ANDROMEDA SPACE ROCKERS
MK-1 Drum Machine

Photocell X

When light hits this sensor, it raises the pitch of the first oscillator.

The Andromeda MK-1 has two analog oscillators that play simultaneously. They are known as damped sine wave oscillators. This type is used in many classic drum machines to simulate bass drum, toms, clave, rimshot, bongo, etc.

Since the MK-1 has independent control of both oscillators, you can make a variety of fresh poppin' noises by playing the photocells with a flashlight.

Personality Center

You can customize the drum's personality by adding extra components to the grid of unused holes. There is a useful opamp and convenient points for power, ground, output, etc. Visit the website for details.

IR Sync IN

This sensor picks up the infrared beam from another Andromeda Space Rockers instrument The sensor is underneath the board to reduce the ambient light hitting it.

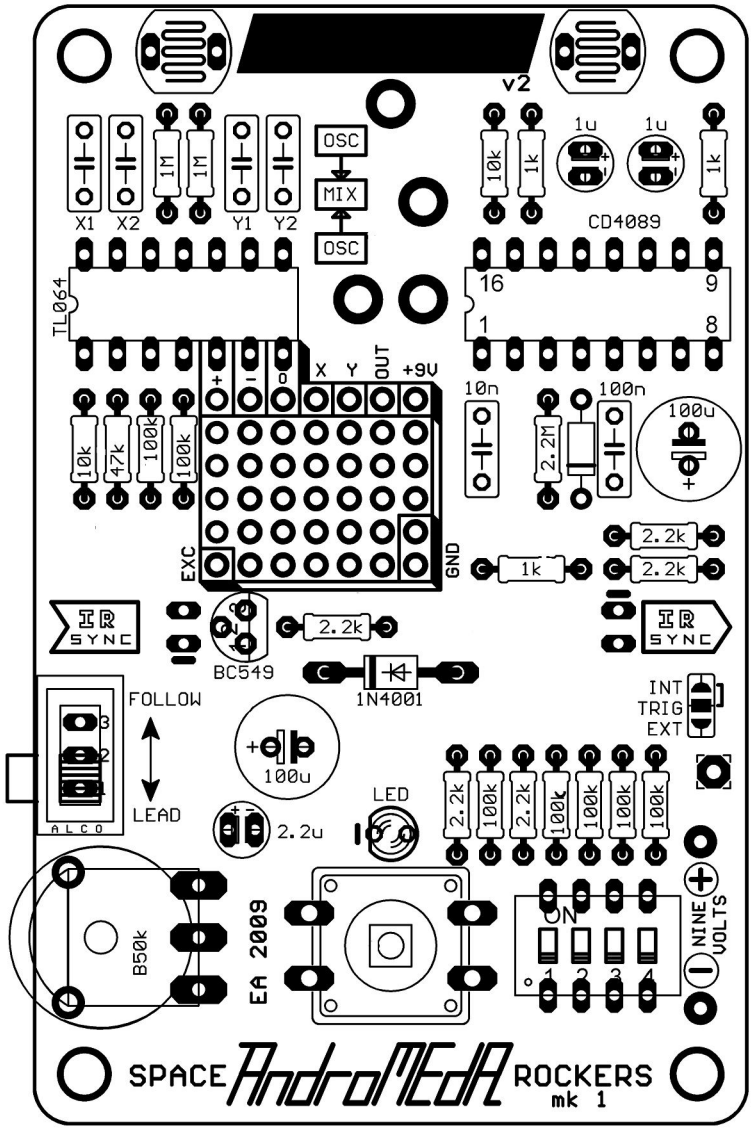
Lead / Follow Switch

When this switch is on FOLLOW, your drum machine matches the tempo of the machine next to it. If there is no signal, the sound will stop.

Set the switch to LEAD and you can adjust the tempo independenly with the thumbwheel

Thumbwheel

The thumbwheel potentiometer controls tempo in LEAD mode. Tempo is variable from 50 – 300 BPM, if we consider the clock as 1/16th notes



ericarcher.net/devices/mk1

Photocell Y

This photocell controls the pitch of the second oscillator

IR Sync OUT

This sends a flashing infrared beam that communicates tempo information to the next device in the network.

INT – EXT Jumper

This functions like a switch, but you configure it by adding a blob of solder. For normal operation, connect INT and TRIG with a blob of solder between them. This connects the internal sequencer to the sound generator.

Or you can experiment with external triggering from a microcontroller, modular synthesizer, etc. Just move the solder blob so it bridges TRIG and EXT. Connect the external trigger source to the EXT pad, its ground should connect to the GND point in the Personality Center.

Rhythm Selector

Brush up your binary skills and think of a number from 0 to 15… For every 16 clock 'ticks', the MK-1 plays a specific number of drum hits. You enter that number into the DIP switch in binary. Here are just a few of the choices:

```
0000 = off
1000 = whole notes
0100 = half notes
0010 = quarter notes
0001 = eighth notes
1111 = fastest setting
```

The Button

Tap the button once to restart the rhythm from its reference point. Use this feature to shift the position of an accent note, or change the syncopation.

If you hold the button down, two things can happen.

```
XXX0 : silence
XXX1 : drum roll
```

ANDROMEDA
SPACE ROCKERS
MK-1 Drum Machine

16 Preset Rhythms
2 Sine Wave Oscillators
Photocell Pitch Control
Infrared Wireless Tempo

Tools you need for this kit

- *Soldering iron (25W - 40W, narrow tip)*
- *Flush cutting pliers*
- *Needle nose pliers*
- *Philips screwdriver*

Start here

Resistors

Bend the leads at a 90-degree angle to the resistor's body, then slip them into the holes on the board. Both legs are equivalent so it doesn't matter which way the resistor is rotated. After inserting the resistor, turn the board over, solder its connections, then clip the leads close to the board.

7	100k resistor
2	10k resistor
3	1k resistor
2	1M resistor
5	2.2k resistor
1	2.2M resistor
1	47k resistor

Diodes

Be sure the striped end of the diode matches the printing on the board.

1	1N4001 diode
1	1N914 diode

Chip Sockets

Make sure the socket is rotated so the notch on its edge matches the printing on the board.

1	14-pin DIP socket
1	16-pin DIP socket

Potentiometer

1	50k linear thumbwheel

Switches

The SPDT slide switch's lever faces the outside edge of the board.

1	12mm tactile switch
1	4-position DIP switch
1	SPDT slide switch

Capacitors

The electrolytic capacitors are polarized. Make sure their long leg goes into the hole marked plus (+).

1	100n polyester
1	10n polyester
2	100u electrolytic
2	1u electrolytic
1	2.2u electrolytic

Four capacitors labeled X1, X2 and Y1, Y2 set the pitch range of the oscillators. They can be any value between 2.2nF and 47nF (0.0022uF - 0.047uF). Smaller values give higher pitched sounds. Here are some suggestions.

Pitch Range	X1, X2	Y1, Y2
High	2.2nF	10nF
Hi-mid	3.3nF	15nF
Lo-mid	4.7nF	22nF
Low	10nF	39nF

Photocells

There are spaces for two CdS photocells on the board. They control the pitch of the oscillators. Use photocells that have a resistance of 5k-50k in the dark, and ~0.1k in bright light. If the dark resistance is too high, the drum will only play a "click" sound unless there is lots of light hitting it.

2	CdS photocells

Transistor

The transistor's flat side must match the printing on the board.

1	BC549B transistor, NPN

Visible LED

This LED should be a 3mm (T1) type, any color.

1	Visible LED (any color)

IR Sync IN

This is a phototransistor. It looks like a black LED. It goes on the bottom of the board with its flat edge toward the white line on the top side of the board. Bend its leads at a sharp 90-degree angle with needle-nose pliers before soldering it in place. Slip a piece of 1/8" diameter black tubing over the phototransistor.

1	PT204-6B phototransistor

IR Sync OUT

This component looks like a pink LED and emits 940nm (invisible) light. It is soldered on the bottom side of the board with its flat edge matching the white line printed on the top side of the board. Bend its leads at a 90-degree angle like the phototransistor.

1	Infrared LED (940nm)

Output Jack

The jack mounts from the underside of the board. Note: Battery power is switched thru the ring terminal of the jack.

1	1/4" Jack

Battery Pod

The battery holder goes on the bottom side. Solder it to the points marked NINE VOLTS. Install two screws from the top side of the board to keep the battery holder in place. (Drill two holes if needed).

1	9V battery holder

i can has chipz now plz?

Install the two chips into their sockets. It helps to bend the leads inward slightly, by pressing against a conductive surface like aluminum foil. Align chips so their notch lines up with the socket's notch.

1	CD4089
1	TL064

My Legs My Legs!

Your drum machine needs its two front legs to sit flat on a surface. Install the legs, made of plastic tubing, using the screws provided. To make tightening it easier, you can grip the leg with pliers while you fasten the screw.

Jumper Setting – IMPORTANT!

Before you use your MK-1 Drum Machine, you must configure it for internal triggering. Find the INT / TRIG / EXT symbol on the top of the board. Add a blob of solder that bridges the pads marked INT and TRIG. (EXT lets you connect a separate sequencer)

Clock / Infrared Network

The LEAD / FOLLOW switch sets the role of this opamp.

In LEAD mode, the opamp is configured as a *relaxation oscillator*, generating steady square waves at a rate you control with the thumbwheel.

In FOLLOW mode, the opamp is a *comparator with hysteresis*. It looks at the voltage information coming from the IR Sync input, and shapes it into a snappin' square wave clock signal.

IR Sync out is transmitted by an infrared (940nm) LED, mirroring the activity of the clock signal.

The clock waveform is typically a 50% duty cycle square wave at 16-th note intervals.

Preset Pattern Sequencer

The MK-1 sequencer is a simple implementation of the CD4089 *Binary Rate Multiplier* chip. The 4089's 4-bit binary input is connected to the Rhythm Selector (DIP switch) using 100k pulldown resistors. The preset rhythm patterns are inherent properties of the 4089 and cannot be changed.

Tapping the button sends a "clear" command, restarting the rhythm pattern from its reference point. This can be confusing because the reference points are located in non-intuitive places… but with practice you get the feel.

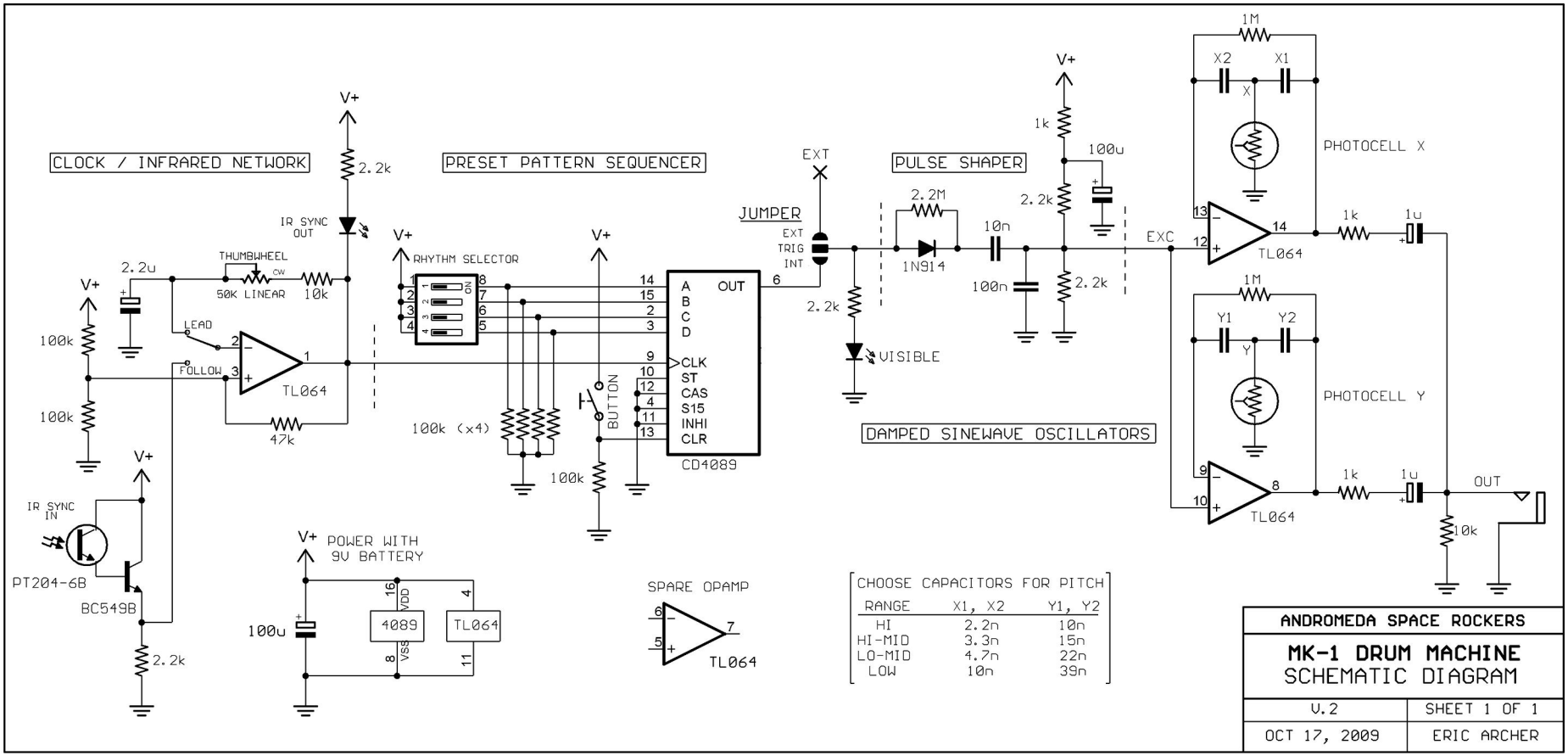
Pulse Shaper

The Pulse Shaper transforms the 4089's digital output into an analog waveform to excite (add energy to) the sine wave oscillators. The 1N914 diode, 2.2M resistor, and 10n capacitor isolate the edge of the 4089's pulse and turn it into a quick 'bump' that simulates the moment a drumstick hits a drum head. The 100n capacitor smooths the attack, almost like choosing a softer tipped drum stick. (Without it, the drum sounds clicky and thin). The 2.2k resistors, 100u cap, and 1k resistor are a bias network that attenuates the excitation waveform while keeping it centered near one-half the supply voltage. This creates the excitation signal (EXC) that drives the oscillators.

Damped Sinewave Oscillators

These are of the classic bridged-T oscillator type, which is in fact a high-Q filter that rings when excited, creating a natural-sounding volume contour. The photocells set the oscillators' resonant frequency. Brighter light = lower photocell resistance = higher pitch. Capacitors X1, X2 and Y1, Y2 determine the pitch range that the drum will play. Typical values are between 2.2n and 47n (0.0022u and 0.047u); smaller capacitors make higher pitch.

The outputs of both oscillators are mixed together via the pair of 1u capacitors. Peak signal level at the output is about 2 volts, and output impedance is roughly 600 ohms.



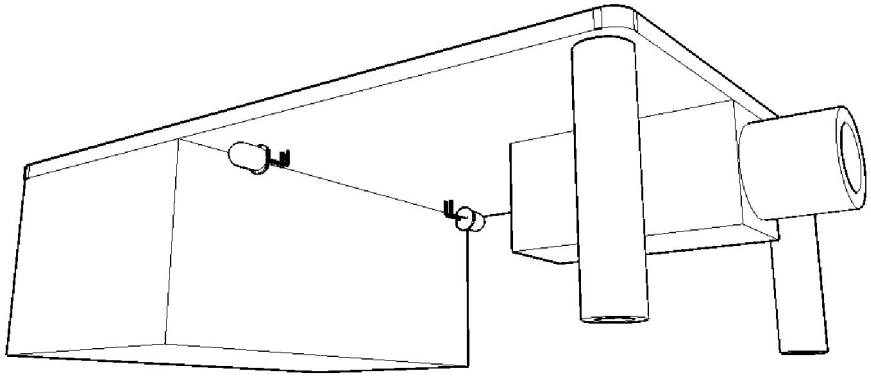
Battery Power

The Andromeda MK-1 circuit uses about 8 milliamps of current, and should provide about 50 hours of playing time from an alkaline 9V battery.

There is no power switch; the power turns ON automatically when a plug is inserted in the jack. This is because the negative lead of the battery (B-) is only connected to the ring terminal of the output jack; when a normal "mono" plug is inserted, the metal of the plug conducts B- to GND, and *poof* the power comes on... this means a stereo (TRS) cable can not be used in the output jack; the unit will not power on in this case.

The circuit is protected against reverse battery polarity with an 1N4001 diode (not shown in schematic).

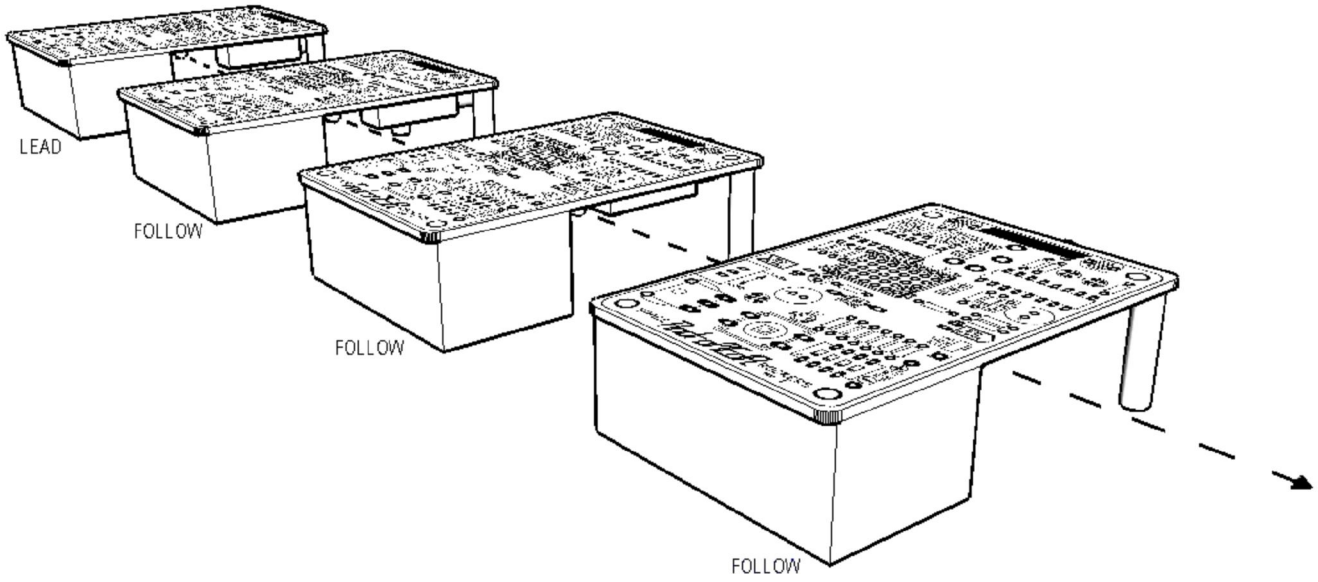
ANDROMEDA SPACE ROCKERS
minimal analog drum machines



Underneath the Board

This view shows the correct way to install the IR Sync transmitter and receiver. When installing the IR components, get the polarity right - be sure that the flat edge of the component is lined up with the white line marked on the top side of the board.

A short piece of 1/8" black tubing should be slipped over the IR Sync IN sensor to help it ignore ambient light.



IR Sync Network Connection

Arrange multiple units in a line as illustrated, with their output jacks pointing away from you. Set the unit on your far left to LEAD. Set all the others to FOLLOW mode.

The maximum working distance for the infrared link is about 12 inches (30cm). Bright incandescent lights can interfere with the network and stop reception. This is because incandescent lights emit lots of infrared. If this is an issue, move the drum machines farther from the light source or prevent the light from reaching the IR Sync sensors.