1. Introduction

Module A-154 is a **supplement** to the **Analog/Trigger Sequencer A-155**. It offers a lot of new features that are not available in the basic control unit of the A-155. The A-154 is used to replace the control unit of **one or two A-155**, i.e. the section marked "Control" with Start / Stop / Step / Reset buttons and inputs in the upper left corner of the A-155 front panel. If the A-154 is used to control the A-155 the control section of the A-155 is put out of action.

These are the most important features of the A-154:

- **5 different running modes**: forward, backward, pendulum, random, CV controlled step adressing. All modes are available as **loop** or **one-shot**
- Manual and **voltage controlled selection** (with attenuator) of the **running mode**
- **5+1 LED display** for the 5 different current modes and one LED for loop/one-shot display
- **Manual** and **voltage controlled selection** (with attenuator) of **first and last step** of the sequence
- In the "**CV Controlled Step Address"** mode the First Step section is used to determine the active sequencer step (in this mode the first/last step feature is not available). Consequently manual and **voltage controlled selection of the active step** is possible
- Internal **voltage controlled clock generator** with manual and **voltage controlled** (with attenuator) **clock rate**, enables variable time length for each step, e.g. controlled by one of the analog rows of the A-155
- **Skipping** of steps, e.g. the gate row of the A-155 can be used to control the skipping of steps
- **LED display** of the clock signal
- Manual and **voltage controlled** (with attenuator) **pulse length** of the clock signal. This features enables **different gate length** (at the same clock rate) **for each step**, e.g. one of the CV outputs of the A-155 can be used to control the PW
- **One or two A-155** can be **controlled** from the A-154
- **8/16 step** mode: In combination with **two A-155** one can select between **parallel (8 steps)** or **serial operation (16 steps)**. The serial operation requires additional **voltage controlled switches** (e.g A-150)
- **Manual and voltage controlled selection** between "old" control unit of the A-155 and A-154 control (**A-154 Master** on/off function)
- With the **One-Shot modes** the A-155/A-154 combination can be used e.g. as a **complex envelope generator.** One analog row determines the levels of the envelope. The second analog row can be used to adjust the time length for each step
- The A-154 requires **at least one A-155**

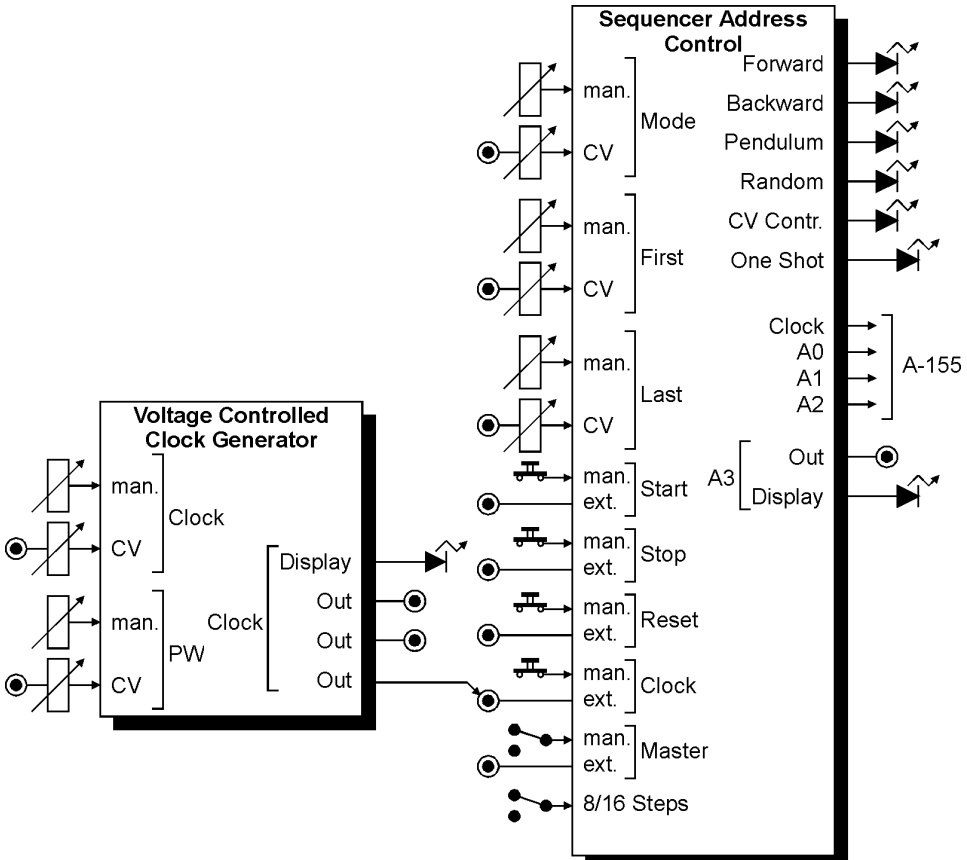


Fig.1: Overall view

2. Basic principles

The current step position of the A-155 is determined by the current *address* of the sequence. The address reaches from 1 to 8 as the A-155 has eight steps available. Internally the address is formed by three digital address signals A0, A1 and A2 having the valencies 1 (A0), 2 (A1) resp. 4 (A2). The connection between step position and the digital values for A0, A1 and A2 is as follows:

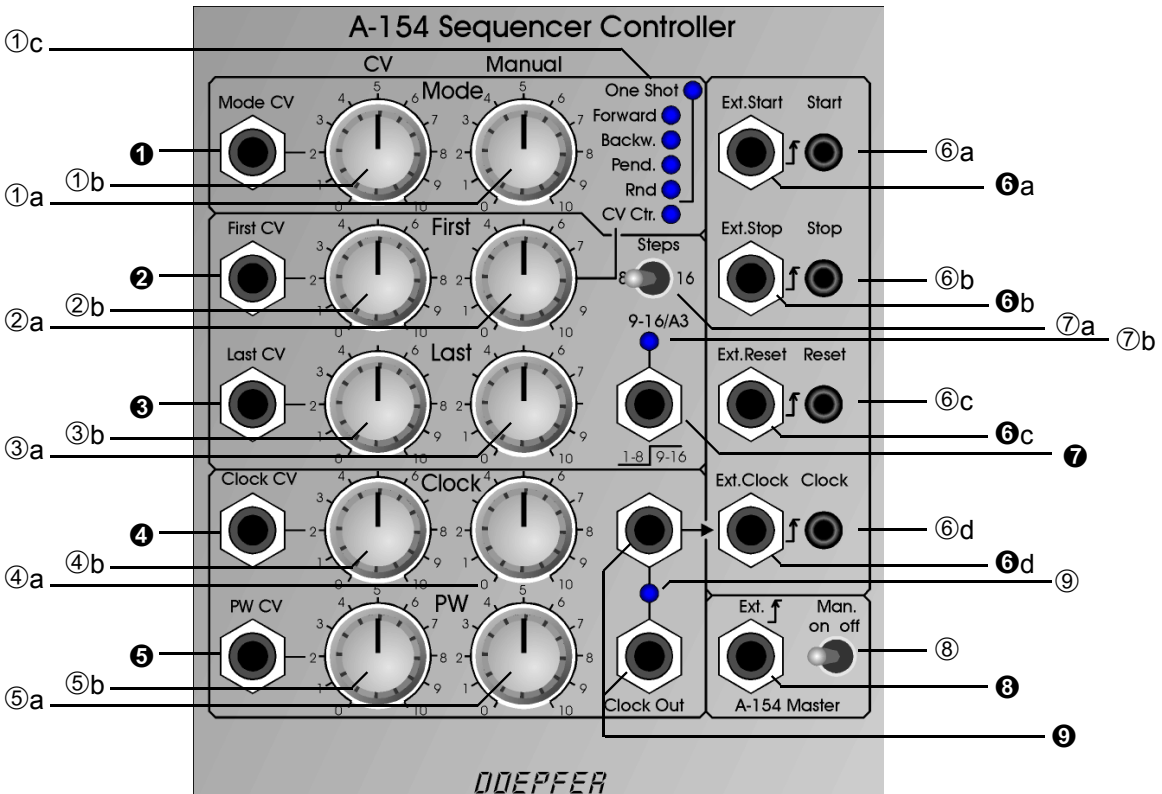
Step position	A0	A1	A2
1	low / 0	low / 0	low / 0
2	high / 1	low / 0	low / 0
3	low / 0	high / 1	low / 0
4	high / 1	high / 1	low / 0
5	low / 0	low / 0	high / 1
6	high / 1	low / 0	high / 1
7	low / 0	high / 1	high / 1
8	high / 1	high / 1	high / 1

The "old" control unit of the A-155 simply generates the address signals A0, A1 and A2 so that the steps 1-8 are selected one after another. If the A-154 is used to drive the A-155 the old control unit (i.e. the section with Start/Stop/Step/Reset buttons and input sockets) is no longer active and the A-154 calculates the address signals A0, A1 and A2 in a more sophisticated way. The type of address succession depends upon the selected mode (forward, backward, pendulum, random, CV addressed, loop/one shot).
In serial mode (i.e. if the A-154 is used to drive two serial running A-155) another address signal A3 with valency 8 is generated. This signal is used to distinguish between the first and second A-155 by means of voltage controlled switches.

In addition the A-154 even generates clock signal with both voltage controlled rate and pulsewidth.

If the A-154 is used to control the A-155 the previous connection between the "old" control unit and the analog resp. trigger/gate rows of the A-155 has to be disconnected and the rows have to be connected to the corresponding signals of the A-154. In the appendix this procedure is described in detail. The combination of A-154 and A-155 does not work before this procedure is carried out. It is not sufficient simply to assemble the A-154 into the A-100 frame !

3. Overview


A-154 Sequencer Controller
CV
Manual
Mode CV
Mode
One Shot
Forward
Backw.
Pend.
Rnd
CV Ctr.
Ext.Start
Start
First CV
First
Steps
8
16
Ext.Stop
Stop
9-16/A3
Last CV
Last
Ext.Reset
Reset
1-8
9-16
Clock CV
Clock
Ext.Clock
Clock
PW CV
PW
Ext.
Man.
on off
Clock Out
A-154 Master
DOEPFER
①c
❶
①b
①a
⑥a
❻a
②b
②a
⑦a
⑦b
❷
⑥b
❻b
③b
③a
⑥c
❻c
❼
❸
④b
④a
⑥d
❻d
⑨
❹
⑤b
⑤a
⑧
❽
❺
❾

Controls:

①**a Manual Mode**: Manual Mode control
①**b Mode CV**: Attenuator for CV input ❶
①**c** Mode display (6 LEDs)
②**a Manual First**: Manual First control
②**b First CV**: Attenuator for CV input ❷
③**a Manual Last**: Manual Last control
③**b Last CV**: Attenuator for CV input ❸
④**a Manual Clock**: Manual Clock control
④**b Clock CV**: Attenuator for CV input ❹
⑤**a Manual PW**: Manual Pulsewidth control
⑤**b PW CV**: Attenuator for CV input ❺
⑥**a Manual Start**: Start button
⑥**b Manual Stop**: Stop button
⑥**c Manual Reset**: Reset button
⑥**d Manual Clock**: Clock button
⑦**a 8/16 Steps**: 8/16 steps switch
⑦**b 9-16/A3**: LED display of A3/output ❼
⑧ **Man On/Off**: A-154 master switch
⑨ **Clock**: Clock display

Inputs / Outputs:

❶ **Mode CV**: Mode control voltage input
❷ **First CV**: First control voltage input
❸ **Last CV**: Last control voltage input
❹ **Clock CV**: Clock control voltage input
❺ **PW CV**: Pulsewidth control voltage input
❻**a Ext. Start**: External Start input
❻**b Ext. Stop**: External Stop input
❻**c Ext. Reset**: External Reset input
❻**d Ext. Clock**: External Clock input
❼ **1-8/9-16**: A3 output (1-8 / 9-16)
❽ **ext. Master**: External master control input
❾ **Clock Out**: Clock output (2x)

4. Controls

①a Manual Mode (knob)/ ①c Anzeige (LEDs)
❶ Mode CV (socket) / ①b Mode CV (knob)

Control ①a is used to select the desired mode manually. This parameter can also be modulated with an external control voltage (CV) applied to socket ❶ (e.g. slow LFO, foot controller, Theremin). Control ①b is used to attenuate the external CV and consequently the influence of the external CV. The current mode is displayed by means of the 6 LEDs ①c.

These modes are available:

- **Forward**
- **Backward**
- **Pendulum**
- **Random**
- **CV Controlled** (step position is controlled by an external CV applied to the *First CV input* ❷)

In addition each mode - except the CV controlled mode - is available even as **One Shot**. This means that the **sequence stops** as soon as the **final step** is reached.

For the first 3 modes the number of steps to reach the final step is exactly defined. For the random mode the number of steps required to reach the final step cannot be predicted (that's why it is called *random*).

Which of the steps is the **final step** depends upon the selected mode and the settings of the **First** and **Last** step section (see below). Examples: first step = 2, last step = 7. In *Forward/One Shot* mode the sequence stops at step 7. In *Backward/One Shot* mode the sequence stops at step 2.

The *CV Controlled* mode is not available as *One Shot* as in this mode the current position is defined by a voltage. In this mode the position of the sequence is controlled by the settings of the **First** section (i.e. the position of the manual First control ②a, the external CV ❷ and the corresponding attenuator ②b)

With increasing mode CV (resp. turning the manual mode control ①a clockwise) the modes are selected in the order as listed above followed by the same modes as one shots.

The required control voltage at socket ❶ to reach all available modes is about 0...+5V (with attenuator ①b at it's maximum and Manual Mode ①a at it's minimum position) .

The current mode is displayed with 6 LEDs. 5 LEDs are used to display the main mode (forward, backward ...). The separate LED labelled *One Shot* lights up if additionally the one shot mode is activated. Example: Both the "Backward" and the "One Shot" LED light up. This means that the *Backward / One Shot* mode is selected.

②**a Manual First** (knob)
②**b First CV** (knob) / ❷ **First CV** (socket)
③**a Manual Last** (Regler)
③**b Last CV** (knob) / ❸ **Last CV** (socket)

This group of elements is responsible for the **First** and **Last step** of the sequence. For both parameters a manual control (knobs ②a and ③a) and an external control voltage input (CV inputs ❷ and ❸) are available. The CV inputs are equipped with attenuators (knobs ②b and ③b). The attenuators are used to adjust the level of the corresponding external CV and consequently the influence of the CV.

The required control voltage at the sockets ❷ resp. ❸ to reach all steps is about 0...+5V (with attenuators ②b resp. ③b at it's maximum and Manual First ②a resp. Manual Last ③a at it's minimum position).

In the *CV Controlled* mode the first/last step function does not work. Rather the controls and the CV input of the **First** section (❷, ②a and ②b) are used in this mode for the **voltage addressed step position** of the sequence. The controls and CV input of the Last section have no function in this mode.

Note : If the sequencer seems not to work (i.e. it remains at a fixed position) please check if the settings of first and last step are the reason for this behaviour. If the value of the last step is the same or smaller than the value of the first step the sequence seems to stop ! But actually always the same step is addressed due to the settings of first and last step! If you do not want to use the first/last step function the manual controls should be set to minimum (②a Manual First) resp. maximum (③a Manual Last) and no external CVs should be applied resp. the attenuators (②b and ③b) should be set to minimum.

④**a Manual Clock** (knob)
④**b Clock CV** (knob) / ❹ **Clock CV** (socket)
⑤**a Manual PW** (knob)
⑤**b PW CV** (knob) / ❺ **PW CV** (socket)

This group of elements is responsible for the internal **clock generator**. Both rate (clock) and gate length resp. pulsewidth (PW) can be controlled independently. For both parameters a manual control (knobs ④a and ⑤a) and an external control voltage input (CV inputs ❹ and ❺) are available. The CV inputs are equipped with attenuators (knobs ④b and ⑤b). The attenuators are used to adjust the level of the corresponding external CV and consequently the influence of the CV.

The independent control of rate and pulsewidth leads to a lot of interesting features. E.g. controlling PW by one of the A-155 CV outputs allows a different gate length for each step. But the tempo (resp. clock rate) is the same for the whole sequence.

Another example is to control the clock rate by one of the A-155 CV outputs. This leads to a different time length (or different tempo) for each step, i.e. the tempo is different for each step. If the A-155 Gate output is used to control the clock rate skipping is possible as beyond a certain control voltage the step time becomes extremely short (less than a millisecond) and the corresponding step is practically leaved out.

Beyond it the parameters of the clock generator can be controlled by other voltages too: e.g. LFO, Random CV, Theremin, ribbon or foot controller, distance or light controlled CV and many more.

The required control voltage at the sockets ❹ resp. ❺ to cover the complete rate resp. PW range is about 0...+5V (with attenuators ④b resp. ⑤b at it's maximum and Manual Clock ④a resp. Manual PW ⑤a at it's minimum position). Beyond about +4.8V at socket ❹ skipping occurs (see above).

⑨ **Clock** (LED) / ❾ **Clock Out** (2 x socket)

The two sockets ❾ are the output of the internal clock oscillator (miniature multiple). The internal clock signal is normalled to socket ❻d Ext.Clock, i.e. the internal clock is used as clock source provided that no plug is inserted into socket ❻d. LED ⑨ is the clock display. Pay attention that for high clock rates (~ above 20 Hz) the human eye will not be able to follow the LED display and the LED seems to be permanently on (with dimmed brightness).

⑥**a Manual Start** (button) / ❻**a Ext. Start** (socket)
⑥**b Manual Stop** (button) / ❻**b Ext. Stop** (socket)
⑥**c Manual Reset** (button) / ❻**c Ext. Reset** (socket)
⑥**d Manual Clock** (button) / ❻**d Ext. Clock** (socket)

These 4 buttons and sockets have nearly the functions as those of the "old" A-155 control unit (refer to A-155 manual for details):

- ⑥a Manual Start: starts the sequence
- ⑥b Manual Stop: stops at the current position
- ⑥c Manual Reset: resets to first step
- ⑥d Manual Clock: advance to next step

- ❻a Ext. Start: positive transition starts sequence
- ❻b Ext. Stop: positive transition stops sequence
- ❻c Ext. Reset: positive transition prepares jump to first step (see below)
- ❻d Ext. Clock: positive transition triggers advance to next step

Socket ❻d Ext.Clock is normalled to the internal clock generator.

If the sequencer does not run though a clock signal is applied probably the stop mode is selected. In this case the start button has to be operated to start the sequence.

Operating the stop button causes the sequencer to stop at its current position. But no reset to first step is carried out!

Operating the reset button prepares the sequencer to jump to the first step as soon as the next clock signal (!) appears. If no clock signal is applied the reset button seems not to work! We believe that it makes more sense to carry out the jump to the first step not until the next positive clock transition occurs. Otherwise the next clock would cause an advance to step 2 (in forward mode and first step =1). Especially for synchronous operation of several sequencers this type of reset control is more useful from our point of view.

Attention! In this detail the A-154 control differs from the "old" A-155 control and from other sequencers. For the A-155 the reset was independent from clock. Operating the reset button caused to jump to step 1 independent from the clock signal and the next clock caused an advance to step 2.

Operating the clock button triggers an advantage to the next step - provided that no clock signal is applied. As the internal clock generator is normalled to the ext. clock socket ❻d one has to insert a plug into the ext. clock socket ❻d to interrupt the internal clock connection. This can be used to take your time to adjust the control settings of each step.

If an internal or external clock signal is applied the clock button can be used to "gate" the clock manually, i.e. as long as the clock button is operated the clock signal is blocked and the sequencer does not advance to the next step until the button is released.

⑦**a 8/16 Steps** (switch)
⑦**b 9-16/A3** (LED) **/ ❼ 1-8/9-16** (socket)

This group of elements is relevant only if two A-155 are driven by the A-154. Switch ⑦**a** is used to switch between parallel (8 steps) and serial operation (16 steps) of the A-155. If only one A-155 is used the switch should be set to position "8" unless you want to create special effects (see below). Switch ⑦a is connected very closely with the function of the address output A3 ❼ 1-8/9-16.

The two A-155 driven by the A-154 always run in parallel as the address signals A0, A1 and A2 are valid for both A-155. To obtain sequences with more than 8 steps another address signal A3 with valency 8 is generated by the A-154. This signal is available at socket ❼ **1-8/9-16** and is displayed with the LED ⑦**b**. This signal is "low" for address range 1...8 and "high" for 9...16. As the A-155 only "know" the addresses 1...8 a voltage controlled switch A-150 is necessary to switch between the corresponding outputs of the first and second A-155. For this socket ❼ has to be connected to the control input of the A-150 and the outputs of the A-155 (e.g. the upper CV outputs of the two A-155) with the inputs of the A-150. The common output of the A-150 is the "new" CV output as by means of the A3-controlled switching function of the A-150 a sequencer with 16 steps is "emulated". The same procedure is valid for trigger and gate rows. The new version of the A-150 (i.e. full switching range up to +12V) has to be used for gate/trigger!

Fig. 2 shows how to patch the upper trigger rows and the upper CV rows of two A-155 with A-154 and A-150.

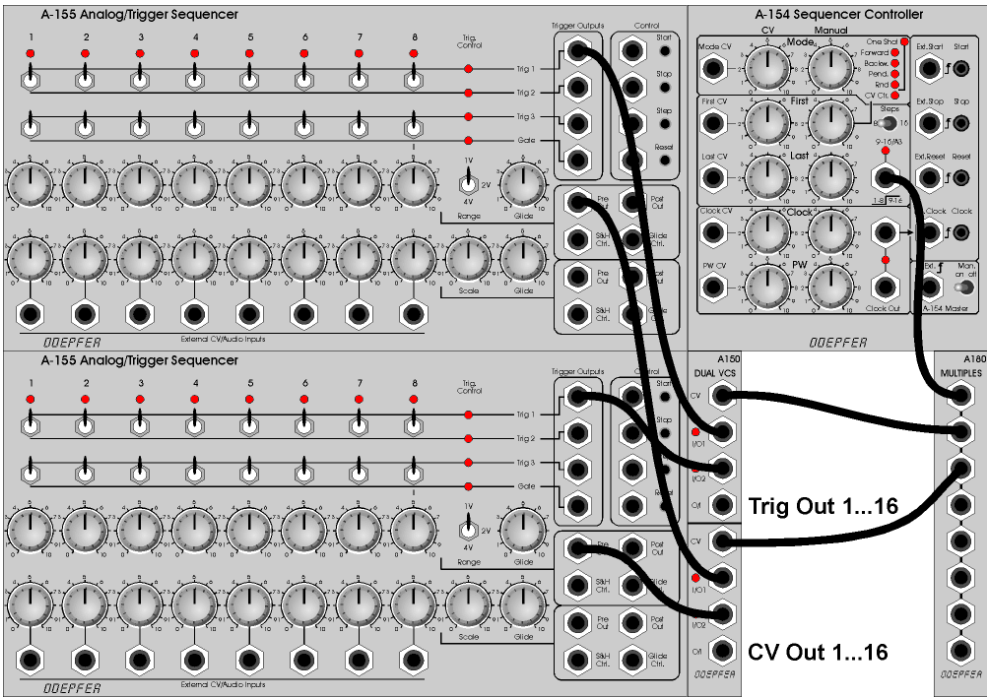


Fig. 2: Connection of A-154 with two A-155 and A-150

The position of switch ⑦a determines if the A-154 manages 8 or 16 steps. Only in position "16" the additional address signal A3 is generated that is required to control the VC switch A-150.

In position "8" all functions (e.g. first/last step, CV addressing) are calculated for sequences with up to 8 steps only and the output A3 is permanently "low".

In position "16" all functions are calculated for sequences with up to 16 steps and output A3 specifies if address 1...8 (A3 = low) or 9...16 (A3 = high) is currently active. The address range of first/last step and CV addressing is now 1...16.

For special effects switch ⑦a may be set to position "16" even with one A-155 only. This leads - without the VC switch A-150 - to some special qualities. If e.g. first step = 3 and last step = 14 the A-155 will run from step 3 to step 8 (address range 1...8; A3 = low, LED ⑦b off), then from step 1 to step 6 (adress range 9...16; A3 = high, LED ⑦b on) and will begin after that again with step 3. Similar happens in case of voltage addressed mode as the ranges 1...8 and 9...16 are repeated with one A-155 only as the switching between the two A-155 with the VC switch A-150 is missing.

It is possible to generate sequences with up to 16 steps too if two trigger rows resp. 2 CV rows of the A-155 are switched with an A-150 (for details see user examples).

⑧ **Man On/Off** (switch) **/ ❽ ext. Master** (socket)

This group of elements defines if the A-155 is controlled by it's "old" control unit or the A-154. The reason for this is the maximum clock frequency of the A-154 (~ 1kHz) which is more than enough for normal sequences. But for special applications of the A-155 (e.g. graphic VCO) it might be necessary to operate the A-155 with frequencies beyond 1kHz. In this case the "old" control unit of the A-155 has to be re-activated as this unit is able to work with higher frequencies.

Switching can be carried out manually with the switch ⑧ or by the external control input ❽. Manual and external control are or-wired, i.e. as soon as the switch is in the "On" position or a high level (> +3.5V) is applied to socket ❽ control by the A-154 is active. Otherwise the "old" control unit of the A-155 is used to run the A-155.

In case that the A-155 does not respond to changes of the A-154 settings probably the "old" control unit of the A-155 is active. In this case the switch ⑧ has to be turned to the "On" position.

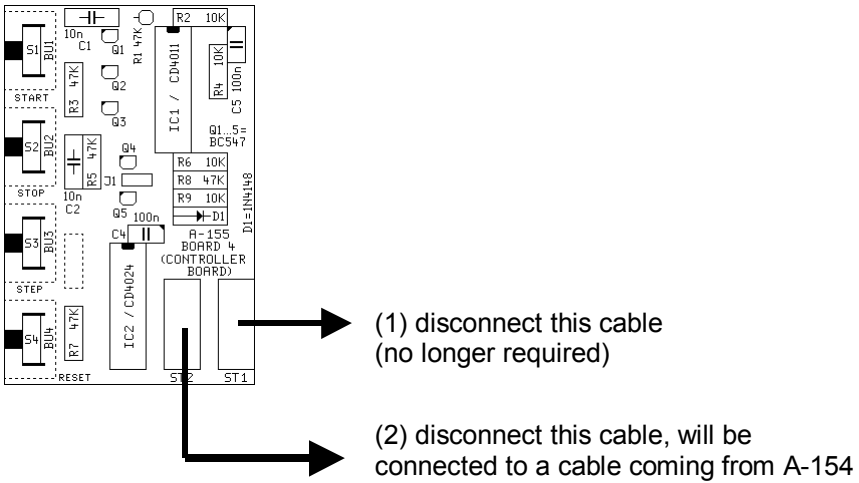
5. User Examples

not yet ready

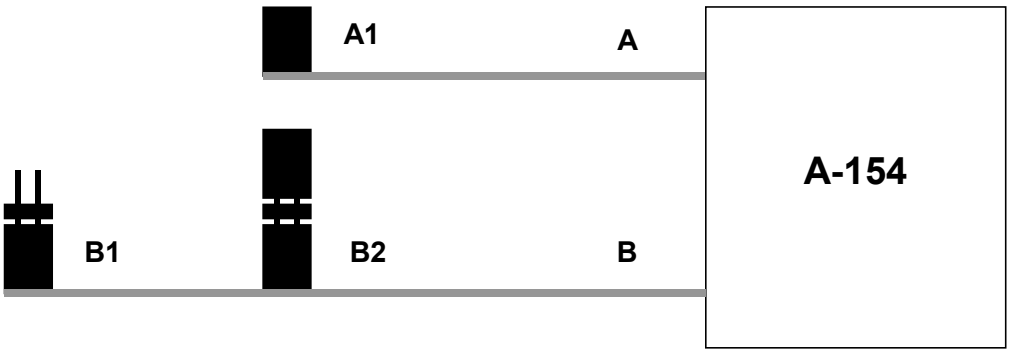
Appendix: Connection A-154 – A-155

(1) Disconnect the 10 pin ribbon cable leading from the connector ST1 of the small A-155 controller board to the bus board. This cable is no longer required. But you may keep it as a bus cable replacement (for other modules with 10 pin connectors).

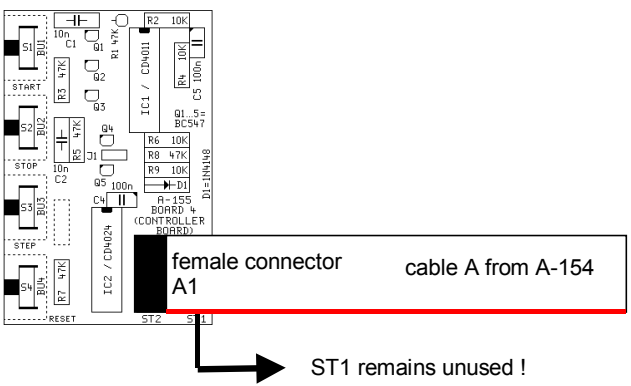
(2) Disconnect the 10 pin ribbon cable leading from the connector ST2 of the small A-155 controller board to the other boards of the A-155 (potentiometer and trigger boards). This cable is connected to another ribbon cable coming from the A-154 (see below).



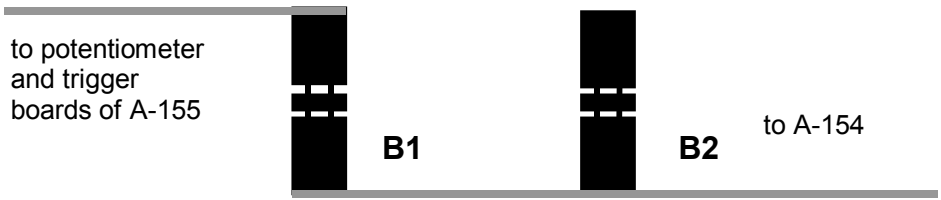
Two 10 pin ribbon cables come from the A-154. One (A) with a 10 pin female connector (A1) at its end and another (B) with two female connectors equipped with pin headers (B1, B2). One of the pin headers (B2) is provided with a second "blind" female connector as short-circuit protection (in case that only one A-155 is controlled by the A-154):



(3) Connect the 10 pin female connector **A1** of cable **A** to the pin header **ST2** of the small A-155 controller board (that has become free). Pay attention to use ST2 but not ST1 ! ST1 remains unconnected ! Otherwise a short circuit is made after power on and the A-154 may be destroyed ! Pay also attention to the polarity of the ribbon cable: the red wire has to show to the bottom if the A-155 module is assembled into the frame.

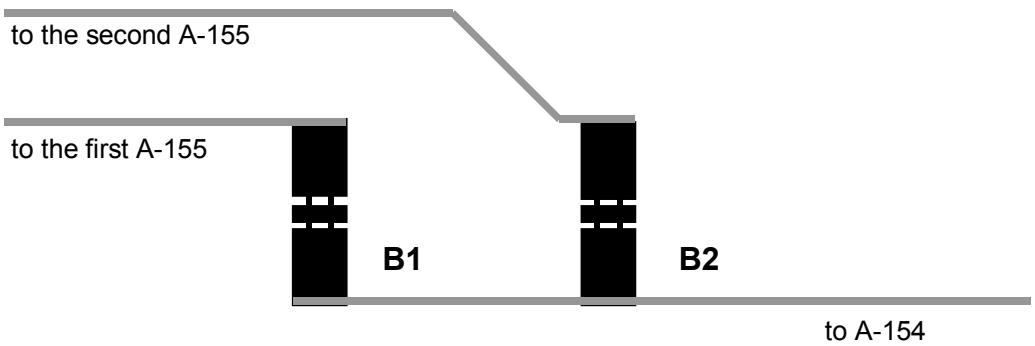


(4) Connect B1 with the female connector at the end of the ribbon cable that was removed from ST2 of the small A-155 controller board (this cable leads to the potentiometer and trigger boards of the A-155). The male pin header inserted into female connector B1 is used to establish this connection. Pay attention the the position of the red wire is the same for both ribbon cables ! The complete connection looks like this:



In case that **two A-155** have to be controlled by the A-154 the second A-155 has to be connected in this way:

Carry out steps (1) and (2) as described above even for the second A-155. Step (3) is not applicable. Step (4) is carried out as described above but B2 is used instead of B1. For this the "blind" female connector has to be removed before the cable coming from the potentiometer and trigger boards of the second A-155 is connected to B2. In this case the complete connection looks like this:



Attention! The second A-155 cannot be controlled by its "old" internal controller board. Both A-155 are controlled by the A-154 or the "old" controller board of the first A-155 depending upon the position of the master switch of the A-154.

Attention! If the controller and/or trigger board of the A-155 has been modified (recognizable by additional electronic parts soldered at the bottom side of the board) the modification has to be cancelled. Otherwise the A-155 will not work flawless in combination with the A-154. For details how to undo the modification please contact technik@doepfer.de.