

.....Spitfire MkII AM Modulator with Crystal Controlled Digital Frequency Synthesizer

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Introduction

Play music from your CD player, Tape, FM radio, MP3 or "Old Time Radio" CD's on your favourite vintage radios! With the **Spitfire** AM Transmitter, it is easy to transmit high quality audio signals to any AM broadcast band radio receiver between 500 and 1800 kHz. Compatible with European and American transmission using 9KHz or 10KHz channel spacing.

- ❑ Accepts audio from any Mono or Stereo source
- ❑ Delivers high quality modulation depth and linearity
- ❑ Ultra stable Crystal controlled Frequency Synthesizer
- ❑ 3 IC and 5 Transistor
- ❑ LED "Modulation Monitor" and Tuning Indicator
- ❑ No FCC license is required, when used as directed it is perfectly legal under Part 15 of the FCC rules. (US Only)

Before using your **Spitfire**, please read Installation and Operating.

Installation

The transmitter is supplied with an external power supply, which provides a **regulated** 15 Volts DC supply and is fitted with a 2.1 mm connector with **centre tip positive**

Earth and Grounding

It is always recommended that you connect the transmitter to GROUND via the EARTH connection on the rear of the unit. Just as a transmitter will not work without an antenna, likewise it will not work without a ground. A "ground" is simply any path from the transmitter circuit ground to earth ground that provides a low RF impedance.

When you connect the transmitter to an AC powered audio source, there is likely to be a low RF impedance path through the audio cable outer shields and then through the mains wiring to GROUND. These "built in" ground paths will provide good performance in many cases, but variations in house wiring and transmitter location may require you to ground the transmitter directly to a separate GROUND.

When you connect the transmitter to a battery powered audio source, there will be no low RF impedance path through the audio cables to GROUND, **in this case you must use the EARTH connection on the rear of the transmitter.**

You can try connecting the ground wire to a copper water pipe, a copper heating pipe or a grounding rod or rods driven into the earth. If you experience noise on the transmitted signal then your EARTH / GROUND is inadequate, connect EARTH connection on the rear of the unit.

Important Note: The **Spitfire** has been designed to operate with the supplied 9-10 foot antenna. Attempting to use other aerials may result in a mismatched condition, reduced range and distorted audio. The aerial wire should be run out straight. Avoid proximity to nearby metal objects. If more range is needed, try relocating the unit to a different location.

Power

Connect a well **regulated** 15 volt power supply with a 2.1 mm connector with **centre tip positive**.

Audio

Apply an audio source to the transmitter (if using headphone output, then keep volume fairly low to start with).

Selecting Operating Frequency

First you should find a area of the medium wave (broadcast) band that is free of any stations and interference, this will vary from location to location – the best way is to tune your AM radio from one end of the broadcast band to the other looking for suitable gaps.

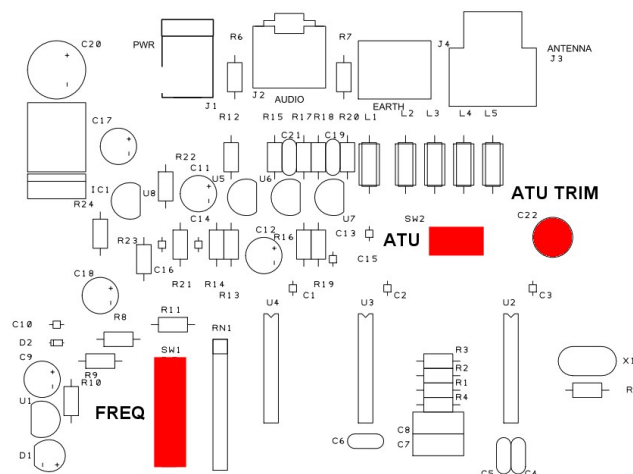
- ❑ More stations will be heard at night so you may need to do this again in the evening.
- ❑ The lower half of the broadcast band is usually less congested.
- ❑ The upper half of the broadcast band will give more range, optimum range will be found from 1000 to 1700 Kc's.

Your **Spitfire** will be pre-set to **1600Kc US** / **1440Kc EU**

Frequencies below 520 or above 1720 are not recommended as these are outside the allocated medium (broadcast) band, however the unit will usually tune below and above those frequencies stated.

Open the Case

- ❑ Turn the Spitfire upside down and undo the two screws to release the top cover.
- ❑ Remove the top cover, you can now see the PCB and access the switches.



Tuning

Next fine tune the signal using the AM radios tuning control, and finally adjust the modulation level for best audio quality.

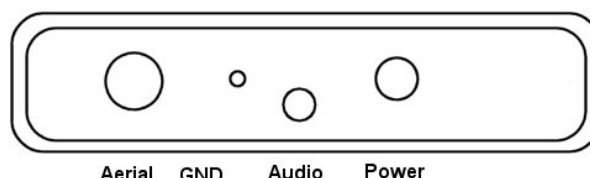
LED Modulation Monitor & Aerial Tuning Indicator

Best transmission will be achieved when the magic eye is gently pulsating. If the LED is very bright try altering the Ariel tuning settings or reducing the audio level.

Operating Notes

Once set-up and the aerial tuned, the only control that needs be adjusted is the audio level if a different audio source is used, the unit will accommodate various sources of audio CD players, tape or cassette decks, PC or FM Radio.

Rear View



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Frequency Setting Chart

When using this chart please make sure you use the correct frequency column **EU** is for 9 KHz Channel spacing and **US** is for 10 KHz Channel spacing.

Channel KHz		Frequency Select Switch							
EU	US	1	2	3	4	5	6	7	8
450	500		ON	ON	ON			ON	ON
459	510	ON		ON	ON			ON	ON
468	520			ON	ON			ON	ON
477	530	ON	ON		ON			ON	ON
486	540		ON		ON			ON	ON
495	550	ON			ON			ON	ON
504	560				ON			ON	ON
513	570	ON	ON	ON				ON	ON
522	580		ON	ON				ON	ON
531	590	ON		ON				ON	ON
540	600			ON				ON	ON
549	610	ON	ON					ON	ON
558	620		ON					ON	ON
567	630	ON						ON	ON
576	640							ON	ON
585	650	ON	ON	ON	ON	ON	ON		ON
594	660		ON	ON	ON	ON	ON		ON
603	670	ON		ON	ON	ON	ON		ON
612	680			ON	ON	ON	ON		ON
621	690	ON	ON		ON	ON	ON		ON
630	700		ON		ON	ON	ON		ON
639	710	ON			ON	ON	ON		ON
648	720				ON	ON	ON		ON
657	730	ON	ON	ON		ON	ON		ON
666	740		ON	ON		ON	ON		ON
675	750	ON		ON		ON	ON		ON
684	760			ON		ON	ON		ON
693	770	ON	ON			ON	ON		ON
702	780		ON			ON	ON		ON
711	790	ON				ON	ON		ON
720	800					ON	ON		ON
729	810	ON	ON	ON	ON		ON		ON
738	820		ON	ON	ON		ON		ON
747	830	ON		ON	ON		ON		ON
756	840			ON	ON		ON		ON
765	850	ON	ON		ON		ON		ON
774	860		ON		ON		ON		ON
783	870	ON			ON		ON		ON
792	880				ON		ON		ON
801	890	ON	ON	ON			ON		ON
810	900		ON	ON			ON		ON
819	910	ON		ON			ON		ON
828	920			ON			ON		ON
837	930	ON	ON				ON		ON
846	940		ON				ON		ON
855	950	ON					ON		ON
864	960						ON		ON

Channel KHz		Frequency Select Switch							
EU	US	1	2	3	4	5	6	7	8
873	970	ON	ON	ON	ON	ON			ON
882	980		ON	ON	ON	ON			ON
891	990	ON		ON	ON	ON			ON
900	1000			ON	ON	ON			ON
909	1010	ON	ON		ON	ON			ON
918	1020		ON		ON	ON			ON
927	1030	ON			ON	ON			ON
936	1040				ON	ON			ON
945	1050	ON	ON	ON		ON			ON
954	1060		ON	ON		ON			ON
963	1070	ON		ON		ON			ON
972	1080			ON		ON			ON
981	1090	ON	ON			ON			ON
990	1100		ON			ON			ON
999	1110	ON				ON			ON
1008	1120					ON			ON
1017	1130	ON	ON	ON	ON				ON
1026	1140		ON	ON	ON				ON
1035	1150	ON		ON	ON				ON
1044	1160			ON	ON				ON
1053	1170	ON	ON		ON				ON
1062	1180		ON		ON				ON
1071	1190	ON			ON				ON
1080	1200				ON				ON
1089	1210	ON	ON	ON					ON
1098	1220		ON	ON					ON
1107	1230	ON		ON					ON
1116	1240			ON					ON
1125	1250	ON	ON						ON
1134	1260		ON						ON
1143	1270	ON							ON
1152	1280								ON
1161	1290	ON	ON	ON	ON	ON	ON	ON	
1170	1300		ON	ON	ON	ON	ON	ON	
1179	1310	ON		ON	ON	ON	ON	ON	
1188	1320			ON	ON	ON	ON	ON	
1197	1330	ON	ON		ON	ON	ON	ON	
1206	1340		ON		ON	ON	ON	ON	
1215	1350	ON			ON	ON	ON	ON	
1224	1360				ON	ON	ON	ON	
1233	1370	ON	ON	ON		ON	ON	ON	
1242	1380		ON	ON		ON	ON	ON	
1251	1390	ON		ON		ON	ON	ON	
1260	1400			ON		ON	ON	ON	
1269	1410	ON	ON			ON	ON	ON	
1278	1420		ON			ON	ON	ON	
1287	1430	ON				ON	ON	ON	
1296	1440					ON	ON	ON	
1305	1450	ON	ON	ON	ON		ON	ON	
1314	1460		ON	ON	ON		ON	ON	

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Channel KHz		Frequency Select Switch							
EU	US	1	2	3	4	5	6	7	8
1323	1470	ON		ON	ON		ON	ON	
1332	1480			ON	ON		ON	ON	
1341	1490	ON	ON		ON		ON	ON	
1350	1500		ON		ON		ON	ON	
1359	1510	ON			ON		ON	ON	
1368	1520				ON		ON	ON	
1377	1530	ON	ON	ON			ON	ON	
1386	1540		ON	ON			ON	ON	
1395	1550	ON		ON			ON	ON	
1404	1560			ON			ON	ON	
1413	1570	ON	ON				ON	ON	
1422	1580		ON				ON	ON	
1431	1590	ON					ON	ON	
Default factory frequency setting									
1440	1600						ON	ON	
1449	1610	ON	ON	ON	ON	ON		ON	
1458	1620		ON	ON	ON	ON		ON	
1467	1630	ON		ON	ON	ON		ON	
1476	1640			ON	ON	ON		ON	
1485	1650	ON	ON		ON	ON		ON	
1494	1660		ON		ON	ON		ON	
1503	1670	ON			ON	ON		ON	
1512	1680				ON	ON		ON	
1521	1690	ON	ON	ON		ON		ON	
1530	1700		ON	ON		ON		ON	
1539	1710	ON		ON		ON		ON	
1548	1720			ON		ON		ON	
1557	1730	ON	ON			ON		ON	
1566	1740		ON			ON		ON	
1575	1750	ON				ON		ON	
1584	1760					ON		ON	
1593	1770	ON	ON	ON	ON			ON	
1602	1780		ON	ON	ON			ON	
1611	1790	ON		ON	ON			ON	
Extended Frequency including 160M Band									
1620	1800			ON	ON			ON	
1629	1810	ON	ON		ON			ON	
1638	1820		ON		ON			ON	
1647	1830	ON			ON			ON	
1656	1840				ON			ON	
1665	1850	ON	ON	ON				ON	
1674	1860		ON	ON				ON	
1683	1870	ON		ON				ON	
1692	1880			ON				ON	
1701	1890	ON	ON					ON	
1710	1900		ON					ON	
1719	1910	ON						ON	
1728	1920							ON	
1737	1930	ON	ON	ON	ON	ON	ON		
1746	1940		ON	ON	ON	ON	ON		

Channel KHz		Frequency Select Switch							
EU	US	1	2	3	4	5	6	7	8
1755	1950	ON		ON	ON	ON	ON		
1764	1960			ON	ON	ON	ON		
1773	1970	ON	ON		ON	ON	ON		
1782	1980		ON		ON	ON	ON		
1791	1990	ON			ON	ON	ON		
1800	2000				ON	ON	ON		
1809	2010	ON	ON	ON		ON	ON		
1818	2020		ON	ON		ON	ON		
1827	2030	ON		ON		ON	ON		
1836	2040			ON		ON	ON		
1845	2050	ON	ON			ON	ON		
1854	2060		ON			ON	ON		
1863	2070	ON				ON	ON		
1872	2080					ON	ON		
1881	2090	ON	ON	ON	ON		ON		
1890	2100		ON	ON	ON		ON		
1899	2110	ON		ON	ON		ON		
1908	2120			ON	ON		ON		
1917	2130	ON	ON		ON		ON		
1926	2140		ON		ON		ON		
1935	2150	ON			ON		ON		
1944	2160				ON		ON		
1953	2170	ON	ON	ON			ON		
1962	2180		ON	ON			ON		
1971	2190	ON		ON			ON		
1980	2200			ON			ON		
1989	2210	ON	ON				ON		
1998	2220		ON				ON		
2007	2230	ON					ON		

ATU Switch Settings

The goal is to find the best ATU switch setting that gives resonance with the lowest value of ATU trimmer setting. Some experimentation will find the best combination.

Mode	Frequency	1	2	3	4
External	All	ON	ON	ON	ON
Internal	1790 – 2500	OFF	ON	ON	ON
Internal	1480 – 2000 kHz	ON	OFF	ON	ON
Internal	1140 – 1610 kHz	OFF	OFF	ON	ON
Default factory frequency setting					
Internal	1000 – 1400 kHz	ON	ON	OFF	ON
Internal	880 – 1230 kHz	OFF	ON	OFF	ON
Internal	830 – 1160 kHz	ON	OFF	OFF	ON
Internal	750 - 1060 kHz	OFF	OFF	OFF	ON
Internal	620 – 870 kHz	ON	ON	ON	OFF
Internal	590 – 820 kHz	OFF	ON	ON	OFF
Internal	570 – 800 kHz	ON	OFF	ON	OFF
Internal	550 – 770 kHz	OFF	OFF	ON	OFF
Internal	530 -740 kHz	ON	ON	OFF	OFF
Internal	510- 710 kHz	OFF	ON	OFF	OFF
Internal	490 -700 kHz	ON	OFF	OFF	OFF
Internal	480 – 670 kHz	OFF	OFF	OFF	OFF

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Trouble Shooting

Audio distorted:	Audio source volume too high.
Hum on audio:	Bad audio cables, check for broken shield wires. Power supply filtering poor. Not using a regulated power supply Not grounding transmitter
No Audio:	Bad audio cables, Audio volume set to minimum.

Specifications

Modulation mode:	High-level AM Power output 100mw
Power requirements:	9 - 15 VDC at < 200mA (Regulated)
Power connector:	2.1mm coaxial (tip positive)
Audio input:	Standard Mono or Stereo signal
Audio connector:	Standard Mono or Stereo RCA Phono
Aerial:	9 foot antenna
Aerial connector:	RCA Phono
Frequency range:	500 to 1800 kHz typical
Crystal controlled PLL:	US - 10.240 MHz (10 KHz Channels) EU - 9.216 MHz (9KHz Channels)
Modulation Monitor:	Combined audio and modulation

The Front Panel LED

The LED will be either ON, OFF, or Pulsing depending on how well the unit has been installed. The goal is to set the unit up so that the LED is completely OFF with no audio and dimly pulsating with audio.

The LED monitors two parameters (a) Antenna Matching and (b) Audio Modulation.

Assuming, you are using the default factory settings and the supplied Antenna

1. Disconnect the Audio Cable, the Earth and the Antenna
2. Power the unit on
The LED should be ON, This indicated a problem with the Antenna, or missing Earth.
3. Now connect the Antenna
The LED should be ON, This indicated Antenna mismatch, or missing Earth.
4. Now tune your radio till you hear the channel (verify by turning the unit on and off) At this stage you have no Earth so there may well be a background hum
5. Now connect the Earth
If the LED is ON then, The Antenna is mismatched, and the ATU switch settings need changing.
If the LED is OFF then, The Antenna is matched.
If the LED is DIM then, a tweak of the ATU switch settings or ATU trimmer may be required.
The goal is to set the unit up so that the LED is either completely OFF or as DIM as possible.
6. At this stage you now have an Earth connection so any background hum should have gone .
7. Now connect the Audio Cable (no Audio playing)
The LED should be DIM or OFF (no Audio playing). If the background hum has come back then you have an Earth Loop (that means there is more than one Earth Connection) the options are (a) Earth Loop Isolator or (b) disconnect the Earth on the unit.
8. Now play some music and adjust audio level until the LED just dimly pulsates
If you get over modulation and the LED is still OFF this is OK just reduce the level slightly till the audio is clean

So basically

- The LED is only fully ON when there is something wrong with the Antenna, or the Earth or the ATU settings or not set to an optimum
- The LED is OFF or as DIM as possible with no audio signal

Lastly Earthing

- On all units you must have a Earth connected either
- Directly to the Earth tab on the Spitfire (or)
- If your Audio source has a good earth connection for example a PC (via the Audio cable)
- Beware of Earth loops use one or the other method

Convert Meters to Frequency

The dials of the majority of British radios will be marked in wavelengths (metres) rather than frequencies.

To convert from one to the other, divide 300,000 by the known figure The result should be rounded up or down to the closest whole number.

Thus 300,000 divided by 1000 KHz gives 300 Metres. Conversely, 300,000 divided by 300 Metres gives 1000 KHz.

External Aerial Tuner and Loading Coil

For many applications, the simple 9 foot Ariel wire supplied with the **Spitfire** will produce satisfactory results around your house.

Note: To Comply with US FCC rules - be sure, that the total length of the Aerial, feed line, and grounding wire is less than 10 feet as required by the FCC Part 15 rules.

A simple but effective hint is to connect the **Spitfire** to longer aerial.

Since the actual wavelength at AM broadcast frequencies is over 950 feet, and the **Spitfire** uses an aerial length of only nine feet, you may want to experiment with a "loaded" antenna for better performance.

Using an 9 foot length of wire, a series inductance of between 300-400 μ H is required to properly load the circuit.

A properly matched antenna will radiate more efficiently and, in some cases, will produce a better-sounding AM signal.

Instead of a complete and complex antenna tuner, many LPAM stations use a variable inductance located at the transmitter output or at the feed point of the antenna. This approach is popular with Part 15 experimenters using simple wire antennas or shortened verticals. Then you try various inductances while the transmitter is on, and see which setting provides the best range.

The variable inductor can be, for example, a coil made of 100 turns of 22-gauge (#22 AWG) enamelled wire that you wind around a piece of PVC pipe 2 or 3 inches in diameter, with taps (connection-points) built into the coil every 10 turns; or any similar inductor.

The various taps in your coil can be wired to a rotary switch, or you can use a small alligator clip to select one at a time.

Warranty

We guarantee the product to be free from defects in materials and workmanship for one years. We will repair or replace such product, if found to be defective in materials or workmanship.

The customer will be responsible for all costs of transportation and insurance, in both directions.

This warranty shall be void and of no force of effect in the event a covered product has been modified in design or function, or subjected to abuse, misuse, mishandling or unauthorized repair.

EARTH and GROUNDING

A good, low impedance ground is required for optimum range and performance.

It is always recommended that you connect the transmitter to GROUND via the EARTH connection on the rear of the unit..

