

|   |                                      |  |
|---|--------------------------------------|--|
|  | <b>CRANIUM<br/>AUDIO<br/>DESIGNS</b> | <b>Application Note:</b><br><br><b>Keen Ocean<br/>TKO-1000/500W-Family</b> |
|---|--------------------------------------|--|

Written By: Cam Jones

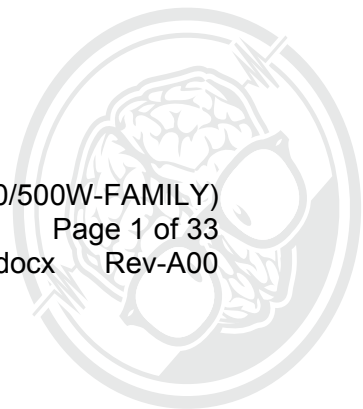
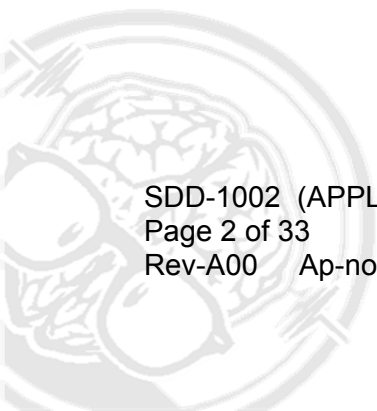


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# 1. Amplifier modules

## Assembly Part numbers

| Part Number | Description                        |
|-------------|------------------------------------|
| MSA-0004-00 | ASSY FINAL TKO-1000W-AMP           |
| MSA-0004-01 | ASSY FINAL TKO-500W-AMP            |
| MSA-0004-02 | ASSY FINAL TKO-1000W-AMP (500W,X1) |
| MSA-0004-03 | ASSY FINAL TKO-500W-AMP (250W,X1)  |

Note that the MSA-0004-02 and MSA-0004-03 are mono amplifiers. On these mono amplifiers, only Channel-1 is populated on the standard 2 channel amplifier board.

## Key Features

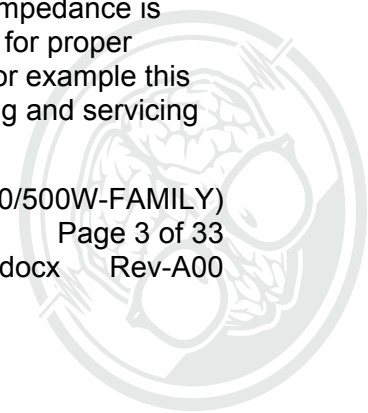
- Dual-mode output stage feedback.
- Input stage soft-clip circuitry.
- Real time readout of amplifier load impedance.
- High power 35A / 150V high speed output Stage FETs (TKO-500W-AMP).
- High power 65A / 200V high speed output Stage FETs (TKO-1000W-AMP).
- 4-transistor discrete high current high speed gate drive stage (TKO-1000W-AMP).
- Extensive load and module protection circuits.

The TKO-1000W-AMP and TKO-500W-AMP assemblies are stand-alone flat panel power solutions designed to be mounted to a supplemental flat panel heatsink. Each 1000W module offers 2 channels of 500W class-D power or 1000W of power into a bridge tied load. Each 500W module offers 2 channels of 250W class-D power or 500W of power into a bridge tied load. Up to two modules can be used in the system, for a total of 4 output channels. Any combination of channel drive powers can be implemented by the end user and internal protection systems will not kick in for total output power levels up to 1000W or 500W for the respective power supplies.

Power supply protection is provided by each amplifier stage having an input soft clipping circuit. Should customer-defined limiters not kick-in for whatever reason; the total output power will be limited to 1100W for the 1000W system and 550W for the 500W system. While it is of course more desirable to limit the amplifier output power via the DSP limiters, the soft clipper allows for a second layer of protection for the overall power system. The soft clipper also displays a fairly benign clipping characteristic. It is not overly harsh to the ear so long as it's not called upon to act with high levels of attenuation.

A dual-mode output feedback topology has been implemented in our power amplifiers. Taking feedback both before and after the reconstruction filter results in lower distortion and greater high frequency linearity delivered to a real speaker load. The high frequency peaking seen on all Class-D output stage reconstruction filters (when driving reactive loading) can be greatly reduced using this type of topology.

Each amplifier also features real time monitoring of the average speaker load impedance. With speaker drive levels at 1W or greater, a voltage representing the output stage impedance is presented to the DSP board. These signals can be used to monitor each driver for proper operation, noting if a driver has opened-up or a voice coil has been shorted. For example this function can be used in a networked system as an aid to monitoring, maintaining and servicing each cabinet in a large array.

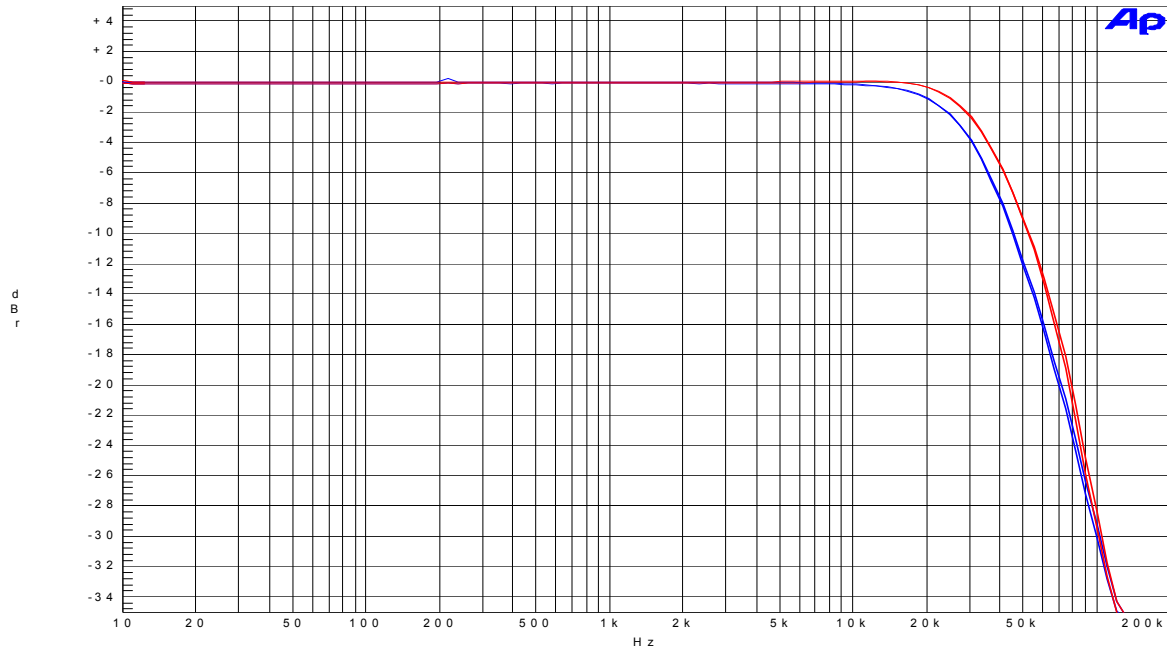


## Amplifier Specifications

| Power Amplifier Ratings  | TKO-500   | TKO-1000  |
|--|---|---|
| Amplifier Topology   | Class-D<br>(Phase-shift self-oscillating Modulation)  |   |
| Carrier Frequency (@ Idle)   | ≈ 400KHz  |   |
| Output Power (0dBr) <ul style="list-style-type: none"> <li>- Both Channels Driven</li> <li>- <math>F_o = 1\text{KHz}</math>, &lt; 3% THD</li> </ul>  | 250W / 250W into 4Ω<br>125W / 125W into 8Ω<br>500W into 8Ω Bridged  | 500W / 500W into 4Ω<br>250W / 250W into 8Ω<br>1000W into 8Ω Bridged |
| Total Harmonic Distortion <ul style="list-style-type: none"> <li>- 1W to ½ rated power (-3dBr)</li> <li>- <math>F_o = 20\text{Hz} - 7\text{KHz}</math></li> <li>- 22KHz measurement bandwidth</li> </ul> | less than 0.2% (Less than 0.01% typical)  |   |
| Power Response <ul style="list-style-type: none"> <li>- 20Hz to 20KHz</li> <li>- 1/2th Rated power (-3dBr)</li> <li>- 4Ω, 8Ω &amp; ∞ resistive loading</li> </ul>  | ± 2dB   |   |
| Dynamic Range<br>(22Hz - 20KHz measurement Bandwidth, referenced to 0dBr)  | 104dB (106dB Typical)   |   |
| Typical Amplifier Efficiency   | 89% @ Full power (1KHz Sine Stimulus)   |   |
| Input Impedance  | 22.5KΩ Balanced   |   |
| Input Signal Preconditioning   | 2nd order Butterworth (-3dB @ 32KHz)  |   |
| Voltage Gain   | 20.0dB (10V / V)  | 23.0dB (14.1V / V)  |
| Input Sensitivity (for 0dBr output)  | +10.0dBV  | +10.0dBV  |
| Output DC Offset   | less than ± 50mV (less than ± 1mV typical)  |   |
| Reconstruction Filter Response   | 2nd order Butterworth @ 41KHz<br>(4Ω resistive loading)   |   |
| Carrier Bleed-Through  | less than 3V p/p (@ idle)   |   |
| Output Muting  | Via speaker relay: Turn-on and turn-off of amplifiers completely silent.  |   |
| Real-time output resistance detector   | 100mV / Ω<br>(@ 1W of output power or greater)  |   |
| Module and Load Protections  | Amplifier Soft Clipper<br>Output DC offset<br>Output stage over current<br>Short circuit protection<br>Amplifier and PSU over temperature<br>Loss of AC Power<br>High frequency pre-loading |   |

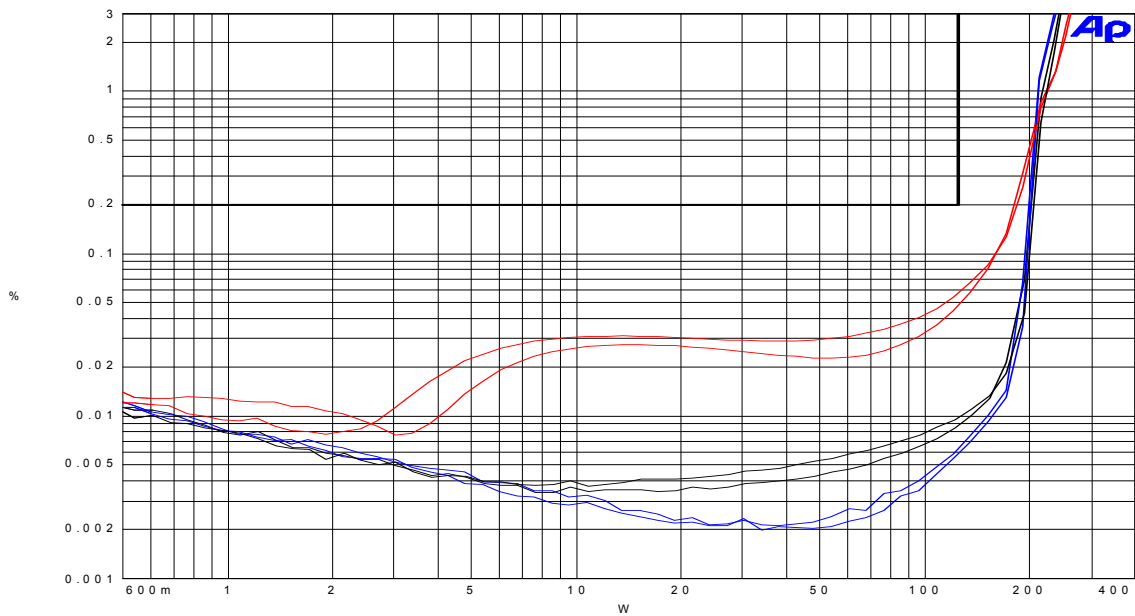


## 500W Performance Measurements Power Response @ 1/2 Power



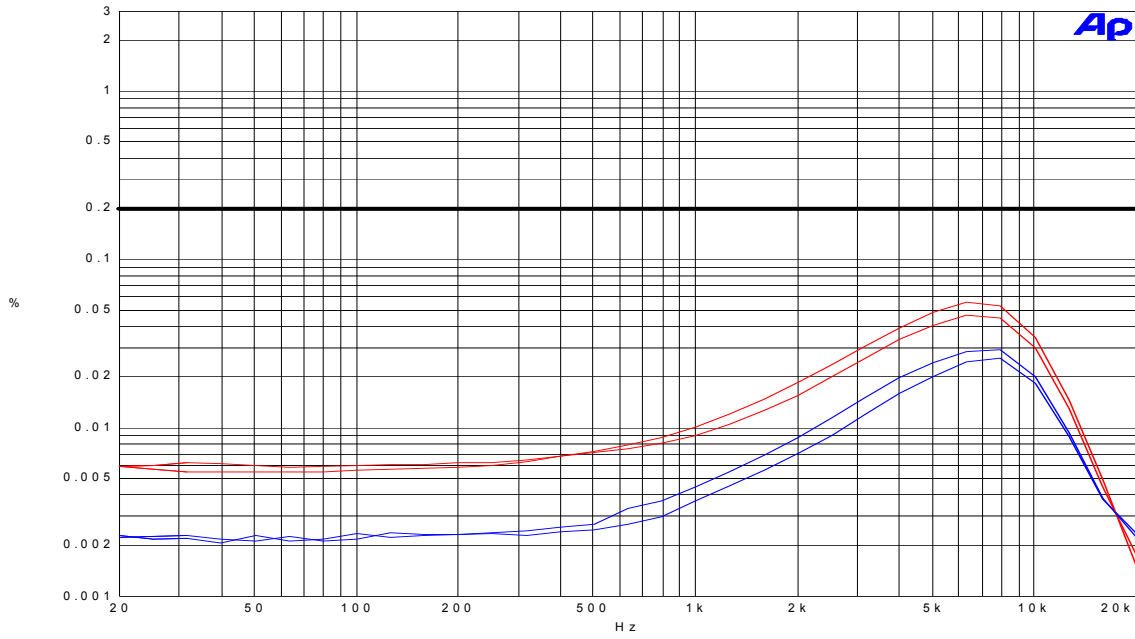
| Sweep | Trace | Color | Line Style | Thick | Data      | Axis | Comment          |
|-------|-------|-------|------------|-------|-----------|------|------------------|
| 1     | 1     | Blue  | Solid      | 1     | Anlr.Ampl | Left | CH-1 INTO 4 OHMS |
| 1     | 2     | Blue  | Dot        | 1     | Anlr.Ampl | Left | CH-2 INTO 4 OHMS |
| 2     | 1     | Red   | Solid      | 1     | Anlr.Ampl | Left | CH-1 INTO 8 OHMS |
| 2     | 2     | Red   | Dot        | 1     | Anlr.Ampl | Left | CH-2 INTO 8 OHMS |

## THD-VS-Level into 4Ω (22 KHz measurement bandwidth)



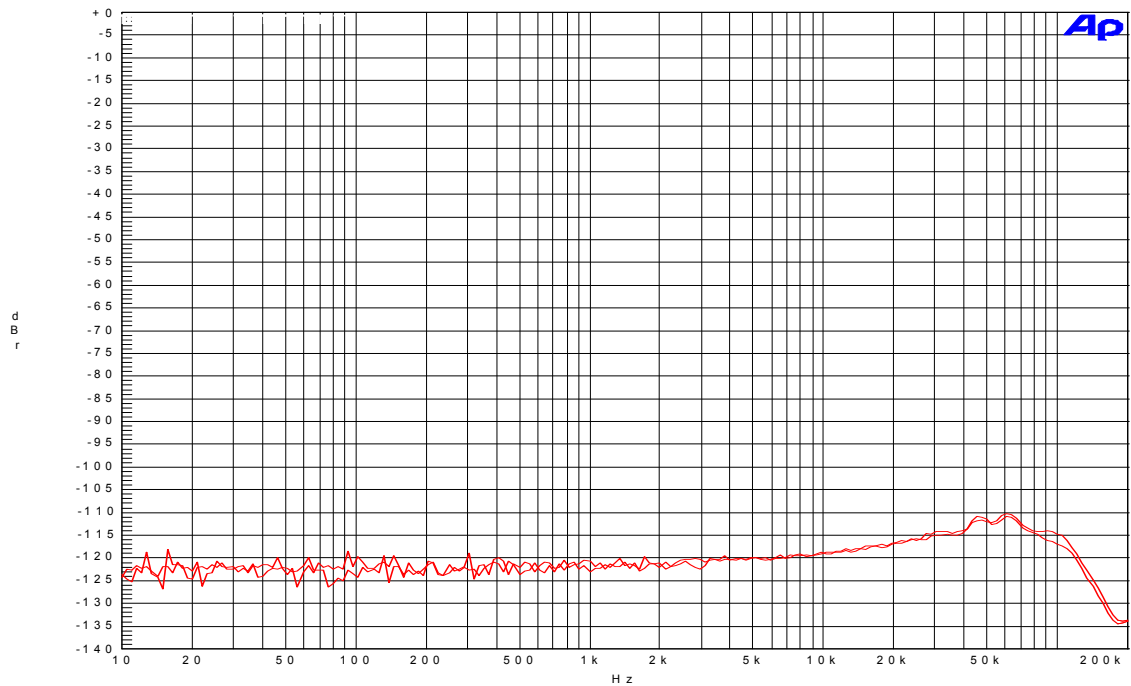
| Sweep | Trace | Color | Line Style | Thick | Data                | Axis | Comment         |
|-------|-------|-------|------------|-------|---------------------|------|-----------------|
| 4     | 1     | Black | Solid      | 2     | S1.Anlr.THD+N Ratio | Left | SPECIFIED LIMIT |
| 6     | 1     | Black | Solid      | 1     | S1.Anlr.THD+N Ratio | Left | CH-1 1KHz       |
| 7     | 1     | Blue  | Solid      | 1     | S1.Anlr.THD+N Ratio | Left | CH-1 20Hz       |
| 8     | 1     | Red   | Solid      | 1     | S1.Anlr.THD+N Ratio | Left | CH-1 7KHz       |
| 6     | 3     | Black | Dot        | 1     | S1.Anlr.THD+N Ratio | Left | CH-2 1KHz       |
| 7     | 3     | Blue  | Dot        | 1     | S1.Anlr.THD+N Ratio | Left | CH-2 20Hz       |
| 8     | 3     | Red   | Dot        | 1     | S1.Anlr.THD+N Ratio | Left | CH-2 7KHz       |

### THD-VS-Frequency into 4Ω (22 KHz measurement bandwidth)



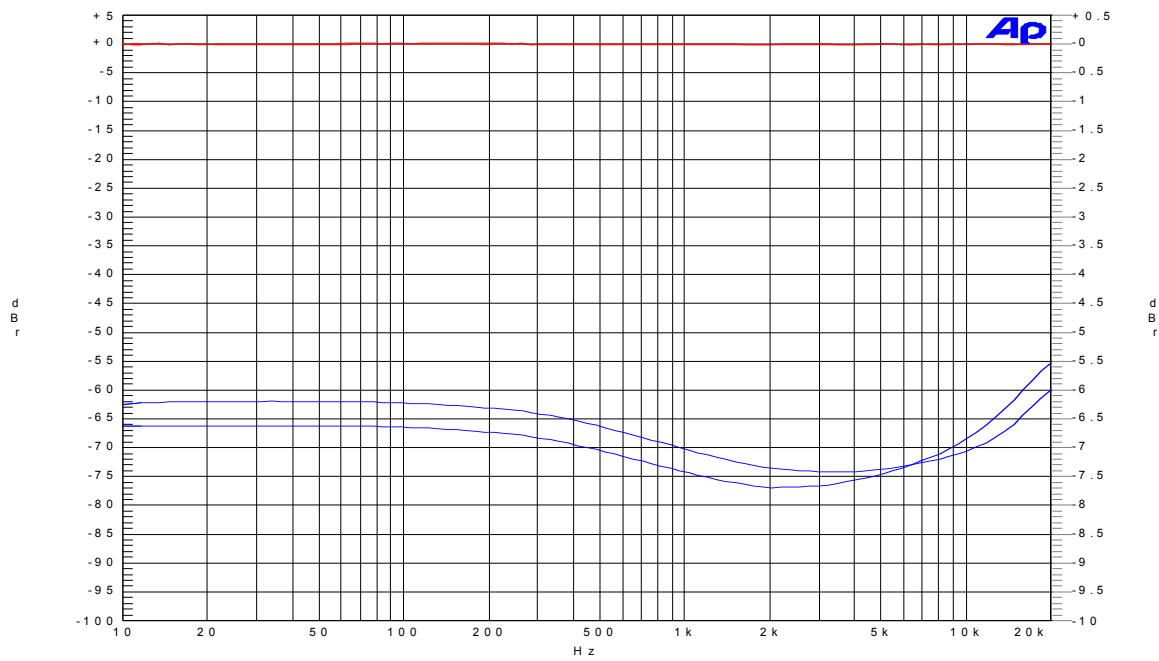
| Sweep | Trace | Color | Line Style | Thick | Data                 | Axis | Comment          |
|-------|-------|-------|------------|-------|----------------------|------|------------------|
| 1     | 1     | Black | Solid      | 4     | S1.A nlr.THD+N Ratio | Left | SPECIFIED LIM IT |
| 6     | 1     | Red   | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-1 @ 125W      |
| 7     | 1     | Blue  | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 25W       |
| 6     | 3     | Red   | Dot        | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 125W      |
| 7     | 3     | Blue  | Dot        | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 25W       |

### 1/3 Octave Noise Floor (0dB<sub>r</sub> = 250W into 4Ω)



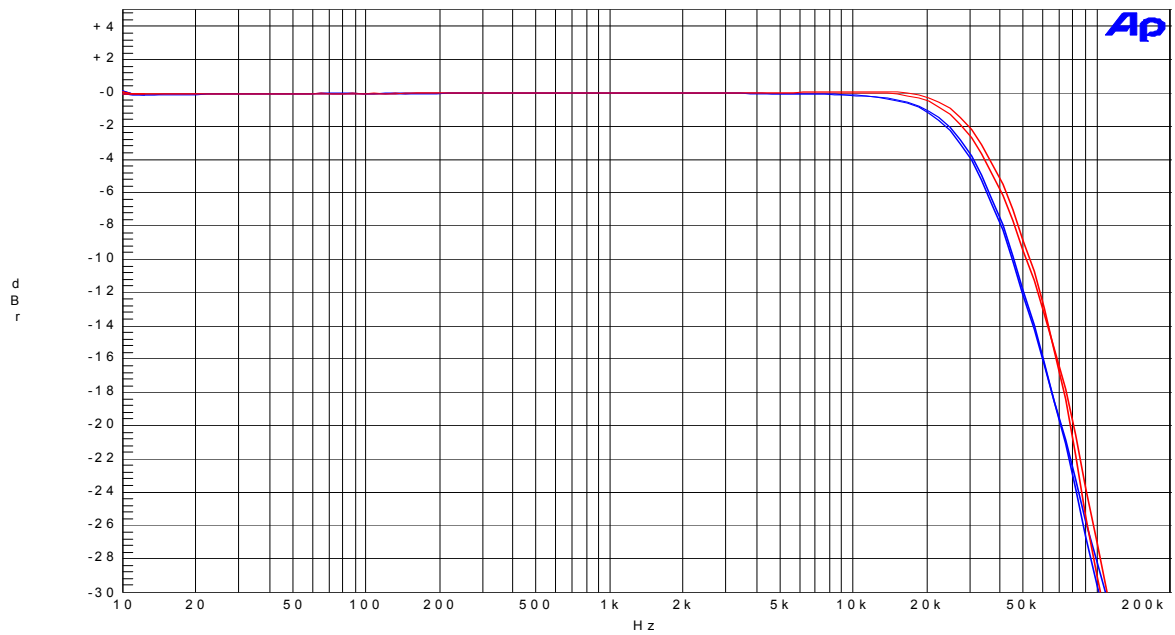
| Sweep | Trace | Color | Line Style | Thick | Data              | Axis | Comment |
|-------|-------|-------|------------|-------|-------------------|------|---------|
| 1     | 1     | Red   | Solid      | 1     | S1.A nlr.Bandpass | Left | CH-1    |
| 2     | 2     | Red   | Solid      | 1     | S1.A nlr.Bandpass | Left |         |

### Crosstalk into 4Ω @ 1/10<sup>th</sup> Rated Power (25W)

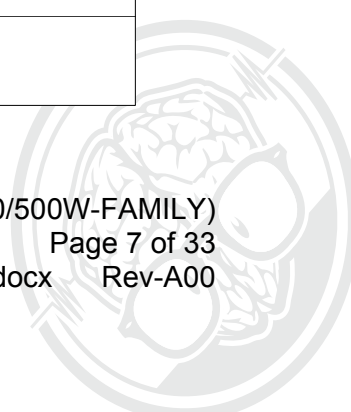


| Sweep | Trace | Color | Line Style | Thick | Data         | Axis  | Comment               |
|-------|-------|-------|------------|-------|--------------|-------|-----------------------|
| 1     | 1     | Blue  | Solid      | 1     | Anlr.BP Ampl | Left  | X-TALK CH-2 INTO CH-1 |
| 1     | 2     | Red   | Solid      | 1     | Anlr.Level B | Right | CH-2 OUTPUT DRIVE     |
| 2     | 1     | Blue  | Dot        | 1     | Anlr.BP Ampl | Left  | X-TALK CH-1 INTO CH-2 |
| 2     | 2     | Red   | Dot        | 1     | Anlr.Level A | Right | CH-1 OUTPUT DRIVE     |

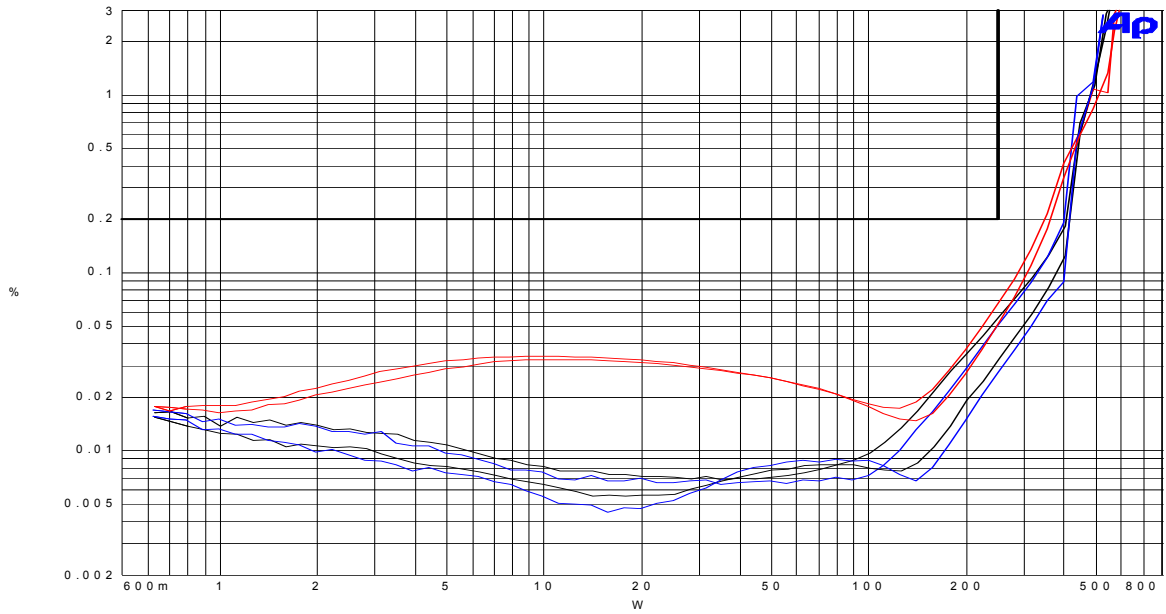
### 1000W Performance Measurements Power Response @ 1/2 Power



| Sweep | Trace | Color | Line Style | Thick | Data         | Axis | Comment          |
|-------|-------|-------|------------|-------|--------------|------|------------------|
| 7     | 1     | Blue  | Solid      | 1     | S1.Anlr.Ampl | Left | CH-1 INTO 4 OHMS |
| 8     | 1     | Red   | Solid      | 1     | S1.Anlr.Ampl | Left | CH-1 INTO 8 OHMS |
| 7     | 2     | Blue  | Solid      | 1     | S1.Anlr.Ampl | Left | CH-2 INTO 4 OHMS |
| 8     | 2     | Red   | Solid      | 1     | S1.Anlr.Ampl | Left | CH-2 INTO 4 OHMS |

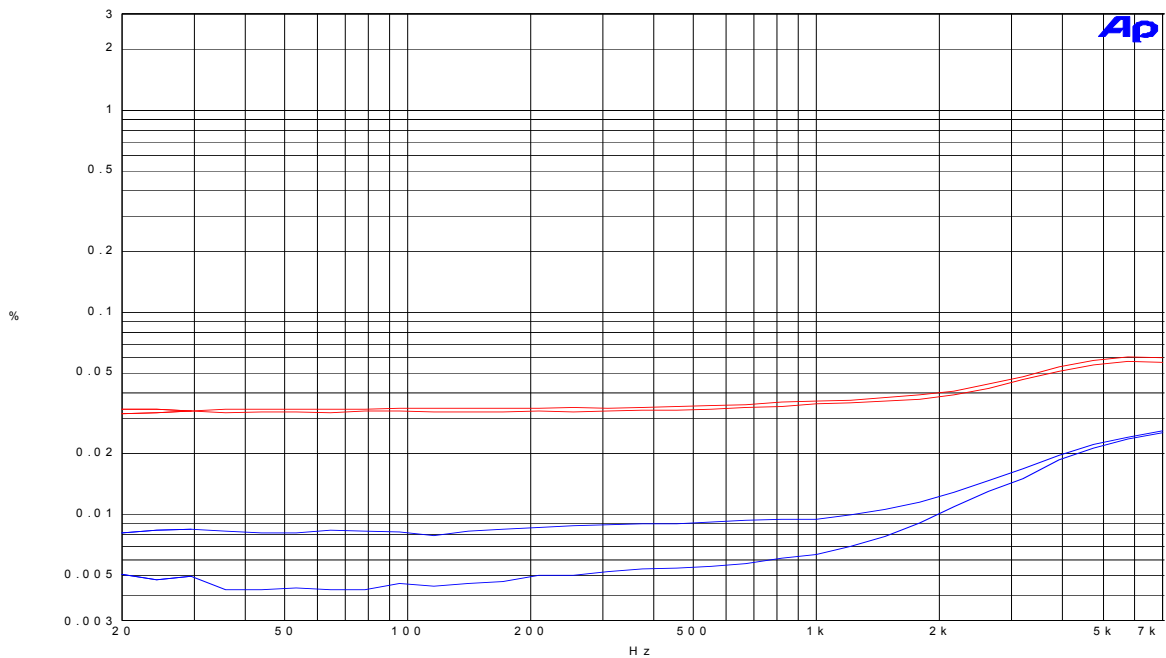


### THD-VS-Level into 4Ω (22 KHz measurement bandwidth)



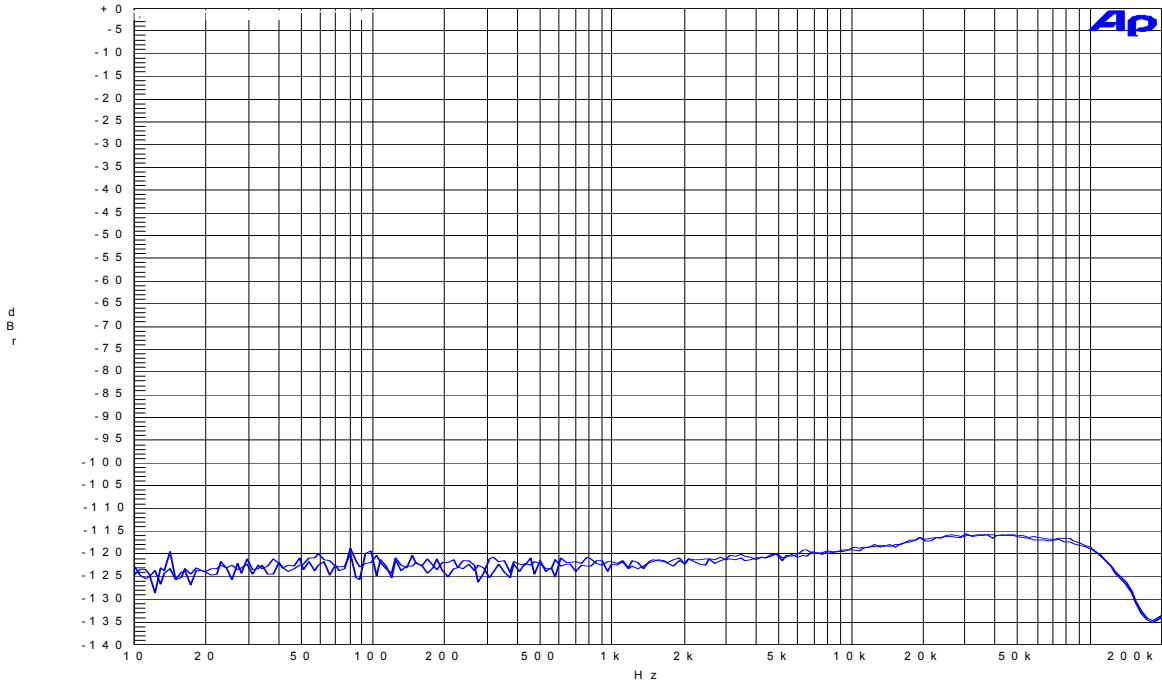
| Sweep | Trace | Color | Line Style | Thick | Data                 | Axis | Comment      |
|-------|-------|-------|------------|-------|----------------------|------|--------------|
| 4     | 1     | Black | Solid      | 2     | S1.A nlr.THD+N Ratio | Left |              |
| 17    | 1     | Black | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-1 @ 1 KHz |
| 18    | 1     | Blue  | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-1 @ 20Hz  |
| 19    | 1     | Red   | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-1 @ 7 KHz |
| 17    | 3     | Black | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 1 KHz |
| 18    | 3     | Blue  | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 20Hz  |
| 19    | 3     | Red   | Solid      | 1     | S1.A nlr.THD+N Ratio | Left | CH-2 @ 7 KHz |

### THD-VS-Frequency into 4Ω (22 KHz measurement bandwidth)



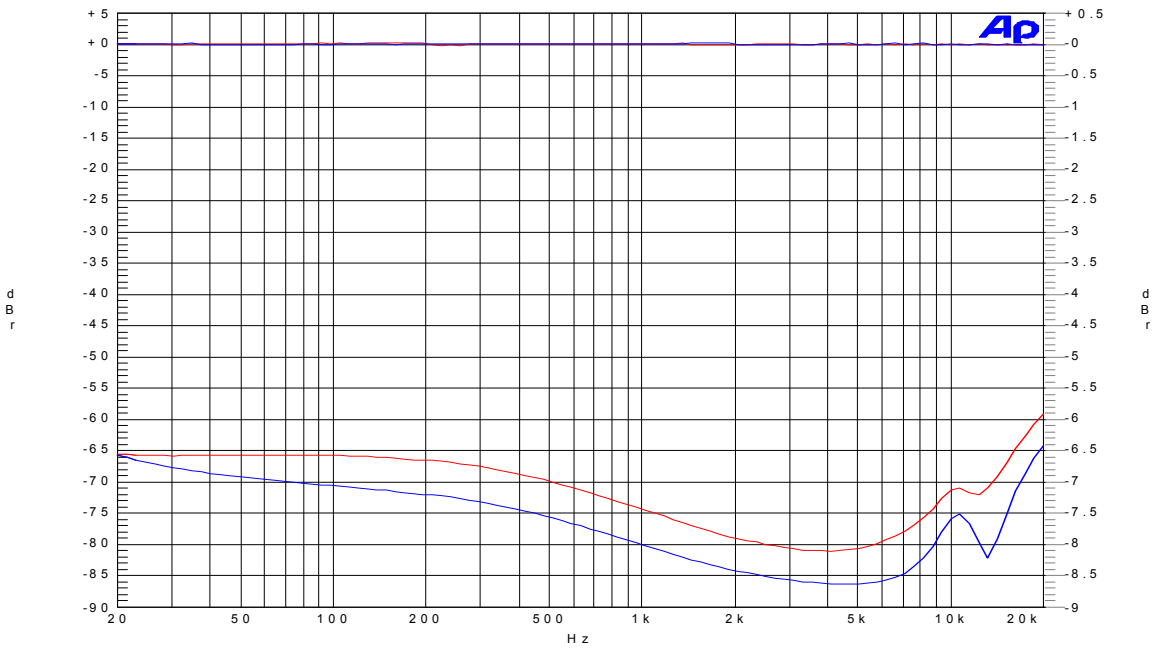
| Sweep | Trace | Color | Line Style | Thick | Data             | Axis | Comment     |
|-------|-------|-------|------------|-------|------------------|------|-------------|
| 9     | 1     | Red   | Solid      | 1     | Anlr.THD+N Ratio | Left | CH-1 @ 250W |
| 9     | 3     | Red   | Dot        | 1     | Anlr.THD+N Ratio | Left | CH-2 @ 250W |
| 10    | 1     | Blue  | Solid      | 1     | Anlr.THD+N Ratio | Left | CH-1 @ 50W  |
| 10    | 3     | Blue  | Dot        | 1     | Anlr.THD+N Ratio | Left | CH-2 @ 50W  |

### 1/3 Octave Noise Floor (0dBr = 500W into 4Ω)

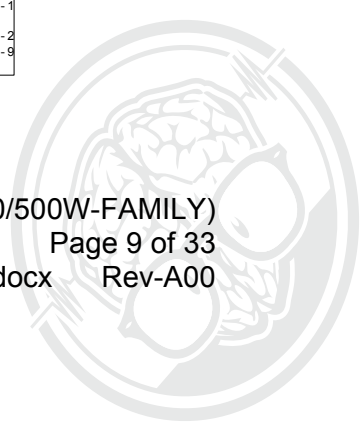


| Sweep | Trace | Color | Line Style | Thick | Data            | Axis | Comment |
|-------|-------|-------|------------|-------|-----------------|------|---------|
| 6     | 1     | Blue  | Solid      | 1     | S1.Anr.Bandpass | Left | CH-1    |
| 6     | 2     | Blue  | Dot        | 1     | S1.Anr.Bandpass | Left | CH-2    |

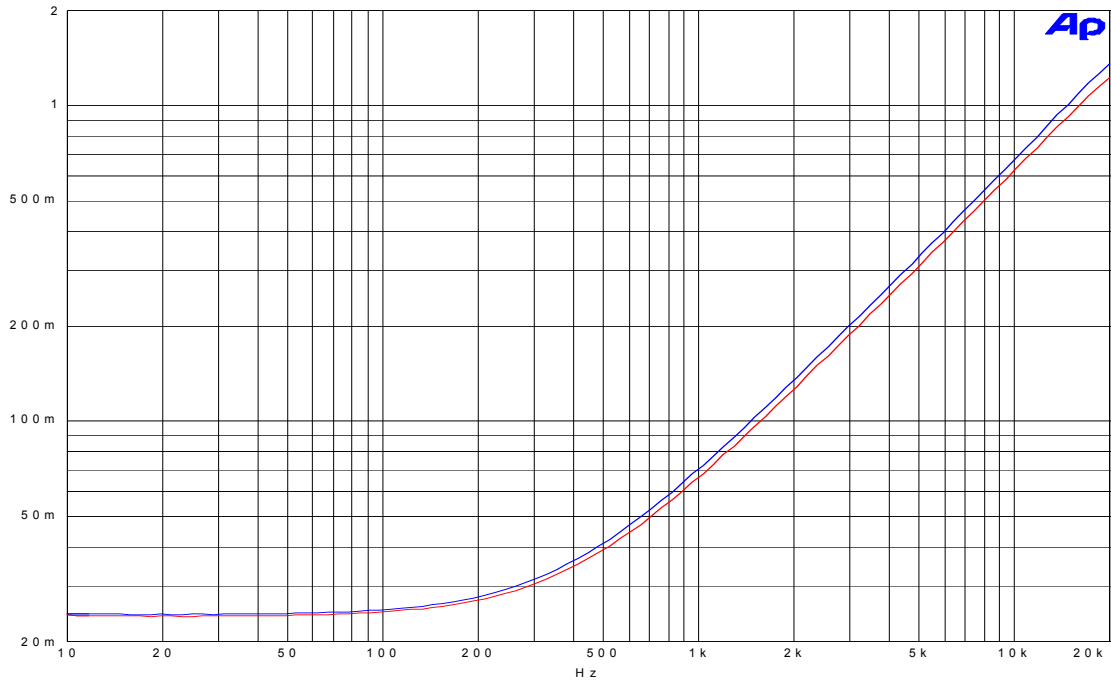
### Crosstalk into 4Ω @ 1/10<sup>th</sup> Rated Power (50W)



| Sweep | Trace | Color | Line Style | Thick | Data        | Axis  | Comment              |
|-------|-------|-------|------------|-------|-------------|-------|----------------------|
| 5     | 1     | Red   | Solid      | 1     | Anr.BP Ampl | Left  | XTALK CH-2 INTO CH-1 |
| 5     | 2     | Red   | Dot        | 1     | Anr.Level B | Right | CH-2 OUTPUT DRIVE    |
| 6     | 1     | Blue  | Dot        | 1     | Anr.BP Ampl | Left  | XTALK CH-1 INTO CH-2 |
| 6     | 2     | Blue  | Solid      | 1     | Anr.Level A | Right | CH-1 OUTPUT DRIVE    |

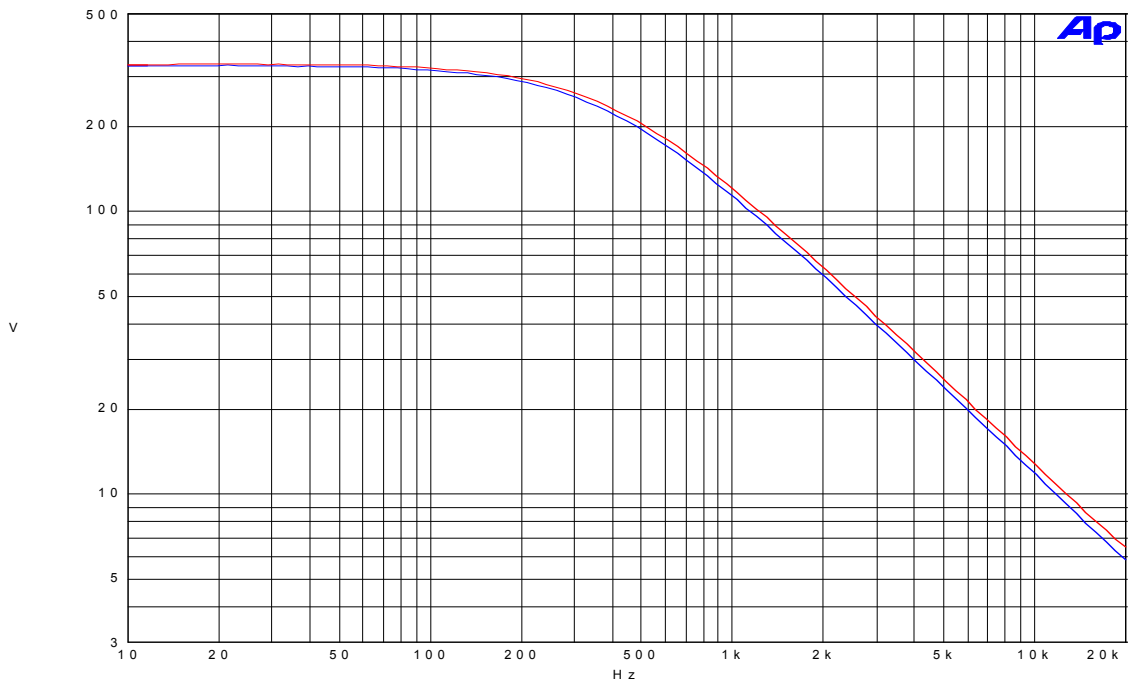


### Output Impedance (Ohms)



| Sweep | Trace | Color | Line Style | Thick | Data              | Axis | Comment       |
|-------|-------|-------|------------|-------|-------------------|------|---------------|
| 1     | 1     | Red   | Solid      | 1     | Anlr.Ampl (2-Ch.) | Left | CH-1 OUTPUT-Z |
| 2     | 1     | Blue  | Dot        | 1     | Anlr.Ampl (2-Ch.) | Left | CH-2 OUTPUT-Z |

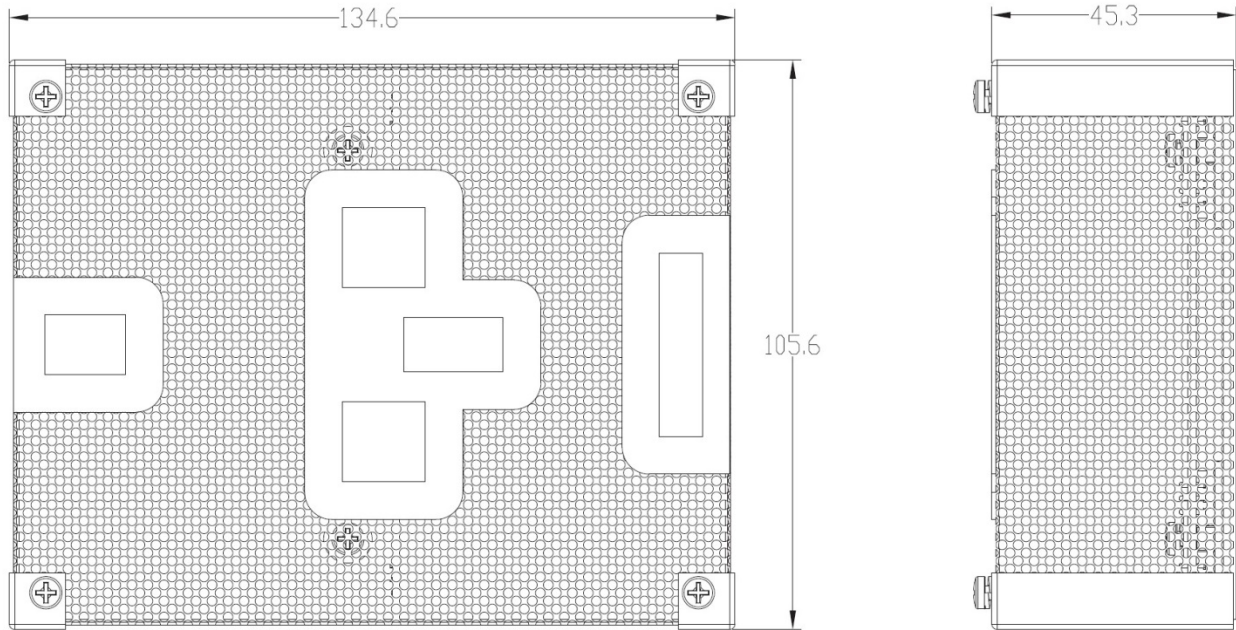
### Output Damping Factor into 8Ω



| Sweep | Trace | Color | Line Style | Thick | Data             | Axis | Comment |
|-------|-------|-------|------------|-------|------------------|------|---------|
| 1     | 1     | Red   | Solid      | 1     | S1.A nlr.Level A | Left | CH-1    |
| 2     | 1     | Blue  | Dot        | 1     | S1.A nlr.Level A | Left | CH-2    |

## Mechanical Dimensions

Weight: 1.05 Lbs. (0.48 KG)



## 2. Power Supply Modules

### Assembly Part numbers

| Part Number | Description              |
|-------------|--------------------------|
| MSA-0006-00 | ASSY FINAL TKO-1000W-PSU |
| MSA-0006-01 | ASSY FINAL TKO-500W-PSU  |

Note that both power supplies are switchable to operate either at 120VAC or 240VAC. Neither supply will operate from a 100VAC (Japan) nominal line voltage.

### Key Features

- Stiff / high speed regulation of main power supply rails.
  - Full output power delivery into transient loading.
  - Low AC line ripple component resulting in low intermodulation distortion.
- Zero Current Switching LLC power supply for Low RF emissions & less stress on switching FETs.
- High power auxiliary keep-alive power supply (7V @ 2.5A).
- Extensive protection circuits surrounding the power supply designed to keep our power system **and your end use product** intact!

The TKO-1000W-PSU and TKO-500W-PSU are flat-panel stand-alone modules, designed to be mounted to a supplemental flat panel heatsink. The power supply is a regulated series resonant LLC design operating from 100 – 260 KHz.

The control loop for this regulated supply has been carefully optimized to have a very tight regulation characteristic of just +3% / -5% from nominal: Why do you care? Because, for example on a hard kick drum transient, the system will deliver its full rated output power, resulting in a system with incredibly tight, punchy, and powerful bass. Given the high level of

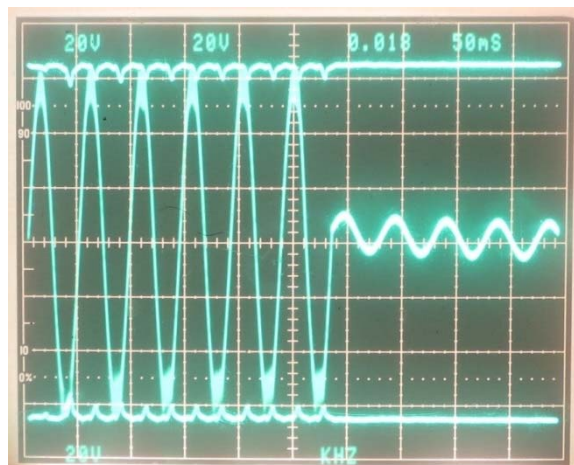


regulation exhibited by the TKO supplies, very little line frequency ripple (120Hz or 100Hz) is present on the rails. This contributes to very low intermodulation distortion when the amplifiers are driven hard (Into clipping).

To the right you will see a scope capture of the TKO-1000W power supply and amp driving a 20Hz sine wave driven to full-rated power of 1000W into an 8Ω bridge tied load. Note that the main two supplies remain regulated to  $\pm 66V$  showing only ripple voltage related to the 20Hz sine wave and that no 120Hz AC line related ripple is apparent. Also note the total lack of supply rail overshoot

Many competing companies use LLC power supplies that are not regulated. Alternately some companies use supplies with a PFC front end (a regulated supply) followed by an unregulated LLC stage. While PFC front ends do a wonderful job of keeping the AC line current in check, their ability to do this also prevents them from following load transients quickly.

To the right is a screen capture of the TKO-1000W amplifier connected to a supply with a PFC front end followed by an unregulated LLC supply. As you can see, even on the 1<sup>st</sup> 20Hz transient the power supply voltage has decayed from  $\pm 66V$  to just  $\pm 43V$ . Rather than the amp delivering the full 1000W of output power (63V peak) this power system is delivering just 400W of output power (40V peak).



Further, even after 300mS of full power loading, the supply is just now almost recovered to full regulated voltage being at around  $\pm 62V$  at the end of the 300mS transient.

Both the 1000W and 500W power supplies are equipped with a keep-alive supply. As a result, the DSP board can shut down or power-up the main power supply while remaining alert to reactivate the system on demand. This can be done digitally (on a family of products with network capability) or in the analog domain by sensing the lack of (or presence of) input signal to the system. This capability is tailored to building very large systems where the ability to wake up the system remotely is desirable. The keep-alive supply has a very high current capability of 2.5A at 7V. This much power for the DSP section can allow for a very complex DSP front end to be designed by our customer if they desire (Large LCD displays, lots of LED indicators, Bluetooth, networking, etcetera).



## AC Input Requirements

|  |  |                                       |  |  |
|--|--|---------------------------------------|--|--|
| Input Voltage Range<br>All World (excluding Japan) <sup>1</sup><br><sup>1</sup> Voltage selection to allow system to operate at the lower or higher input AC voltage range is set by either:<br>- Rear Panel Voltage selector Switch.<br>- PSU board level jumper.                       | 110 – 132VAC / 220 – 264VAC                                    |                                       |  |  |
| Input Frequency Range  | 50 – 60Hz  |                                       |  |  |
| TKO Powered System Size  | <b>500W System</b>   |                                       | <b>1000W System</b>                          |  |
| Input Power Requirements (Nominal)<br><sup>1</sup> Full rated output power<br><sup>1,2</sup> 20% (1/5) rated output power<br><sup>1,2</sup> 12.5% (1/8) rated output power<br>Module @ Idle (Quiescent Condition)<br><sup>1</sup> 1KHz Sine Stimulus<br><sup>2</sup> Pink Noise Stimulus | 120VAC<br>655W<br>155W<br>110W<br>30W                          | 240VAC<br>640W<br>150W<br>105W<br>30W | 120VAC<br>1300W<br>295W<br>200W<br>40W       | 240VAC<br>1210W<br>280W<br>195W<br>40W |
| Equipment Construction Class   | Class-I (To be used in products with a 3rd wire safety ground) |                                       |  |  |
| Inrush Surge Current (Cold Start)  | Less than 100A Peak at any input voltage.                      |                                       |  |  |
| Power Factor (@ Full output power)   | 0.70 typical   |                                       |  |  |
| Fusing   | F1 T 5A H 250V<br>F2 T 2.5A H 250V<br>F3 T 1A H 250V           |                                       | T 10A H 250V<br>T 2.5A H 250V<br>T 1A H 250V |  |

## End Use Product Markings

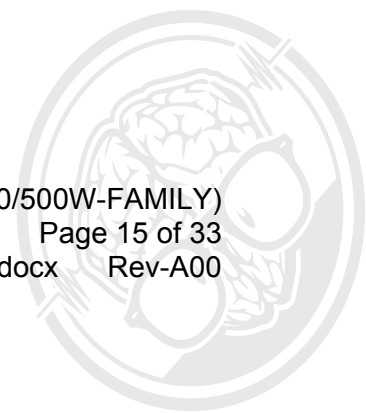
|  |                                   |  |                     |
|--|-----------------------------------|--|---------------------|
| Input Voltage Range:<br>Without rear panel Voltage selector<br>With rear panel Voltage selector  | “120V~” or “240V~”<br>“120/240V~” |  |                     |
| Input Frequency Range  | “50 - 60Hz”                       |  |                     |
| TKO Powered System Size  | <b>500W System</b>                |  | <b>1000W System</b> |
| Input Power Requirements<br>(Power Consumption shall be measured on end-use product while operating at 1/8th rated power output using pink noise as the signal stimulus. | “150W”                            |  | “250W”              |

## Power Supply Specifications

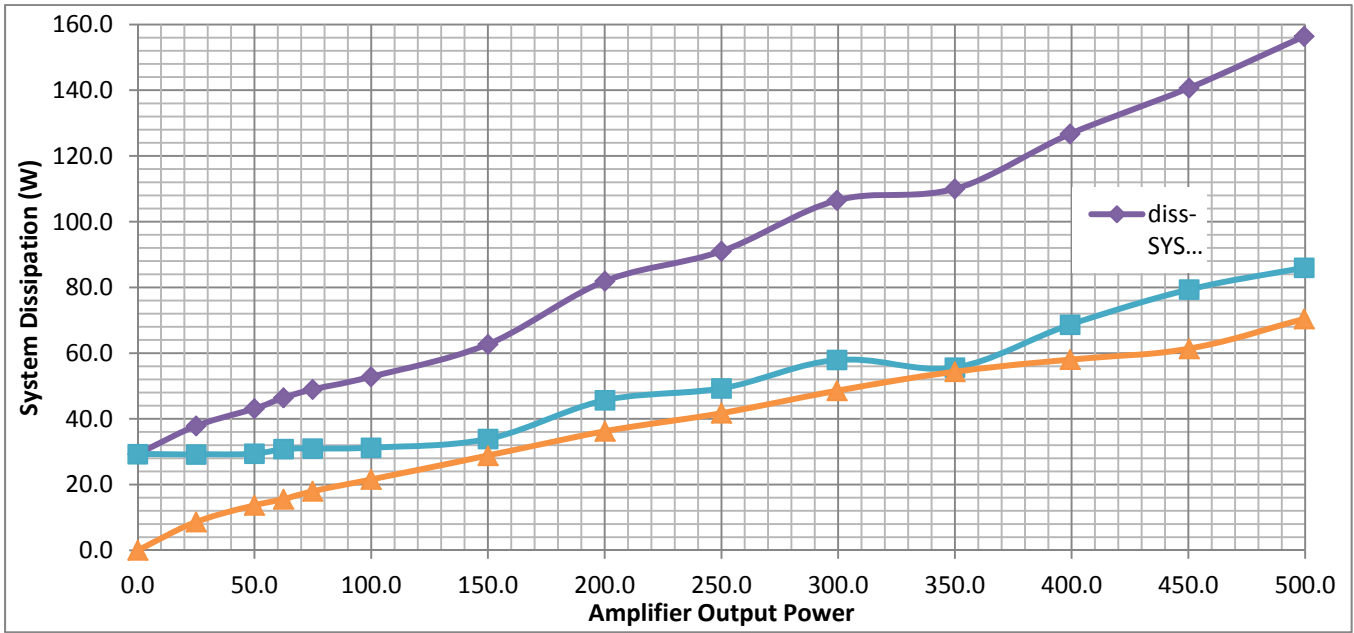
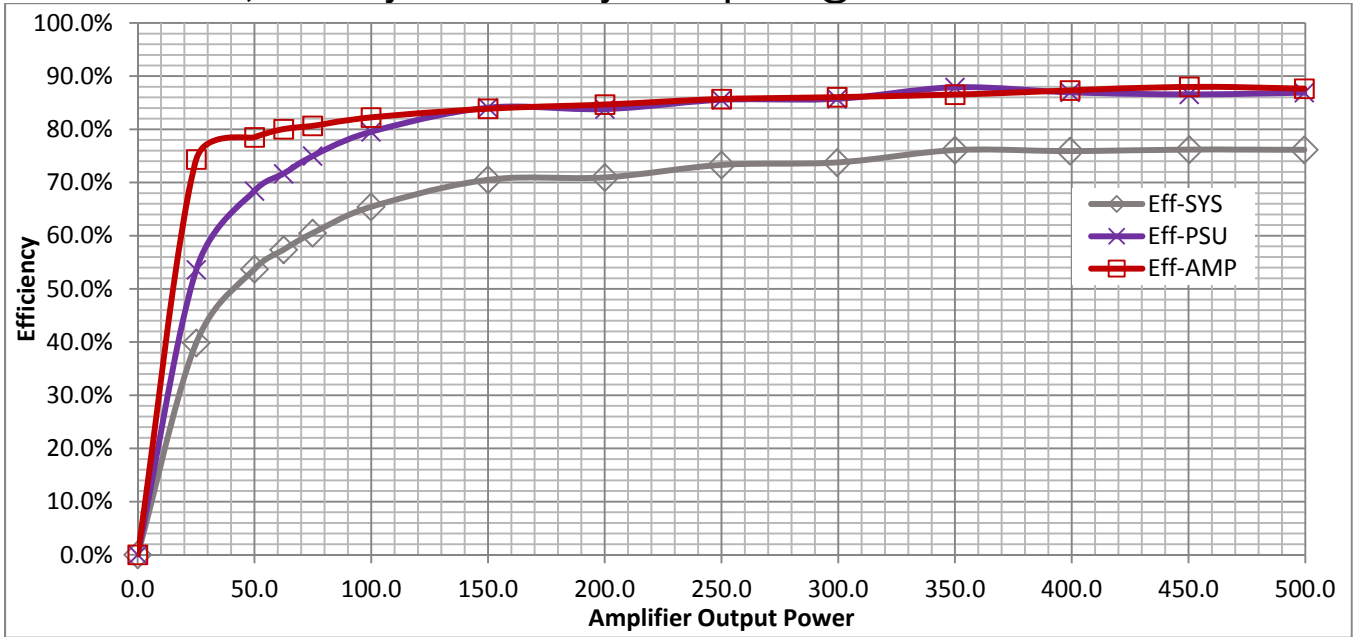
| Power Supply Ratings   | TKO-500-PSU   | TKO-1000-PSU   |
|--|---|--|
| <b>Main Supply Section</b>                                       |   |  |
| Topology   | Series Quasi-Resonant (LLC)<br>Very fast responding loop closed around ± 48V supplies |  |
|  |   | Very fast responding loop closed around ± 66V supplies |
| Input Regulation Range<br>(From quiescent to full power loading) | 108 - 132VAC / 216 – 264VAC<br>(±10%)   |  |

|   |  |   |
|---|--|---|
| Operating Frequency   | 110 – 260 KHz  | 100 – 250 KHz   |
| Winding Isolation   | Supplies referencing GND-AMP ( $\pm$ HV-Supplies), AGND ( $\pm$ 16V supplies) & DGND (+ 7V Keep Alive Supply) are galvanically isolated from each other excepting small bleeder resistors (10 $\Omega$ to chassis ground). Primary supply employs reinforced insulation to all secondary supplies meeting class-I construction requirements. |   |
| Transient response (High voltage rails):  | Nominal output Voltage +3% Maximum<br>Nominal output Voltage - 5% Maximum  |   |
| - Full Power to Quiescent   |  |   |
| - Quiescent to Full Power   |  |   |
| <b>High Voltage Supply Ratings</b>  | <u>+48V</u>  | <u>+66V</u>   |
| Quiescent Operation   | <u><math>\pm</math>50V Max. @ <math>\pm</math>80mA</u>   | <u><math>\pm</math>69V Max. @ <math>\pm</math>80mA</u>                |
| Full power Operation  | <u><math>\pm</math>48V <math>\pm</math> 3V @ <math>\pm</math>6.0A</u>  | <u><math>\pm</math>66V <math>\pm</math> 4V @ <math>\pm</math>8.6A</u> |
| V-Ripple-LF   | 4V p/p Max.  | 6V p/p Max.   |
| Full Power PSU Protection   | Amplifier Soft Clipping Circuits immediately activated limiting power level to 110% of rated output.   |   |
| Maximum Operating time at Full power rating   | 20 Seconds (After which 25% power protection circuits are activated via soft clipper)  |   |
| 25% power PSU Protection  | Amplifier Soft Clipping Circuits activated after 20 seconds limiting power level to 25% of rated output.   |   |
| Long Term Power Output capability<br>(Rated for continuous operation in 45°C ambient environment) | 20 % of Full power   |   |
| Abnormal environment temperature protection   | Should power transformer temperature rise abnormally high, Amplifier Soft Clipping Circuits will limit power level to 10% of rated output.   |   |
| Over temperature Fail-safe  | Should power transformer temperature rise even higher (120°C), main supply will shut down until temperatures cool adequately (100°C).  |   |
| <b>Low Voltage Supply Ratings</b>   | <b><math>\pm</math> 16V</b><br>(-2)  | <b>+V-GATE</b><br>(1,3)   |
| Output Voltage  | $\pm$ 15.5V $\pm$ 1.5V   | +13.5V $\pm$ 0.9V   |
| Rated Output Current<br>(Continuous operation in 0°C to 45°C ambient)                             | $\pm$ 500mA<br>(With $\pm$ 175mA available to DSP module)  | 300mA   |
| Output Noise Level<br>(RMS measurement, 22Hz - 20KHz Bandwidth, @ rated output current)           | -30dBV   | -30dBV  |
| (1) Referenced to -48V or -66V supply   |  |   |

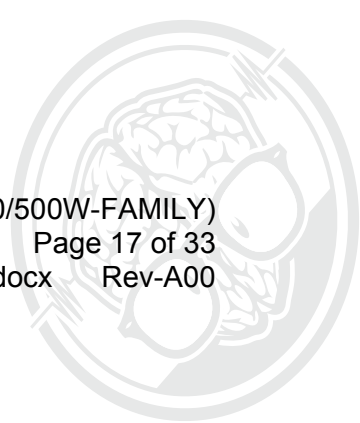
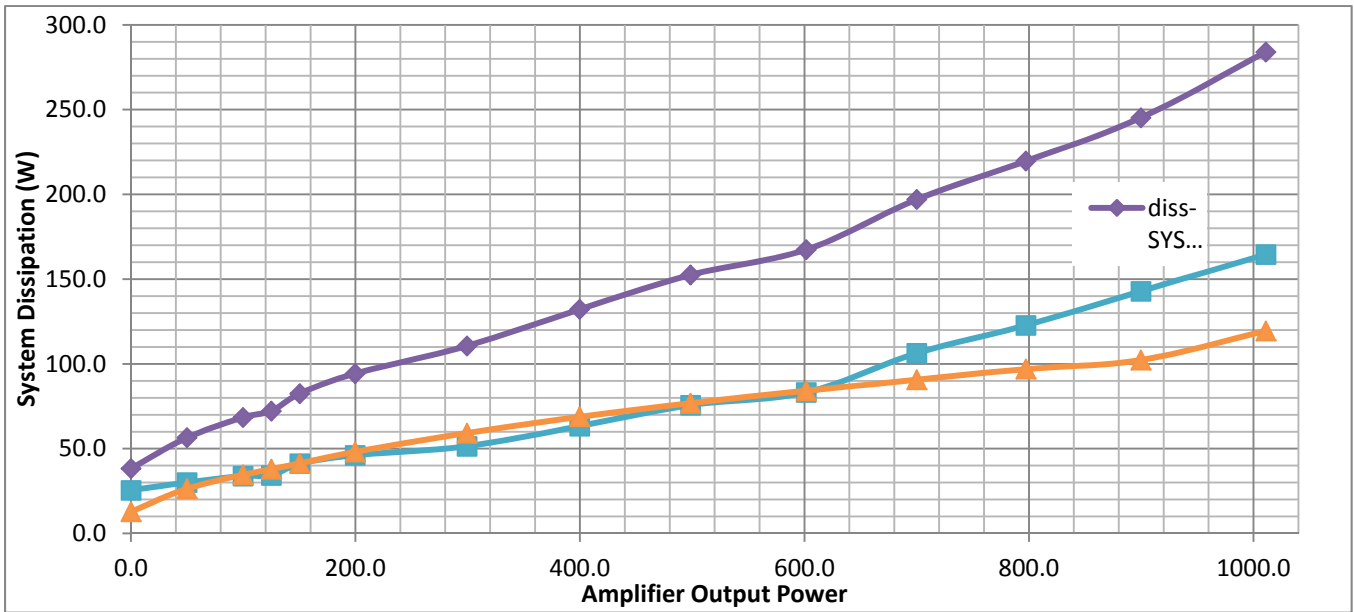
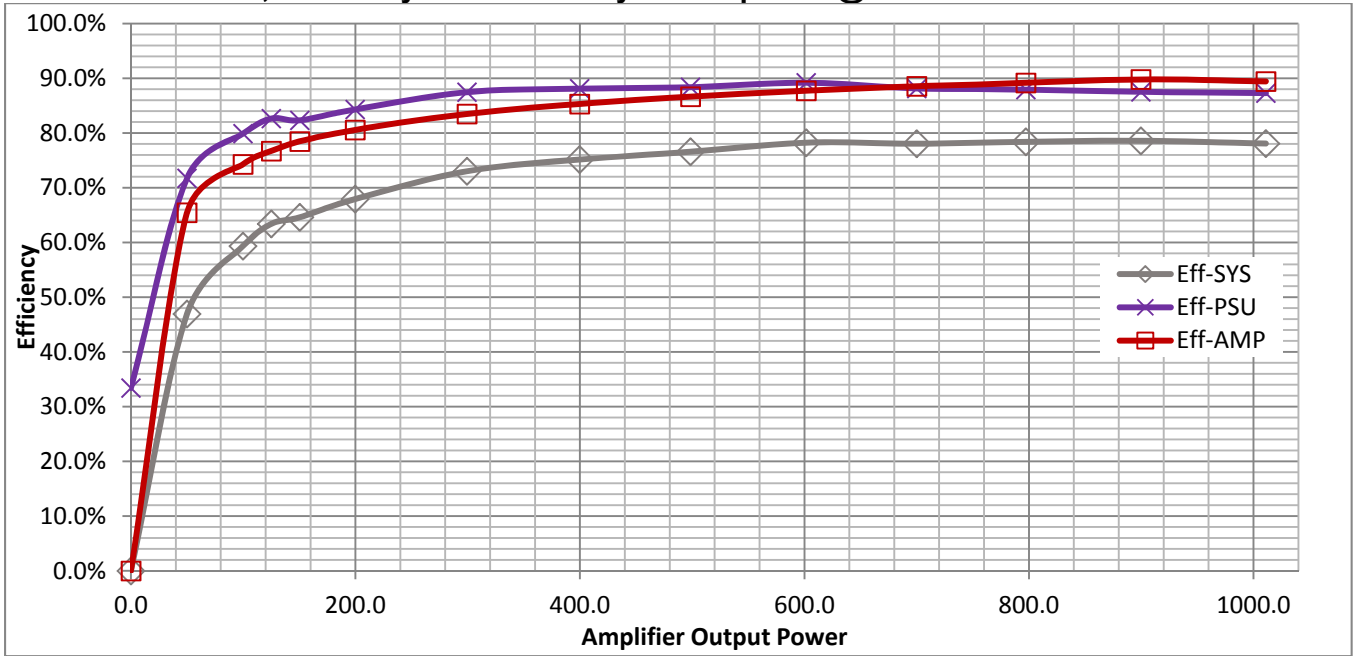
|   |   |
|---|---|
| (2) Supply regulation derived via cross regulation on main high voltage supplies        |   |
| (3) Supply output voltage regulated via additional series linear regulation             |   |
| <b>Keep Alive Supply Section</b>  |   |
| Topology  | Discontinuous Conduction Mode Flyback   |
| Operating Frequency   | 130KHz  |
| Input Voltage Range   | 90-132VAC / 180-264VAC  |
| Rated Output Voltage  | +7V $\pm$ 0.4V (Referenced to DGND)   |
| Rated Output Current  | +7V @ 3A<br>(With 2.5A available to DSP module)   |
| Output Noise Level<br>(RMS measurement, 22Hz - 20KHz Bandwidth, @ rated output current) | < -30dBV (-50dBV typical)   |
| Transient Response  | Output voltage change will be less than $\pm$ 10% of nominal voltage when load changes from 10% to 100% or 100% to 10% of full loading on all supplies. |
| Overshoot   | Overshoot on +7V output will not exceed 10% during supply turn-on or turn-off.  |
| <b>Both Supply Sections</b>   |   |
| Short Circuit Protection  | All supply outputs protected via either current sensing short circuit protection or fusing to ensure against permanent damage.                          |
| Over Voltage Protection   | Transient protection via ZNR. Supply shall not operate above 140 / 280VAC   |
| Under Voltage Protection  | Supply will not operate below 80/160VAC and start below 90 / 180VAC   |
| Brownout Protection   | Supply will shut down under excessive loading and low AC input voltage to prevent permanent supply damage.  |



### 500W PSU, AMP & System Efficiency & Dissipation @ 120VAC

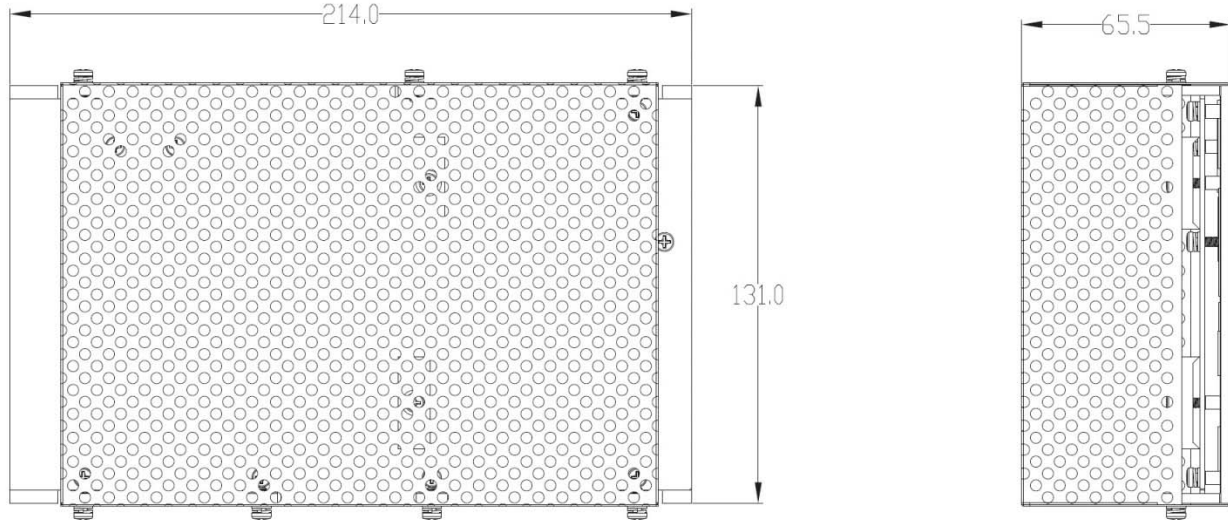


### 1000W PSU, AMP & System Efficiency & Dissipation @ 120VAC



### Mechanical Dimensions

Weight: 2.6 Lbs. (1.16 KG)



## 3. DSP Module

### Assembly Part numbers

| Part Number | Description                       |
|-------------|-----------------------------------|
| MSA-0005    | ASSY FINAL TKO-STUDIO-MONITOR-DSP |

### Key Features

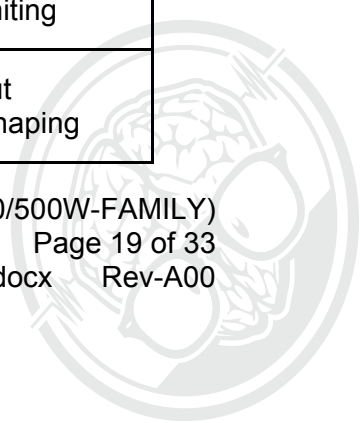
- 32 bit floating point signal processing.
- 24 bit AKM A/D and D/A converters.
- 2 DSP processing channels for independent low frequency and high frequency outputs.
- 8 bands of equalization per channel for speaker tone customization.
- 3 user-configurable rear panel controls for features such as LF boost, HF boost, etc.
- Signal processing configurable via USB control app for rapid product line development.

A powerful DSP solution that ties the package of power supply and amplifiers together, is the third and final piece added onto a product's rear panel. The TKO-SMON-DSP board is a low cost single input dual output DSP drive solution. This front end is a powerful yet very cost effective solution that allows a high quality product to hit low price points. It is also a very simple tool to use to evaluate the performance of our amplifiers and power supplies in your own test labs.

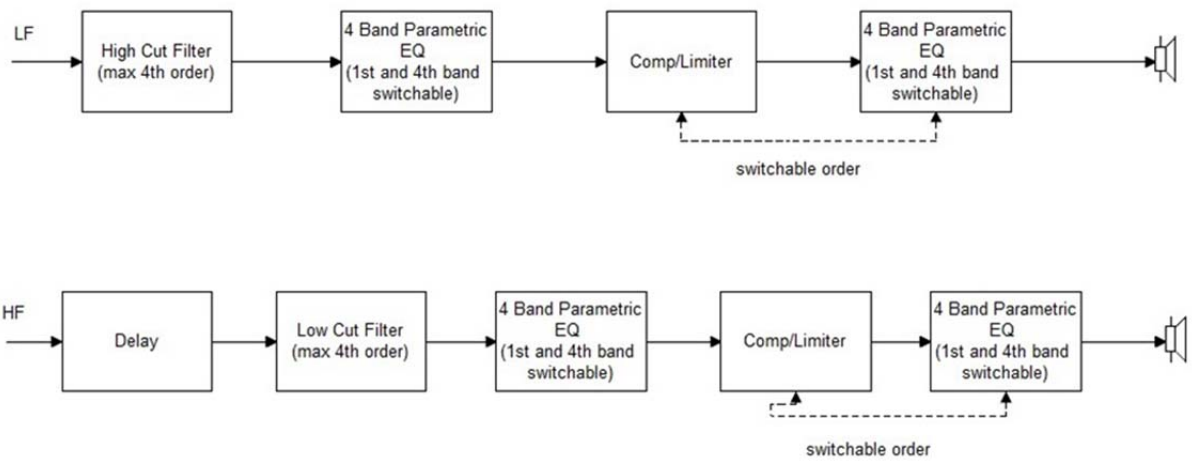
We provide your team with a computer application to tailor the DSP engine's compressors, parametric equalizers, LP and HP filter functions, delay functions, etc. Rear panel controls can also be customized via the control app, allowing you to add features like vocal boost EQ, low frequency boost or high frequency cut to your product.

**DSP Specifications**

| <b>DSP Ratings</b>  |   |
|---|---|
| Number of A/D converters  | 1   |
| Resolution  | 24 bits   |
| Dynamic Range   | 103dB   |
| Number of D/A converters  | 2   |
| Resolution  | 24 bits   |
| Dynamic Range   | 106dB   |
| Sample Rate (System)  | 44.1KHz, 48KHz  |
| Frequency Response  | $\pm 1\text{dB}$ 20Hz - 20KHz (-1dBFS)  |
| Maximum Analog Through-put gain   | +10.7dB   |
| Maximum input Level   | +20 dBV   |
| Maximum Output Level  | +12dBV (2dB greater than clip level of amps)  |
| <b>Panel Controls and connectors</b>  |   |
| Input Level control Range   | Off to + 10.7dB throughput gain   |
| Balanced Inputs   | XLR   |
| Un-balanced Inputs  | 1/4" TS Phone & RCA   |
| Power Indicator   | Rear panel, hard wired to +7V PSU   |
| <b>Software features</b>  |   |
| Phase Flip (0° / 180°)  | Output-1 & 2  |
| Input Clip Detector   | Input-1, Digital detector, rear panel indicator   |
| User Defined controls and switches  | Parameter control switches (X3) each with 4 LED's for displaying function<br>Bi-Color control of front panel LED lighting |
| Peak power Limiter  | Output-1 & 2 (I.E. amp clip prevention and LF excursion protection)   |
| Average power compressor  | Output-1 & 2 (I.E. Driver thermal Protection)   |
| Delay<br>(adjustable 0 - 2 mS in single samples)  | Output-1 & 2 (LF & HF time alignment)   |
| High Cut Filter<br>(1 <sup>st</sup> -4 <sup>th</sup> order ; adjustable Q & Fc)                     | LF output<br>(LF crossover)   |
| Low cut filter<br>(1 <sup>st</sup> -4 <sup>th</sup> order ; adjustable Q & Fc)                      | HF output<br>(HF Crossover)   |
| EQ-1 (4 bands)<br>1 <sup>st</sup> and 4 <sup>th</sup> bands editable<br>HP/LP/Allpass/shelving/peak | LF output and HF output<br>tone shaping, excursion limiting   |
| EQ-2 (4 bands)<br>1 <sup>st</sup> and 4 <sup>th</sup> bands editable<br>HP/LP/Allpass/shelving/peak | LF output and HF output<br>final post compressor tone shaping   |

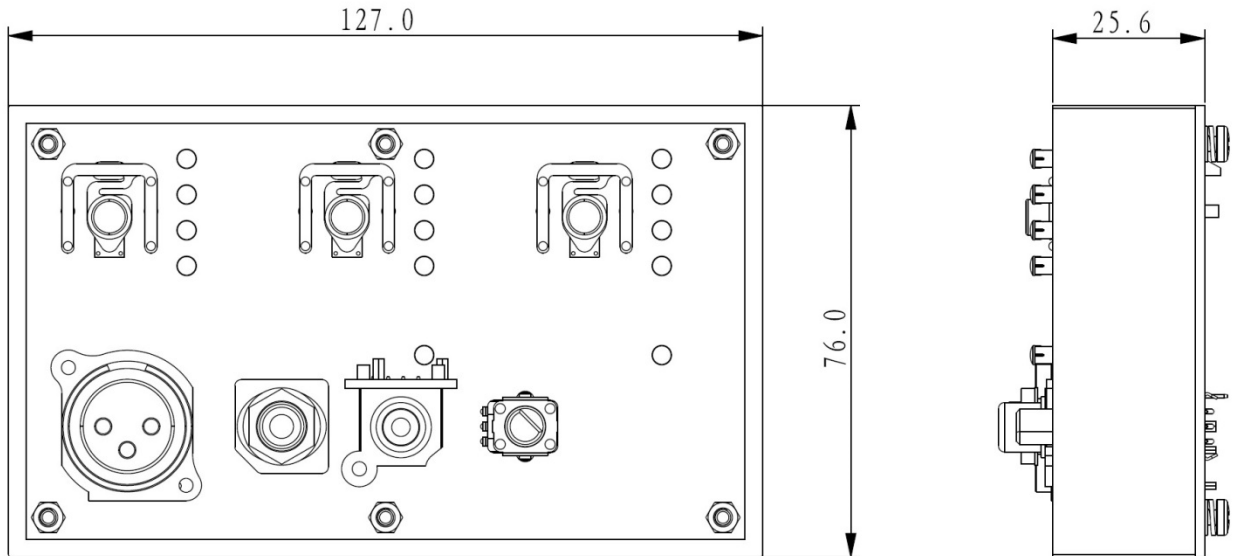


## DSP Functional Block Diagram



## Mechanical Dimensions

Weight: 0.39 Lbs. (0.18 KG)





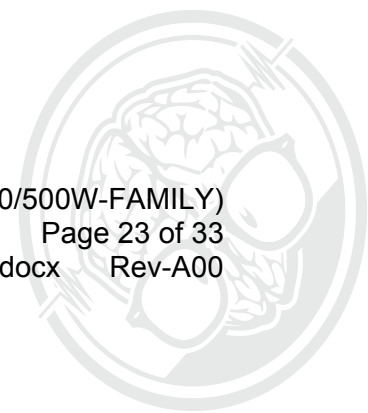
## 4. System Control Signals, Protection Circuits and Indicators

In the system a logical low signal will be no greater than 0.5V above the DGND supply. A Logical high level signal will typically be pulled up to the native DSP supply voltage (+3.3V) via passive pull-ups on the DSP board.

| Signal Name (Ground reference) | PCB Location  | LED Indicator (Board) | Description   |
|--------------------------------|---------------|-----------------------|---|
| \AMP-MUTE (DGND)               | PSU, AMP, DSP | AMP-ON (AMP)          | <p>Open Collector output, can be brought low by any board, resistive pull-up on DSP board. Amp muted when true.</p> <p>True when:<br/>           1 \PWR-BAD true or;<br/>           1 \PSU-STBY true or;<br/>           1 \PSU-THERM true or;<br/>           \AMP-THERM true or;<br/>           When output stage DC fault detected on either amp or;<br/>           When initiated by DSP board.</p> <p>1 Fast into mute, 900mS out of mute</p>                |
| \PWR-BAD (DGND)                | PSU, DSP      | PWR-GOOD (PSU)        | <p>Open Collector output, resistive pull-up on DSP board.</p> <p>True at initial power up and 40 - 70mS after the loss of AC line power.</p>  |
| \PSU-STBY (DGND)               | PSU, DSP      | PSU-STBY (PSU)        | <p>Open Collector output, can be brought low by PSU or DSP boards, resistive pull-up on DSP board. When true the Main Q-resonant supply is placed into standby mode.</p> <p>True When:<br/>           \PSU-THERM true or;<br/>           When initiated by DSP board.</p>   |
| \LIM-PKPWR (DGND)              | PSU, DSP      | PK-PWR-LIM (PSU)      | <p>Open Collector output, brought low by PSU board, resistive pull-up on DSP board.</p> <p>When True the amp soft clip circuit is called in to limit amplifier output power.</p> <p>The Short term average power is monitored on the +66V/(+48V) supply. When supply power exceeds 110% of rated power (1100W for the 1000W rated output speaker power in the case of the 1000W product) the soft clip circuit quickly throttles back output power to 110%.</p> |

|                    |          |                   |   |
|--------------------|----------|-------------------|---|
| \LIM-AVGPWR (DGND) | PSU, DSP | AVG-PWR-LIM (PSU) | <p>Open Collector output, brought low by PSU board, resistive pull-up on DSP board.</p> <p>When True the amp soft clip circuit is called in to limit amplifier output power.</p> <p>The Short term average power is monitored on the +66V/(+48V) supply. When supply power exceeds 25% of rated output speaker power for a sustained period of time (20S) the soft clip circuit quickly throttles back output power to just 25% of rated. This allows for high levels of sustained full power output in the field, and also allows for adequate time to perform full power functional testing at factory. Full power operation time limited to protect silicon and magnetics from catastrophic overheating and failure.</p> |
| \PSU-THERM (DGND)  | PSU, DSP | PSU-THERM (PSU)   | <p>Open Collector output, brought low by PSU board, resistive pull-up on DSP board.</p> <p>When True \PSU-STBY goes low, shutting down the main supply.</p> <p>When Q-res transformer core temperature exceeds 120°C the supply is shut down. Supply returns to normal operation at 100°C.</p>  |
| PSU-TEMP (DGND)    | PSU, DSP | None              | <p>Linear temperature sensor output, 10mV/°C gain (0°C = 0V). Monitors the temperature of the main Q-Resonant transformer core.</p> <p>Minimum load: 500KΩ</p>  |
| SOFT-CLIP (AGND)   | PSU, AMP | None              | <p>The analog soft clip voltage is used to drive the soft clip circuit on the front end of each power amplifier. This in turn limits the output power of all amplifiers simultaneously to reduce power demand on the main supply.</p> <p>Events that trigger this limiter:<br/> /LIM-PKPWR true or;<br/> /LIM-AVGPWR true or;<br/> /LIM-THERM true.</p>   |

|                                      |          |                           |   |
|--------------------------------------|----------|---------------------------|---|
| /AMP-1-CLIP<br>/AMP-2-CLIP<br>(DGND) | AMP, DSP | CLIP-1<br>CLIP-2<br>(AMP) | Open Collector output, brought low by AMP board, resistive pull-up on DSP board.<br><br>Sensitivity: Shall be true at $\leq 2\text{dB}$ of amplifier overdrive. Clip event shall be pulse stretched to 500mS for clear visibility on output line & LED indicators.  |
| LOAD-RES-1<br>LOAD-RES-2<br>(DGND)   | AMP, DSP | None                      | Amplifier output voltage and current is rectified and averaged and sent into a 1Q multiplier to calculate the speaker load resistance on each amplifier channel.<br><br>Gain: $100\text{mV} / \Omega$<br>DSP may need to voltage limit this signal (up to +7V) to prevent damage to A/D converter monitoring these lines.<br><br>Output impedance: $2\text{K}\Omega$<br><br>DSP will need to gate when using this measurement based upon having adequate speaker drive level ( $> 2\text{V RMS}$ on speaker output line) as accuracy of the detector is poor at very low drive levels and high load impedances. |
| AMP-TEMP<br>(DGND)                   | AMP, DSP | None                      | Linear temperature sensor output, $10\text{mV}/^\circ\text{C}$ gain ( $0^\circ\text{C} = 0\text{V}$ ). Monitors the temperature of the main heatsink between the 4 amplifier output FET's<br><br>Minimum load: $500\text{K}\Omega$  |
| /AMP-THERM<br>(DGND)                 | AMP, DSP | AMP-THERM<br>(AMP)        | Open Collector output, brought low by AMP board, resistive pull-up on DSP board.<br><br>When main heatsink temperature exceeds $95^\circ\text{C}$ this line becomes true driving /AMP-MUTE low. Line is allowed to go back high when amplifier temperature reaches $75^\circ\text{C}$ .   |
|                                      | PSU      | Additional LEDs           | Additional LEDs on PSU board:<br>+7V; +16V; -16V; +66V (+48V); -66V (-48V); +V-GATE   |



## 5. General System Specifications

|   |  |                                 |
|---|--|---------------------------------|
| Operating Temperature range<br>1/5 Rated Power  | Continuous operation in ambient temperatures up to 45°C<br>(With required supplemental heat sinking) |                                 |
| Cooling Requirement<br>(Supplementary Heatsinking)<br>- 20% of Rated power<br>- 45°C ambient<br>- Continuous operation  | <0.45°C/W (TKO-1000W)<br><0.85°C/W (TKO-500W)  |                                 |
| Minimum enclosure volume<br>(On which UL temperature testing was based upon)  | 1 Ft <sup>3</sup> (28.3 L)   |                                 |
| Reliability   | Minimum MTBF of 25,000 Hours according to MIL-HDBK217F.  |                                 |
| Typical Overall System Efficiency (AC input power to speaker output power using Class-D amplifiers.)<br>@ Full power (1KHz Sine Stimulus)<br>@ 1/5 rated (Pink Noise Stimulus)<br>@ 1/8 rated (Pink Noise Stimulus) | 120VAC<br><br>77%<br>67%<br>60%  | 240VAC<br><br>81%<br>69%<br>62% |

## 6. Connector Pin-Outs

### AC Input Connections

#### PSU to external power switch or IEC inlet (J1 on PSU board)

Connector type and pin-out: 7.92mm spaced square-pin connector

Receptacle: JST Part # VHR-3N (or equal)

Crimp Connector: JST Part # SVH-21T-P1.1 (or equal)

<http://www.jst-mfg.com/product/pdf/eng/eVH.pdf>

| Pin # | Net Name | Notes  |
|-------|----------|--|
| 1     | Line     | Rated for 7A continuous, Use UL-1015 18AWG min (Brown) |
| 2     | Neutral  | Rated for 7A continuous, Use UL-1015 18AWG min (Blue)  |

If a power switch is used in the end use design by our customers, it must be rated for 7A/125VAC and 3A/250VAC with certifications for USA, Canada, and the European Union (I.E. UL, C-UL, & ENEC).

### PSU to Voltage selector switch (J2 on PSU board)

Connector pins go to a voltage selector switch (open for 240V operation, closed for 120V operation). Customers not wanting this function can simply place or not place a shorting jumper across these pins to tailor the power supply to the proper voltage.

Connector type and pin-out: 7.92mm spaced square-pin connector

Receptacle: JST Part # VHR-3N (or equal)

Crimp Connector: JST Part # SVH-21T-P1.1 (or equal)

<http://www.jst-mfg.com/product/pdf/eng/eVH.pdf>

| Pin # | Net Name | Notes  |
|-------|----------|--|
| 1     | 120V-1   | Rated for 7A continuous, Use UL-1015 18AWG min |
| 2     | 120V-2   | Rated for 7A continuous, Use UL-1015 18AWG min |

If a voltage selector switch is used in the end use design by our customers, it must be rated for 4A/125VAC and 2A/250VAC with certifications for USA, Canada, and the European Union (I.E. UL, C-UL, & ENEC) and designed to comply with the special requirements of UL/EN 60065.

### PSU, AMP & DSP Interconnections

#### PSU to AMP high current (J4 on PSU board and J8 & J9 on AMP board)

Connector type and pin-out: CONN RECEP 6P FEM MINI-FIT-JR 94V0

Receptacle: Molex Part # 39-01-2065 (or equal)

Crimp Connector: Molex Part # 39-00-0079 (or equal)

[http://www.molex.com/molex/products/family?key=minifit\\_jr&channel=products&chanName=family&pageTitle=Introduction](http://www.molex.com/molex/products/family?key=minifit_jr&channel=products&chanName=family&pageTitle=Introduction)

All cables to be fabricated using UL-1015 16AWG wire.

| Pin # | Net Name     | Notes  |
|-------|--------------|--|
| 1     | - 66V (-48V) | PSU-Output: High current output                  |
| 2     | GND-AMP      | PSU-Output: High current amplifier ground return |
| 3     | +66V (+48V)  | PSU-Output: High current output                  |
| 4     | +V-GATE      | PSU-Output: +13.5V Class-D amp bias supply       |
| 5     | GND-AMP      | PSU-Output: High current amplifier ground return |
| 6     | +66V (+48V)  | PSU-Output: High current output                  |

#### AMP to Speakers (J11 on PSU board)

Connector type and pin-out: CONN RECEP 4P FEM MINI-FIT-JR 94V0

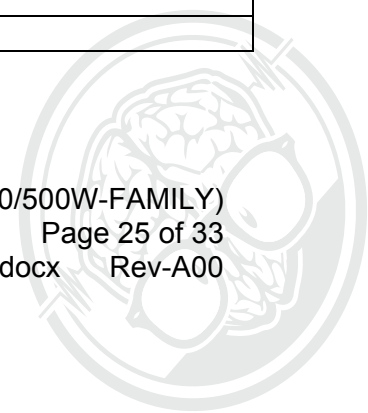
Receptacle: Molex Part # 39-01-2045 (or equal)

Crimp Connector: Molex Part # 39-00-0079 (or equal)

[http://www.molex.com/molex/products/family?key=minifit\\_jr&channel=products&chanName=family&pageTitle=Introduction](http://www.molex.com/molex/products/family?key=minifit_jr&channel=products&chanName=family&pageTitle=Introduction)

All cables to be fabricated using UL-1015 16AWG wire.

| Pin # | Net Name | Notes                      |
|-------|----------|----------------------------|
| 1     | +AMP-1   | Amplifier Channel-1 Output |
| 2     | +AMP-2   | Amplifier Channel-2 Output |
| 3     | GND-AMP1 | Amplifier Channel-1 Return |
| 4     | GND-AMP2 | Amplifier Channel-2 Return |



### PSU to AMP low current (J5 on PSU board and J6 & J7 on AMP board)

Connector type and pin-out: CONN RECEP 6P FEM 2.5mm 94V0

Receptacle: JST Part # XHP-6 (or equal)

Crimp Connector: JST Part # SXH-001T-P0.6 (or equal)

<http://www.jst-mfg.com/product/pdf/eng/eXH.pdf>

All cables to be fabricated using UL-1007 26AWG wire or ribbon cable.

| Pin # | Net Name  | Notes   |
|-------|-----------|---|
| 1     | +7V       | PSU-Output: Relay and control logic supply                              |
| 2     | DGND      | PSU-Output: +7V return  |
| 3     | /AMP-MUTE | Open collector, PU on DSP   |
| 4     | +16V      | PSU-Output: AGND referenced   |
| 5     | - 16V     | PSU-Output: AGND referenced   |
| 6     | SOFT-CLIP | PSU-Output: Control voltage to amplifier front end soft-clipper circuit |

### PSU to DSP (J3 on PSU board and J4 on DSP board)

Connector type and pin-out: CONN RECEP 15P FEM 2.5mm 94V0

Receptacle: JST Part # XHP-15 (or equal)

Crimp Connector: JST Part # SXH-001T-P0.6 (or equal)

<http://www.jst-mfg.com/product/pdf/eng/eXH.pdf>

All cables to be fabricated using UL-1007 26AWG wire or ribbon cable.

| Pin # | Net Name    | Notes                                     |
|-------|-------------|---|
| 1     | AGND        | PSU-Output                                |
| 2     | +16V        | PSU-Output: AGND return                   |
| 3     | -16V        | PSU-Output: AGND return                   |
| 4     | +7V         | PSU-Output: DGND return                   |
| 5     | +7V         | PSU-Output: DGND return                   |
| 6     | DGND        | PSU-Output                                |
| 7     | DGND        | PSU-Output                                |
| 8     | PSU-TEMP    | PSU-Output: 10K $\Omega$ output impedance |
| 9     | /AMP-MUTE   | Open collector, PU on DSP                 |
| 10    | /PWR-BAD    | Open collector, PU on DSP                 |
| 11    | /PSU-STBY   | Open collector, PU on DSP                 |
| 12    | /LIM-AVGPWR | Open collector, PU on DSP                 |
| 13    | /LIM-PKPWR  | Open collector, PU on DSP                 |
| 14    | /LIM-THERM  | Open collector, PU on DSP                 |
| 15    | /PSU-THERM  | Open collector, PU on DSP                 |

## AMP to DSP (J1 on AMP board and J3 on DSP board)

Connector type and pin-out: CONN RECEP 12P FEM 2.5mm 94V0

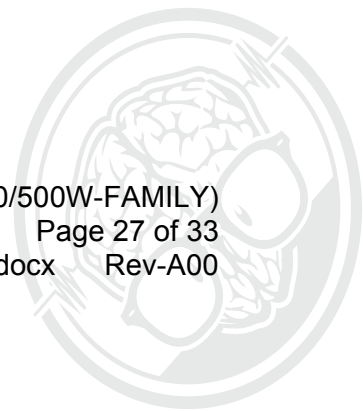
Receptacle: JST Part # XHP-12 (or equal)

Crimp Connector: JST Part # SXH-001T-P0.6 (or equal)

<http://www.jst-mfg.com/product/pdf/eng/eXH.pdf>

All cables to be fabricated using UL-1007 26AWG wire or ribbon cable.

| Pin # | Net Name-<br>(AMP) | Net Name<br>(DSP-CH 1&2) | Net Name (DSP-<br>CH 3&4) | Notes                                     |
|-------|--------------------|--------------------------|---------------------------|---|
| 1     | /AMP-1-CLIP        |                          | /AMP-3-CLIP               | Open collector, PU on DSP                 |
| 2     | AGND               |                          |                           | Amp AGND reference                        |
| 3     | +AMPIN-1           |                          | +AMPIN-3                  | Amp non-inverting input                   |
| 4     | - AMPIN-1          |                          | - AMPIN-3                 | Amp inverting input                       |
| 5     | LOAD-RES-1         |                          | LOAD-RES-3                | AMP-Output; 1K $\Omega$ output impedance  |
| 6     | AMP-TEMP           | AMP-TEMP-12              | AMP-TEMP-34               | AMP-Output: 10K $\Omega$ output impedance |
| 7     | /AMP-THERM         | /AMP-THERM-12            | /AMP-THERM-34             | Open collector, PU on DSP                 |
| 8     | /AMP-2-CLIP        |                          | /AMP-4-CLIP               | Open collector, PU on DSP                 |
| 9     | AGND               |                          |                           | Amp AGND reference                        |
| 10    | +AMPIN-2           |                          | +AMPIN-4                  | Amp non-inverting input                   |
| 11    | - AMPIN-2          |                          | - AMPIN-4                 | Amp inverting input                       |
| 12    | LOAD-RES-2         |                          | LOAD-RES-4                | AMP-Output; 1K $\Omega$ output impedance  |



## 7. Safety and Regulatory Agency Requirements

As of the publication of this application note, preliminary EMC testing has been completed with favorable results. Safety compliance testing (to be performed by Underwriters Laboratories) has not yet started.

Note that the 500W system passes the AC line harmonics testing listed below. The 1000W system however fails at the specified 1/8<sup>th</sup> rated power. This comes as no surprise as the supply is not power factor corrected. The customer will need to take advantage of the loophole for “professional products” allowed in the standard requiring them to notify the “Supply authority” to get past this deficiency. This is typically handled by a single statement in the product’s declaration of conformity required for products imported into the European Union. The suggested form of this statement is as follows:

***“Due to line current harmonics, we recommend that you contact your supply authority before connection.”***

|  |  |
|--|--|
| Product Safety   | <ul style="list-style-type: none"> <li>- UL 60065, 8th Edition</li> <li>- CAN/CSA-C22.2 No. 60065-03 (R2012) + Amendment 60065A-03 (R2012) + Amendment 60065B-03 (R2012)</li> <li>- EN 60065, 8th Edition, 2014-06-27</li> </ul>           |
| Touch Current  | <p>Shall not exceed 750uA as defined by UL 60065, CAN / CSA-C22.2, IEC 60065 Ed. 8 Section 9.1.1.1.b. &amp; 9.1.1.1.d.</p> <p>(In house measurements show touch current to be 432uA worst case for all products, all AC line voltages)</p> |
| AC Line Harmonics  | Module shall be tested as per EN 61000-3-2:2014, Class-A Equipment, Annex C3, limits Table-1 concerning AC line harmonic current.  |
| EMC<br>(Conducted Emissions, Radiated Emissions, Immunity) | <p>EN 55032:2012</p> <p>EN 55103-2:2009</p> <p>EN 61000-3-2:2014</p> <p>EN 61000-3-3:2013</p> <p>FCC 15.107:2015</p> <p>FCC 15.109(g):2015</p> <p>FCC 15.109:2015</p> <p>ICES-003:2012 updated 2014</p>                                    |
| EMC Market compliance:                                     | United States, Canada, Europe, Australia, New Zealand  |

## 8. Environmental Specifications

|                               |   |
|-------------------------------|---|
| Operating Ambient Temperature | +5°C to +45°C                           |
| Storage Temperature           | -20°C to +80°C                          |
| Operating Humidity            | 5% to 95%                               |
| Storage Humidity              | 5% to 95%                               |
| Operating Altitude            | 2000M (6500Ft) Max.                     |
| Vibration                     | 5Hz – 50Hz, 1G in three orthogonal axes |
| Shock                         | 20G                                     |



## 9. Studio Monitor Panel Assembly

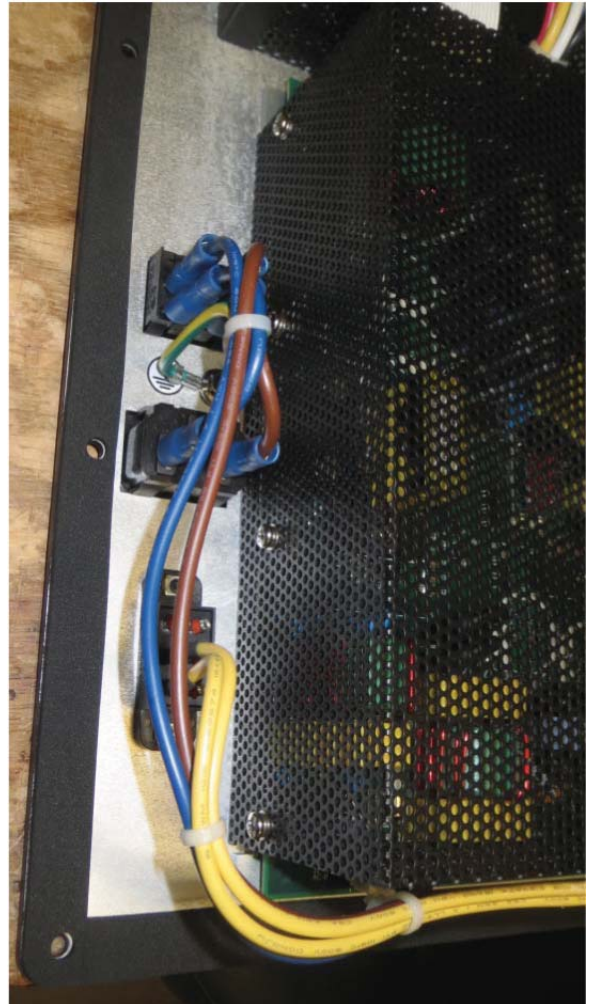
### Assembly Part numbers

| Part Number | Description                       |
|-------------|-----------------------------------|
| MSA-0002-00 | ASSY FINAL TKO-1000W-PANEL-S-MON1 |
| MSA-0002-01 | ASSY FINAL TKO-500W-PANEL-S-MON1  |

### Assembly Instructions

If you are a customer who purchased a studio monitor panel assembly you will note that a few minutes of assembly are required. Please refer to photos on these two pages as well as the panel assembly drawing on the next page.

- Note that the 12 truss head wood screws (item-4) are to secure the studio monitor panel assembly into your end use speaker product.
- Install both the upper and lower gaskets (item-9) taking care to line the hole up in the center of the gasket with the related hole in the panel assembly.
- Install the side gaskets (item-8) to where they butt tight against the sides of the top and bottom gasket to prevent air leakage.
- Install the IEC inlet (item-1) with the ground wire facing the top of the main panel (item-7). Secure the ground wire onto the ground stud directly above using the hex nut (Item-13). Not that the terminal lug on the wire should be facing towards the edge of the panel.
- Push the power switch (item-2) into place in the panel with the “1” facing the panel top.
- Install the short brown wire (item-19) from IEC “L” terminal to switch terminal directly above.
- Install the short blue wire (item-20) from IEC “N” terminal to switch terminal directly above.
- Install voltage selector switch (item-14) with the 115V markings on top and 230V markings on the bottom. Secure selector using flathead machine screws (item-5, X2).
- Remove DSP board assembly from packing (item-10). Apply a light bead of silicon sealer (not provided) around the perimeter of the assembly’s aluminum extrusion to act as an air seal between the assembly and the panel.
- Install the DSP assembly onto the panel with the rear connectors facing down. Secure the assembly using flathead screws (item-5, X6). Secure the XLR and RCA jack with sheet metal flathead screws (item-6, X3). Finally secure the ¼” jack with a flat washer and nut (items-24, 25).



- Install all LED light pipes (item-3, X14). These can be set fully in place with a light tap with the back of a plastic screw driver.
- Install the 15 pin cable (item-17) to J4 on the DSP board.
- Remove the AMP board from its box (item-11) and place it upside down on a work surface. Apply a thin / even coat of heat transfer grease (item-23) on the bottom side of the assembly (the aluminum panel). Try and keep the grease out of the 6 mounting holes on the assembly and away from the edges of the panel. By doing this both sides of the main panel assembly will not get messy. I would suggest masking around the perimeter of the amp assembly and cutting 6 small tape squares to cover the mounting holes. Even doing this, I still always seem to make a bit of a mess: Man I hate this transfer grease!! Please don't be tempted to not use the grease though, as we need it for proper cooling of the assembly.
- Secure the amp assembly to the back panel with flathead screws (item-5, X6)
- Unscrew the 4 sems screws securing the amp shield assembly. Install 6-pin cable (item-16) at J6 on amp board. Secure 6-pin power cable (item-18) to J8. Install the 12-pin cable (Item-15) to J1. Poke the cables back through the amp cover and secure the cover back in place.
- Plug the other end of the 12-pin cable into J3 on the DSP board.
- Remove the power supply assembly (item-12) from its packing box. Turn the supply over and apply the thermal transfer grease to the bottom of the supply on the aluminum panel / heatsink. As with the amp, take care to mask the sides of the assembly and the 12 mounting holes. Install the power supply assembly to the panel using the flathead screws (item-5, X12).
- Plug in the connector end coming from the voltage selector switch into J2 on the power supply board.
- Install the brown and blue cable assembly (item-21) at J1 on the power supply. Attach the other end of this cable to the power switch with the brown wire placed above the other brown wire on the switch and then blue above blue. The picture on the last page for further detail.
- Install the 3 cable ties (item-22) as is shown in picture on the last page.
- Plug in other end of the 15-pin cable to J3 on PSU and the other end of the 6-pincable onto J5 on the PSU. Secure the final end of the 6-pin power cable coming from the amp board to J4. See the picture above for further details.

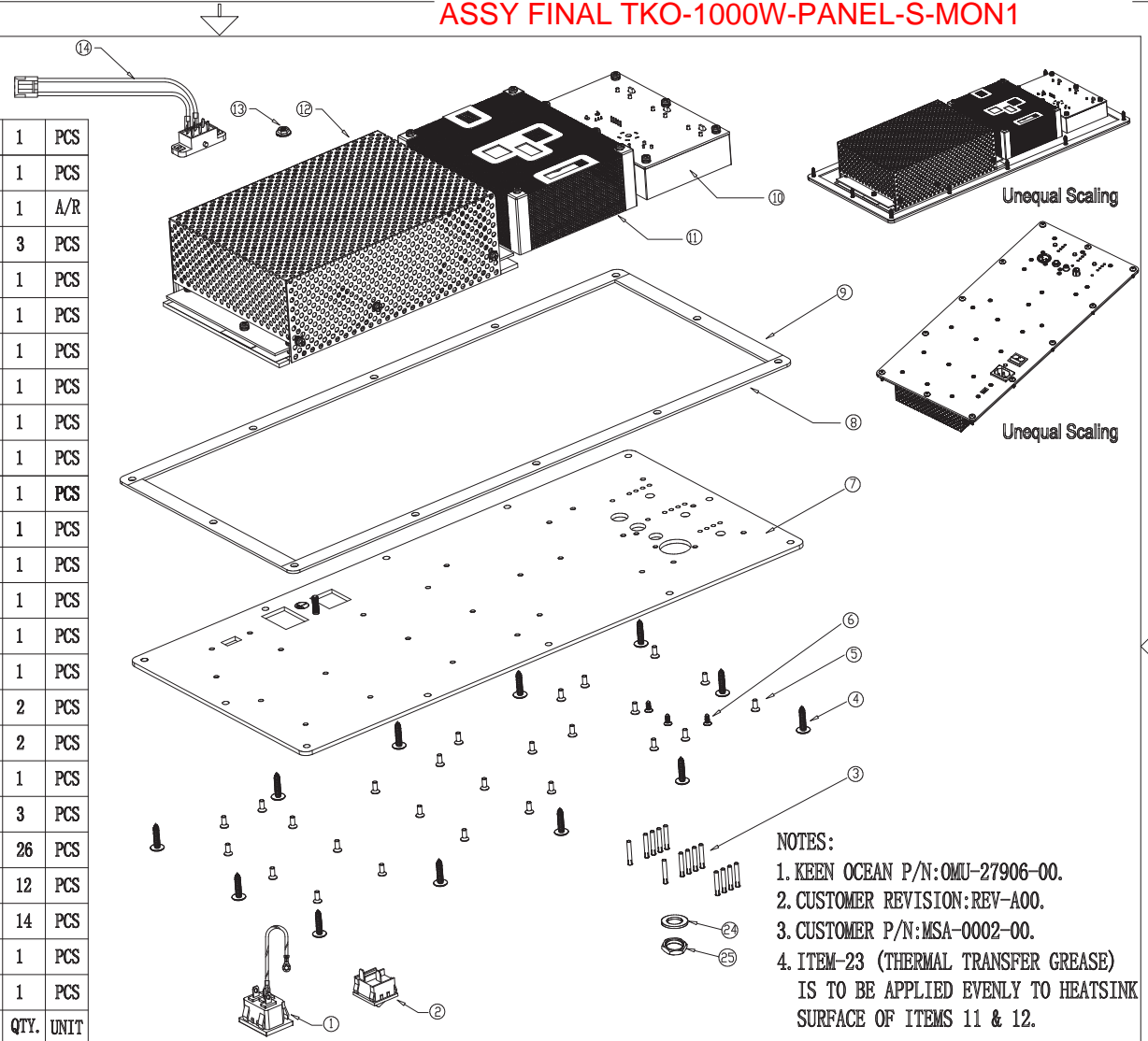


The assembly of the studio monitor panel is now complete and is ready for use.

MSA-0002-00  
ASSY FINAL TKO-1000W-PANEL-S-MON1

生產商(全名) :

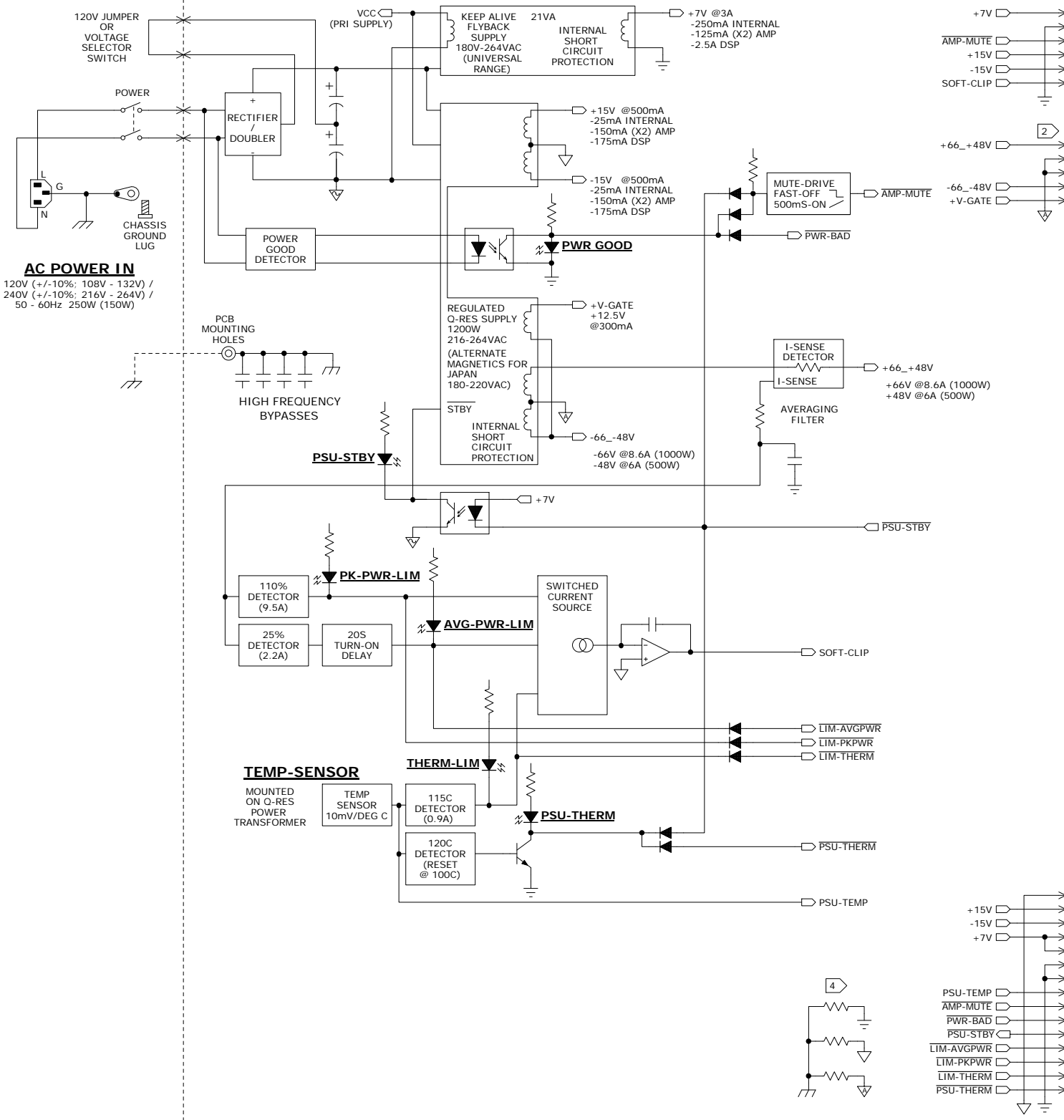
|      |              |                    |   |      |      |
|------|--------------|--------------------|---|------|------|
| 25   | MHN-0002     | /                  | NUT HEX 1/4" JACK (PART OF CON-0017)                          | 1    | PCS  |
| 24   | MHW-0003     | /                  | WSHR FLAT 1/4" JACK (PART OF CON-0017)                        | 1    | PCS  |
| 23   | MHM-0002     | ADEA2ABX           | THERMAL TRANSFER GREASE PASTE 1.2W/MK                         | 1    | A/R  |
| 22   | MHC-0001     | TIEA100AX          | CBL TIE 100mm NATURAL   | 3    | PCS  |
| 21   | CBL-0402-230 | ACS/OMU27906-00IW4 | CBL 3.96mm RECEPT TO 4.8mm FASTON 2C 230mm.                   | 1    | PCS  |
| 20   | CBL-0302-075 | ACS/OMU27906-00HW4 | CBL 4.8mm FASTON (X2) 16AWG 75mm BLU.                         | 1    | PCS  |
| 19   | CBL-0301-075 | ACS/OMU27906-00GW4 | CBL 4.8mm FASTON (X2) 16AWG 75mm BRN.                         | 1    | PCS  |
| 18   | CBL-0206-150 | ACS/OMU27906-00DW4 | CBL MINI-FIT-JR 6C 16AWG 150mm MULTI-COLOR.                   | 1    | PCS  |
| 17   | CBL-0115-215 | ACS/OMU27906-00CW4 | CBL 2.5mm-SHRD (X2) RIBBON 15C 26AWG 215mm WHITE.             | 1    | PCS  |
| 16   | CBL-0106-175 | ACS/OMU27906-00BW4 | CBL 2.5mm-SHRD (X2) RIBBON 6C 26AWG 175mm WHITE.              | 1    | PCS  |
| 15   | CBL-0112-150 | ACS/OMU27906-00AW4 | CBL 2.5mm-SHRD (X2) RIBBON 12C 26AWG 150mm WHITE.             | 1    | PCS  |
| 14   | CBL-0300-220 | ACS/OMU27906-00EW4 | CBL VOLT-SELECT TO 3.96mm RECEPT 2C YEL 220mm.                | 1    | PCS  |
| 13   | MHN-0001     | NUTDEMO4098NAAX    | NUT HEX-FLANGE M4 X 0.7 STL ZN.                               | 1    | PCS  |
| 12   | MSA-0006-00  | SWP-27561-00       | ASSY FINAL TKO-1000W-PSU.                                     | 1    | PCS  |
| 11   | MSA-0004-00  | OMU-27562-00       | ASSY FINAL TKO-1000W-AMP.                                     | 1    | PCS  |
| 10   | MSA-0005     | OMU-27652-00       | ASSY FINAL TKO-STUDIOMONITOR-DSP.                             | 1    | PCS  |
| 9    | MHG-0002     | SPE173013BAAX      | GASKET TKO-PANEL-S-MON-1 TOP & BTM.                           | 2    | PCS  |
| 8    | MHG-0001     | SPE450013BAAX      | GASKET TKO-PANEL-S-MON-1 SIDES.                               | 2    | PCS  |
| 7    | MSA-0007     | MCTA2790600AX      | MAIN PANEL TKO-1000W PSU+AMP+DSP UL-TESTER ALUMINUM 1100-H14. | 1    | PCS  |
| 6    | MHS-0007     | SCM0300080AKPHAX   | THREAD CUTTING SCREW FOR XLR & RCA.                           | 3    | PCS  |
| 5    | MHS-0006     | SCM0300080MKPHAX   | SCR MACH M3 X 8mm FLAT PHIL STL BLK-OX.                       | 26   | PCS  |
| 4    | MHS-0005     | SCM0420190ATPHAX   | SCR SHT-MTL M4.2 X 19mm TRUSS PHIL STL BLK-OX.                | 12   | PCS  |
| 3    | MHL-0001     | PLPC2790600AX      | LIGHT PIPE LED 3.1mm X 25.4mm 94-V0.                          | 14   | PCS  |
| 2    | SWR-0001     | SWHRL3-221-G3BK-AX | SWITCH ROCKER DPST 250V 6A BLK 21 X 24mm PANEL.               | 1    | PCS  |
| 1    | CBL-0300-090 | ACS/OMU27906-00FW4 | CBL IBC-INLET TO RING 16AWG GRN-YEL 90mm.                     | 1    | PCS  |
| ITEM | CUST P/N     | KO P/N             | DESCRIPTION   | QTY. | UNIT |



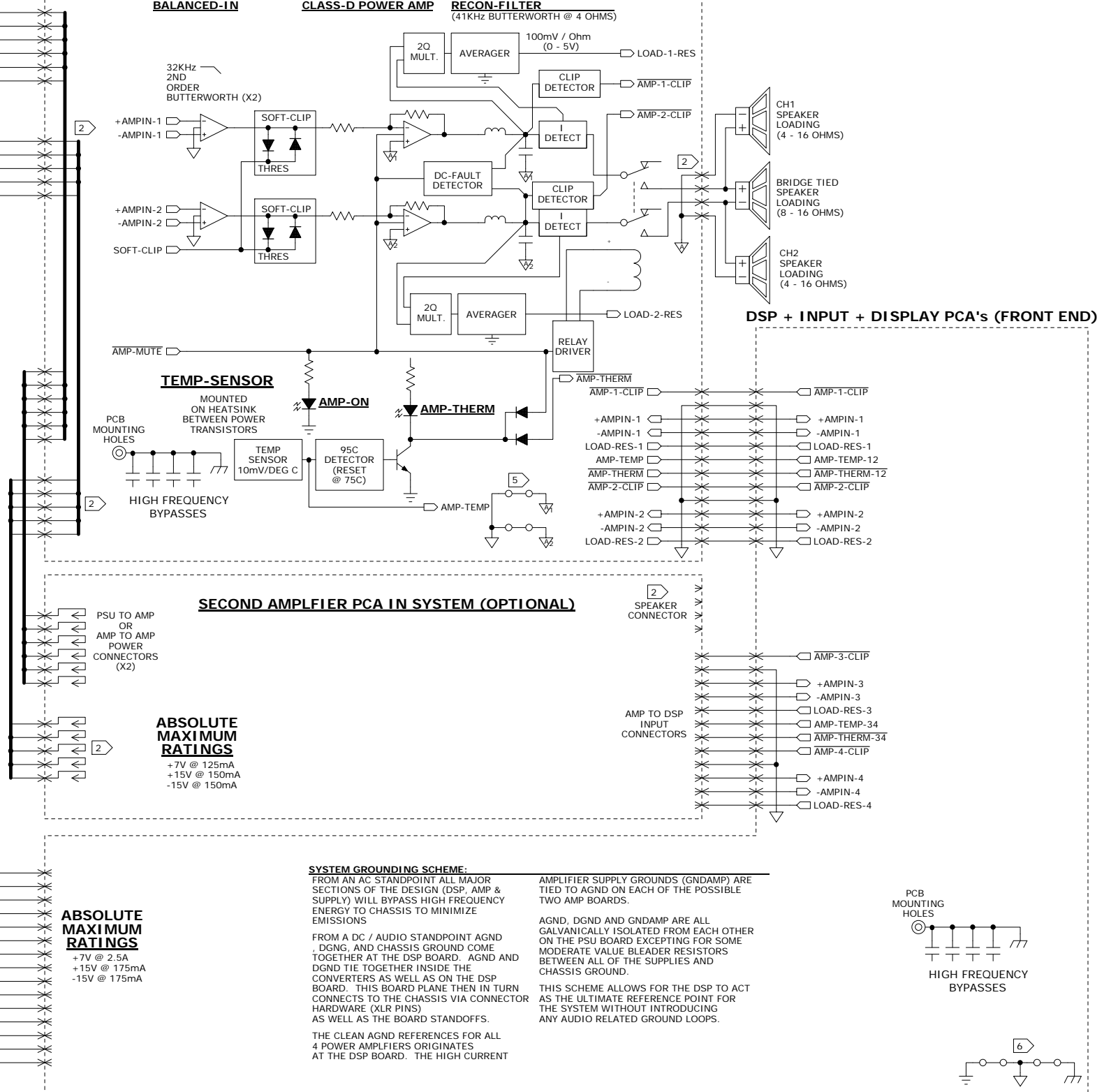
NOTES:  
 1. KEEN OCEAN P/N:OMU-27906-00.  
 2. CUSTOMER REVISION:REV-A00.  
 3. CUSTOMER P/N:MSA-0002-00.  
 4. ITEM-23 (THERMAL TRANSFER GREASE) IS TO BE APPLIED EVENLY TO HEATSINK SURFACE OF ITEMS 11 & 12.

|    |      |     |    |    |   |   |       |        |           |
|----|------|-----|----|----|---|---|-------|--------|-----------|
| 序号 | 修改内容 | A 版 | 签名 | 日期 | 三视图方向   | 河源天裕电子塑胶有限公司                                | 材质:   | 签名     | 日期        |
|    |      |     |    |    | 除另外注明外:所有尺寸为mm<br>公差:0 ±0.35mm<br>0.0 ±0.2mm<br>0.00±0.1mm<br>角度±0.5° |   | 加工:   | 编制:QYX | 2015.7.23 |
|    |      |     |    |    |   | 名称: ASSY FINAL ,<br>TKO-1000W-PANEL: S-MON1 | 比例:   | 审核:    |           |
|    |      |     |    |    |   |   | 客户图号: | 确认:    |           |
|    |      |     |    |    |   |   | 适用编号: |        |           |

1000W (500W) POWER SUPPLY PCA (PCA-1001-XX)

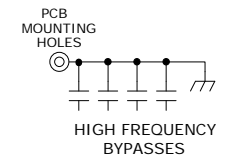


1000W (500W) 2-CHANNEL AMP PCA (PCA-1000-XX)



- NOTES:**
1. ALL CONNECTORS THAT ARE UNMARKED IN THE SCHEMATIC ARE 2.5mm SPACED TJC3 TYPES.
  2. CONNECTORS ARE MOLEX MINI-FIT-JR CHINA EQUIVALENTS.
  3. AGND AND GND-AMP ARE TIED TOGETHER ON EACH AMPLIFIER PCA.
  4. AGND AND DGND CONNECTED TOGETHER ON THE DSP BOARDS BOTH ON THE PCB VIA TRACE SHORTING AND IN THE CONVERTER CHIPS BY THEIR SHARED CONNECTION IN THE PACKAGE. THE ENTIRE SYSTEM THEN GETS GROUNDED DIRECTLY TO THE CHASSIS VIA INPUT AND CONNECTORS AS WELL AS PCB MOUNTING STANDOFFS.
  5. SEE SDD-1000 FOR FURTHER SYSTEM DETAILS.

**SYSTEM GROUNDING SCHEME:**  
 FROM AN AC STANDPOINT ALL MAJOR SECTIONS OF THE DESIGN (DSP, AMP & SUPPLY) WILL BYPASS HIGH FREQUENCY ENERGY TO CHASSIS TO MINIMIZE EMISSIONS  
 FROM A DC / AUDIO STANDPOINT AGND, DGND, AND CHASSIS GROUND COME TOGETHER AT THE DSP BOARD. AGND AND DGND TIE TOGETHER INSIDE THE CONVERTERS AS WELL AS ON THE DSP BOARD. THIS BOARD PLANE THEN IN TURN CONNECTS TO THE CHASSIS VIA CONNECTOR HARDWARE (XLR PINS) AS WELL AS THE BOARD STANDOFFS.  
 THE CLEAN AGND REFERENCES FOR ALL 4 POWER AMPLIFIERS ORIGINATES AT THE DSP BOARD. THE HIGH CURRENT AMPLIFIER SUPPLY GROUNDS (GNDAMP) ARE TIED TO AGND ON EACH OF THE POSSIBLE TWO AMP BOARDS.  
 AGND, DGND AND GNDAMP ARE ALL GALVANICALLY ISOLATED FROM EACH OTHER ON THE PSU BOARD EXCEPTING FOR SOME MODERATE VALUE BLEADER RESISTORS BETWEEN ALL OF THE SUPPLIES AND CHASSIS GROUND.  
 THIS SCHEME ALLOWS FOR THE DSP TO ACT AS THE ULTIMATE REFERENCE POINT FOR THE SYSTEM WITHOUT INTRODUCING ANY AUDIO RELATED GROUND LOOPS.



|                  |          |   |  |                   |          |
|------------------|----------|---|--|-------------------|----------|
| APPROVALS        | DATE     |   | 1567 SKY TERRACE SE<br>SALEM, OR 97306<br>U.S.A. |                   |          |
| DRAWN: Cam Jones | 03-23-15 |   |  |                   |          |
| CHECKED:         |          | <b>TKO-1000W/500W-PSU+AMP+DSP<br/>BLOCK DIAGRAM &amp; GROUNDING</b> |  |                   |          |
| NP ENG:          |          |   |  |                   |          |
| MATERIAL:        |          |   |  |                   |          |
| MFG:             |          |   |  |                   |          |
| MFG ENG:         |          | SIZE: D   | SCALE: NONE                                      | DWG. NO. SDD-1001 | REV. A00 |
| ISSUED:          |          | DWG FILE: SDD-1001-A00.sch  |  | SHEET 1 OF 1      |          |

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## 12. Document Revision

| Revision | Date          | Description     |
|----------|---------------|-----------------|
| Rev-A00  | Dec. 18, 2016 | Initial Release |

