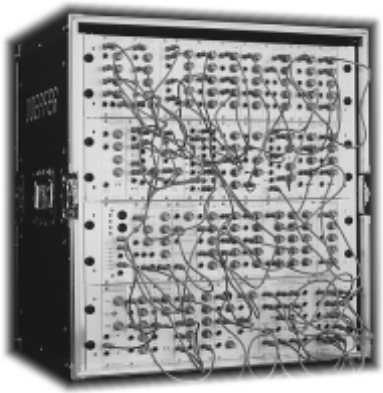
SYSTEM A - 100

Owner's Manual



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Warning:

Inside the A-100 power supply are dangerous voltages. It is essential to take careful note of the following safety instructions:

- Before opening up the case or moving a module or blanking panel, **always take the mains power supply plug out**. This applies equally to removing or replacing any panel or module.
- All empty spaces in the rack must be filled with blanking panels.
- Before use, the top and bottom covers must also be properly fixed in place. If modules are permanently fixed (eg. built into a 19" rack case) then the top of the highest of the rack systems and the bottom of the lowest must have their covers properly fitted.

The instrument must never be operated outdoors but only in dry, closed rooms. Never use the instrument in a humid or wet environment nor near inflammables.

Important safety notes.

Whenever electrical equipment is used, several basic precautions need to be taken, including the following:

- Before using any part of the instrument, read the instructions and notes carefully.
- The instrument may only be used for the purpose described in this operating manual. Due to safety reasons, the instrument must never be used for other purposes not described in this manual. If you are not sure about the intended purpose of the instrument please contact an expert.
- The instrument may only be operated with the voltage written on the power input on the rear panel.
- Before opening the case disconnect the power plug.
- All eventual modifications must only be carried out by a qualified person who will follow the valid safety instructions. Every modification should becarried out only at the manufacturer or an authorized service company. Any modification not released by the manufacturer leads to the extinction of the operation permission.
- The instrument must never be operated outdoors but only in dry, closed rooms. Never use the instru-

ment in a humid or wet environment nor near inflammables.
- Do not use this instrument in damp environments, or close to water.
- No liquids or conducting materials must get into the instrument. If this should happen the instrument must be disconnected from power immediately and be examined, cleaned and eventually be repaired by a qualified person
- Do not use this instrument in close proximity to heat sources such as radiators or ovens. Don't leave it in direct sunlight.
- This instrument must be assembled or installed in a 19" rack in a way that guarantees sufficient ventilation and air circulation.
- The instrument must not be exposed to temperatures above 50°C or below -10 °C. In use, the instrument must be at a minimum temperature of 10 °C.
- Keep the top side of the instrument free in order to guarantee proper ventilation, otherwise the instrument could be overheated. Never place heavy objects on the instrument.
- This instrument can, without any external amplification or in combination with a headphone or speaker amplifier, produce sound levels which can damage your hearing. Don't work at high sound levels for prolonged periods of time, and don't ever use levels which cause discomfort.
- The instrument's mains power supply lead should be disconnected if it is not used for any substantial period. If there is any damage the cables must be repaired or replaced by an authorized person
- Do not tread on the mains supply lead.
- In disconnecting the lead, pull the plug, not the cable.
- If this instrument is connected to others, check in their manuals for connection instructions.
- Make particularly sure that no object falls into the instrument, and that no liquid gets into it.
- Transport the instrument carefully, never let it fall or overturn. Make sure that during transport and in use the instrument has a proper stand and does not fall, slip or turn over because persons could be injured
- The instrument must be checked and serviced by a qualified technician in the following cases:
  a. the power supply lead or connector is damaged in any way,
  b. an object or fluid has somehow got into the instrument,
  c. the instrument was exposed to rain,
  d. the instrument stops working properly or starts to behave erratically,
  e. the instrument is knocked over or dropped and/ or its case is damaged.
- As stated above, there are no user-serviceable parts in the instrument. Refer all repairs to qualified service personnel.

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10. Using the modules

☞ Because the A-100 is a modular system, each module has its own separate manual, which can be inserted into this ring-binder.

About this manual

This user manual describes the A-100 modular synthesizer system, and explains how to use each section of it.

If this is your first time using the A-100, please make sure you are familiar with all the safety instructions (eg. pages ii - iv) and important notes (chapter 1).

Because of the modular nature of the A-100, this manual is also designed to be modular.

Chapter 2 (Overall design) describes the physical make-up of the system - and particularly how to install the individual modules into the 19" rack.

Chapter 3 (The A-100 signal flow) details the A-100's signal path: the basic principles of voltage control, how to bring MIDI into the equation, and the possibilities for voltage-controlled modulation.

Chapter 4 describes the **A-100 Basic System**.
Chapter 5 details **accessories**.
Chapter 6 explains the **standard items included**.
Chapter 7 suggests **further reading**.

Chapter 8 (Module overview) gives a run-down of the individual modules presently available, and an idea of their potential uses.

Chapter 9 (Appendix) deals with installing an extra 5V power supply, for modules such as the A-190 and A-191.

Detailed descriptions of the **individual modules** follow, in **self-contained chapters,** with descriptions, user examples, and patching aids. When buying individual modules, the relevant manual chapters which are included should be inserted into this ring binder.

In the manual, you'll find various symbols used:

 important user and safety advice

 note

① ... diagram numbering of module controls

❶ ... diagram numbering of module in / outputs

❒ next step in a list of instructions

 practical hint or tip

Introduction

In the A-100, Doepfer have produced a capable and versatile analog modular synthesizer, built in the style of the classic modular systems of the seventies.

The renaissance of analog synthesis in the last few years shows that analog sound production has a vital place alongside sampling and digital synthesis, and can produce sounds that are unobtainable by any other means. In addition to the unique sounds of its oscillators, filters, amplifiers, phasers, frequency shifters, wave-modifiers, different control sources, and so on, analog synthesis can provide almost unbounded modulation opportunities, conventional and unconventional - limited only by the number and variety of modules available.

In designing the A-100, our priorities were: good sound quality; ease of integration into a MIDI system; diversity of modules available; and, maybe most important of all, affordability.

Of course, a modular system doesn't just have advantages. Creative work with an audio construction kit like this takes time and practice, especially to start with.

Anyone who wants to be able to check out all its available sounds at the press of a button will be very disappointed with a modular system. Each unique sound has to be puzzled out, and may never be exactly repeated.

Nor are there any fixed rules for connecting the various modules. A modular is an open system, in which practically anything is possible, and that's where the fun really starts. Diversity and experimentation - and sometimes lateral thinking - are the keys to its power.

Although the user manuals for each module are very comprehensive, they can't substitute entirely for a general overview and knowledge of analog synthesis. Some very good specialised books have been written on the subject, and although some may be out of print, it's crucial to find one or two of them, and learn from them. With that, the whole world of modular systems will open up to you, and you'll suddenly appreciate their fascination and sheer sonic power.

We hope your A-100 brings you serious pleasure!

July, 2009

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1. Important information

⚠ **As well as the important safety notice (see ii - iii) please also read and take note of the following points.**

1.1 Connecting to the electricity supply

- The system A-100 must only be connected to the mains voltage that is specified at the back of the A-100 frame (220 V to 240 V / 50 Hz or 110 to 120 V / 60 Hz).
- If the fuse has to be replaced only the type of fuse specified at the back of the A-100 frame is allowed. If another fuse is used the warranty is void and the A-100 may be damaged. The fuse is located at the mains inlet on the back of the A-100 frame (exception: suitcase version with mains inlet at the front). To replace the fuse one has to disconnect the mains cable and remove the fuse holder (e.g. with the aid of a screw driver). The fuse holder is a small black plastic part that is inserted into the mains inlet.
- Do not connect the A-100 to a socket or outlet which is also being used by equipment such as electric motors, lighting dimmers, etc, which can cause interference. Use a separate outlet for the A-100.

1.2 Installation

- Do not expose the A-100 to rain or moisture.
- Operation is allowed only in a dry environment in a closed room but not in the open country.
- The installation near a large amplifier or other equipment which uses powerful mains transformers may cause hum.
- Do not install the A-100 in close proximity to equipment which produces an electromagnetic field (monitors, computers, etc.), to avoid the possibility of mutual interference.
- Use in a dusty environment should be avoided.

1.3 Care and maintenance

- Apart from cleaning the instrument, no other user-maintenance is recommended, of the modules or system busses. Internal maintenance should be carried out only by qualified technicians (see pages ii - iii: "**Important safety notice**").
- For regular cleaning, use a soft, dry, or slightly damp cloth. To remove dirt, if necessary, use a cloth slightly moistened with a very diluted mild detergent. This should be more than sufficient to clean the instrument. Never use solvents like petrol, alcohol, or thinners.

Fuse values for different mains voltages and power supplies		
	Type of power supply	
Mains voltage	**A-100NT12 (standard power supply, 650 mA output current)**	**A-100PSU2 (power supply with ring core/toroid transformer and 1.2A output current)**
115V	250 mA time lag (slow blow)	630 - 800 mA time lag (slow blow)
230V	125 mA time lag (slow blow)	315 - 400 mA time lag (slow blow)

2. Overall design

2.1 Introduction

The A-100 modular system is based on a standard **19" rack system A-100 G** into which individual **Modules** can be fitted in any chosen layout.

The **rack system** (see Fig. 1) conforms to the 19" standard, and consists of two sections each 3U high, tied together by 6U side panels. It contains two system busses (①), the internal power supply (②) , and the main electrical supply socket (③).

Module **front panels** are all 3U high. Their width is measured in HP (1 HP = 5.08 mm). The rack system has a **usable width** of **84 HP** (see Fig. 1). If the modules you install don't use up the entire 84 HP, then you must cover up the spaces with **blanking panels**.

In each rack system there are two system bus bars (one for each section), to each of which up to 14 modules can be connected, using ribbon cable. The bus bar serves to supply power to the modules, and also to send control voltages etc. to some of the modules (see Chapter 3).

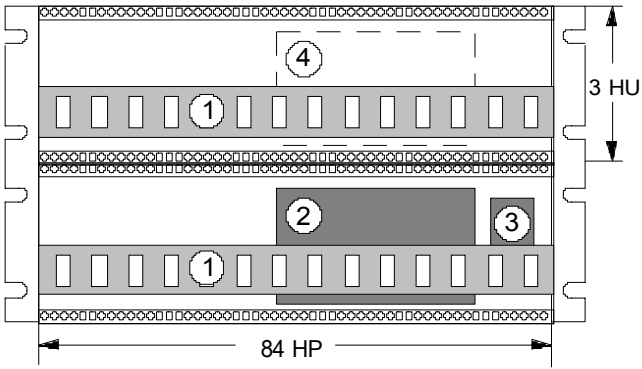


Fig. 1: A look inside the A-100 G rack system

The rack system power supply produces voltages of +12 V and -12 V and can put out a **maximum current of 650 mA**. In setting up a modular system, make sure that the total current required by all the modules doesn't exceed this maximum. If it does, then a second power supply (see Accessories) will need to be installed (at position ④, Fig.1). As a rule, though, one power supply should be sufficient for a rack system.

2.2 Installing modules

Important:

***Before* you install a module into the rack system:**

- ❒ Calculate the total **current requirement** of **existing modules** plus the **new module/s.**
- ❒ Check that this total is **less than 1200mA**.
- ❒ If it is, the existing power supply is fine.
- ❒ But if the **total current requirement** is **more than 1200 mA**, you must install a second power supply (see Accessories) before installing the module/s. Follow the installation notes that come with the second power supply.

☞ Ignoring this warning can result in damage to your system, and will void your guarantee!

Once you've checked that there is sufficient current in reserve for the extra module/s, there's nothing to stop you going ahead and installing them. Read on!

- ❒ First of all, take the A-100's plug out of the wall socket.
- ❒ Plug the supplied **ribbon cable** into the module's **bus socket** (see ① in Fig. 2). As a rule, the cable is 16-way, but some modules only have a 10-way cable. Look carefully at the cable, and then press the appropriate connector onto the module's bus pins (see ② in Fig. 2).

  ⚠ Check very carefully that it is connected so that the coloured marking on the ribbon cable is at the bottom of the module's connector (see ③ in Fig. 2), and that the connection is perfect, and **pushed fully home, not at a slight angle.** Failure to check this may result in the module's instant destruction as soon as the power is turned back on.

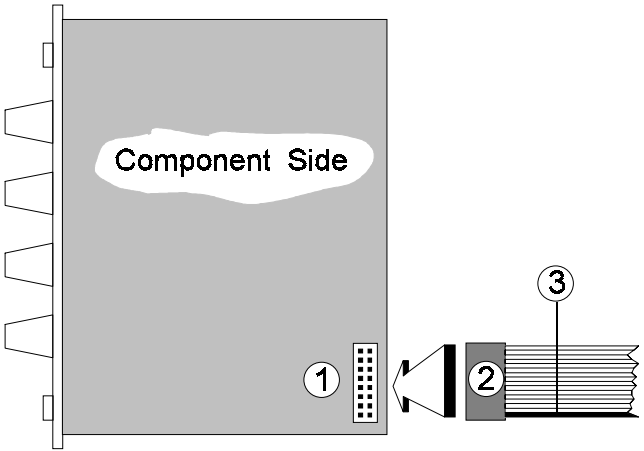


Fig. 2: Connecting the ribbon cable to the module

❒ Now join the free end of the ribbon cable (see ② in Fig. 3) to the nearest available position on the system bus board (see ① in Fig. 3).

⚠ Check very carefully that it is connected so that the coloured marking on the ribbon cable is at the bottom of the bus connector (see ③ in Fig. 3), and it is **pushed fully home, not at a slight angle.** Failure to check this may result in the module's instant destruction as soon as the power is turned back on!

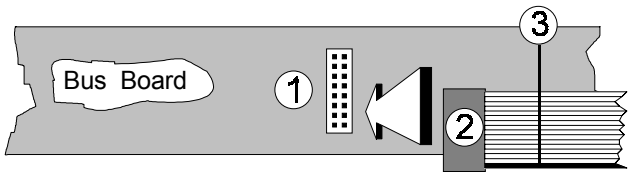


Fig. 3: Connecting the ribbon cable to the bus board.

☞ When you're installing extra modules, it may be necessary to take another module or two out, to allow you easier access to the bus board.

❒ Place the module carefully into the space in the rack, and fasten it firmly in place with the supplied screws. Put back any covers or blanking plates, and screw them in firmly.

❒ Now plug the system A-100 back into the main power supply, and switch it on.

❒ Test out the newly installed module.

If it doesn't seem to be working as expected, **immediately** disconnect the system from the power supply again.

In this case, double-check the connections, making completely sure that the ribbon cable is the right way round where it connects to the module and the bus.

Once your system is assembled and operational, you should make use of the the **patch sheets** which come with each module.

Photocopy the patch sheets for each of your modules, cut these out, and stick them onto a sheet of paper in the order in which they occur in your system (see Fig. 4). Then photocopy this sheet, and use the copies to note down good settings and patches.

2.3 Interconnecting modules

For connecting modules to each other, you need **mono mini-jack (Ø 3.5 mm) patch leads**. You can obtain patch leads from us (see Accessories in chapter 5) in different lengths.

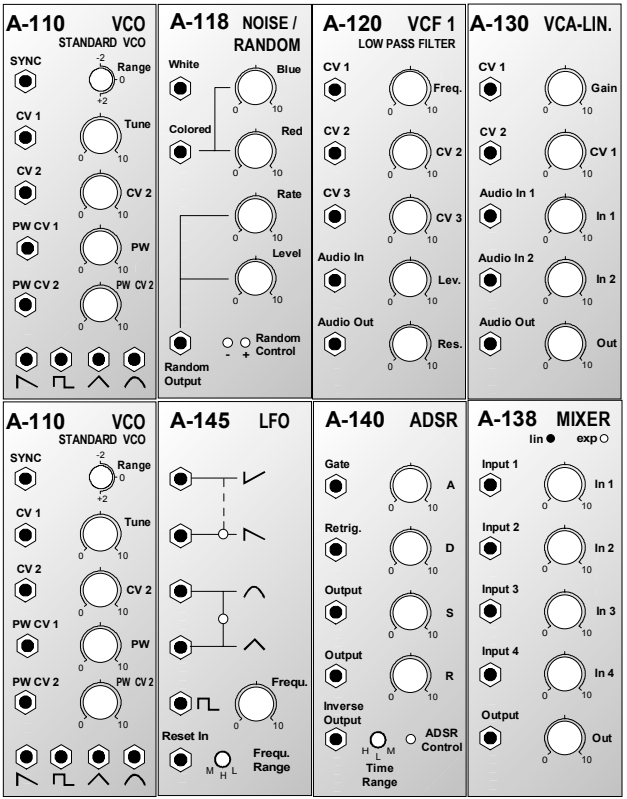


Fig. 4: Example of a personal patch sheet.

3. Signal flow in the A-100

3.1 The Principles of Voltage Control

What makes analogue synthesizers (and modular systems in particular) special is that the important parameters of the sound sources (VCO, noise, etc.) and modifiers (VCF, VCA, etc.) can be altered not just by hand, but by **voltage control**.

This principle was turned into reality by the “father of the analogue synthesizer”, Robert Moog, who produced the first commercially available synthesizer in the sixties. It gives vast flexibility and the potential to make sounds that have never been made before.

Fig. 5 shows the principle of voltage control, with examples of control voltages affecting a filter (VCF) and an oscillator (VCO).

In the case of the **VCF,** the parameter which is being voltage-controlled is the **Cut-Off Frequency f_c**. The amount of control voltage input present changes the cut-off frequency, and thus the frequency of the signal that the VCF lets through - see the shaded area in the diagram.

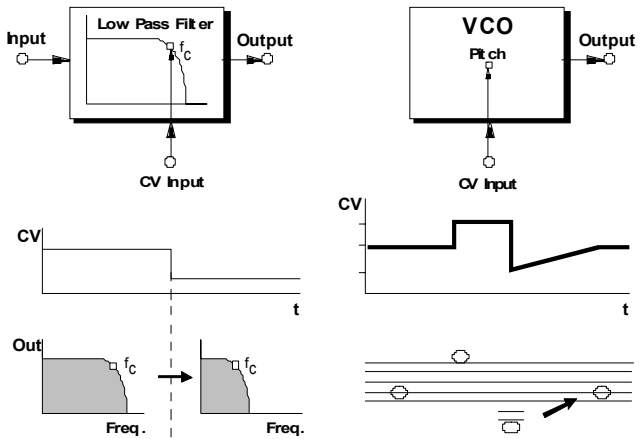


Fig. 5: The principles of voltage control

In the case of the **VCO**, it’s the **pitch** which is controlled by a voltage: an increase of 1 volt corresponds to an increase of one octave in the pitch.

With a sudden change of voltage, the pitch changes suddenly, while with a smoother, continuous change, portamento is created.

As well as modules which can be affected by voltage control, there are other modules like the ADSR and LFO which themselves produce voltages to control other modules.

Usually, these modules need a **Trigger Signal** to bring them into action. For instance, a **GATE Signal**, corresponding to a key being pressed on a keyboard, can set off an ADSR, which then puts out its variable voltage **"envelope"** to affect other modules (see Fig. 6).

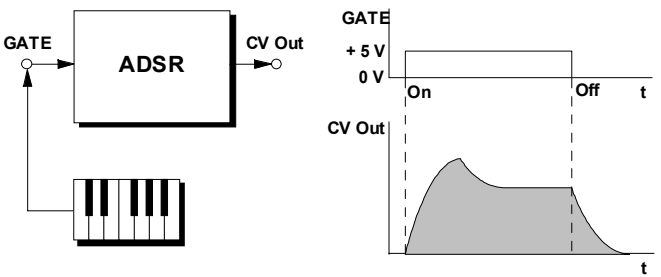


Fig. 6: The envelope generated by an ADSR

3.2 Signals in the A-100

In the System A-100 there are three types of signal:

- Audio Signals
- Control voltages
- Trigger voltages

Audio Signals are produced by the sound source Modules (such as VCO or NOISE), and lie in the range from -5 V to +5 V (10 V_{SS}). The System A-100 can also let you use **external** Audio Signals (e.g. Microphone, Electric Guitar, Keyboard).

☞ To interface satisfactorily, the level of **external Audio Signals** must be brought up to the A-100's operating level.
Module **A-119 (External Input)**, is ideal for this job, having among other things an internal pre-amp, and two inputs of different sensitivity.

Control voltages, as produced by modulation sources like the LFO and ADSR, are typically from -2.5 V to +2.5 V (5 V_{SS}) for the LFO, and from 0 V to +8 V for the ADSR.

Trigger or Gate Signals, which start a process or function, are typically from 0 V to +5V or 0V to +12 V, with the trigger occurring as the **leading edge** of the waveform shoots up from 0 V to +5V/12 V. The A-100 modules usually output +12V, but the corresponding inputs of A-100 modules (e.g. Gate, Clock, Reset) will also work with lower levels (typ. +5V).

These definitions of the various signals, and the distinctions between them - sound sources and modulation sources - are right in principle, but a modular system like the A-100 often makes a mockery of them. In a modular set-up, all of the modules produce voltages, and can be used as control voltages or triggers, thus blurring the distinction between the various types.

For example, the output from an LFO can be used as an audio signal, as a control voltage for a VCF or VCA, or as a trigger signals for a sequence.

It's just about true to say that anything can be modulated by anything else, so that a modular system gives the musician extraordinary flexibility and individuality.

3.3 The System Bus in the A-100

The A-100's **System Bus** supplies power to the modules. It also carries the internal control system (**INT.GATE** and **INT.CV)**, which some of the modules (such as the VCO A-110, or ADSR A-140) can tap into. You can choose whether these modules receive these signals, by altering an internal jumper.

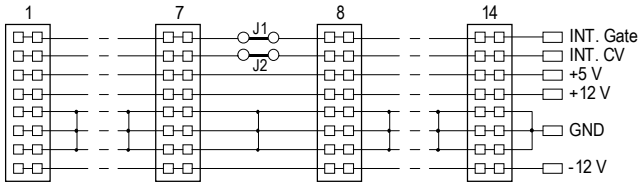


Fig. 7: The A-100 system bus

If you use the **A-190** MIDI-/CV-Interface in your system, when you press a key on your MIDI keyboard, the gate and CV1 signals from the A-190 will be sent via the INT.GATE and INT.CV to all modules on the bus.
The INT.GATE and INT.CV signal busses can be **split into two equal halves** by removing jumpers **J1** and **J2** (see Fig. 7), so that for each whole bus, you can have two separate **CV/GATE subsystems**.

If on the other hand you'd like to have the same internal CV and gate available **on two busses at once**, you need to link the two together, with the special CV/gate leads, the A-100 BC.

This is how you go about it:

❒ Remove the A-100 from the electrical supply.

❒ Remove Jumpers **J1** and **J2**(see p.9) from the upper (see Fig. 8 ❶) and lower (see Fig. 8 ❷) system bus boards.

❒ Replace the jumpers with the special CV / gate leads, A-100 BC (see Fig. 8 ①, ②).

⚠ Make absolutely sure that you connect the leads correctly, joining up the upper INT CV with the lower INT CV, and the upper INT GATE with the lower, to avoid possible damage when you switch back on!

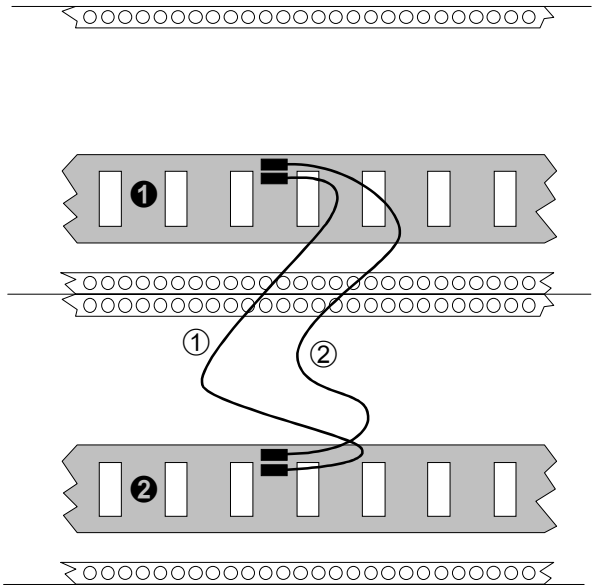


Fig. 8: Making a common INT.CV and INT.GATE signal path between the upper and lower busses.

3.4 Integrating the A-100 with MIDI

To link the A-100 into a MIDI system, you can use external MIDI interfaces like our **MCV4**, **MSY2** or **MCV24**.

The **MIDI-CV/SYNC Interface A-190-1** is a MIDI-to-CV/Gate/Sync interface with the following outputs:

- CV 1 (for pitch control, 12 Bit)
- CV 2 (any MIDI-Controller, 8 Bit)
- Gate
- Clock
- Start / Stop

The A-190 automatically sends pitch control CV and gate information out on the INT.CV and INT.GATE busses.

Another solution is the usage of the low cost **MIDI-CV Interface A-190-2** which has one Gate and four CV outputs available.

Another suitable MIDI-CV Interface for A-100 was the 24-channel **MCV24**, a 19" rackmount with its own power supply. As the MCV24 is no longer in production you will have to try to find a second hand unit.

VC Modules like the A-141 VC-ADSR and A-147 VC-LFO can be controlled via the A-190-1 or A-190-2, so that, for instance, a continuous MIDI controller can alter envelope parameters in real time. Since these controllers can be recorded by a MIDI sequencer, VC modules are effectively programmable.

Analog sequencing can be provided by the A-155 or the external **MAQ 16/3 MIDI Analog Sequencer.**

To convert up to 16 control voltages in the range 0...+5V (e.g. from a Theremin A-178 or Joy-Stick A-174-1 or Foot-Controller A-177-2 or ribbon controller A-198) into MIDI controllers the **CV-to-MIDI interface A-192** is the right choice.

4. A-100 Basic Systems

It's not in the nature of modular systems to have hard and fast rules about which modules should be included. But if you're just starting out along the modular path, it may be difficult to choose a sensible first set of modules. Accordingly, we've designed Basic Systems with all the modules mounted in a rack system, and 30 patch leads thrown in as well. For an exact run-down of the modules included in Basic System 1 (**A-100BS1**), see the table on the right of this page, and the illustration on the next page. To integrate BS1 it into a MIDI system, you would need a separate MIDI interface, such as an MCV4 or MCV24. In the Basic System 2 (**A-100BS2**) the MIDI interface A-190 is included (instead of A-150 and A-162). We also have available a small Mini System (**A-100MS**). See our topic prospectus for details.
The purpose and function of other modules will become more apparent as you work with your system, and you will be able to decide which extra modules you need for your particular purposes.

In the future other types of complete systems may be available. We are planning an Expansion System containing nearly all modules not included in the Basic Systems, a Vocoder System and a Sound Processing System without VCO's for external audio signals.

Pos.	Quantity	Module	Function	HP
upper	2	A-110	VCO	20
	1	A-114	Dual Ring Modulator	4
	1	A-115	Audio Divider	8
	1	A-116	Waveform Processor	8
	1	A-138b	Mixer (log)	8
	1	A-120	VCF 1 - 24 dB Low Pass	8
	1	A-121	12 dB Multimode Filter	12
	1	A-130	VCA (lin)	8
	1	A-131	VCA (log)	8
lower	1	A-118	Noise / Random	8
	1	A-148	Dual Sample & Hold	4
	2	A-145	LFO	16
	1	A-160	Clock Divider	4
	1	A-161	Clock Sequencer	4
	1	A-180	Multiples	4
	1	A-138 a	Mixer (lin)	8
	1	A-170	Dual Slew Limiter	8
	1	A-150	Dual VCS	4
	1	A-162	Dual Trigger Delay	8
	2	A-140	ADSR	16

Part	Description
A-100BUS	**Separate system bus** One bus board with 14 connectors for connecting modules, 3 control LEDs (+12,-12,+5V)
A-100AD5	**5V Low cost adapter** Additional power supply producing +5 V / 100 mA; can be connected to any free socket on the system bus board. For modules which require 5V (eg. A-113, 190, 191). This is a cheaper alternative to the NT5 +5 V power supply.
A-100NT5	**Separate 5 V power supply** +5 V / 500mA additional power supply, assembled and tested.
A-100PSU2	**Separate 12 V power supply** +/-12 V 1200mA additional power supply, assembled and tested.
A-100B...	**Blanking panels / back panels** **B1**: 1 HP / **B2**: 2 HP / **B4**: 4 HP / **B8**: 8 HP / **B42: 42 HP / B84**: 84HP
A-100B84P	**Back panel for power supply** Punched ready for power supply installation, with switches, safety fixings, and power supply connection cable.
A-100C ...	**Patch lead** Leads with two moulded 3.5mm plugs **C30**: 30 cm / **C50**: 50 cm / **C80**: 80 cm / **C120**: 120 cm

continued on next page ...

Part	Description
A-100OPM	**A-100 User Manual** Contains detailed description and instructions for use of all the currently available modules. It is included when you buy a complete system (A-100BS1, BS2, MS). When buying individual modules or frames, you have to order the manual separately. If you order the manual in advance the price for the manual will be credited when ordering a complete system later (not only a single module).
A-100SM	**A-100 Service Manual** Contains the schematics, silk screens, parts lists, assembly, test, basic principles and adjustment instructions of all currently available modules. The words (e.g. assembly instructions) are in German language but schematics, components overlays and parts lists are international. Available only to A-100 customers.

6. Items included as standard

The following parts are included in each order:

A-100BS1/BS2/MS - Basic Systems

- Rack system (basic frame), completely assembled, including two system bus boards, one 12V, 650mA power supply, internal power cables.
- All modules specified for the System (BS1, BS2 or MS) completely assembled, tested and mounted into the frame
- 30 patch leads for A-100BS1 and BS2
- 15 patch lead for A-100MS
- External power lead.
- Complete instruction manual (containing the manuals of all modules)
- +5V supply is not included (only the +5V low cost adapter for A-100BS1 and MS)

A-100G3/G6 - Rack System 3HU/6HU

- Rack system, completely assembled, including two system bus boards, one 12V, 650mA power supply, internal power cables.
- External power lead.
- +5V supply is not included

A- XXX - any module

- Module A-XXX.
- Ribbon cable for connection to the system bus.
- Fixing screws.

The instruction manual is not included when ordering a single module or frame. In this case the complete instruction manual has to be ordered additionally!

7. Further reading

The resources in the following list should help you increase your knowledge of analog synthesis, and the skill with which you can use modular systems like the A-100.

Specialist books

In English

Allen Strange, **Electronic Music Systems, Techniques and Controls**, 2nd edition, Wm. C. Brown Co. Publishers, Iowa, USA. ISBN 0-697-03602-2*

This book by Allen Strange is very comprehensive and thoroughly recommended, because as well as all of the basics it also includes a huge number of patches and practical tips. It's easy to read, instructive and very well organised. If your bookstore has trouble ordering a copy, then try the publishers. In Europe, try McGraw-Hill Publishing, tel +44 (0)1628 502500; or Susurreal, tel +44 (0)1363 774627), who had copies at £25 including postage in late 1996.

Vail, **Vintage Synthesizers**, GPI Books / Miller Freeman Inc. San Francisco, 1993, ISBN 0-87930-275-5* (A background read rather than great technical help.)

Synthesizer Technique ISBN 0-88188-715-3 and **Synthesizer Basics** ISBN 0-88188-714-5 - (revised re-prints of very useful and authoritative articles from Keyboard magazine, by Moog, Rhea, Milano, Coster, Duke, Powell, Gleeson, DeFuria, Anderton, et al.)

Crombie, **The Synthesizer & Electronic Keyboard Handbook** ISBN 0 330 28681 1, and **The New Complete Synthesizer** ISBN 0-7119-0701-3 (The latter especially is a good general introduction.)

Trythall, **Principles and Practice of Electronic Music,** 1973, ISBN 0-448-40002-6 (an early classic.)

Forrest, **The A-Z of Analogue Synthesisers, Part One (A-M)**, ISBN 0 9524377 0 8*, and **Part Two (N-Z),** ISBN 0 9524377 1 6* : Susurreal, England. tel +44 (0)1363 774627, fax +44 (0)1363 777872, email: pforrest@mail.eclipse.co.uk (A background read rather than great technical help.)

Chamberlin, **Musical applications of microprocessors**, Hayden Book Company, Rochelle Park / New Jersey, 1980, ISBN 0-8104-5773-3

* Only the books whose ISBN numbers are followed by an asterisk are definitely in print as of Dec 1996.

Specialist books in German

Dellmann / Thewes, **Synthesizer-Handbuch**, Musik Media / Augsburger Druck- und Verlagshaus, 1985

Enders, **Die Klangwelt des Musiksynthesizers**, Franzis-Verlag München, 1985, ISBN 3-7723-7761-0

Chapman, **Formant Musik-Synthesizer**, Elektor-Verlag Aachen, 1979, ISBN 3-921608-10-4

Aigner, **Formant Musik-Synthesizer-Erweiterungen**, Elektor-Verlag Aachen, 1981, ISBN 3-921608-19-8

Becker, **Synthesizer von gestern**, Musik Media Verlag Augsburg, 1990, ISBN 3-927954-00-4
Becker, **Synthesizer von gestern Vol. 2**, Musik Media Verlag Augsburg, 1995, ISBN 3-927954-01-2

Specialist magazines

The following useful magazines can mostly only be found second-hand or may possibly be available in some libraries, for photocopying articles.
Elektor, Elektor-Verlag Aachen

Elrad, Heise-Verlag Hannover

Electronic Musician, Polyphony Publishing Co., Oklahoma City / USA

Electronics and Music Maker / Music Technology, Cambridge, England.

Polyphony, Polyphony Publishing Co., Oklahoma City / USA

Synthesource (Curtis/CEM house magazine)

Video

A very good introduction to the basic techniques and programming methods of digital and analogue synthesis can be found in the 120-minute video **"The Secrets of Analog and Digital Synthesis"** by Steve deFuria (VH017, Warner Bros.).

8. Module Overview

(as of July 2009)

The following table may be used for planning and arranging an A-100 system regarding to need of space and current.

Module	Width [HP]	Current [mA]	Current@5V [mA]	Description
A-101-1	16	30	-	**Vactrol Steiner Filter** Vactrol filter with different inputs (!) for low/band/highpass
A-101-2	8	20	-	**Lowpass Gate** Combination of lowpass and VCA with vactrol (vactrol = LED/LDR- combination)
A-101-3	30	50	-	**12-Stage Modular Vactrol Phase Filter** Modular phaser with separate in/outputs for each stage and 2 polarizers
A-101-9	8	40	-	**Dual Universal Vactrol Module** 4 voltaged controlled resistors for modification of other modules
A-102	8	30	-	**Diode Lowpass** *(combined manual A-102/A-103)* voltage controlled 18 dB low pass with diodes as frequency controlling elements
A-103	8	30	-	**18 dB Lowpass** *(combined manual A-102/A-103)* voltage controlled 18 dB low pass (with TB303 type transistor ladder)
A-104	20	30	-	**Trautonium Formant Filter** Quad Low/Band Pass Filter as used in the so-called Trautonium (see A-113)
A-105	8	20	-	**SSM 24 dB Lowpass** *(combined manual A-105/A-122)* voltage controlled 24 dB low pass with the legendary SSM2044 circuit
A-106-1	14	40	-	**X-treme filter** voltage controlled MS20 filter clone, low/highpass simultaneously, +/- clipping controls
A-106-5	8	30	-	**SEM filter** voltage controlled 12 dB filter (SEM type), lowpass/notch/highpass with mixer, bandpass
A-106-6	12	50	-	**XP filter** voltage controlled filter (XP type) with 15 different filter types
A-107	26	200	-	**Multitype Morphing Filter** voltage controlled multitype filter with 36 different filter types and morphing feature

Module	Width	Curr.	Curr.@5V	Description
A-108	12	40	-	**6/12/24/48 dB Low Pass / Band Pass** voltage controlled low pass (ladder type) with 4 different slopes and bandpass
A-109	20	40	-	**Voltage Controlled Signal Processor** combination of 24 dB low pass, VCA and panning unit (CEM3379 based)
A-110	10	70	-	**VCO (Standard)** voltage controlled Oscillator with 4 different waveforms, hard-sync input
A-111-1	14	40	-	**VCO (High End)** like A-110 but improved waveforms, linear FM input, soft-sync input
A-111-5	26	80	-	**Synthesizer Voice** miniature synthesizer voice with VCO, VCF, VCA, ADSR and two LFOs
A-112	10	50	-	**SAMPLER** 8 bit sampler and wavetable oscillator
A-113	26	30	100	**Submarmonic Generator** Sound Generation unit as used in the so-called Trautonium (4 subharmonic oscillators)
A-114	4	40	-	**Dual Ring Modulator** 2 separate ring modulators
A-115	8	20	-	**Audio Divider** frequency divider for audio signals (rectangle waveforms)
A-116	8	20	-	**WP - VC Waveform Processor** module for dynamic waveform modification
A-117	8	20	-	**DNG / 808 - Digital Noise / Random Clock / 808-Source** digital noise and clock generator, 808-like sound source
A-118	8	20	-	**Noise / Random** analog noise generator with white and adjustable colored noise, random voltage
A-119	8	30	-	**External Input / Envelope Follower** Input module for external audio signals, includes envelope follower and gate generator
A-120	8	30	-	**VCF 1 - 24 dB Low Pass 1** voltage controlled 24 dB low pass (Moog type)

Module	Width	Curr.	Curr.@5V	Description
A-121	12	30	-	**VCF 2 - 12 dB Multimode Filter** voltage controlled 12 dB multimode filter (low pass, high pass, band pass, notch)
A-122	8	20	-	**VCF 3 - 24 dB Low Pass 2** *(combined manual A-105/A-122)* voltage controlled 24 dB low pass (with CEM3320, Oberheim type)
A-123	*8*	*20*	*-*	***VCF 4 - 24 dB High Pass*** *(module no longer available)voltage controlled 24 dB high pass*
A-124	8	30	-	**VCF 5 - 12 dB Wasp Multimode Filter** reproduction of the strange multimode filter used in the EDP Wasp Synthesizer
A-125	8	20	-	**VCP - Voltage Controlled Phaser** voltage controlled FET based phase shifter with resonance
A-126	8	80	-	**VCFS - Voltage Controlled Frequency Shifter** voltage controlled analog frequency shifter
A-127	28	100	-	**VCRF - Triple Voltage Controlled Resonance Filter** 3 independent voltage controlled band pass filters with 3 LFOs
A-128	20	20	-	**Fixed Filter Bank** filter bank with 15 band filters
A-129-1	20	100	-	**Vocoder Analysis Section** Analysis section of the modular vocoder
A-129-2	12	80	-	**Vocoder Synthesis Section** synthesis section of the modular vocoder
A-129-3	16	40	-	**Vocoder Slew Limiter** universal 5-fold voltage controlled slew limiter/attenuator/offset generator
A-129-4	8	30	-	**SLC - Slew Limiter Controller** controller module for slew limiter function of A-129/3
A-129-5	8	30	-	**VUV - Voiced / Unvoiced Detector** module for recognition of "voiced/unvoiced" speech

Module	Width	Curr.	Curr.@5V	Description
A-130	8	20	-	**VCA - Voltage Controlled Amplifier** voltage controlled amplifier with linear response
A-131	8	20	-	**VCA - Voltage Controlled Amplifier** voltage controlled amplifier with exponential response
A-132-1	4	20	-	**Dual Low Cost VCA** two simple voltage controlled amplifier with linear response
A-132-2	8	30	-	**Quad VCA** four VCAs with independent inputs and outputs, common loudness/level control
A-132-3	8	30	-	**Dual linear/exponential VCA** two separate VCAs with selectable control scale (switch, linear or exponential)
A-133	8	30	-	**Dual Voltage Controlled Polarizer** two special VCAs with positive and negative (=inverting) amplification
A-134-1	8	40	-	**VC PAN - Voltage Controlled Panning / Crossfader** module for voltage controlled panning or crossfading
A-134-2	4	20	-	**Dual VC Crossfader** Two separate voltage controlled crossfaders
A-135-1	22	30	-	**VC MIX - Voltage Controlled Mixer** 4 separate VCAs with common output
A-135-2	*?*	*?*	-	***VCF/VCA/Panning subsystem*** *(still under development)* *subsystem with VCFs with VCQ, VCAs and VC panning units with common stereo output*
A-136	8	30	-	**Distortion/Waveshaper** distortion and wave-shaping / wave-modifying module with extensive control possib.
A-137-1	14	40	-	**Voltage Controlled Wave-Multiplier I** waveform multiplier with 4 VC parameters: Multiples, Harmonics, Folding, Symmetry
A-137-2	14	30	-	**Voltage Controlled Wave-Multiplier II** makes one sawtooth VCO sound like five VCOs (four VC algorithmic phase shifters)

Module	Width	Curr.	Curr.@5V	Description
A-138 a/b/c	8	10/20c	-	**Mixer**, mixer for audio or control voltages (a: linear or b: logarithmic controls or c: polarizing mixer)
A-138d	8	20	-	**Manual Crossfader / Effect Insert Module** manually controlled crossfader and module to insert external effect units
A-138e	16	10	-	**Quad Three-Way Crossfader / Mixer / Polarizer** four separate three-way crossfader (i.e. fading between 3 different input signals)
A-138m	*~20*	*~?*	-	***4 x 4 Matrix Mixer*** *(still under development)* *matrix mixer with four inputs and four outputs, each row can be switched to uni/bipolar*
A-138x	8	0	-	**Mix Expander** expanding unit for A-138a/b, expands the number of available inputs to 9
A-139	*8*	*100*	-	***Headphone Amplifier*** *(module no longer available)* *stereo headphone amplifier with separate level and common loudness control*
A-140	8	20	-	**ADSR - Envelope Generator** envelope generator with 4 parameters: attack, decay, sustain, release; retrigger function
A-141	14	30	-	**VC-ADSR - Voltage Controlled Envelope Generator** voltage controlled envelope generator with 4 voltage controlled parameters
A-142	8	40	-	**VC Decay** voltage controlled envelope generator with one voltage controlled decay
A-143-1	28	70	-	**Complex Envelope Generator / Quad AD** Four daisy chained AD type envelope generators with polarizing mixer
A-143-2	26	70	-	**Quad ADSR** Four ADSR envelope generators with EOA/EOD/EOR gate outputs and retrigger feature
A-143-3	14	70	-	**Quad LFO** Four LFO modulation oscillators with triangle, rectangle and saw outputs, range switch
A-143-9	8	30	-	**Quadrature LFO/VCO** voltage controlled LFO/VCO, four sine outputs with 90 degrees phase shift between e.a.

Module	Width	Curr.	Curr.@5V	Description
A-144	8	30	-	**Morphing Controller** control voltage modifier to obtain morphing effects in combination with A-135
A-145	8	30	-	**LFO 1** modulation oscillator with 5 waveforms
A-146	8	20	-	**LFO 2** modulation oscillator with 2 waveforms and waveshape control
A-147	8	40	-	**VCLFO** voltage controlled modulation oscillator with 4 waveforms
A-148	4	20	-	**Dual S&H** two independent sample & hold devices
A-149-1	12	40	-	**Quantized/Stored Random Voltages** Replica of the legendary Buchla module "Source of Uncertainty" (part 1)
A-149-2	4	40	-	**Digital Random Voltages** expansion module for A-149-1, generates 8 digital random voltages/gates (high/low)
A-150	4	30	-	**Dual VCS - Voltage Controlled Switsches** two independent voltage controlled switches
A-151	4	20	-	**Quad Sequential Switch** electronical "rotary switch" with 4 positions
A-152	16	40	-	**Voltage Addressed Switch** electronical 8-fold "rotary switch" with voltage controlled addressing
A-154	22	60	-	**Enhanced Sequencer Controller** Expansion module for A-155, adds additional running modes and features to A-155
A-155	50	100	-	**Analog / Trigger Sequencer** 8 step analog and trigger sequencer
A-156	8	50	-	**Dual Quantizer** two control voltage quantizers with special selection features

Module	Width	Curr.	Curr.@5V	Description
A-160	4	40	-	**Clock Divider** frequency divider for clock/gate signals
A-161	4	20	-	**Clock Sequencer** clock sequencer expansion for clock divider A-160
A-162	8	40	-	**Dual Trigger Delay** two independent trigger delay devices
A-163	8	40	-	**Voltage Controlled Divider** divides the frequency of an audio signal by an integer factor controlled from a CV
A-164-1	6	10	-	**Manual Gate Module** three manually generated gate/trigger signals
A-165	4	20	-	**Dual Trigger Modifier** two independent trigger modifiers (inverter + transition edge detector)
A-166	8	40	-	**Logic Module** dual module with logical AND/OR/EXOR combinations + 2 logical inverters
A-167	8	20	-	**Analog Comparator/Offset-Generator/Subtractor** compares the difference of two voltages with fixed value and generates a gate from this
A-170	8	20	-	**Dual Slew Limiter** two independent portamento controllers or integrators
A-171	8	20	-	**VC Slew Limiter** voltage controlled portamento controller/integrator
A-172	4	10	-	**Maximum/Minimum Selector** selects from up to 4 analog inputs the maximum and minimum voltage
A-174-1	10	40	-	**Joy Stick** module with 2 separate CV outputs controlled by the X/Y position of the joy stick
A-174-2	~14	~20	-	***Wheels Module*** *(still under development)* *2 wheels, factor setting: one with, one without reset spring, uni- or bipolar CV output*

Module	Width	Curr.	Curr.@5V	Description
A-175	4	20	-	**Dual Voltage Inverter** two independent analog voltage inverter with displays
A-176	8	20	-	**CVS - Control Voltage Source** 3 manual adjustable control voltages
A-177-1	*8*	*30*	*-*	***External Foot Controller I*** *(module no longer available)* *interface module for 2 foot controlers and one double foot switch*
A-177-4	*4*	*~ 20*	*-*	***External Foot Controller II*** *(still under development)* *simple interface module for one foot controller and one double foot switch*
A-178	8	60	-	**Theremin Control Voltage Source** variable voltage/gate source controlled by hand movement
A-179	*8*	*60*	*-*	***Light Controled Voltage Source*** *(module no longer available)* *variable voltage/gate source controlled by light intensity*
A-180	4	-	-	**Multiples I** 8-fold multi connector (may be splitted into two 4-fold multi connectors)
A-181	4	-	-	**Multiples II** two multiples with 3.5 mm and 1/4“ mono and stereo sockets
A-182	6	0	-	**Switched Multiple** eight sockets that can be switched to one of two busses or turned off
A-183-1	*4*	*0*	*-*	***Dual Attenuator*** *(still under development)* *two simple passive attenuators*
A-183-2	*4*	*~ 20*	*-*	***Offset Generator + Attenuator/Polarizer*** *(still under development)* *generates an offset voltage that is added to an attenuated or inverted input voltage*
A-183-3	*4*	*~ 20*	*-*	***Amplifier*** *(still under development)* *simple DC coupled amplifier with adjustable gain, max. gain can be swithed to 1,2 or 4*
A-185-1	4	30	-	**Bus Access Module** module for access to bus signals CV and gate
A-185-2	6	30	-	**Precision Adder / Bus Access** high precision CV adder (0,1%) with four inputs and optional access to bus CV

Module	Width	Curr.	Curr.@5V	Description
A-186	4	0	-	**Gate / Trigger Combiner** 7 inputs that are "OR-wired" to the output, mainly for combination of gate/trigger signals
A-187-1	*?*	*?*	-	***Voltage Controlled DSP Effects Module*** *(still under development)* *DSP based effects module with four voltage controlled parameters*
A-188-1	14	80	-	**BBD Module** BBD module, available with 6 different BBD circuits from 128 to 4096 stages
A-188-2	30	120	-	**Tapped BBD Module** BBD module with 6 taps, single outputs and two (stereo) submixers
A-189-1	8	60	-	**Voltage Controlled Bit Modifier** 16 different voltage controlled bit modification effects (e.g. bit cruncher) with VC sample rate
A-190-1	10	10	• / 50	**MIDI-CV/SYNC-Interface** MIDI-to-CV and sync interface
A-190-2	6	30	-	**MIDI-CV-Interface** low cost MIDI-to-CV interface with manual glide control and four CV outputs
A-190-3	*?*	*?*	-	**Polyphonic MIDI/USB-CV-Interface** *(still under development)* *Midi-CV interface with four CV and gate outputs, different monophonic/polyphonic modes*
A-191	*12*	*30*	*• / 50*	***MIDI-CV-Interface/Shepard Generator*** *(module no longer available)16-fold* *MIDI-to-CV interface and Shepard generator*
A-192-1	12	100	-	**Voltage-to-MIDI Interface** 16 CV inputs (0...+5V) are converted into MIDI control change messages
A-192-2	*?*	*?*	-	**CV/Gate-to-Midi/USB-Interface** *(still under development)* *converts CV/Gate signals into Midi note messages*
A-195-1	*?*	*?*	-	**Pitch-to-CV/Gate/Midi/USB-Interface** *(still under development)* *converts clean monophonic audio signals into CV/Gate/Midi/UBS*

Module	Width	Curr.	Curr.@5V	Description
A-196	8	40	-	**Phase Locked Loop Module (PLL)** linear VCO + 3 phase comparators + lowpass in the form of a so-called PLL circuit
A-197-1	*14*	*50*	*-*	***Analog Meter*** *(module no longer available)Analog display (moving coil instrument with back light), 3 display modes*
A-197-2	34	100	-	**LCD Scope** (available only as kit without the scope) kit to install a Velleman LCD scope into the A-100 system
A-198	8	40	-	**Trautonium / Ribbon-Controller** Trautonium manual resp. ribbon controller, made of module + manual
A-199	10	80	-	**Spring Reverb** electronically simulated reverb by means of 3 spiral springs

9.1 Adding a 5V power supply

Some A-100 modules, for instance the A-113, A-190 or A-191, need an extra 5 V power supply, as well as the standard one. You can provide this with the **A-100 NT5** 5 V supply (or in certain circumstances, you can use the 100 AD5 5 V adaptor - see 9.2).

⚠ **If you are considering installing and connecting the NT5, it's crucial to take note of the following safety instructions:**

- **The installation and connection of the NT5 must only be carried out by a qualified electrician or technician.**
- **If no suitable expert is available, the rack must be sent to a service centre or direct to Doepfer Musikelektronik for the power supply to be fitted.**
- **Danger! Before installation and connection of the power supply, it is essential that the whole rack is isolated completely from the mains current.**

The 5V power supply needs to be mounted near to the main power input, on the blank upper back panel with four stand-offs, nuts, serrated washers, and bolts. Newer back panels (about since summer 1999) are already equipped with 4 monting holes required for the 5V supply. For back panels manufactured earlier the 4 holes have to be drilled to receive the power supply fixing bolts (Ø from. 3 to 3.5mm).

The NT5 **connection diagram** (Fig. 10) is on the next page. Check again that the rack is totally disconnected from the mains power supply, then:-

❒ Remove the two 115/230V mains cables (normally blue and black or brown cables) from the 12V power supply mains input, and reconnect them to the corresponding mains connectors on the 5V supply. The case shield / GND cables/connections remain unchanged as the shielding is connected directly to the metal frame (the yellow/green cable).

❒ Join up the two parallel connectors from the 5V mains input to the mains input of the 12V supply (using the correct wires from the blue and black or brown ones supplied).

❒ Connect the two low voltage outputs of the 5V supply (ground and +5V) to the system bus board which requires the 5V supply.

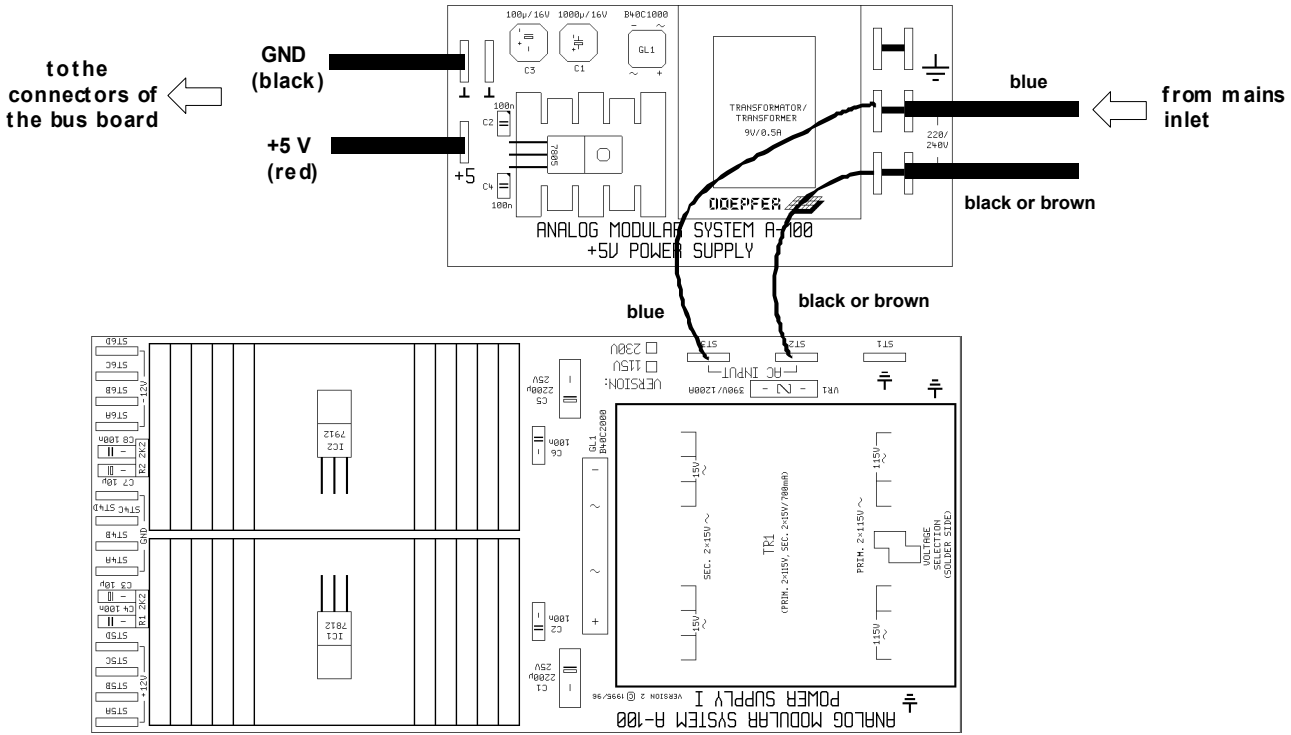


Fig. 10: NT5 power supply connections

⚠ The **yellow/green** wire is the **safety (earth) connection**, and must be never replaced by a different colour.

If you've been using the AD5 low-cost 5V adaptor, but are now installing an NT5, you must **remove the AD5** before commissioning the NT5!

9.2 Installing the AD5 low-cost 5V adaptor

The **AD5** can be used for the 5V power supply, as long as the following applies:

- The current for the modules that require a 5V supply doesn't exceed 100 mA (e.g. only one A-190 or A-191)
- There is enough current handling still available on the +12V supply to cope with the current requirements of the 5V modules.

The AD5 adaptor can be connected to any available 16-way socket on the system bus board (see Fig. 11). This will feed +5V to modules on that bus, as long as their current requirements don't exceed 100mA.

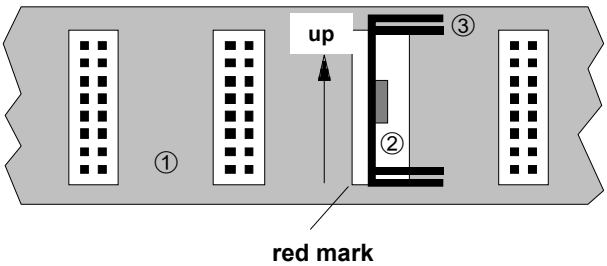


Fig. 11: Connecting the 5V low-cost adaptor (①: system bus board, ②: AD5, ③: heat sink)

To install the AD5, do the following:

Isolate the A-100 rack from the mains power supply by removing the main plug.

❒ Carefully insert the AD5 into a free socket on the bus board.

⚠ Make sure that the AD5 is the right way up, and aligned correctly with the bus socket. The correct position is shown on a sticker (with the **arrow pointing upwards**, and the **red mark at the bottom -** see Fig. 11).

The fins of the heat sink should be facing to the right.

It's vital to make certain that the 16-way plug and socket marry exactly, and aren't displaced up or down a pin, or to the left or right. If they are misaligned, the adaptor and/or the power supply may be damaged immediately you switch on.

9.3. Using the mini power supply/ bus

9.3.1. Introduction

The **A-100 MNT** (**Mini power supply / bus**) is composed of a miniature power supply and system bus, with connectors for four modules. It's designed to be used with a small set-up of just a few modules, in your own custom-designed case.

The idea is that then you can use individual A-100 modules - for instance the filters, the filterbank, ferquency shifter, sampler, MIDI interface, etc. - as free-standing pieces of equipment, **which can easily be integrated with your other instruments or recording equipment.**

The power supply provides the usual A-100 system requirements of **+12 V** and **-12 V**, and an additional **+5 V** supply, for the few modulses (for instance A-190, A-191) which need it.

The **maximum current loading capacity** totals **100 mA** for **+/- 12 V** and/or **50 mA** for the **+5 V** supply.

The sytem bus provides connections for four System A-100 modules. As well as the power supply, it also carries "INT.CV" and "INT.GATE" connections (see A-100 manual, main introduction, chapter 3, 'The A-100 signal flow'.).

The A-100 MNT is supplied as standard with an **external power supply**, which has to be connected to the socket on the MNT's circuit board.

⚠ The external power supply's transformer supplies **alternating current (AC)**.

If you want to use another power supply instead of the one supplied, it must have a voltage output of about **7 to 9 V AC** and **a capacity of at least 300 mA**.

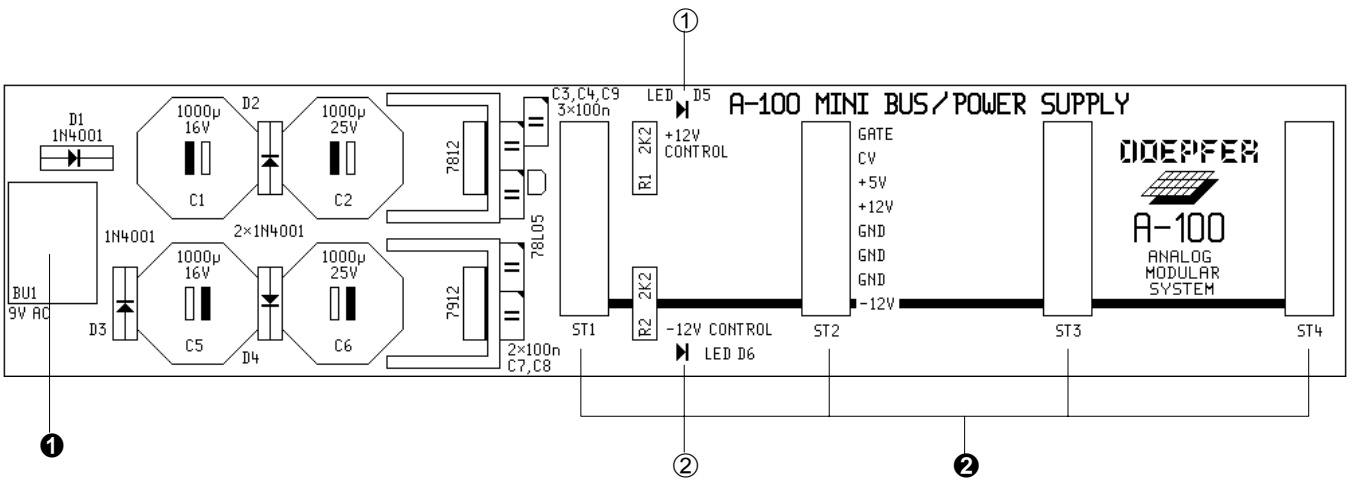
If you connect an external power supply which produces direct current (DC), the A-100 MNT simply won't work!

⚠ Both the A-100 MNT and any connected modules must be **firmly fixed into a proper casing.**

Any sort of **"flying construction" is absolutely discouraged,** because if two conductors from separate modules accidentally make contact, (for instance if the bus-bars from one module ended up touching another module's bus-bars), damage will almost certainly result.

In cases like that, the DOEPFER guarantee is definitely void.

9.3.2. A-100 MNT - Overview



Controls:

① **LED** : LED indicator for +12 V supply.

② **LED** : LED indicator for -12 V supply.

In- / Outputs:

❶ **BU 1** : Input for external power supply (7 ... 9 V AC)

❷ **ST 1 ... ST 4** : Bus output sockets for four modules.

9.3.3. Controls / indicators

① LED • ② LED

LEDs ① and ② indicate that the power supply is working properly. Once the MNT is connected, both LEDs should come on.

⚠ If both LEDs don't come on, first of all check that mains power is available at the socket which the MNT power supply was connected to; then that the mains adaptor is actually putting out voltages, and that a DC adaptor hasn't been used by mistake. If both these points are checked, then the MNT must be defective. The same applies if just one of the LEDs comes on.

9.3.4. In- / outputs

❶ BU 1

This is the socket to which the plug from the external power supply is connected.

❷ ST 1 ... ST 4

The sockets labelled ❷ on the diagram on p.2 are where the modules are connected.

So... to connect modules up to the MNT .....

❒ Disconnect the power supply lead from socket ❶.

❒ Connect the **ribbon cable supplied with each module** to the module's **bus connector** (see ① in Fig. 1). As a rule, this is 16-way, but on some modules it's only 10-way. Check that the cable connector is oriented correctly, (see ② in Fig. 1), and press it on to the module's bus pins.

⚠ Be very careful to ensure that **the coloured marking** on the ribbon cable is at the **bottom of the module's connector** (see ③ in Fig. 1) and that the connection is perfect, and **pushed fully home, not at a slight angle**. Failure to check this may result in the module's instant destruction as soon as the power is re-connected.

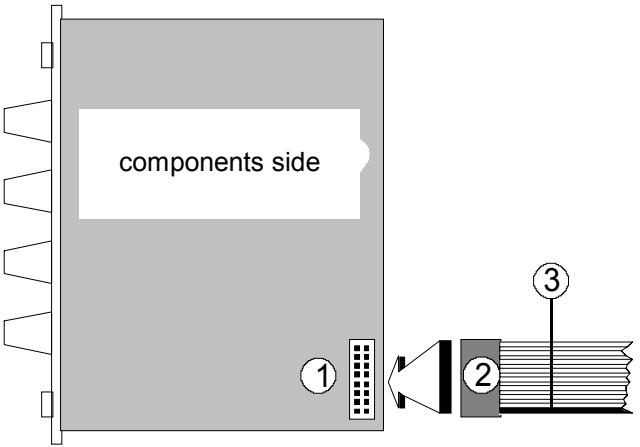


Fig. 1: Connecting the ribbon cable to the module

❒ Now join the free end of the ribbon cable (see ② in Fig. 2) to the nearest available position on the system bus board (see ① in Fig. 2).

⚠ Again ensure that **the coloured marking** on the ribbon cable is at the **bottom of the module's connector** (see ③ in Fig. 1) and that the connection is perfect, and **pushed fully home, not at a slight angle**. Failure to check this may again result in disaster.

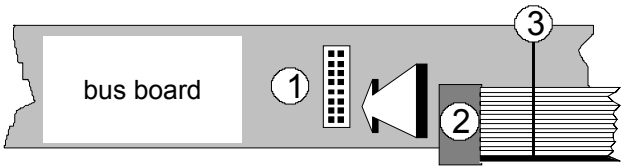


Fig. 2: Connecting the ribbon cable to the bus board.

❒ Now fix the module solidly in its case.

❒ Re-connect the A-100 MNT's power supply, and then switch on the mains again.

❒ Test out the newly installed module.

If it doesn't seem to be working as expected, **immediately** disconnect the system from the power supply again.

In this case, double-check the connections, making completely sure that the ribbon cable is the right way round where it connects to the module and to the bus.