

Configuring Multiple Amplifier Systems

For AE Techron 7548 and 7796 Amplifiers

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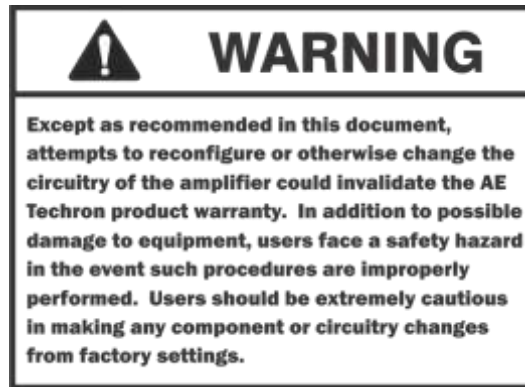
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Introduction

In most cases, the 7000 series amplifiers are manufactured and shipped in customer specified configurations. This document is for customers that need to reconfigure their 7548 or 7796 amplifiers for increased voltage and/or current. This document will provide general theory and guidance for the customer who desires to change the amplifier configuration.

This document assumes significant competence on the part of the reader in terms of amplifier systems, electronic components, and good electronic safety and working practices.



Safety First

Throughout this document special emphasis is placed on good safety practices. The following graphics are used to highlight certain topics which require extra precaution.



Special Applications

This document deals with the more common or typical modifications and applications. For users who require special configurations not covered in the document you are encouraged to contact AE Techron for assistance in modifying the 7548 or 7796 amplifiers for your special application.

Multiple Amplifier Systems

An AE Techron 7548 or 7796 amplifier may be paired with another 7548 or 7796 amplifier to increase the available output current and/or voltage. This document explains the objectives of such amplifier systems and provides general guidelines for the construction.

Construct systems of multiple amplifiers according to the following principles:

1. Use only the same model AE Techron amplifiers to construct multiple amplifier systems. Do not connect, for example, a 7548 with a 7796 or an amplifier made by another manufacturer. Such improper connections could damage the amplifiers.
2. Never directly connect one amplifier's Output terminal (on the output terminal block) to another amplifier's Output terminal. The resulting circulating currents will waste power and may damage the amplifiers. Depending on the configuration, the Output terminal of one amplifier may only be directly connected to the next amplifier's Sampled Common (or sometimes Common) terminal, to the load, or to a ballast resistor.
3. Potentially lethal voltages and currents are present within the amplifiers. While the 7548 and 7796 amplifiers' chassis are earth grounded, all internal grounds are floating. Particularly in systems assembled for increased voltage, all internal grounds of Slave amplifiers could carry lethal voltage levels.
4. Connect input signal to Master amplifier only. Contact AE Techron for detailed input signal instructions.
5. Wire specifications are important. Contact AE Techron for output wiring specifications of multi-amplifiers systems.

Because the internal circuitry of a 7548 or 7796 amplifier is not connected to chassis ground, the amplifier is well suited for use in series or parallel with matching amplifiers. Configurations with more amplifiers not covered by this document may be possible. The 7548 and 7796 amplifiers have an internal 2000V standoff potential limitation. Contact AE Techron for other possible amplifier systems.

The following amplifier systems are valid for both controlled-voltage mode and controlled-current mode of operation.

To choose between differential or single-ended output use the following guidelines:

1. Differential output is less expensive (because it needs fewer optical couplers) and is easier to build than single-ended output.
2. Single-ended output must be used if the load will ever be ground referenced.



Master/Slave Settings

In multiple AE Techron 7548 or 7796 amplifier configurations, one amplifier is designated as the “Master” amplifier and the one or more amplifiers connected to it are designated as “Slaves”. In Slave amplifiers, the input signal, selection of CV or CC operation, and (if applicable) CC compensation are controlled by the Master amplifier. Amplifiers are factory-set as Masters. The Master setting is also correct for single amplifier operation.

NOTE: Before using a Master amplifier, either by itself or in a system, ensure that the 2.7 ohm circulating ground current bleed resistor is installed between the Sampled Common and chassis ground on the output connector. The purpose of this resistor is to reduce noise caused by small circulation ground currents. Use of the resistor in Slave amplifiers depends on the circuit configuration. Whenever an OPTOC is used (the Slave amplifier is not ground referenced), the resistor is not used on that Slave amplifier. (If installed when not required, the resistor may burn out.)

To operate the amplifier as a Slave, complete these steps:

1. With power to the amplifier turned off, loosen the four Allen head screws on the front cover of the amplifier and remove the front cover.
2. Locate the jumpers P1 and P2 on the main circuit board (see Figure 2.2).
3. Move both jumpers to the SLAVE position.

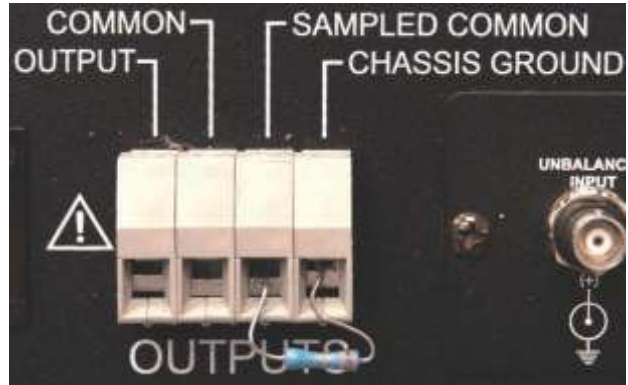


Figure 2.1 - Circulating Ground Current Bleed Resistor



Figure 2.2 - Master / Slave Setting

Output Wiring Principles

This section outlines the minimum output wiring requirements in terms of size, length, and rating for connecting multi-amplifier systems.

Wire size or gauge should be selected to exceed the expected current it will carry. Figure 3.1 shows the minimum matching requirements of wire gauge and continuous duty amperage limits.

Control the length of the wire connecting each amplifier with care. Particularly in parallel applications, the branches to each amplifier should match within a tolerance of +/- ¼ inch. Similarly, in any Y-branching application, both legs should be of the same length with a tolerance of +/- ¼ inch.

Wires connecting the amplifier (output) commons or sampled commons together should be as short as is practical.

Wire rating refers to the allowable voltage handled by the wire. In configuring multi-amplifier systems for increased voltage, make sure that the wire insulation is appropriate for the intended voltage.

Figure 3.1 - Wire Current Carrying Capacity

Continuous Duty Current* (Amperes)	American Wire Gauge (AWG)	Diameter (mm)	Diameter Mils (.001 in)
46	8	3.264	128.5
33	10	2.588	101.9
23	12	2.053	80.8
17	14	1.628	64.1
13	16	1.291	50.8
10	18	1.024	4.3

*Minimum value for insulated wire in free air (i.e. not bundled).

Series Systems for Increased Voltage

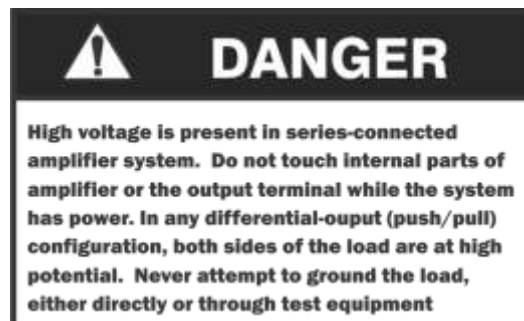
Two AE Techron 7548 or 7796 amplifiers can be assembled in series configuration to approximately double available voltage to a load. The following examples could be used for either controlled-voltage or controlled-current mode.

To assemble a series system:

1. Identify one amplifier as the “Master” unit. Set P1 and P2 jumpers to the MASTER position.
2. Connect the signal source to the input of the Master amplifier.
3. On the other amplifier, set jumpers P1 and P2 to the SLAVE position.
4. Using the correct interconnect cables and OPTOC module, if required, connect the cables as shown in Figure 4.1 differential output or Figure 4.2 for single-ended output.

The series differential (push/pull) wiring system may only be used if the load connected to the amplifiers is floating and not ground referenced. For a ground referenced load, the single-ended output (unbalanced) wiring must be used.

For other multiple series amplifier configurations, please contact AE Techron for more information.



TWO-SERIES DIFFERENTIAL-OUTPUT SYSTEM

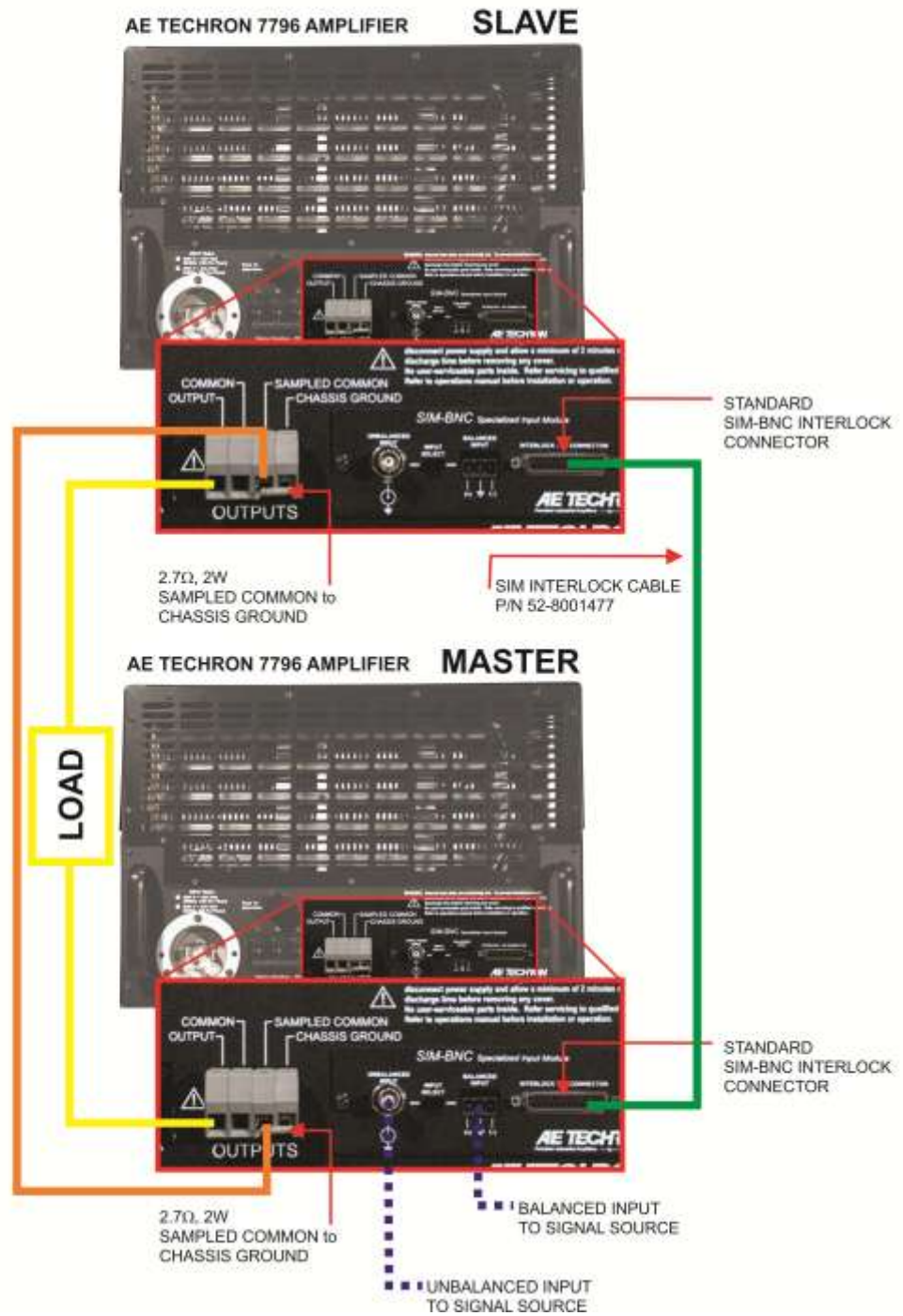


Figure 4.1 – Two Series Differential (Push/Pull) Output Wiring for Floating Load

TWO-SERIES SINGLE-ENDED OUTPUT SYSTEM

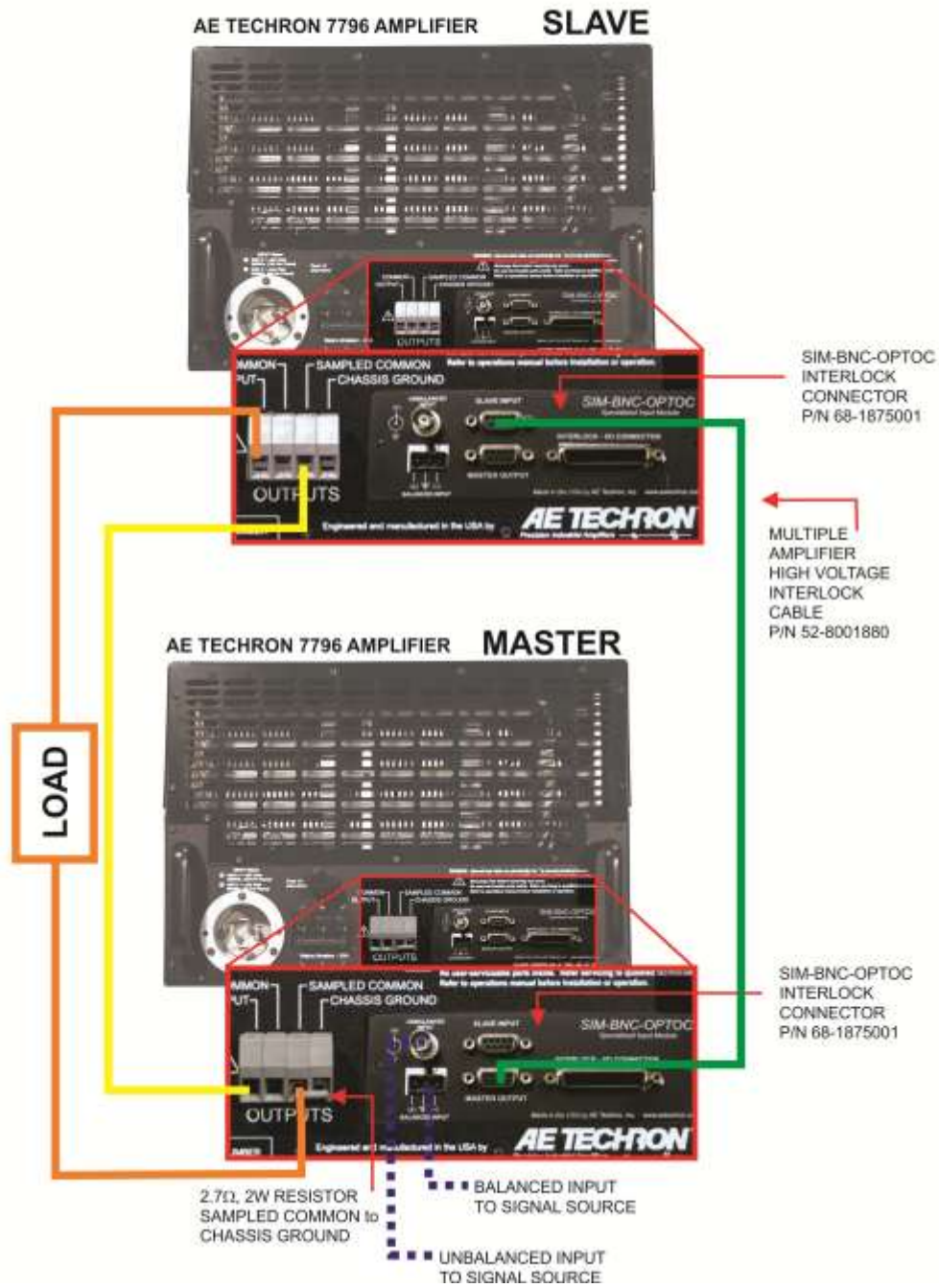


Figure 4.2 – Two Series Single-Ended (Unbalanced) Output Wiring for Ground-Referenced Load

Parallel Systems for Increased Current

AE Techron 7548 or 7796 amplifiers can be assembled in a parallel configuration to increase the available output current to the load.

All amplifiers connected in parallel require “ballast” resistors. Since no two amplifiers in parallel will put out exactly the same voltage, the amplifier with the highest voltage would drive some voltage into the other amplifiers. The ballast resistor (or current sharing/isolating resistor) absorbs this small voltage difference and serves to isolate the amplifiers in a parallel circuit. To obtain the required resistors for this application, please contact AE Techron

The AE Techron 7548 and 7796 amplifiers have internal provisions for up to four paralleled amplifiers (one Master and three Slaves). Contact AE Techron for further assistance in paralleling additional amplifiers.

Two AE Techron 7548 or 7796 amplifiers can be assembled in parallel configuration to approximately double available current to a load. The following examples could be used for either controlled voltage or controlled current mode.

To assemble a series system:

1. Identify one amplifier as the “Master” unit. Set P1 and P2 jumpers to the MASTER position.
2. Connect the signal source to the input of the Master amplifier.
3. On the other amplifier, set jumpers P1 and P2 to the SLAVE position.
4. Using the correct interconnect cables that can be obtained from AE Techron, connect the cables as shown in Figure 4.1 for parallel output.
5. Control the length of the wire connecting each amplifier with care. Particularly in parallel applications, the branches to each amplifier should match within a tolerance of $\pm 1/4$ inch. Similarly, in any Y-branching application, both legs should be of the same length with a tolerance of $\pm 1/4$ inch.
6. Wires connecting the amplifier (output) commons or sampled commons together should be as short as is practical. See Section 3, “Output Wiring Principles,” for information on choosing wiring gauge and length.

TWO-PARALLELED OUTPUT SYSTEM

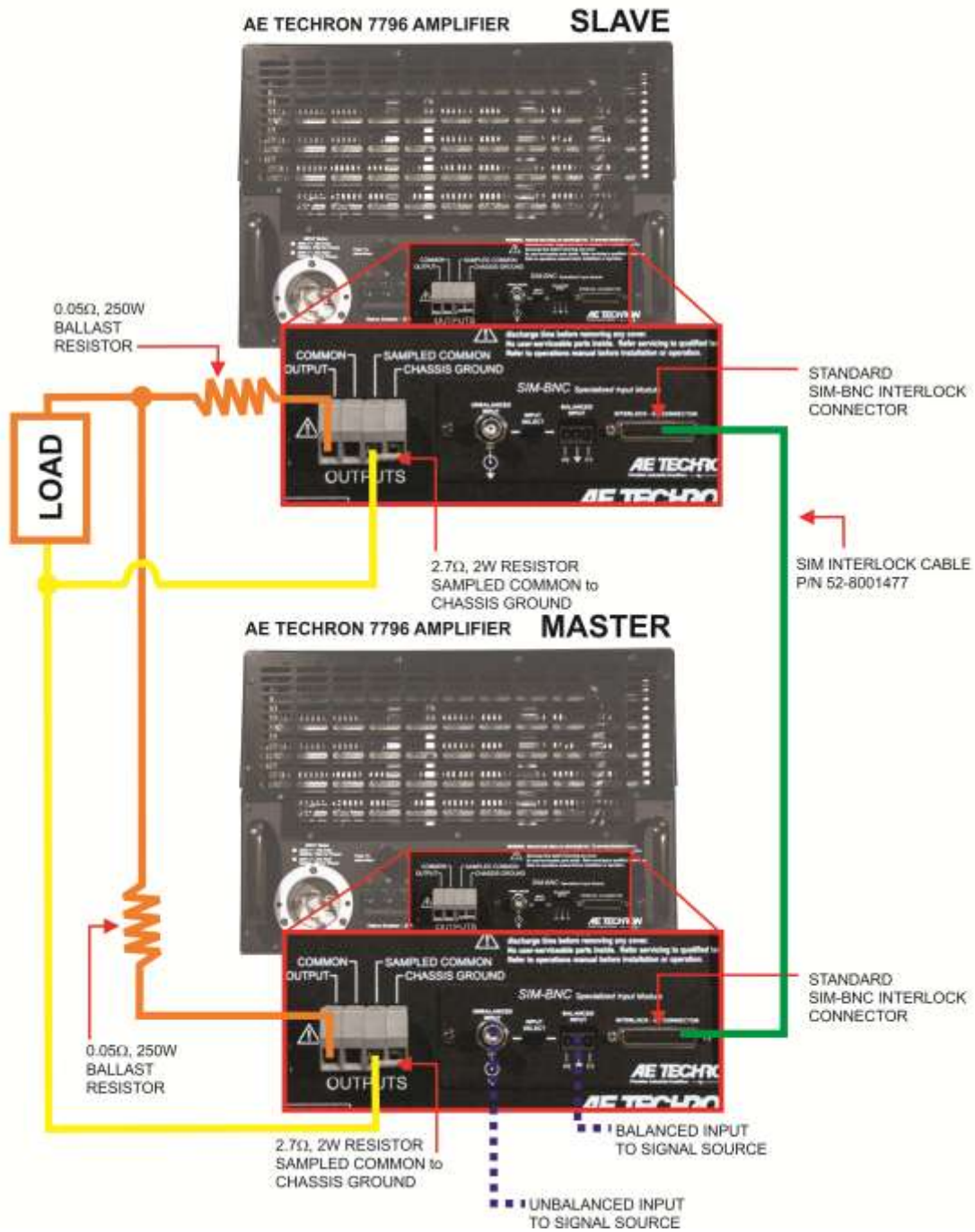


Figure 5.1 – Parallel Output Wiring

SIM : Interlock I/O Connector Pinouts and Functions

Pin #	Function	Description	Signal Levels
1	Amplifier Output	Used for driving slave amplifiers, monitoring amplifier output voltage	Can be greater than $\pm 200V_{peak}$. NOTE: Wired to amplifier output, resistor limit (5.6 ohm, $\frac{1}{4}W$).
2	Sampled Common	Used for driving slave amplifiers (Reference), Controlled Current or Controlled Voltage	Amplifier External Reference, $5V_{peak}$ max from Common
3	Input, 1+	High Level Input, Slave Input, Unity gain, aka “Non-inverting Input”	Can accept output of “Amplifier Output”, $\pm 200V_{peak}$, or Sample Common.
4	Interlock	Multiple amplifier interlock, status, remote off	Status; 0–8Vdc amplifier to standby, 12–15Vdc amplifier(s) in “Run” state. When connected to interlock common amplifier(s) will be forced to standby. To interlock multiple amplifiers (sharing the same sample common power connections) connect Interlock together (daisy chain).
5	Amp Ready	Used for OPTOC, individual amplifier status (Not optocoupled)	To drive customer optocoupler, $-1.2V$ at 6mA to Interlock Common.
6	I MON +	Non-inverted Current Monitor Output; 7548/7796 : 1V/20A unbalanced, 2V/20A balanced, not isolated; 7224 : 1V/5A unbalanced, 2V/5A balanced, not isolated.	Low voltage output; 7548/7796 : $\pm 200A_{peak}$ output = $\pm 10V_{peak}$, unbalanced; $\pm 20V_{peak}$, balanced. 7224 : $\pm 50A_{peak}$ output = $\pm 10V_{peak}$, unbalanced; $\pm 20V_{peak}$, balanced.
7	Current Sum 1 (+)	Current monitor summing + input for slave 1, “Parallel, Controlled Current” applications only	Accepts input from I MON – slave output.
8	Current Sum 2 (+)	Current monitor summing + input for slave 2, “Parallel, Controlled Current” applications only	Accepts input from I MON – slave output.
9	Current Sum 3 (+)	Current monitor summing + input for slave 3, “Parallel, Controlled Current” applications only	Accepts input from I MON – slave output.
10	Sample Common	Amplifier Reference, used for OverTemp, Overload, Run and OverVoltage outputs	Amplifier External Reference.
11	Overtemp + Out	Amplifier status, amp ready reports if a “Power Transformers or “Output Wells” is “Over Temp”, Amplifier will be forced to standby	Pulls to ground must be used with internal $-24V$ supply. Can run an optocoupler.
12	Run + Out	Amplifier status, amp ready reports amplifier is in the “Run” state	Pulls to ground must be used with internal $-24V$ supply. Can run an optocoupler.
13	$-24V$	Power from amplifier for external logic, Optical Isolating Module (OPTOC)	$-24V_{dc}$, 30mA
14	Common	Used for driving slave amplifiers, Controlled Voltage only	Amplifier Internal Reference.
15	Input, 1 -	High Level Input, Slave Input, Unity gain, aka “Inverting Input”	Can accept output of “Amplifier Output”, $\pm 200V_{peak}$, or Sample Common.
16	$+24V$	Power from amplifier for external logic, Optical Isolating Module (OPTOC)	$24V_{dc}$, 30mA.
17	Interlock Common	Used for OPTOC module and external status, remote on/off.	Amplifier External Reference.
18	Spare	No function	
19	I MON -	Inverted Current Monitor Output; 7548/7796 : 1V/20A unbalanced, 2V/20A balanced, not isolated; 7224 : 1V/5A unbalanced and 2V/5A balanced, not isolated.	Low voltage output; 7548/7796 : $\pm 200A_{peak}$ output = $\pm 10V_{peak}$, unbalanced; $\pm 20V_{peak}$, balanced; 7224 : $\pm 50A_{peak}$ output = $\pm 10V_{peak}$, unbalanced; $\pm 20V_{peak}$, balanced.
20	Current Sum 1(-)	Current monitor summing - input for slave 1, “Parallel, Controlled Current” applications only	Accepts input from I MON + slave output.
21	Current Sum 2(-)	Current monitor summing - input for slave 2, “Parallel, Controlled Current” applications only	Accepts input from I MON + slave output.
22	Current Sum 3(-)	Current monitor summing - input for slave 3, “Parallel, Controlled Current” applications only	Accepts input from I MON + slave output.
23	Overload Out	Amplifier status, amp ready reports “Overload” status, indicates voltage limit, current limit, or distorted output	Pulls to ground must be used with internal $-24V$ supply. Can run an optocoupler.
24	Overvoltage Out	Amplifier status, amp ready reports AC Line Over Voltage	Pulls to ground must be used with internal $-24V$ supply. Can run an optocoupler.
25	Reset	Remote Reset, restores operation after “OverloadLatch” or “OverTemp”	Requires $-15V_{dc}$ to reset amplifier