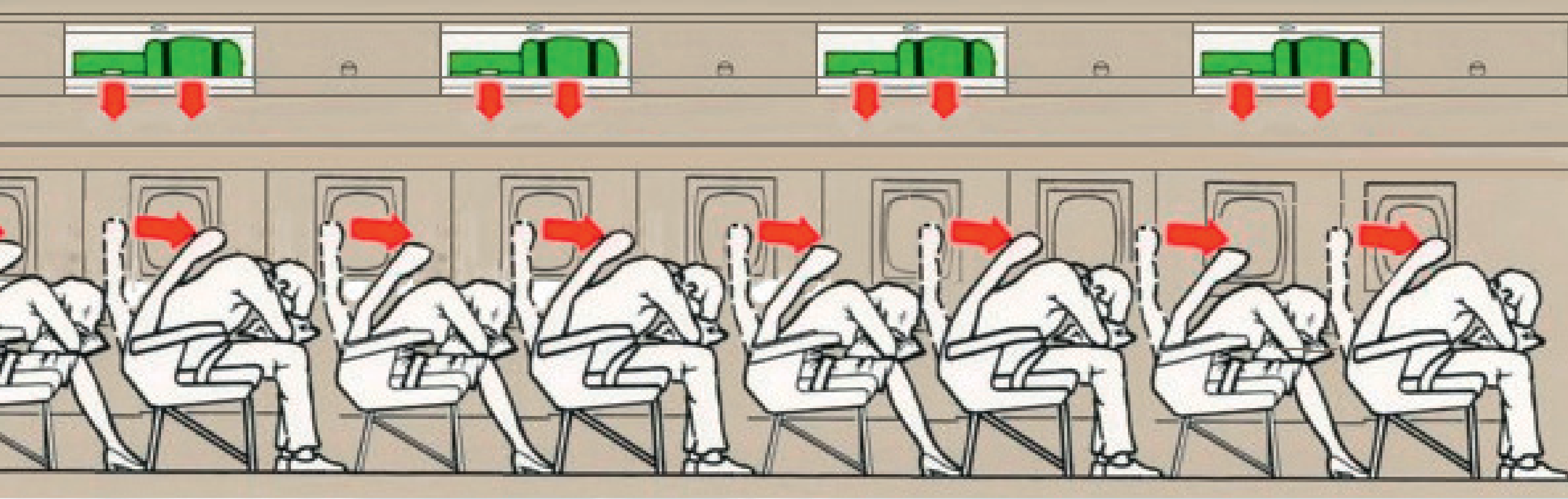
TERMINAL

operated by

Endorphin.es
AIRWAYS

Including Vactrol Replacement Instructions

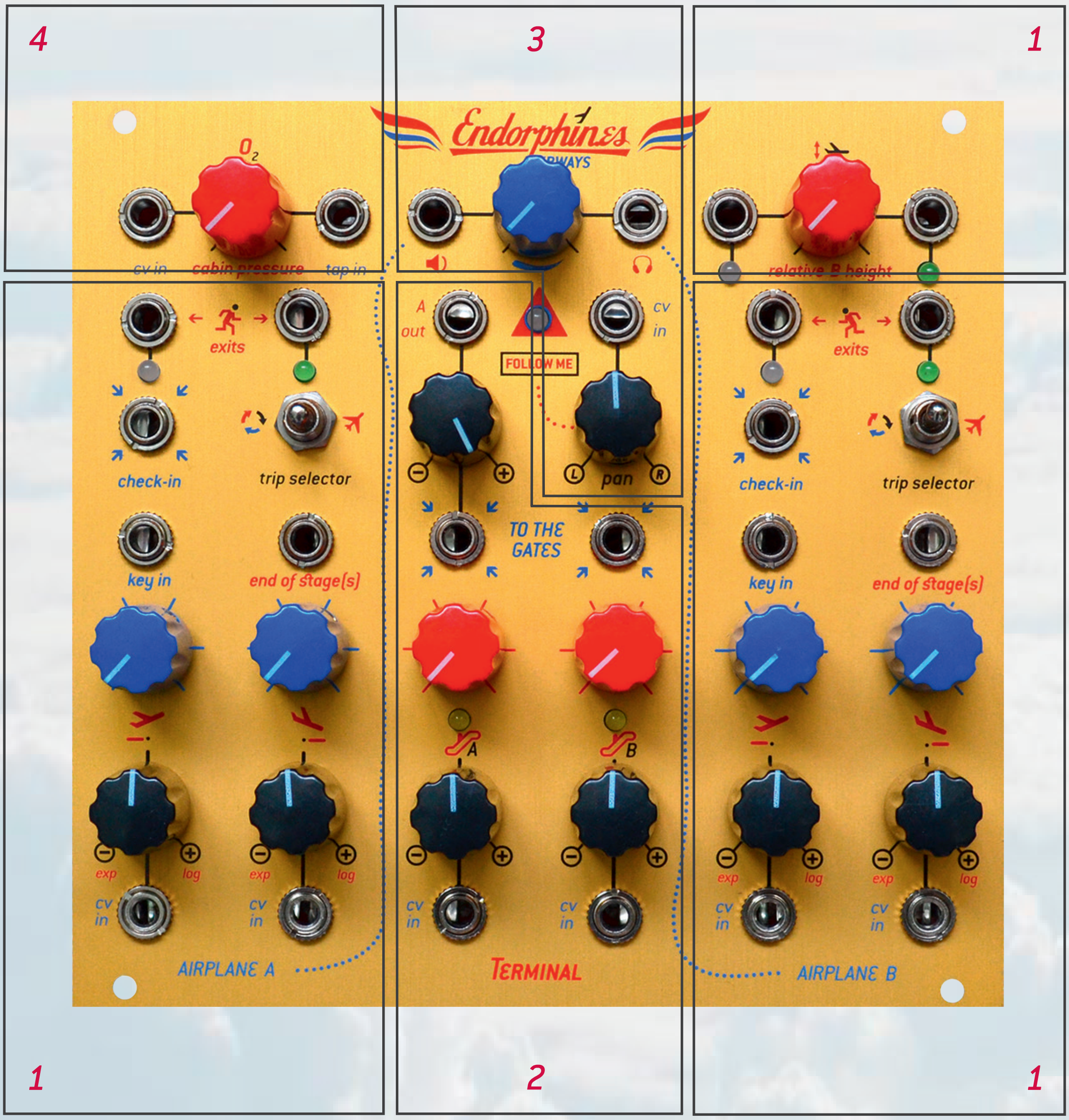
Safety-instructions v. 1.6



"Once you have tasted flight,
you will forever walk the earth with your eyes turned skyward,
for there you have been, and there you will always long to return."

Leonardo da Vinci

Terminal operated by Endorphin.es Airways



GOING BEYOND EXPECTATIONS:

- 26 HP/TE width, up to 1" in depth (super slim & therefore shuttle friendly)
- Dual voltage controlled AD/AR/looping envelope generators with arbitary voltage controlled slope shapes: from EXP to LIN to LOG without stretching the time length of a certain slope
- 1 volt per octave control over envelopes in the looping mode (to use the envelopes as band-limited oscillators)
- Dual opto-coupler controlled gates with universal sockets for a quick and simple exchange: one can use the factory supplied opto-couplers, replace them with other ones or even roll your own: slow, fast, ringing – whatever! The choice is yours!
- Voltage controlled cabin pressure effect. Add space to the final mix with the proper CV and TAP controls
- Don't forget the stereo – a dedicated stereo headphone output with voltage controllable panning

1. AIRPLANES

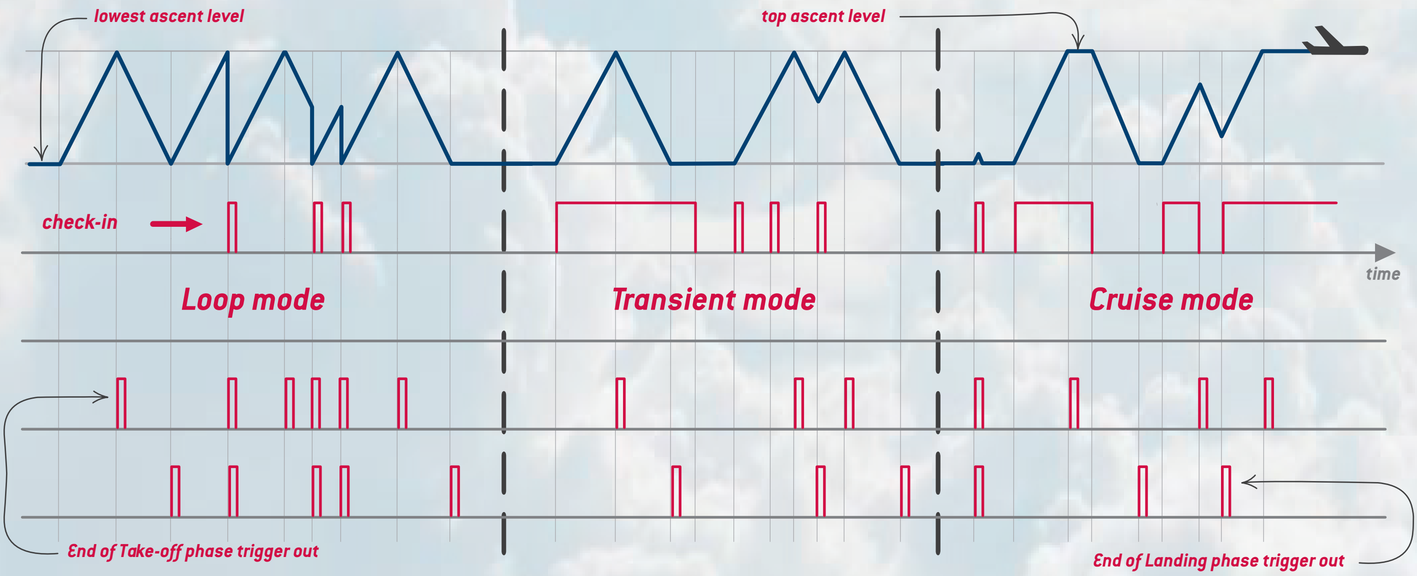
Airplanes are transient function generators that generate control voltages after an incoming trigger/pulse. Each Airplane has two phases: ***take off*** (a.k.a. attack, ascent, climb, rise, upward, up) and ***landing*** (a.k.a. release/decay, descent, dive, sink, fall, downward, down), and features separate bi-polar (-5 ... +5 volts) and uni-polar (0 ... +8 volts) outputs (***exits***) as well as ***end of*** current, Airplane's ***stage*** trigger outputs (zero or +6 volts). The relative brightness of LEDs under each exit shows the current amplitude and help to monitor the output voltage polarity: red when the voltage goes below 0 volts and green when the output goes higher than 0 volts. At calm both Airplanes stay on hold waiting for an upcoming launch signal (at the ***check-in*** jack). There are 3 different modes in which the Airplanes can fly:

Cruise mode (a.k.a. sustained, AR/ASR, on hold, long-haul flight) mode (trip selector in far right position) the Airplane takes off to thee highest level after receiving a triggergate (higher than approximately 0.65 volts constant signal) and stays in cruising mode as long as the gate signal remains high. At any moment the gate signal drops, the Airplane performs the landing. During landing the Airplane will immidiatly gain altitude (so called going-around or aborted landing) when a triggergate arrives.

Transient mode (a.k.a. AD, shorthaul flight) mode (trip selector in the middle position, the Airplane performs a take off after an incoming trigger signal (may be short trigger or constant gate higher than 0.65 volts). Reaching the top of the ascent level, the Airplane immediately performs a landing. Same as in Cruise mode, during a landing the Airplane will immidiatly gain altitude after reciving a trigger or a gate signal.

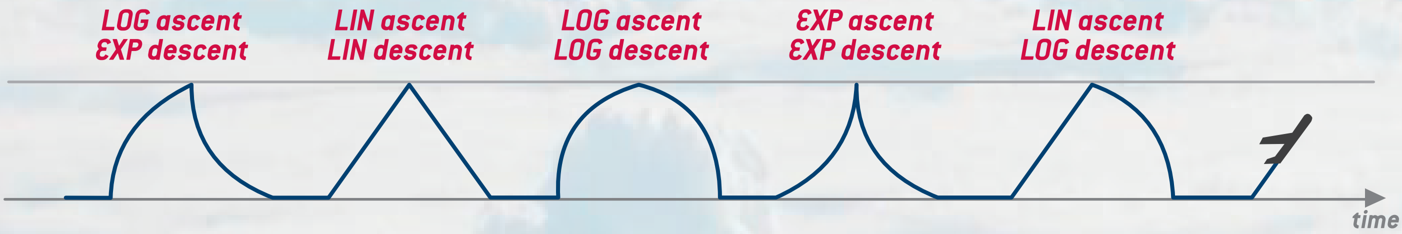
Toggling Looping mode (a.k.a. cycled, nonstop flight, LFO) (trip selector in far left position) enables the Airplane to take off. Reaching the top of the ascent level, the Airplane performs a landing. At the lowest descent stage the take off immediately begins gain altitude again and so on up to infinite. In this mode it fill function as an LFO.

The ***End Of Stage*** outputs return short 1 ms triggers after take off or landing stages havebeen either fully ended or went into cruising or in holding mode or were interrupted by the next stage after a trigger signal (the mode end of stage trigger is selectable via jumpers for each stage and each Airplane separately on the backside of the ***Terminal*** – see the ***Jumperizationaddendum***).



AT TAKE OFF & LANDING

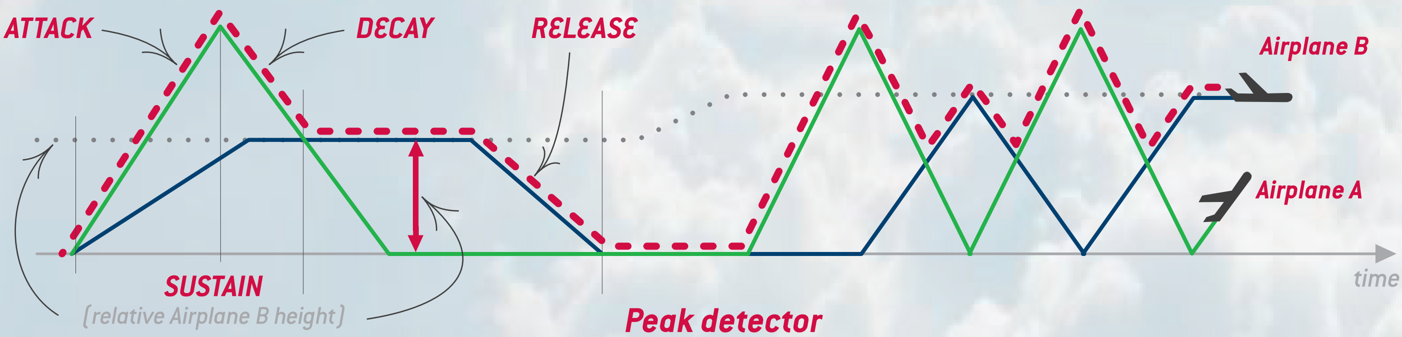
The duration of take off and Landing stages are separately voltage controlleable and may be controlled manually with the according knob or via incoming control voltage (the amount of CV is defined by using the knob as an attenuverter). When nothing is plugged into the CV and key inputs, take off and Landing knobs vary the duration time of corresponding stage from 1 millisecond to 10 seconds. When no control voltage plug is inserted into the appropriate ***CV IN*** jack, each attenuverting knob defines bending of the according curve of the certain slope: either to ***exponential*** shape (knob is in far counterclockwise position), to ***linear*** (knob is in centered position), or to ***logarithmic*** (knob position is far clockwise). These knobs have ***exponential*** characteristic for turning them in both sides from the centerposition – i.e., the control changes slightly when the knob is close to the middle position and more dramatically when the knob comes closer to its far left and right positions. Adjusting the linearity ***doesn't change the duration time of the according stage***, as it's usually expected in analog envelope generators (when feedback signal from the envelope's output was routed into CV IN of a certain stage and at the same time playing with the polarity and amplitude of that signal changed the shape but affected the diration of the stage). Altering the shape of the stage may obtain continuosly variable responces that require precise shape, as for example 'vactrol' ones.



Slopes curves examples

The CV Input for each Airplane's stage requires ***3.5 mm mono plug (not stereo)*** to function properly. The range of acceptable-voltage is ±5 volts (10 Vpp). It's also possible to contol the shape of the slope (from exp-to-lin-to-log) instead of the time. By installing appropriate jumper settings (see the ***Jumperization Chart***) the control of the input voltage is changed from 'control over parameter time' to 'control over parameter shape'.

The ***Peak Detector*** continuously tracks the heights of both Airplanes and outputs the CV of one which is higher at the moment. There is an attenuating knob ***'relative B height'*** for decreasing the height of Airplane B related to the Airplane A. Triggering both envelopes at same time – when Airplane A is in transient and Airplane B in cruise mode – allows to obtain an approximate ***ADSR***-alike envelope output. Herewith the ***Attack*** and ***Decay*** stages are defined by the take off and Landing rates of Airplane A, ***Sustain*** will be defined by the 'relative Airplane B height' knob and ***Release*** by the Landing rate of AirplaneB:



Peak detector

In ***looping*** mode both Airplanes work as ***Voltage Controlled Oscillators*** with ***separately controlled*** take off and Landingslope rates as well as ***separately controlled*** shapes of each slope. The take off and landing knob in far counterclockwise position, with no additional voltage applied, each stage has a durationof 1 ms or 500 Hz per whole cycle.

The ***keyIn*** jack handles ***one volt per octave exponential input*** to control/modulate the VCO under incoming voltage. The acceptable control voltage range is ***positive only, from zero up to 6,6 volts***– i.e., aproximately six and a half octaves above the *current pitch* of the cycled envelopes but not higher than ***15 kHz.***

The ***key in*** the input works in any mode and alters take off and landing rates simultaneously, i.e., short each of the stage's duration twice by increasing the input for one volt. Thus applying some constant voltage to ***key in*** will offset the time duration of both stages's making the whole envelope even snappier.

As opposed to the ***cruise*** and ***transient*** modes, in ***looping*** mode the ***check-in*** trigger doesn't change the direction from landing to take off, ***but entirely restarts the envelopes take off stage acting as hard sync for the VCO***. Patching the end of take off trigger into check-in jack, the Airplane takes off and immediately restarts and then takes off again, and so on, infinite looping which results in a rising sawtooth wave at the Airplanes outputs.

When the shape of each slope is linear, the output of each Airplane is a band-limited triangle wave with adjustable rise and fall slope times. When the curve of certain slope becomes other than linear, or some hard sync is applied at high audio rates some ***aliasing*** may be heard because of sharp edges of slopes and the digital nature of the envelopes. The envelopes themselves run at 12 bit resolution and a 48 kHz sample rate.

By patching the ***end of take off*** stage trigger from one Airplane into the ***check-in*** input of another one, enables both Airplanes to fly simultaneously with the launch time shifted for one stage(sometimes it's called as ***quadrature*** mode).

2. GATES/GATEWAYS

The Gates or Gateways are opto-coupler-controlled Sallen-Key low-pass filter amplifiers. That means altering the gates offsets will alter both frequency cutoff and amplitude of the signal giving natural musical response, similar to acoustic instruments. Each gate has ***attenuverting CV inputs*** and gate A has an ***attenuverting audio input.*** In the middle position of the attenuverting knob no signal will pass into the according input. Cranking the knob clockwise will increase the passing of the original signal and turning the knob counterclockwise results in passing the inverted signal.

By default each gate alters the cutoff frequency and amplitude that suits best for bongo and other 'pinging' timbres. There is one extra ***Voltage Controlled Filter*** mode that enables full ***12db/oct*** filteringwithout altering the amplitude of the signal. See the ***Jumperization chart***.

Afterwards both gates sum together and follow to the final output section. There is also ***separate output of gate A***. Inserting a plug to it will disconnect gate A from the mixer (and no summing happens) so you may feed the output of gate A into other modules or directly into the audio input of Gate B to obtain a more steep cutoff slope. The inputs of each gate are ***DC-coupled*** and may be normalled to each other (see the ***Jumperization chart***). That means some signal plugged into one Gate may be plugged simultaneously into another one as well.That connection breaks when any other plug (even an unconnected one) is inserted into anothersgate's audio input. Passing the same signals at both gates and playing with the input phase and amplitude of gate A using the attenuverterso the offsets of each gate will result in mixing of a low-passed signal with the pure invertedsignal. That'll result in a ***high-pass*** effect.

There is no dedicated control of ***resonance*** (emphasis) at the gates but it may be achieved with a additional mixer module or by patching the ***mono final output*** (marked with a loudspeaker) into the input of agate, i.e., organizing the feedback loop of the signal. It is convenient to send feedback into gate A where additional control over input phase and volume is givenby the attenuverting knob.

Since the gates are opto-coupler-based, feeding back the signal results in a sound with a ***special character*** because of particular attack and decay chrachteristics and the 'memory' of opto-couplers response. Unfortunately that means no audio-rate modulation of the gates. However, the gates can be ***pinged*** (opened) with a short trigger like the ones that are coming from the ***end of stage*** outputs, which result in very special sound when the gate is opened. Usually referred to as the classic ***Buchla Bongo*** sound. That short trigger should be connected to the gate's CV input and the attenuverting knob in full clockwise position.

We supply the Terminal with a certain type of vactrols that vary from one product to another. They may be very slow, slow or fast as hell. Please consider the batch of the modules at your dealer.

You may create own ***self-rolled opto-couplers*** or ***photoresistive opto-isolators*** using a light-emitting diode (***LED***) connected to light-dependent resistor (***LDR***) with a dark heat shrink around it. The more the LDR is enlightened by the LED, the more the gate opens (increases its cutoff offset frequency). The LEDs undereach manual gate's knobs light up in same way as the LEDs in the opto-couplers for a convenient visual control.When the LED is off, the output of the according gate is literally muted. The opto-couplers are plugged into sockets on the backside of the module for a simple and fast exchange to other ones. You may roll you own ones or try factory made ones from ***PerkinElmer®*** (a.k.a. Vactrols®, trademark of Excelitas Technologies Corp.) or ***Silonex®*** (NSL-32SR3, trademark of Advanced Photonix, Inc.): two single or one dual opto-coupler per each Gate (see the ***Jumperization chart*** for proper pinout). The sockets for opto-couplers use the industry standard pitch for hole's sockets (multiple to 0.1" or 2.54 mm) for use with IDC-type PLS 4-pin strips..

3. FINAL OUTPUT

The Final Output section has separate ***stereo*** and ***mono*** outputs, which share the same volume knob.

At full gain (knob fully clockwise) and center Panning knob the audio signal at the mono output is literally at a standard modular level (roundabout ±5V or 10Vpp). The Mono output is ***DC-coupled*** and has ***1kOhm*** output impedance, as ordinary modular audio outputs are.

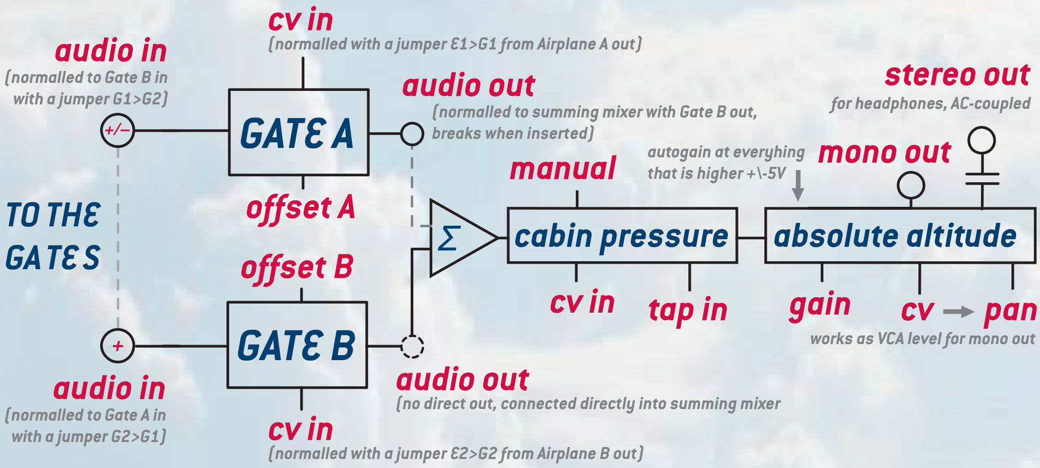
It is possible to plug headphones or stereo amplifiersystem directly into stereo output, marked with the headphone icon. The stereo output is ***AC-coupled*** (to prevent possible damage of your audio system by DC signals) and has got a pretty good level of output current to drive a wide range of headphones. The output amplitude of the stereo out is lower than the ordinary modular level and is close to ordinary ***line*** level. ***Please connect only stereo headset/amplifiers to the stereo output.***

Attention: turn the gain to minimum first and then increase the volume slowly for comfort listening as it may damage your ears as well as your audio system at high gain.

The ***Pan*** (panning) knob controls the spread of the output stereo signal to the left or the right channel.

The according bi-coloured LED will light up in green when the signal will be panned to the right channel, and in red when it's panned to the left channel – or will not light up at all when the panning is exactly in the middle of the stereo field. Panning can be controlledwithvoltage, accepting bi-polar±5 volt signals, where negative voltages will turn the panning to the left and positive voltages to the right channel.

Panning control simultaneously alters the output level of the mono output from minimum at full counterclockwise ***pan knob*** to max at its full clockwise position.



4. CABIN PRESSURE

The Cabin Pressure is a digital effect that recreates some sort of ***reverb/echo with a few reflections (taps)*** at a 12 bit 30 kHz sample rate**.** The rate of the taps is voltage controllable. The cabin pressur is especially usefull for live performances to add some air to the final audio output.

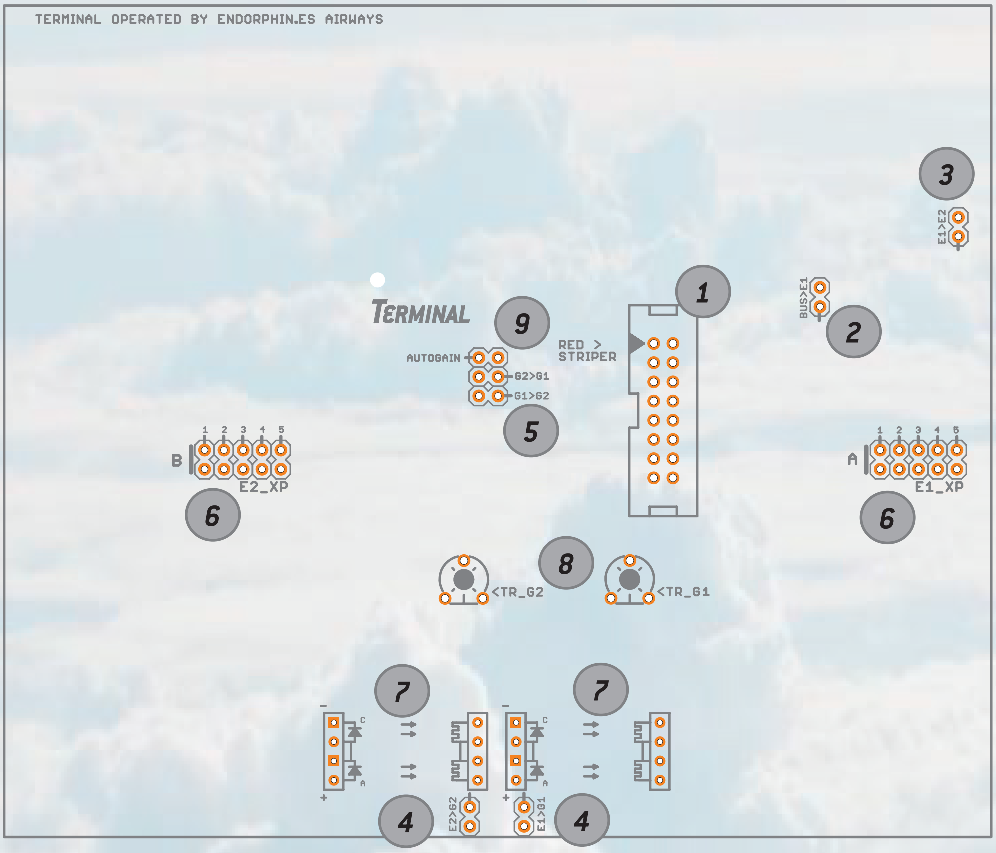
The knob as well as the according voltage input, control the amount of the echo sent to the final mix as well as increase the echo tail from zero effect at full counterclockwise knob up to 5 seconds tail at full clockwise position. Tap tempo allows to createrhytmic delay effects that are also syncronized to the rest of the instruments used. It accepts low frequency trigger signals higher than 0,65 volts, namely BPM clock of the track. When the incoming clock signal is faster, it resembles some sort of chorus effect, and at ratesfaster than 50-60 Hz, the taps become almost mute in echo tails but may be recognized as a short clicks at attack sounds only. It's possible to remove the plug from the tap clock input jack because it will remain the same speed once it was synconized. Three sequential taps (triggers) are enough to adjust the echo to a new tempo. At the modules' power-up the maximal tempo is set by until new clock will come.

The ***Power consumption*** of the module is the following: ***max 185 mA from positive +12 volts rail*** and ***max 115 mA from negative -12 volts rail or up to 300 mA in total.*** No +5 volt bus power is required.

JUMPERIZATION ADDENDUM

The Terminal is a small yet complex module which every user can customise it to his own needs.

Below is an illustration of Terminals backside.



1. Doepfer A-100 bus IDC-connector. We advise that you use the supplied 16-pin ribbon cable!

Please ensure that the ***red stripe*** of the cable (the side with the top pair of pins/wires) is connected to the ***negative*** -12V rail when plugging the cable into your power distribution board. If the ribbon cable is connected backwards, you could damage the module. Please check twice before you make the connection and turn on your modular since failure/malfunction due to a wrongly connected module (***"magic smoke"***) is not covered by our warranty.

2. When the ***BUS>E1*** jumper is installed, the gate signal from the 15/16th pin of the Doepfer A-100 system bus (***bus gate***) goes directly to the trigger input of the ***check-in*** of the ***Airplane A.*** However, the connection is temporarily broken when any plug is inserted into the ***Airplane A's check-in jack***.

3. When the ***E1>E2*** jumper is installed, the trigger input signal of the "***check-in"*** of the ***Airplane A*** is normalled to the trigger input ***"check-in" of the Airplane B***. Thus triggering Airplane A only will launch Airplane B simultaneously. The connection is temporarily broken when any plug is inserted into the ***Airplane B's check-in jack***.

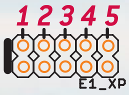
4. When either ***E1>G1 or E2>G2*** jumpers are installed, the bi-polar output of the according ***Airplane A or Airplane B*** is normalled to the CV input of ***the accordinggate A or gate B***. The connection is temporarily broken when any plug is inserted into according ***gate A*** or ***gate B CV input jack***.

5. When either ***G1>G2*** or ***G2>G1*** jumpers are installed, the according gate's audio input is normalled to other gate's audio input. Both connections are temporarily broken when any plug is inserted into gate A's or gate B's ***audio input jack***.

6. Each Airplane has a10-pin expansion slot where jumpers are installed:

All of the pins are able to either carry jumpers or to connect an expansion module.

The expansion module will be help you to a conveniently use both Airplanes as VCOs as well as all the switched functions described below. The jumpers must be installed vertically, separately for each pair of ***1-5 pins*** to customize the functions below:

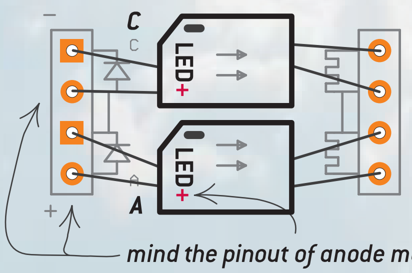


- when jumper ***(1)*** (most left one, marked with a bold white line nearby) is installed it will enable full ***12db/oct VCF*** mode on the according A or B gate. When enabling the VCF mode on the gate A, it is possible for example, to use this gate for CV processing as a voltage controlled slew limiter (portamento) for controlling the pitch of a VCO.
- when jumper ***(2)*** is installed, the Airplane will output a short 1ms trigger after the end of each take off (attack) stage.
- when jumper ***(3)*** is installed, the Airplane will output a short 1ms trigger after end of each landing (decay/release) stage at the end of stageoutputs. Jumpers***(2)*** and ***(3) can be installed simultaneously*** giving you a trigger when a stage has ended at the ***end of stage*** outputs. ***When Combining the end of stage triggers, one may obtain additional functions such as 2x or 1/2 clock multipying or even more when chaining both Airplanes together.***
- when jumper ***(4)*** is installed, the control voltage at ***CV input*** of ***take off*** stage ***will control the shape of the slope instead of its time***. The attenuverter will polarize the accepted incoming voltages of maximum ±5 volts into positive (knob in far clockwise position) or negative (inverted, knob at far counter-clockwise position) amount of the control voltage applied. For example, when a current of +5 volts is applied into the ***CV input*** when the ***attenuverting knob*** is far clockwise, this will result in a LOG (logarithmic) curve and turns into an EXP (exponential) when the attenuverting knob will be in thefar counterclockwise position.
- when jumper ***(5)*** is installed, the control voltage at the ***CV input*** of the ***landing*** stage ***will control the shape of the slope instead of its time***. Thus when using ***(4)*** and ***(5)*** jumpers you won't be able to control the time of the slope via CV separately anymore but can only manualy change it with the according knobs or via the ***key in*** 1v/oct input when controlling both stages at the same time.

7. Sockets for opto-couplers. Either two single either one dual opto-coupler must be installed into the sockets at each gate. In bottom of the backside of the Terminal, the left pair of opto-couplers corresponds to gate B and & the right to gate A.

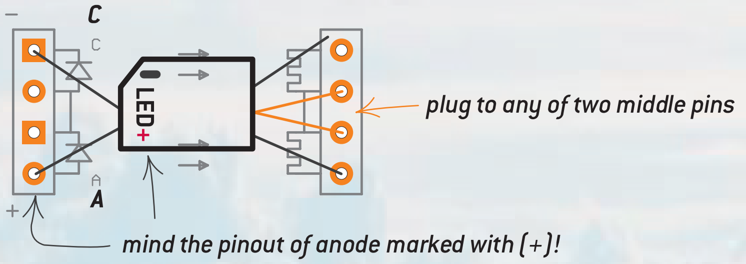
The opto-couplers should be installed exactly as it is written on the silkscreen on the back-side of the module. Please replace them only when the module is disconnected from the power source as this could harm the unit due to mishandling.

When installing two single optocouplers watch the polarity of each LED's pins. For example, ***PerkinElmer Optoelectronics®*** ***(Excellitas) VTL5Cx series Axial Vactrols*** has a cut on its cover at the cathode'sleg side and ***LED+*** marking at anode's side. ***Silonex®*** NSL-32SR3 opto-couplers has a ***dot*** at LED's cathode pin. Thus both factory made opto-couplers should be installed ***as are*** with labels on their covers upside up minding the pinouts:

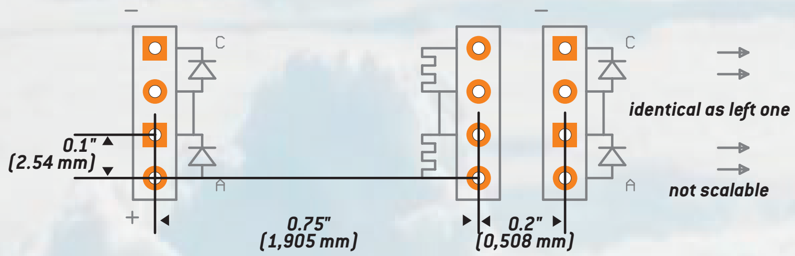


mind the pinout of anode marked with (+)!

When installing one dual opto-coupler, the LED's pins should be connected to the most distanced pins marked ***C*** for cathode (shorter leg) and ***A*** for anode (longer leg). Dual opto-couplers have three pins. The side LDR's pins should be connected to the appropriate socket's side pins and the middle LDR's pin should be connected to any of two socket's middle pins:



Before installing the opto-couplers you may want to cut their legs off to 1 cm length each and bendthem 90° down to fit into socket. After installing new opto-couplers and checking the gates are working properly, you may apply a small amount of hot glue to the spots where the pins are inserted into the sockets to ensure the opto-couplers will stay there firmly.



Drawing of sockets for opto-couplers. View from the rear side of the Terminal module (bottom side of the PCB)

If you're rolling your own optp-couplers, it's important to ensure the dark encapsulation of the LED to the LDR to avoid outside light passing to the LDR which may lead to bleeding (i.e., passing of small amounts of the signal when fully closed).

8. TR_G1 and ***TR_G2*** are the trimmers for gate A or gate B opto-coupler's LED'ssensivity. Use it to adjust the the Gate's opening range to fit the whole knob's turn — from full closed Gate at far counterclockwise knob to fully openedgate at full clockwise position. The module is factory pre-trimmed for suppliedopto-couplers. Adjust this trimmer when you replace the factory op-to-couplers to ***Vactrol***®/(Excelitas)or other ones. Without trimming, your gates may already open fully when the manual gate knob is still less than halfway open.

9. When the ***AUTOGAIN*** jumper is installed, the special ***Auto Gain Control*** is enabled. It ensures that the overall amplitude at the final output can't go higher than ±5volts (10 Vpp) to avoid clipping at the gate's mixer (especially when mixing the two ±5 volts signals coming from each gate) as well as clipping at long echo tails. It's not a limiter and it will not clip (saturate) the high peaks of the signal, yet will simply decrease the overall output level to fit into ordinary modular levels. Attack time is literally instant and decay time is around 1 second and was chosen specifically for these situations. At some staccato timbres the 'pumping' effect may increase because of high amplitudes in the signal.

The characteristics of the product described are subject to change without notice.

See more details on changing the Vactrols to the ones that suit your taste the best on the following pages!

SERVICE NOTE #1 – choosing and replacement the Vactrols for the Gates

During the Terminal development we tested different optocoupler (vactrol) types that will fit to lo-pass gates in a musical way and it was decided to make sockets and supply the module with some default vactrols so customer may conveniently replace them to their own needs.

Each of two Gates in Terminal requires one dual or a pair of single opto-couplers.

Essentially, the vactrol (or opto-coupler) itself is a LDR (photo-resistor) coupled with a LED in some dark encapsulation package. Dual factory versions have one LED and two LDRs connected in series (thus they have three legs from that side). The more the LDR is enlightened by the LED, the more appropriate Gate opens.

The first batch of Terminals was supplied with VTL5C4/2 (manufactured by Excelitas Technologies Corp. and Perkin Elmer / Valtec were preceded it) - dual, the slowest and maybe rarest vactrols that are perfect for that typical bongo sound when pinged by a short pulse. According to datasheet they have something like 1.5 seconds respond time from the fully open to something like a semi-closed state. In the next few seconds after no CV/manual offset applied, that type of vactrol closes fully with literally no bleed. Indeed, it has a very natural response (like string of a guitar) with small saturation in the passed signal (their own characteristic). They have almost instant attack time but are very slow in decay - slow speed is the price for its naturalness and low bleed at full closed state.

Moreover, the vactrols also have so called ‘memory’ effect – that means that playing some time with the Gates (i.e. exposing their LDR to light) might alter their response with some time (especially that corresponds to the slowest VTL5C4(/2) ones).

As you may see from other modular synthesizers manufactures, VTL5C3/2 dual ones or a pair of VTL5C3 or Silonex (Advanced Photonix, Inc.) NSL-32SR3 single ones are direct replacement for faster/classic vactrol options. It’s also possible to roll own vactrol connecting an LDR with a LED and a small piece of heat shrink (see second chapter of that addendum).

WARNING: replacing the vactrols by repeating all the steps laid out in that document foresees that you may have some experience with soldering. We are not responding for repair procedures that may arise with vactrols replacement and rolling own ones. In any case, if some of your replaced vactrols with not work, you may always switch to factory ones to ensure that you are doing everything right.

Hope you enjoy our product and if you don’t like slow or fast speed/character of the included opto-couplers you may pick the ones the fit best to your musical need to use Terminal module at full.

1. There are different places you may order factory made vactrols:

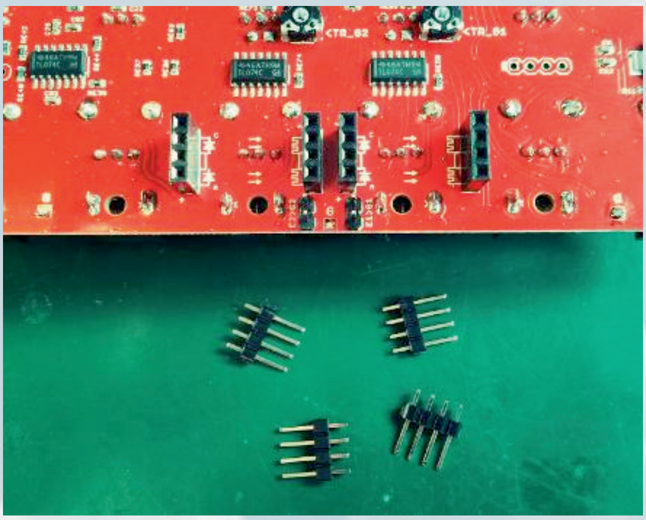
Thonk.co.uk, Alliedelec / RS-online as well as Farnell, Mouser, Mammonth Electronics or Smallbear Electronics.

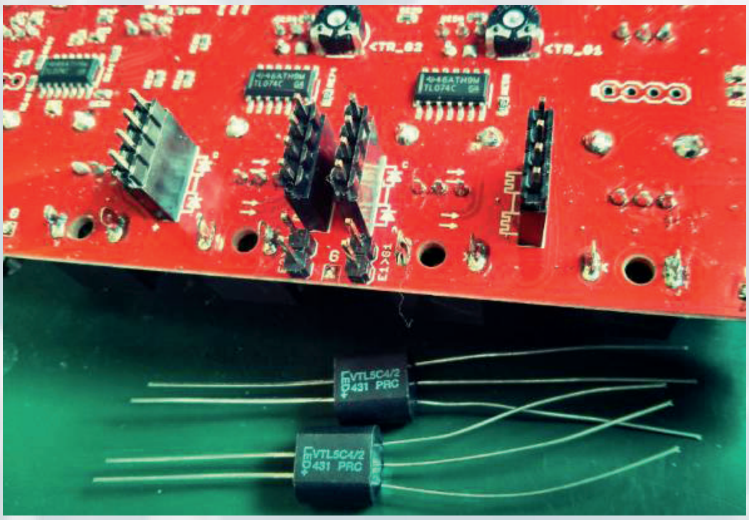
Initial schematic of vactrols placement is described in Terminal’s manual on the last page.

Navigate to the backside of the Terminal module to its bottom part and take the factory supplied opto-couplers from their sockets off.

What else you need is to have is 2pcs. of single row 4-pin header strips (IDC type, 2.54mm/0.1” pitch distance) for each Gate (PLS-4). Alternatively you may take PLS-40 40-pin strip and cut as many 4-pin pieces as you need using clamps or some sharp paper knife (Conrad code: 10120183, Mouser code: 571-9-146284-0, Farnel code: 61304011121, Tayda-electronics code: A-197)

Insert the pin strips into the sockets with longer metal pins inside the sockets and shorter pins upside and prepare the vactrols:

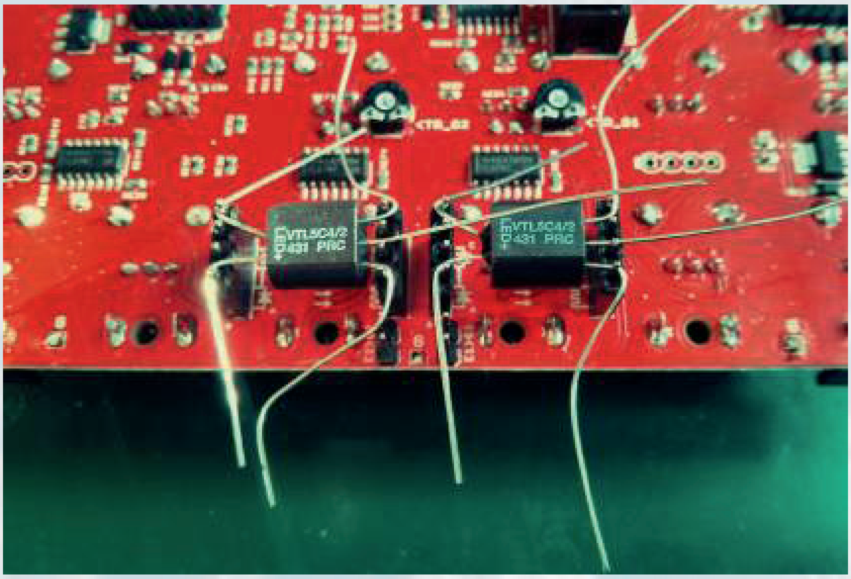




The easiest way is to take dual vactrols (the ones that have five legs while single ones have four):

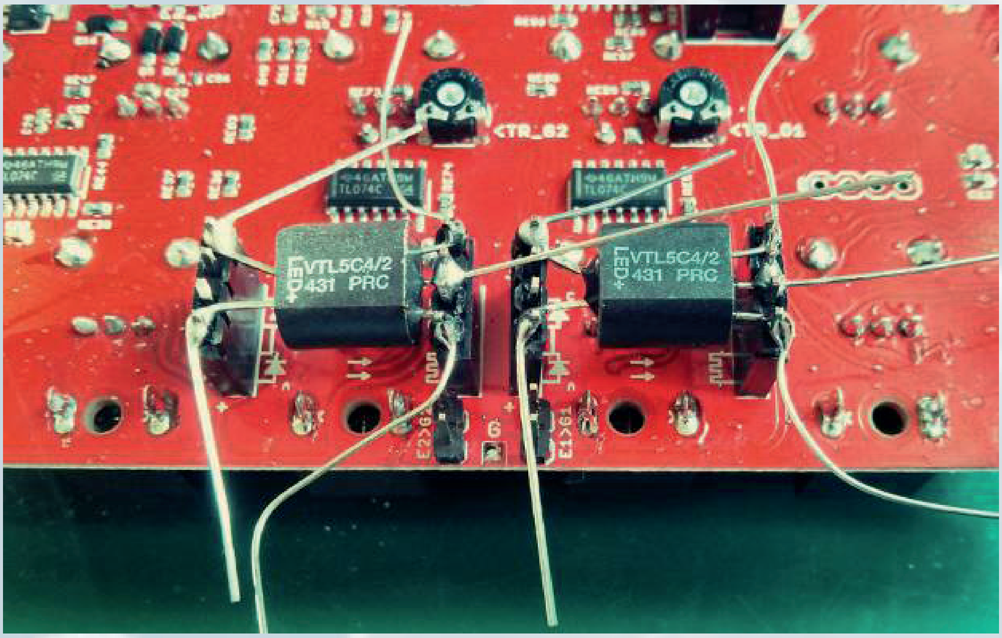
- VTL5C4/2 – short attack but very slow decay (natural response). Perfect for bongo/pinging so even no envelope generator is required;
- VTL5C3/2 – more classic ones with moderate decay. Fits to most typical music applications but give way shorter bongos when pinging;
- VTL5C4 or VTL4C3 – are single versions or the two options above. You need two of them instead of one dual for each Gate. Mixing different types may also obtain interesting results;
- NSL-32SR3 – single ones – have more or less same characteristics as VTL5C3.

Put the vactrols on the IDC pins and bend the legs to different sides as on the picture below:



The factory vactrols should be put with their wires between the IDC pins with the graphics labeled upside up. The side with two LED pins (labeled as LED+ on the vactrol's case) should be on the left side of appropriate socket (LED+ on the vactrol should be on the same side where + is marked on the PCB).

Solder all the legs to the pins in the following way:



LED's legs (in case dual vactrol) should be soldered to the most upper and bottom pins. Two middle pins of each socket are internally connected and should not be soldered or connected when using dual vactrols. Two middle pins from the LDR's side are also internally connected and may be soldered together. After soldering, cut all the long legs cut from the vactrols off so they will not connect somewhere else.

Afterward you may turn the Terminal module on. Don't screw it into the case so far until you checked the vactrols are properly trimmed using <TR_G1 and <TR_G2 trimmers.

The trimmer position for the factory made VTL vactrols should be usually the most CCW position (the LEDs under each Gate on the faceplate will not glow at full when the Gates are fully opened). The trimmer position for self-rolled vactrols should be usually the most CW position (the LEDs under each Gate on the faceplate glow at full when the Gates are fully opened).

2. Rolling your own vactrols may be a lot of fun and may be the faster way to replace the vactrols to the desired ones by obtaining the light depending resistors (LDR) from the nearest electronic supermarket.

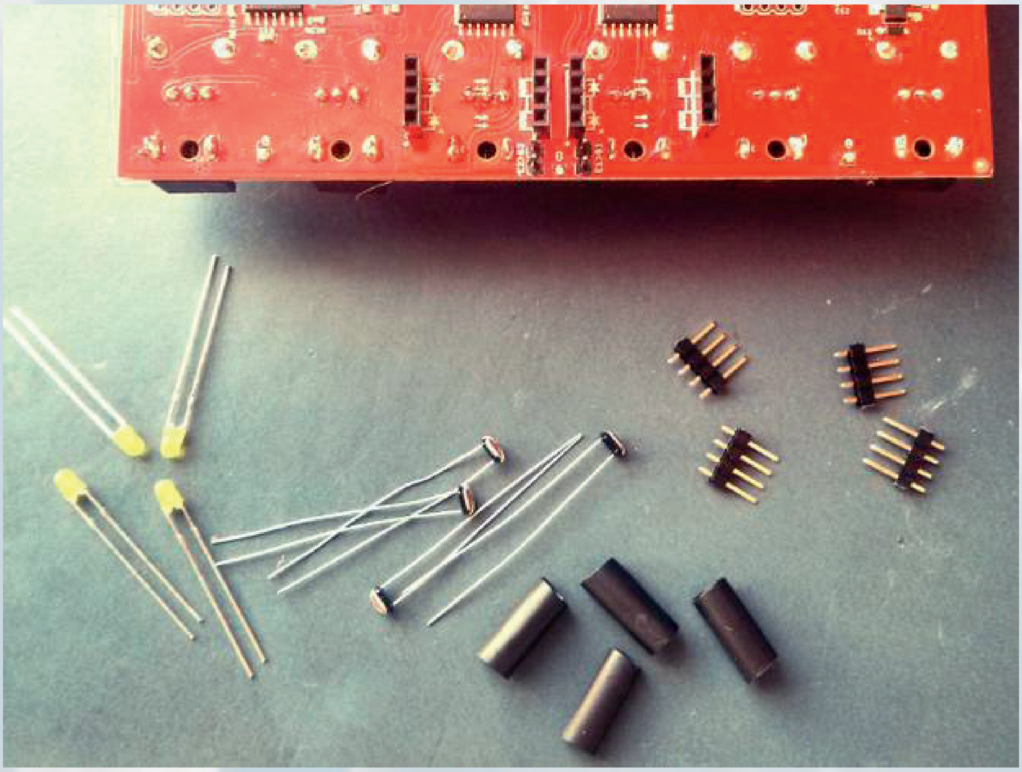
Original VTL vactrols have red LEDs inside with a clear (non-diffused) lens with very narrow angle light spot. However we found out that ordinary ***yellow*** 3mm LEDs with round diffused lens fit very nice in combination with almost any photo-resistors. Other colors of LEDs may give another LDR response. You may try other colors or their combination as well. ***We just recommend yellow since we find their response better from our point of view.***

First you should check your local supplier with the photo-resistors they have in stock. There are a few important characteristics you may choose the photo-resistors according to their datasheets:

- R_{MIN} (fully open state under full light) may be 100Ɛ1kƐ10k Ohm. That value is not relevant as the next one.
- R_{MAX} (fully closed, dark state) must be 500kƐ1M Ohm and higher. The higher resistance RMAX is, the less bleed vactrol may have when corresponding Gate is fully closed.
- the diameter of the photo-resistor shouldn't be more than 5-6mm so its head will be tightly 'shrinked' with 3mm LED. The heating tube-shrink diameter may be up to 5-6mm – choose the one in which your LDRs will fit. You may try 5mm LEDs as well.

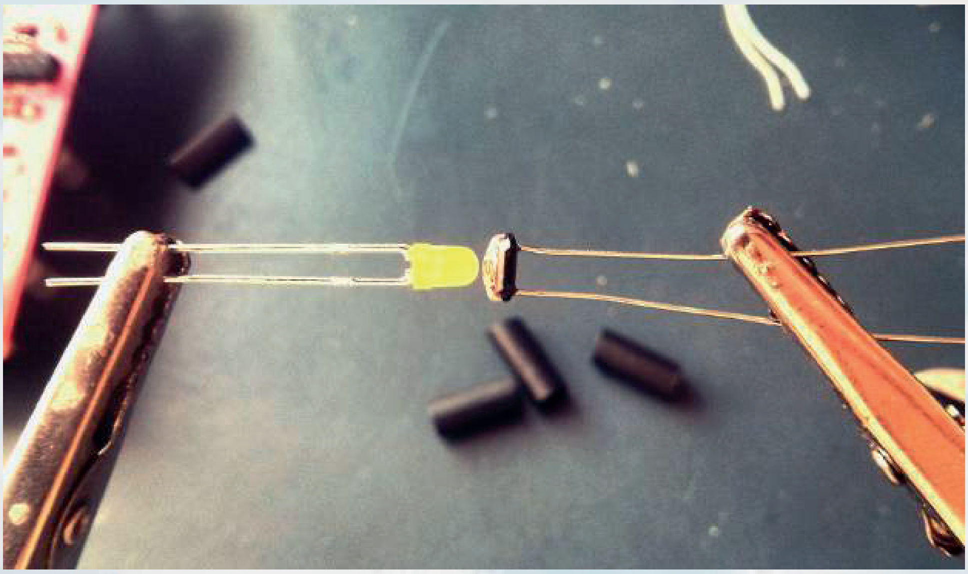
Here is a list of a wide spread photo-resistors models you may get from the nearest radio supermarket (like Conrad in EU):

- Perkin Elmer / Excellitas: A 9013 (Conrad #145475), A 9014, A 9060 13, A 9060 14 (may have less bleed than A 9060 13), A 9060 33, A 9060 34, A9950 13, A 9950 14 (may have less bleed than A 9950 13);
- Mobicon Electronic Components: MLG4427, MLG4437 MLG4447;
- Waitrony (from Tayda-electronics): MPNKE-1072, item: SKUA-1528.

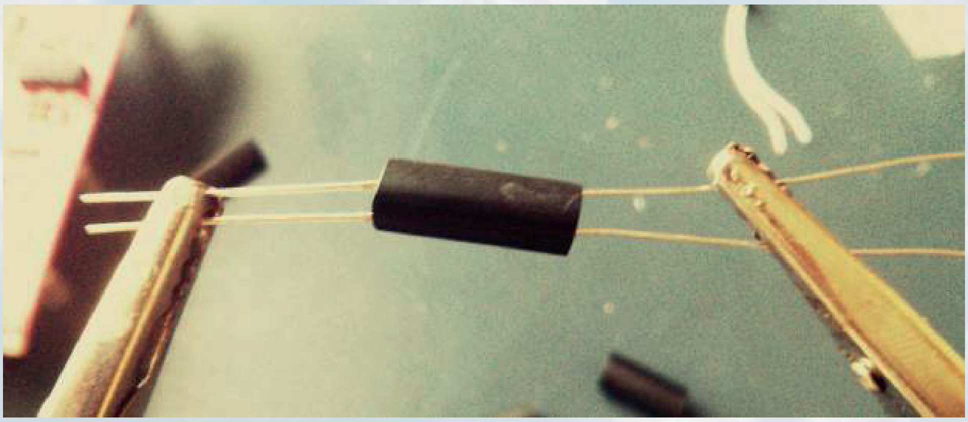


Same as in chapter 1 – you need to prepare 2pcs. of PLS-4 4-pin strips for each Gate. Additionally you need to prepare 2 pcs. of black 1cm length heat-shrink tube per each Gate.

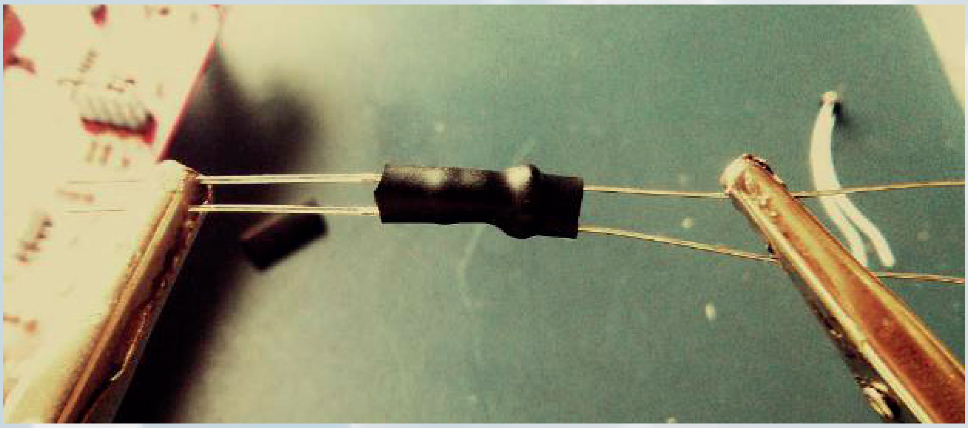
Insert the pin strips into the sockets with longer metal pins inside and shorter pins upside and let's prepare the vactrols. For each Gate you may need two vactrols or four altogether for both Gates.



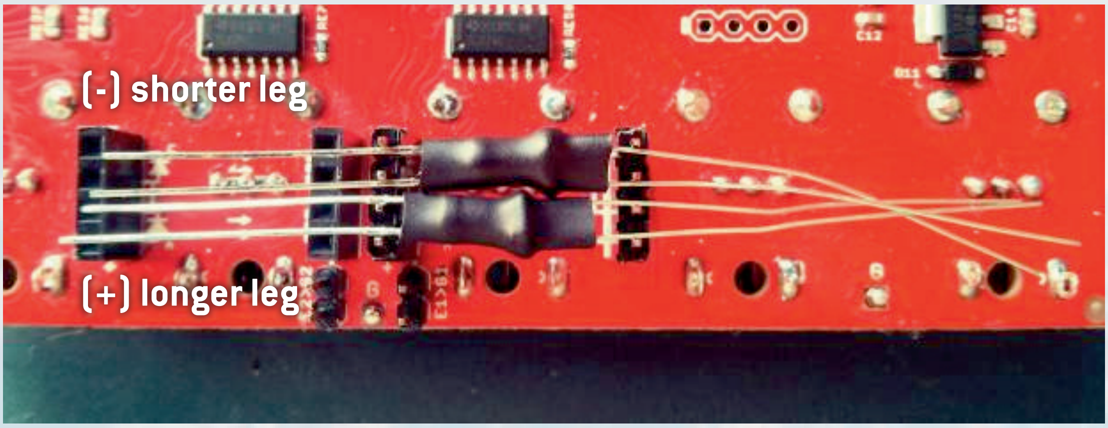
Using 'fifth-hand' instrument fix the LDR in one clamp and the LED in the other so they will look and slightly touch each other. Put the heat shrink tube in the place where LDR and LED meet as on the picture below. You may shift heat-shrink tube aside to ensure LDR and LED are fixed closely and then return the tube back to cover LDR+LED couple. Apply hot air or warm from a candle or lighter or match to the heat-shrink tube. If you don't have hot air gun and use open fire only, then don't bring the fire light too close to the heat-shrink tube so the heat-shrink tube will not become over-burned and rotten.



And finally you should obtain the following result (for all of 2 or 4 vactrols):

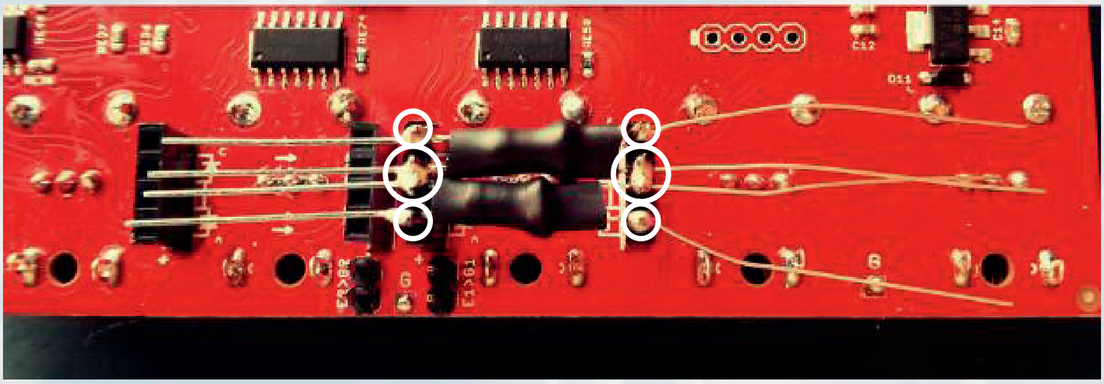


Put the vactrols on the IDC pins as on the picture below:



When soldering only one pair or vactrols at once and putting it aside, there is no need to bend their legs and makes soldering much easier. Don't touch the soldering iron too long to the pins however the side with LDR legs should be soldered properly since sometimes cold soldering may appear at LDR's legs. The side with the LED legs (LEDs always have square legs and the one with anode (+) is always longer and cathode (–) is always shorter) should be on the side where + and – are marked near appropriate sockets. The LDR's pins don't have any orientation so the most important is to put the vactrol in a way that LED pins will be put properly: shorter leg on the top corresponds to (–), and longer below corresponds to (+) and then again for the other vactrol and on the picture above and below.

When two vactrols are put on the sockets, solder them in 6 places as on the picture below:



After soldering, cut all the long legs cut from the vactrols off so they will not connect somewhere else.

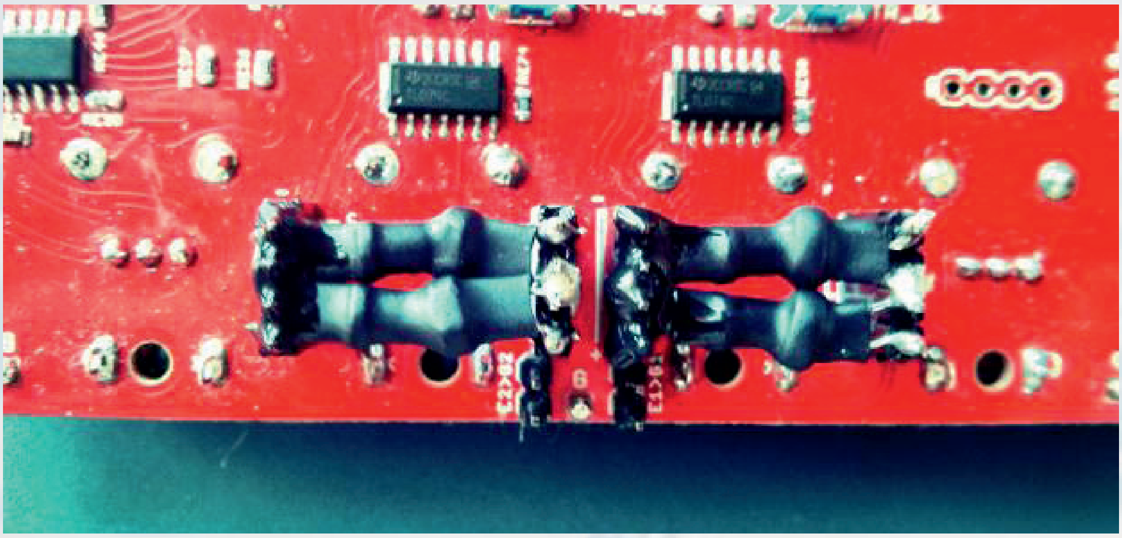
You may put the vactrol pair off the socket for easier cutting legs with the scissors. Repeat the procedure for another pair of vactrols. Afterwards install both pair of vactrols in the sockets.

Afterward you may turn the Terminal module on. Don't screw it into the case so far until you checked the vactrols are properly trimmed using <TR_G1 and <TR_G2 trimmers.

The first thing to check when you turn the Terminal on is manually open both Gates and notice if both yellow LEDs under each Gate's knobs light up. Afterwards plug any signal into 'TO THE GATES' input of each Gate and ensure that the signal appears in the headphones stereo or mono outputs. Turn the knob fully CCW and then CW to ensure the whole turn opens and closes the Gate fully in the most CW and CCW positions.

The trimmer position for self-rolled vactrols with diffused yellow LEDs is usually at the most CW position (the LEDs under each Gate on the faceplate glow at full when the Gates are fully opened).

Additionally you may cover the side of the pins with LED with black hot glue to eliminate any light penetration on the LDR when LED doesn't light (and as a result – eliminate bleeding at fully closed condition):



Hope you enjoy our product and if you don't like slow or fast speed/character of the included opto-couplers you may pick the ones the fit best to your musical need to use Terminal module at full.

Sincerely Yours

the Endorphines Cabin Crew