

# MODEL SOUNDS INC.

The World's Ultimate RC Sound Systems

Integrating The ShockWave<sup>®</sup> 3 Sound Module With  
EDF Afterburner LED Lighting Sets

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## INTRODUCTION

The ShockWave 3 sound module has many composite sound sets (.sfx8 files) for modern EDF (Electric Ducted Fan) model jet planes, most of which include genuine afterburner sound recordings.

The afterburner sounds are activated on throttle position and are usually set, by default, to about 75% of maximum throttle position. This setting is often done using the ShockWave 3 PC Windows application software. However, in the 5.1.1. and later releases of firmware, the user will be able to set the throttle position at which the afterburner sound plays using a push button on the board.

The ShockWave 3 sound module has built in four LED switched outputs implemented as electronic switches that switch their output to the system negative battery terminal. They are general purpose switched outputs that rely on an external power source and LED loads for complete functionality.

These LED switched outputs were originally envisioned to provide LED gun muzzle flashes in synchronism with gunfire sounds in the sound set. However, they have since grown to provide functionality far beyond that, but are always associated with one or more sounds in the sound set. They can be configured, using the ShockWave 3 PC Application Software, to function as on/off switches for navigation lights, or to provide a timed on-off sequence with or without a repeat function, or even to provide proportional PWM (pulse width modulation) outputs for a smoker unit fan control, including an engine start-up burst of extra smoke (i.e. fan speed).

For use with model airplanes using EDF units it is relatively simple to implement firmware and software changes that allow for one or more of the four LED switches to come on automatically in synchronism with the afterburner sound. This has been done in the 5.1.1 and later releases of firmware/software.

## COMMERCIALLY AVAILABLE AFTERBURNER/CENTERBURNER LED LIGHTING SETS

There are many commercially available Afterburner/Centerburner LED lighting sets in the market place today. Just do an on-line web search for Afterburner/Centerburner LED lighting and many search results come up.

There are two main varieties – LED rings and center LED arrays.

All come with, or are designed to use, a controller board that allows them to come on at and above a user determined throttle setting and that also provides for a flickering effect and/or variable brightness effect as the throttle stick is increased in position. The flickering effect better simulates an actual afterburner flame at the rear of a real jet engine.

More advanced lighting sets use multi-coloured (i.e. Red/Green/Blue or Red/Yellow/Blue) LEDs to change colour from orange to yellow to white as the throttle stick is increased. Most, however, use a single colour of LED, usually amber or yellow.

They come in two main varieties:

**Figure 1 - Afterburner LED Rings**



<p><b>These are Rings of LEDs such as this.</b></p> <p>These are series/parallel wired LED arrays and may be designed for various supply voltages, usually 2S – 3S LiPo (7.4 – 11.1 Volts).</p>	<p><b>These are strips of surface mounted LEDs, complete with current limiting series resistors.</b></p> <p>Usually designed for a 12V power supply and are usually powered on a 3S LiPo (nominal voltage of 11.1Volts). Come with self-adhesive backing tape. Least expensive.</p>
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Figure 2 - Centerburner LED Arrays



The Centerburner by RC Geek	Gooniac RC EDF Creations
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The term “Centerburner” is used as a product name by RC Geek and also by a Chinese outfit, but is also used in a generic sense to describe a centre mounted LED array, as opposed to an outer ring of LEDs. The term “Centerburner” is not a registered trade mark.

## INTEGRATING AFTERBURNER LIGHT SETS WITH THE SHOCKWAVE 3 SOUND MODULE

In the ShockWave 3 5.1.1 and later release of firmware, there are two methods to integrate afterburner light sets with the sound module and to achieve automatic synchronization between the afterburner sound and the afterburner lights switching on and off.

These two MODES of operation are:

**MODE 1** - Using an existing afterburner controller that comes with the LED light set.

**MODE 2** - Using a built-in afterburner controller function in the ShockWave 3 firmware using the existing four LED switched outputs to drive the LED arrays directly without the need for the external controller.

**MODE 1** is most suitable for beginners and requires the least effort and thought to make it work. Most afterburner controllers come with a wiring harness and battery connector making installation in the model easier.

**MODE 2** is most suitable for advanced modellers who like tinkering and can be used with home-made LED light sets or afterburner rings that don't come with a controller.

Both methods will switch on the LED arrays and flicker them in sync. with the afterburner sound in the sound set. Using the **MODE 2** ShockWave 3 afterburner controller, the user can select his own flicker rate (the time period between brightness changes) and flicker depth (the lower brightness level to which the LEDs may dim to).

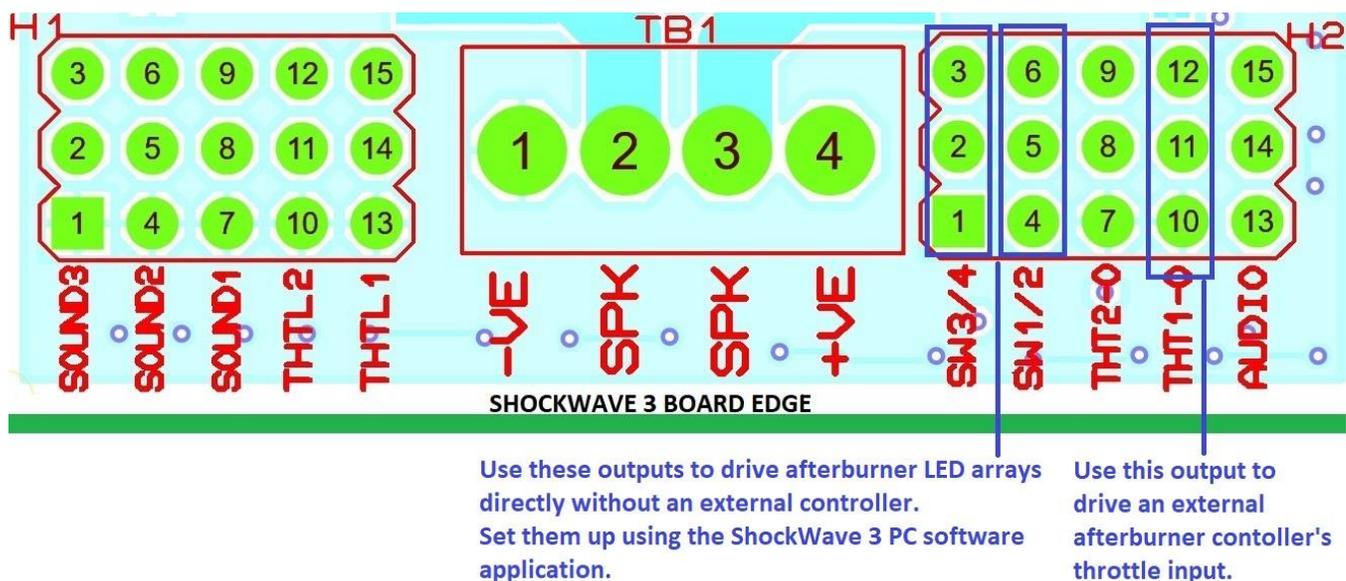
The setup of the **ShockWave 3 SW1/2/3/4** switched outputs for afterburner control is done using the **ShockWave 3 PC Application Software** in its **Control Panel->Switches Tab**.

Using the currently shipping batch of ShockWave 3 Rev.08 boards, it is probably easier to use **MODE 1**, since **MODE 2** will require a custom wiring harness unless the receiver voltage and the LED voltage are exactly the same.

The next production batch of ShockWave 3 boards, which will be Rev. 10, will have slightly different pin functions on header 2 and will allow a separate LED battery to be directly attached to the sound module. Then no additional wiring harness would be required.

Connections for both afterburner modes are shown here:

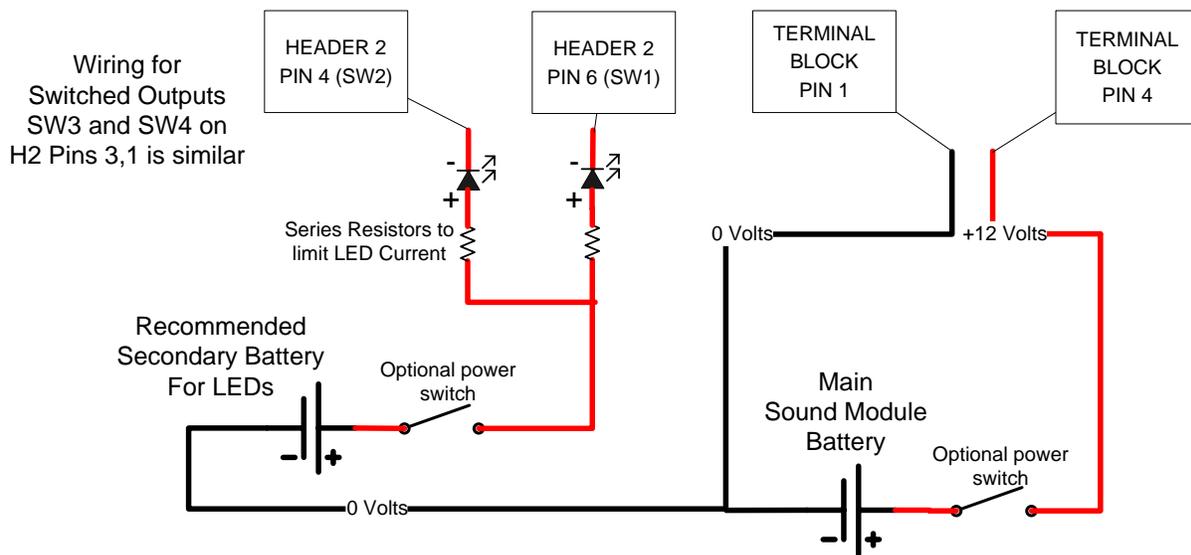
USE SHOCKWAVE 3 HEADER 2 (H2) FOR AFTERBURNER MODE 1 AND 2 LED CONNECTIONS



**MODE 1** connections on Header 2 pins are on pins 10, 11, 12 as shown above. Connect the external afterburner controller's throttle input to these pins with the brown or black -ve lead connected to pin 10.

**MODE 2** connections on Header 2 pins are on pins 1, 3 and 4, 6 as shown above. In the current Rev.08 boards the centre pins are connected to the receiver power which, unless your receiver and all the servos are high voltage types, will usually be too low to drive the LED arrays.

Figure 3: Example Wiring for Switched Outputs



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.

## SETTING THE THROTTLE POSITION FOR AFTERBURNER SOUND ON SHOCKWAVE 3

In the ShockWave 3 5.1.1. firmware release and later, you can set the throttle position at which the afterburner sound starts to play, using push buttons on the ShockWave 3 board as follows:

1. With the Engine sound already playing, move the THHTL1 (Engine1) throttle1 stick for that radio channel to the position where you want the afterburner sound to start playing.
2. Push and release **BUTTON2** quickly.
3. The afterburner sound will start and the new throttle position will be set into the Throttle Ranges section of the .afx8 sound set file.
4. After you have set the afterburner position this way, the sound module will be unresponsive to throttle position changes until you power it off and power it up again.

Continued over ...

5. To set the afterburner sound for Engine2 (THCTL2) move the throttle2 stick instead and follow the above steps.

## MAKING YOUR OWN AFTERBURNER LIGHTS

In recent years LED arrays for automotive turn signal lights are readily available at relatively low cost. These are optimized for 12Volt vehicle systems so would work well on a 3S LiPo RC battery. Modellers who are more adventurous can try modifying stock automotive LED turn signal bulbs such as those shown here:



LED turn signal bulbs like these are readily available on Amazon.com - <https://www.amazon.com/gp/product/B07D56Q756>. Various bulb designs, LED configurations and bases are available. It is necessary to carefully disassemble the base plastic molding, taking care not to damage the small circuit board which contains a constant current driver. *Note:* This is not a voltage regulator, but a current regulator.

Then you have to design and make a 3D printed “end bell” that fits snugly over the end of your EDF fan unit and allows the LED bulb to be glued firmly into it.

Several RC hobbyists have already done this and have posted in RCgroups.com (e.g. <https://www.rcgroups.com/forums/showthread.php?3313547-Make-your-own-flickering-EDF-afterburner>

Several EDF afterburner bell housing 3D printed projects with STL files have been posted on Thingiverse.com such as here: <https://www.thingiverse.com/thing:4042564>

If your exhaust tunnel is very long, then it is better to mount the LED bulb nearer to the exhaust exit to get a better afterburner visual effect. Then you will need to 3D print a separate mounting cradle for the LED bulb instead of an EDF end bell.

If you really want to get down to basics and have some electronics experience soldering and wiring LEDs and having printed circuit boards made, it is possible to build your own LED arrays, but this is very labour intensive. There are multiple approaches – using one or two high power LEDs intended for illumination purposes, using a multi-LED array of smaller 5mm LEDs intended for signalling applications, or using ready made surface mount LED strips which come with a self-adhesive backing and are often designed for 12Volt use.

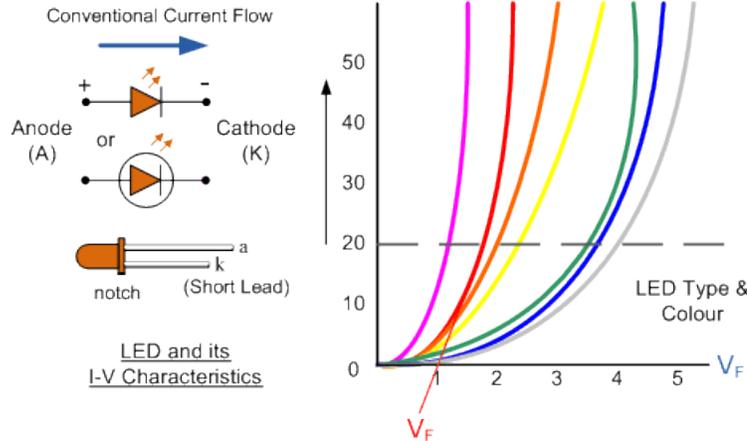
Generally speaking, high power LEDs for illumination purposes results in fewer LEDs and simpler wiring but they are all surface mount types making soldering and mounting more difficult and also require heatsinking to dissipate their heat. Therefore, they are more difficult to assemble and are not recommended unless you have specialist surface mount soldering experience.



The more common 5mm round radial leaded LEDs shown here are easier for the amateur modeller to use and assemble.



**Figure 4 - Typical LED Current vs Voltage Curves**

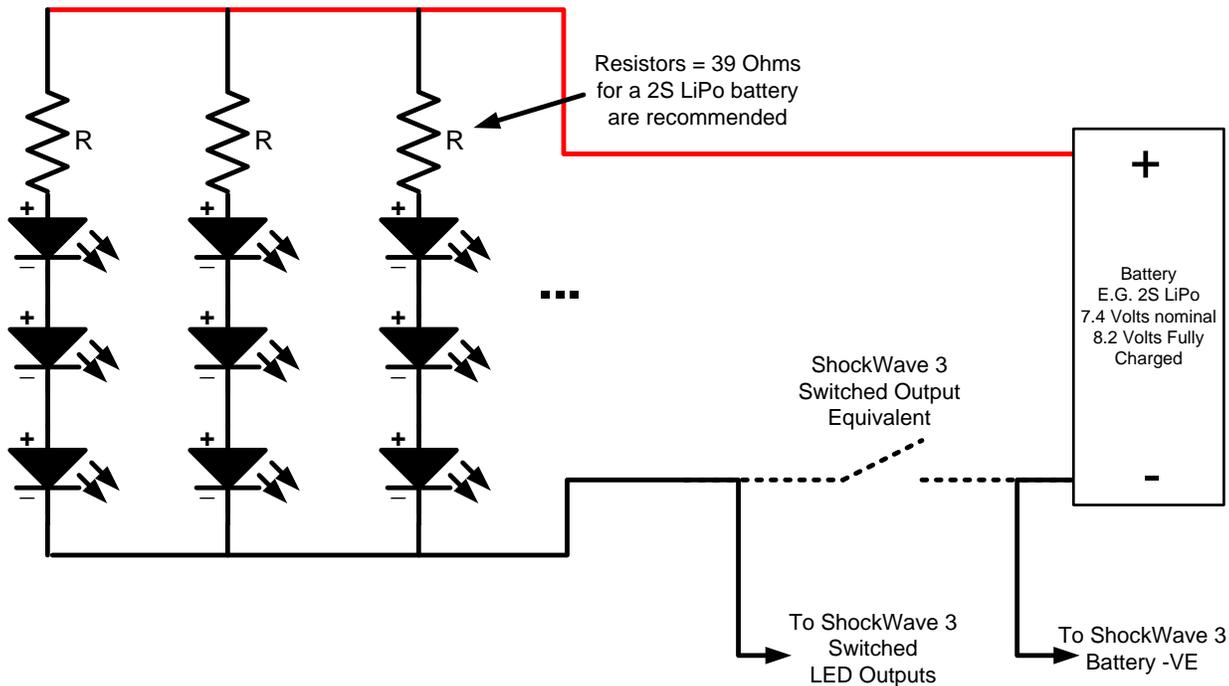


All diodes, LEDs included, have a very steep current vs voltage curve as shown here:

LEDs such as these in a yellow colour usually have a forward voltage rating of about 2.0-2.2 Volts at a forward current of 20mA.

To use them at a practical battery voltage of a 2S LiPo, for example, they should be wired in series together with a series current limiting resistor as shown next:

**Figure 5 - Series/Parallel Connections of LED Arrays**



The series resistors are recommended to prevent the LEDs from drawing too much current and burning themselves out. For example, as shown above, each diode will have about 2.2Volts across it, so three in series will have about 6.6Volts. But the 2S LiPo can have as high a voltage as 8.2Volts when fully charged. If that full battery voltage was applied directly to the three LEDs in series they would each see  $8.2 / 3$ Volts

= 2.73Volts which means the LED would try to draw about 30mA which may shorten their life since they are designed to consume 20mA.

Usually, the maximum power rating of 5mm LEDs is in the region of 60milliWatts (mW). At a forward voltage of 2.2V and a current of 20mA they are dissipating  $2.2 \times 20 = 44\text{mW}$ . At a forward voltage of 2.73Volts and a current of 30mA they are dissipating  $2.73 \times 30 = 82\text{mW}$  which exceeds their maximum power rating, hence the likelihood of a shortened lifetime without the series resistors.

When used in an afterburner lighting set, the LEDs are not switched on continuously but their current is modulated to give a flickering effect. Therefore, the average current will be less than the maximum so you may get away with no series resistors, but this is bad design practice.

## USING ALUMINIUM TAPE IN THE EXHAUST PIPE

Whichever way you acquire an afterburner light set, either buying a commercially made one or build it yourself, its visual performance can be improved by lining the inside of the EDF exhaust pipe with reflective aluminium self-adhesive tape to reflect all of the light produced back into the exhaust cavity.

If you use this, then be absolutely sure to overlap the start of the tape lining underneath the end of the EDF unit, otherwise the air flow may pickup the edge of the tape and lift it resulting in a catastrophic failure of the airplane.

## RECOMMENDED VENDOR/BRAND

At Model Sounds Inc., we have evaluated various afterburner alternatives and can highly recommend the CenterBurner by RC Geek – available here: <https://thercgeek.com/the-centerburner/>