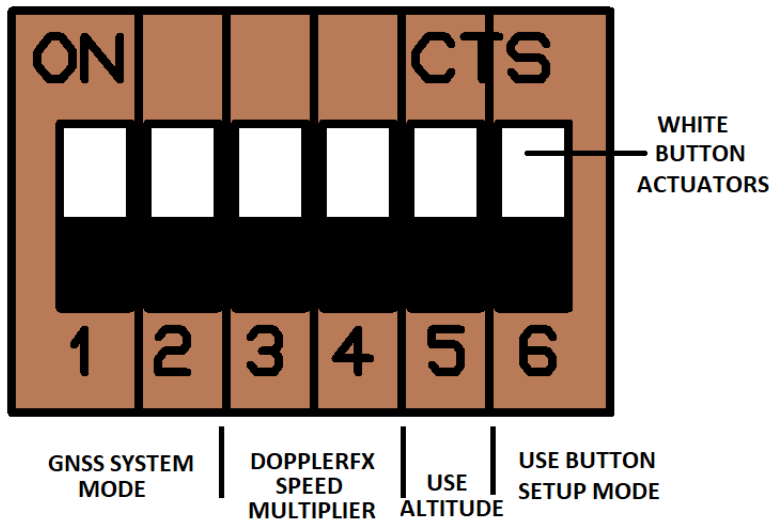
THE SIX-POSITION MINI DIP SWITCH

At the right-hand side of the board there is a six-position mini **DIP (Dual Inline Package)** switch. This switch is used to set various optional modes without having to resort to using the **ShockWave 3 PC** software application.

Most of these options relate to the DopplerFX feature.

Switch details are shown on the next page ...

Figure 9: Diagram of six-position mini DIP Switch



When delivered, the **ShockWave 3** sound module will come with all switches in their default **ON** position as shown here.

To operate these switches, use a tiny flat blade screwdriver.

DO NOT use a pointed instrument which may damage the small white plastic switch actuators.

GNSS SYSTEM MODE

The GNSS System mode is used only when a Model Sounds Inc. DopplerFX accessory board is connected. These switches set which GNSS satellite systems will be used by the DopplerFX feature.

DOPPLERFX SPEED MULTIPLIER

The DopplerFX Speed multiplier switches set how much artificial Doppler shift is applied to the sounds when the model is in motion.

USE ALTITUDE

The Use Altitude switch sets whether to take altitude into consideration when computing the artificially generated Doppler shift.

All of these switches are explained in full detail in the separate DopplerFX manual.

USE BUTTON SETUP MODE

The last switch in position 6 is used to set whether the sound module uses the default “[Automatic Throttle Setup Procedure](#)” setup or the more precise “[Precision Manual Throttle Button Setup Procedure](#)”.

When in the **ON** position, the module uses the **Automatic** setup procedure.

When in the **OFF** position, it uses the **Precision Manual** setup procedure.

CHAPTER 16 – MISCELLANEOUS

UPDATING THE FIRMWARE IN THE SHOCKWAVE 3 MODULE

Firmware is the program code that runs in the processor chip on the **ShockWave 3** module. The **ShockWave 3** module features a **microSD Card Bootloader** program that is a separate small program that runs in a separate area of the microcontroller's FLASH program memory. The latest firmware is always available for download from our web site in the **Support->Downloads** section. Users can update the firmware themselves by copying the downloaded **ShockWave3Firmware.hex** file to the **ShockWave 3** sound module 's microSD card.

The instructions for performing a firmware upgrade are in a separate PDF file called **"UpdatingShockWave3FirmwareUsingMicroSD.pdf"** found in the **Manuals-Instructions** folder of the microSD card in the **ShockWave 3** module.

SETTING LOW BATTERY VOLTAGE ALARM SOUNDS

If you have the optional **ShockWave 3 PC** Windows Software application, you can use the **ShockWave 3 PC Control Panel->Hardware Tab** to set low battery voltage alarms. This allows you to set battery low voltage alarms that trigger when the battery voltage for either the receiver or main battery voltage or both fall below set threshold values.

The sounds that play to announce low battery voltages are system sounds that are pre-set by Model Sounds Inc. These are played at any time the battery voltages fall below their low level limit(s) specified in the **ShockWave 3 PC Control Panel->Hardware Tab**.

You can set the number of times the alarm sound will play when first triggered by the low voltage condition. This allows a possibly annoying alarm sound to be played only a small number of times and then allows you to bring in the model to home quietly.

WHAT ARE THE TWO BUTTONS USED FOR?

The two buttons are used primarily for the optional ["Precision Button Throttle Setup Procedure"](#) - see previously. They are also used for the E-Z-Sync™ feature which allows for push button synchronization of the engine start-up and shut-down sounds to the motor/propeller rotation.

BUTTON 2 is also used to initiate a re-FLASHing of the firmware - see the separate PDF document named **"UpdatingShockWaveFirmwareUsingMicroSD.pdf"** in the **Manuals-Instructions** folder of the microSD card.

WHAT DO THE LEDS MEAN?

The LEDs on the sound module will flash at various rates either separately, together or alternately to indicate what is going on inside the module as follows:

<u>Sound Module Mode</u>	<u>LEDs State</u>	<u>Meaning</u>
Initial Startup	Red, Green, Blue, Orange LEDs all on together for about 1 second	Basic initialization starting, testing the LEDs, and starting the RTOS task scheduler.
USB Mode	Blue Flashing about once per second	USB Mode Normal operation. When ShockWave 3 PC application is launched, blue LED starts flashing rapidly.
Any mode	Green on steady	Any sound is playing.
Any mode	Red/Green flashing rapidly alternately	The module is waiting for the receiver to establish valid R/C signals.
Any Mode	Red Flashing rapidly	MicroSD card is not present in the sound module, or cannot be read.
Any mode	Red/Green Flashing together about once per second	MicroSD card file system cannot be mounted, or cannot be read.
Any mode	Blue/Green Flashing together about once per second	The SELECT_YOUR_SOUNDSET_HERE.txt file is missing, misspelled or cannot be read.
Any Mode	Red Flashing twice per second	Configuration data in .sxf7 file cannot be read.
Any mode	Orange/Blue Flashing together about twice per second	Problem reading or writing the hardware settings in the .sfx8 file.
Any mode	Red/Blue Flashing together about twice per second	Problem reading or writing the Multi-Sync settings in the .sfx8 file.
Regular playback mode	Red flashing briefly once every 2 seconds	One of the THRTL1 or SOUND1 inputs is not valid or is not connected or the receiver is not switched on.
Regular playback mode	Green flashing briefly once every 2 seconds	The Throttle1 input is receiving a valid R/C signal from the receiver. This is the normal operating condition.
Any mode	Red/Green on steady	The firmware has halted, i.e. has “crashed”. The sound module is inoperable until re-powered up. May also mean low receiver battery voltage – check battery voltage.

WHERE ARE HARDWARE SETTINGS STORED?

Hardware settings are those configurable settings that control how the **ShockWave 3** board itself behaves, rather than settings relating to the sounds.

There are some hardware settings that are always stored in the non-volatile EEPROM (Flash) memory chip on the **ShockWave 3** Module. These are :

1. Startup Delay.
2. Single/Multi Sound Mode.
3. Low Battery Voltage Alarm Settings.

By default, hardware settings, except those above, are stored in a special section of the **.sfx8** file that the **ShockWave 3** module opened when it was powered up. That is convenient if you want the hardware settings to travel along with the sounds.

However, there are some hardware settings that have nothing to do with sounds at all and are really settings or attributes of the module itself.

These are :

1. Input modes for THTTL1, THTTL2, SOUND1, SOUND2 and SOUND3 inputs
2. Idle Off Delay for THTTL1, THTTL2 inputs.
3. Offset # and Timeout for SOUND1/SOUND2/SOUND3 inputs

Using the optional Windows **ShockWave 3 PC** application, you can choose to store these settings in non-volatile EEPROM memory on the **ShockWave 3** Module by checking the **ShockWave 3 PC Control Panel->Hardware Tab Use Flash** checkbox. Then you can experiment with different **.sfx8** files without having to reset the hardware settings again each time you change the file.

CHAPTER 17 – TECHNICAL SPECIFICATIONS

- Sound file format : Uncompressed 16 bit/44100 samples/second.
- Main Supply Voltage Range : 4.5 Volts – 26 Volts for the on-board Audio power amplifier.
- Low-level : 4.5 Volts – 12 Volts for the low-level system supply
Supply Voltage Range (this is usually the receiver supply).
- Current Consumption: 200 mA from receiver or USB supply.
250 mA from receiver or USB supply when writing to microSD Card.
2 Amps max. from main power supply of 26 Volts when playing sounds.
Add 35 mA when DopplerFX Accessory board is connected.
Note: Switched LED loads consume extra current.
- Supplied microSD Card : 8 GB - may increase with time.
- Loudspeaker Impedance : 4 or 8 Ohms – DO NOT use lower than 8 Ohms on voltages greater than 14.4 Volts supply.
- Power Output into 8 Ohms : Maximum 9 W/12V, 20W/18V, 40W/26 Volts supply, depending on the individual sound playing.
- Power Output into 4 Ohms : Maximum 20W/14.4V – higher voltages not permitted when using 4 Ohms.
- Number of Audio Channels : **TWO channel playback is possible using an external stereo amplifier.**
The onboard amplifier is mono and plays a mix of left and right channels.
Engine1 sounds are usually on the right channel, Regular sounds and Engine2 sounds are usually on the Left channel.
- Audio Line Out Signal Level: 1.0V RMS – AC coupled into 10KOhms load minimum.
- Switched Outputs: 1 Amp maximum per output, 4 Amps maximum with all four outputs together, 30 Volts maximum switching.
- Size : 46mm x 69mm x 14mm
- Weight : 33 grams (1.2OZ)
- Output is Short-Circuit, Overload and Thermally Protected, BUT IS NOT REVERSE BATTERY PROTECTED.

TECHNICAL SPECIFICATIONS (CONTINUED)

Up to sixteen regular (non-engine) sounds + Two separate Engine sounds :

Four sounds can play simultaneously at 16 bits/44100 samples/second (DopplerFX feature not included).

Throttle input can be used as a fourth SOUND Select input if not needed for engine sound.

Second Throttle input can be used as a fifth SOUND Select input if not needed for second engine sound.

SOUND3 input defaults as control input for DopplerFX Feature (See separate DopplerFX manual document for details).

Sound Select Modes : Switched R/C 1xN, Switched R/C 1x1, Proportional R/C, 3-Position R/C, LogicLevel 1xN, LogicLevel 1x1, Keypad (SOUND1 input only).
Mechanical switches can also be used in the LogicLevel modes.

Sound Select Modes are selected in the **ShockWave 3 PC Control Panel->Hardware Tab**

Switched R/C 1xN : One ON/OFF switch channel or stick is used to switch N sounds on/off. (Default Mode)

1. Toggle Tx Switch for SOUND1/2 input from OFF to ON and back to OFF N times to select sound N. After a short timeout (adjustable), Sound N will start playing.
Repeat to switch Sound N Off. This is **Latched** Mode.
2. OR Toggle SOUND1/2 input from OFF to ON and back to OFF N-1 times and then move to ON and hold it there – Sound N will play for as long as the switch is in that ON position.
Release the switch to the OFF position to switch Sound N Off. This is **Momentary** Mode.
3. For a single sound just move the Tx Switch from OFF to ON and hold it there. The sound (selected by the Offset #) will play while the Tx Switch is in the ON position.

Switched R/C 1x1 : One ON/OFF channel or stick is used to switch ONE sound on/off.

1. Flip Tx Switch for SOUND1 input from OFF to ON to select sound N, where N is determined by the Offset number in the SOUND1 Input Mode section of the **ShockWave 3 PC Control Panel->Hardware Tab**, I.E. if the offset is 0, sound #1 will play, if the offset is 4, sound 5 will play etc.
2. Flip Tx Switch for SOUND1 input from ON to OFF to turn sound N OFF.

The Logic Level 1xN or 1x1 modes operate similarly as above, but with logic level inputs instead of R/C inputs.

Proportional R/C : One proportional channel is used to switch four sounds on/off.

1. Move Tx stick half-forward for more than 1 second = Sound 1 ON;
2. Move stick quickly full forward = Sound 2 ON;
3. Move Tx stick half-backwards for more than 1 second = Sound 3 ON;
4. Move stick quickly full backwards = Sound 4 ON;
5. Which specific sounds are played for Sound 1/2/3/4 is programmable using the SHOCKWAVE 3 PC SW application.
6. Proportional R/C mode is always latched action.

3-Position R/C

3-Position R/C switch on transmitter should be in centre OFF position when transmitter and receiver are switched on. Then:

1. Move in one direction to switch selected sound # N on.
2. Move in opposite direction to switch sound # M on.
3. Move back to centre OFF position to switch sound clip N or M OFF.
4. Sound clips N and M are selected using the **ShockWave 3 PC Control Panel->Hardware Tab.**

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