ASM-2 Manual

Appendix A

Assembly Guidelines

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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 e-mail any comments to me at the address given below.

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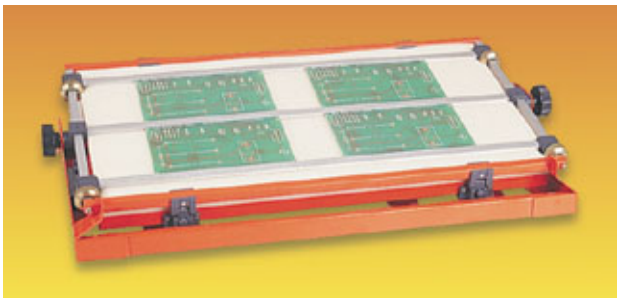
Assembly Instructions

Included with your ASM-2 pcb is a large drawing which is a blow-up of the silkscreen showing the location for each component as per the various schematics. Builders should use this in conjunction with both the schematics and the Bills Of Materials provided on the Support CDROM, to determine which component goes where. Builders should also read the other documentation provided on this CDROM and also follow the web links to other constructors for additional ideas and notes on constructing your ASM-2.

When assembling the board we recommend one of the following two strategies:-

1) Assembly of the full board by component type. In this method the board is built up in layers starting with resistors and diodes, then ICs, capacitors, trimpots and transistors. One disadvantage of this approach is that the unit cannot be tested until the complete board has been assembled. I use a PCB Assembly Jig (see photograph) which means that I can insert components and solder them without having too bend the legs over to retain them. This is a big bonus if you wish to experiment with the board as it makes component removal a lot easier.



2) Assembly by module. In this method each module is assembled in its entirety one at a time. Once assembled, the module can be tested with, in many, cases minimal external componentry being added. One disadvantage of this method is that you will need to connect some external components to some of the modules for testing and this will require some connecting and disconnecting to allow for easy assembly of the next stage. This approach does not work with my PCB Assembly Jig and the previous method as the variations in component heights affects the height of the components on the board preventing the component retainer from working properly.

Option (2) may suit users with less confidence in their assembly skills as they can quickly determine if a module works properly and as to how things are going.

Once you have figured out what components you want to stuff, mark up the drawings to show this.

Occasionally some components may become obsolete or very difficult to get hold of. In these instances, substitute components are provided. Wherever possible, these will be pin compatible (as well as functionally compatible) allowing them to be inserted in to the PCB without modifications. However, this is not always possible and some components may need to have their legs bent to fit the PCB location. We are continually on the lookout for alternative substitutes and will replace components in our kits as approved substitutes become available.

ASM-2 Manual – Appendix A

General notes on the assembly of the ASM-2 PCB:

All resistors on the PCB are on a 0.4” pitch whilst most diodes are on a 0.3” pitch and so these components can be generally preformed before insertion in to the pcb. Capacitors in the range 1nF to 1uF are normally on a 0.2” pitch whilst smaller capacitors are either 0.2” pitch (generally ceramics) or 0.4” pitch (polystyrene). Tantalums and electrolytics are generally on a 0.2” pitch. A resistor colour code chart is on the CD included with your kit.

Integrated Circuits (IC) may be socketed if desired (a kit of sockets is available) but is not required in normal use. If you wish to experiment with the modules then we recommend the use of IC sockets. If used, we strongly recommend using machine-turned-pin sockets as these offer better long-term use.

Wiring to the boards is made easier by having all of the module connections at the edges of the PCB. We recommend running your cables around the outside of the boards in a loom leaving the centre of the board clear. This will be a boon when setting up and adjusting the modules and will also simplify debugging should it be needed. This will result in slightly longer cable runs but this should not adversely affect the quality of the system through induced noise. Colour coding of cables is not a pre-requisite but once again using colour-coded cables will simplify tracing faults. The table below gives two examples of suggested colour schemes:-

Cable Colour	Function	Or	Cable Colour	Function
Red	+15V		Red	
Black	Ground		Black	
Yellow	-15V		Yellow	
Orange	Control Voltages - In		Orange	VCO*
Pink	Control Voltages – Out		Blue	ADSR
			Green	VCA*
Grey	Signals – In*		Brown	VCF*
White	Signals – Out*		Grey	NOISE*
			White	LFO
			Pink	GLIDE

* Audio signals are better wired using screened audio cable.

The first scheme on the left will have the advantage of allowing you to bulk buy a handful of cable colours but will make fault finding a little harder. The second scheme, on the right, will require smaller quantities of more cable colours but will allow you to trace wires for a given module more easily. I would recommend this second approach for beginners.

For the choice of wire type and sizes I would suggest:-

- 7/0.2mm (24AWG – 7/32AWG) for control wires
- 16/0.2mm (22AWG – 7/30AWG) for power rails (NB: 7/0.2mm is also fine for this purpose
- Single-core screened audio cable for all signal wires

When selecting audio cable, choose the smallest outside diameter possible. I use 10/0.12mm with an OD of 1.6mm. Larger cable OD will result in a larger cable loom. When connecting screened cable you should only connect one end of the screen to GND. In the ASM1-Genie this GND connection was provided by running a length of tinned copper wire around the outside of the pcb. This was achieved by placing eyelets on each corner of the pcb (using the pcb fixing holes to support the eyelets) and then attaching the wire to the free end of the eyelets. This approach means that the screen terminations are evenly spread around the board making it easier to maintain the wiring. The free end of the screen is cut flush with the end of the outer sleeve of the cable and either shrouded with a piece of heatshrink or masked by teasing the outer sleeve over the exposed wire.

Nowadays its is recommended that you treat all semiconductor parts as static-sensitive, especially the CA3140s (that's why they get soldered in last). Be really careful with these – they are unbelievably easy to blow up. You can, optionally, use ic-sockets for the IC's if you want. It is recommended to use sockets for the CD4002 and LM358 chips in the ADSRs, and for the output buffer op-amps in the VCF. Also, you may want to socket the CA3140s in the VCOs since they are so easy to blow up.

Component Substitutions and Your Own Modifications:
If you know what you're doing, go for it. If not, stick with the recommended parts.

TEMPCO's:
The ASM kits include a TEMPCO resistor for each of the VCO's. A TEMPCO can also be used in the VCF but is not included in the kit as this is less critical. The ASM kits provide a 1% metal film resistor for the VCF. The pcb has positions for the TEMPCO on the pcb but builders are referred to the photo which shows one method for improving the thermal bonding between the TEMPCO and the MAT-02. In this approach the TEMPCO is actually placed directly underneath the MAT-02. Thermal contact is improved through the application of some heatsink compound.

The current design of the VCO modules requires TEMPCOs with a Positive Temperature Coefficient (PTC) of 3300ppm. Your VCO module kits will contain one of the following configurations for this component:-

1. A 3300ppm resistor. In this case resistors R137 and R187 should be replaced with a wire link
2. A 3500ppm resistor. In this case your kit will also include 2 off 62R 50ppm resistors which should be fitted in positions R137 and R187

Thermal contact:
All of the critical exponential converter components are physically placed next to each other so that they can be in physical contact. The transistors and the TEMPCO resistors (if used) should, ideally, be thermally bonded together with heatsink compound, for best thermal results. This is totally optional and only for those who are after perfect performance.

Bills of Materials (BOMs):
The following pages provide the BOMs for the ASM-2 and are provided as:-

1. A BOM for the overall pcb to assist when purchasing your kit, and
2. BOMs for each individual module to assist with identification of components during construction. These BOMs should be used in conjunction with the schematics and component overlay.

Components are given 3 or 4 digit identifiers such as C301, R221 and Q1201. The first of these three digits (two in the case of 4-digit numbers) relates to the schematic sheet number on which the component can be found whilst the last 2-digits are a sequence number for that component category on the sheet.

When building your own order for components you should note the following points:-

1. All resistors are 1% 0.5W Metal Film (MRS25 Series). In most cases these can be replaced by lower tolerance (up to 10%) resistors. Also in most cases you can also use Carbon Film.
2. Capacitors in the range 1nF and 1000nF are generally Polyester (BF or MKS2 Series). Substitutes should be of a low-noise, high-stability type.
3. Capacitors below 1nF are generally 2.5% 160VDC Polystyrene (FCS Series) but Silvered Mica will also work fine. In some cases it is possible too use a high-stability NPO Multilayer Ceramic capacitor.
4. Decoupling capacitors are listed as 100nF X7R Multilayer Ceramics. Values in the range of 47nF to 150nF can be freely used in these positions and any good quality capacitor that will fit the RAD-0.2 footprint can be used.
5. Capacitors of 1uF and above are polarised and should either be MDT or TAP Series Tantalum or low-impedance Aluminium Electrolytics.

Some schematics include panel-mounted components. Where shown, these components are required for the proper operation of the circuit. These components are NOT included in ASM2 kit.

Additionally, some schematics include some control voltage input controls. These controls are, again, not included in our kits but have been included to show nominal component values and wiring details to assist the user in building/designing their modules. The values shown are similar to those that are being used in the ASM*x*-Genie and, as such, will be made available in kits when the ASM*x*-Genie is released.

Bills Of Materials for the ASM-2

The following pages list the Bill Of Materials for the complete ASM-2 pcb and should be used when purchasing the parts for your build.

These BOMs do NOT include any components that are external to the ASM-2 pcb such as pots and switches. If not already done, then readers are advised to read Appendix B and look at the ASM1-Genie and ASM2-Genie for suggestions regards completing your ASM-2 design.

You can configure your pcb as an ASM-1 by simply omitting the relevant components. All ASM-2 enhancements are in ADDITION to the original ASM-1 and so, other than being a slightly larger pcb, you can reproduce an ASM-1 without modifications to the pcb.

Bill of Material for ASM-2 – Part 1

Used	Part Type	Description	Mouser
RESISTORS			
2	10R	0.5W 1% Metal Film Resistor	273-10
4	22R	0.5W 1% Metal Film Resistor	273-22
1	33R	0.5W 1% Metal Film Resistor	273-33
3	47R	0.5W 1% Metal Film Resistor	273-47
4	150R	0.5W 1% Metal Film Resistor	273-150
1	200R	0.5W 1% Metal Film Resistor	273-200
6	220R	0.5W 1% Metal Film Resistor	273-220
2	270R	0.5W 1% Metal Film Resistor	273-267
2	330R	0.5W 1% Metal Film Resistor	273-330
2	390R	0.5W 1% Metal Film Resistor	273-390
4	470R	0.5W 1% Metal Film Resistor	273-470
3	680R	0.5W 1% Metal Film Resistor	273-680
2	820R	0.5W 1% Metal Film Resistor	273-820
34	1K	0.5W 1% Metal Film Resistor	273-1K
4	1K2	0.5W 1% Metal Film Resistor	273-1.2K
11	1K5	0.5W 1% Metal Film Resistor	273-1.5K
1	1K8	0.5W 1% Metal Film Resistor	273-1.8K
1	2K	0.5W 1% Metal Film Resistor	273-2K
7	2K2	0.5W 1% Metal Film Resistor	273-2.2K
1	2K4	0.5W 1% Metal Film Resistor	273-2.4K
6	2K7	0.5W 1% Metal Film Resistor	273-2.7K
6	3K	0.5W 1% Metal Film Resistor	273-3K
3	3K3	0.5W 1% Metal Film Resistor	273-3.3K
2	3K9	0.5W 1% Metal Film Resistor	273-3.9K
1	4K7	0.5W 1% Metal Film Resistor	273-4.7K
2	5K6	0.5W 1% Metal Film Resistor	273-5.6K
5	6K8	0.5W 1% Metal Film Resistor	273-6.8K
25	10K	0.5W 1% Metal Film Resistor	273-10K
4	12K	0.5W 1% Metal Film Resistor	273-12K
10	15K	0.5W 1% Metal Film Resistor	273-15K
3	18K	0.5W 1% Metal Film Resistor	273-18K
3	20K	0.5W 1% Metal Film Resistor	273-20K
4	22K	0.5W 1% Metal Film Resistor	273-22K
1	27K	0.5W 1% Metal Film Resistor	273-27K
1	33K	0.5W 1% Metal Film Resistor	273-33K
1	39K	0.5W 1% Metal Film Resistor	273-39K
11	47K	0.5W 1% Metal Film Resistor	273-47K
1	51K	0.5W 1% Metal Film Resistor	273-51K
2	56K	0.5W 1% Metal Film Resistor	273-56K
9	68K	0.5W 1% Metal Film Resistor	273-68K
4	75K	0.5W 1% Metal Film Resistor	273-75K
2	91K	0.5W 1% Metal Film Resistor	273-91K
83	100K	0.5W 1% Metal Film Resistor	273-100K
1	150K	0.5W 1% Metal Film Resistor	273-150K
3	200K	0.5W 1% Metal Film Resistor	273-200K
1	270K	0.5W 1% Metal Film Resistor	273-270K
2	300K	0.5W 1% Metal Film Resistor	273-300K
2	330K	0.5W 1% Metal Film Resistor	273-330K
2	390K	0.5W 1% Metal Film Resistor	273-390K
2	430K	0.5W 1% Metal Film Resistor	273-430K
6	560K	0.5W 1% Metal Film Resistor	273-560K
13	1M	0.5W 1% Metal Film Resistor	273-1M
2	1M2	0.5W 1% Metal Film Resistor	273-1.2M
2	1M5	0.5W 1% Metal Film Resistor	273-1.5M
3	2M2	0.5W 1% Metal Film Resistor	273-2.2M

Used	Part Type	Description	Mouser
POTENTIOMETERS			
1	100R 25T	Spectrol 64W Multiturn Trimpot	594-64W100
2	200R 25T	Spectrol 64W Multiturn Trimpot	594-64W200
2	500R 25T	Spectrol 64W Multiturn Trimpot	594-64W500
1	1K 25T	Spectrol 64W Multiturn Trimpot	594-64W101

6	10K 25T	Spectrol 64W Multiturn Trimpot	594-64W102
21	100K 25T	Spectrol 64W Multiturn	594-64W104
2	500K 25T	Spectrol 64W Multiturn	594-64W504

Used	Part Type	Description	Mouser
SPECIAL RESISTORS			
2	62R 50ppm	50ppm 1% Metal Film Resistor	N/A
2	1K 3500ppm	1000R 3500ppm/C	N/A

Bill of Material for ASM-2 – Part 3

Used	Part Type	Description	Mouser
POLYSTYRENE CAPACITORS			
4	10pF	2.5% 100VDC Polystyrene	N/A
2	22pF	2.5% 100VDC Polystyrene	N/A
2	33pF	2.5% 100VDC Polystyrene	N/A
2	100pF	2.5% 100VDC Polystyrene	23PS110
2	330pF	2.5% 100VDC Polystyrene	23PS333
2	2200pF	2.5% 100VDC Polystyrene	23PS224
POLYESTER CAPACITORS			
2	1nF	63V 10% Metallised Polyester	75MKT1826210014
1	2n2	63V 10% Metallised Polyester	75MKT1826222014
1	5n6	63V 10% Metallised Polyester	
2	8n2	63V 10% Metallised Polyester	
6	10nF	63V 10% Metallised Polyester	75MKT1826310014
4	68nF	63V 10% Metallised Polyester	75MKT1826368015
2	100nF	63V 10% Metallised Polyester	75MKT1826410064
36	100nF Ceramic	Multilayer Ceramic 50V X7R	80-C412C104K5R
2	120nF	63V 10% Metallised Polyester	
2	220nF	63V 10% Metallised Polyester	75MKT1826422064
1	470nF	63V 10% Metallised Polyester	75MKT1826447064
5	680nF	63V 10% Metallised Polyester	75MKT1826468064
4	1000nF	63V 10% Metallised Polyester	75MKT1826510064
TANTALUM AND ELECTROLYTIC CAPACITORS			
2	1uF 16V	20% MDT 16V Resin-dipped Tantalum	581-TAP105K016SCS
2	1uF 25V	20% MDT 25V Resin-dipped Tantalum	581-TAP105K025SCS
1	2u2 35V	20% 35V Radial Aluminium Electrolytic	647-UVP1H2R2MDA
3	4u7 25V	20% MDT 16V Resin-dipped Tantalum	581-TAP475K025SCS
3	10uF 16V	20% MDT 16V Resin-dipped Tantalum	581-TAP106K016SCS
1	100uF 16V	20% 16V Radial Aluminium Electrolytic	647-UVP1H101MPA
1	220uF 16V	20% 16V Radial Aluminium Electrolytic	647-UVP1H221MPA
2	470uF 25V	20% 25V Radial Aluminium Electrolytic	647-UVP1H471MPA

Bill of Material for ASM-2 – Part 4

Used	Part Type	Description	Mouser
SEMICONDUCTORS			
2	1N4001	1A 50V Power Diode	512-1N4001
31	1N4148	Signal Diode	333-1N4148
5	2N3904	NPN Transistor	511-2N3904
2	2N3906	PNP Transistor	511-2N3906
2	4002	Dual 4-input NOR Gate	511-4002BM
2	4053	Triple 2-Channel Analog Mux/Demux	511-4053BM
1	7815	3-terminal +15V Voltage Regulator	512-KA7815
1	7915	3-terminal –15V Voltage Regulator	512-KA7915
1	40106	Hex Schmitt Triggers	511-40106
6	BC549C	NPN Transistor	512-BC549
2	CA3046	5 NPN General-purpose Transistors	N/A
4	CA3080	Operational Transconductance Amplifier	N/A
6	CA3140	4.5MHz Wide-bandwith Op-amp	570-CA3140E
3	J108	Fast-switched FET	N/A
2	LF412	Dual BI-FET low-power Op-amp	595-LF412CP
2	LM311	Comparator	595-LM311D
1	LM317LZ	3-terminal Adjustable Regulator	511-LM317LZ
3	LM329 – 6V9	Precision Reference	N/A
1	LM337LZ	3-terminal Adjustable Regulator	511-LM337LZ
4	LM358	Low-power Dual Op-amp	512-LM358AN
1	LM1458	Dual Op-amp	
1	LM1496	Balanced Modulator/Demodulator	N/A
2	MAT02	Dual-matched NPN Transistors	N/A
4	OA91	Germanium Signal Diode	N/A
5	TL081	Low-noise JFET Op-amp	511-TL081CN
7	TL082	Dual Low-noise JFET Op-amp	511-TL082CN
7	TL084	Quad Low-noise JFET Op-amp	511-TL084CN
2	TL074	Quad Low-noise JFET Op-amp	511-TL074CN

Bill of Material for ASM-2 – Part 5

Used	Part Type	Description	Mouser
HARDWARE			
2	M3 Locknut	M3 Locknut or nut and washer	
2	M3 x 8mm Bolt	M3 Stainless-steel bolt	
2	TO-220 Heatsink	9 Deg C/W Heatsink Vertical	532-523002B00

The following items are NOT included in the ASM-2 Component Kit

Used	Part Type	Description	Mouser
HARDWARE			
1	+/-21VDC @ 300mA	4-way 0.2″ connector	
32	8-pin	DIP IC Socket	
12	14-pin	DIP IC Socket	
2	16-pin	DIP IC Socket	
6	CON2	2-way 0.1″ connector	
30	CON3	3-way 0.1″ connector	
8	CON4	4-way 0.1″ connector	
2	CON5	5-way 0.1″ connector (2-way + 3-way)	
3	CON6	6-way 0.1″ connector	
1	CON8	8-way 0.1″ connector	
3	Peripheral Power	4-way 0.1″ connector	