

D-Cell504

Class D power amplifier module for professional audio applications

USER GUIDE

Version 4.0

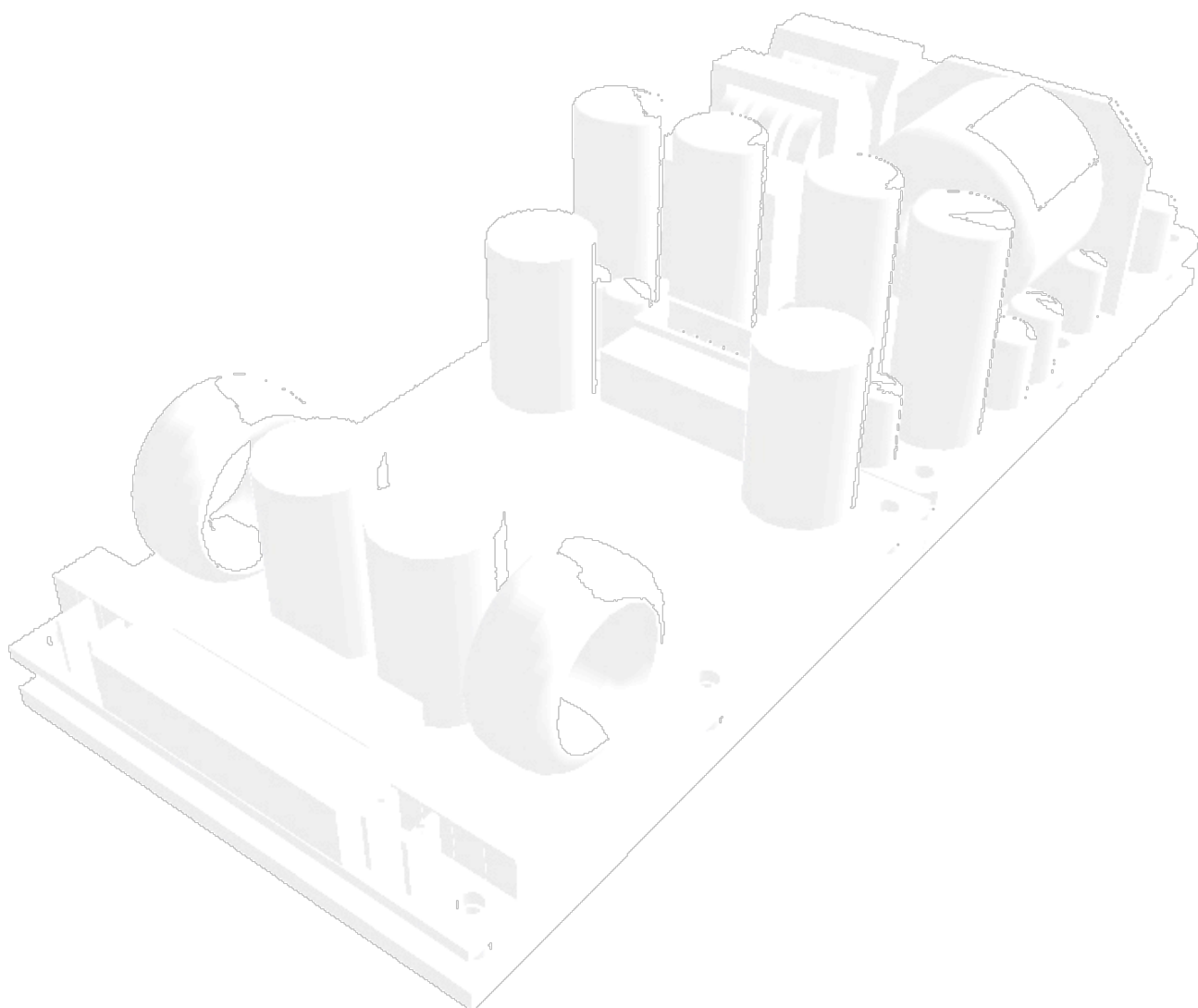


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SAFETY INSTRUCTIONS

CAUTION: To reduce the risk of electric shock, do not remove the cover. No user-serviceable parts inside. Refer servicing to qualified service personnel.

WARNING: To prevent fire or electric shock, do not expose this equipment to rain or moisture.

SAFEGUARDS: Electrical energy can perform many useful functions. This unit has been engineered and manufactured to assure your personal safety. Improper use can result in potential electrical shock or fire hazards. In order not to defeat the safeguards, observe the following instructions for its installation, use and servicing.

NOTES: This equipment has been tested and found to comply by Notified Body (DIRECTIVE 2004/108/EEC-EMC) pursuant to the product family standard for audio professional use:

EN 55103-1 and EN 55103-2 standard (with the limits for E1 and E2 electromagnetic environment); EN61000-3-2, EN 61000-3-3

This is a Class B product.

This equipment has been tested and found to comply by Notified Body (DIRECTIVE 2006/95/EEC L.V) pursuant to the audio apparatus safety requirements: Standard EN 60065.

Warning Notices

LOCATION

Install the amplifier in a ventilated enclosure (IP20 at least), where it will not be directly exposed to high temperature or humidity.

Do not install the amplifier in a location that is exposed to direct rays of the sun, or near to hot appliances or radiators. Excessive heat can adversely affect the operation and internal components. Installation of the module in a damp or dusty environment may result in malfunction or accident.

PRECAUTIONS REGARDING INSTALLATION

Placing and using the amplifier for long periods on heat-generation sources will affect performances. Avoid placing the amplifier on heat-generating sources. Install this amplifier as far as possible from tuners and TV sets. An amplifier installed in close proximity to such equipment may cause noise or degradation of the picture

Safety rules

- This device must be powered exclusively by earth connected mains sockets in electrical networks compliant to the IEC 364 or similar rules.
- Is absolutely necessary to verify this fundamental requirement of safety and, in case of doubt, require an accurate check by a qualified personal.
- The constructor cannot be considered responsible for eventual damages caused to persons, things or data for the missing of accurate earth link.
- Provide the installed unit with bipolar switch to disconnect both mains connection with at least 3mm of distance of the switch contacts.
- Before powering this device verify that the module is supplied with the correct voltage rating.
- Verify that your mains connection is capable to satisfy the power ratings of the device.
- Do not spill water or other liquids into or on the unit.
- Do not use this unit if the electrical power cord is frayed or broken.
- Do not remove the cover. Removing the cover will expose you to potentially dangerous voltage.
- No naked flame sources such like lighted candles should be placed on the module.
- Contact the authorized center for ordinary and extraordinary maintenance.
- Input mains and output power connection wirings must not to be accessible to the user.
- Use this device only within the operating temperature range indicated in this manual.
- A minimum clearance of 10 mm around the module is required for safety and ventilation reasons

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ONLY FOR IS VERSION WITH IEC CONNECTION TO MAINS:

- The "IS" version of the device includes IEC mains connection as shown in the figure below:



The fuse included is of the type 3.15A 250V 5x20 FAST. For safety reasons, always replace this component with one of the same type.

The replacement has to be made only by Powersoft's authorized personnel.

- The integration of the device in any system must allow an easy access to the mains connection and the switch.
- The switch is on OFF state when the "0" symbol is pressed down, and is in ON state when the "I" symbol is pressed down.

ONLY FOR IS VERSION WITH POWERCON CONNECTION TO MAINS:

- The "IS" version is also available* with PowerCon in and out connection as shown in the figure below:



- The maximum output current that can be drawn from the PowerCon output connector is 7A / 1600W

**not all the models are available with PowerCon in and out: contact Powersoft for more info*

SECTION 1 - DESCRIPTION

Models and Versions

Thanks to its modularity and versatility, D-Cell504 can be used in a number of different configurations and is available in many versions, as listed below:

BASIC UNITS

- AC Power Supply Unit
- DC Power Supply Unit
- 2-channels Amplifier Unit
- 2-channels Amplifier Unit with DSP on board

Both AC and DC Power Supply Units can drive up to 2 Amplifier Units, resulting in a 4 channel configuration that can be used to drive 3-ways systems, sub + satellites systems, or simply to increase the power available on two speakers, each driven by one amplifier in bridged mode.

The DSP used on the D-Cell504 is a 2-in/4-out, so a fully processed 4 channel configuration need only one amp with DSP and the second without DSP, with the first one feeding the processed inputs of the second. For a proper routing of the signals, a "4-channel kit" is provided by Powersoft, consisting in a small PCB with all the connectors and cables needed to manage even the signals needed for proper LED signalation. Contact Powersoft for details.

INTEGRATED SOLUTIONS

"IS" versions of the D-Cell504 represent plug'n'play solutions, allowing an easy and quick integration into your project and dramatically reducing the time-to-market.

All "IS" versions consist in a platform where the basic units are mounted, and include:

- an aluminum die cast back panel with fins for heat dissipation
- connection to mains power (IEC available for all models, PowerCon in and out for some)
- an interface panel providing:
 - o 2 XLR connectors (male+female for mono input + link out or double female for stereo input)
 - o input volume potentiometer
 - o 4 LED for Ready/Signal/Temperature/Clip signalation
 - o 4 LED indicating which DSP preset is currently used*
 - o pushbutton for DSP preset selection*
 - o 20 poles connector for DSP programming*

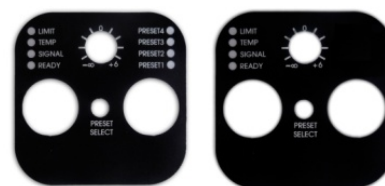
**only on DSP versions.*

"IS" versions list:

- 2 channel version – no DSP – mono input + link out – IEC connection to mains
- 2 channel version – no DSP – stereo input – IEC connection to mains
- 2 channel version – with DSP – mono input + link out – IEC connection to mains
- 2 channel version – with DSP – mono input + link out – PowerCon in/out
- 2 channel version – with DSP – stereo input – IEC connection to mains
- 4 channel version – with DSP – mono input + link out – IEC connection to mains
- 4 channel version – with DSP – stereo input – IEC connection to mains

The "IS" versions of D-Cell504 are shipped with two different labels to be thrust upon the interface, one with DSP presets LEDs, the other without such LEDs.

See Section 5.5 for more details on the preset stored in this evaluation sample.

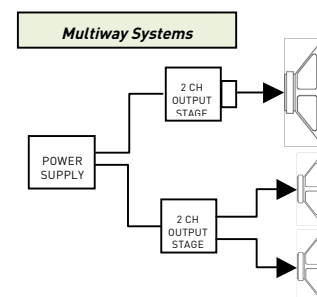
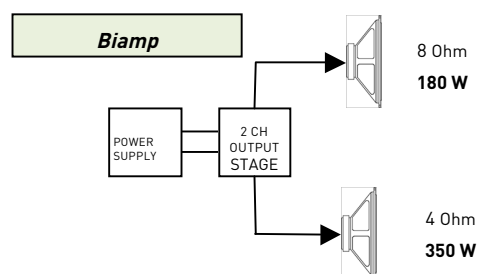
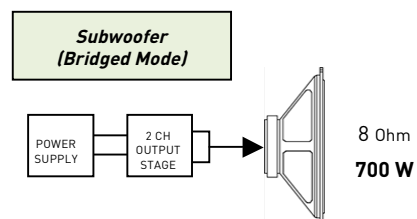
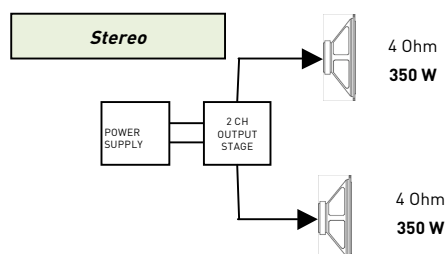


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Key Features

- ✓ **Power Factor Correction (PFC):** for worldwide operation, easy and error proof connection to mains voltage
- ✓ **Modularity:** separate power supply and amplification stages for easy and flexible integration
- ✓ **Multistage architecture:** possibility of feeding two amplification stages with a single power supply unit for multi-channel applications
- ✓ **Novel State of the Art Fixed Frequency PPM-PWM modulation :** Unmatched audio performance from any perspective, intrinsic immunity to intermodulation artifacts in multi-channel applications
- ✓ **Customizable Power Output:** 350W + 350W @ 40hm, 350W @ 40hm + 180W @ 80hm
- ✓ **Compact size and EMI/safety certification:** for quick and easy product development
- ✓ **Very High efficiency/Low consumption**
- ✓ **High quality audio:** fixed frequency modulation design for predictable high end performance
- ✓ **Comprehensive/smart protection features:** thermal, overcurrent, non audio signals
- ✓ **Optional On Board DSP 2 In - 4 Out:** 24 bit AD/DA conversion, 28X28 bit multiplier with 56 bit accumulator, full double precision processing. Sigma Studio ® based full set of filtering, equalization, dynamic processing and more.
- ✓ **Auxiliary DSP processed outputs:** for slaving other not DSP equipped units
- ✓ **Load Monitoring:** for transducer health diagnostic and safety regulation compliance
- ✓ **Small Footprint Low Weight:** 100 x 78 x 45 mm, 263g (Amplifier Unit) / 300g (Power Supply Unit) - including heat sink Aluminum plate.
- ✓ **Programmable Output Stage Impedance:** for special acoustic design and transducers matching (Patent PCT/IT2006/00615).
- ✓ **Optional High Performance Ethernet Digital Audio Routing and Control Board**

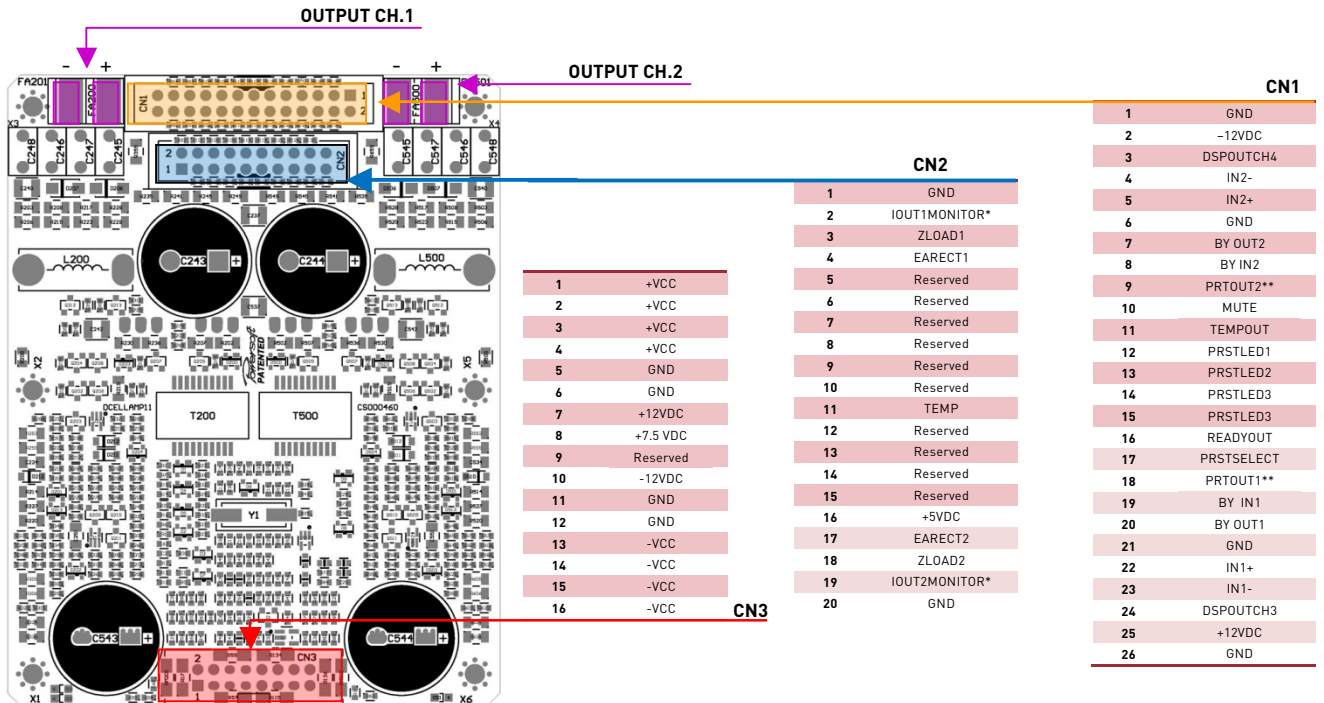
Applications examples



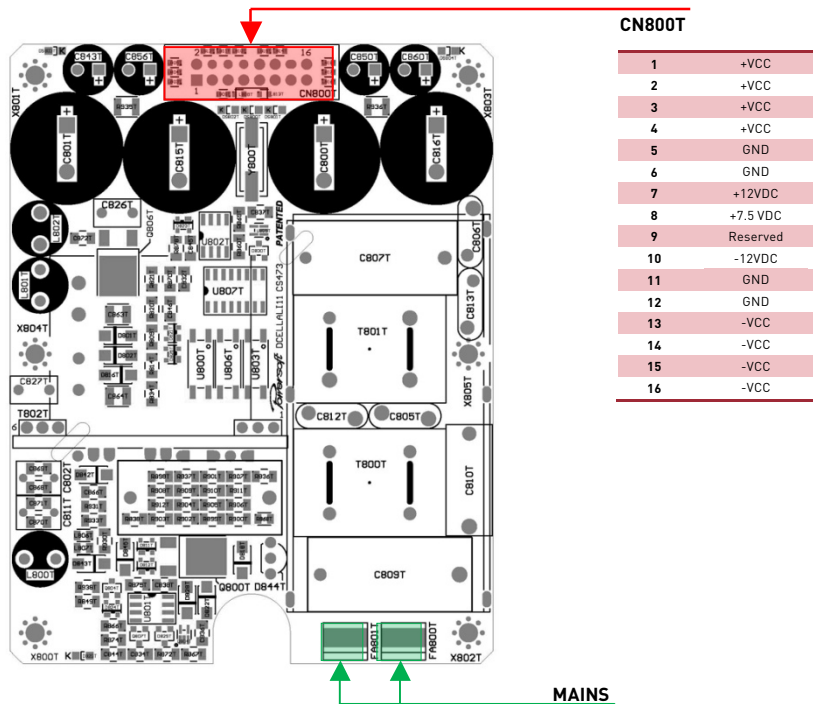
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Connections

AMPLIFIER UNIT: CONNECTING LAYOUT



POWER SUPPLY UNIT: CONNECTING LAYOUT



SECTION 2 - SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Mains Input Section

	Value	Tol.	Notes
Mains Voltage Range:			
Minimum off-line voltage	115 V _{AC}	± 10%	
Maximum off-line voltage	230 V _{AC}	± 10%	
Mains Frequency Range:			
Minimum	50 Hz		
Maximum	60 Hz		
Start-up Voltage	90 V _{AC}		
Shutdown Voltage	290 V _{AC}		
Minimum Operational Voltage	70 V _{AC}		
Minimum EIAJ GPR* Voltage	100 V _{AC}		
Max Input Voltage	265 V _{AC}		

* EIAJ GPR = Burst mode Guaranteed Power Rating

Aux Supply

Output Connector & Pin	Voltage (V _{DC})	Max current draw	Max Capacitive Load
CN2 – pin 16	+ 5 V _{DC}	50 mA	47 µF
CN800T – pin 8 CN3 – pin 8	+ 7,5 V _{DC}	250 mA	47 µF
CN1 – pin 25 CN800T – pin 7 CN3 – pin 7	+ 12 V _{DC}	+ 100 mA	47 µF
CN1 – pin 2 CN800T – pin 10 CN3 – pin 10	- 12 V _{DC}	- 100 mA	47 µF

Output Section

	Value	Notes
Minimum Load (SE)	2 Ω	
Minimum Load (BTL)	4 Ω	
Max current draw from output	35 A	

TIMING SPECS

	Value	Notes
Power supply start-up delay	2 s	Time from reaching minimum off-line voltage to all power supplies are good and amplifier is active

PHYSICAL DIMENSIONS

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	Power Supply	Amplifier
Weight	300 g	263g
External Dimensions	100x78x45 mm (3,94x3,07x1,77 in)	100x78x45 mm (3,94x3,07x1,77 in)
Ext. Dimensions (IS version)	330x100x61 mm (13x3,937x2,4 in)	

THERMAL SPECIFICATIONS

	Value	Notes
Max Operating Ambient Temperature	50 °C	Tropical Conditions

POWER RATINGS

OUTPUT POWER per channel (measured at 230Vac)	8 Ω	4 Ω
Continuous – 1 kHz, 0.5% THD	2 x 170 W	2 x 250 W
EIAJ test – 1 kHz, 1% THD	2 x 190 W	2 x 350 W
BRIDGED MODE configurations:	16 Ω	8 Ω
EIAJ test – 1 kHz, 1% THD	1 x 380 W	1 x 700 W

EFFICIENCY

	Typical	
Total Power Efficiency (1/2 max output power - 8 Ω load)	78 %	
Power Factor (1/2 max output power - 8 Ω load)	Better than 0.97	

Amplifier Unit Audio Specifications

D-CELL504

Input impedance	10 kΩ Balanced to ground	Slew Rate @ 8 Ω	30V/μs input filter bypassed
Gain	32 dB (voltage gain: x40)	Damping factor	20 Hz – 200 Hz → 1000
Frequency response	5 Hz - 45 kHz (-3dB) for 1W @ 8Ω	Distortion	≤0.005% (THD, DIM, SMPTE)
S/N ratio (unbalanced inputs)	→ 118 dBA (20-20kHz, A-weighted)	Output Noise (unbalanced inputs)	50 μV _{RMS} (Typical)
S/N ratio (balanced inputs)	→ 113 dBA (20-20kHz, A-weighted)	Output Noise (balanced inputs)	90 μV _{RMS} (Typical)
Absolute Output DC offset	← 4 mV	Output Stage Efficiency	93% (typical)
Input Sensitivity	2,22 dBu / 1 V _{RMS}	Output type	Unbalanced to ground

Powersoft reserves the right to make improvements in manufacturing or design which may affect product specifications.

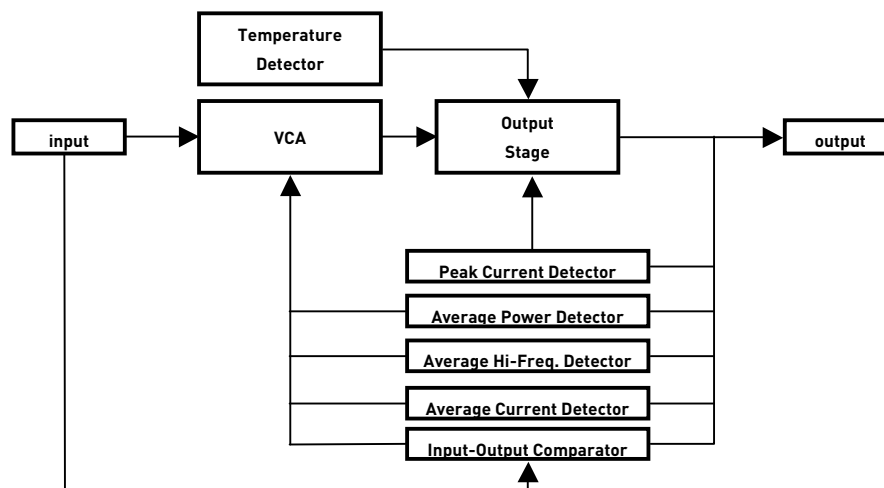
D-CELL504DSP & D-CELL504DSP-IS

Input impedance	10 kΩ Balanced to ground	Slew Rate @ 8 Ω	30V/μs input filter bypassed
Gain	32 dB (voltage gain: x40)	Damping factor	20 Hz – 200 Hz → 1000
Frequency response	10 Hz - 22 kHz (-3dB) for 1W @ 8Ω	Distortion	≤0.05% (THD, DIM, SMPTE)
S/N ratio (unbalanced inputs)	→ 100 dBA (20-20kHz, A-weighted)	Output Noise (unbalanced inputs)	450 μV _{RMS} (Typical)
S/N ratio (balanced inputs)	→ 98 dBA (20-20kHz, A-weighted)	Output Noise (balanced inputs)	490 μV _{RMS} (Typical)
Abs. Output DC offset	← 4 mV	Output Stage Efficiency	93% (typical)
Input Sensitivity	2,22 dBu / 1 V _{RMS} (DSP selectable)	Output type	Unbalanced to ground

Powersoft reserves the right to make improvements in manufacturing or design which may affect product specifications.

SECTION 3 – FEATURES

Protections



1) Clip limiter:

Acts as input stage gain reduction since Input/Output comparison detects differences exceeding 1% THD.

Time constants are defined for +3dB input drive respect to input sensitivity:

Attack time = 5mS ; Hold time = 10mS ; Decay time = 70mS

2) Average Power Limiter:

Acts as input gain reduction to reach a stationary output power of 120W independently to load conditions.

Integration constant delay Time= 4 sec.

3) Average High Frequency Limiter:

Acts as input gain reduction to reach a stationary output voltage of -K*[dB] respect to full output swing for frequencies above 7 KHz

4) Average Current Protection:

Acts as amplification stage shutdown (mute) when average output current of 7.5 A_{rms} is measured.

5) Peak Current Shut Down:

Acts as output stage switching process inhibition.

Self resetting after 2 Seconds.

Tripping point= 35 A

6) Temperature Protection:

Acts reducing the output stage gain above temperature level of 85°C (temperature on output power devices proximity).

T plate $\leq -80^{\circ}\text{C}$ = TEMPOUT not active

T plate $\geq 80^{\circ}\text{C}$ = TEMPOUT active (turns on/off and the led blinks **slowly**)

T plate $\geq 85^{\circ}\text{C}$ = TEMPOUT active (turns on/off and the led blinks **fast**)

T plate $\geq 90^{\circ}\text{C}$ = Output Shutdown; TEMPOUT steady on

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Energy Save & FAN OUPUT

Note: This feature is available only with the D-CELL504DSP-IS and D-CELL504-IS version

To help reduce power consumption when no signal is present at the input, D-Cell504DSP-IS provides the possibility to activate "Energy Save" Mode.

D-Cell504DSP-IS enters in Energy Save condition when input signal level is, for at least **10 seconds**, lower than the threshold level of **-60 dBV (-62 dBu)**.

To activate Energy Save Mode, you have simply to join the solder pads indicated with **J1003** (see Section 4.1, Schematic 3 - Clip Limiter & Energy Save) as shown in the following figure:



The Fan Output is located on the Interface's PCB, near the Energy Save's solder pads.

Maximum current draw from the Fan Outputs: **100 mA**

Auxiliary output

Three auxiliary output supplies are available in all versions of D-Cell504, to power your external circuits and devices.

AUX 1:

Voltage	type	Available on (Unit/Connector/Pin):	Max current draw	Max Capacitive Load
$\pm 12.5 V_{DC}$	Regulated	AMP/CN1/pin25 (+12 V _{DC}) ; AMP/CN1/pin2 (-12 V _{DC})	± 100 mA	47 μ F

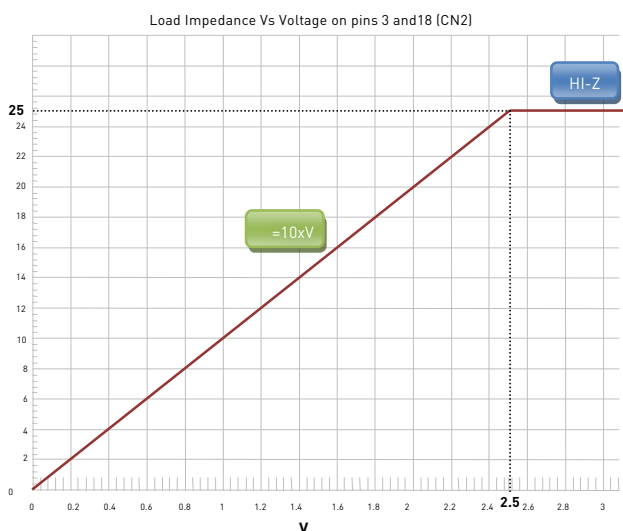
AUX 2:

Voltage	type	Available on (Unit/Connector/Pin):	Max current draw	Max Capacitive Load
7.5 V _{DC}	Regulated	AMP/CN3/pin8 ; PS/CN800T/pin8	250 mA	47 μ F

AUX 3:

Voltage	type	Available on (Unit/Connector/Pin):	Max current draw	Max Capacitive Load
5 V _{DC}	Regulated	AMP/CN2/pin16	50 mA	47 μ F

LOAD IMPEDANCE MEASURE



D-Cell504 gives you the possibility to get information about the load impedance on both channels: this permits investigation of loudspeaker behavior to troubleshoot the system and constant voltage networks.

The value can be read via pin 3 (for channel 1 load impedance) and pin 18 (for channel 2) of the CN2 connector (See Section APPENDIX A: CONNECTORS DESCRIPTION & SPECIFICATIONS for details).

The correspondence between voltage at these pins and the load impedance is indicated is the following:

From 0 to 2,5 V:

load impedance value in Ohm = 10 x voltage value in V

From 2,5 V to ∞ :

Hi-impedance

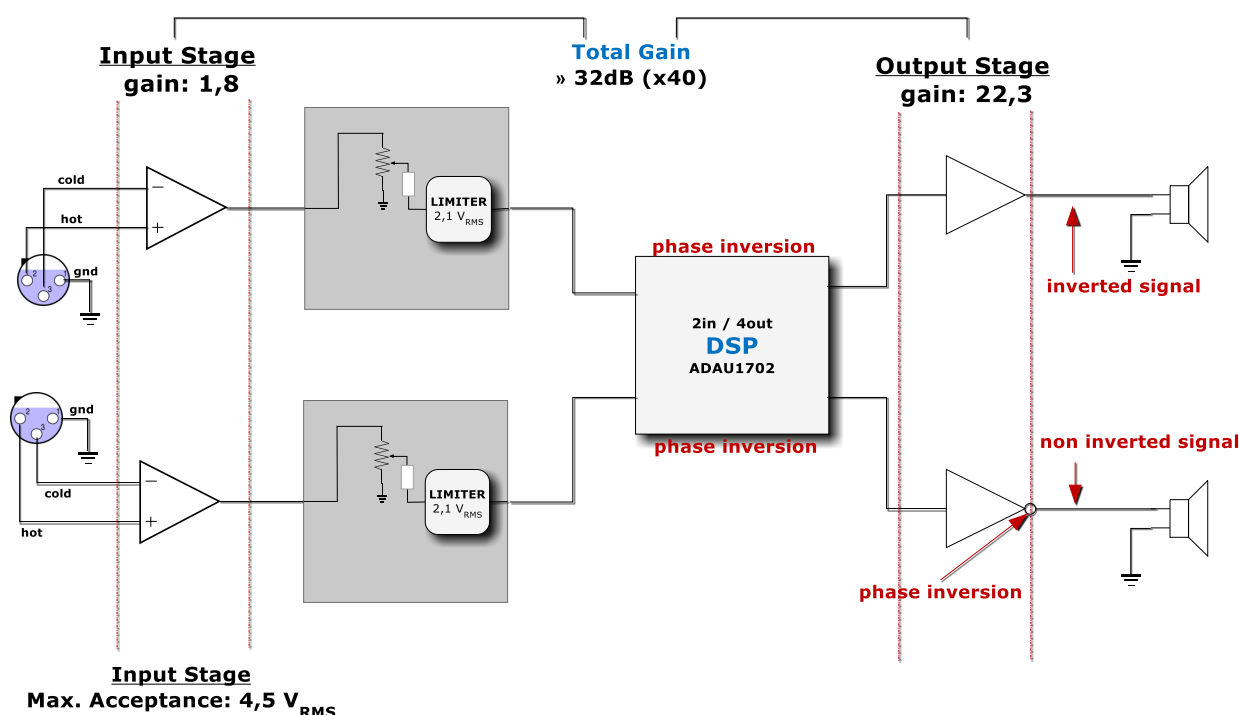
SECTION 4 – DESIGNER'S GUIDE

AUDIO SIGNAL PATH

The D-Cell504 is designed to optimize the performances and to guarantee the best audio quality by exploiting all the characteristics of its components.

It's really important, for anyone who develop its own product around D-Cell, to well understand the path of the audio signal throughout the different stages: this will help you to get the best results from your project.

Figure 4.1 - The audio signal path.



Note 1: The Interface Board is available only in the D-Cell504DSP-IS version: you can build your own Interface Board starting from one of the schemes that you find in Section 4.1

Note 2: The DSP is available only in the D-Cell504DSP and D-Cell504DSP-IS versions.

Note 3: The figure above refers to a general configuration, with two separate input signals: when using the same input in parallel for both channels, you can use only one potentiometer in the Interface Board.

Note 4: The Max Input Amplification Stage Level (4,5 V_{RMS}) is the level above which occurs saturation of the input stage. This is different from the Input Sensitivity, that is the input level above which you exceed the maximum output voltage.

Note 5: The Limiter circuit included in the Interface Board is intended to maintain a signal level that allows to reject disturbances from the input stage and at the same time to achieve optimal Signal to Noise Ratio in DSP stage:

Note 6: The DSP block causes a phase inversion, and another inversion is present at the output stage of channel 2: therefore, the channel 1 output is inverted, while at the channel 2 output is present a not-inverting signal. The reason of this configuration and the correct way to setup the desired operation mode are explained in Chapter 0

Note 7: The Pre Limiter (@2,1 V_{RMS}) can be bypassed following the instructions in Section 4.1.

Wiring Configurations & Operation Modes

- D-Cell's output stage is designed to work in balanced supply mode: this allows better exploitation of power supply capacitors and power supply dynamic.

The physical signal path, as shown in Figure 4.1, lead to have CH1 in inverting operation respect to CH2.

In particular, CH1 output is inverting, while CH2 is non-inverting.

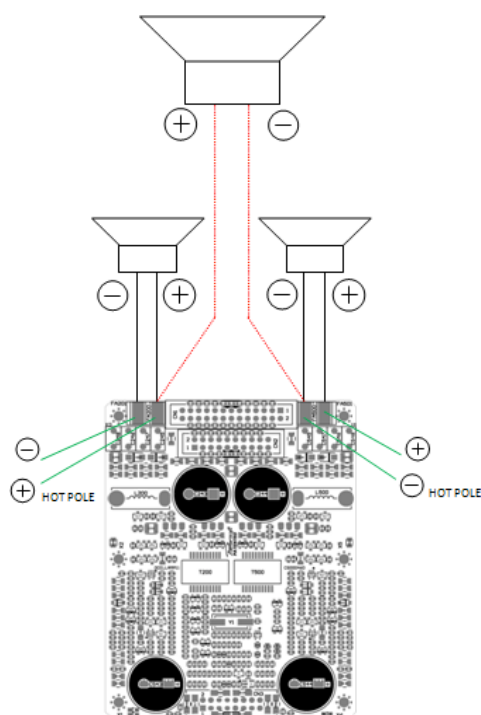
The first inversion is operated, on both channels, inside the DSP: this means that in the **D-Cell504** basic version, without the DSP, we have the opposite situation, with CH1 non-inverting output and CH2 inverting output.

- For proper connection please read carefully the following connecting instructions.

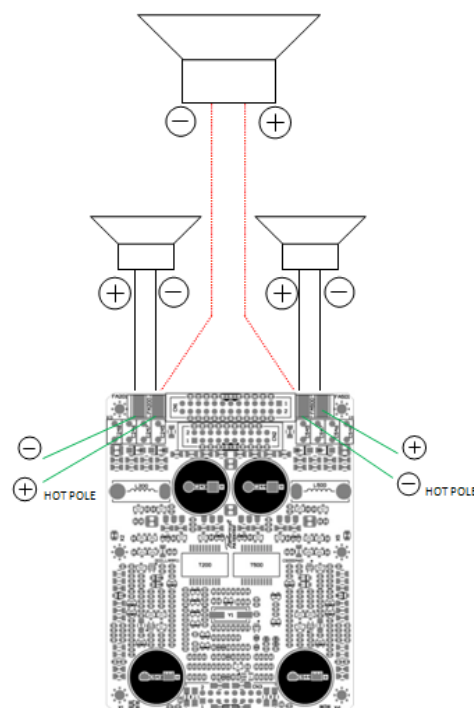
The inverting channel's output connector hot pole is the negative and the positive of the output is grounded:
do not to reverse output signal of inverting channel to maintain grounded negative output.

Damage of the unit may occur in case of equally phased outputs.

VERSIONS WITHOUT DSP



VERSIONS WITH DSP



INPUT CONFIGURATION SETUP

The default input configuration of the interface panel includes two female XLR connectors, for stereo input configuration (See Section 4.1 for detailed schematics), and with the Pre-Limiter indicated in Section 0 activated.

You can change this setup by following the instructions below, referring to the schematics in Section 4.1.

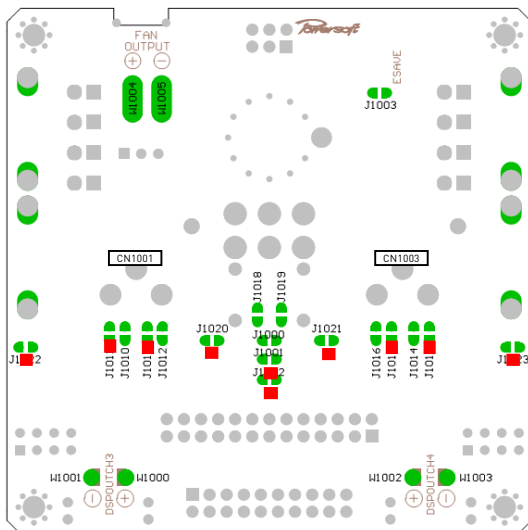
1) MONO CONFIGURATION WITH PRE LIMITER:

In XLR CN1001 FEMALE linked to Out XLR CN1003 MALE

Jumpers that have to be soldered:

J10001 – J1002 – J1011 – J1013 – J1015 – J1017

J1020 – J1021 – J1022 – J1023



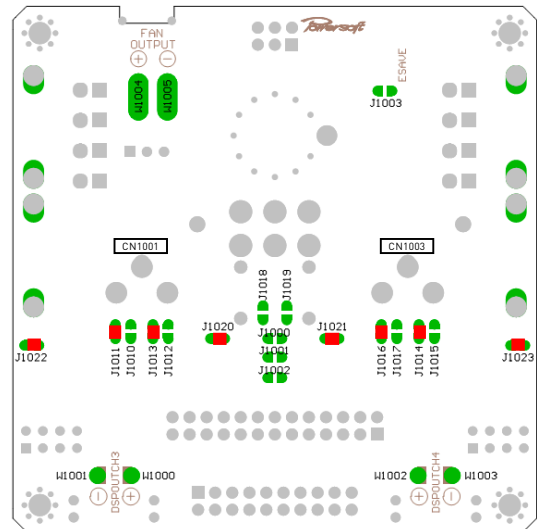
3) STEREO CONFIGURATION WITH PRE LIMITER:

Independent XLR In CN1001 FEMALE - CN1003 FEMALE

Jumpers that have to be soldered:

J1011 – J1013 – J1014 – J1016

J1020 – J1021 – J1022 – J1023.



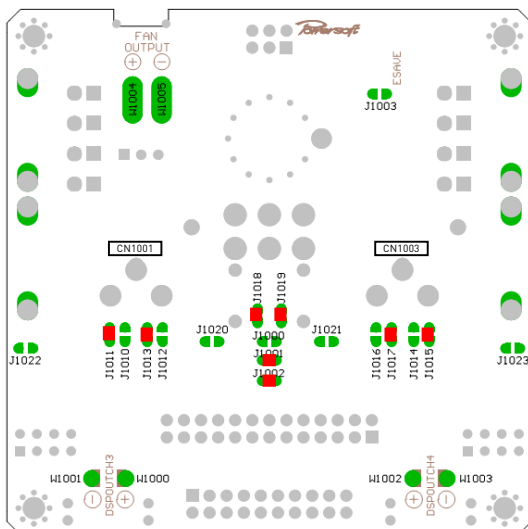
2) MONO CONFIGURATION WITHOUT PRE LIMITER:

In XLR CN1001 FEMALE linked to Out XLR CN1003 MALE

Jumpers that have to be soldered:

J10001 – J1002 – J1011 – J1013 – J1015 – J1017

J1018 – J1019.



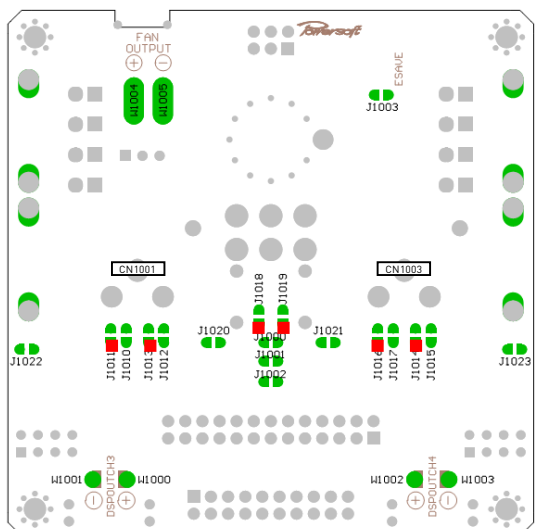
4) STEREO CONFIGURATION WITHOUT PRE LIMITER:

Independent XLR In CN1001 FEMALE - CN1003 FEMALE

Jumpers that have to be soldered:

J1011 – J1013 – J1014 – J1016

J1018 – J1019.

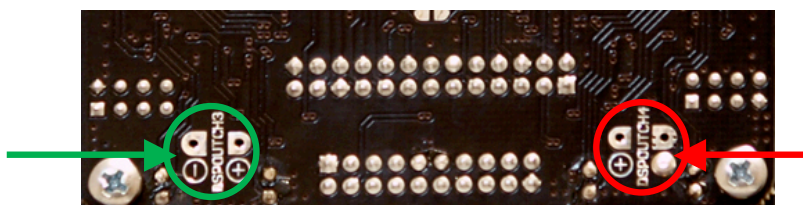


DSP OUTPUT

The DSP mounted on the D-Cell offers 4 different outputs, that can be used to feed an additional amp unit with processed signal: this allows to easily setup multistage architectures.

Outputs 1 and 2 of the DSP are automatically routed to the outputs of the amp unit that hosts the DSP itself.

Outputs 3 and 4 are available on the PCB in the position indicated in the following picture:

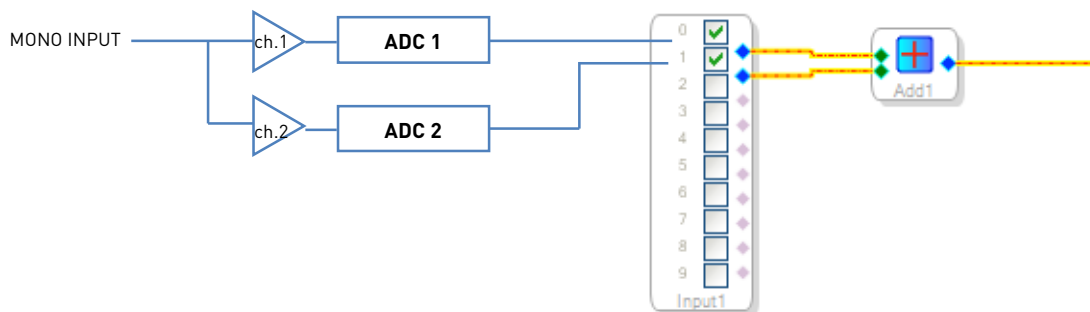


IMPROVING QUALITY PERFORMANCES

The SNR of the standard DSP version of the D-Cell can be increased choosing the right connection when using a mono input:

- 1) Set up the interface panel for mono configuration as indicated in Section 4.1 (in case you are using a MONO-IS version, you can ignore this step, since the interface panel is already correctly set up and the input signal goes to both amplifier's channels)
- 2) Within SigmaStudio, take both input ADC signals and sum them .

The resulting signal path is represented by the following figure:

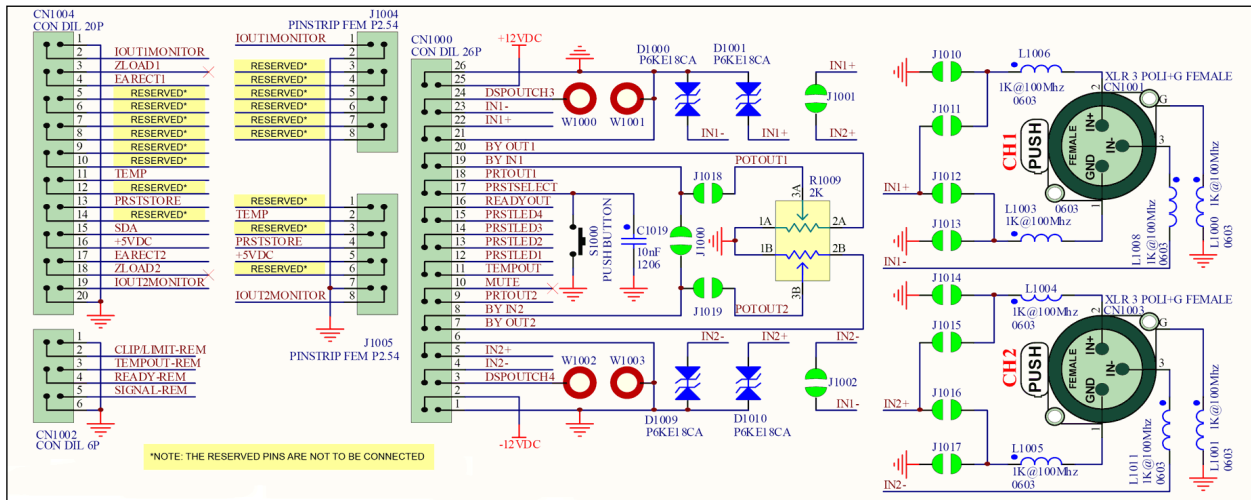


NOTE: The step 2) will obviously result in a signal level double than the one of the signal coming from each ADC. If you want to restore that level, you have to use a Linear Gain block and set it to 0,5.

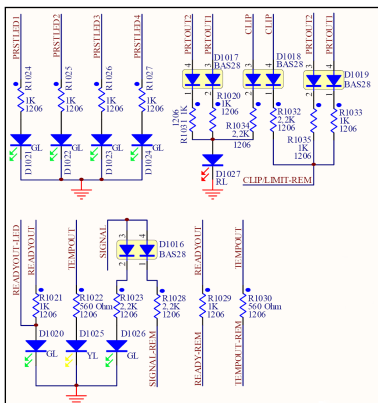
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Interface Board

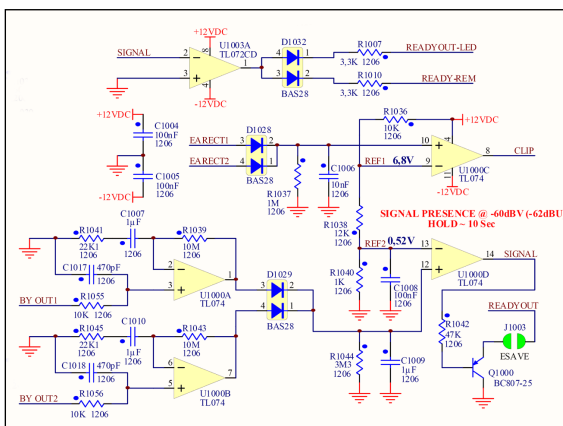
SCHEMATIC 1 - INPUT/OUTPUT SECTION



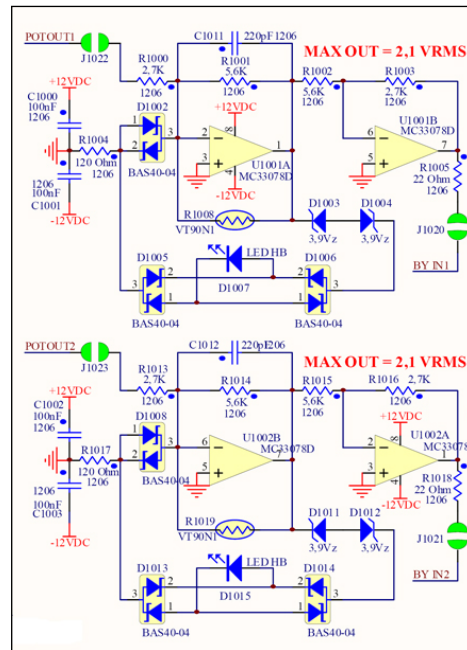
SCHEMATIC 2 - LEDS



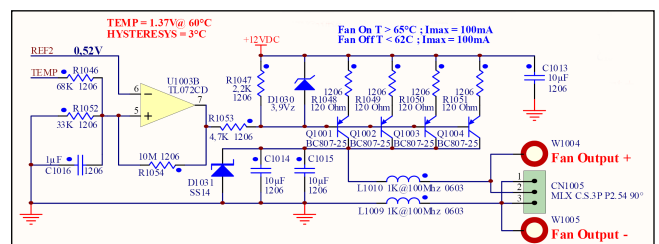
SCHEMATIC 3 - CLIP LIMITER & ENERGY SAVE



SCHEMATIC 4 - PRE-LIMITER



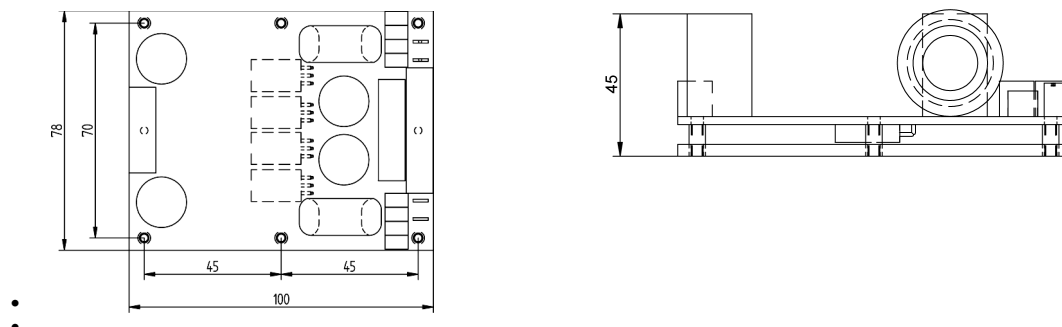
SCHEMATIC 5 - FAN OUT



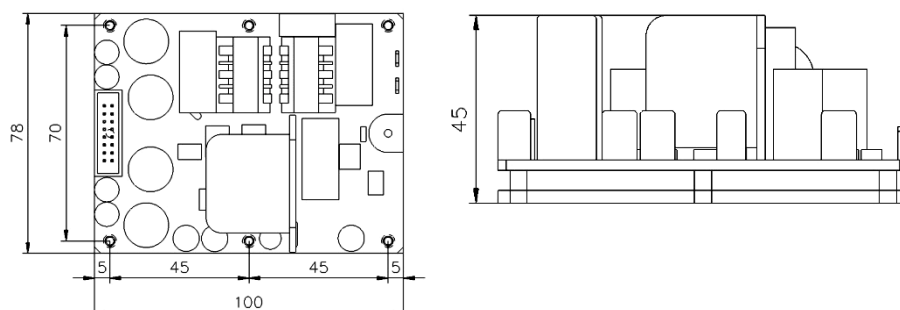
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Mechanical mounting

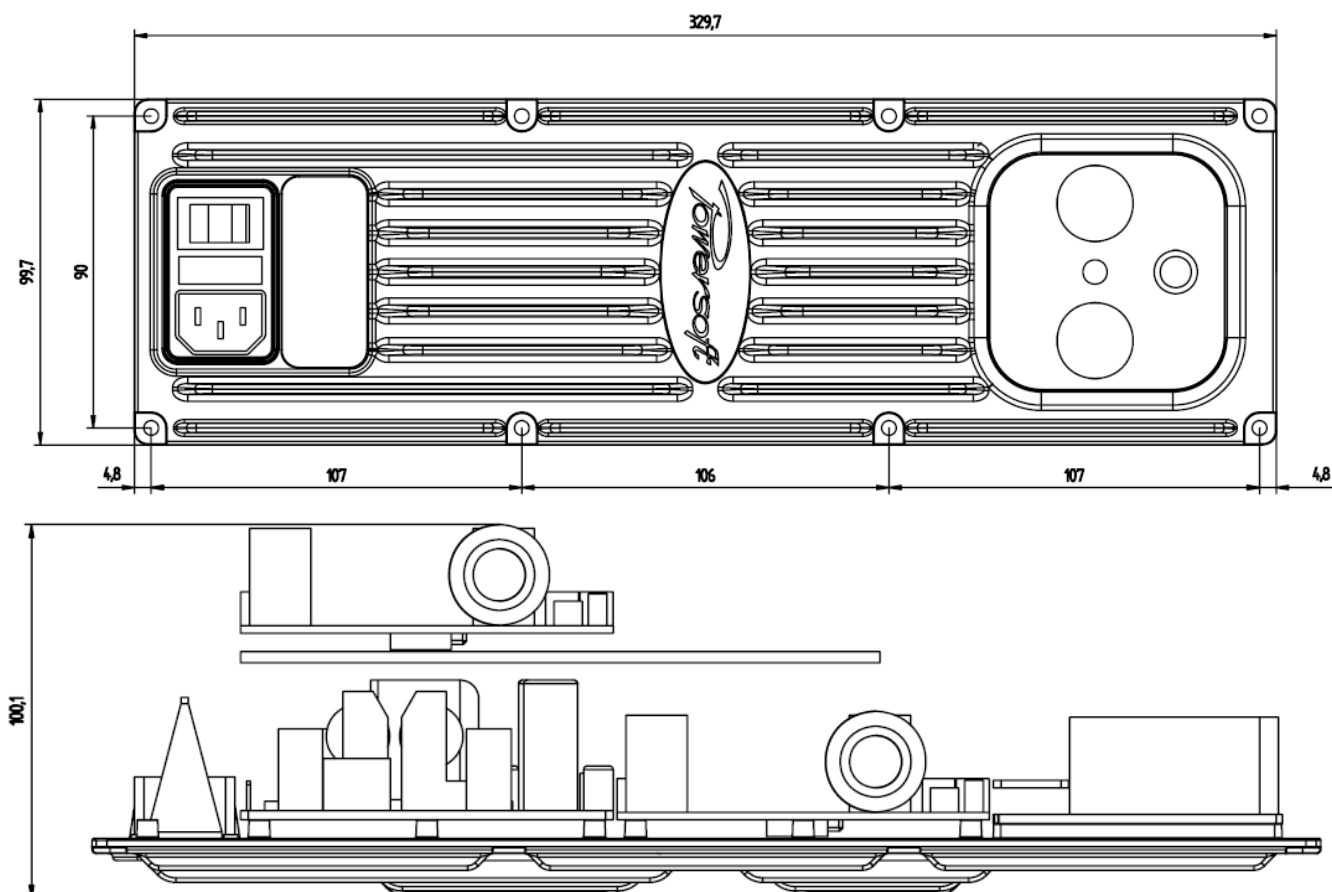
AMPLIFIER UNIT



POWER SUPPLY UNIT



MOUNTING BOARD (ONLY IS VERSION)



Thermal Design

This device must be correctly heatsinked for correct and reliable operation.

The dissipated power can be calculated is:

$$\text{Maximum dissipated power} = \frac{\text{Maximum Output Power} \times (1 - \text{Efficiency}^*)}{4^{**}} + \text{Idle Power}$$

* Typical efficiency = 0.78 ; ** 6 dB power crest factor program

Considering that thermal protection is set at 80°C on bottom aluminium plate, thermal resistance of the heatsink is derived from the following formula:

$$R_{th(\text{heatsink})} = \frac{\text{Maximum operating temperature} - \text{Maximum ambient temperature}}{\text{Maximum dissipated power}}$$

For example, with a maximum output power of 700W and a typical efficiency of 78%, an Idle Power of 16W the expected dissipated power is:

$$(700W \times (1 - 0.78) / 4) + 16W = 38.5W + 16W = 54.5W$$

For a maximum ambient temperature of 50°C and a maximum operating ambient temperature of the module of 70°C is necessary an heatsink of 0.367°C/W

$$R_{th(\text{heatsink})} = \frac{70^{\circ}\text{C} - 50^{\circ}\text{C}}{54.5W} = 0.367^{\circ}\text{C/W}$$

Proper heat sink planarity is strongly suggested to allow thermal transfer from the bottom plate to the heatsink, thermal compound is recommended.

In case of installation inside of loudspeaker enclosure, proper spacing of at least 10 mm is necessary between the frame of the unit and side components or surfaces of the enclosure.

SECTION 5 – SIGNAL PROCESSING

SIGMASTUDIO® Installation

This chapter describes how to install the SigmaStudio on a computer running the Microsoft Windows operating system.

System Requirements

- Windows XP Professional or Home Edition with SP2; Windows 2000 with SP4; Windows ME; Windows Server 2003
- 128 MB of RAM (256 MB recommended)
- 50 MB of available hard disk space
- 1024 x 768 screen resolution
- USB 1.1/2.0 data port (Required for use with Evaluation hardware only)

Note 1: SigmaStudio can be installed under Windows Vista, however Windows Vista is not officially supported at this time and Analog Devices cannot offer any technical support regarding Vista installation or issues.

Note 2: SigmaStudio needs the Microsoft .NET Framework v2.0 to work: if you don't have it already installed on your computer, the SigmaStudio installation program will automatically try to download it and install it. Please check that you are connected to the internet to allow SigmaStudio installer to download the Microsoft .NET Framework 2.0. Anyway, you can independently download it and install it from Microsoft's website: the "Microsoft .NET Framework Version 2.0 Redistributable Package" installation and updates are available for download directly from www.microsoft.com/downloads.

Step 1: Before You Install

- Quit any applications you are running.
- Confirm that the Microsoft .NET Framework v2.0 is installed.

[The "Microsoft .NET Framework Version 2.0 Redistributable Package" installation and updates are also available for download from the www.microsoft.com/downloads section of Microsoft's website or directly from the link:

<http://www.microsoft.com/downloads/details.aspx?FamilyID=0856eacb-4362-4b0d-8edd-aab15c5e04f5&displaylang=en>]

Step 2: Application Setup

- Run the setup application (Sigma Studio.msi).
- Review the contents of the license agreement.
- If installing SigmaStudio for the first time, restart your computer when the installation is complete.

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DSP Programming Setup

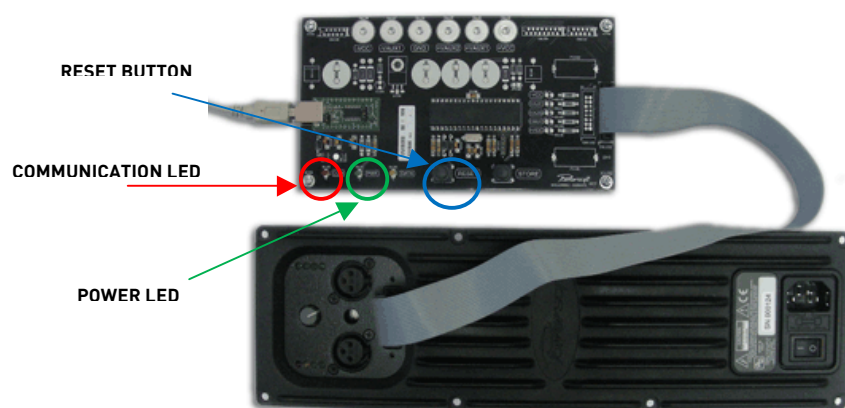
What you need to program your D-Cell504DSP:

- DCELLPROG11 Programming Board
- USB cable (for the communication between PC and DCELLPROG11 Programming Board)
- 16 poles Flat Cable (for connection between DCELLPROG11 Programming Board and D-Cell504DSP or D-CELL504DSP-IS)
- D-CELL504DSP or D-CELL504DSP-IS

Powering up the board.

The DCELLPROG11 Programming Board is powered via the 16 poles Flat Cable by the D-Cell itself.

- Connect the amplifier and the Programming Board as indicated in the following picture if you're using an IS version or to connector CN2 of the output stage unit if you're using the version without chassis, and turn on the D-Cell504.



- The POWER LED should be lit.

Connecting the board to the computer

- 1) Use the included USB cable to make a connection between the evaluation board and an available USB port on your computer.
- 2) Windows should recognize the device, and Found New Hardware Wizard should display.
- 3) Select "Install from a list or specific location (Advanced)" and then "Search for the best driver in these locations." Ensure that "Search removable media" is unchecked and "Include this location in the search" is checked.
- 4) Browse to find the USB drivers folder. (By default, it should be at C:\Program Files\Analog Devices Inc\Sigma Studio\USB Drivers.) Click OK and Next to begin the installation. (Click Continue Anyway if you're prompted with "the software hasn't passed Windows Logo testing.") Click Finish when done.

NOTE: During the programming operations, in the start up phase and more in general when DSP and the programmer communicate, the COM LED will be on for a very short time. When the COM LED is steady on, it indicates that the in/out communication is not correctly working. In this case, press the RESET BUTTON to reinitialize the communication.

SIGMASTUDIO® QUICK START

These are abbreviated instructions to help get you started.

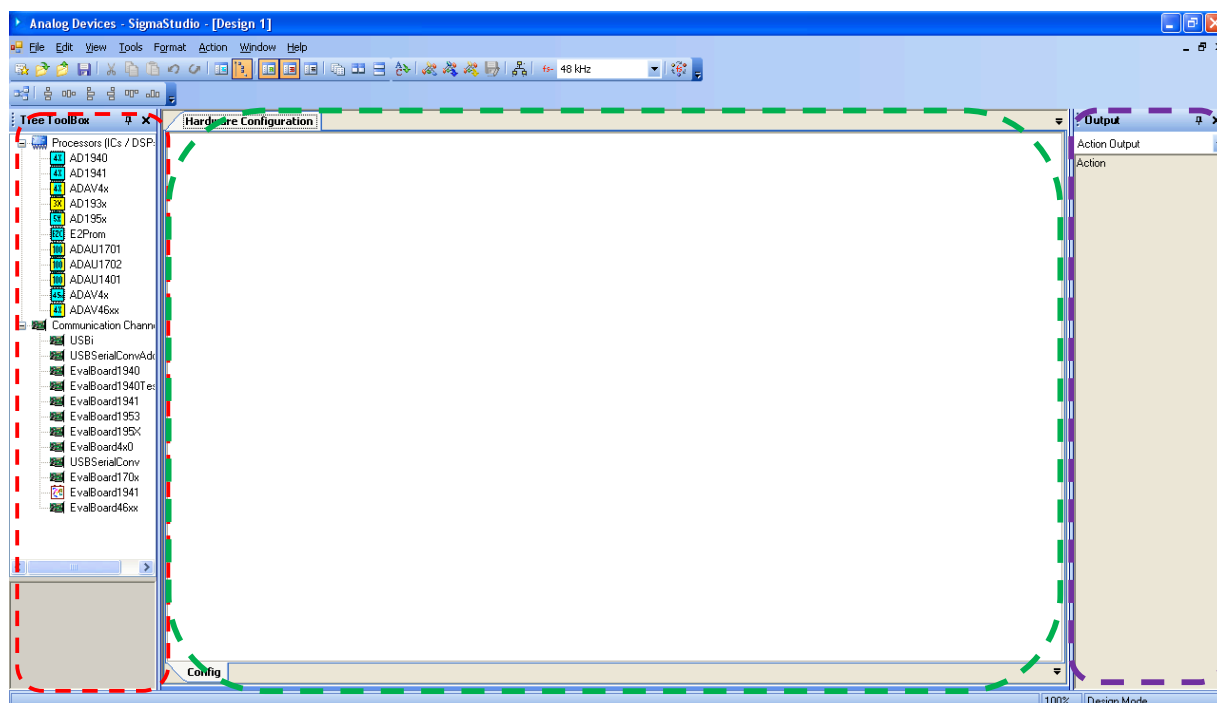
Please refer to the SigmaStudio Help for detailed instructions, tutorials and examples: You can find the guide by clicking the "Help" menu of SigmaStudio or in the folder ..\Program Files\Analog Devices Inc\Sigma Studio 3.0\Help\

A LOOK TO THE WORKSPACE.

The first time you start SigmaStudio, it displays the Program Window with an empty layout .

Create a New Project (File\New Project or CTRL+N).

The Program Window should look something like this:



You can see three different areas, indicate in the previous picture by three different dashed lines

- At the left (red rectangle) there is the **Tree ToolBox** area, where you can find the basic building blocks to design your project.
- At the center (green rectangle) can be displayed the **Hardware Configuration Tab** (to set up the communication between the software and your programming board) or the **Schematic Tab** (to create your DSP design dragging blocks from the Toolbox window).
- At the right (purple rectangle) there are the **Workspace windows** that display important project information

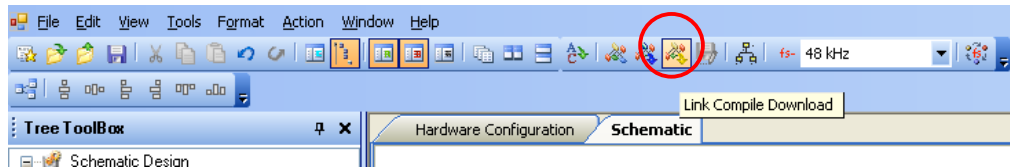
You can change the desktop arrangement to meet your needs and preferences, including resizing, moving, and hiding windows and toolbars. For more details, see the SigmaStudio Help.

“Ready-Download” mode: Real Time setting and listening

With SigmaStudio and the ADAU1702 DSP you can monitor in real time the changes you’re making in your project.

To do it, once you connected the blocks and built the path from inputs to outputs,

- **click Link-Compile-Download** on the taskbar (see following figure):



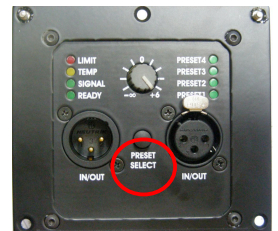
Assuming the project compiled without error, you will be now in Ready-Download mode: you should be able to hear audio and the effect of the changes on parameters (e.g. volume sliders, filters cutoff frequencies, etc...) .

Note that you will exit from Ready-Download mode any time you disconnect some block.

PRESETS storage

When you completed the set-up of your project, to store these settings in one of the Presets Banks available in the DSP, do the following:

- **Push the Preset select button** on the Interface Board until you select the bank where you want to store your preset.
- **Click Link-Compile-Download on SigmaStudio**
- **Press the Store button** on the programming board

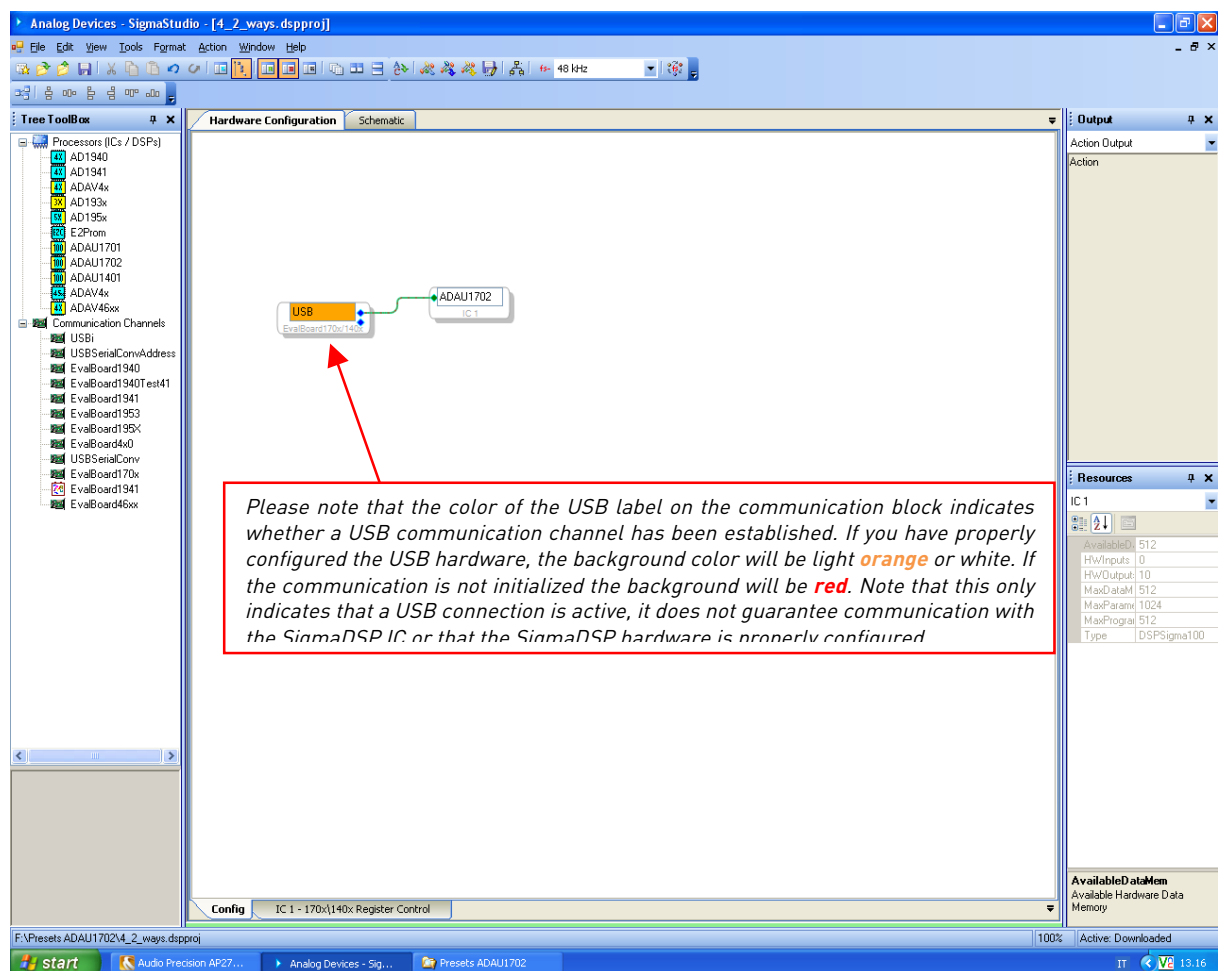


Examples

Example 1: Stereo Audio Input/Output with Volume Control.

- 1) Launch SigmaStudio and create a new project. The Hardware Configuration tab and workspace will display.
- 2) Drag an ADAU1702 and an EvalBoard170x block from the "Tree Toolbox" area at the left of the Program Window, into the workspace.
- 3) Connect the EvalBoard170x to the ADAU1702 block by clicking and dragging from the top blue output pin to the green input pin.

The result should look something like this:



- 5) Click Schematic (tab at the top of workspace).
- 6) Click IO in the Toolbox and drag an Input block to the workspace.
- 7) Click Volume Controls in the Toolbox and drag a Single Volume Control to the workspace.
- 8) Right-click that block (called Single 1) and choose Add Algorithm IC1 Gain (no slew). (This adds input / output.)
- 9) Connect the Input block's blue output pins to the green input pins on the Volume Control.

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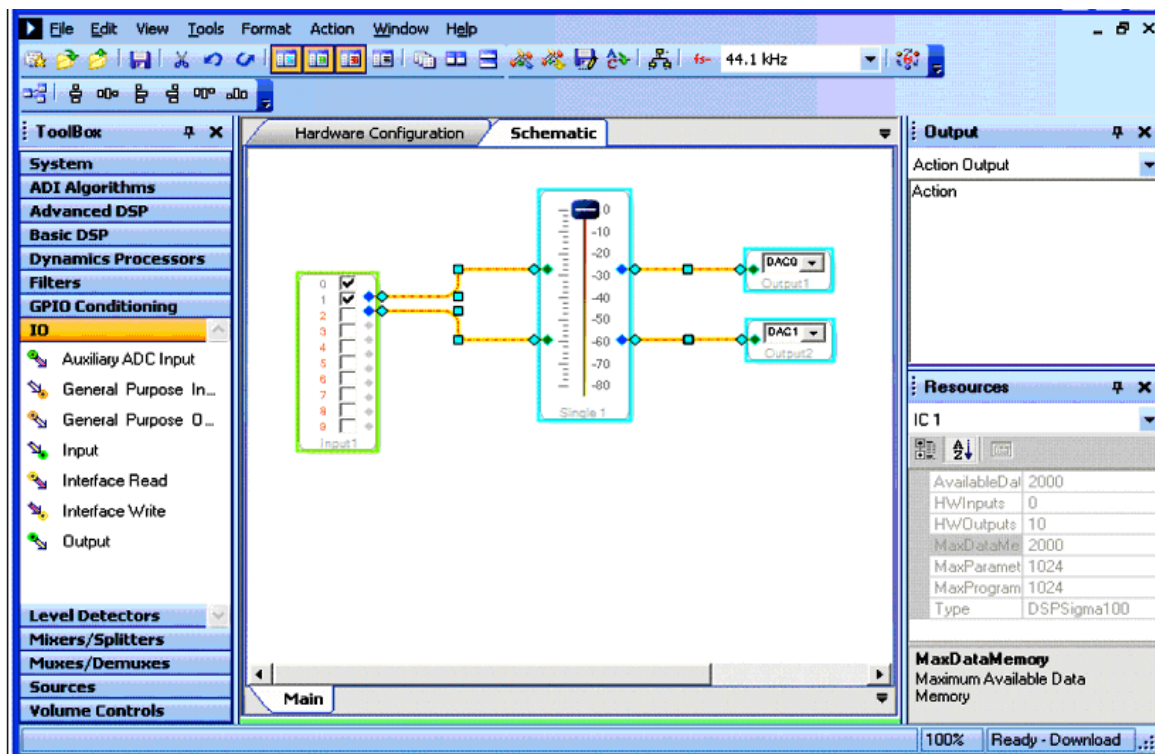
10) Click IO in the Toolbox and drag two Output blocks to the workspace.

11) If your speakers aren't connected to outputs 0/1, use the dropdown to change them to the correct outputs.

12) Connect the Volume Control blue output pins to the green input pins on the Output blocks.

13) After ensuring that your board is powered and connected to the PC, click Link-Compile-Download on the taskbar.

Assuming the project compiled without error, you will be in Ready-Download mode and see something similar to this figure.

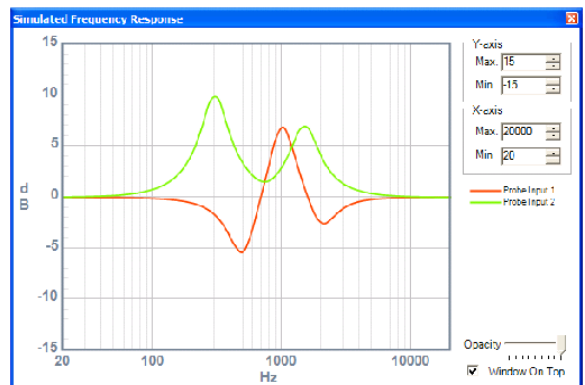
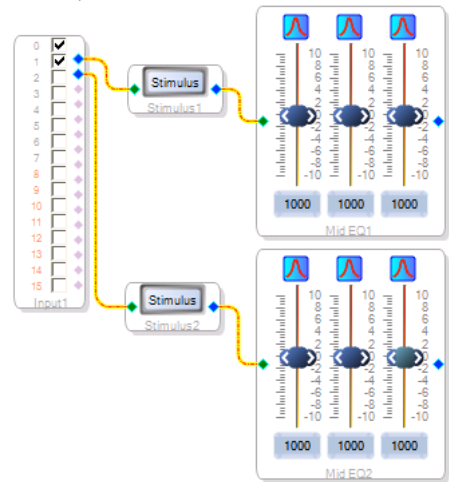


14) Start your source playing and you should hear audio. Move the volume slider to change the level.

Example 2: Probe and Stimulus Blocks

Complete the first example in order for an explanation of the input, output, and EQ blocks that are used in this tutorial. Its purpose is to show you how to use probe and stimulus blocks to monitor the frequency response of the filters you set.

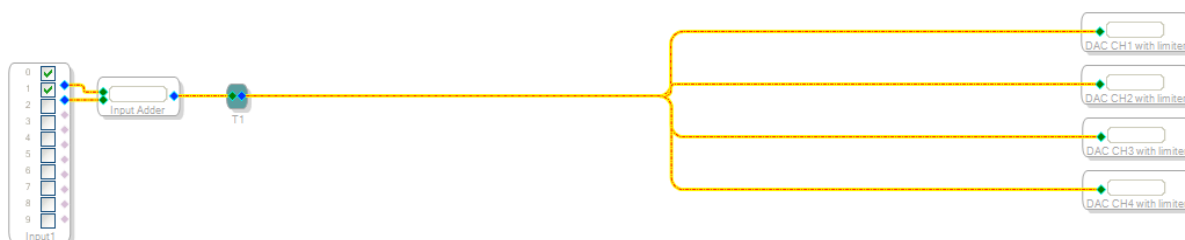
- 1) Insert an **Input** from the **IO** tab of the ToolBox.
 - 2) Click the **System** tab and drag two **Stimuliblock** blocks to the workspace.
 - 3) Connect wires from the input channels to the Stimuliblock block.
 - 4) Insert two **Medium Size Eq** blocks from the **Filters** tab.
 - 5) For each EQ block, right-click and select **Add Algorithm** → **IC 1** → **Single - Double Precision**.
 - 6) Right-click each again and select **Grow Algorithm** → **1. Single - Double Precision** → **2**.
 - 7) Connect wires from the output of the Stimuliblock block to the input of the EQ block.
 - 8) Click the **System** tab and drag one **Probeblock** block into your workspace.
 - 9) Right-click the block and select **Add Pins**.
 - 10) Connect wires from the output of the EQ to the input of the Probeblock.
 - 11) Click the **IO** tab and drag two **Output** blocks into the workspace.
 - 12) Connect wires from the output of the probes to the input of the Output block. Your workspace should look like this:
- Compile the project: Click **Link Compile Download** on the toolbar or select **Action, Link Compile Download**.
- 13) Click the **Probe** block to bring up the Simulated Frequency Response window. There will be nothing displayed.
 - 14) Click the **Stimulus** block buttons to bring up the Frequency Response window. You can now view in real time any changes you make to the EQ. The response for the above parameters is shown here:



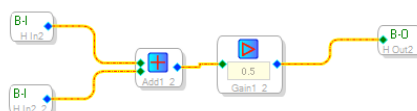
POWERSOFT PRESETS

On the evaluation version of D-CELL504DSP-IS the same basic preset is stored in all four memory locations of the DSP. The following figure shows the corresponding project of SigmaStudio:

PARALLEL INPUT ADC



The content of the first block (**Input Adder**) is the following:

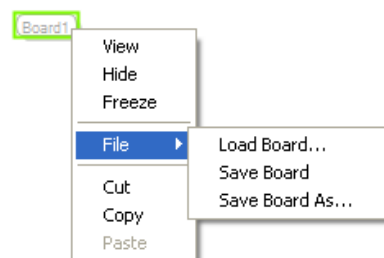


As you can see, it's only an adder with a linear gain, and its function is to gain 3dB of SNR without changing the level of the resulting signal.

At the end of the path there are the four DACs available on the DSP: the corresponding blocks (**DAC CHx with limiter**) contain a compressor which parameters have been set so that it acts as a limiter that prevent the saturation of the DAC: **we recommend to always use this block at the end of the path.**

To load the DAC limiter block in your own project, do the following operation:

- Drag a "Hierarchy Board" from the Schematic Design group in the TreeToolBox (or, that is the same, from the System group in the ToolBox) into the Schematic area.
- Right-click on the block just created and choose File/Load Board from the contextual menu.
- Select the "POWERSOFT_DAC_limiter_block.dspbrd" file* and open it.



*The "POWERSOFT_DAC_limiter_block.dspbrd" file is included in the "Powersoft_D-Cell_Package.zip" downloadable from the Download/Modules/ section of Powersoft's website:

<http://www.powersoft-audio.com>

In this package you will find other examples of presets designed for different configurations: Subwoofer, 2-way speakers, Subwoofer + 2 Satellites systems, etc..

APPENDIX A: CONNECTORS DESCRIPTION & SPECIFICATIONS

POWER SUPPLY UNIT: CONNECTORS DESCRIPTION

Mains Input

ID code:	Manufacturer:	Model/Code:
FA800T	Various	6.3x0.8 mm female Faston
FA801T	Various	6.3x0.8 mm female Faston

Out connectors

ID code:	Description	Manufacturer:	Model/Code:
CN800T	CONNECTOR PINOUT CON DIL 16P	Molex 22-01-2035	(Molex ordering number)

CN800T: Pins description

PIN	Description	Notes
1	+VCC	
2	+VCC	
3	+VCC	
4	+VCC	
5	GND	
6	GND	
7	+12VDC	Connect to pin 7 of CN3 connector on Amplifier Unit
8	+7.5 VDC	Connect to pin 8 of CN3 connector on Amplifier Unit
9	Reserved	TO NOT BE USED
10	-12VDC	Connect to pin 10 of CN3 connector on Amplifier Unit
11	GND	
12	GND	
13	-VCC	
14	-VCC	
15	-VCC	
16	-VCC	

AMPLIFIER UNIT: CONNECTORS DESCRIPTION

Input connectors (from Power Supply)

ID code:	Description	Manufacturer:	Model/Code:
CN3	CONNECTOR PINOUT CON IDC 16P	various	

Output connectors

ID code:	Description	Manufacturer:	Model/Code:
CN1	CONNECTOR PINOUT CON IDC 26P	various	
CN2	CONNECTOR PINOUT CON IDC 20P	various	

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CN1: Pins description

PIN	Description	Notes
1	GND	
2	-12VDC	Auxiliary Voltage
3	DSPOUTCH4	Ch 4 DSP output
4	IN2-	
5	IN2+	
6	GND	
7	BY OUT2	
8	BY IN2	
9	PRTOUT2**	Ch 1 Output protection flag , HIGH = protection active see Section 0, points 4) and 5)
10	MUTE	Mute Command (pull to GND to mute the outputs)
11	TEMPOUT	Temperature Protection flag, see Section 0 point 6)
12	PRSTLED1	Preset 1 Selection Led
13	PRSTLED2	Preset 2 Selection Led
14	PRSTLED3	Preset 3 Selection Led
15	PRSTLED3	Preset 4 Selection Led
16	READYOUT	ready status output (led drive) and fast output shut downs
17	PRSTSELECT	Push button for preset scroll selection, pull to GND to scroll.
18	PRTOUT1**	Ch 1 Output protection flag , HIGH = protection active see Section 0, points 4) and 5)
19	BY IN1	
20	BY OUT1	
21	GND	
22	IN1+	
23	IN1-	
24	DSPOUTCH3	Ch 3 DSP output
25	+12VDC	Auxiliary Voltage
26	GND	

CN2: Pins description

PIN	Description	Notes
1	GND	
2	IOUT1MONITOR*	Limiter detector output signal (channel 1): high when one of the limiting protections is active (see Section 0)
3	ZLOAD1	Load impedance analog output signal
4	EARECT1	Rectified error amplifier output Channel 1, see Section 4.1
5	Reserved	TO NOT BE USED
6	Reserved	TO NOT BE USED
7	Reserved	TO NOT BE USED
8	Reserved	TO NOT BE USED
9	Reserved	TO NOT BE USED
10	Reserved	TO NOT BE USED
11	TEMP	Analog temperature monitor output (see Section 0) - Connected to CN1000-pin11 on the Interface Board
12	Reserved	TO NOT BE USED
13	Reserved	TO NOT BE USED
14	Reserved	TO NOT BE USED
15	Reserved	TO NOT BE USED
16	+5VDC	see.....
17	EARECT2	Rectified error amplifier output Channel 2, see Section 4.1
18	ZLOAD2	Load impedance analog output signal
19	IOUT2MONITOR*	Limiter detector output signal (channel 2): high when one of the limiting protections is active (see Section 0)
20	GND	

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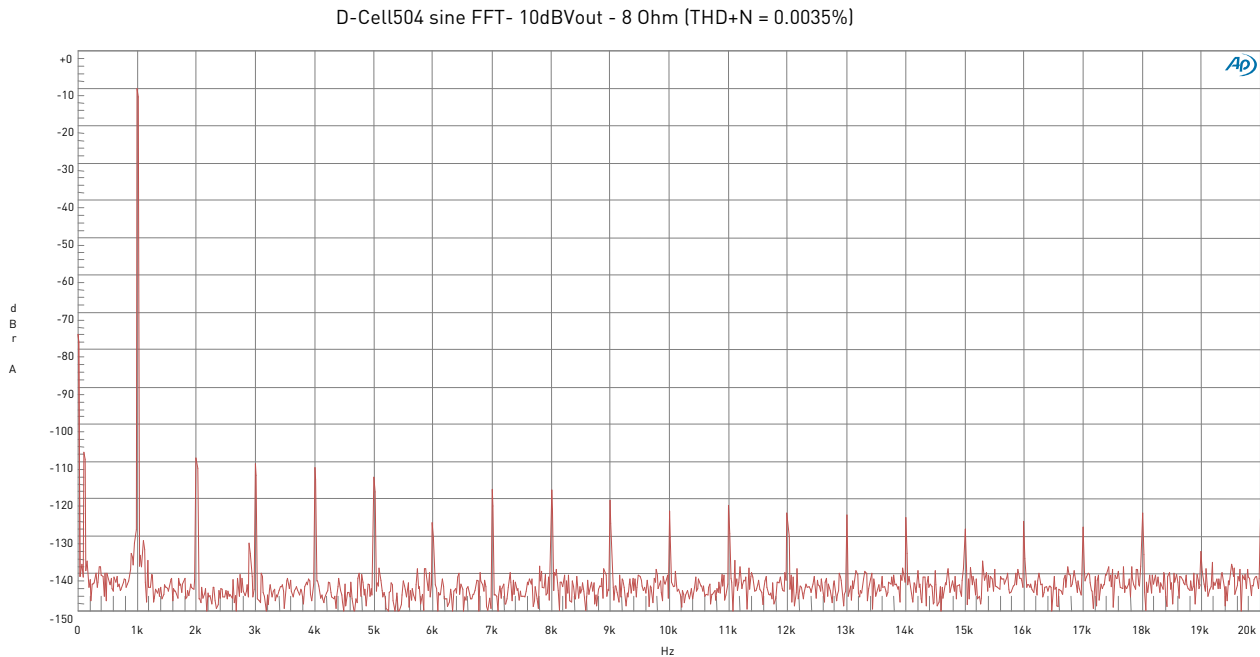
CN3: Pins description

PIN	Description	Notes
1	+VCC	
2	+VCC	
3	+VCC	
4	+VCC	
5	GND	
6	GND	
7	+12VDC	Connect to pin 7 of CN800T connector on Power Supply Unit
8	+7.5 VDC	Connect to pin 8 of CN800T connector on Power Supply Unit
9	Reserved	To not be used
10	-12VDC	Connect to pin 10 of CN800T connector on Power Supply Unit
11	GND	
12	GND	
13	-VCC	
14	-VCC	
15	-VCC	
16	-VCC	

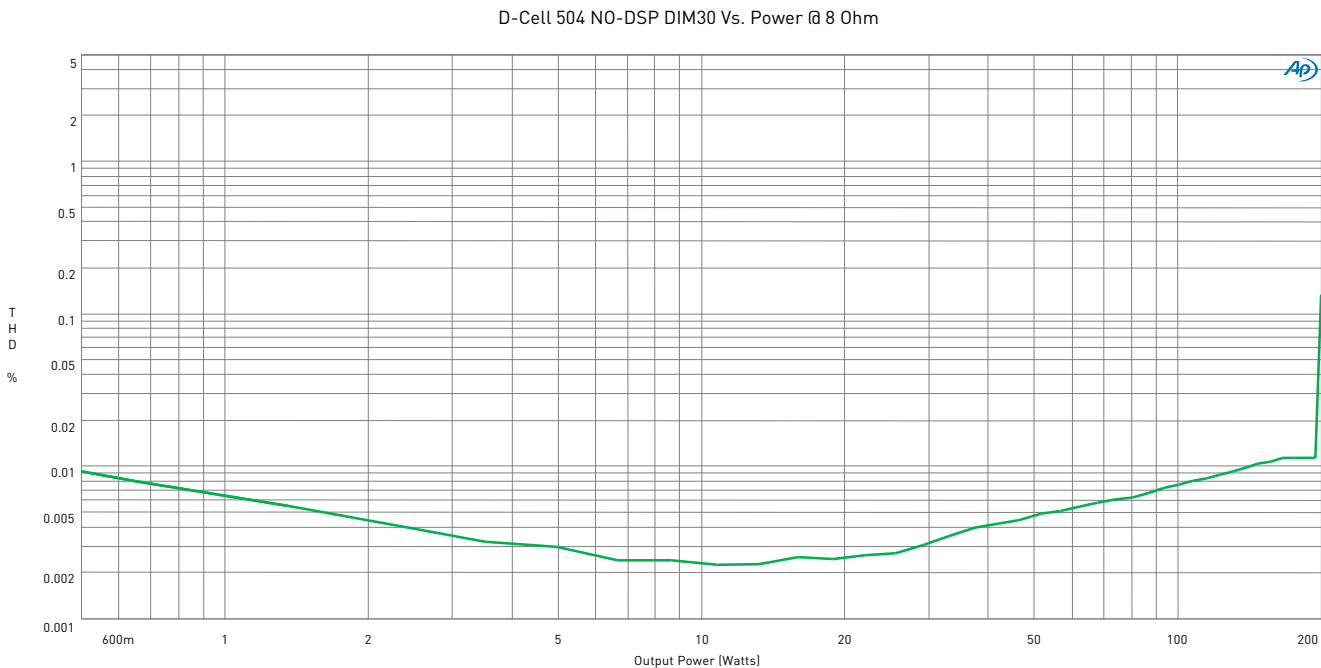
APPENDIX B: AUDIO PERFORMANCES

D-Cell504

FFT



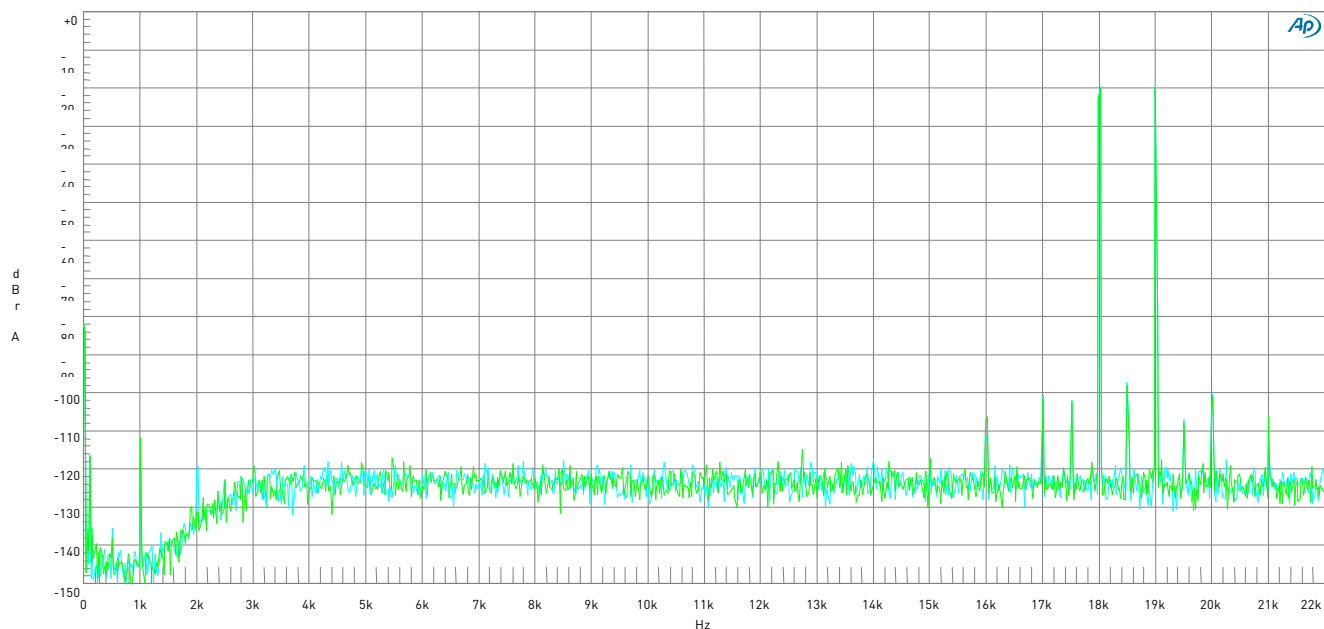
DIM30 VS. POWER



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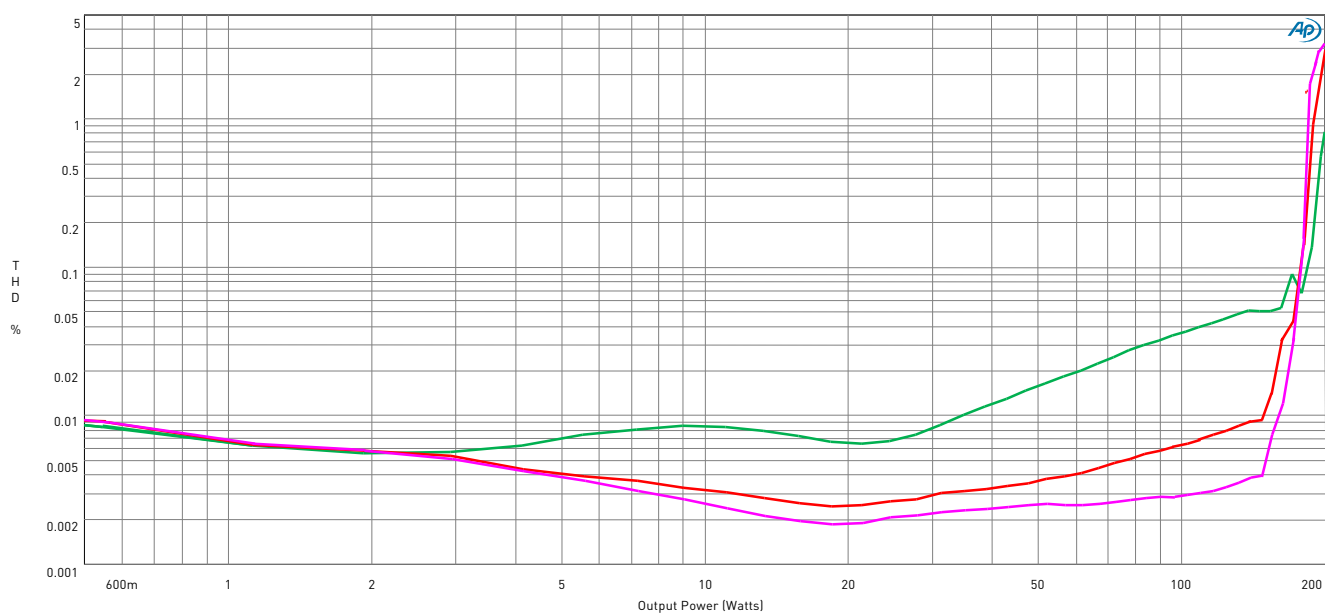
INTERMODULATION DISTORTION

D-Cell504NO-DSP FFT IMD (18.5KHz-1KHz)- 20dBV_{out} (respect max. voltage - 4 Ohm (THD+N = 0.0025%))



THD VS. POWER

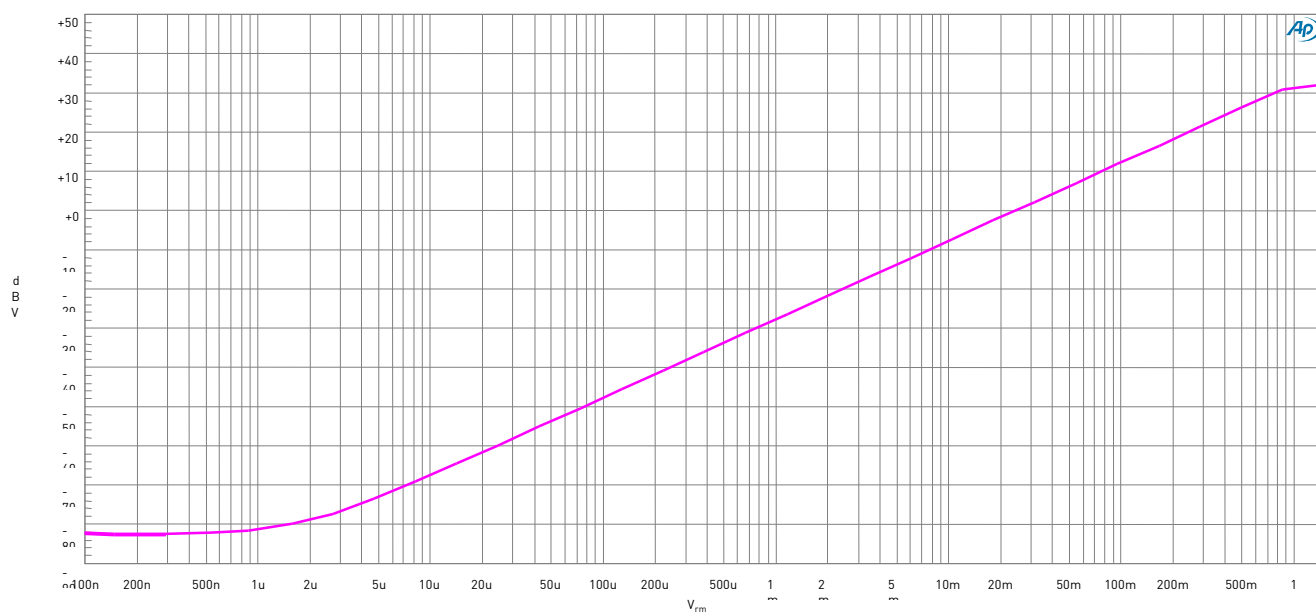
D-Cell 504 NO-DSP THD Vs. Power 100Hz- 1KHz- 7KHz @ 8 Ohm



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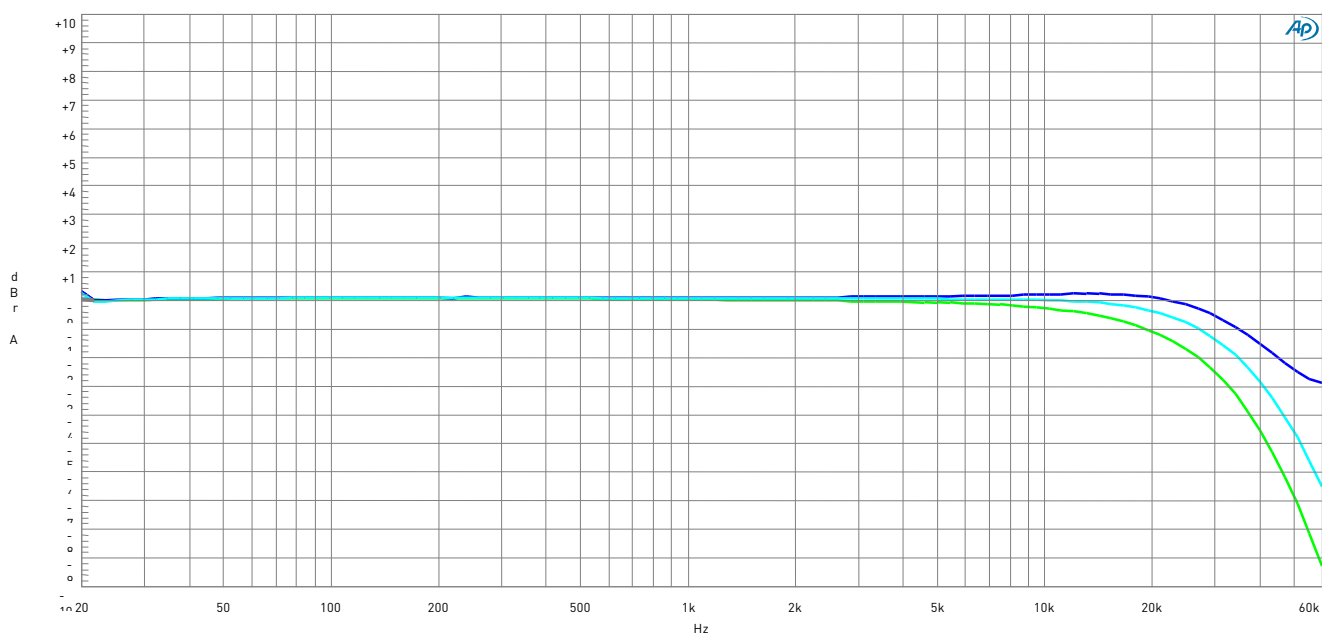
DYNAMIC RANGE

D-Cell504 NO-DSP Dynamic Range @ 8 Ohm



FREQUENCY RESPONSE

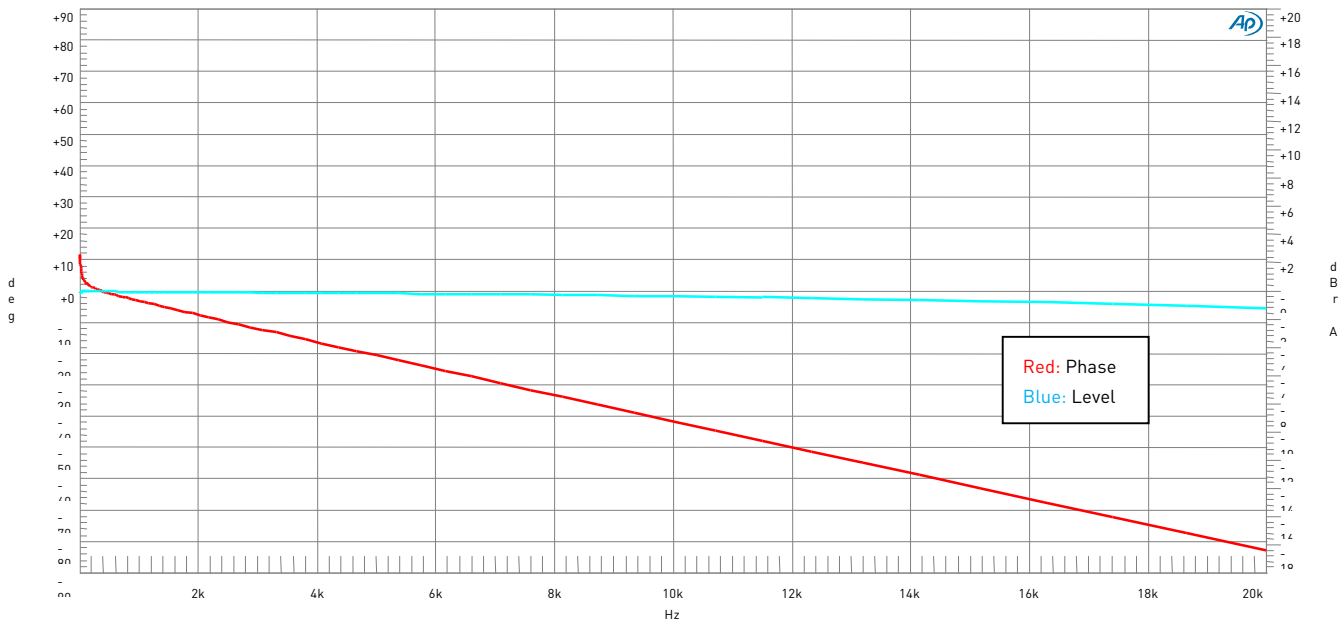
D-Cell504 NO-DSP Frequency Response **Open** **80hm** **4 Ohm**



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I/O PHASE VS. FREQUENCY

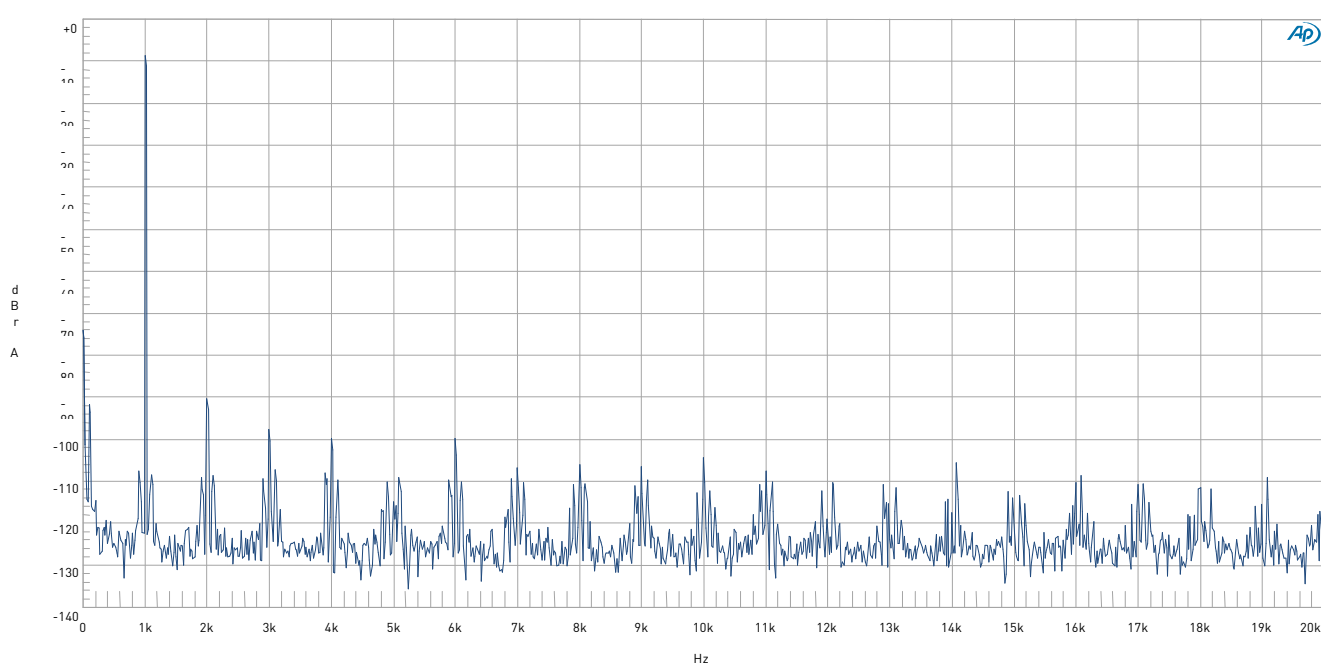
D-Cell504 NO-DSP In-Out Phase 8 Ohm (total delay = 9 μ s)



D-Cell504DSP & D-Cell504DSP IS

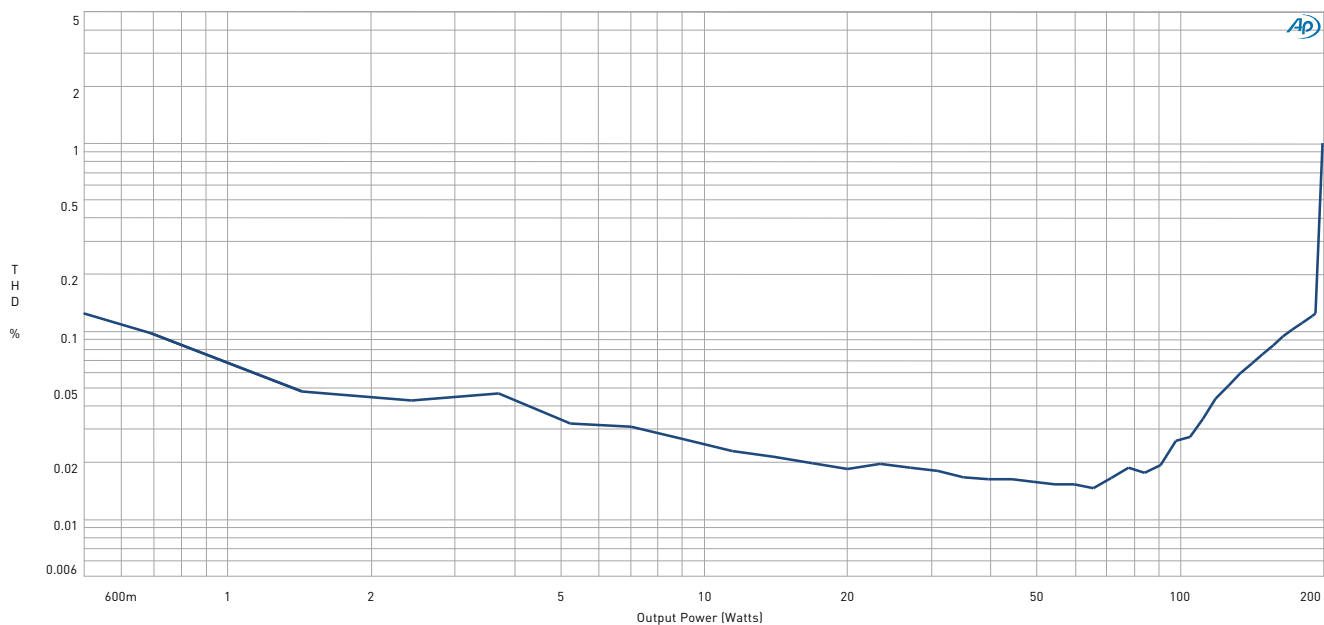
FFT

D-Cell504DSP sine FFT- 10dBV_{out} (respect to max voltage) - 8 Ohm (THD+N = 0.015%)



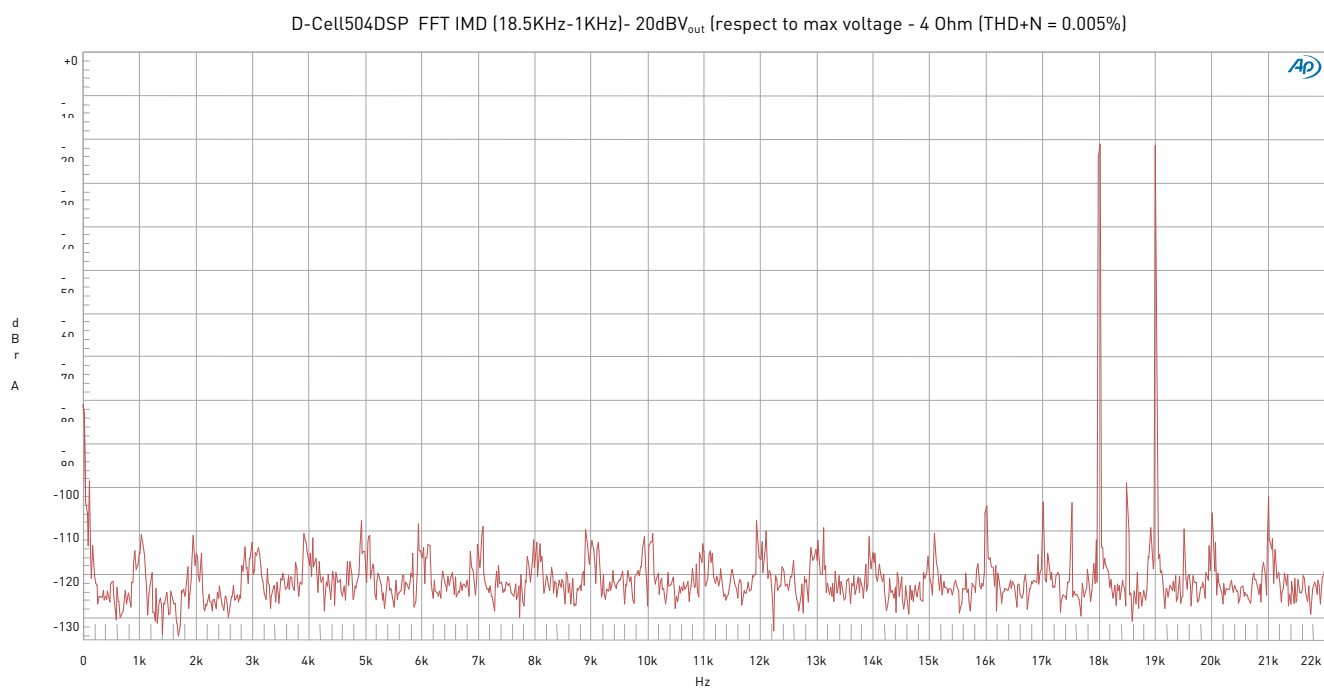
DIM30 VS. POWER

D-Cell 504DSP DIM30 Vs. Power @ 8 Ohm

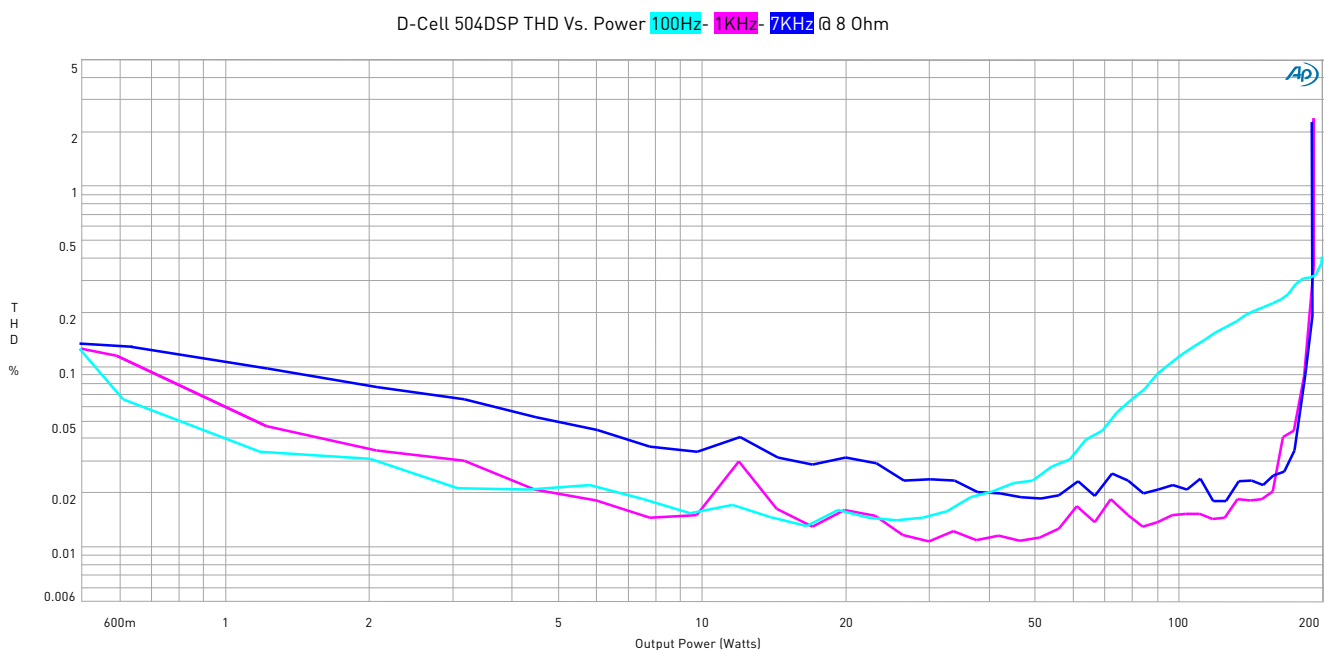


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INTERMODULATION DISTORTION



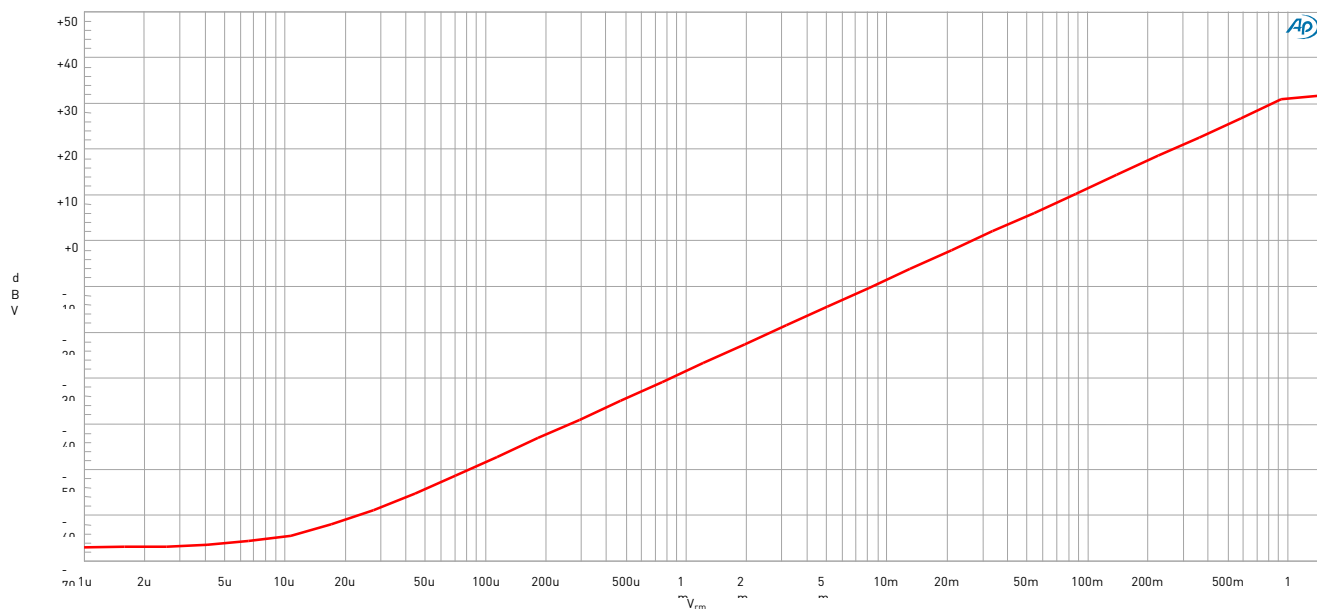
THD VS. POWER



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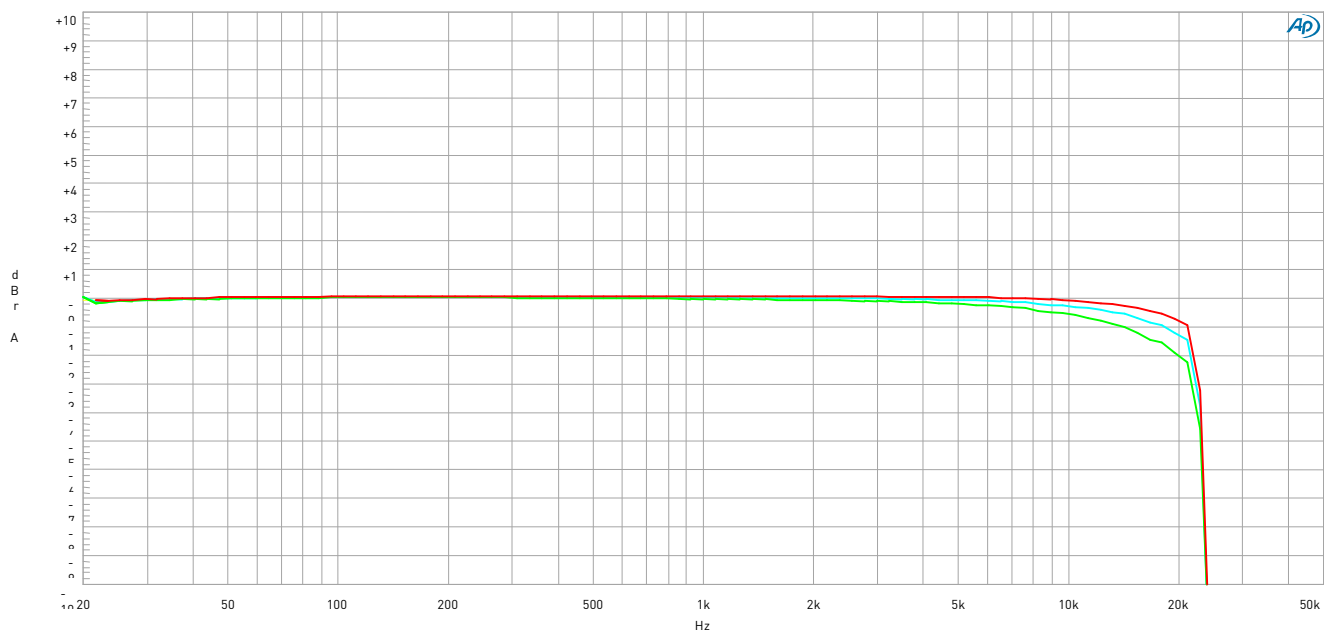
DYNAMIC RANGE

D-Cell504DSP Dynamic Range @ 8 Ohm



FREQUENCY RESPONSE

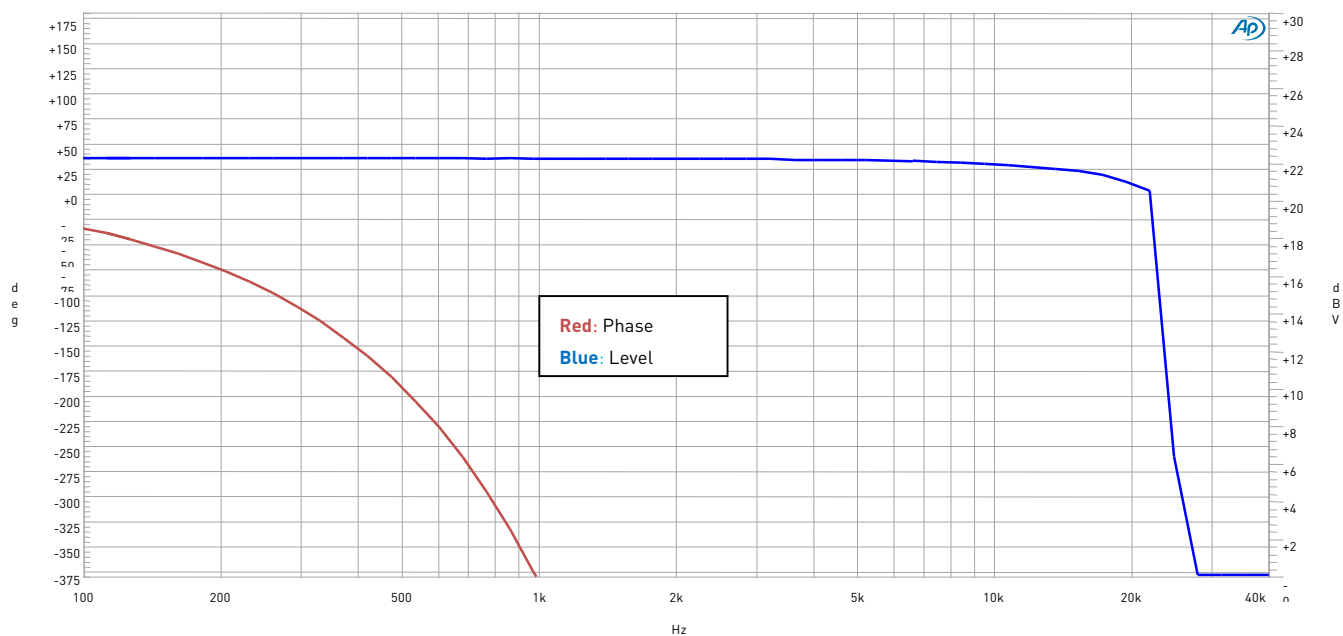
D-Cell504DSP Frequency Response **Open** - **8 Ohm** - **4 Ohm**



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I/O PHASE VS. FREQUENCY

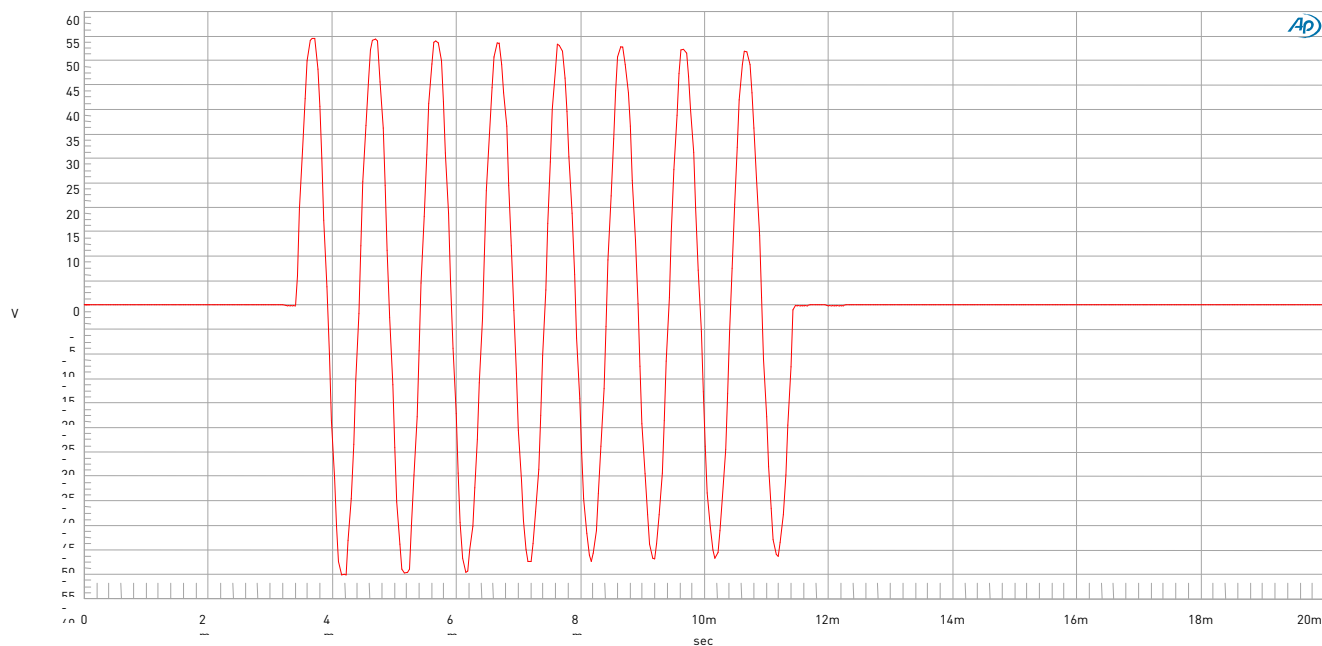
D-Cell504DSP In-Out Phase 8 Ohm (total delay = 1 ms)



COMMON MEASURES D-Cell504DSP / D-Cell504

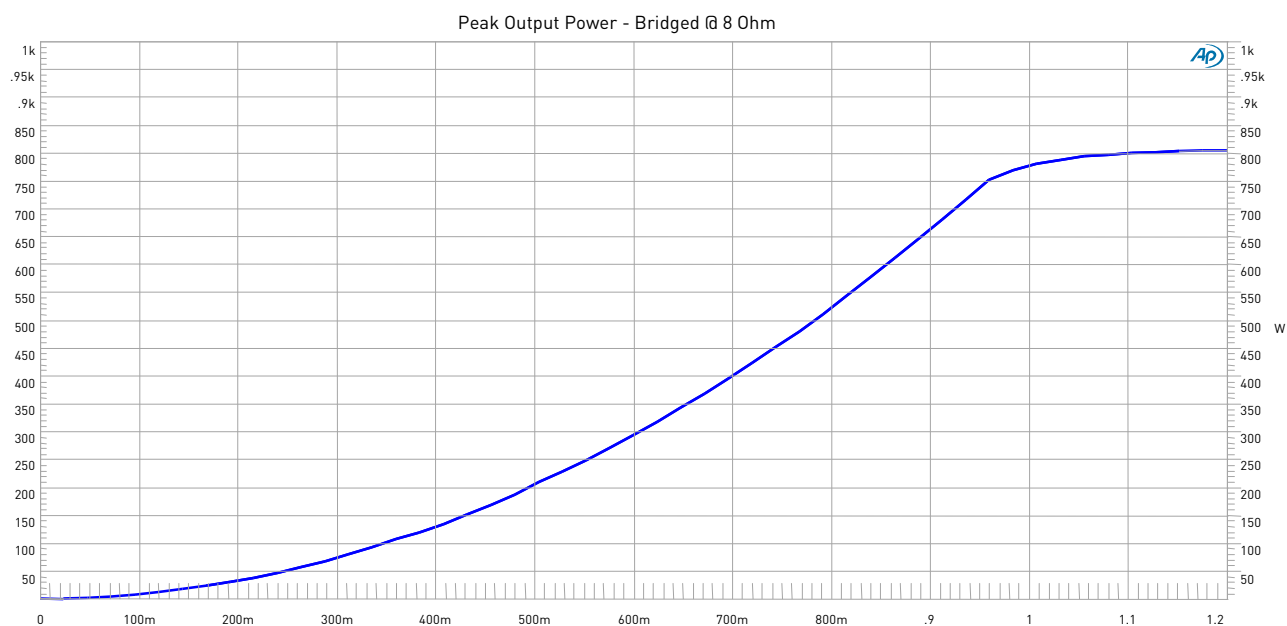
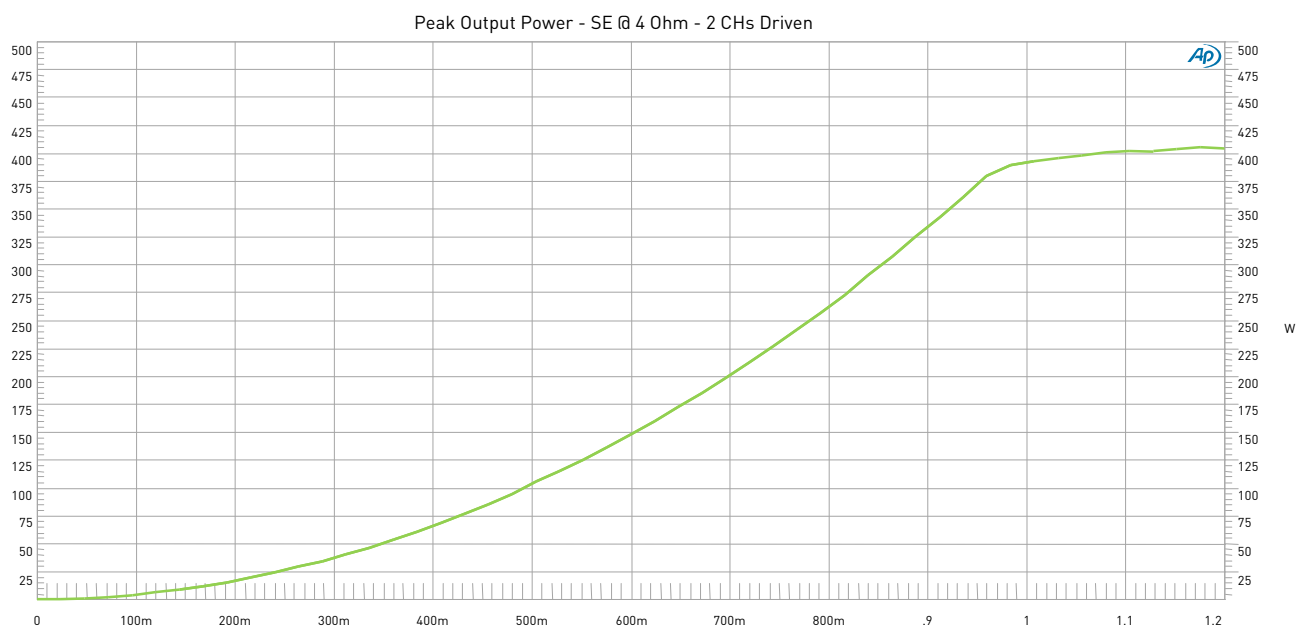
EIAJ BURST

Burst - 0dBV @ 4 Ohm



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PEAK OUTPUT POWER



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