AE TECHRON®

4301 Series Operator's Manual

For GR-1089 Section 10 and ATIS-0600315.2007
DC Voltage Variations and Transients 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.

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1 Introduction

Thank you for your decision to purchase the 4301 amplifier system. This product has been specially designed for EMC testing of network telecommunications equipment and is capable of producing the waveforms required for transient voltage measurements as described in GR-1089 Section 10 and ATIS-0600315.2007.

The 4301 is designed to work with a standard arbitrary wave form generator or signal source that can be triggered. The system can be ordered with an optional Fluke 281 arbitrary waveform generator, which comes pre-programmed with the required transient waveforms and integrated into the 4301 system. When equipped with the Fluke 281 option, the 4301 provides a complete solution for GR-1089 Section 10/ATIS-0600315.2007 testing.

The 4301 system is available in four standard configurations and is capable of slew rates of up to 60 V/µsec. In its largest configuration (model 4301-240), the 4301 system 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 system has a voltage gain of 20 and can accept input voltages of up to ±10V.

The 4301-240 cabinet has been designed with space and power provisions for the installation of other electronics, if desired.

Lower power versions of the 4301 amplifier solution are available for users with lower current requirements: 4301-180 (180A), 4301-120 (120A) and 4301-60 (60A). For more information on these lower power versions, please refer to the "Specifications" section of this manual; or contact your local AE Techron representative or AE Techron directly.

1.1 Features

- Complete solution for GR-1089 Section 10 and ATIS-0600315.2007 DC Voltage Variations and Transients Testing.
- Optional Fluke 281 AWG comes pre-programmed and integrated into the 4301 system.
- Slew rates up to 60 V/µsec.
- Up to 240A DC at +50VDC or –50VDC (4301-240 configuration).
- Can provide pulses of up to 800 amps at voltages of up to ±100V (4301-240 configuration).
- Adjustable compensation allows the system to maintain a 50V/2 µsec rise-time over a wide range of current outputs.
- Cabinet design allows for additional customization.

1.2 About AE Techron

AE Techron, Inc. is a recognized world leader in the design and manufacture of precision, audio-frequency power amplifiers and product safety compliance systems for the EMC marketplace. Their flagship 7224 linear amplifier features a DC-300 kHz bandwidth; it has been recognized by Ford for use in EMC-CS-2009 testing. Other products offer solutions for power susceptibility and conducted immunity testing found in Telecom (GR 1089 Section 10/ATIS-0600315.2007), Aviation (DO-160, MIL-STD-461), and Automotive (SAE J1113-22, ISO 16750-2, MIL-STD1275, GMW3172). With a focus on complete testing systems and configurable amplifier solutions for difficult requirements, AE Techron meets the challenges of the EMC industry by providing innovative design and exacting performance.

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 that require extra precaution.

Figure 2.1 Cable Lift Rings

DANGER

DANGER represents the most severe hazard alert. Extreme bodily harm or death will occur if these guidelines are not followed. Note the explanation of the hazard and instruction for avoiding it.

WARNING

WARNING alerts you to hazards that could result in severe injury or death. Note the explanation of the hazard and the instructions for avoiding it.

CAUTION

CAUTION indicates hazards that could result in potential injury or equipment or property damage. Once again, note the explanation of the hazard and the instructions for avoiding it.

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 4301-240 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 of the larger 4301 systems to facilitate product removal (**see Figure 2.1**).

To uncrate the **4301-60 system**, remove three sides of the crate, and then use the four handles on the sides of the cabinet to lift the cabinet up from the bottom packaging material and over the wooden supports.

The 4301 cabinet is mounted on casters or wheels 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

All 4301 systems require 208V, 3-phase, 5-conductor wiring. Supply a suitable gauge wiring depending on the system configuration: 4301-240: 120A; 4301-180: 90A; 4301-120: 60A; and 4301-60: 30A.

WARNING

ELECTRIC SHOCK HAZARD.
Power Supply wiring should only be performed by a qualified, licensed electrician.

To perform the power supply installation, complete the following steps.

CAUTION

Due to high current requirements, this unit contains specialized cable placement that must be maintained. Re-routing of cables and wires within the cabinet could result in product damage or failure.

1. Open cabinet back access door and locate wiring barrier strip panel located at top of cabinet (see **Figure 2.2**). On **4301-60** models, the wiring strip is mounted on the inside of the hinged panel. Remove the cabinet door and then remove the two screws on the left edge of the panel to access the wiring strip (see **Figure 2.3**).

2. Route input cable through cabinet. On 4301-240, 4301-180 and 4301-120 systems, the punch-outs are located at the top and bottom of cabinet back for easier routing (see **Figure 2.4**). On 4301-60 systems, cable can be routed through the pre-punched access holes located at the bottom of the cabinet (see **Figure 2.5**).
3. Wire power cable as specified on barrier strip (see **Figures 2.6 and 2.7**).

Figure 2.2 Barrier Strip Wiring Panel
(4301-240, 4301-180, and 4301-120 systems)

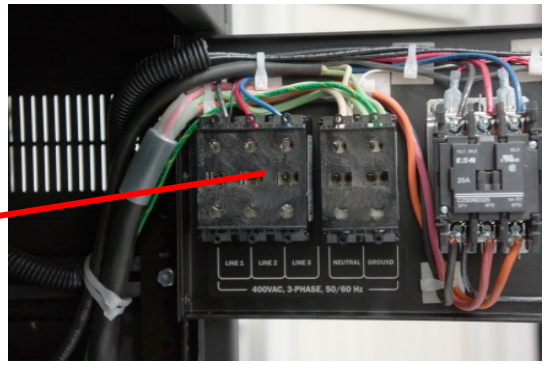

Figure 2.3 Barrier Strip Wiring Panel
(4301-60 system)

Figure 2.4 Cabinet Punch-Outs (all models except 4301-60)

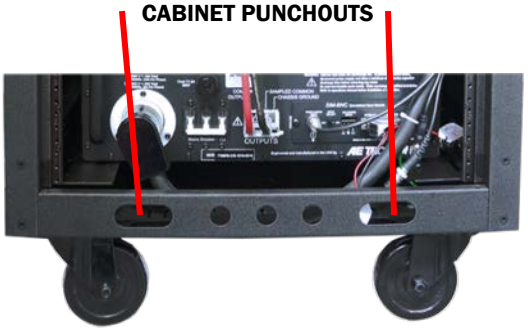

Figure 2.5 Cabinet Punch-Outs
(4301-60 system)

Figure 2.6 Barrier Strip
(all models except 4301-60)

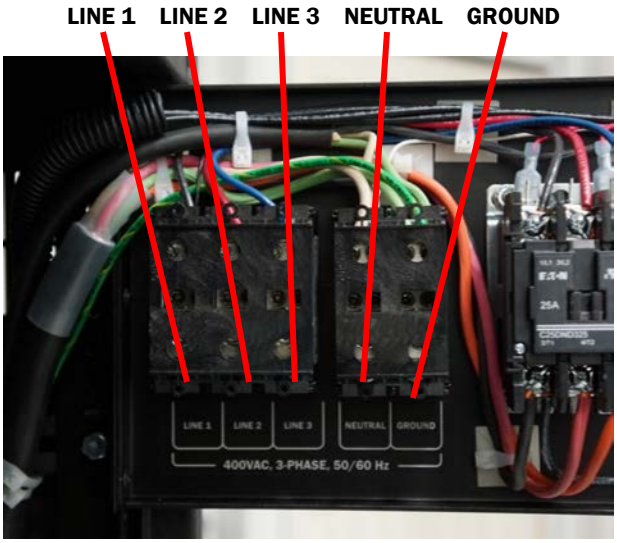

Figure 2.7 Barrier Strip (4301-60 system)

Figure 2.8 Signal Input, External Trigger Output, Current and Voltage Monitor BNC connectors (4301-240 model shown)

2.4 Connecting the Inputs

Connect from an arbitrary waveform generator to the Signal Input BNC connector located on the cabinet front input/output panel (see **Figure 2.8**).

2.5 Connecting the External Trigger Output

Connect from the External Trigger Output BNC connector located on the cabinet front input/output panel to the Trigger In connector on the arbitrary waveform generator (see **Figure 2.8**).

2.6 Connecting the Current and Voltage Monitors (optional)

BNC connectors for Current and Voltage monitoring are located on the cabinet front input/output panel (see **Figure 2.8**). Connect from the cabinet front-panel BNC connectors to your measuring device. For proper measurements, the measuring device should have an input impedance of at least 100 kOhms. **NOTE:** The current monitor output has been filtered and cannot properly display the fast transient waveforms.

Voltage Monitor:

4301-240: 10V output = 1V monitor output.
4301-180: 10V output = 1V monitor output.
4301-120: 10V output = 1V monitor output.
4301-60: 20V output = 1V monitor output.

Current Monitor:

4301-240: 80A output = 1V monitor output.
4301-180: 60A output = 1V monitor output.
4301-120: 40A output = 1V monitor output.
4301-60: 20A output = 1V monitor output.

Figure 2.9 Signal Output Pin Plug connectors

2.7 Connecting the Signal Outputs

Using the supplied 250A Pin-Plug connectors (or optional Anderson SB350 connectors), wire two cables to connect to the Equipment Under Test. Insert the wired connectors into the Output Signal connectors (see **Figures 2.9 and 2.10)**.

Figure 2.10 Optional Anderson SB350 Signal Output connectors

3 Operation

3.1 Main Power Selector

4301-240, 4301-180 and 4301-120 models:
The cabinet Main Power Selector is located near the top of the cabinet on the cabinet front (see **Figure 3.1**). Turn the Main Power selector to the "ON" (|) position to enable the main power supply. To disable the main power supply, turn the Main Power selector to the "OFF" (0) position.

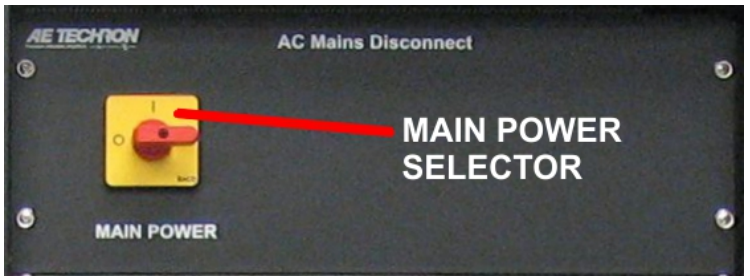

Figure 3.1 Main Power Selector

4301-60 model:
The amplifier Power/Breaker switch is located on the amplifier back panel and can be accessed through the cabinet's rear door (see **Figure 3.2**). Turn the Power Switch/Circuit Breaker up to provide power to the amplifier. To disable power to the amplifier, turn the Power Switch/Circuit Breaker to the down position.

Figure 3.2 4301-60 Back-Panel Power Switch/Circuit Breaker

CAUTION

All amplifiers in the system must be set to the same compensation setting for proper system operation.

3.2 Amplifier Compensation Panel

The 4301 system is equipped with an adjustable compensation system, which allows the 4301 to maintain a 50V/2µS rise-time over a wide range of current outputs. Select the optimum compensation setting based on the system model and the total current required at the system output (see **Figure 3.4**). **NOTE:** In general, adjust the peak voltage and DC offset of the input signal to achieve the required output waveform.

Figure 3.3 Amplifier Compensation Control

Depending on the model, your 4301 system will contain from one to four amplifier Compensation Controls (see **Figure 3.3**). Each Compensation Control independently controls the compensation setting for that amplifier. **IMPORTANT:** For proper system operation, the Compensation setting for all amplifiers in the

	Compensation Setting				
	Model	**0**	**1 (blue)**	**2 (green)**	**3 (yellow)**
Current Required	4301-60	0-6A (compensation off)	6-12A	12-50A	50-60A
	4301-120	0-12A (compensation off)	12-24A	24-100A	100-120A
	4301-180	0-18A (compensation off)	18-36A	36-150A	150-180A
	4301-240	0-24A (compensation off)	24-50A	50-200A	200-240A

Figure 3.4 Selecting the Optimum Compensation Setting

system must be the same. When the amplifier is receiving AC power, the colored LED associated with the selected Compensation setting will be lit.

3.3 Amplifier 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 amplifier in the 4301 system. The Controls and Indicators include Multi-function LCD Screen, Navigation Buttons, Input Buttons and LED Status Indicators.

3.3.1 LCD Screen Display and Controls

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 control of the Bi-Level Power Supply function. In addition, the LCD Display gives details and prescribed corrective actions in the event of a fault condition.

3.3.1.1 Voltage and Current Displays

By default, the 4301 LCD Display for each amplifier will default to the Multi-Display showing values for Peak and RMS Voltage and Peak and RMS Current (see **Figure 3.5**). If desired, the following optional Voltage and Current displays can be selected by pressing the Down arrow on the Navigation Buttons:

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

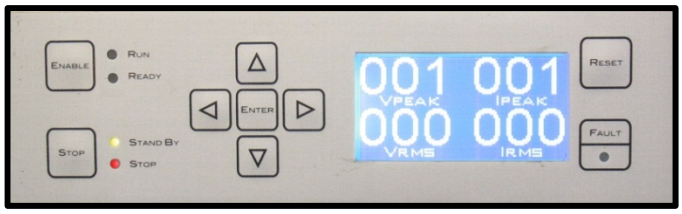

Figure 3.5 Amplifier Front Control Panel Displaying Default LCD Screen

CAUTION

The special "Trigger" power-supply function used in the 4301 requires all amplifiers in the system to be placed in one of two Trigger modes: Waiting for Manual Trigger **for the Master amplifier and** Waiting for Master Trigger **for all Slave amplifiers.** Failure to place all amplifiers in the proper Trigger mode could result in product damage or failure.

3.3.1.2 Bi-Level Power Supply Setting

The Bi-Level Power Supply design used by the 4301 amplifiers allows each unit to switch automatically between high- and low- voltage modes based on the application requirements, or to switch from low- to high-voltage mode when triggered. By default, the 4301 will power up in **Bi-Level Auto** mode, and all amplifiers in the system will automatically adjust their power-supply settings based on the application requirements. The Bi-Level Auto setting works well for most general-purpose uses when the application requirements are greater than 60 volts.

For purposes of **ATIS testing,** one of two "trigger" modes must be selected via the LCD Screen control panel for all amplifiers in the system. The **Waiting for Manual Trigger** mode must be selected for the system's "Master" amplifier, and the **Waiting for Master Trigger** mode must be selected for the remaining "Slave" amplifiers in the system.

By default, the Master amplifier of the system will be the amplifier placed in the uppermost position in the rack. The amplifier status as Master or Slave is also indicated on the amplifier LCD screen during the power-up sequence. **Note: The 4301-60 system contains only one amplifier (the Master amplifier), so only the Waiting for Manual Trigger setting should be used for that system model.**

To change to an alternate setting, wait until power-up is complete, and then use the arrow keys on the Navigation Buttons to scroll Down to the Bi-Level Auto screen. Use the Left and Right arrow keys to select the desired Bi-Level Setting. Available settings include:

1. **Bi-Level 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. **Bi-Level High:** Used for diagnostic purposes. **Do not select this mode unless directed by an AE Techron Service Technician.**
3. **Bi-Level Low:** Used for diagnostic purposes. **Do not select this mode unless directed by an AE Techron Service Technician.**
4. **Waiting for Manual Trigger:** Select this setting for the "Master" amplifier in the 4301 system when using the 4301 Trigger function, such as when performing ATIS testing. When in this mode, pressing the Enter button on the Master amplifier will cause the Bi-Level Power Supply setting to switch automatically while a precise signal delay provides very fast, smooth Slew Rate. The 4301 Trigger function is recommended for all applications requiring a 25 V/µs or faster slew rate.
5. **Waiting for Master Trigger (selection available only on Slave amplifiers):** Select this setting for all "Slave" amplifiers in the 4301 system when using the 4301 Trigger function, such as when performing ATIS testing. When in this mode, all Slave amplifiers will perform automatic power-supply switching when the trigger function is activated via a press of the Enter button on the Master amplifier. The 4301 Trigger function is recommended for all applications requiring a 25 V/µs or faster slew rate.

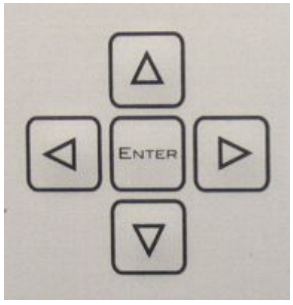

Figure 3.6 Navigation Buttons

3.3.2 Navigation Buttons

The Navigation buttons (see **Figure 3.6**) provide four arrow keys to allow navigation through the various LCD display options.

3.3.3 Main Status Indicators

Four Main Status Indicators, located on the front control panel for each amplifier, monitor and indicate the internal conditions of the amplifier. (See **Figure 3.7**.)

Figure 3.7 Main Status Indicators

Stop (red) and Standby (yellow) illuminated – When the Stop and Standby indicators are lit, the amplifier is in Stop Mode. When the Stop button on the amplifier front panel is pressed, the amplifier will enter Stop mode. The amplifier may also enter Stop mode after powering up if the amplifier is configured to enter Stop mode on startup. In Stop mode, the amplifier's low-voltage transformer is energized but the high-voltage transformers are not.

Standby (yellow) illuminated: When the Standby indicator is lit on one or more of the amplifiers, and one or more of the amplifiers has no LEDs lit, the unlit amplifier has no power or has not been turned on, and the other amplifiers in the system will be held in Standby mode. In Standby mode, the amplifier's low-voltage transformer is energized but the high-voltage transformers are not.

Ready (yellow) and Run (green) illuminated: When the Ready and Run indicators are lit, the amplifier is in Run mode. The amplifier's high-voltage transformers are energized and the unit will amplify the input signal. Run mode is initiated by: (1) the Enable push button, or (2) when the amplifier powers up in Run mode (factory default).

3.3.4 Fault Status Indicator

The Fault Status Indicator (**Figure 3.8**) is a red LED located on the front control panel for each amplifier. When the Fault Status LED is blinking, it indicates that the amplifier's Bi-Level Power Supply has been set to operate in Bi-Level High mode.

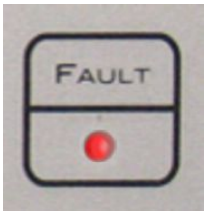

Figure 3.8 Fault Status Indicator

When the Fault Status LED stays lit, it indicates that the amplifier was forced into Stop mode by a fault condition. The root cause of the fault condition and corrective actions are displayed on the LCD display.

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. Allow the unit to cool, and the amplifier will automatically reset when the unit has cooled to operating temperature. If, after allowing the unit to cool, the unit does not reset, press the Reset button to bring the amplifier 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 amplifier instability, undesired oscillation, or the fly back protection bridge is shorted. Factory service is usually required when this fault condition occurs.

3.3.5 Input Buttons

Three Input Buttons located on the front control panel for each amplifier control the operation mode of the unit (see **Figure 3.9**).

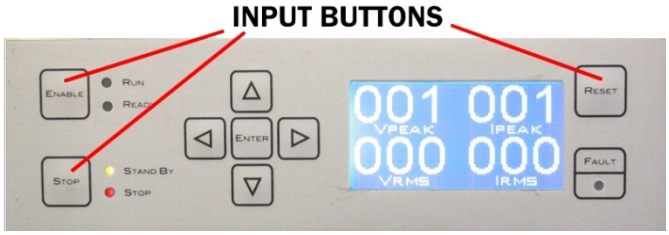

Figure 3.9 Input Buttons

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

3.4 Startup Sequence

3.4.1 System Power-up

Turn the Main Power selector to the "ON" (|) position to enable the main power supply (see **Figure 3.1 or 3.2**). When Main Power is enabled, the unit will automatically begin the power-up sequence to activate the system. When the power-up sequence is complete for all amplifiers, the Stop and Standby LEDs will be lit for all amplifiers, and the LCD Screen will display the V_{PEAK} / V_{RMS} / I_{PEAK} / I_{RMS} meters (multi-display) (see **Figure 3.5**).

For 4301-60 models, power on the amplifier using the back-panel Power/Breaker switch.

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

3.4.2 Enabling the System

To enable the system, press the Enable button on the front control panel for each amplifier. When all amplifiers are Enabled, the Run and Ready LEDs will be lit and the amplifiers will amplify the input signal (see **Figure 3.10**).

Figure 3.10 Enabled Amplifier LED Display

4 ATIS-0600315.2007 Protective Device Operation Transient Testing

The ATIS-0600315.2007 and GR-1089-CORE Standards require 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 rise-time of 5 µs or greater, the default Bi-Level Power Supply setting for the unit (**Bi-Level Auto**) should be used. However, for those waveforms requiring a rise-time of less than 5 µs, the Trigger function and the two associated "Trigger" settings should be used. Complete the following procedure to perform the 4301 Trigger function.

TRIGGER FUNCTION PROCEDURE

1. **CREATE or SELECT WAVEFORM:** Using an arbitrary waveform generator, create the required input waveform. If using the 4301's optional Fluke arbitrary waveform generator, see **Section 5** for instructions on selecting the pre-loaded waveform.
2. **MAKE CONNECTIONS:** Connect Signal Input and Output. Connect from the 4301's External Trigger Output connector to your waveform generator's Trigger In/Sync connector. Connect to Current and Voltage Monitor outputs (optional).
3. **SELECT COMPENSATION SETTING:** Adjust the Compensation setting for each amplifier in the system based on the total required current output (see **Figure 3.4**). **CAUTION:** Compensation setting for all amplifiers in the system must be the same.
4. **POWER SYSTEM:** Turn "ON" (|) the Main Power to the 4301 and allow each amplifier to enter Standby mode. Note: On the 4301-60 model, power the amplifier ON using the back-panel Power/Breaker switch.
5. **SET TRIGGER MODES:** Using the Navigation arrow keys on the front control panel of each amplifier, set the Bi-Level Power Supply mode for the **Master** amplifier to **Waiting for Manual Trigger** (see **Figure 4.1**). Set the Bi-Level Power Supply mode for all **Slave** amplifiers to **Waiting for Master Trigger** (see **Figure 4.2**). Note: The Waiting for Master Trigger is not used on the 4301`-60 system.

Figure 4.1 Master Amplifier Bi-Level Setting at "Waiting for Manual Trigger"

Figure 4.2 Slave Amplifier Bi-Level Setting at "Waiting for Master Trigger"

Figure 4.3 Triggering Countdown

Figure 4.4 Test Successfully Completed

6. **TRIGGER TRANSIENT TESTING:** To generate the transient waveform, push the **Enable** button on the **Master** amplifier. The LCD Screen Display for the Master amplifier will cycle through a 5-second countdown, output a 10 mS signal to the AWG through the External Trigger Output, and then trigger all amplifiers in the 4301 system to amplify and send the incoming input signal waveform (see **Figure 4.3**).
7. **VERIFY SUCCESSFUL TESTING:** After the input signal has been sent, the LCD Screen for each amplifier will display "Triggered" to verify the successful completion of the test waveform (see **Figure 4.4**).

IF DUT FAILS TEST: If the DUT fails using the Total Protective Device Operation Transient, run the individual transient waveforms to determine the cause of failure. If using the 4301's optional Fluke arbitrary waveform generator, see **Section 5** for instructions on loading these alternate waveforms into the AWG.

5 Using the Optional Fluke Arbitrary Waveform Generator for ATIS DC Transient Testing

The 4301-series Telecom Test Systems may be purchased with an optional Fluke arbitrary waveform generator. The Fluke 281 AWG comes mounted in the 4301 cabinet and pre-configured for the DC voltage variations and transient testing described in ATIS-0600315.2007.

At power-on, the Fluke AWG will load **Setup1,** which produces the negative Total Protective Device Operation Transient as show in **Figure 5.1.** Waveform segments and setups for alternate waveforms that can easily be loaded to the AWG are also included. All alternate waveforms, including the Impulse Transient (**Figure 5.2**), Overvoltage Transient (**Figure 5.3**) and Undervoltage Transient (**Figure 5.4**), as well as positive and negative versions of each waveform, have been designed to load smoothly and be easily shaped and edited.

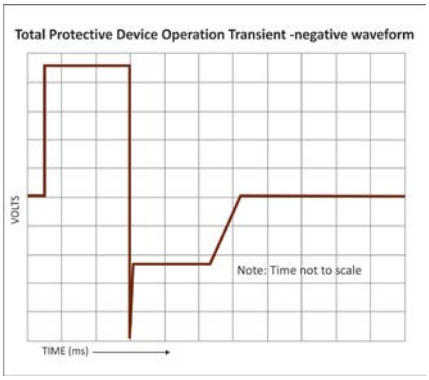

Figure 5.1 Total Protective Device Operation Transient – negative waveform

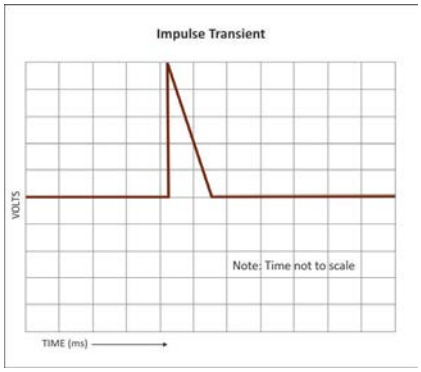

Figure 5.2 Impulse Transient

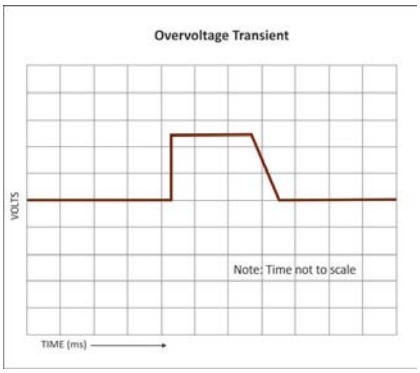

Figure 5.3 Overvoltage Transient

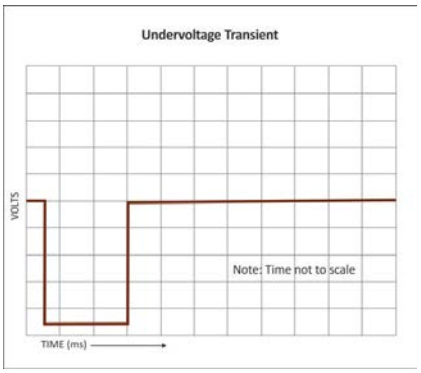

Figure 5.4 Undervoltage Transient

This section provides instructions for equipment operation to complete the following tasks:

- Run Setup1: ATIS Total Protective Device Operation Transient – negative waveform (unit default).
- Recall and run other Setups or waveform inversions: Setup1 positive, Setup2 positive or negative, Setup3 positive or negative, or Setup4 positive or negative.
- Store a new Setup or replace an altered Setup.
- Use *Waveform Manager Plus*[1] software and a PC to adjust the waveform segments used in the Setups.
- Verify and adjust the AWG Settings for ATIS DC Transient testing Setups.
- Verify the Sequences and waveform segments used to produce each transient waveform.

For general information about using the Fluke 281 AWG, please refer to the *Fluke 281, 282, 284 Users Manual.* For general information about using *Waveform Manager Plus,* please refer to the software's online *Help* files.

[1] *Waveform Manager Plus* was developed by TTi (Thurlby Thandar Instruments Ltd.). This Windows-based software provides for the creation, editing and management of arbitrary waveforms. It is available as a free download from www.tti-test.com (registration is required).

5.1 Run Setup1

The Fluke 281 AWG included in the 4301 system has been programmed to load the negative waveform for ATIS Total Protective Device Operation Transient (Setup1) at power up (see **Figure 5.1**).

Complete the following steps to run Setup1:

1. Locate the POWER switch on the Fluke AWG and turn to the ON (|) position. See **Figure 5.5.**
2. Locate the SEQUENCE button and press once to bring up the Sequence control screen on the LCD display (see **Figure 5.6**).
3. Push the soft-touch button next to the **run** option to start running Setup1.

NOTE: Once Setup1 is running, complete the steps in **Section 4** to perform ATIS testing.

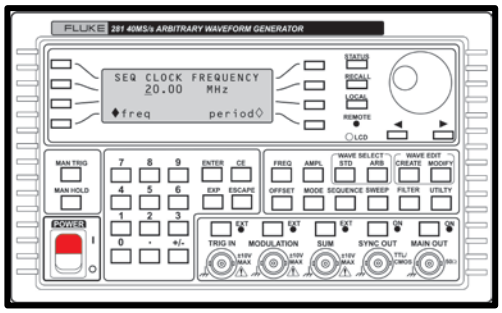

Figure 5.5 Fluke AWG power switch

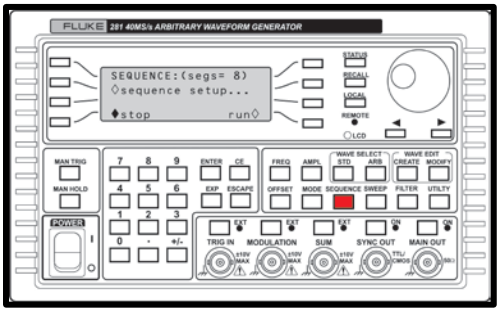

Figure 5.6 Selecting the Sequence control screen

5.2 Recall and Run Other Pre-loaded Setups

The ATIS-0600315.2007 standard specifies that appropriate positive or negative protective device operation transient testing be done using either the combined waveform (Total Protective Device Operation Transient) or three separate waveforms, each applied separately. The three separate waveforms required by the ATIS DC transients' standard can be produced using Setup2, Setup3 and Setup4, which have been pre-loaded into the Fluke 281 AWG. These Setups contain the required AWG setting and Sequences necessary to recreate the waveforms, but the waveform segments used in these Setups (as well as the positive waveform segments for Setup1) are **NOT** stored in the AWG and must be loaded into the AWG from your PC using *Waveform Manager Plus* software before running one of these Setups.

IMPORTANT

The positive waveform segments for Setup1, and ALL waveform segments for Setup2, Setup3 and Setup4 are NOT stored in the Fluke AWG. The required segments must be loaded into the AWG from your PC using *Waveform Manager Plus* software before running one of these Setups. Failure to load the appropriate segments will result in test failure.

IMPORTANT: The following procedure will replace the waveform segments required to run the factory-default Setup1. To run Setup1 on the AWG after running an alternate Setup, repeat this procedure to re-install the Setup1 waveform segments to the AWG.

Complete the following steps to recall, load waveform segments, and run Setup2, Setup3 or Setup4 on the Fluke 281 AWG.

1. Locate the RECALL button on the Fluke AWG and press once to bring up the Recall menu (see **Figure 5.7**).
2. Turn the rotary control to increment or decrement the Store number.
   Store No 2: Recalls Setup2, which produces the Impulse Transient (see **Figure 5.2**).

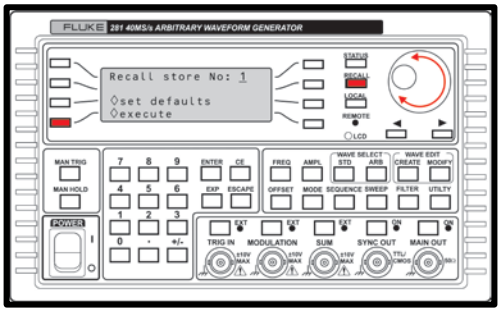

Figure 5.7 RECALL menu

Store No 3: Recalls Setup3, which produces the Overvoltage Transient (see **Figure 5.3**).
Store No 4: Recalls Setup4, which produces the Undervoltage Transient (see **Figure 5.4**).

3. Use the soft-key to select **execute** to load the Setup.
4. Install the *Waveform Manager Plus* software on your PC. **NOTE:** The *Waveform Manager Plus* software installation files are available on the *Fluke DDS Function Generators, Arbitrary Waveform Generators and Waveform Manager Plus v4.01 CD* provided with this product.
5. Copy waveform files from the *4301 Product Information and Resources CD* to your PC's hard-drive or other accessible location. **NOTE:** AE Techron recommends you copy all waveforms, including the directory structure, to your PC and reserve the CD for a backup. However, the waveforms can also be loaded directly from the CD to the AWG.
6. Connect a GPIB cable (not included) from the GPIB port on your PC to the GPIB port located next to the AWG on the cabinet front panel (see **Figure 5.8**).
7. Open *Waveform Manager Plus* and select **I/O control > Download setup...** from the top drop-down menu to open the Download Parameters window (see **Figure 5.9**). Confirm the following selections: **"Fluke"** for Instrument Make; **"28x"** for Instrument Model; **GPIB0** for Interface Type; and TCP port of **9221**. The Interface Address will typically be set to **5**. This address can be confirmed through the Fluke AWG's **remote** menu on the unit's **UTILITY** screen. When all settings have been confirmed, select **Ok** to complete the Download setup. **NOTE:** *Waveform Manager Plus* should retain these Download settings.
8. Access the waveform files required to run the Setup by selecting **File > Open** from the *Waveform Manager Plus* top drop-down menu (see **Figure 5.10**). The waveforms are organized within the directory structure according to the collection of waveforms required for each Setup. Refer to the chart in **Figure 5.11** to locate the desired waveforms to load to the AWG.

Figure 5.8 GPIB Port Location

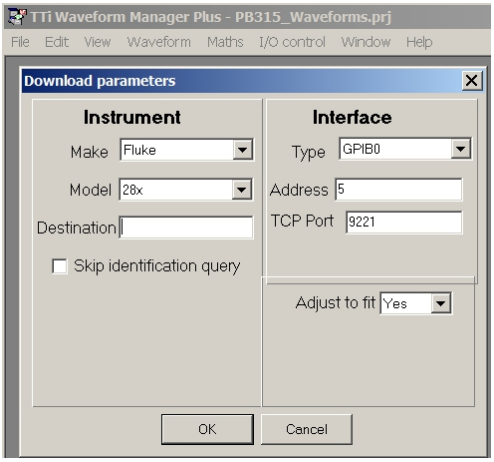

Figure 5.*9 Waveform Manager Plus* Download Setup

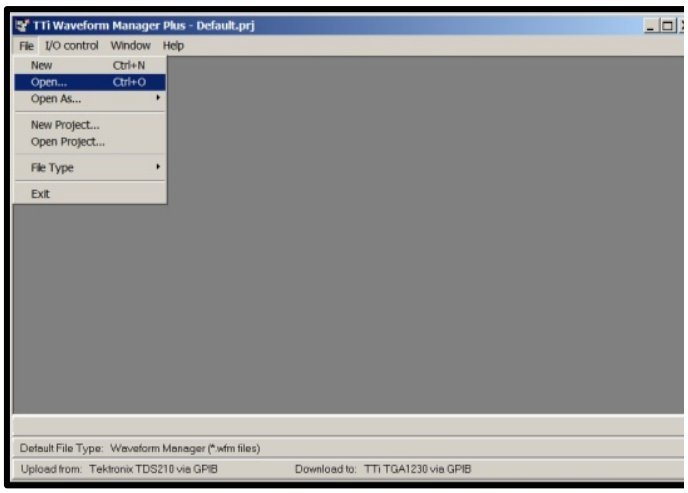

Figure 5.10 Opening Waveform Segments in *Waveform Manager Plus*

Figure 5.11 Waveform Segments Reference Chart

FOLDER	SETUP	WAVEFORM SEGMENTS
PB315_Full_Negative_Waveform*	Setup1	BLANK.wfm, DC1.wfm, DC2.wfm, DC3.wfm, FALL1.wfm, FALL2.wfm, FALL3.wfm, RISE1.wfm
PB315_Full_Positive_Waveform		BLANK.wfm, DC1.wfm, DC2.wfm, DC3.wfm, FALL1.wfm, FALL2.wfm, FALL3.wfm, RISE1.wfm
PB315_Impulse_Negative_Waveform	Setup2	DC1.wfm, DC4.wfm, FALL2.wfm, IMPULSE.wfm
PB315_Impulse_Positive_Waveform		DC1.wfm, DC4.wfm, FALL2.wfm, IMPULSE.wfm
PB315_Overvoltage_Negative_Waveform	Setup3	DC1.wfm, DC3.wfm, DC4r.wfm, FALL3.wfm, OVERVOLTAGE.wfm
PB315_Overvoltage_Positive_Waveform		DC1.wfm, DC3.wfm, DC4r.wfm, FALL3.wfm, OVERVOLTAGE.wfm
PB315_Undervoltage_Negative_Waveform	Setup4	DC1.wfm, DC2.wfm, DC4.wfm, FALL1.wfm, UNDERVOLTAGE.wfm
PB315_Undervoltage_Positive_Waveform		DC1.wfm, DC2.wfm, DC4.wfm, FALL1.wfm, UNDERVOLTAGE.wfm

*This set of waveform segments comes pre-loaded on the Fluke AWG.

9. For each waveform segment file required for the Setup, open the .wfm (waveform) file, and then select **I/O control > Execute download** from the top drop-down menu (or enter **Ctrl+D**).
10. When all required waveform segments have been downloaded to the AWG, locate the SEQUENCE button and press once to bring up the Sequence control screen on the LCD display.
11. To begin generating the waveform immediately, make sure the MAIN OUT port is turned on, and then push the soft-touch button next to the **run** option to start running the Setup. **CAUTION:** Output voltage will be generated at the amplifier output.

IMPORTANT: Waveform segments with the same name that appear in multiple folders are **NOT** interchangeable. Each folder contains a unique set of waveform segments. The waveform segment files have been named using a generic naming scheme to allow for easy file segment replacement.

NOTE: This procedure can also be used to download the positive waveform segments for Setup1 or any other Setup.

Setups also can be created manually and run through the Fluke AWG. Setups 1-4 can then be Recalled using the above procedure.

New Setups also can be saved for later recall, if desired. The Fluke 281 AWG provides storage for up to nine Setups. See **Section 5.3** for more information on storing and replacing Setups.

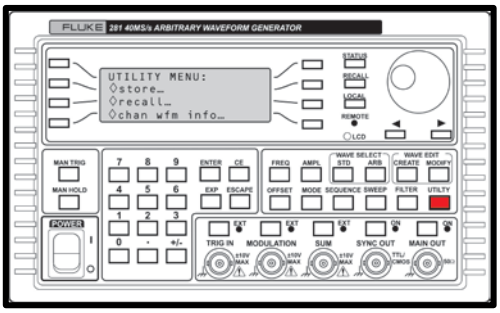

Figure 5.12 UTILITY menu

5.3 Storing and Replacing Setups in Nonvolatile Memory

A Setup stores the current settings of the AWG in the unit's nonvolatile memory. These settings can be recalled later, even

after the unit's power has been cycled. The Fluke 281 AWG has room for storage of up to nine Setups.

Complete the following steps to store AWG settings as a new Setup or replace an existing Setup with new settings.

1. Locate the UTILITY button and press once to bring up the Utility menu (see **Figure 5.12**).
2. Use the soft-key to select the **store** option (see **Figure 5.13**).
3. Turn the rotary control to increment or decrement the Store number. Preloaded factory Setups are located in Stores 1-4; to avoid overwriting these Setups, choose Stores 5-9 for storing alternate Setups.
4. Use the soft-key to select the **execute** function to store the current AWG settings as a Setup in the Store number selected.

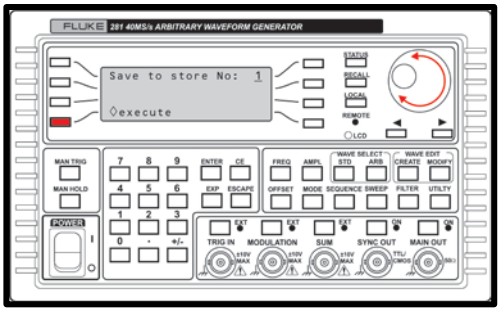

Figure 5.13 Adding a Setup to the AWG Store

NOTE: A Setup can be recalled using the UTILITY menu Recall option as well as by using the RECALL button on the AWG front panel.

5.4 Using *Waveform Manager Plus* software

Waveform Manager Plus software provides the means to adjust the individual waveform segments that are used in the DC Transient Setups stored in the Fluke AWG. In addition, the software makes it easy to create additional waveforms or waveform segments using your PC, which can then be loaded into the AWG for other testing purposes.

Several testing variables can affect the final waveform that is presented to the DUT, including current requirements and line inductance. If you are seeing sag in the waveform during testing, one or more waveform segments may need to be adjusted.

The individual waveform segments that are used in each Setup can be found on the *4301 Product Information and Resources CD* provided with this product. AE Techron recommends you copy all waveform segments, including the directory structure, to your PC and reserve the CD for a backup.

Install the *Waveform Manager Plus* software, which is available from the *Fluke DDS Function Generators, Arbitrary Waveform Generators and Waveform Manager Plus v4.01 CD* provided with this product. After the software installation is complete, access the desired waveform segment file by selecting **File > Open** from the *Waveform Manager Plus* top drop-down menu. The waveform segments are organized within the directory structure as a collection of the waveform segments required for each Setup. Refer to **Figure 5.11** to locate the desired waveform for editing.

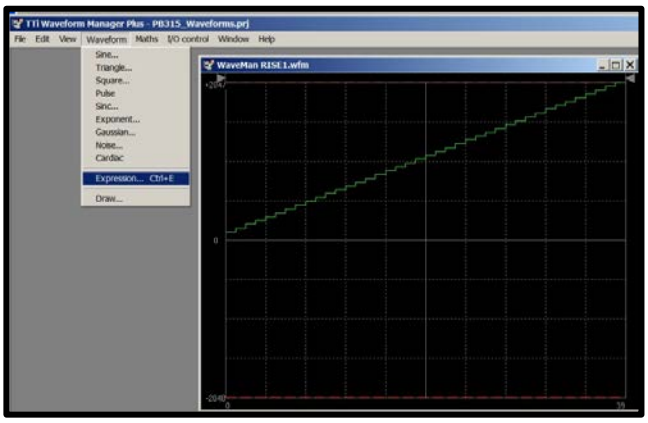

Figure 5.14 Opening the Expression Window

Once the original waveform segment has opened in *Waveform Manager Plus*, we recommend that you create a new folder to contain the edited segment. This will allow you to open reuse the original segment for future

testing. We also recommend that you save the new waveform segment file using the same file name as the original waveform segment. This will allow you to use the preloaded Setups on the AWG without making changes to the Sequence.

5.4.1 Editing a Waveform Segment Using the Expression Window

The waveform segments used in the DC Transient testing Setups can be created or edited using the *Waveform Manager Plus* Expression Window.

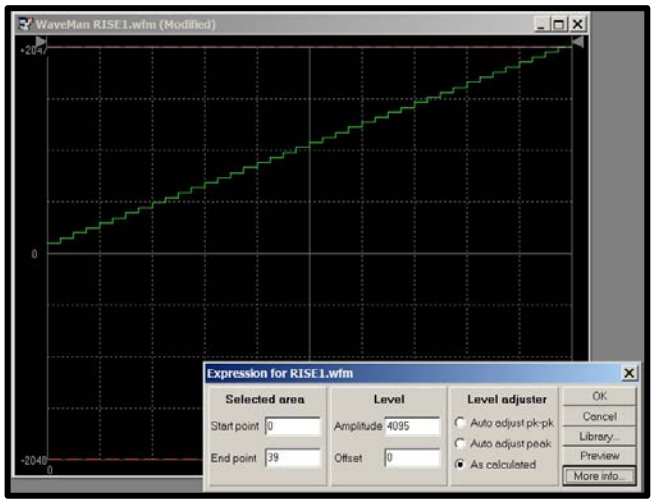

Figure 5.15 *Waveform Manager Plus* Expression Window

To edit a waveform, open the waveform file in *Waveform Manager Plus*, and then select **Waveform > Expression** from the top drop-down menu (see **Figure 5.14**) or enter **Ctrl+E**.

The Expression Window will open and display basic waveform parameters, including **Start point, End point, Amplitude** and **Offset** (see **Figure 5.15**). To adjust these parameters, enter the new value(s) in the input boxes.

Select the **More info...** button to view and edit the waveform expression that controls the slope of the waveform (see **Figure 5.16**).

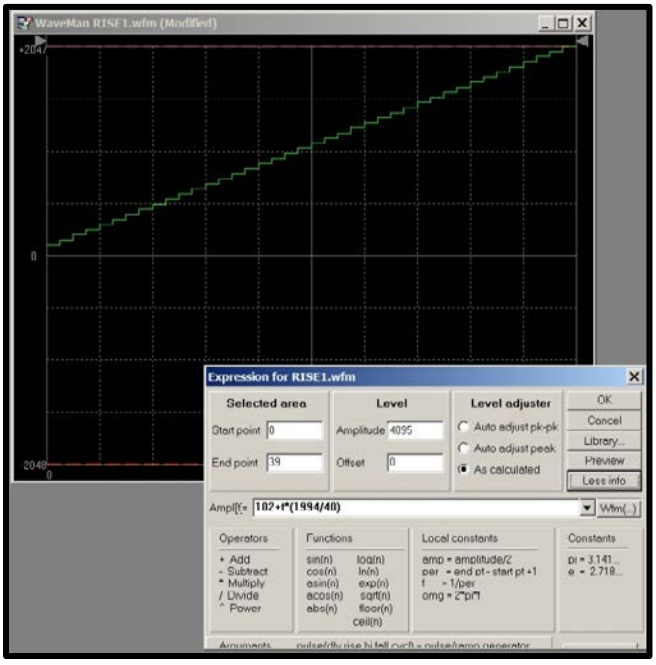

Figure 5.16 *Waveform Manager Plus* Formula Editor

To determine the waveform expression, refer to the following formula:

Ampl[t] = B+t*(C/S)

Where:
B = Beginning voltage * 20.48
t = Constant
C = Voltage change * 20.48
S = Number of samples (fall or rise time in µS/0.05)

EX: The Expression **Amp[t] = 102+t*(1994/40)** will result in a waveform beginning at 5V and rising 97.35V over 2 µS.

NOTE: Expression based on ±100V maximum amplitude and a frequency setting of 20MHz.

The **Preview** option will allow you to preview the resulting waveform before committing to the changes. Select **OK** to apply the new formula and/or parameters and to close the Expression Window.

Select File > Save As... > Internal to save the edited waveform as a new file. We recommend that you save the new waveform file to a new directory using the same file name as the original waveform. This will allow you to retain the original waveform and use the preloaded Setups on the AWG without making changes to

the Sequence, since the new waveform will overwrite and replace the waveform stored on the AWG when it is downloaded.

5.4.2 Editing a Waveform Using the Draw Mode

The *Waveform Manager Plus* Draw mode allows the mouse to be used to draw or edit the waveform in the waveform window. This method can be used for detailed shaping of the waveform (see **Figure 5.17**).

To enter Draw mode, select **Waveform > Draw** from the top drop-down menu.

When the Draw mode is entered, two new buttons will appear in the waveform window: Finish and Undo. An x-y value panel will also appear at the bottom center of the waveform window. The x-y panel is continually updated with the point number (x) and point value (y) as the mouse is moved around in the waveform window.

To adjust a waveform, left-click and drag on the line at the point where shaping is desired. The cursor will change to a pencil and, as the mouse is moved, the waveform point values will be changed to follow the mouse trail. To stop adjusting the waveform at that point, right-click and the cursor will change back to an arrow. To resume editing at another point on the waveform, left-click and drag at the new point, and the cursor will change back to a pencil.

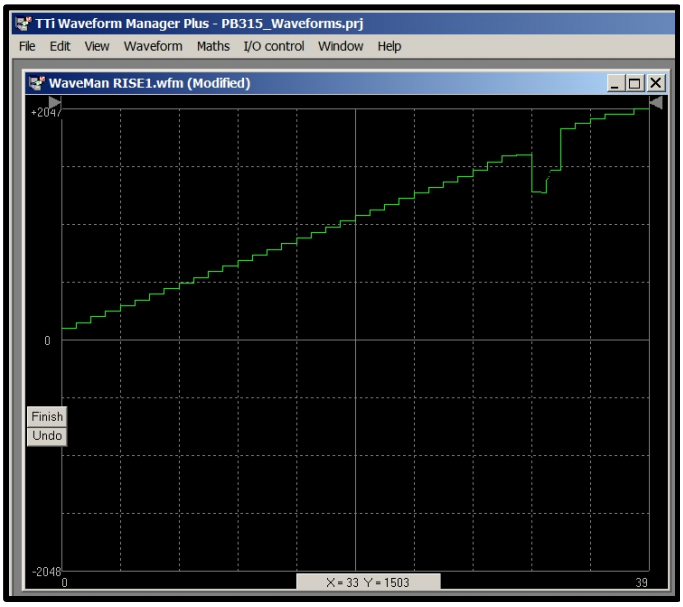

Figure 5.17 Shaped Wave using the *Waveform Manager Plus* Draw Tool

To undo all changes since the Draw mode was entered, click the Undo button.

To keep the modified waveform and exit Draw mode, left-click on the Finish button located on the left side of the waveform window.

5.5 Verify and Adjust the AWG Settings for ATIS DC Transient Testing

The following section details the process for viewing and adjusting the pre-loaded AWG settings and Sequence contained in a Setup. You can use these settings to re-create a Setup, if required, due to unit memory failure or accidental erasure. Some of the AWG settings can also be adjusted depending on your testing and reporting requirements. **NOTE:** The following AWG settings are the same for all DC Transient Testing Setups stored in the AWG.

IMPORTANT: A Setup must be enabled to review the settings of the Setup.

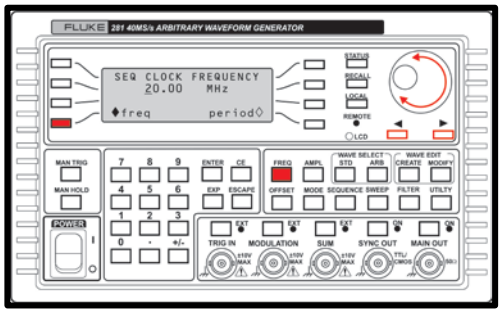

Figure 5.18 FREQuency settings

FREQuency Settings (Figure 5.18)

Push the FREQ button to bring up the Frequency control screen. Setup presets are:

Frequency: 20.00 MHz
Sample Period: .05 uS
freq option selected

Typically, no adjustments are recommended for the AWG Frequency setting, since this will affect the sample period as defined in the waveforms. If the Frequency setting is altered, a matching adjustment must be made to each of the waveforms.

If it is determined that a frequency adjustment is required, adjust the frequency by turning the rotary control to increment or decrement the numeric value in steps determined by the position of the edit cursor (flashing underline); the cursor can be moved with the left- and right-arrowed cursor keys. A value for the desired frequency also can be entered directly using the AWG keypad.

AMPLitude Settings (Figure 5.19)
Push the AMPL button to bring up the Amplitude control screen. Setup presets are:

Amplitude: +10.0 Vpp
Vpp option selected
Load: hiZ

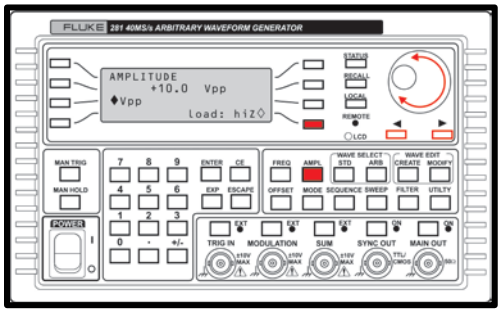

Figure 5.19 AMPLitude settings

To adjust the Amplitude, turn the rotary control to increment or decrement the numeric value in steps determined by the position of the edit cursor (flashing underline); the cursor can be moved with the left- and right-arrowed cursor keys. A value for the desired amplitude also can be entered directly using the AWG keypad.

OFFSET Settings (Figure 5.20)
Push the OFFSET button to bring up the Offset control screen. Setup presets are:

Program: +0.0 mVdc
Load: hiZ

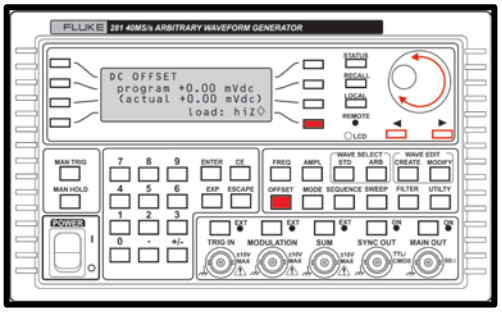

Figure 5.20 OFFSET settings

To adjust the Offset, turn the rotary control to increment or decrement the numeric value in steps determined by the position of the edit cursor (flashing underline); the cursor can be moved with the left- and right-arrowed cursor keys. A value for the desired amplitude also can be entered directly using the AWG keypad.

MODE Settings (Figure 5.21)
Push the MODE button to bring up the Mode control screen. Setup presets are:

continuous option selected
gated option unselected
triggered option unselected

No adjustments are recommended to the MODE settings.

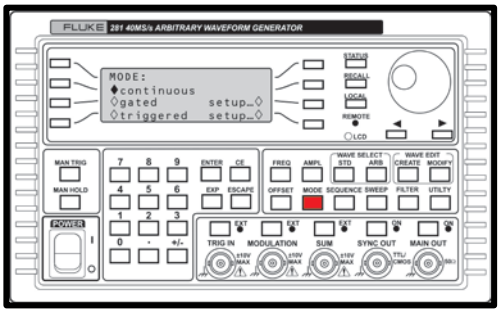

Figure 5.21 MODE settings

SWEEP Settings
The Sweep function is not used in generation of the ATIS waveforms and should be set to OFF.

FILTER Settings (Figure 5.22)
Push the FILTER button to bring up the Filter control screen. Setup1 presets are:

Mode: auto
Type: 10MHz Bessel

No adjustments are recommended to the FILTER settings.

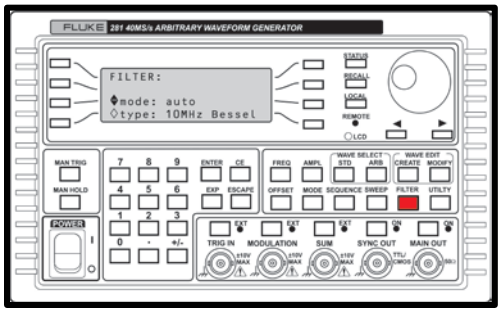

Figure 5.22 FILTER settings

TRIGger IN Settings (Figure 5.23)
Push the TRIG IN button to bring up the Trigger In control screen. Setup1 presets are:

Source: external
Slope: positive
Period: 1.00 ms

No adjustments are recommended to the TRIG IN settings.

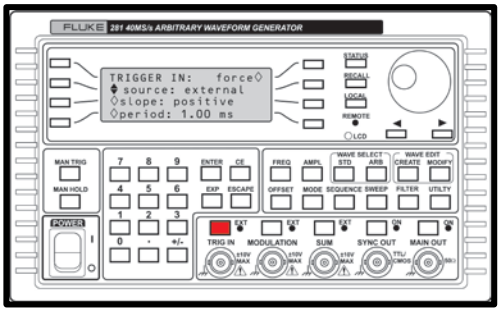

Figure 5.23 TRIG IN settings

MODULATION, SUM and SYNC OUT ports are not used and should be set to OFF.

MAIN OUT port should be set to OFF until setup is complete. Turn MAIN OUT to ON to begin generating output voltage.

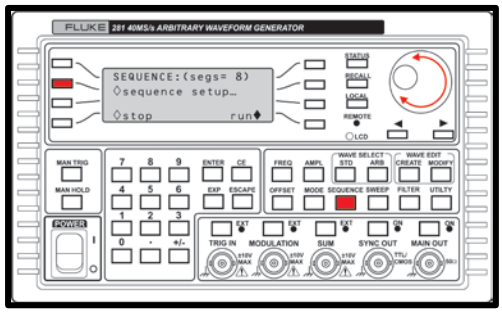

Figure 5.24 SEQUENCE settings

5.6 Verify the Sequences for each Transient Waveform

Each transient waveform used for the ATIS DC Transient testing is comprised of several waveform segments. These waveform segments are run according to the timing and order defined by a Sequence. The Sequence for each transient waveform is unique and must be followed in order to create the required transient waveform. These Sequences are stored as a part of each pre-loaded Setup that is stored in the AWG nonvolatile memory.

To verify the Sequence settings for each Setup, follow the procedure below and refer to the Setup Segment Settings tables.

Verifying the SEQUENCE Settings

Push the Sequence button to bring up the Sequence control screen. Select the soft-key to bring up the sequence setup submenu (see **Figure 5.24**).

Each Setup contains several segments. Use the rotary control to increment or decrement the segment number to review the presets for each segment (refer to the Sequence charts on the following page). **NOTE:** ALL unused segments in a Sequence must be turned OFF.

No adjustments are recommended to the SEQUENCE settings. To make adjustments to the individual waveforms, use the *Waveform Manager Plus* software on your PC. See **Section 5.4** for more information.

Setup1 – Total Protective Device Operation Transient

Segment 1 **wfm:** DC1 **step on:** trig edge **cnt:** 00001	**Segment 2** **wfm:** FALL1 **step on:** count **cnt:** 00001 **off/on:** on	**Segment 3** **wfm:** DC2 **step on:** count **cnt:** 00100 **off/on:** on	**Segment 4** **wfm:** RISE1 **step on:** count **cnt:** 00001 **off/on:** on
Segment 5 **wfm:** FALL2 **step on:** count **cnt:** 00001 **off/on:** on	**Segment 6** **wfm:** DC3 **step on:** count **cnt:** 00100 **off/on:** on	**Segment 7** **wfm:** FALL3 **step on:** count **cnt:** 00001 **off/on:** on	**Segment 8** **wfm:** DC4 **step on:** count **cnt:** 00100 **off/on:** on

Setup2 – Impulse Transient

Segment 1 **wfm:** DC1 **step on:** trig edge **cnt:** 00001	**Segment 2** **wfm:** IMPULSE **step on:** count **cnt:** 00001 **off/on:** on	**Segment 3** **wfm:** FALL2 **step on:** count **cnt:** 00001 **off/on:** on	**Segment 4** **wfm:** DC4 **step on:** count **cnt:** 00100 **off/on:** on

Setup3 – Overvoltage Transient

Segment 1 **wfm:** DC1 **step on:** trig edge **cnt:** 00001	**Segment 2** **wfm:** OVERVOLTAGE **step on:** count **cnt:** 00001 **off/on:** on	**Segment 3** **wfm:** DC3 **step on:** count **cnt:** 00100 **off/on:** on	**Segment 4** **wfm:** FALL3 **step on:** count **cnt:** 00001 **off/on:** on
Segment 5 **wfm:** DC4 **step on:** count **cnt:** 00100 **off/on:** on			

Setup4 – Undervoltage Transient

Segment 1
wfm: DC1
step on: trig edge
cnt: 00001

Segment 2
wfm: FALL1
step on: count
cnt: 00001
off/on: on

Segment 3
wfm: DC2
step on: count
cnt: 00100
off/on: on

Segment 4
wfm: UNDERVOLTAGE
step on: count
cnt: 00001
off/on: on

Segment 5
wfm: DC4
step on: count
cnt: 00100
off/on: on

6 Customization Options

6.1 Additional Cabinet Space (4301-240, 4301-180 and 4301-120 models only)

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).

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 6.1**.

Figure 6.1 Removing the Blank Rack Panel

6.2 Powering Additional Components

An auxiliary outlet has been provided within the 4301 cabinet, as shown in **Figures 6.2 and 6.3**. 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 **Figures 2.2 and 2.3**).

Figure 6.2 120V Auxiliary Outlets

All models except 4301-60: A breaker switch that controls the power to the auxiliary outlets as well as other single-phase cabinet circuits is provided as shown in **Figure 6.4**. The breaker switch can be accessed through the cabinet rear door and is located above and to the left of the Wiring Block. **NOTE:** When the auxiliary breaker is tripped, the cabinet functionality will be disabled.

Figure 6.3 230V Auxiliary Outlets

4301-60 models: A breaker switch that controls the power to the auxiliary outlets is provided as shown in **Figure 6.5**. The breaker switch can be accessed through the cabinet rear door and is located on the outside of the AC wiring panel. **NOTE:** When the auxiliary breaker is tripped, the cabinet functionality will NOT be disabled.

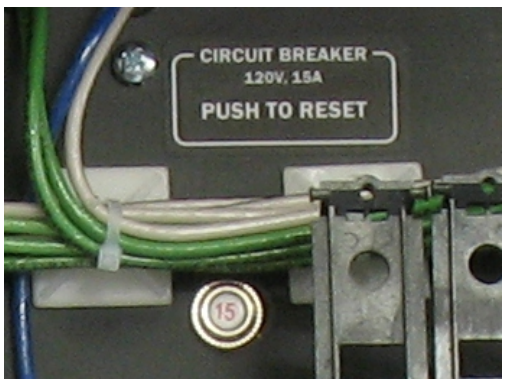

Figure 6.4 Auxiliary Outlet Breaker Switch (all models except 4301-60)

Figure 6.5 Auxiliary Outlet Breaker Switch (4301-60 models)

7 Maintenance

Simple maintenance can be performed by the user to help keep the equipment operational. The following routine maintenance is designed to prevent problems before they occur. See **Section 8, Troubleshooting,** for recommendations for restoring the equipment to operation after an error condition has occurred.

Preventative maintenance is recommended after the first 250 hours of operation, and every three months or 250 hours thereafter. If the equipment environment is dirty or dusty, preventative maintenance should be performed more frequently.

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

7.1 Clean Amplifier Filters and Grills

CAUTION

Before you begin, make sure the 4301 Main Power switch is in the OFF position.

7.1.1 Tools Required

The recommended equipment and supplies needed to perform the functions required for this task are described below.

- Torx T15 driver
- Vacuum cleaner or compressed air blower
- Damp cloth (use water only or a mild soap diluted in water)

To ensure adequate cooling and maximum efficiency of the internal cooling fans, the amplifier's front and rear grills should be cleaned periodically. To clean the amplifier grills and filter, complete the following steps:

1. Disconnect the system from its power source by turning the Main Power switch to the OFF position.
2. Remove the four Torx-head screws, located along the left and right edges of each amplifier's front panel using a Torx T15 driver. Retain.
3. Remove each amplifier's front cover by pulling straight towards you.
4. Using a vacuum cleaner, vacuum the front ventilation grills, including the filters behind each grill.
5. Using a damp cloth, clean the front ventilation grills. Dry with a clean cloth or allow to air dry.
6. Open the cabinet rear door and locate each amplifier's back panel grill.
7. Using a vacuum cleaner, vacuum the back ventilation grills.
8. Using damp cloth, clean the back ventilation grills.
9. Using a vacuum cleaner, remove any dust that has accumulated within the cabinet interior.
10. Close the cabinet rear door and reinstall amplifier front filters and ventilation grills. Secure the front grills using the retained screws
11. **IMPORTANT: Grills and filters should be completely dry before restarting amplifier.**

8 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.

8.1 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" (0) 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.

8.2 No LEDs Illuminated or No Fans

If one or more of the amplifier's front Control Panels has no LEDs illuminated and the fans for any amplifier are inoperative, check the following:

4. Turn "OFF" (0) the power at the Main power selector.
5. Wait three to five minutes for the Power Supply capacitors to discharge.
6. Open the rear door of the cabinet and inspect the back-panel circuit breakers for each amplifier, as shown in **Figure 8.1**. Make sure each circuit breaker is in the UP position.
7. Locate the Fuse F1 Cover for each amplifier as shown in **Figure 8.1**.
8. For each amplifier, remove the Fuse Cover and Fuse F1. Inspect and replace the fuse if necessary.
9. Return Fuse F1 to its receptacle and replace the Fuse Cover.

Figure 8.1 Back-Panel Circuit Breakers and Fuse F1 Location

8.3 No Power to the Cabinet, including Aux Power

If all of the amplifiers in the system have no power (front Control Panel LEDs are not illuminated and the fans are inoperative), and system auxiliary power is also inoperative, check the following:

1. Turn "OFF" (0) the power at the Main power selector.
2. Wait three to five minutes for the Power Supply capacitors to discharge.

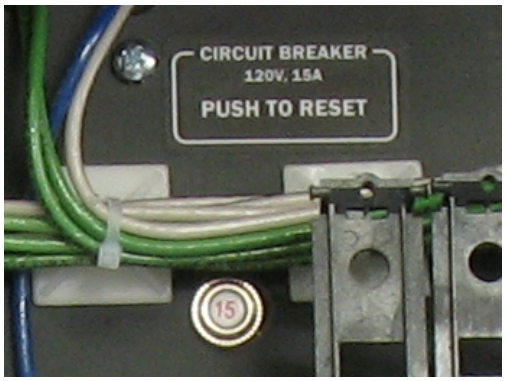

Figure 8.2 Auxiliary Power Breaker Switch (all models except 4301-60)

3. Open the rear door of the cabinet and inspect the Auxiliary Power Breaker Switch located above and to the left of the Wiring Block (or on the outside of the wiring panel on 4301-60 models), as shown in **Figures 8.2 and 8.3**. If the circuit breaker is tripped, push to reset. **Note:** On 4301-60 models, the Auxiliary breaker will cut power to the auxiliary outlets only.
4. On all models except 4301-60, locate the Main Power Breaker Switch located below the Wiring Access Panel, as shown in **Figure 8.4**. If the circuit breaker is tripped, switch it to the ON (|) position. On **4301-60 models,** locate the contactor breaker switch located on the outside of the wiring panel as shown in **Figure 8.5**. If the circuit breaker is tripped, push to reset.
5. Close cabinet rear door and turn the Main power selector to "ON" (|).
6. If one or both circuit breakers continue to trip during normal operation, contact AE Techron Technical Support.

Figure 8.3 Auxiliary Power Breaker Switch (4301-60 models)

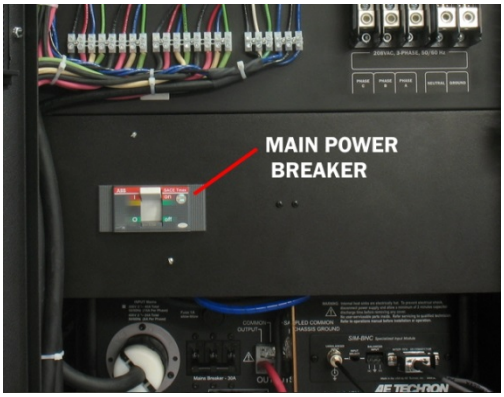

Figure 8.4 Main Power Breaker Switch (all models except 4301-60)

Figure 8.5 Contactor Breaker Switch (4301-60 models)

8.4 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.

8.5 Overvoltage Fault Warning Message

The 4301 amplifiers will protect themselves 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 amplifier out of this Fault condition.

8.6 Standby LED Remains Illuminated

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

8.7 Over Temperature Fault Warning Message

The overheating of any amplifier in the 4301 system may occur for two possible reasons:

1. Excessive Power Requirements
2. Inadequate Airflow

8.7.1 Excessive Power Requirements

An amplifier in 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.

8.7.2 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 amplifier. 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 amplifier 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.

8.7.3 Resetting After OverTemp

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

8.8 Fault LED Remains Illuminated/Output Device Fault

The 4301 amplifiers contain protection circuitry that 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.

9 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. This will help 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

10 Specifications

10.1 Performance

Maximum Continuous DC Current (±50VDC):

4301-240: 240A
4301-180: 180A
4301-120: 120A
4301-60: 60A

Maximum Pulse DC Current (up to ±100VDC):

4301-240: 800A
4301-180: 600A
4301-120: 400A
4301-60: 200A

Voltage Gain: 20

Maximum Input Voltage:

±10V, unbalanced

Figure 10.1 4301 system amplifier module

10.2 Indicators and Controls (4301 system amplifier modules)

LED Displays:

Indicators for Run, Ready, Standby, and Stop status, and Fault conditions in the output stage.

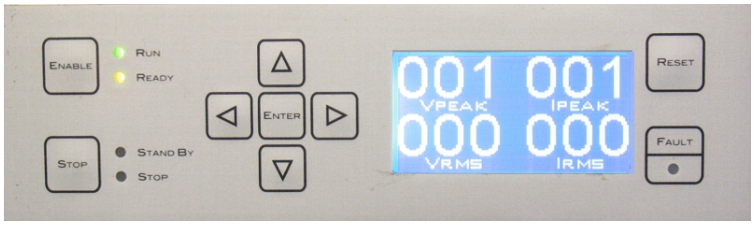

Figure 10.2 4301 amplifier module control panel

LCD Display:

Can be user-configured for up to four simultaneous displays reporting one, two, or all four of the following: Voltage Peak, Voltage RMS, Current Peak and Current RMS. When the amplifier module is in a Fault condition, the LCD Display lists the type of fault condition and gives suggested corrective action.

Figure 10.3 4301 amplifier module compensation control and indicators

Navigation Buttons:

The Navigation Buttons provide four arrow keys to allow navigation through the various LCD display options.

Soft Touch Switches:

Soft touch switches allow the selection of Run (Enable), Stop and Reset functions.

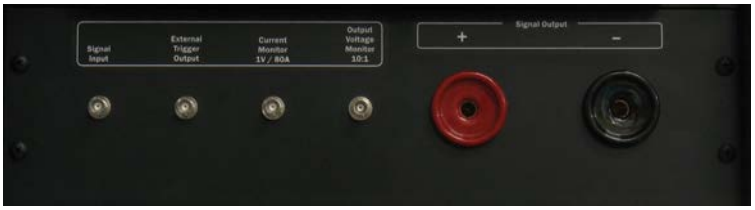

Figure 10.4 4301 system input/output panel

Compensation Setting:

A four-position rotary control allows the selection of optimum compensation settings according to the total current required at the system output.

Compensation LEDs:

When the amplifier module is receiving AC power, the colored LED associated with the selected Compensation setting will be lit.

10.3 Inputs and Outputs

Signal Input:

A BNC connector located on the cabinet front input/output panel accepts input from an arbitrary waveform generator.

External Trigger Output:

A BNC connector located on the cabinet front input/output panel provides the signal to the Trigger In connector on the AWG.

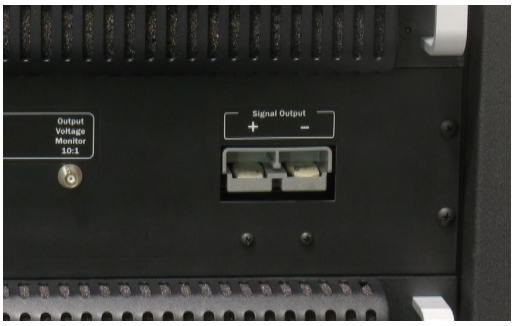

Figure 10.5 Optional SB350 output connectors

Current Monitor Output:

A BNC connector located on the cabinet front input/output panel provides scaled voltage output for current monitoring:
4301-60: 20A output = 1V monitor output.
4301-120: 40A output = 1V monitor output.
4301-180: 60A output = 1V monitor output.
4301-240: 80A output = 1V monitor output.

Figure 10.6 Optional Fluke 281 AWG is integrated into the 4301 system

Voltage Monitor Output:

A BNC connector located on the cabinet front input/output panel provides scaled voltage output for voltage monitoring: 4301-240, 4301-180 and 4301-120: 10V output = 1V monitor output; 4301-60: 20V output = 1V monitor output.

Signal Output:

250A Pin Plug connectors (or optional Anderson SB350 connectors) provide signal output to the equipment under test.

10.4 Protection

Fault:

The Fault LED on an amplifier module will light if the module's output stage stops operating. If this happens, contact AE TECHRON for servicing information.

AC Under/Over Voltage Protection:

If the AC line voltage rises or drops more than10% of the nominal operating voltage, the system will be forced to Standby.

Over Current:

Each amplifier module contains breaker protection on both the unit's main power supply and the low-voltage supplies. The 4301 system provides a Main Power breaker switch and an Auxiliary Power breaker switch located inside the cabinet rear door.

Over Temperature

Each amplifier module contains separate output transistor, heat-sink and transformer temperature monitoring and protection circuits.

10.5 Options:

AWG Option:

A Fluke 281 AWG can be integrated into the 4301 system. The optional AWG comes pre-programmed with the required test waveforms and is mounted securely within the 4301 cabinet. A GPIB port located next to the AWG on the system front panel allows communication with the AWG through a user-supplied computer.

Customization:
A pre-wired, single-phase auxiliary outlet box is provided on all systems. The 4301-240, 4301-180 and4301-120 systems also are configured with space for additional customer customization, if desired.

10.6 Physical Characteristics

Cabinet:
Welded steel cabinet with a textured black, powder-coat finish.

Main Power:
A main power selector located on the system front panel controls the main power supply to the system (4301-240, 4301-180, and 4301-120 systems only).

Required AC Mains (±10%):

Three-phase, 208-VAC; 47-60 Hz, 5-conductor wiring.

4301-240: 120A AC service
4301-180: 90A AC service
4301-120: 60A AC service
4301-60: 30A AC service

Three-phase, 400-VAC; 47-60 Hz, 5-conductor wiring.

4301-240: 60A AC service
4301-180: 45A AC service
4301-120: 30A AC service
4301-60: 15A AC service

Operating Temperature:
10°C to 50°C (50°F to 122°F), Maximum Output Power de-rated above 30°C (86°F).)

Humidity:
70% or less, non-condensing.

Cooling:
The 4301 system amplifier modules employ forced air-cooling from front to back through removable filters via six 100 ft3/min. fans per unit. No space is required between rack-mounted modules. Provide room at the cabinet back to allow for proper airflow.

Dimensions (H x W x D):
4301-240 and 4301-180: 74 in. x 22 in. x 31.5 in. (188 cm x 55.9 cm x 80 cm).
4301-120: 52 in. x 22 in. x 31.5 in. (132 cm x 55.9 cm x 80 cm).
4301-60: 27 x 34 x 22.5 in. (68.6 x 86.4 x 57.2 cm).

Net Weight:
4301-240: 850 lbs. (386 kgs.)
4301-180: 697 lbs. (316 kgs.)
4301-120: 454 lbs. (206 kgs.)
4301-60: 307 lbs. (139 kgs.)

Shipping Weight:
4301-240: 1050 lbs. (476 kgs.)
4301-180: 897 lbs. (407 kgs.)
4301-120: 589 lbs. (267 kgs.)
4301-60: 458 lbs. (208 kgs.)