



Power Supplies

For use with the
ASM-1, ASM-2 and other
Analogue Synthesisers

Revision 1c
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Please note that this document is still currently under revision and we apologise for any errors or omissions.
Readers should feel free to email any comments to elby_designs@ozemail.com.au.

Power Supplies

This document presents two general-purpose power supplies suitable for use with the ASM family of analogue synthesisers as well as any electronic project requiring clean, well-regulated power supplies.

The first design is a low-cost solution utilising a popular family of fixed voltage regulators suitable for systems requiring up to 500mA per rail whilst the second solution is a heavier duty supply for systems requiring up to 1A.

Both designs are linear power supplies which, although requiring a large and sometimes heavy mains transformer, do provide a much cleaner output than switched-mode power supplies and are the generally preferred solution for audio applications.

The PSU-1 and PSU-2 Kits include all components and hardware required to construct the relevant module with the exception of the mains transformer and any protective cover. Most good electronic hobby shops can usually supply a suitable transformer.

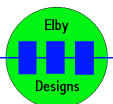
Both the PSU-1 and the PSU-2 are suitable for use with the ASM-1 and ASM1-Genie. The ASM-2 already includes an onboard regulated power supply but in applications where the ASM-2 is used in conjunction with other modules you might wish to use a more powerful, better quality power supply like the PSU-2 (in which case you can bypass the onboard power supply).

Also included in this documentation are details of the RAW-DC pcb which provides an unregulated dual-output suitable for powering regulator circuits and the ASM-2.

!! WARNING !!

Operation of these modules will require that the user to connect the board to a transformer, which in turn will require connecting to mains-borne power.

Readers are advised that they **MUST** use **EXTREME CAUTION** when working with mains-borne voltages and that they must **ENSURE** that the entire unit is electrically safe.



PSU-1 Power Supply Rev 2

Power supply voltages in a synthesiser must be stable. The design presented here is based on the 78xx and 79xx family of fixed voltage regulator ICs.

Each regulator can comfortably supply over 300mA and, with larger heatsinking, handle up to 1A.

This unit is ideally suited to the ASM-1 builder on a low budget.

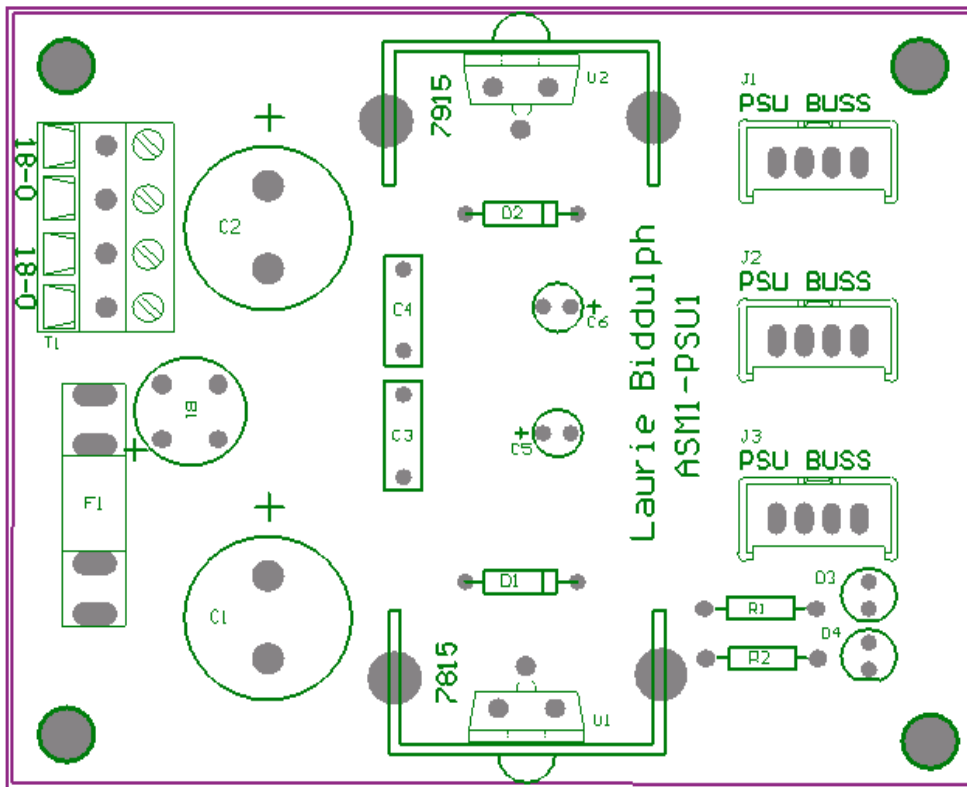


Figure 1: PSU-1 Component Overlay (not to scale)

By substituting different members of the 78xx/79xx regulator family the user is able to create a variety of different output voltages such as +/-12V, +/-5V as well as asymmetrical supplies such as +5V/-8V.

NOTES:

- LEDs, if used, should, ideally, be panel mounted.
- LEDs should be rated to at least 30mA as R1 & R2 set the LED current to approximately 20mA.
- Use insulating washers on U1 & U2 if the heatsinks will come in contact with any metalwork.
- Connector T1 may be replaced with soldered wire connections if desired.
- Connectors J1-J13 have two ground (GND) connections which may be used for separate analog (AGND) and digital (DGND) grounds for improved noise immunity. Alternatively, either or both may used as a single common GND.
- Transformer T1 may be either a centre-tapped transformer or one (or two) transformers with individual secondaries. See the appendix for schematics.
- The on-board heatsinks may be substituted with larger heatsinks if a greater current capacity is required. I would also recommend increasing the size of C1 and C2.

Setting up

Once constructed check that the two outputs terminals are within specification.



PSU-2 Power Supply Rev 1

Power supply voltages in a synthesiser must be stable and, preferably, easily adjustable. The design presented here is based on the tried and trusted 723 precision voltage regulator IC.

It will be noted from the schematic that both circuits are positive regulator circuits with an external power transistor to increase the output current. The negative supply is obtained simply by linking the positive output of this circuit to ground. This design does have the slight disadvantage that separate transformer windings and rectifiers are required for circuit but it does mean that both circuits are of identical design.

Each supply is equipped with foldback current limiting, and can comfortably supply over 800mA. When limiting occurs (at about 1.2A) the output voltage will fall and the current will fold back to about 500mA with a short-circuited output. Current limiting of any of the outputs is indicated by extinction of the LED indicator connected across that output.

By adjusting the relevant components, any output voltage from around 5V to 15V can be selected. Higher output voltages can also be achieved but will require a higher transformer output and will probably require that the electrolytics be replaced with ones having suitable higher voltage ratings.

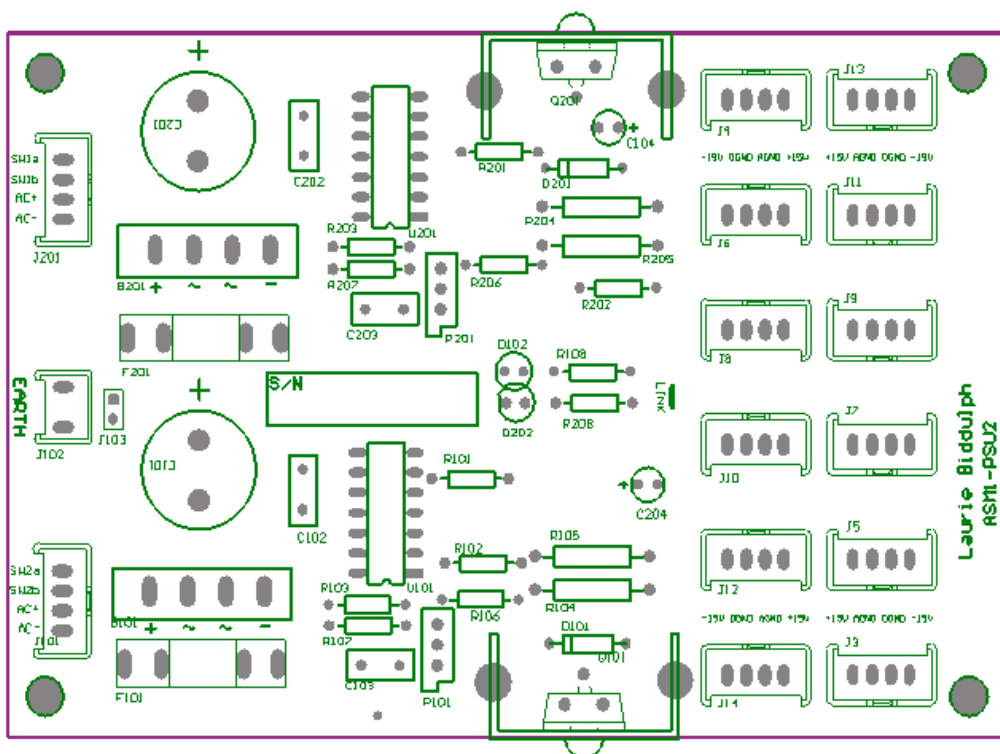


Figure 2: PSU-2 Component Overlay (not to scale)

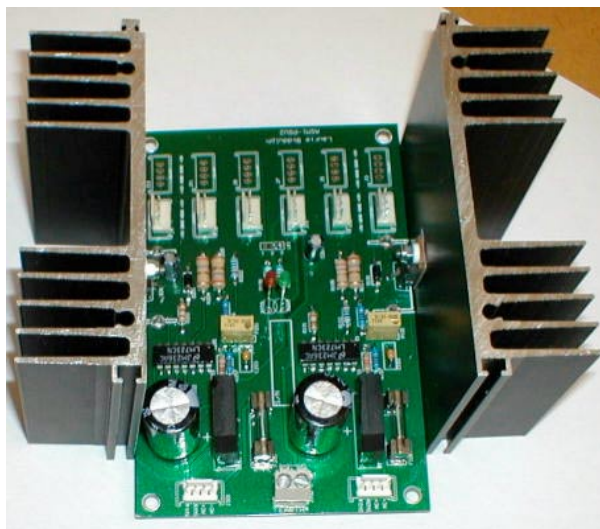
NOTES:

- LEDs, if used, should, ideally, be panel mounted.
- LEDs should be rated to at least 30mA as R108 & R208 set the LED current to approximately 20mA.
- We strongly recommend that the ON/OFF switch (S101) be linked out and replaced with a suitable mains power switch at the input to the transformer.
- Use insulating washers on Q101 & Q102 if the heatsinks will come in contact with any metalwork.
- Connectors J101 & J201 may be replaced with soldered wire connections if desired.
- Connector J102 is provided so that the whole board (and thus the whole system) can be grounded to true earth at ONLY the one point.
- Connectors J103 to J114 have separate analog (AGND) and digital (DGND) grounds for improved noise immunity. Alternatively, either or both connections can be used as a common GND.
- LK101 must be fitted to common the analog and digital ground circuits.

Setting up

Once constructed, the only adjustments required are to P101 and P102. Using an accurate voltmeter, adjust P101 until +15.0V +/-0.2V is measured at the positive output rail. Adjust P102 until -15.0V +/-0.2V is measured at the negative output rail.

Once your system is complete you should recheck these two settings with all modules connected and functioning.



PSU-2 fitted with optimum heatsinks.

RAW-DC Power Supply Rev 2

This simple little unit converts an AC voltage from a transformer in to a rough (pre-regulated) DC supply suitable for further power conditioning by regulator circuits.

The ASM-2 is an example of a unit that can use this pcb. As it is not desirable to have AC voltages on or near to audio circuits like the ASM-2 it was decided to omit this `pre-regulator' circuit from the pcb design. This approach allows the transformer and its associated AC voltages to be mounted as far away as possible from the main circuitry.



As there are very few components in this unit and they are all reasonably large, it is quite possible to hardwire these components in-situ although a neater solution is achieved by using this pcb.

As with any power supply design there are mains voltages involved and constructors must obey the basic safety rules for handling mains equipment during construction and also ensure that any user of the final system is also adequately protected from these lethal voltages.

Construction

Construction of these modules is very straight-forward, however, as with any electronic circuit the builder should pay careful attention to the orientation of polarised components such as diodes, LEDs and electrolytic capacitors.

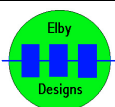
With the board fully dressed, you will need to apply power using a mains transformer.

Readers are duly reminded again that working with mains voltages can be LETHAL!!!!

The completed unit should be housed in an electrically safe housing such as a plastic enclosure. Ensure adequate ventilation for the board to allow the heatsinks to function correctly and ensure that ALL mains-related connections are sleeved and protected from prying fingers (heatshrink tubing is an ideal method for doing within the enclosure). If building the power supply inside your main synthesiser cabinet then you may omit the enclosure as long as the mains-related terminals are adequately insulated from accidental contact. You should mount the transformer and power supply pcb as far away from your main synthesiser circuitry to reduce any affects from induced noise from the transformer or temperature fluctuations from the heatsinks.

The LEDs may be replaced with panel mounted models to provide a visual indication that power is applied and that the power supply is functioning. You should not, however, use these LEDs as an indication of the status of the mains circuit as, in a worst-case scenario, the power supply board may have failed or been disconnected but mains voltages may still be present in the system.

Similarly, fuses may also be replaced by a panel-mounted model. Please ensure when selecting such a unit that it offers the best protection for the user in preventing accidental contact with the fuse whilst still making contact with the mains power.

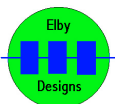


Bills Of Materials (BOM)

The following pages provide Bills Of Materials for the products described in this document.

Readers should note that the Mouser/Farnell part numbers given are, generally, typical component suggestions. In many cases alternative components may be used as long as they meet the basic specifications listed. It is the responsibility of the reader to ensure that the components used are suitable for their specific application.

When making a choice for a suitable component readers are recommended to read the product details in the Mouser/Farnell catalogues to ensure that that the component they select meets or betters the product details as described in that catalogue. In many cases components from alternative suppliers may be used and, in some cases, devices with a better specification may also be substituted.



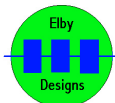
Bill of Materials for PSU-1

Resistors		Value	Description	Package	Qty	Mouser	Farnell
R1, R2	680R	0.5W 1% Metal Film	Axial 0.4"	2		335-093	
Capacitors		Value	Description	Package	Qty	Mouser	Farnell
C1, C2	1000uF 35V	Electrolytic	RB 0.2"	2		320-1612	
C3, C4	100nF	Polyester	Radial 0.3"	2		146-079	
C5, C6	10uF 25V	Electrolytic (Low ESR)	RB 0.1"	2		320-1533	
Semiconductors		Value	Description	Package	Qty	Mouser	Farnell
U1	7815	Fixed Voltage Regulator	TO-220	1		701-877	
U2	7915	Fixed Voltage Regulator	TO-220	1		301-2815	
B1	1A5 400V	Bridge Rectifier	WO4	1		646-696	
D1, D2	1N4001	50V 1A rectifier diode	Axial 0.4"	2		251-677	
D3, D4	Red LED	Optional	Panel	2		170-163	
Miscellaneous		Value	Description	Package	Qty	Mouser	Farnell
T1	5A 5.08mm	4-way terminal block	5.08mm pitch	1		304-1475	
F1	1A Anti-surge	Anti-surge fuse	20 x 5mm	1		898-922	
		20mm PCB fuse clips		2		926-851	
J1-J3	0.1" pitch	4-way pcb connector		3		143-141	
		4-way crimp housing		3		143-128	
		30-22AWG crimp		12		143-116	
	Heatsink	Type 6021		2		170-070	
	M3 x 10mm	Stainless steel bolt for heatsink		2		278-063	
	M3 Locknut	Nut for heatsink		2		710-8163	
PCB	Rev 2	PSU-1 Rev 2		1			

Power Supplies

Bill of Materials for PSU-2

Resistors	Value	Description	Package	Qty	Mouser	Farnell
R101, R201	3K9	0.5W 1% Metal Film	Axial 0.4"	2		336-087
R102, R202	1K	0.5W 1% Metal Film	Axial 0.4"	2		335-490
R103, R203	22K	0.5W 1% Metal Film	Axial 0.4"	2		336-269
R104, R105, R204, R205	2R7	1W 5% Carbon Film	Axial 0.6"	4		550-681
R106, R107, R206, R207	6K8	0.5W 1% Metal Film	Axial 0.4"	4		336-142
R108, R208	680R	0.5W 1% Metal Film	Axial 0.4"	2		335-903
Presets	Value	Description	Package	Qty	Mouser	Farnell
P101, P201	2K	Multi-turn	64W	2		348-983
Capacitors	Value	Description	Package	Qty	Mouser	Farnell
C101, C201	2200uF 35V	Electrolytic	RB 0.2	2		361-8663
C102, C202	100nF	Polyester	Radial 0.3"	2		146-079
C103, C203	470pF	Polystyrene (or NPO Ceramic)	Radial 0.4"	2		146-072
C104, C204	10uF 25V	Electrolytic (Low ESR)	RB 0.1	2		320-1545

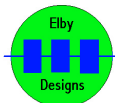


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Bill of Materials for PSU-2 (continued)

Semiconductors	Value	Description	Package	Qty	Mouser	Farnell
U101, U201	723	Adjustable voltage regulator	DIP-14	2		411-905
B101, B201	400V 6A	Bridge rectifier		2		433-214
Q101, Q201	MJE3055	60V 4A power transistor	TO-220	2		361-082
D101, D201	1N4001	50V 1A rectifier diode	Axial 0.4"	2		251-677
D102, D202	Red LED	optional	Panel	2		170-163
Miscellaneous	Value	Description	Package	Qty	Mouser	Farnell
J101, J201		4-way terminal block	5.08mm Pitch	2		304-1440
J102		2-way terminal block	5.08mm Pitch	1		
F101, F201	2A 20mm	Anti-surge or Slow-Blow fuse		2		898-946
		20mm PCB fuse clips		4		926-851
J103-J114		4-way pcb connector		12		143-141
		4-way crimp housing		12		143-128
		3-22AWG crimp		48		143-116
Heatsink	2.2°C/W			2		170-763
	DPDT	250V 10A Switched IEC mains inlet	Panel	1		561-186
	M3 x 10mm	Bolt for heatsink		2		278-063
	M3 locknut	Nut for heatsink		2		710-8163
Spacer	M4 x 6mm	Untapped nylon spacer		4		
PCB	PSU-2	Printed circuit board		1		



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Power Supplies

Bill of Materials for RAW-DC (configured to suit ASM-2)

Semiconductors	Value	Description	Package	Qty	Mouser	Farnell
BR2	400V 6A	Bridge rectifier		1		
Capacitors	Value	Description	Package	Qty	Mouser	Farnell
C1, C2	4700uF 35V	Radial Electrolytic		2		
Miscellaneous	Value	Description	Package	Qty	Mouser	Farnell
J1, J2	3-way	3-way screw terminal	0.2" pitch	2		
		Wire link		1		

