EPSUX3V2 USER MANUAL

High performance 160W triple outputs laboratory power supply

EPSUX3V2Manual.odt
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A	11/2015	Preview manual – not for release	ON

Contents

EPSUX3V2 view

1) What is it ?

The EPSUX3v2 is a compact and powerful laboratory power supply, having three outputs that can delivers up to 160W cumulated.

The design of the EPSUX3V2 use a state of the art SMPS front end with active power factor correction (PF) and resonant LLC converter. The rules of thumb are to reach the highest efficiency, low EMI level and very compact design. It also provide very low output noise allowing to supply sensitive electronics without encontering issue.

Each outputs are designed on separate plugin board, the EPSUX3REGV1.
They use an innovative topology, mixing synchronous buck converter and LinearTech high performance linear voltage regulators. These regulators feature extremely fast transient load response and despite the off-line smps input stage and the switching pre-regulator inside the PSU, maintain very low output noise level.

The three outputs are fully isolated from each others, allowing various configurations to your loads.In addition, they can be combined in serial or parrallel to increase voltage or current up to 60V or 9A.

Because we need very often to use symetrical voltage, a front panel toggle switch allow tracking mode operation of CH1 and CH2 with unique voltage setting. A second toggle switch enable or disable all outputs at the same time, makes easier outputs connexions/isolation.

For each channel, a bright 3 digits 7 segments leds display allow reading of output voltage or current. Simply pressing shortly the channel encoder switch the display and setting mode from voltage to current. Voltage and current measurements are auto-scaled for maximize reading resolution.

Fore safe operation, the PSU include many protections features ;

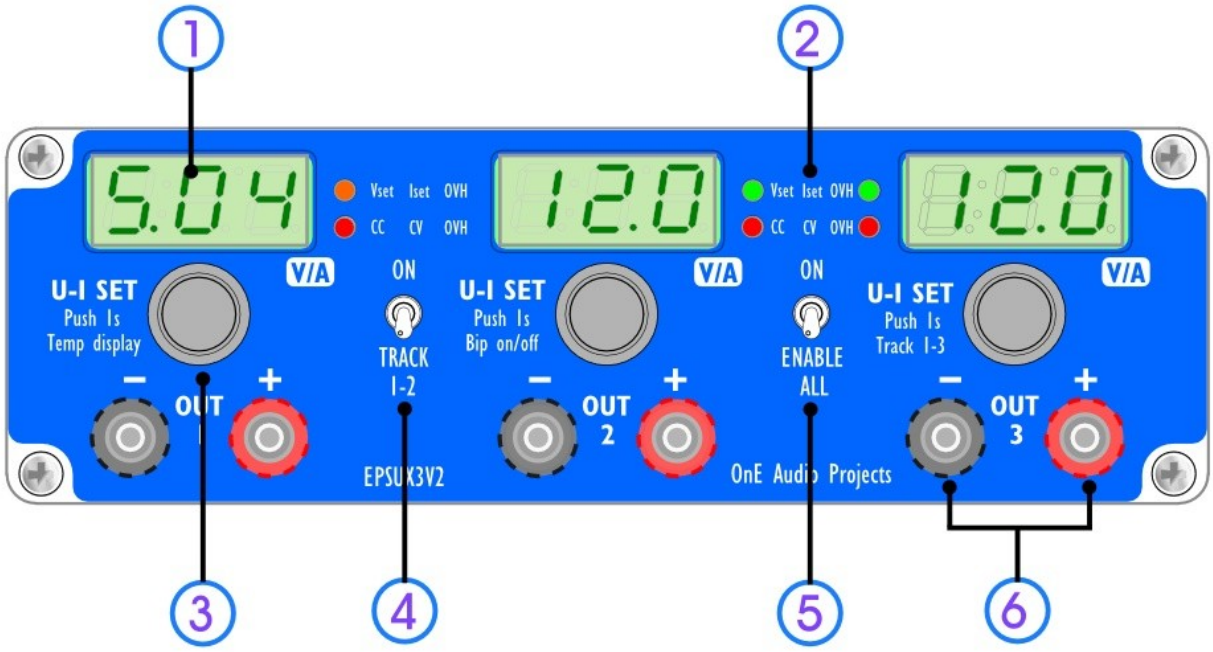
- ✔ Short-circuit protection (CC mode limite current to ~3,5A).
- ✔ Overvoltage and reverse polarity protection (unidirectionnal transil diode).
- ✔ Linear regulator internal overtemperature (shutdown if Tj>140°C).
- ✔ Internal case temperature management with outputs shutdown if Tc> 70°C.

The total output power of the PSU can be up to 160W and despite the high efficiency, thermal management is essential. For this purpose, a temperature controlled rear fan and a the bottom front airing allow hot air extraction to keep PSU running cooler and safe.

PICTURE 1

2) Instrument overview

1) Front panel description



(1) 7 segment leds displays:

The three leds displays allow to measure voltage or current on each outputs separately.
The voltage and current measurement is autoscale, with commo moving, so :.
In voltage setting/measurement mode, the diplay resolution is 10 mV for less than 10V (9,99 V) and 100mV between 10 to 20V (20,0V).

In current setting/measurement mode, the diplay resolution is 1 mA for less than 1 A (999 mA) and 10 mA between 1 to 3A (3,00 A).

They can displays also some additional informations :

- Internal case temperature sensor measurement (in °C).
- Encoders “bip” function on/off setting.
- Channel 1 to 3 slave mode on/off setting.

(2) Channel status indicator led 1 and 2:

Next to digits display, 2 bicolors leds give informations about channel status.
The table below summarize all leds status colors with corresponding status :

Table 1

LED 1	Status	LED 2	Status
OFF	Output is turned off	OFF	Output is turned off
Green	Voltage mode setting and display	Green	CV regulation mode
Orange	Current mode setting and display	Orange	CC regulation mode
Red	Thermal shutdown of linear regulators	Red	Thermal shutdown , Tcase ≥70°C
Blink*	Slave mode; Voltage follow CH1 settings.	Blink*	Slave mode; Voltage follow CH1 settings.

(3) Rotary encoder with push-button:

The rotarys encoders allow many functions. By default, you can set the output voltage when turning it right (up) or left (down).

If you press shortly the encoder button, you enter in current limit setting mode and the 7 segments display will show the output current. To inform user if voltage or current settings and display mode is active, the Led1 change color as follow (see Table 1) :

- Green = Voltage setting and display
- Orange = Current setting and display

Because of the available number of digital increments are high (256 from 0 to full scale), the rotarys encoders pluses speed is slow (80mV/detents) when the encoder is turned slowly.
When the encoder is turned faster, the increments speed is multiplied by 4 (320mV/detents).
This adaptative mode allow precise and fast setting to target setting value.

(4) Output enable toggle switch:

This switch allow to enable or disable all outputs at same time.
When it's turn on, outputs voltage have a rising slope depending on current settings because the output will charge the output capacitor (internal 120µF + extrenal) at a current level equal to current limit setting.

For exemple, if Ilim is set to 1A and Cout = 0 (only the internal 120µF) the rate by ms will be ;

V=IT/C = (1x0,001)/140,1e-6 = 7,1V/ms
If the output is set to 12v, it will be reached in 12/7,1 = 1,7 ms.

(5) Tracking mode toggle switch:

The PSU has two tracking modes. In any case, the CH1 is always the MASTER channel.

The front panel toggle switch enabled the first mode. When “on” it allow voltage setting of symmetrical voltage with only one button between CH1(Master) and CH2(Slave).

In tracking mode, then Master control both CH1 and CH2 voltage, but current settings still individual. The two leds of the slave channel blink at 1Hz to show that this channel is controlled by the Master (see Table 1).

The second tracking mode is activated when pressing encoder of CH3 for about 1s.
When this mode is active, the CH3 track CH1 as CH2 with the toggle switch.

So, it is possible when activate both tracking modes to use only CH1(Master) to set all the three channels. This is needed if you want connect all outputs in parrallel to get the maximum output current and allowing 20V 9A operation (3x3A).
When both tracking modes are active, and because the current settings must be the same when all channels operate together in series or parralle, the current setting is only defined by the master channel (CH1).

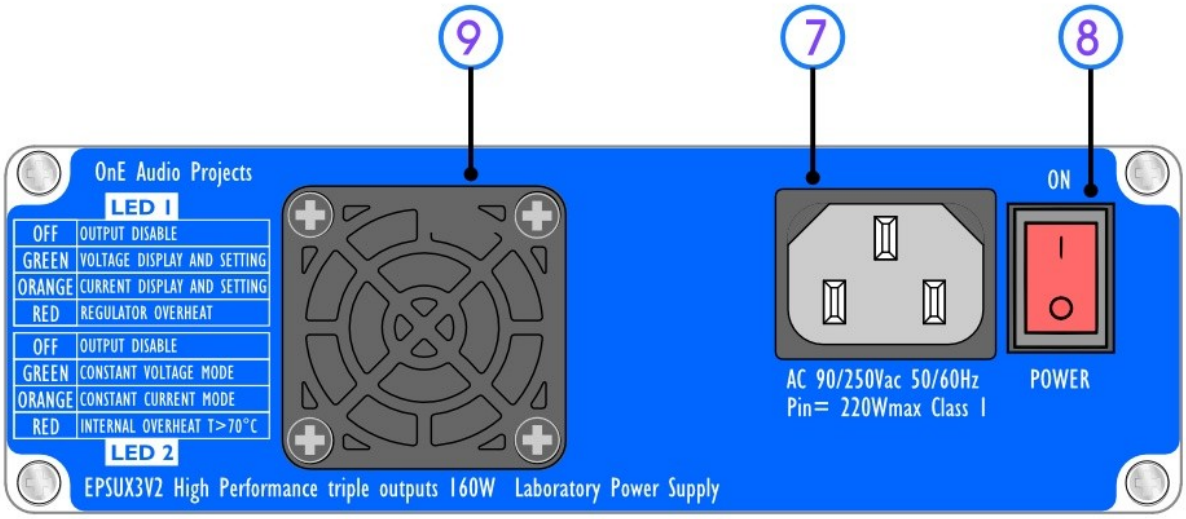
All slave channels have their indicators leds blinking at 1Hz to inform user that tracking is active.

(6) Bananas outputs connexions:

This is the outputs connexions of the PSU. You can use standard 4mm bananas, or strip wires.

When outputs are connected in parralel mode to increase the current, you must ensure good current sharing between outputs in using same length and section of wire from each outputs to load.

2) Rear panel description



(7) Main input:

CEE input main connector with earth. Because the EPSUX3v2 is a Class I device, the power cord **must include earth for proper electrical protection**.

The enclosure is connected to PE, but all outputs are floating. A safety "Y" type capacitors are connected between each grounds channels and earth.

(8) Power switch :

The rear switch allow to fully switch on or off the EPSUX3V2. When this switch is in "off" position, the PSU consume no power. In standby mode (outputs disable), power consumption is about 7W.

When the PSU is turned off and before all voltage dissepear, all actual encoders settings (V/I) are stored in CPLD EEPROM. At the next startup, the CPLP will recover previous settings.

(9) System fan:

The rear fan combined with bottom front airing (holes grid) all heat extraction inside enclosure when high ouptut power is required.
To avoid unwanted noise, the fan operate only on demand with these rules :

- Fan turned off when Tcase < 40°C
- Linear fan speed from 40% to 100% full speed between 40 to 60°C.
- Full speed if Tcase > 60°C.

To avoid dust acculation, the rear fan filter must be cleaned regularly. If the filter is damaged, it must be replaced.

3) Internal temperature measurement.

The motherboard of the PSU include a SMD digital thermal sensor.
It is placed in order to give accurate value of internal enclosure air temperature.
The temperature value is used to control fan speed, and to disable PSU if an overheating occur.

User can view internal temperature measurement at any time directly on the leds diplay.
To toggle displays in temperature reading, you must press for a least 1s the push button of the CH1 rotary encoder. The temperature measurement is displayed until CH1 encoder push button is pressed again for 1s (back to V/I reading).

Note that when temperature reading is active, the V and I settings are not allowed.
(but of course outputs continue to be working).

4) Encoder increment “bip” sound on/off.

By default, short bips appear when turning the rotarys encoders. The bip tone is high when increasing value, and low when decreasing it.
The bip volume is low, but if these sound bother you, you can turn off bips.
To toggle the bip on/off setting, you must press for a least 1s the push button of the CH2 rotary encoder.
You will show on displays the message “Bip –- on” or “Bip –- off” for about 1s.

Note that the bip setting value (“on” or “off”) is stored in EEPROM, so at next startup the PSU will keep last bip setting.

5) Tracking modes.

There is two differents tracking mode available on the PSU.
The main tracking mode allow to control both CH1 and CH2 together (with CH1 setting knob).
This mode is active by moving up the “track 1-2” front panel toggle switch. This function is very convenient when we need symetrical voltage.

The second tracking mode allow to ask that the third channel to be also controlled by CH1.
So, the CH1 (Master channel) will control all three outputs at same time.
It control voltage settings as current limit settings values.
Note that this mode can ba active without “track 1-2” toggle switch on, in this case you will only have tracking between CH1 (Master) and CH3 (Slave).

3) Technical specifications

6) Mechanical specfications

Parameter	
Physical dimensions	165 x 220 x 62 mm (6,32 x 8,66 x 2,03 inch)
Weight (without main câble)	1,3 Kg (2,87 lbs)
Product Class	Class II (with earth connexion)

7) AC Input.

Parameter	Min	Typ	Max	Unit
Line voltage range (50 or 60Hz)	90	--	265	Vac
Power factor at Vac= 115V @ Pout=100W		0,99		--
Power factor at Vac= 230V @ Pout=100W		0,93		--
No load power consumption (Vin=230Vac 50Hz)		7		W
Maximum cumulated output power			160	W
Full load input power (Po=160W, Vin=230Vac 50Hz)			200	W
Full load efficiency (Vin 230Vac, Po=160W, Vo=3x20V@2,7A)		> 80		%
Operating ambiant temperature range	0	--	40	°C
Internal case temperature thermal shutdown (rising)		70		°C
Internal case temperature thermal shutdown recovery (falling)		50		°C
Holdup time (Vac 90 to 265V, Po=160W)	12			ms

8) DC outputs :

Parameter	Min	Typ	Max	Unit
Output voltage range	0,1	--	20	Vdc
Encoder voltage increment		80		mV
Current limit range	0,02	--	3,5	Adc
Encoder current increment		22		mA
Output noise (Bw=5Hz...20MHz, Vo =10V Io=1A) *		40		µVrms
Audio band output noise (Bw=10Hz...100kHz, Vo =10V Io=1A)		20		µVrms
Wideband spectral noise density (5Hz~20MHz)		9		nV/√Hz
Output regulation recovery time (12V 0,5- 2A step)		TBD		µs
Total output capacitors		120		µF
Insulation voltage between outputs		500		Vac

** : Output noise level do not depend on output voltage.*

9) Combinated outputs modes:

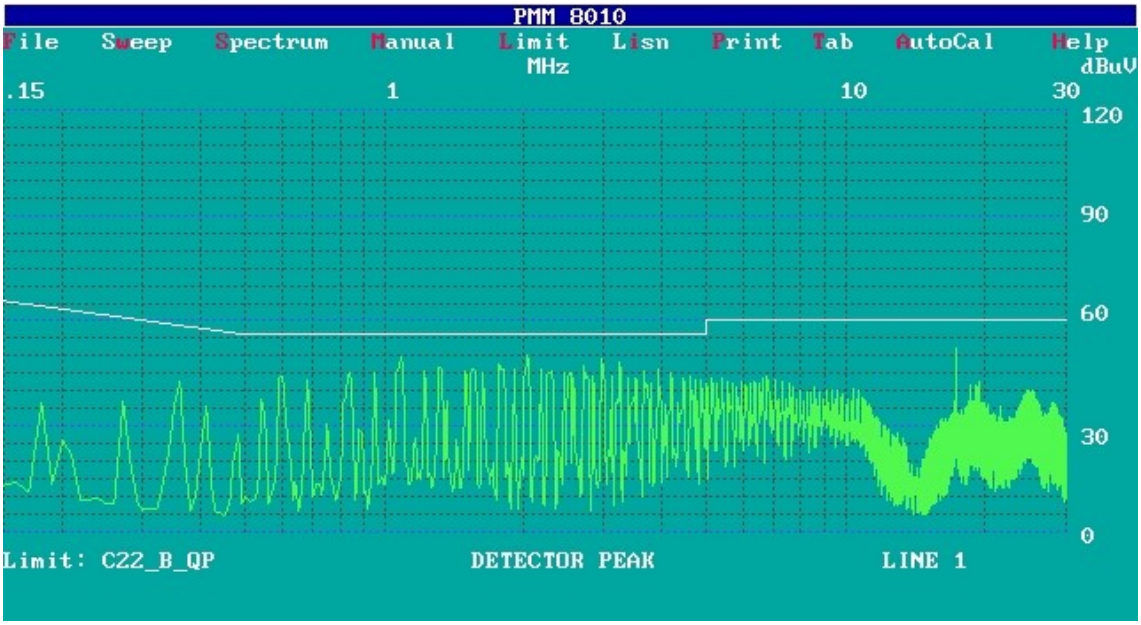
Parameter	Min	Typ	Max	Unit
Serial mode maximum output voltage (Imax=3A)		60		Vdc
Parrallel mode maximum output current (Vmax=20V)*		9		Adc

** : Same outputs wires length is necessary to equilibrate current on each channel.*

4) EMI signature.

10) Line conducted mode emission

P out = 160W (17V 3A resistive loads on each channels).- V line = 230 Vac 50 Hz.
Measurement bandwidth : 150kHz to 30MHz. Detection mode : Peak. Limit Level Class B.



11) Outputs noise spectrum.

Vo= 12V Io = 1 A (CH1) V line = 230 Vac 50 Hz.
Measurement bandwidth : 10Hz to100 kHz measured with ERMSDCV2 filter and EADCAKMV1.
Verified with Racam 9300F.

12) Ouputs transient load response.

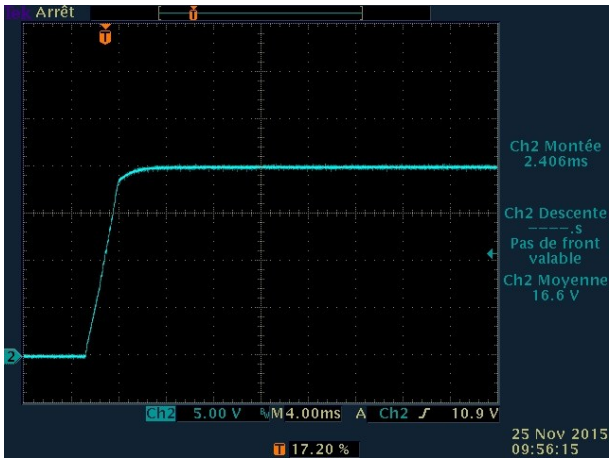
Vo= 12V Io = 500mA to 1,5A step (CH1), V line = 230 Vac 50 Hz.

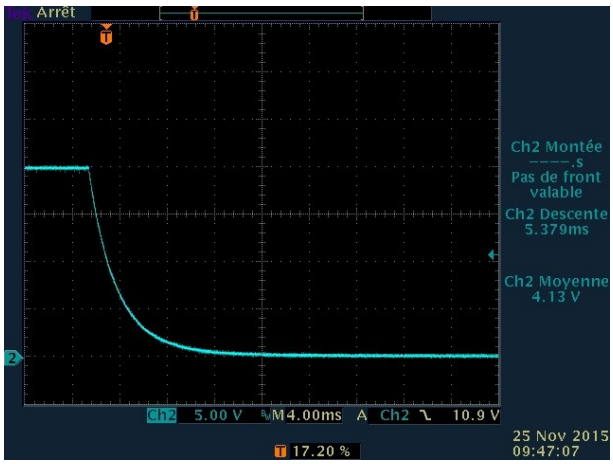
13) Ouputs time domain noise .

Vo= 12V Io = 1 A. (CH1), V line = 230 Vac 50 Hz.Bandwidth: 20MHz.

14) Ouput rise and fall time (resistive load) .

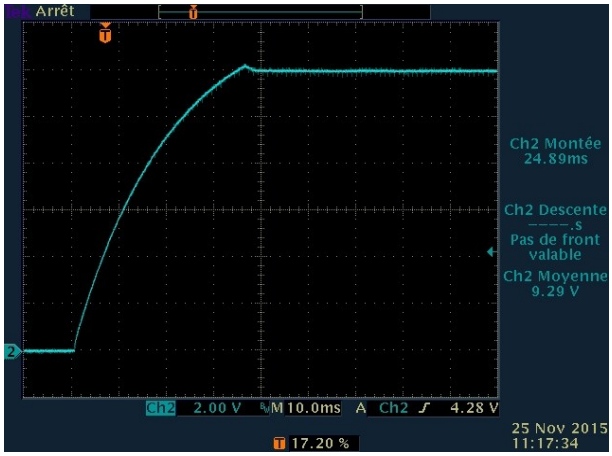
Vo= 12V Io = 500 mA. (CH1),V line = 230 Vac 50 Hz.

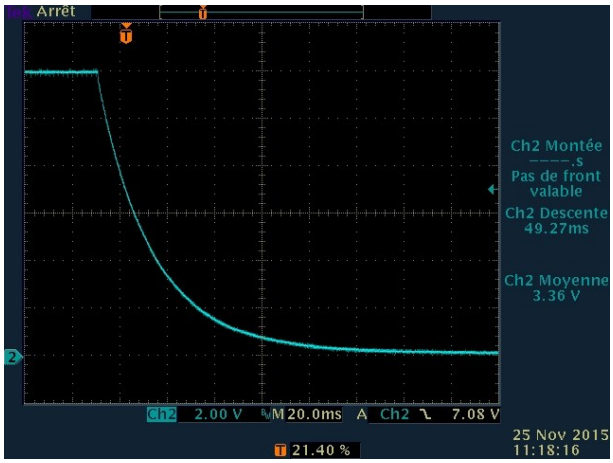




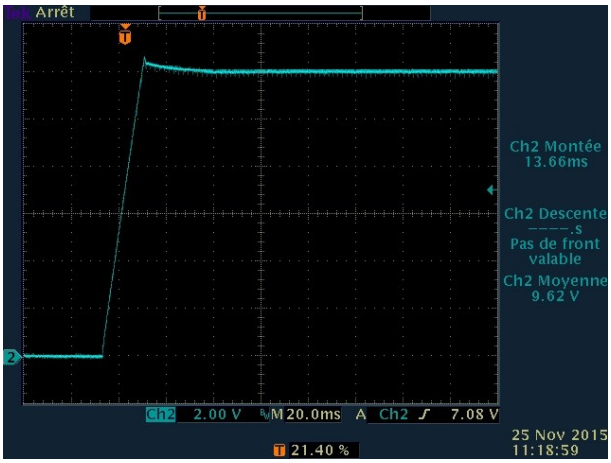
15) Capacitive load response .

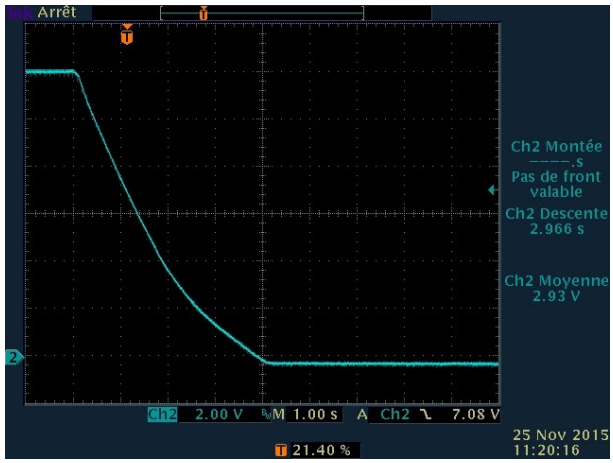
Vo= 12V Io = 0 A, Co = 4700 µF (CH1), V line = 230 Vac 50 Hz.





Vo= 12V Io = 2,55 A, Co = 4700 µF (CH1), V line = 230 Vac 50 Hz.





END OF MANUAL

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The full thread desribing project construction can be find on DIYaudio.com forum.
Bare printed circuit board with full project design folder are available for sale.
"Frex" member.

Others OnE Audio Designs :

- **ERMSDCV2**, DC-1MHz RMS voltmeter & 80dB 10Hz-100kHz Ultra low noise amplifier.
- **EOSC10KV2**, ultra low THD (-160 dBc) 10kHz reference oscillator.
- **AA5381V1**, 24bits/192kHz stand alone high performance Analog to Digital converter.
- **EHAMP08**, Remote controlled TPA6120 based headphone amplifier.
- **EXDAC**, Symmetric outputs high performance audio DAC with headphone amplifier.