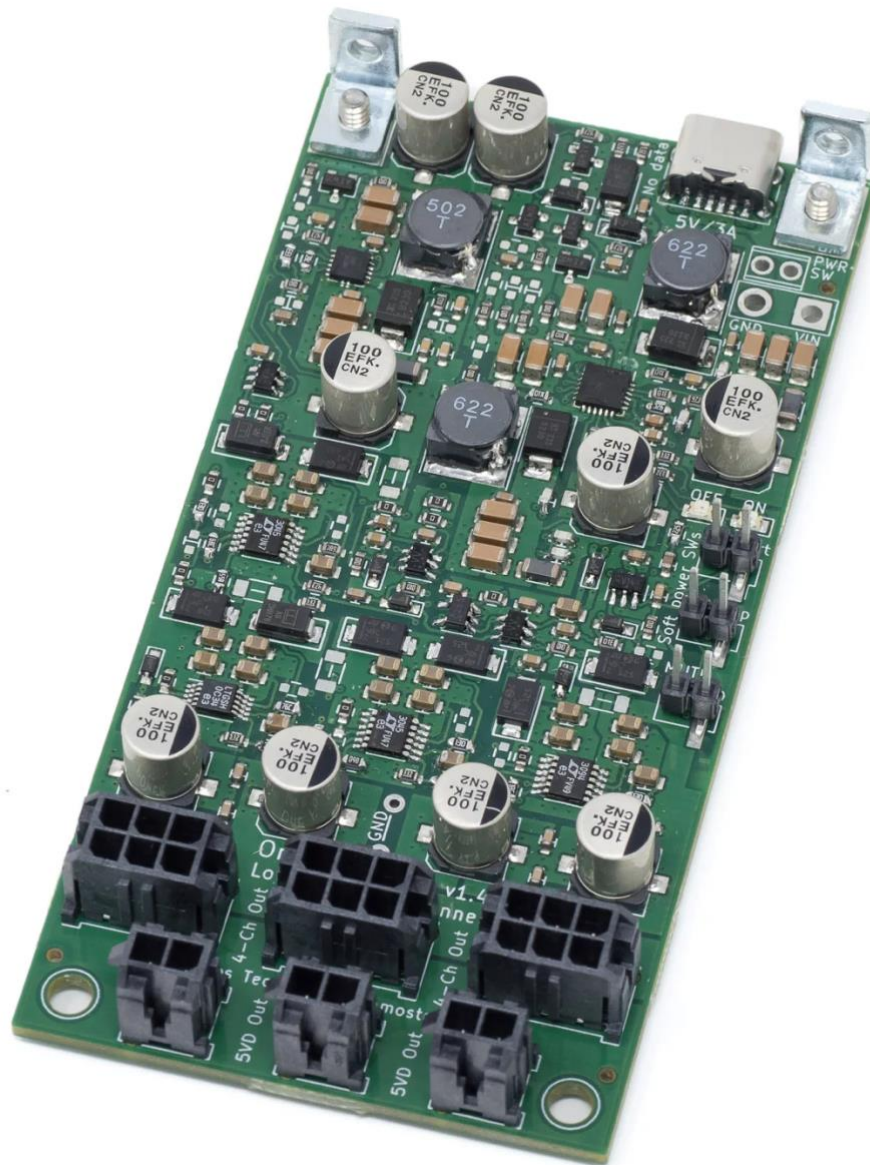


# One Four All - Low-Noise Audio PSU



Four-channel low-noise audio PSU.

- Combines switching converters and high-end LT30xx linear regulators to achieve the best of both:
  - Four different output voltages from a single 5V-input in a compact form factor.
  - Very low-noise, clean, and stable outputs.
- Comprehensive protection features provide peace of mind.
- Very easy system integration with other Kaamos audio boards – only add power cables.
  - Can power multiple Kaamos audio boards.
- Input power supply can be a generic USB-charger or power bank.

---

The board is delivered tested and all SMD components soldered down, including the USB-connector. One 6-pin and one 2-pin Molex are soldered down, the rest are provided loose (unless solder down option is selected). Power switch connection is shorted (see details below) so the board is ready to use.

## 1 One Four All – Low-Noise Audio PSU

- 5V input via USB-C or wires:
  - At least 2A USB supply recommended, heavy loading requires 3A.
  - Use USB power bank for fully isolated power.
  - 5V input is boosted and filtered before regulated for output.
- Generates the following supplies from a single 5V input:
  - VD - 5V digital, up to 400mA.
  - VA - 6V analog reference supply, up to 150mA.
  - VP/VN (+/-13.3V analog amplifier/opamp supply), up to 250mA per supply.
- Molex Micro-Fit power output connectors to power multiple Kaamos boards (subject to current limits) with simple connections:
  - 2-pin Molex for digital-only boards.
  - 6-pin Molex for mixed-signal boards.
  - All output connectors are in parallel so total current per supply must be within the limits.
- Extensive protection features for increased reliability and robustness:
  - Power-up sequencing to decrease inrush current.
  - Input reverse polarity protection.
  - Input over-voltage protection and under-voltage shutdown.
  - Current limit and under-voltage shutdown on each output channel; if one shuts down, all shut down.
- Soft-start and soft-stop to toggle the PSU between standby and active states.
- Mute output to quickly mute DACs in case of output failure.



One Four All powering DAR 18 and W-DAC XLR.

## 2 Power switch

One Four All (OFA) has a soft-start and soft-stop switches that toggle between standby and active states. However, we strongly recommend turning the PSU completely off when not in use - a solid advice for all electronics. To do this, you can unplug the USB-supply or turn off the supplying power bank; however, we also provide a placeholder for a hard power switch. The placeholder header is in series with the power input and shorted by default so that the board is ready to use; however, we do recommend wiring a switch here if the input power supply is not easily unplugged.



VIN pad above is in parallel with the USB power - do not use both simultaneously. PWR SW is a placeholder for the power switch and is shorted with a wire by default.

As with input wiring, the wiring for the power switch and the switch itself should have low resistance to minimise voltage drop between the supply and the board. See the [board guide](#) for more information.

### 3 User instructions

Upon power-up, the PSU turns on automatically. All output channels are turned on in a sequence to minimise start-up current spike. Successful ON-state is signalled by the ON-LED. If soft-stop is engaged, the PSU goes to standby state and the OFF-LED is lit. Soft-start turns the outputs on again.

Should the OFF-LED light after a power-up, please see startup troubleshooting in the [OFA Guide](#).

Active-high (around 5V) mute output can be used to signal standby-state to external circuits.

### 4 Important information on order

- All required SMD components are soldered down and the board is fully tested.
- USB-connector, one 6-pin Molex output, one 2-pin Molex output, and SMD-pinheaders are soldered down. The rest of the connectors are provided unsoldered (unless solder down option is selected); this allows you to solder wires to the power outputs. Power switch connection is shorted so the board is ready to use.
- Please ensure you have the skills to solder the remaining components and wires to connect the board in your system – and most of all understand what you are doing.
- If you need help prior to purchase, please [contact us](#).

### 5 Order contents

The board is delivered with following parts included:

- Fully tested board with all SMD components populated.
- 3pcs 6-pin Molex power connector (1 soldered down).
- 3pcs 2-pin Molex power connector (1 soldered down).
- 3pcs 1x2 male SMD-pinheader (soldered down).
- PCB panel mount kit for USB-end:
  - 2pcs small L-brackets.
  - 4pcs 4-40 1/4" bolts.
- PCB bottom mount kit:
  - 2pcs 6mm standoff.
  - 2pcs M3 bolt with 2.5mm hex end.
  - 2pcs M3 nut.
  - 2pcs M3 flat washer.
  - 2pcs M3 teeth washer.

## 6 More information

See the [One Four All Guide](#) for more information on the following topics:

- Input voltage range and impact of wiring resistance.
- Number of boards OFA can supply.
- Soft-start and soft-stop.
- OFA startup problems.

## 7 Files

- Schematics may be released later on
- [Component placement and board dimensions](#)

## 8 Measurement results

### 8.1 Audio performance

Comparing [W-DAC](#) and [ADC AK5572](#) performance when using linear bench power supply or One Four All, no differences have been measured in the audio performance figures such as dynamic range and THD+N.

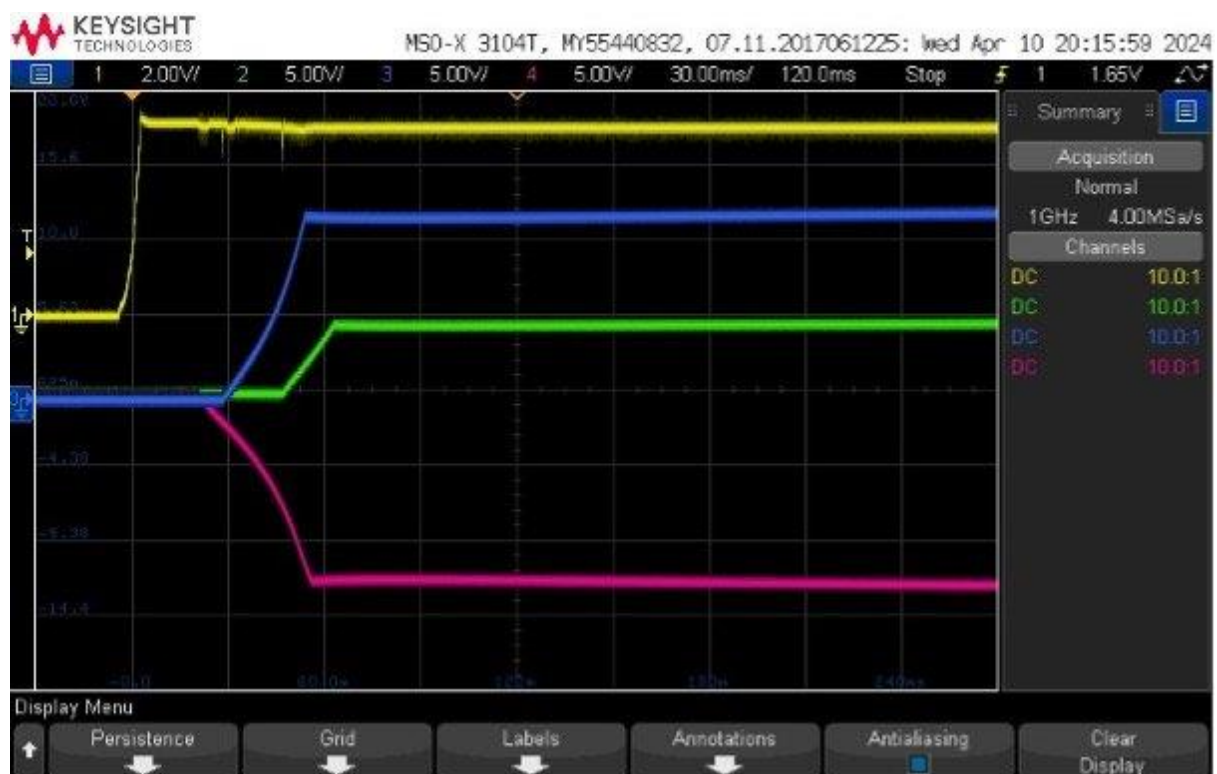
### 8.2 Current consumption

Following are examples of current taken from 5V input supply. The current depends on the exact board input voltage; any voltage drop in the input wiring means higher input current.

- Outputs on, no load: 90mA.
- Outputs off: <2mA.
- VD 100mA, VA 100mA, VP/VN 100mA each: 1.2A.
- VD 200mA, VA 100mA, VP/VN 200mA each: 2.2A.
  - It is normal the board gets very warm under this loading; the hottest components can get near 80C - and even hotter if loaded to the maximum. VP/VN loading stresses the board more than VD/VA loading.

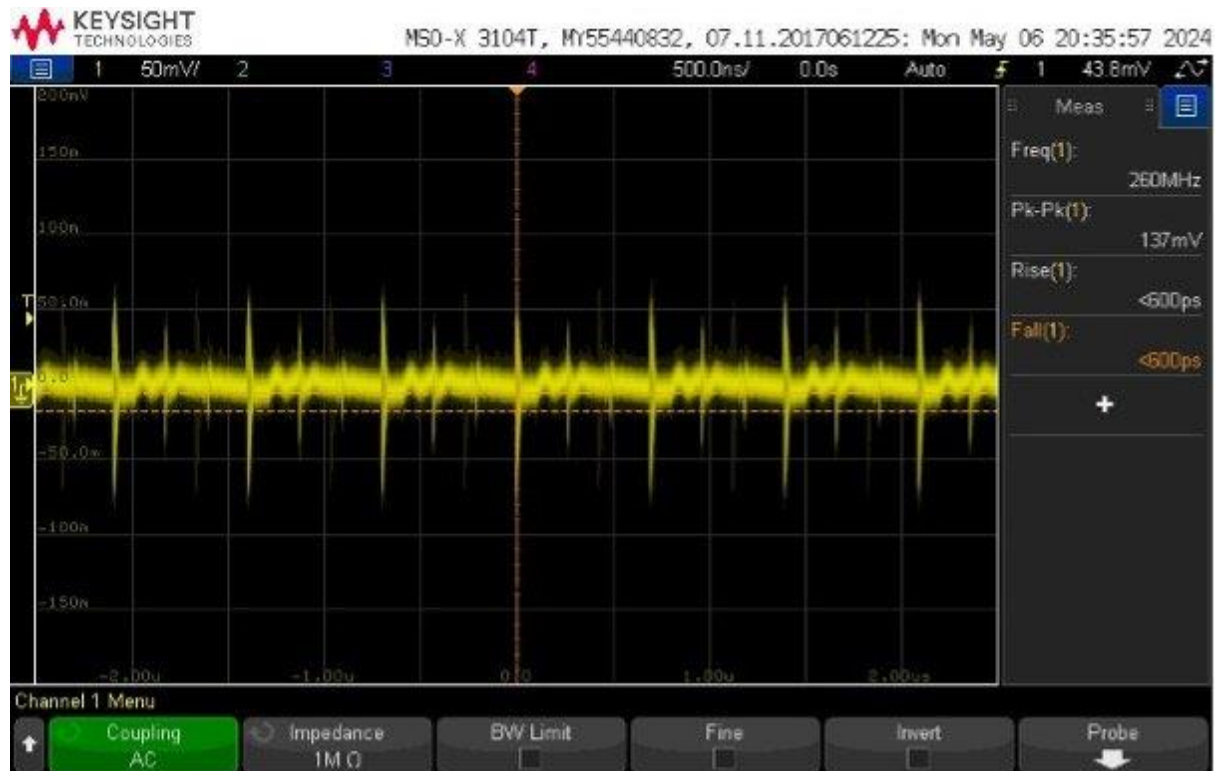
### 8.3 Startup

Below is the startup sequence: Yellow VIN, green VD, blue VP, and pink VN (VA not shown but is similar to VD). There is around 200ms delay at startup until the supply monitor circuit is activated. If outputs are not up by then (e.g. due to too high load resistance or capacitance) the PSU triggers under-voltage shutdown and does not power up.

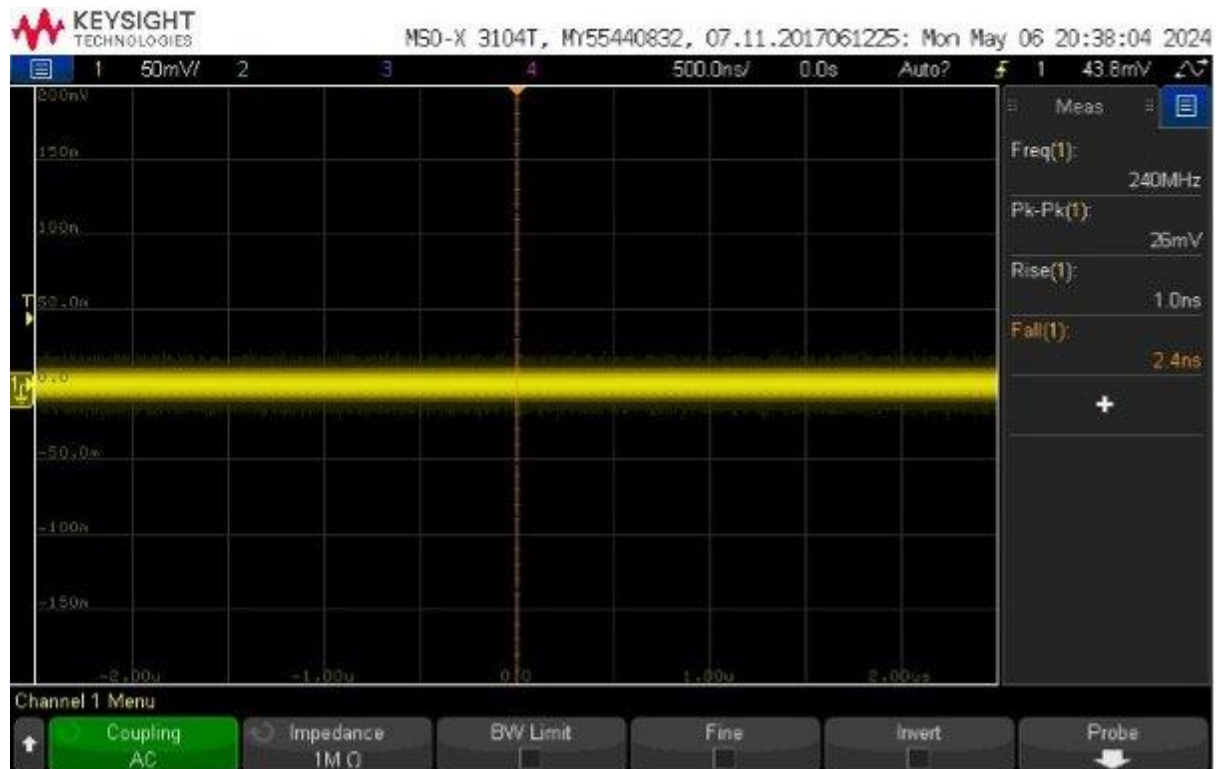


## 8.4 Cleaning input supply

This example uses Anker 735 USB-charger to supply One Four All, and the noise of the 5V input and 5VD output is compared.



5V input from USB-charger.



VD output.

As we see, the PSU effectively cleans the input and the 5V input is not used directly for VD output. Instead, it goes through a switcher, filters, and a high-performance LDO.

## 8.5 Output noise

Noise has not been characterised accurately but to see it is roughly as expected. The noise of the power rails was lower than the measurement instrument capability; therefore, the values are only given as "better than" the instrument limit.

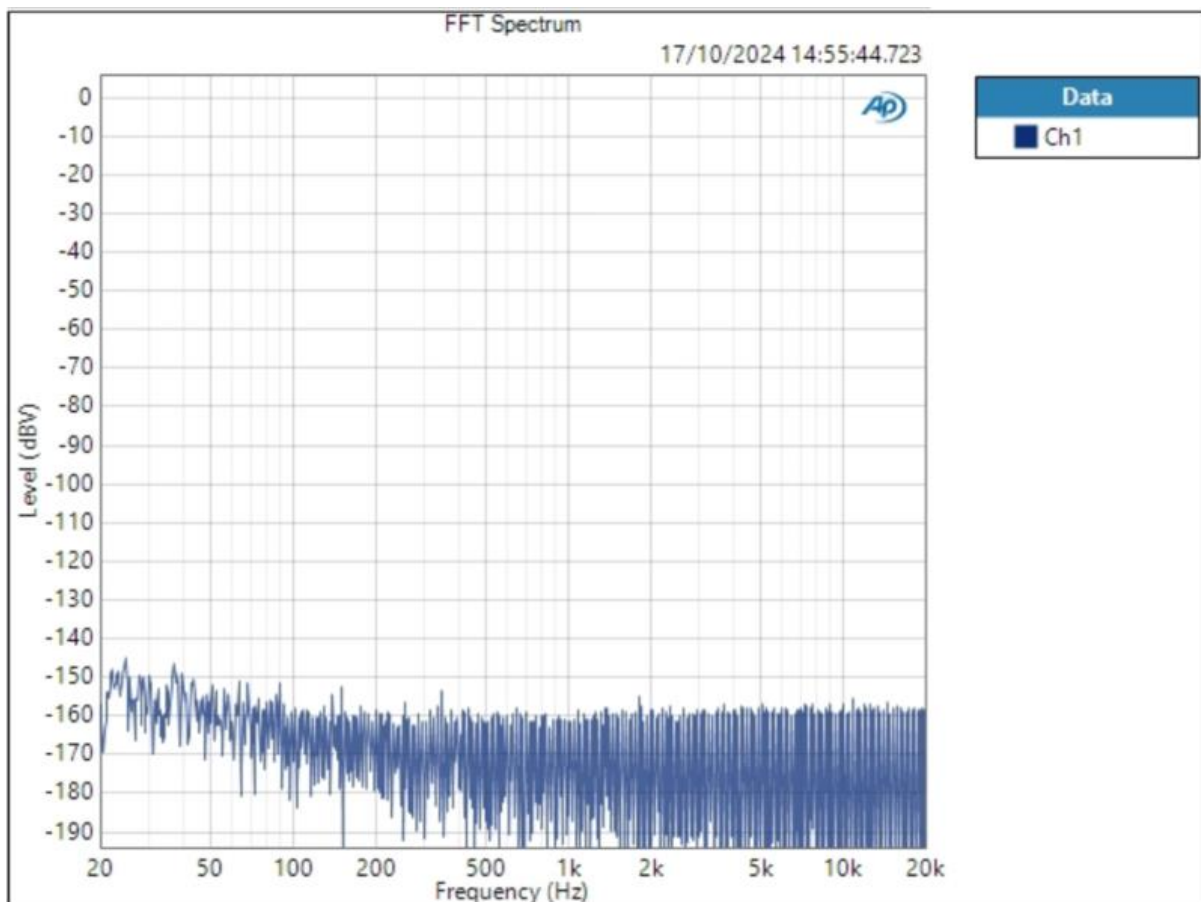
Measurement conditions:

- Source: Anker 735 USB-charger.
- Loading: 100mA per output rail.

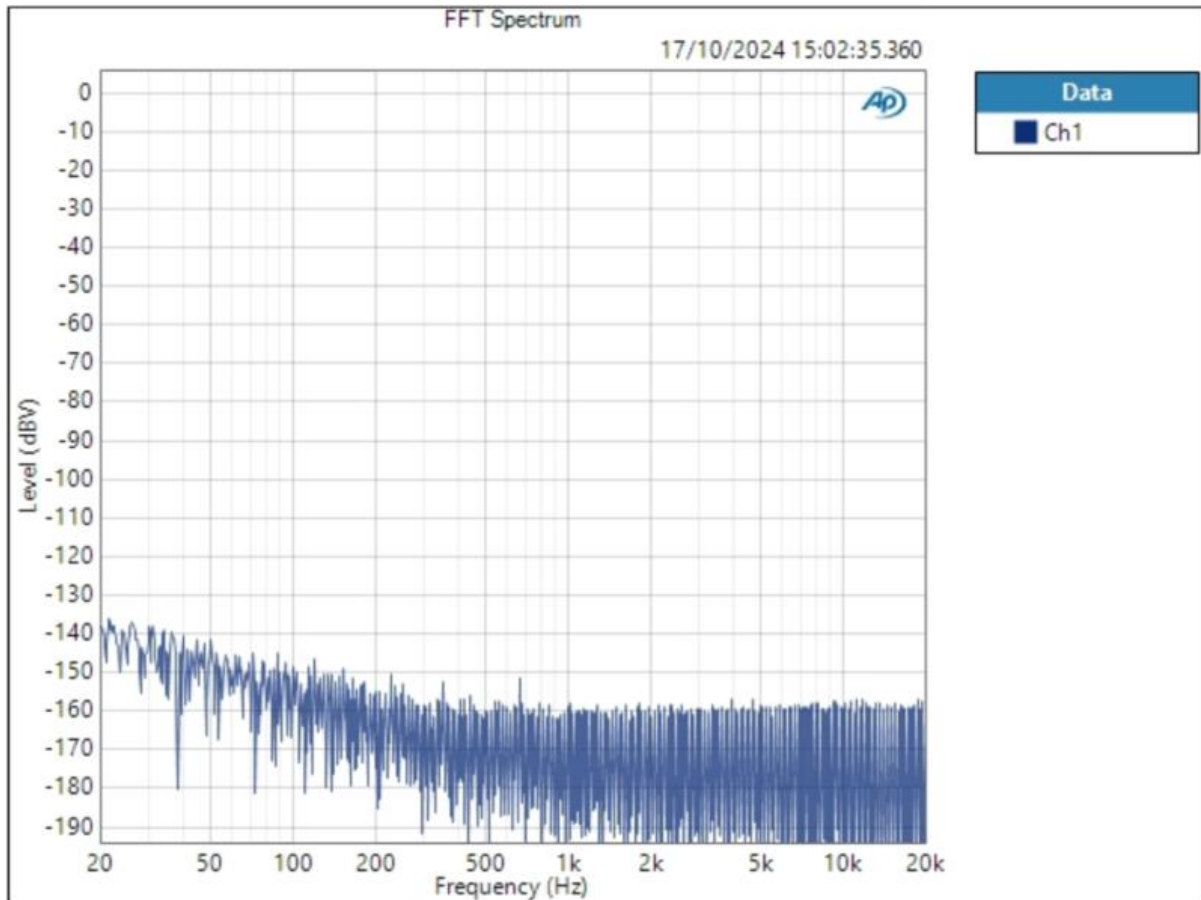
The following results apply to all rails (VD, VA, VP, VN):

- Noise in 20kHz bandwidth: <1uV RMS
- Noise in 90kHz bandwidth: <2uV RMS
- Noise in 1MHz bandwidth: <10uV RMS

The noise floor is almost flat at least until 1MHz in our measurements, except for the slight increase in the low frequencies, shown below. VD is better, while VA, VP, and VN look practically identical.



VD noise floor (256k FFT).



VN noise floor (256k FFT), VP/VN are similar.

These measurements do not show the switching frequencies; we will try to get higher bandwidth results one day but currently do not have measurement kit for that.

## 8.6 Switching transients

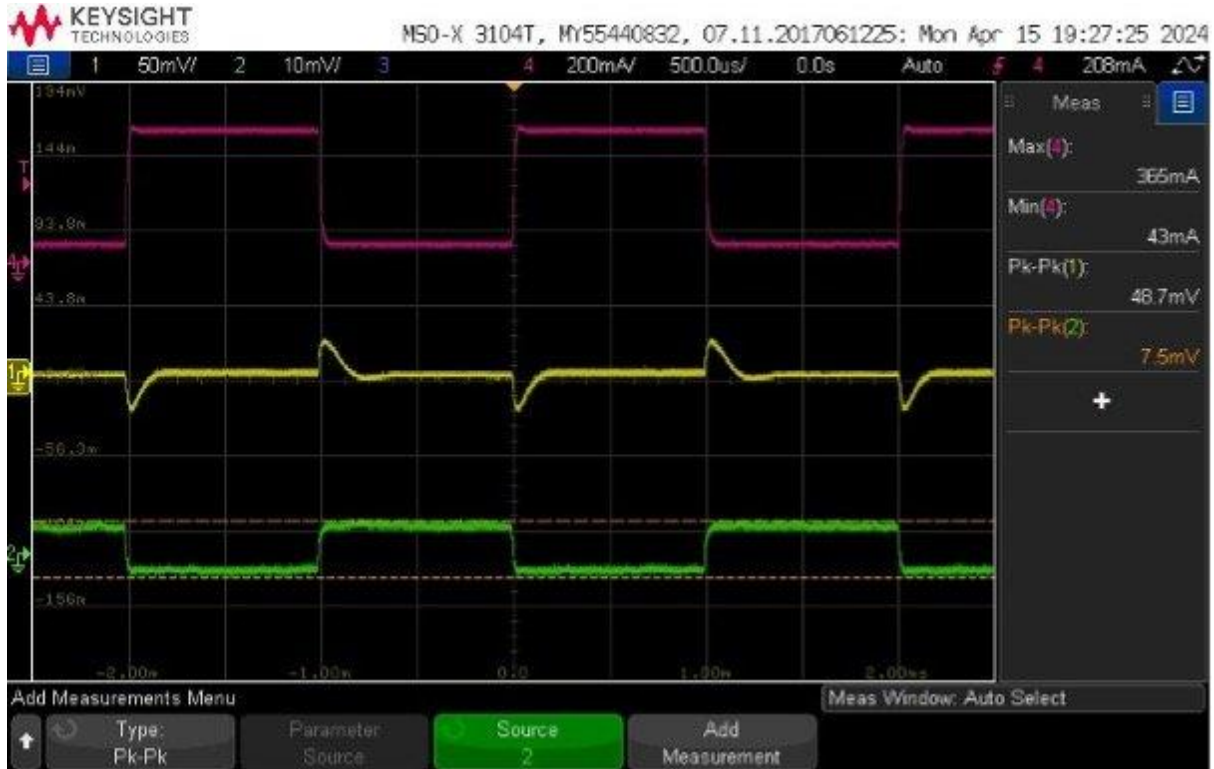
The converters work at a bit over 1MHz switching frequency which is the fundamental frequency of the ripple; however, CLC filters and LT30xx LDOs with very high PSRR push the ripple below the noise floor. However, when the switches (FETs and diodes) turn on and off, they create spikes with ringing in the 250-350MHz range which is more difficult to work with. Moreover, getting reliable measurement results is not straightforward as probes and cables easily pick up this ringing.

A lot of effort has been spent to attenuate the transients. The first line of defence is at the switching node where a properly calculated RC-snubber greatly attenuates the ringing (by sacrificing a bit of efficiency), verified by careful active probe scope measurements. Then we have small capacitors plus a high-bandwidth ferrite followed by another set of small capacitors, forming a CLC-filter. Finally, we have the LDOs with capacitors. However, transients at this high frequency just go through the LDOs so we need to rely on the passives and parasitics for filtering. Overall result is significant attenuation of the switching spikes but the reality is that they are never completely gone - we just need to push them as low as we can.

It is worth noting that switching transients are not only present in switching power supplies. Rectifier diodes in linear power supplies are switching elements as well, causing similar switching spikes that need attention.

## 8.7 Load transient response

Load transients cause no ringing at the output. There is a small step due to DC-resistance and shared output path between all the output Molex connectors. Below is an example from VD where it is the worst due to the highest current output. The load is stepping between 50-350mA (pink), while yellow is the voltage before the LDO and green after the LDO. This small 7mV step is due to the voltage drop in the output trace resistance when the measurement is done at the output connector.



VD load transient response.

## 9 Board version history

Current version is v1.5 and it is the first proper released revision after the early bird v1.4. The changes between the two are minor, mostly in clarifying the silkscreen.