



4301 Operation Manual

Complete Solution for ANSI-T1.315-2001 Protective Device Output Transient Testing

Limited One-Year Warranty

SUMMARY OF WARRANTY

AE TECHRON INC., of Elkhart, Indiana (Warrantor) warrants to you, the ORIGINAL COMMERCIAL PURCHASER ONLY of each NEW **AE TECHRON INC.** product, for a period of one (1) year from the date of purchase, by the original purchaser (warranty period) that the product is free of defects in materials or workmanship and will meet or exceed all advertised specifications for such a product. This warranty does not extend to any subsequent purchaser or user, and automatically terminates upon your sale or other disposition of our product.

ITEMS EXCLUDED FROM WARRANTY

We are not responsible for product failure caused by misuse, accident or neglect. This warranty does not extend to any product on which the serial number has been defaced, altered, or removed. It does not cover damage to loads or any other products or accessories resulting from **AE TECHRON INC.** product failure. It does not cover defects or damage caused by the use of unauthorized modifications, accessories, parts, or service.

WHAT WE WILL DO

We will remedy, at our sole discretion, any defect in materials or workmanship by repair, replacement, or refund. If a refund is elected, you must make the defective or malfunctioning component available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at our factory. Expenses in remedying the defect will be borne by **AE TECHRON INC.**, including one-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

When you notify us of your need for warranty service, we will give you an authorization to return the product for service. All components must be shipped in a factory pack or equivalent which, if needed, may be obtained from us for a nominal charge. We will take corrective actions within a reasonable time of the date of receipt of the defective product. If the repairs made by us are not satisfactory, notify us immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

You are not entitled to recover from us any consequential or incidental damages resulting from any defect in our product. This includes any damage to another product or products resulting from such a defect.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this warranty. The warranty is not extended by the length of time for which you are deprived of the use of this product. Repairs and replacement parts provided under the terms of this warranty shall carry only the unexpired portion of this warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

There is no warranty that extends beyond the terms hereof. This written warranty is given in lieu of any oral or implied warranties not contained herein. We disclaim all implied warranties, including, without limitation, any warranties of merchantability or fitness for a particular purpose. No action to enforce this Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

AE TECHRON INC. Customer Service Department
2507 Warren St. Elkhart, IN, 46516, U.S.A.
(574) 295-9495
www.aetechron.com

1 Introduction

Thank you for your decision to purchase the 4301 amplifier solution. This product has been specially designed to meet or exceed the testing requirements for high current ANSI-T1-315-2001 testing.

This amplifier solution is capable of either the combined waveform single measurement or multiple wave form/multiple measurement methods as described in section 5.4 of the standard.

The 4301 amplifier solution is capable of slew rates of up to 60 V/ μ sec and, in its largest configuration, can provide up to 240A of DC at +50VDC or - 50VDC and can provide pulses of up to 800 amps at voltages of up to +/- 100V.

The 4301 is designed to work with a standard arbitrary wave form generator or signal source that can be triggered. The system has a voltage gain of 20 and can accept input voltages of up to +/- 10V.

The cabinet has been designed with space and power provisions for the installation of other electronics, if desired, such as a dedicated signal source.

Lower power versions of the 4301 amplifier solution are available for users with lower current requirements. For more information on these lower power versions, please contact your local AE Techron representative or AE Techron directly.

1.1 Features

- Complete solution for ANSI-T1.315-2001 Protective Device Output Transient Testing
- Slew rates up to 60 V/ μ sec
- Up to 240A DC at +50VDC or -50VDC
- Can provide pulses of up to 800 amps at voltages of up to +/-10V
- Cabinet design allows for additional customization

1.2 About AE Techron

AE Techron focuses on the development of power conversion and amplifier solutions for difficult environments. In addition to a line of standard power supplies and power amplifier products, AE Techron provides the design and manufacture of custom, high-quality, low-volume electronic products for research, military and industrial applications.

2 Setup

2.1 Safety First

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



2.2 Unpacking and Installing the 4301

The 4301 will be delivered to the ship-to address enclosed in a wooden crate and transported on a special, shock-absorbing pallet. With the addition of packaging, the 4301 weights more than 850 pounds. To avoid serious injury and/or product damage, use a heavy-duty lift or other suitable equipment to unpack and move the product to its place of installation.

To uncrate the product, remove one side of the crate, then use a lift or other suitable equipment to glide the 4301 from the crate and off the pallet. Cable lift rings are installed at the cabinet top corners to facilitate product removal (see Figure 2.1).

In addition, the 4301 cabinet is mounted on casters to allow rolling on a flat, smooth surface. To avoid damage to product casters and/or possible tipping, always push the cabinet from the front and avoid rough or pitted surfaces.

2.3 Connecting the Power Source



The 4301 requires 5-conductor wiring suitable for 120 A service. To perform the power supply installation, complete the following steps.

1. Open cabinet back access door and locate wiring barrier strip access panel (located at top of cabinet (see Figure 2.1). Remove four corner screws to access barrier strip.

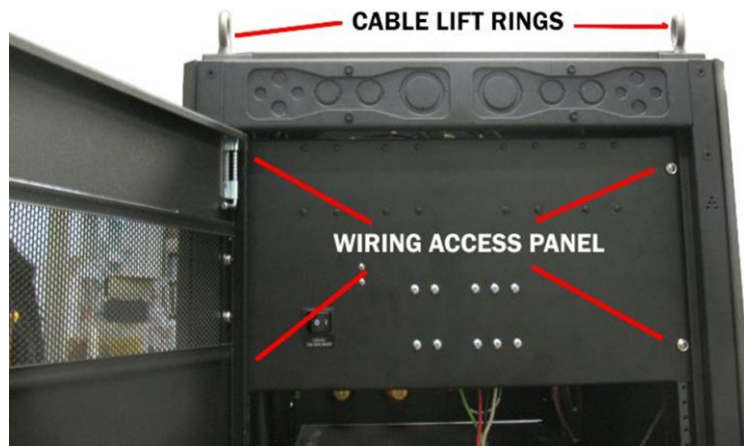
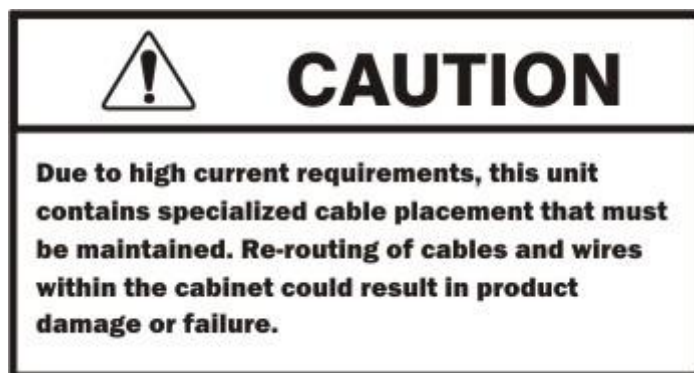


Figure 2.1 Cable Lift Rings and Barrier Strip Access Panel



2. Route input cable through cabinet. Punch-outs are located at the top and bottom of cabinet back for easier routing (see Figure 2.2).



Figure 2.2 Cabinet Punch-Outs

3. Wire power cable as specified on barrier strip (see Figure 2.3).

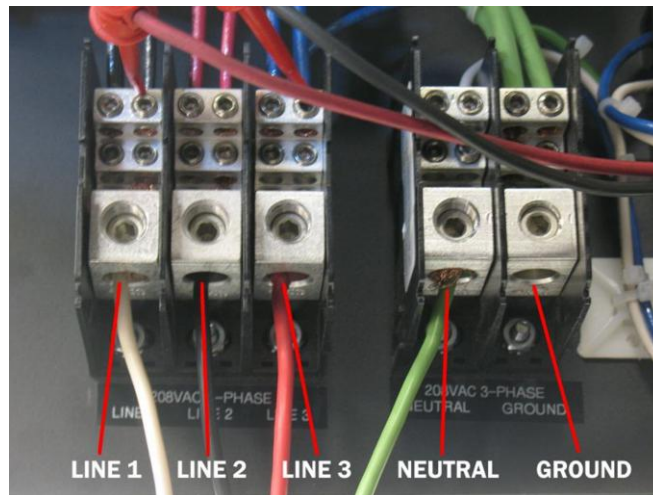


Figure 2.3 Barrier Strip

2.4 Connecting the Inputs

Connect from an arbitrary waveform generator to the Input Signal BNC jack located on the cabinet front as shown in Figure 2.4.

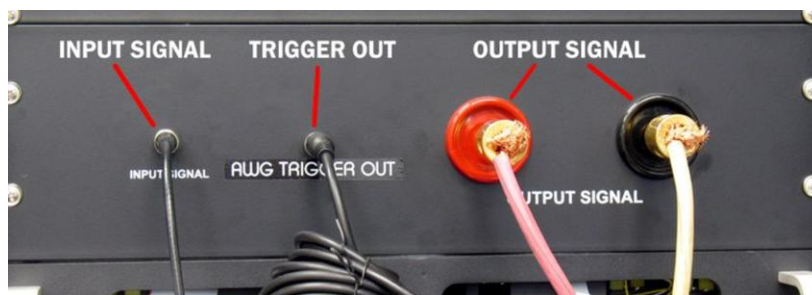


Figure 2.4 Input Signal, Trigger Out, and Output Signal Jacks

2.5 Connecting the AWG Trigger Out

Connect from the AWG Trigger Out BNC jack located on the cabinet front to Trigger In connector on the arbitrary waveform generator (see Figure 2.4).

2.6 Connecting the Signal Outputs

Using the supplied 250A Pin-Plug connectors, wire two cables to connect to the Equipment Under Test. Insert the wired Pin-Plug connectors into the Output Signal jacks as shown in Figure 2.4.

3 Operation



3.1 Main Power Selector

Turn the Main Power selector to the “ON” (I) position to enable the main power supply (see Figure 3.1). To disable the main power supply, turn the Main Power selector to the “OFF” (O) position.



Figure 3.1 Main Power Selector

3.2 Startup Sequence

When Main Power is enabled, the unit will automatically begin the power-up sequence to activate the unit. When the power-up sequence is complete for all channels, the Stop and Standby LEDs will be lit for all channels, and the LCD Screen will display the $V_{PEAK}/V_{RMS}/I_{PEAK}/I_{RMS}$ meters (multi-display) (see Figure 3.2).

NOTE: As a safety precaution, this unit powers up in Standby mode. While in Standby mode, the unit will not amplify the input signal.



Figure 3.2 Default LCD Screen Display

3.3 Enabling the Unit

To enable the unit, press the Enable button on the front control panel for all channels. When each channel is Enabled, the Run And Ready LEDs will be lit and the channel will amplify the input signal (see Figure 3.3).



Figure 3.3 Enabled Channel LED Display

3.4 Front Control Panel

The 4301 will contain from one to four front control panels, depending on the model. Each control panel can be used independently to control one channel of the 4301. The Controls and Indicators will include: Multi-function LCD Screen, Navigation Buttons, Input Buttons and LED Status Indicators.

3.4.1 LCD Screen Display

The multi-function LCD Display provides peak and RMS values for voltage and current measured directly from the amplifier output. The LCD Display also allows manual selection of the Bi-Level function. In addition, the LCD Display gives details and prescribed corrective actions in the event of a fault condition.

3.4.1.1 Voltage and Current Displays

By default, the 4301 LCD Display for each channel will default to the Multi-Display showing values for Peak and RMS Voltage and Peak and RMS Current (see Figure 3.3). If desired, the following optional displays can be selected by pressing the Down arrow on the Navigation Buttons:

- | | |
|------------------------|-----------------------|
| 1. V_{PEAK}/I_{PEAK} | 4. V_{RMS}/I_{PEAK} |
| 2. V_{RMS}/I_{RMS} | 5. I_{RMS}/I_{PEAK} |
| 3. I_{RMS}/V_{PEAK} | 6. V_{RMS}/V_{PEAK} |

3.4.1.2 Bi-Level Power Supply Setting

The Bi-Level Power Supply design used by the 4301 allows the unit to operate in high- or low-voltage modes, or to automatically switch between modes based on the application requirements (Bi-Level Auto mode). By default, the 4301 will power up in Bi-Level Auto mode. To change to an alternate setting after power-up is complete, use the arrow keys on the Navigation Buttons to scroll Down to the Bi-Level Auto screen. Then use the Left and Right arrow keys to select the desired Bi-Level Setting. Available settings include:

1. **Auto:** Unit will automatically switch between low- and high-voltage modes according to the application requirements. Use this setting for continuous operation when the application requirements are greater than 60 volts.
2. **Low:** Unit will remain in low-voltage mode. This setting is recommended for applications requiring 60 volts or less, peak.
3. **High:** Unit will remain in high-voltage mode. **NOTE: This setting is not recommended for use in continuous operation.**
4. **Trigger:** Voltage-mode switches automatically while a precise signal delay provides very fast, smooth Slew Rate. This setting is recommended for applications requiring a 25 V/ μ s or faster Slew Rate.

3.4.2 Navigation Buttons

The Navigation buttons (see Figure 3.5) provide four arrow keys to allow navigation through the different voltage and current measurement functions on the LCD display.

Enter Button: The Enter button has been provided for future expansion and has no function at this time.

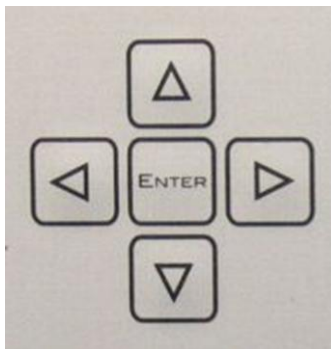


Figure 3.5 Navigation Buttons

3.4.3 Main Status Indicators

Four Main Status Indicators located on the front control panel for each channel monitor and indicate the internal conditions of the channel. (See Figure 3.6.)

- **Stop (red)** – This indicates that the unit is in Stop Mode. Stop Mode is initiated by the Stop push button.
- **Standby (yellow)** – This indicates that the amplifier is in Standby mode. When in Standby mode, the low-voltage supply is energized but the high-voltage main power supply is not. The Standby indicator goes out when the amplifier goes into the Run mode.

- **Ready (yellow)** – This indicates that the amplifier is in the Ready mode. This indicator comes on when only when all fault status modes are in ready condition.
- **Run (green)** – This indicates that the unit will amplify the input signal. The unit will only pass a signal when the Run Indicator is lit.



Figure 3.6 Main Status Indicators

3.4.4 Fault Status Indicator

The Fault Status Indicator (Figure 3.7) is a red LED located on the front control panel for each channel. When the Fault Status LED is lit, it indicates that the channel was forced into Standby mode by a fault condition. The root cause of the fault condition and corrective actions are displayed on the LCD display.

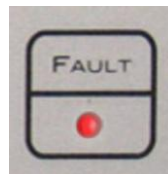


Figure 3.7 Fault Status Indicator

The following list details the possible Fault conditions and the prescribed remedies:

- **Overload Fault** – An Overload fault condition is caused by amplifier output clipping. Lower the input signal and, if needed, press the Reset button to bring the unit out of the fault condition.
- **Over-Temperature Fault** – An Over-Temperature fault condition is caused by the output transistor heat sinks getting too hot. After allowing the unit to cool, press the Reset button to bring the channel out of this fault condition.
- **Over-Voltage (high-line) Fault** – An Over-Voltage fault condition is caused by the three phase line supply voltage exceeding 110% of the rated line voltage. Reduce the input voltage and press the Reset button to bring the unit out of this fault condition.
- **Output Device Fault** – An Output Device fault condition is caused by an output transistor failing, unit or channel instability, undesired oscillation, or the flyback protection bridge is shorted. Factory service is usually required when this fault condition occurs.

3.4.5 Input Buttons

Three Input Buttons located on the front control panel for each channel control the operation mode of the unit (see Figure 3.8).

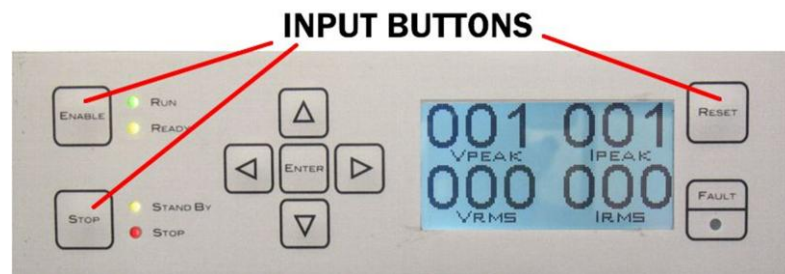


Figure 3.8 Input Buttons

- **Enable Button** –The Enable button moves the channel from Standby mode and into Run mode. To completely enable the 4301 and allow the unit to amplify signal, the Enable buttons for each channel must be individually pushed.
- **Stop Button** – The Stop button forces the unit into the Standby mode. Pushing the Stop button for any channel will place the entire unit in Standby mode. In this mode, power on two legs of the three phase mains input power is interrupted by internal solid state relays. To completely disconnect the AC Mains, use the Main Power selector.
- **Reset Button** – The Reset button brings a channel out of a Standby mode caused by a Fault condition. When the channel displaying a Fault condition is reset, the 4301 will move into Run mode.

4 ANSI T1.315-2001 Protective Device Operation Transient Testing

Section 5.4 of the ANSI T1.315-2001 Standard requires testing for protective device operation transient. This testing may be done using the waveform in Figure 1 of the Standard, or using the three waveforms shown in Figures 2 through 4 of the Standard, each applied separately.

For those waveforms requiring a risetime of 5 μ s or greater, the default Bi-Level Power Supply setting for the unit (Auto) should be used. However, for those waveforms requiring a risetime of less than 5 μ s, the Trigger mode setting and the following procedure should be used:

1. Using an arbitrary waveform generator, create the required input waveform.
2. Connect the AWG Trigger Output to the waveform generator Trigger Input connection.
3. Turn “ON” (I) the Main Power to the 4301 and allow each channel to enter Standby mode.
4. Set the Bi-Level Power Supply mode for all channels to “Trigger” using the Navigation arrow keys on the front control panel for each channel (see Figure 4.1).
5. To begin testing, push the Enable button for any channel. The LCD Screen Display for the Master channel will cycle through a 5-second countdown, then amplify and send the input signal waveform (see Figure 4.2).
6. After the input signal has been sent, the LCD Screen for each channel will display “Triggered” to verify the successful completion of the test (see Figure 4.3).

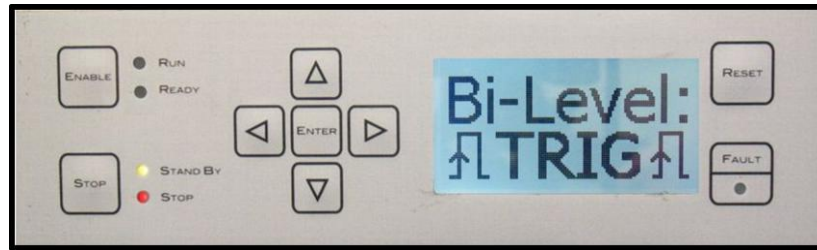


Figure 4.1 Bi-Level Setting at “Trigger”



Figure 4.2 Triggering Sequence



Figure 4.3 Test Successfully Completed

5 Customization Options

The 4301 cabinet has been configured with space for additional customer customization, if desired. Additional rack space has been provided near the top of the 4301 cabinet to allow mounting of additional component(s). A pre-wired, 120V auxiliary outlet box is also provided.

5.1 Mounting in Cabinet

All 4301 components are mounted in a standard EIA (Electronic Industries Association) rack. If adding additional components to the rack, consult the component manufacturer for information on the best way to mount and secure your custom component.

To access available cabinet rack-space, remove the four screws securing the blank rack panel, as shown in Figure 5.1.



Figure 5.1 Removing the Blank Rack Panel

5.2 Powering Additional Components

A 120-V auxiliary outlet has been provided within the 4301 cabinet, as shown in Figure 5.2. The auxiliary outlet is located near the top right, rear corner of the cabinet interior and can be accessed by removing the Wiring Access Panel (see Figure 2.1).

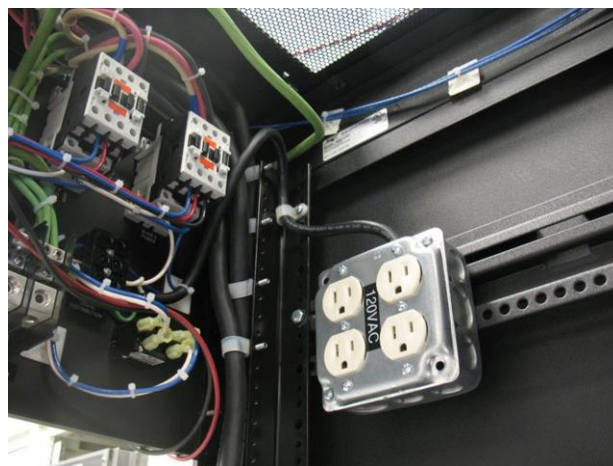


Figure 5.2 120V Auxiliary Outlet

A breaker switch that controls the power to the 120V auxiliary outlets as well as other 120V cabinet circuits is provided as shown in Figure 5.3. The breaker switch can be accessed through the cabinet rear

door and is located on the lower left corner of the Wiring Access Panel. NOTE: When the 120V breaker is turned to “OFF” (O), the cabinet functionality will be disabled.

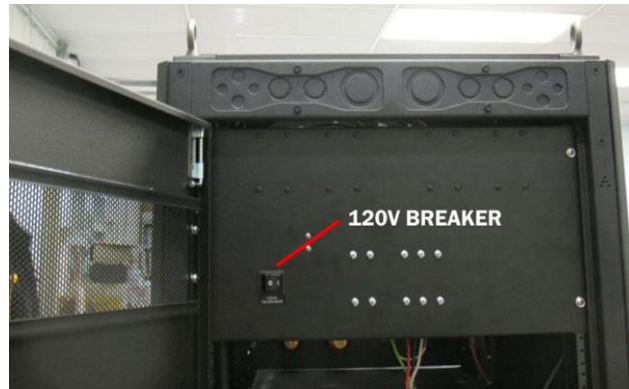


Figure 5.3 Auxiliary Outlet Breaker Switch

6 Troubleshooting

This section provides a set of procedures for identifying and correcting problems with the 4301. Rather than providing an exhaustive and detailed list of troubleshooting specifications, this section aims to provide a set of shortcuts intended to get an inoperative unit back in service as quickly as possible.

The procedures outlined in this section are directed towards an experienced electronic technician; it assumes that the technician has knowledge of typical electronics safety, repair and test procedures.

Please be aware that the 4301 undergoes frequent engineering updates. As a result, modules and electronic assemblies may not be interchangeable between units.

6.1 Visual Inspection

Before attempting to troubleshoot the 4301 while it is operating, please take time to complete a visual inspection of the internal components of the unit.

1. To perform a Visual Inspection, first turn “OFF” (O) the power at the Main power selector.
2. Wait three to five minutes for the Power Supply capacitors to discharge.
3. Open the rear door of the cabinet and visually inspect all cables, wires and connectors. Note any frayed or burned wiring, loose connections or other physical signs of the source of faulty operation.

6.2 No LEDs Illuminated or No Fans

If none of the LEDs on any of the front Control Panels are illuminated and/or the fans for any channel are inoperative, check the following:

1. Turn “OFF” (O) the power at the Main power selector.
2. Wait three to five minutes for the Power Supply capacitors to discharge.
3. Open the rear door of the cabinet and inspect the back-panel circuit breakers for each channel, as shown in Figure 6.1. Make sure each circuit breaker is in the UP position.
4. Locate the Fuse F1 Cover for each channel as shown in Figure 6.1.

5. For each channel, remove the Fuse Cover and Fuse F1. Inspect and replace the fuse if necessary.
6. Return Fuse F1 to its receptacle and replace the Fuse Cover.



Figure 6.1 Back-Panel Circuit Breakers and Fuse F1 Location

6.3 Overload Fault Warning Message

An Overload fault condition is caused by amplifier output clipping. Lower the input signal and, if needed, press the Reset button to bring the unit out of the fault condition.

6.4 OverVoltage Fault Warning Message

The 4301 will protect itself from AC mains voltage that is 10% above the voltage specifications. If the AC mains voltage is more than 10% above the operating voltage, reduce the AC mains voltage to the proper level. Then press the Reset button to bring the unit out of this Fault condition.

6.5 Standby LED Remains Illuminated

The Standby indicator for any channel may remain illuminated if the output wells or power transformer for that channel have overheated. If overheating is the problem, see the following topic (“OverTemperature Fault Warning Message”).

6.6 OverTemperature Fault Warning Message

The overheating of any channel of the 4301 may occur for two possible reasons:

1. Excessive Power Requirements
2. Inadequate Airflow

6.6.1 Excessive Power Requirements

A channel of the 4301 will overheat if the required power exceeds the component’s capabilities. High duty cycles and low-impedance loads are especially prone to cause overheating. To see if excess power requirements are causing overheating, check the following:

1. The application's power requirements fall within the specifications of the product.
2. Faulty output connections and load.
3. Undesired DC offset at the Output and Input signal.

6.6.2 Inadequate Airflow

If the unit chronically overheats with suitable power/load conditions, then the unit may not be receiving adequate airflow. To check for adequate airflow, proceed with the following steps:

1. Check air filters for each channel. Over time they can become dirty and worn out. It is a good idea to clean the air filters periodically with a mild detergent and water.
2. Visually inspect fans for each channel to assure correct operation while unit is ON. Any inoperative, visibly slow, or reverse-spinning fan should be replaced.

An OverTemp condition places the unit in Standby mode. If the OverTemp pulse is extremely short, as in the case of defective wiring or switches, the OverTemp pulse may be too brief to observe.

6.6.3 Resetting After OverTemp

To reset the unit after an OverTemp has occurred, make sure fans are running, then remove the input signal from the unit. Allow the fans to run for five minutes, then push the Reset button for each channel to reset.

6.7 Fault LED Remains Illuminated/Output Device Fault

The 4301 contains protection circuitry which disables the unit if an output stage is behaving abnormally. This usually indicates an output transistor has shorted.

To clear the Fault condition, follow these steps:

1. Turn off the signal source.
2. Turn off the Main Power selector.
3. Turn Main Power selector back on. If the Fault LED doesn't illuminate again, turn the signal source on.
4. If the Fault LED is still illuminated and the Fault condition doesn't clear, call Factory Service to determine the components requiring service.

7 Servicing your Unit

If the troubleshooting procedures are unsuccessful, one or more of the unit's components may need to be returned for Factory Service. Please contact AE Techron Technical Support at 1-574-294-9495 for help in determining the source of the Fault condition and to avoid shipping unnecessary components back to the AE Techron Service Department.

All units under warranty will be serviced free of charge (customer is responsible for one-way shipping charges as well as any custom fees, duties, and/or taxes). Please review the Warranty at the beginning of this manual for more information.

All service units must be given Return Authorization by AE Techron, Inc. before being returned. Return Authorizations can be requested on our website or by contacting our Customer Service Department.

Please take extra care when packaging your components for repair. Suitable packaging materials should be used and are available from AE Techron for a nominal fee.

Please send all service units to the following address and be sure to include your Return Authorization Number on the box.

AE Techron, Inc.
Attn: Service Department / RMA#
2507 Warren Street
Elkhart, IN 46516