Operation Manual

3A Series – Rev 1.3 P/N 160922-10

3A Series
Programmable AC & DC load

ADAPTIVE Power Systems

Worldwide Supplier of Power Equipment

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1 Contact Information

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2 Front Matter

2.1 Limited Warranty

Adaptive Power Systems, Inc. (APS) warrants each unit to be free from defects in material and workmanship. For the period of one (1) year from the date of shipment to the purchaser, APS will either repair or replace, at its sole discretion, any unit returned to the APS factory in Irvine, California or one of its designated service facilities. It does not cover damage arising from misuse of the unit or attempted field modifications or repairs. This warranty specifically excludes damage to other equipment connected to this unit.

Upon notice from the purchaser within (30) days of shipment of units found to be defective in material or workmanship, APS will pay all shipping charges for the repair or replacement. If notice is received more than thirty (30) days from shipment, all shipping charges shall be paid by the purchaser. Units returned on debit memos will not be accepted and will be returned without repair.

This warranty is exclusive of all other warranties, expressed or implied.

2.2 Service and Spare Parts Limited Warranty

APS warrants repair work to be free from defects in material and workmanship for the period of ninety (90) days from the invoice date. This Service and Spare Parts Limited Warranty applies to replacement parts or to subassemblies only. All shipping and packaging charges are the sole responsibility of the buyer. APS will not accept debit memos for returned power sources or for subassemblies. Debit memos will cause return of power sources or assemblies without repair.

This warranty is exclusive of all other warranties, expressed or implied.

2.3 Safety Information

This chapter contains important information you should read BEFORE attempting to install and power-up APS Equipment. The information in this chapter is provided for use by experienced operators. Experienced operators understand the necessity of becoming familiar with, and then observing, life-critical safety and installation issues. Topics in this chapter include:

- Safety Notices
- Warnings
- Cautions
- Preparation for Installation
- Installation Instructions

Make sure to familiarize yourself with the **SAFETY SYMBOLS** shown on the next page. These symbols are used throughout this manual and relate to important safety information and issues affecting the end user or operator.

SAFETY SYMBOLS

Direct current (DC)

Alternating current (AC)

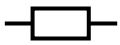
Both direct and alternating current

Three-phase alternating current

Protective Earth (ground) terminal

On (Supply)

Off (Supply)



Fuse

Caution: Refer to this manual before this Product.

Caution, risk of electric shock

2.4 Safety Notices

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Adaptive Power Systems assumes no liability for the customer's failure to comply with these requirements.

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category I, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 80% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the AC power supply mains through a properly rated three-conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired Fuses or short circuit the fuse holder. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

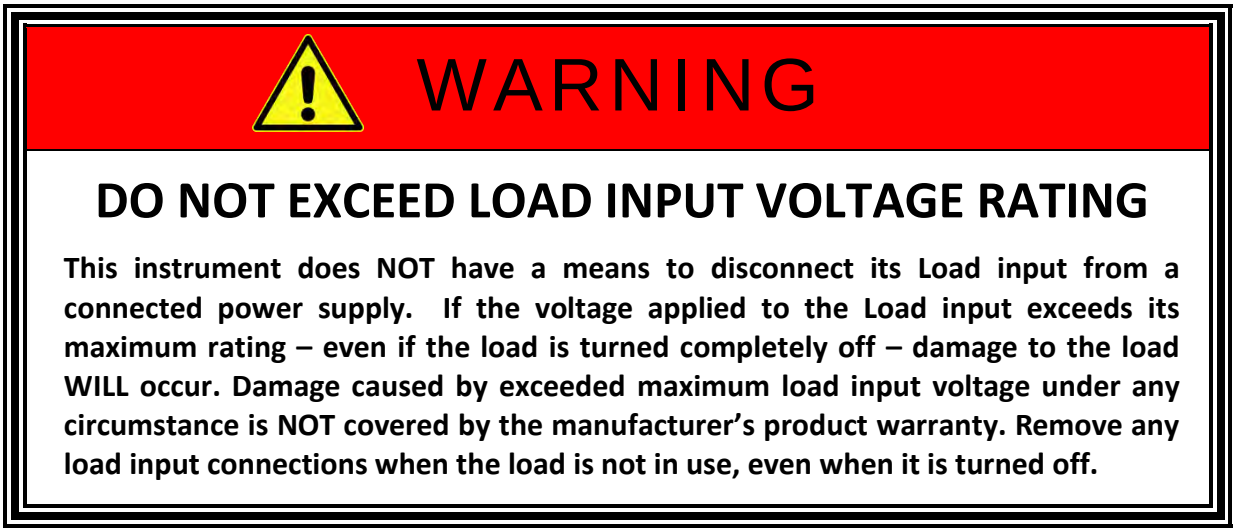
DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT EXCEED INPUT RATINGS.

This instrument may be equipped with a line filter to reduce electromagnetic interference and must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0 mA peak.

DO NOT EXCEED LOAD INPUT VOLTAGE RATING.



DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an Adaptive Power Systems Sales and Service Office for service and repair to ensure that safety features are maintained.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

3 Product Overview

This chapter provides an overview of the APS 3A Series programmable AC & DC load modules. It introduces the reader to general operating characteristics of these loads.

3.1 General Description

The APS 3A Series electronic load is designed to test, evaluation and burn-in of AC or DC power supplies and batteries. The APS 3A Series electronic load can be operated from the front panel (manual mode) or using RS232 or GPIB remote control. The 3A Series load modules must be installed in either a four slot 34M04 or single slot 34M01 mainframe to be functional. The mainframe provides bias supplies and cooling for the 3A load module(s). Also refer to the 4-slot 34M04 Operation Manual (P/N 160924) or single-slot 34M01 Operation Manual (P/N 160921) for specific information on using the 3A load modules with these mainframes.

The VI curve constant power contours of the various 3A Series models are shown in the Technical Specification Section. Maximum current and power capability depends on the specific model.

3.2 Operating Modes

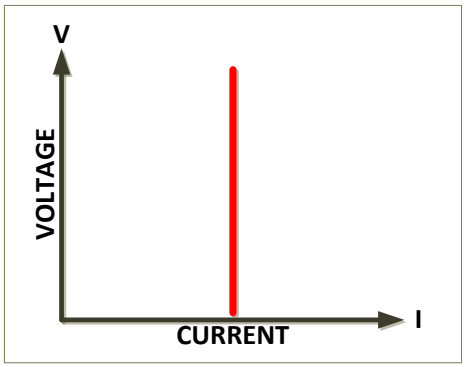
Available operating modes for all models are:

- Constant Current (CC) mode
- Linear Constant Current (LIN) mode
- Constant Resistance (CR) mode

A more detailed explanation of each mode and under what condition each mode is most appropriate to use follows.

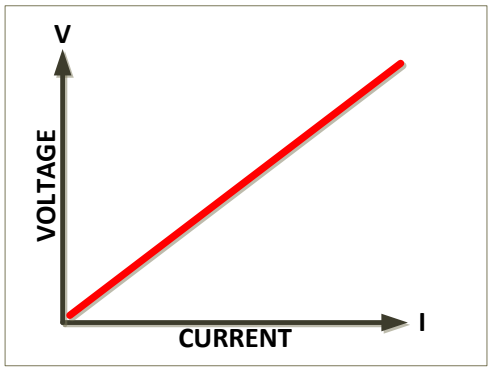
3.2.1 Constant Current Mode

This is the most commonly used mode of operating when testing a voltage source such as an AC power source, DC Supply or battery. In this mode of operation, the load will sink a constant level of current as set by the user, regardless of any voltage variations. A real time feedback loop ensures a stable current under any voltage variation of the DC supply or battery.



This mode is recommended for load regulation testing, loop stability testing, battery discharge testing and any other form of voltage regulation loop testing.

3.2.2 Linear Constant Current Mode (LIN)



When operating in linear constant current mode, the load current input into the 3A Series load depends on the current setting regardless of the input voltage, e.g., the current rms level remains unchanged. The load current will follow the input voltage waveform in real-time.

The LIN mode is implemented through a high-bandwidth auto gain control circuit (ACG) and the ACG output current control signal will track the input voltage. The AGC circuit produces a constant amplitude output signal so long as the amplitude of the input signal exceeds an adjustable reference voltage applied to the peak detector. The reference voltage may be changed to change the range of input voltage resulting in a constant-amplitude output.

The AGC circuit responds almost instantly to adjust for a sudden increase in input voltage. This fast voltage transient response makes the LIN mode especially suitable for non-sinusoidal AC voltage inputs such as step waveform, square waveform and any AC input voltage with a highly distorted waveform.

3.2.3 Constant Resistance Mode (CR)

In Constant Resistance mode, the load will sink current directly proportional to the sensed DC input voltage. The ratio between DC voltage and current is linear per ohms law and can be set by the user within the operating range of the AC & DC load. The current is defined by the formula shown here where R is the set value in CR mode and V is the dc input voltage from the unit under test.

$$I = V/R$$

CR mode is useful for battery discharge testing of battery systems used to power constant impedance loads as the voltage will decrease as the battery discharges over time resulting in reduced current sinking.

3.2.4 Current Read-back

The current levels and load status for each load module can be set from the front panel or over the remote control interface. During testing, load input voltage and load current can be read back but the current read back will typically display the average current level unless the dynamic current frequency setting is low enough. An analog current monitor output is provided to allow capturing of dynamic current on a digital storage scope or data recorder.

3.3 External Sync Mode

An analog input is provided at the rear panel of the 34M01 mainframe and four analog inputs are provided at the rear panel of the 34M04 mainframe. These inputs allow analog synchronization of the AC current with an external reference. Without an external sync signal, the AC load will sink to the sensed AC input voltage using it internal zero crossing detection circuit.

Note: This mode is supported in Constant Current (CC) and Linear Current (LIN) modes only.

3.4 Product Features

The following key characteristics apply to all 3A Series models.

- Fully programmable electronic AC & DC load module with flexible configuration and dual range capabilities.
- Fully remote control of all load settings and metering read back.
- Dual high accuracy and high-resolution voltage and current meters.
- DC or 0.1 to 400 Hz frequency range support (CC and LIN modes).
- Power factor (PF) and crest factor (CF) control (CC and LIN modes).
- Load ON/OFF switch change and power supply turn ON.
- Internal or external voltage sensing.
- Automatic Go/NoGo testing.
- Full protection from over power, over temperature, over voltage, and reverse polarity.
- Analog current monitor output (I-Monitor).
- External sync input.
- Variable speed fan control for quiet operation.

3.5 Accessories Included

The following accessories are included with each 3A Series AC & DC load module. If one or more of these is missing upon incoming inspection of the product, please contact Adaptive Power Systems customer service.

Item	Quantity
Operation Manual in hardcopy or PDF Format on CD ROM	1
AC Line Cord	1
Banana Terminal, Red	1
Banana Terminal, Black	1
Voltage Sense alligator clip lead cable, Red/Black (1 meter, 39.4”)	1
M6 Round Screw	1
Certificate of Conformance	1

Table 3-1: Included Accessories

3.6 Interface Options

Following options can be ordered at time of original purchase or may be added at a later time.

Option	Model No.
RS-232 Interface - Standard	34M01
RS-232 Interface - Standard	34M04
GPIB Interface Option	34M01-01
GPIB Interface Option	34M04-01

Table 3-2: Available Remote Control Interface Options

4 Technical Specifications

Technical specifications shown here apply at an ambient temperature of 25° C ± 5°. Refer to V-I curve and Very Low Voltage V-I Curve charts by models for operating envelope.

4.1 Operating Ranges

MODEL	3A060-20		3A150-08		3A300-04	
OPERATING RANGES						
Power Ranges	0 - 300 VA		0 - 300 VA		0 - 300 VA	
Current Ranges	0 -10 Arms	10 -20 Arms	0 - 4 Arms	4 - 8 Arms	0 - 2 Arms	2 - 4 Arms
Voltage Range	10 - 60 Vrms		15 - 150 Vrms		30 - 300 Vrms	
Frequency	DC, 40 - 400Hz (CC Mode) / DC - 400Hz (LIN,CR Mode)					
AC Waveforms	Sine, Square, Step, DC					

4.2 Operating Modes

MODEL	3A060-20		3A150-08		3A300-04	
OPERATING MODES						
CC Mode - High Range	0 -10 Arms	10 -20 Arms	0 - 4 Arms	4 - 8 Arms	0 - 2 Arms	2 - 4 Arms
Resolution	2.5 mA	5 mA	1 mA	2 mA	0.5 mA	1 mA
Accuracy	50Hz & 60Hz: ± 0.5% OF (SETTING + RANGE) / > 60 Hz: ±(0.5% OF SETTING + 1% OF RANGE)					
CC Mode - Low Range	0.000- 1.000 A		0.000- 0.400 A		0.000- 0.200 A	
Accuracy	±2% OF (SETTING + RANGE)					
CC Linear Mode - .	Refer to CC Mode data					
CF Mode - Range	√2 - 3.5 / 1.5 - 1.9 / 3.0 - 3.4					
Resolution	0.5 / 0.1 / 0.1					
Lagging	-0.30 to -0.85 for CF 2.0 to 3.5					
Leading	+0.30 to +0.85 for CF 2.0 to 3.5					
CR Mode Range	0.3 - 1.2 KΩ	12.3 - 4.8 KΩ	1.875 - 7.5 KΩ	7.5 - 30 KΩ	7.5 - 30 KΩ	30 - 120 KΩ
Resolution[1]	0.83 mS	0.2083 mS	0.13 mS	0.033 mS	0.033 mS	0.0083 mS
Accuracy	50Hz & 60Hz: ± 0.5% OF (SETTING + RANGE) / > 60 Hz: ±(0.5% OF SETTING + 2% OF RANGE)					

4.3 Protection Modes

MODEL	3A060-20		3A150-08		3A300-04	
PROTECTION						
Over Power (OP)	315 VA		315 VA		315 VA	
Over Current (OC)	10.5 A	21 A	4.2 A	8.4 A	2.1 A	4.2 A
Over Voltage (OV)	63 V		157.5 V		315 V	
Over Temperature (OT)	+85° C / +185° F					

[1] Note: S = Siemens or mho, unit of conductance. 1S = 1/Ω = A/V

4.4 Power Factor Range

MODEL	3A060-20	3A150-08	3A300-04
POWER FACTOR RANGE			
Lagging PF	CF: √2 to 3.5 . PF: - 0.30 to -0.85		
Leading PF	CF: √2 to 3.5 . PF: + 0.30 to +0.85 or 1.00		

4.5 Metering

MODEL		3A060-20	3A150-08	3A300-04
METERING				
Voltage	Range	0 - 60 V	0 - 150 V	0 - 300 V
	Resolution	0.01 V	0.01 V	0.1 V
	Accuracy	±(0.5% OF SETTING + 0.2% OF RANGE)		
Current	Range	0 - 20 A	0 - 8 A	0 - 4 A
	Resolution	0.01 A	0.001 A	0.001 A
	Accuracy	50Hz & 60Hz: ± 0.5% OF (READING + RANGE) / > 60 Hz: ±(0.5% OF READING + 2% OF RANGE)		
Power	Range	0 - 300 W		
	Resolution	0.1 W		
	Accuracy	50Hz & 60Hz: ± 0.5% OF (READING + RANGE) / > 60 Hz: ±(0.5% OF READING + 2% OF RANGE)		
Apparent Power	Range	0 - 300 VA		
	Resolutions	0.1 VA		
	Accuracy	Derived from Volt and Current Measurement		

4.6 Analog I/O

MODEL	3A060-20	3A150-08	3A300-04
ANALOG I/O			
Current Monitor Out Scale	5 A/V	2 A/V	1 A/V
Range	0 – 4 V full scale	0 – 4 V full scale	0 – 4 V full scale
Accuracy	± 0.5% OF (SETTING + RANGE)		
External Sync In	Optically Isolated Input, TTL level, Zin = 330 Ohm. Requires 50% duty cycle signal-10/330		

4.7 Power & Cooling

MODEL	3A060-20	3A150-08	3A300-04
AC INPUT AND COOLING SPECIFICATIONS			
Power	Supplied by 34M01 or 34M04 mainframe		
Cooling	Supplied by 34M01 or 34M04 mainframe		

4.8 Dimensions & Weight

MODEL	3A060-20	3A150-08	3A300-04
DIMENSIONS AND WEIGHT			
Dimensions (H x W x D)	143 x 108 x 405 mm / 5.6" x 4.25" x 15.9		
Weight (Net)	3.5 kg / 7.7 lbs	3.5 kg / 7.7 lbs	3.5 kg / 7.7 lbs

4.9 Environmental

MODEL	3A060-20	3A150-08	3A300-04
ENVIRONMENTAL			
Operating Temperature	0 - 40° C / 32 - 104° F		
Relative Humidity	80% max. non-condensing		
Environmental	Indoor Use Only, Pollution Degree 2		
Altitude	2000 meter / 6500 feet max. Operating		
EMC & Safety	CE Mark		

4.10 Voltage versus Current Operating Envelope Charts

Following charts show constant power operating envelopes for each load module. Operation below the low voltage level is not possible as the load will turn off if insufficient input voltage is sensed.

4.10.1 Model 3A060-20 V-I Curves

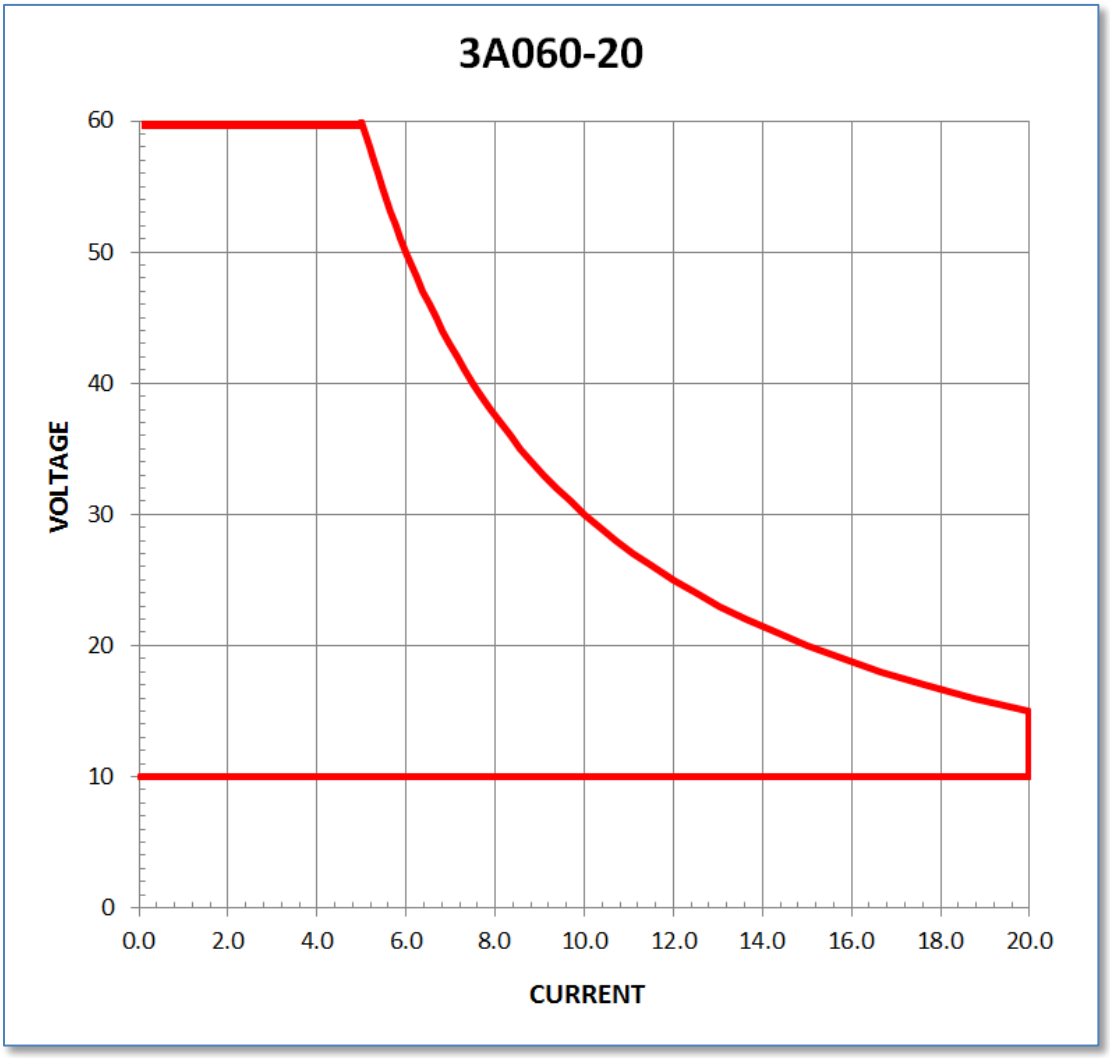


Figure 4-1: Module 3A060-20 V-I Curve

4.10.2 Model 3A150-08 V-I Curves

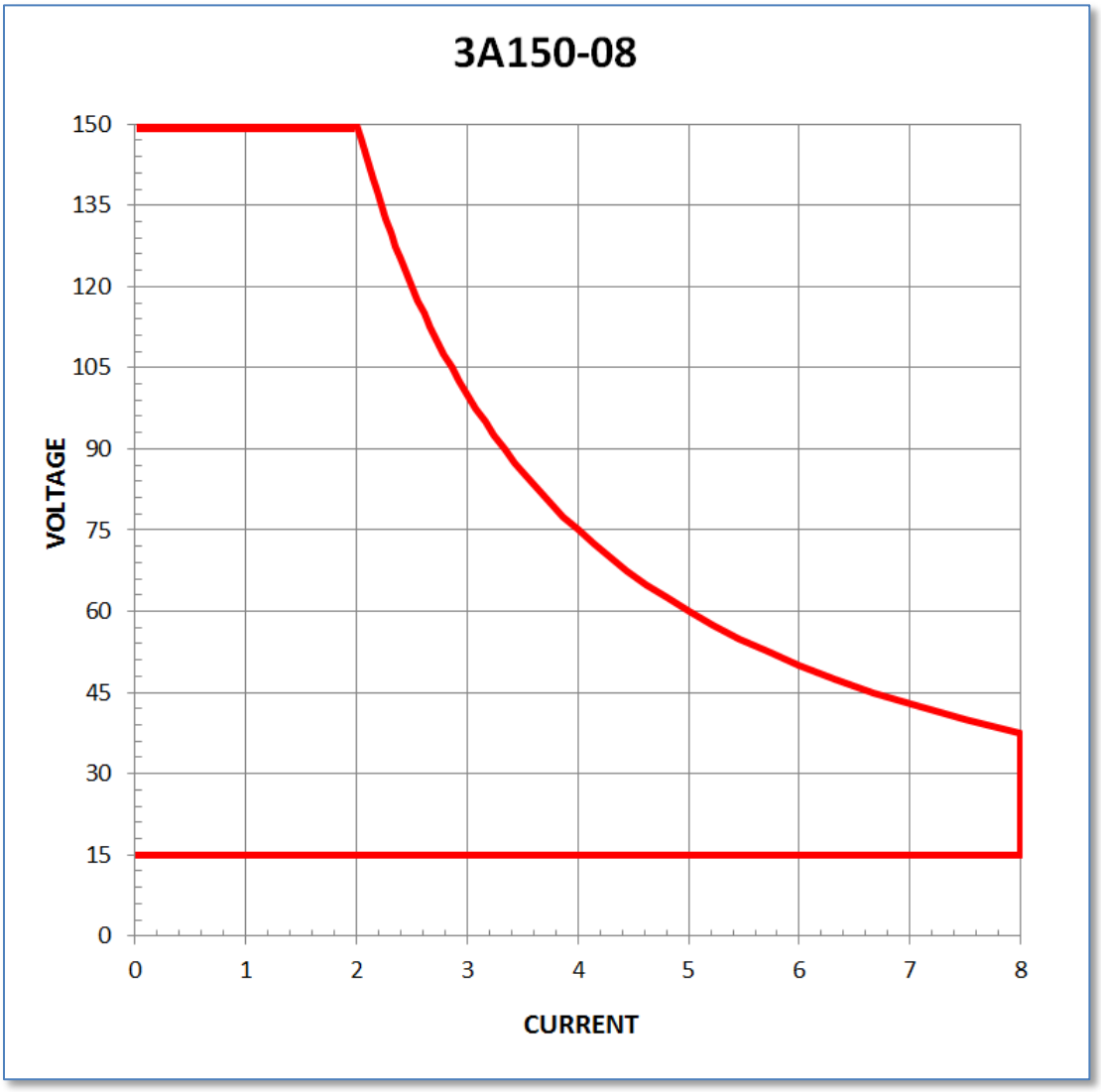


Figure 4-2: Module 3A150-08 V-I Curve

4.10.3 Model 3A300-04 V-I Curves

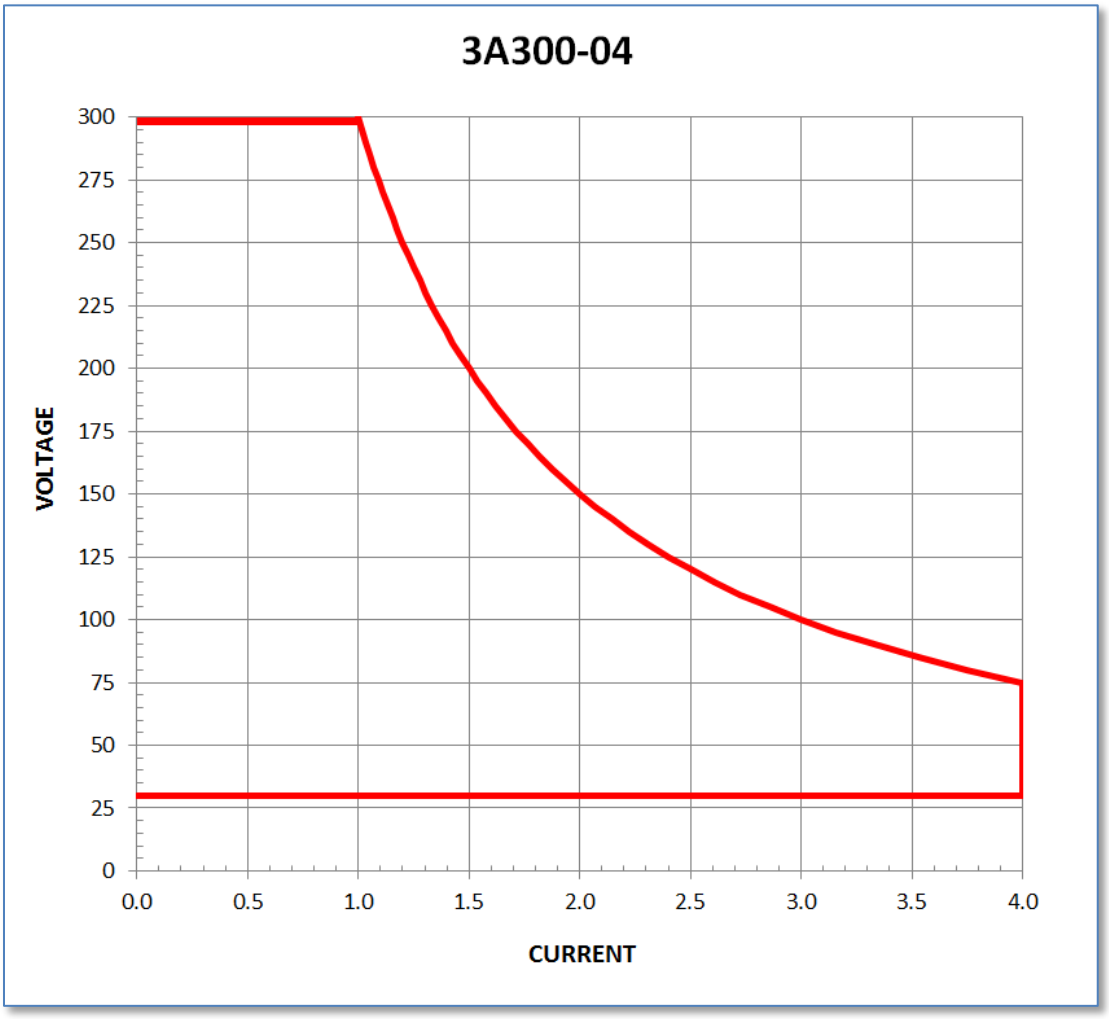


Figure 4-3: Module 3A300-04 V-I Curve

5 Unpacking and Installation

5.1 Inspection

The 3A Series AC & DC loads are carefully inspected before shipment. If instrument damage has occurred during transport, please inform Adaptive Power Systems' nearest sales and service office or representative.

3A Series modules ordered at the same time as the 34M01 or 34M04 mainframe chassis will be shipped installed in the mainframe. 3A Series modules ordered separately or if more load modules are ordered with a given mainframe type, will be shipped packaged separately.

5.2 Installation and Removal of 3A Series Load Modules

This section deals with the procedures for installing a 3A Series electronic load in a 34M01 or 34M04 mainframe or removing a module same from its mainframe. Once properly installed, 3A Series load modules can be used without any further adjustment.

Unless mainframe and load modules are purchased separately or more modules were order than can be installed in the mainframe, all purchased load modules will be installed in the mainframe prior to shipment. Any additional modules will be shipped separately and will have to be installed by the user at the appropriate time by removing one of the other modules from the mainframe.

A 3A Series load modules that are installed in the mainframe can be operated from their front panel keyboard or through one of the available RS232 or GPIB remote control interfaces.

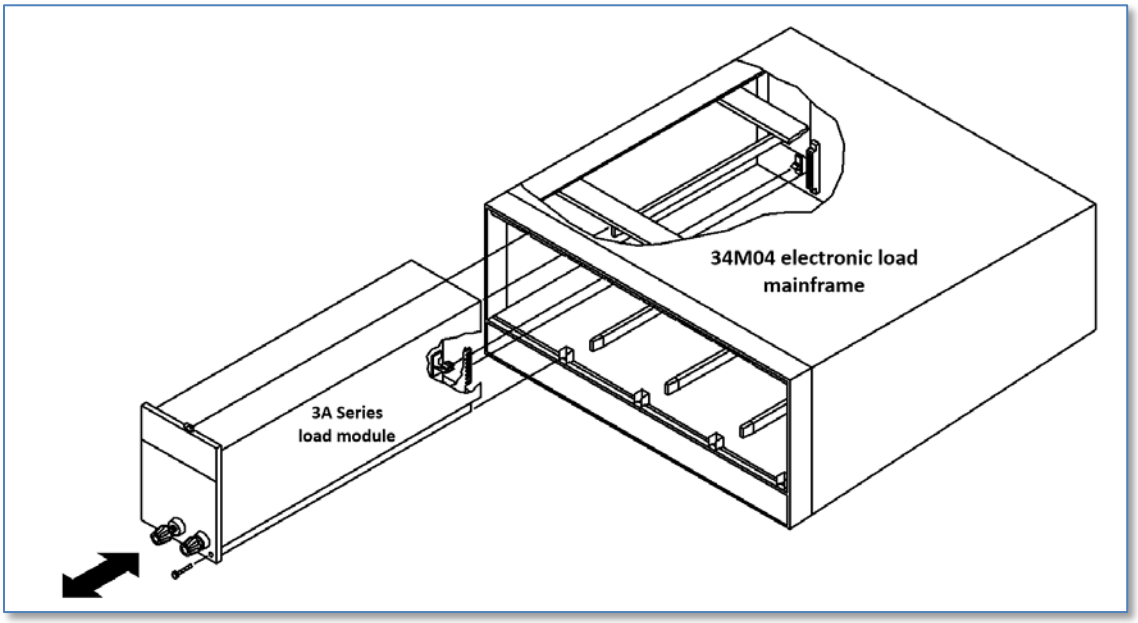


Figure 5-1: Installation or removal of a load module

Procedure for installation of 3A Series load modules:

1. Prior to installation of a load module, please **TURN OFF** the power switch of the mainframe. **Failure to do so could damage a load module.** (No hot-swap capability).
2. Align the upper and lower guide-slot of the module position inside the mainframe into which the module is to be installed and carefully insert the load in that slot position.
3. As shown in Figure 5-1, push the load module into the mainframe by pressing against the two load input terminals on the front panel until the module is fully seated.
4. Tighten the locking screw located at lower right side of the front panel.
   NOTE: Do NOT over-tighten this screw. It does not need to support the weight of the module, just prevent it from pulling out when removing cables from the front panel.
5. Turn on the power of the mainframe only **after** all load modules are securely installed.

Procedure for removal of 3A Series load modules:

To REMOVE a module, reverse steps 4 through 3 in the installation procedure above.

5.3 Cleaning

To clean this product uses a soft or slightly damp cloth.

CAUTION

BEFORE you clean the unit, switch the mains power off and disconnect the input line cord.
・Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
・Please ensure that no liquid is allowed to penetrate this product.

5.4 Powering Up

Refer to the 34M01 Mainframe Operation Manual (P/N 160921) or 34M04 mainframe Operation Manual (P/N 160924).

5.5 In Case of Malfunction

In the unlikely event of an instrument malfunction or if the load module does not function, please attach a warning tag to the instrument to identify the owner and indicate that service or repair is required. Contact Adaptive Power Systems or its authorized representative to arrange for service.

5.6 Load Connection

WARNING

DO NOT EXCEED LOAD INPUT VOLTAGE RATING

This instrument does NOT have a means to disconnect its Load input from a connected power supply. If the voltage applied to the Load input exceeds its maximum rating – even if the load is turned completely off – damage to the load WILL occur. Damage caused by exceeded maximum load input voltage under any circumstance is NOT covered by the manufacturer's product warranty. Remove any load input connections when the load is not in use, even when it is turned off.

When setting up for a new test and connecting any equipment to the AC & DC load, proceed as follows:

1. Check that the output of the equipment under test is **OFF**.
   Note: Some power equipment's output may still be energized even if the equipment has been turned off or its output is turned off. This is especially true for DC power supplies.

   Note: When working with batteries, it is recommended to provide a suitable disconnect relay or switch so the load connection can be disconnected from the battery for handling purposes.
2. Connect one end of the load wires to the load input terminals on the front panel of the relevant module.
3. Check the polarity of the connections and connect the other end of the load wires to the output terminal of the equipment under test.
4. When connecting multiple loads to the same EUT, makes sure the load wire lengths to each load are the same.

5.7 Interface Options

Remote control interfaces are provided by the 34M01 or 34M04 mainframe that houses the 3A load module(s). Refer to the 34M01 or 34M04 Operation Manual for more details.

5.8 External Sync Connector

The external sync connector is located on the rear panel of the 34M01 or 34M04 mainframe. Refer to Section 3.3, "External Sync Mode".

6 Front Panel Operation

This Chapter provides an overview of front panel operation for the 3A Series AC & DC loads. For remote control operation, refer to Section 8 “Remote Control Programming” of this manual for an overview of available programming commands.

6.1 Front Panel Layout

The front panel layout is shown in Figure 6-1 below. All user controls are directly below the LED display. Load connection, external voltage sense connections and current monitor are arranged along the bottom edge of the front panel.

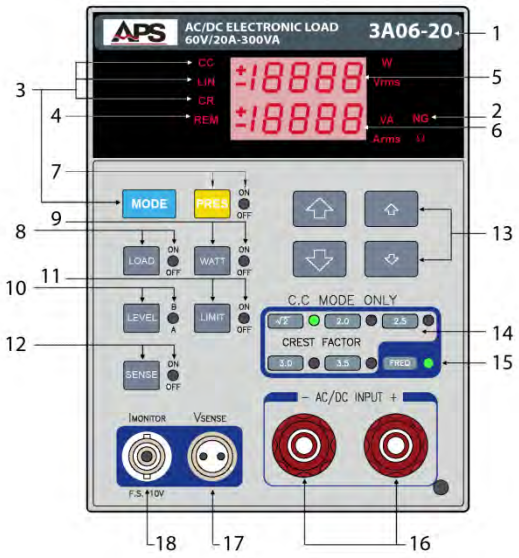
Figure 6-1: 3A Series Load Front Panel

Large LED readouts for settings and read-back values are at the top of the module front. Refer to next section for an overview of all user controls.

6.2 User Controls, Displays and Connectors

The following user controls, indicator and displays are common to all 3A Series load modules. The purpose and function of each control and indicator is explained in the table below. Refer to figure for the location of each control and indicator.

1. Model Number and ranges
2. Go/NoGo indicator illuminates if upper or lower limit settings are exceeded
3. Operating Mode Indicators and MODE key
4. REMOTE state indicator
5. Multi-purpose 4½ digit display – Voltage or Power
6. Multi-purpose 4½ digit display – Current or Apparent Power
7. Preset Mode On/Off key Controls settings shown on LED display
8. LOAD ON/OFF button and indicator
9. WATT display mode On/Off key and indicator



10. Level A or B Setting Toggle key and indicator
11. Limit Mode On/Off and indicator
12. Internal or External Voltage Sense Mode selection key and indicator
13. Rough and Fine Setting Adjustment Up/Down keys
14. Crest Factor Selection keys
15. Frequency, BANK and SYNC setting key
16. Load Input Terminals
17. External Voltage Sense Connector
18. Current Monitor Output BNC.

Figure 6-2: Front Panel User Controls and Indicators

The various controls and indicators are explained in more detail in the table below. The Item numbers correspond to the indices in Figure 6-2 above.

Key #	Description	
1	Indicates the **model number** and key performance specifications of the load.	
2	**Go/NoGo** indicator illuminates when upper or lower limit settings for Voltage, Current, Power or VA are exceeded.	
3	**MODE key and annunciators** There are three operating modes can be selected by pressing the "MODE" key. The sequence is Constant Current (CC), Linear Constant Current (LIN) and Constant Resistance (CR) and then repeats. When pressing the "MODE" key, the CC, LIN and CR mode indicator will be lit respectively when the appropriate operating mode is selected. The operating theorem of CC, LIN and CR mode is described in Section 3.2, "Operating Modes".	
4	The Remote Indicator (REM) is used to indicate the status of remote operation. Front panel operation is locked out while the remote annunciator is ON. In case of Local mode or manual operation, the Remote annunciator is OFF	
5	This is the upper 4½ digit multifunction display. It's function depends on the operating mode the load is in as described in the next rows:	
	Default Condition	This display will show the voltage at the load connection (internal sense) or at the load (external sense) Vrms.

Key #	Description	
	WATT ON mode	In WATT mode (see 9), the upper display shows the measured true power consumed by the load in Watts.
	LIMIT ON mode	In LIMIT mode, the upper display shows the UPPER limit settings for No/Go mode measurement limits in the following sequence: Vrms ⇨ Arms ⇨ W ⇨ VA.
	PROTECTION mode	If an over voltage condition has triggered the OVP protection mode, the upper display will display "oVP"
	FREQ ON mode	If FREQ mode is set to ON (see 15), the Frequency, Bank and Sync setting information will be displayed on the upper LED display in the following order: Frequency setting "FrEq" ⇨ Bank selection "bAn" ⇨ SYNC selection "Sync".
6	This is the lower 4½ digit multifunction display. It's function depends on the operating mode the load is in as described in the next rows:	
	PRESET OFF mode	The lower display will show the load current in Arms.
	PRESET ON mode	The lower display will show the pre-set values for manual or remote control mode for the active operating mode: CC and LIN Modes: Displays set value of CC level A and B in Arms. CR Mode: Displays set value of R level A and B in Ω. Protection Mode: If over current, over power or over temperature conditions are detected, this display will show "oCP", "oPP" or "oTP".
	LIMIT ON mode	In LIMIT mode, the lower display shows the LOWER limit settings for No/Go mode measurement limits in the following sequence: Vrms ⇨ Arms ⇨ W ⇨ VA.
	PROTECTION mode	If an over voltage condition has triggered the OVP protection mode, the upper display will display "oVP"
	FREQ ON mode	If FREQ mode is set to ON (see 15), the lower display will show: Frequency: Frequency setting as DC or 0.1 through 400Hz. Bank: 0 through 10 Sync: ON or OFF
7	**PRESet Key and annunciator** Pressing the "PRES" key will toggle the PRESET mode ON or OFF. When ON, the A and B set values for the selected mode can be set and are displayed on the LED read-outs. When OFF, it means the set A and B levels are the active setting for the load. In PRESET OFF condition, the upper 4 1/2 digit monitor displays the voltage input to load in Vrms while the lower 4 1/2 digit monitor displays the current flowing into electronic load in Arms. In PRESET ON condition, the PRES LED indicator is lit and both upper and lower 4 1/2 digit monitors will have different displays depending on selected operating mode as shown below:	
	CC mode	The set values of Level A / B load current are displayed on the lower 4 1/2 digit monitor in Arms. "Arms" annunciator is ON.
	LIN mode	The set values of Level A / B load current are displayed on the lower 4 1/2 digit monitor in Arms. "Arms" annunciator is ON.
	CR mode	The set values of Level A / B load resistance are displayed on the lower 4 1/2 digit monitor in Ω. The "Ω "annunciator is ON.

<table>
<tr><th>Key #</th><th>Description</th></tr>
<tr><td>8</td><td>LOAD ON/OFF key and annunciator
The LOAD key is used toggle the electronic load ON or OFF. When OFF, the load will sink no current even if a EUT is connected. It remains in a high impedance state.
When the load is turned ON, it will start sinking current based on any input voltage present that is within range, operating mode setting and A/B setting parameters.
The LOAD LED annunciator will be lit when the LOAD is engaged (ON), even if no EUT is connected and no current is flowing into the load.</td></tr>
<tr><td>9</td><td>WATT key and Indicator
Pressing the WATT key toggles the WATT mode on or off. The data displayed on the two numeric displays is a function for both WATT and PRES mode as follows:
<table>
<tr><td>PRESET OFF</td><td>WATT ON:</td><td>Watt mode is ON and the upper display shows the true power consumed by the load in Watt, while the lower display shows the apparent power consumed by the load in VA.</td></tr>
<tr><td></td><td>WATT OFF</td><td>Watt mode is OFF and the upper display shows the voltage in Vrms, while the lower display shows the current sunk by load in Arms.</td></tr>
<tr><td>PRESET ON</td><td colspan="2">In PRESET ON condition, the PRES LED indicator is lit and both upper and lower 4 1/2 digit monitors will have different displays depending on selected operating mode as shown below:</td></tr>
<tr><td></td><td>CC mode</td><td>The set values of Level A / B load current are displayed on the lower 4 1/2 digit monitor in Arms. “Arms” annunciator is ON.</td></tr>
<tr><td></td><td>LIN mode</td><td>The set values of Level A / B load current are displayed on the lower 4 1/2 digit monitor in Arms. “Arms” annunciator is ON.</td></tr>
<tr><td></td><td>CR mode</td><td>The set values of Level A / B load resistance are displayed on the lower 4 1/2 digit monitor in Ω. The “Ω “annunciator is ON.</td></tr>
</table></td></tr>
<tr><td>10</td><td>LEVEL A/B key and annunciator
Pressing the LEVEL key will toggle load settings between A (LED indicator off) and B values (LED indicator lit).
This feature allows a pair of settings to be saved to memory for rapid transition switching between current or resistance settings.</td></tr>
</table>

<table>
<tr><th>Key #</th><th>Description</th></tr>
<tr><td>11</td><td>LIMIT key and annunciator
Pressing the LIMIT key will place the load in the LIMIT ON state. This allows changes to be made to the upper and lower measurement test limits for Go/NoGo operation. The display functions in LIMIT ON Mode are selected in sequence by repeatedly pressing the LIMIT key as follows:
Voltage Limit: Upper display shows upper voltage limit setting in Vrms, Lower display shows lower voltage limit setting in Vrms.
Current Limit: Upper display shows upper current limit setting in Arms, Lower display shows lower current limit setting in Arms.
Power Limit: Upper display shows upper true power limit setting in Watts, Lower display shows lower true power limit setting in Watts.
VA Limit: Upper display shows upper apparent power limit setting in VA, Lower display shows lower apparent power limit setting in VA.
Refer to section for key #13 below for adjusting upper and lower limit values.

After five presses of the LIMIT key, the LIMIT annunciator will turn off and the load returns to the LIMIT OFF state.</td></tr>
<tr><td>12</td><td>SENSE key and annunciator
The voltmeter and internal trigger circuit of the 3A Series load can sense either at the load terminals or at the EUT, if the external voltage sense cabling is connected to the point of load. The SENSE key switches between INTERNAL (annunciator OFF) and EXTERNAL (annunciator ON) voltage sense modes.</td></tr>
<tr><td>13</td><td>Coarse and Fine Tuning Up/Down Arrow keys
There are two sets of up/down arrow keys directly below the display area. The larger set of keys allows coarse setting adjustments to be made. What parameter settings they adjust depends on the selected mode as follows:
<table>
<tr><td>PRESET ON</td><td>⇧ ⇩ Coarse increment or decrement of load setting
⇧ ⇩ Fine increment or decrement of load setting</td></tr>
<tr><td>LIMIT ON</td><td>⇧ ⇩ Increment or decrement UPPER limit settings
⇧ ⇩ Increment or decrement LOWER limit settings</td></tr>
<tr><td>FREQ ON</td><td>Depends on AC parameter selected</td></tr>
<tr><td>Frequency (FrEq)</td><td>⇧ ⇩ Coarse increment or decrement of Frequency setting
⇧ ⇩ Fine increment or decrement of Frequency setting</td></tr>
<tr><td>Bank (bAn)</td><td>⇧ ⇩ Fine increment or decrement of bank selection (either set of keys)
⇧ ⇩ Fine increment or decrement of bank selection (either set of keys)</td></tr>
<tr><td>Sync</td><td>⇧ ⇧ External Sync ON
⇩ ⇩ External Sync OFF</td></tr>
</table></td></tr>
<tr><td>14</td><td>√2, 2.0, 2.5, 3.0, 3.5 Key and annunciators
These 5 keys only function while in CC mode of operation. All keys are disabled in either LIN or CR modes. They are used to select from 5 different Crest Factor values for the AC load current from the selected waveform Bank.

Note: The CF value decals on these keys only reflect the actual CF value stored in bank zero (0). For all other bank selections, the actual CF value may be different. Refer to Section 6.2.2, “Waveform and Crest Factor Bank Selection” for details.</td></tr>
</table>

Key #	Description	
15	**FREQ key and annunciator** The function of this key depends on the selected operating mode as follows:	
	CC mode	After pressing the FREQ key, the annunciator will turn on. Parameters are selected in the following order by repeatedly pressing the FREQ key: FREQ ⇨ BANK (except in DC mode) ⇨ SYNC ⇨ Off Available AC parameter setting ranges are: FREQ DC, 0.1 to 400 Hz. BANK 0 through 10 for 11 banks total SYNC ON = External Sync, OFF = Internal Sync
	LIN & CR modes	After pressing the FREQ key, the annunciator will turn on. Pressing the FREQ key again will turn it off.
16	**AC or DC Load Input Connections** Before connecting any source or supply to the 3A load module banana jack connectors, make sure that the rated specification of the voltage and current of the 3A Series model will not be exceeded. Before wiring the load input, please refer to Section 7.1, "INPUT Terminals" to avoid damaging the internal circuits and connectors.	
17	**V Sense Connector** Refer to Section 7.4, on "Voltage Sense Input Terminals" for information on external voltage sense connections.	
18	**I-Monitor Output BNC** Refer to Section 7.5, on "Current Output Monitor (I-Monitor)" for further information on using this feature.	

Table 6-1: Front Panel Display and Keyboard Functions

6.3 Coarse and fine Adjustment Ranges

The maximum load current of 3A loads can be adjusted to either 20.00 A, 8.000 A or 4.000 A respectively depending on the model used. The relationship between the adjustment variation of the load current or resolution and buttons is shown in Table 6-2, Table 6-3 and Table 6-4 for each available load model.

During operation, when the time for depressing one of the four buttons, e.g., rough tuning, fine tuning, increment and decrement, exceeds one second, the resolution of load current adjustment changes every 10ms, e.g., the rate of change of the load current will increase so that reaching the desired end value can be completed in the shortest amount of time. This occurs as long as neither minimum nor maximum set values are reached and key pressing is not interrupted.

Model 3A060-20		Range I		Range II	
FULL SCALE LOAD CURRENT		10 A		20 A	
CURRENT	RANGE	20.00 A			
METER	RESOLUTION	0.01 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		↑	↑	↑	↑
KEY'S STEP RESOLUTION		25 mA	2.5 mA	50 mA	5 mA

Table 6-2: Model 3A060-20 Course and Fine Adjustments

Model 3A150-08		Range I		Range II	
FULL SCALE LOAD CURRENT		4 A		8 A	
CURRENT	RANGE	8.000 A			
METER	RESOLUTION	0.001 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		↑	↑	↑	↑
KEY'S STEP RESOLUTION		10 mA	1 mA	20 mA	2 mA

Table 6-3: Model 3A150-08 Course and Fine Adjustments

Model 3A300-04		Range I		Range II	
FULL SCALE LOAD CURRENT		2 A		4 A	
CURRENT	RANGE	4.000 A			
METER	RESOLUTION	0.001 A			
COURSE/FINE LOAD CURRENT ADJUSTMENT KEY		↑	↑	↑	↑
KEY'S STEP RESOLUTION		5 mA	0.5 mA	10 mA	1 mA

Table 6-4: Model 3A300-04 Course and Fine Adjustments

6.1 AC or DC Load Mode Selection

The 3A Series modular loads are capable of operating in both AC and DC mode. The mode of operation is determined by the frequency of the AC voltage sensed as follows:

6.1.1 AC Mode Setting

For use as an AC load, the frequency setting of the load must be set in accordance with the frequency of EUT. Even if the output frequency of the EUT is 50 Hz, the frequency setting of the electronic load must still be set to 50.0 Hz using the FREQ function key or command. (See Section 6.1, “Front Panel Layout”.

6.1.2 DC Mode Setting

For use as a DC load, the electronic load must be set to DC. DC mode is set using the FREQ key. When DC is set, the Bank function will not be available. (Fixed to DC, the display will not show BANK).

6.2 AC Load Parameter Settings

The following parameters are specific to using the 3A Series in AC load mode as opposed to DC load mode and only apply to AC applications.

- Frequency Setting
- Waveform and Crest Factor Bank Selection
- Synchronization Source Setting

6.2.1 Frequency Setting

The range for the frequency setting of the 3A Series load is either DC or from 0.1 to 400 Hz. If a value below 40Hz is entered, the frequency setting will automatically be set to DC.

Setting the expected AC frequency of the AC input voltage allows the 3A Series load to synchronize to it properly using its internal synchronization circuits.

Once set, the SYNC setting has to be set to OFF for the frequency setting to be valid.

Remote Control Mode

When using the remote control interface, it is possible to auto-detect the AC input voltage frequency by sending the following command.

AFREQ

Purpose: To enable or disable the auto-frequency detection function.

Command syntax: AFREQ {SP} {0 | 1 | OFF | ON} {;|NL}

Description:

AFREQ ON Enables the auto frequency detect function. Load will sense input voltage frequency and synchronized the load current to the input voltage. In this mode of operation, the regular “FREQ” command is ineffective.

AFREQ OFF Disables the auto frequency detect function. This requires the frequency to be set using the “FREQ” command. When AFREQ mode is turned off, the set frequency will be fixed to the last detected input frequency.

For Example：

AFREQ ON

AFREQ OFF

6.2.2 Waveform and Crest Factor Bank Selection

The 3A Series load provides 11 built-in stored waveform sets at various crest factors totaling 55 waveforms. The content of Bank memory table is shown in Table 6-5 below. Details of various waveform types are further in the next few paragraphs.

Waveform	BANK	WAVE = 0	WAVE = 1	WAVE = 2	WAVE = 3	WAVE = 4	Phase Shift
Sine wave	0	√2	2.0	2.5	3.0	3.5	
	1	1.5	1.6	1.7	1.8	1.9	
	2	3.0	3.1	3.2	3.3	3.4	
C.F. = 2	3	P.F. = -0.85	P.F. = -0.80	P.F. = -0.75	P.F. = -0.70	P.F. = -0.65	Lagging PF
C.F. = 2.5	4	P.F. = -0.75	P.F. = -0.70	P.F. = -0.65	P.F. = -0.50	P.F. = -0.40	
C.F. = 3.5	5	P.F. = -0.50	P.F. = -0.45	P.F. = -0.40	P.F. = -0.35	P.F. = -0.30	
C.F. = 2	6	P.F. = +0.85	P.F. = +0.80	P.F. = +0.75	P.F. = +0.70	P.F. = +0.65	Leading PF
C.F. = 2.5	7	P.F. = +0.75	P.F. = +0.70	P.F. = +0.65	P.F. = +0.50	P.F. = +0.40	
C.F. = 3.5	8	P.F. = +0.50	P.F. = +0.45	P.F. = +0.40	P.F. = +0.35	P.F. = +0.30	
Square	9	1.0	1.1	1.2	1.3	1.4	
DC	10	√2 dc	2 dc	2.5 dc	3.0 dc	3.5 dc	

Table 6-5: Waveform Bank Data Table

Note: If the Frequency setting is set to DC, the wave form information is fixed at the DC level. The Bank selection function is not available unless Frequency is set to AC.

Banks 0, 1 & 2 Sinusoidal Waveforms

Current crest factor (C.F.) values for use with a sinusoidal AC input voltage are contained in the first 15 locations, banks 0 through 2, each containing five C.F values ranging from √2 to 3.5. These wave shapes are shown below.

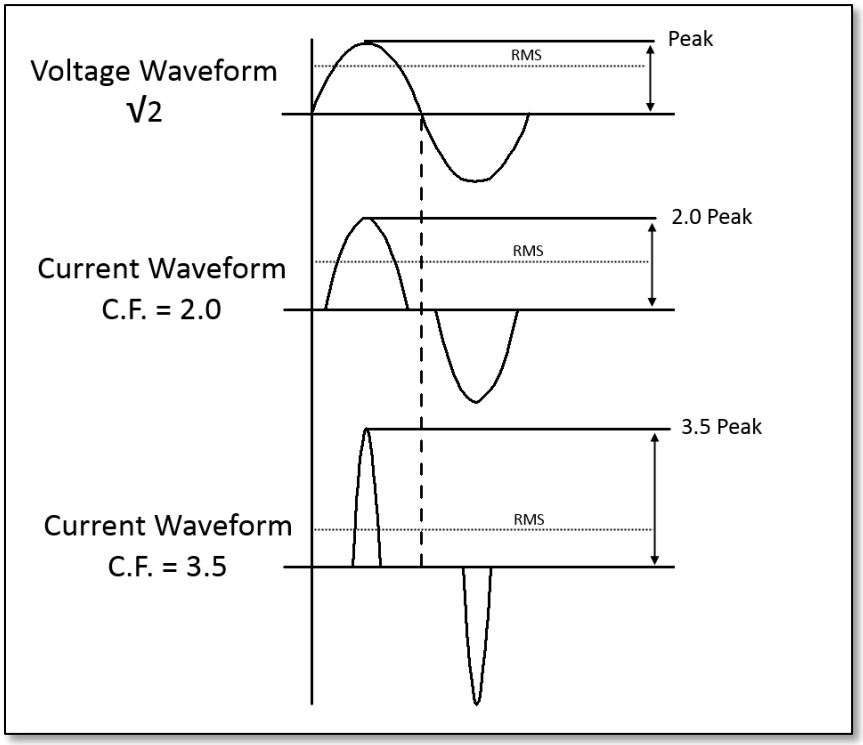


Figure 6-3: Waveforms in Banks 0 through 2

Banks 3, 4 & 5 Sinusoidal Waveforms with Negative Displacement Power Factor

Banks 3 through 5 contain waveforms at various crest factor values in the range of 2.0 to 3.5 with negative displacement power factor values from -0.85 to -0.30.

Total is 15 waveforms. Waveform definition is shown in below.

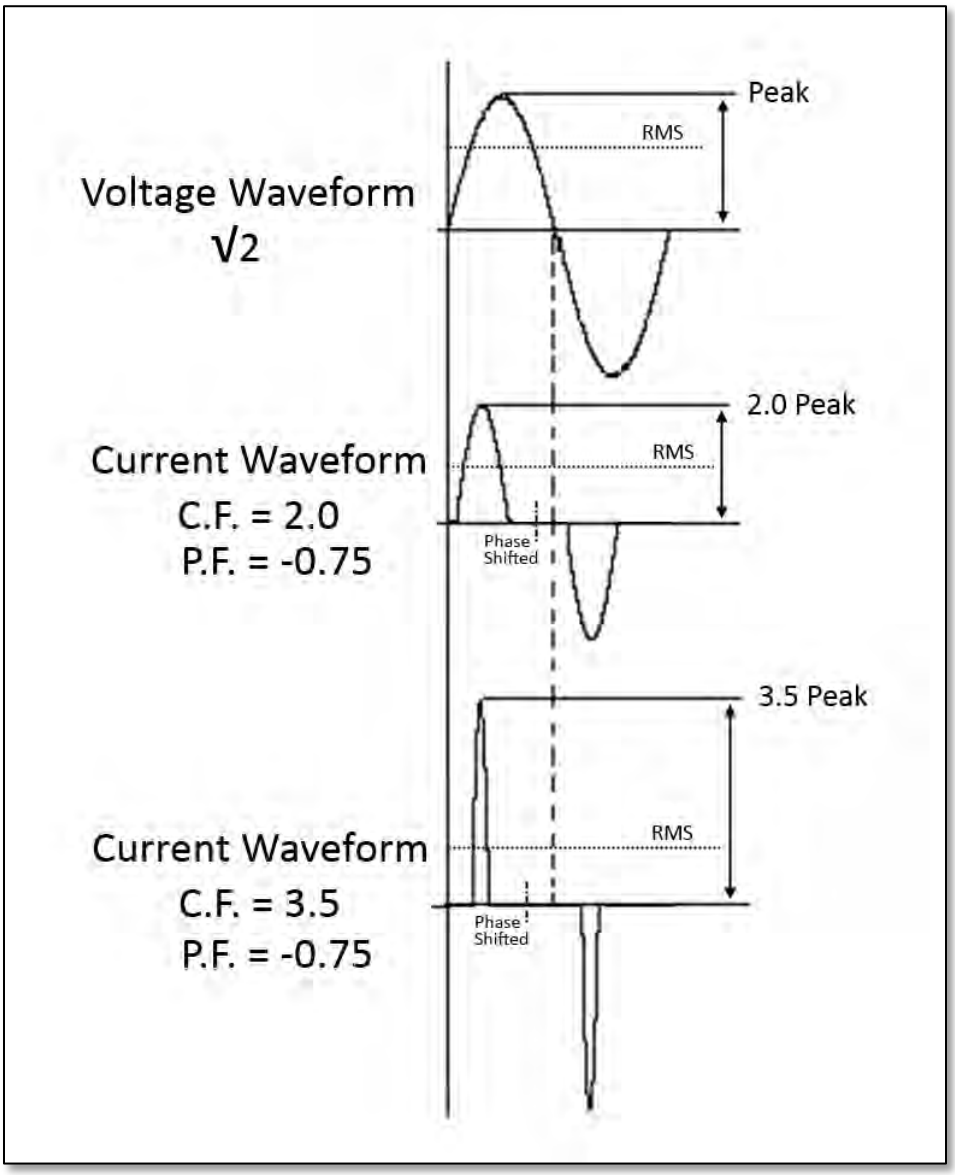


Figure 6-4: Waveforms in Banks 3 through 5

Banks 6, 7 & 8 Sinusoidal Waveforms with Positive Displacement Power Factor

Banks 6 through 8 contain waveforms at various crest factor values in the range of 2.0 to 3.5 with positive displacement power factor values from +0.85 to +0.30.

Total is 15 waveforms. Waveform definition is shown in below.

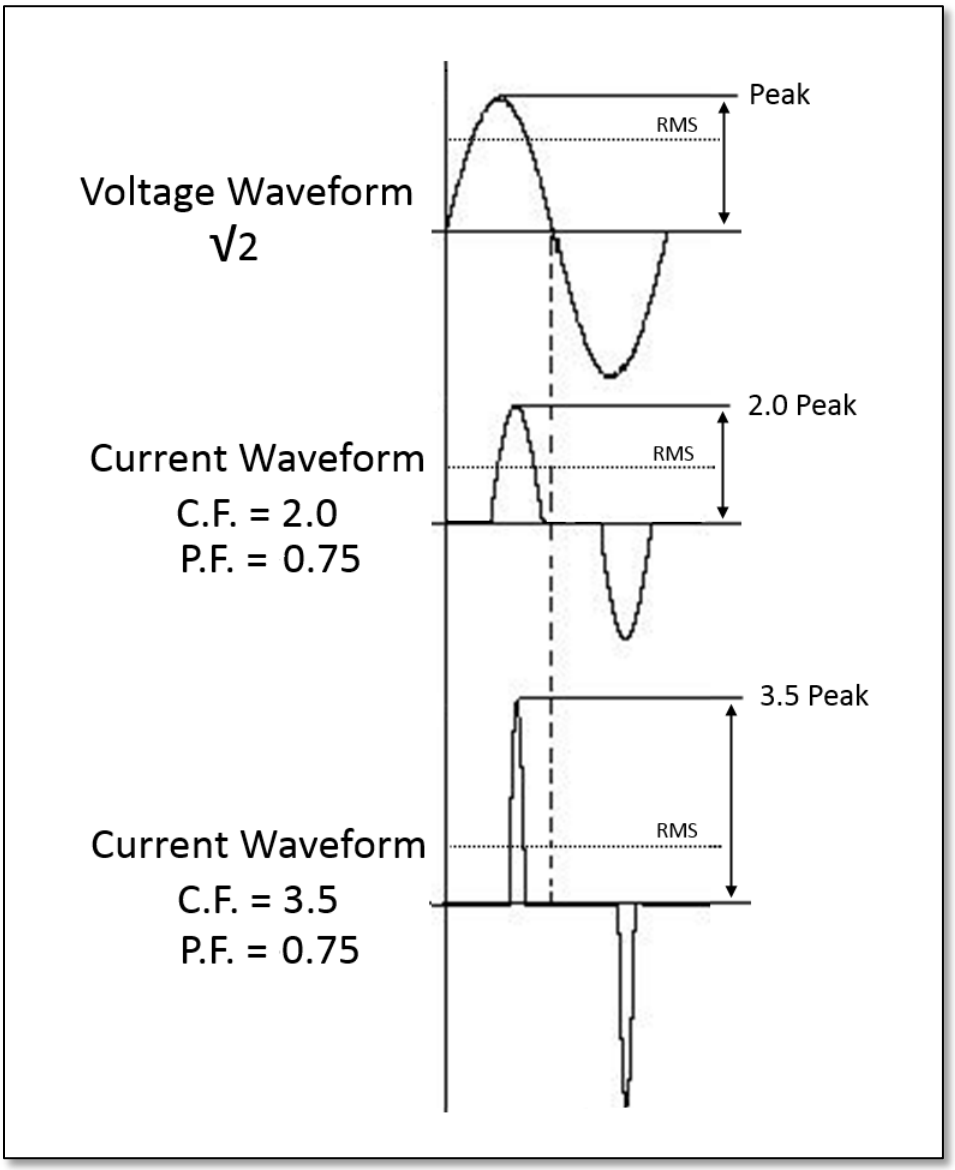


Figure 6-5: Waveforms in Banks 6 through 8

Bank 9 Square Waveforms

Bank 9 contains square waveforms at various crest factor values in the range of 1.0 to 1.4.

Total is 5 waveforms. Waveform definition is shown in below.

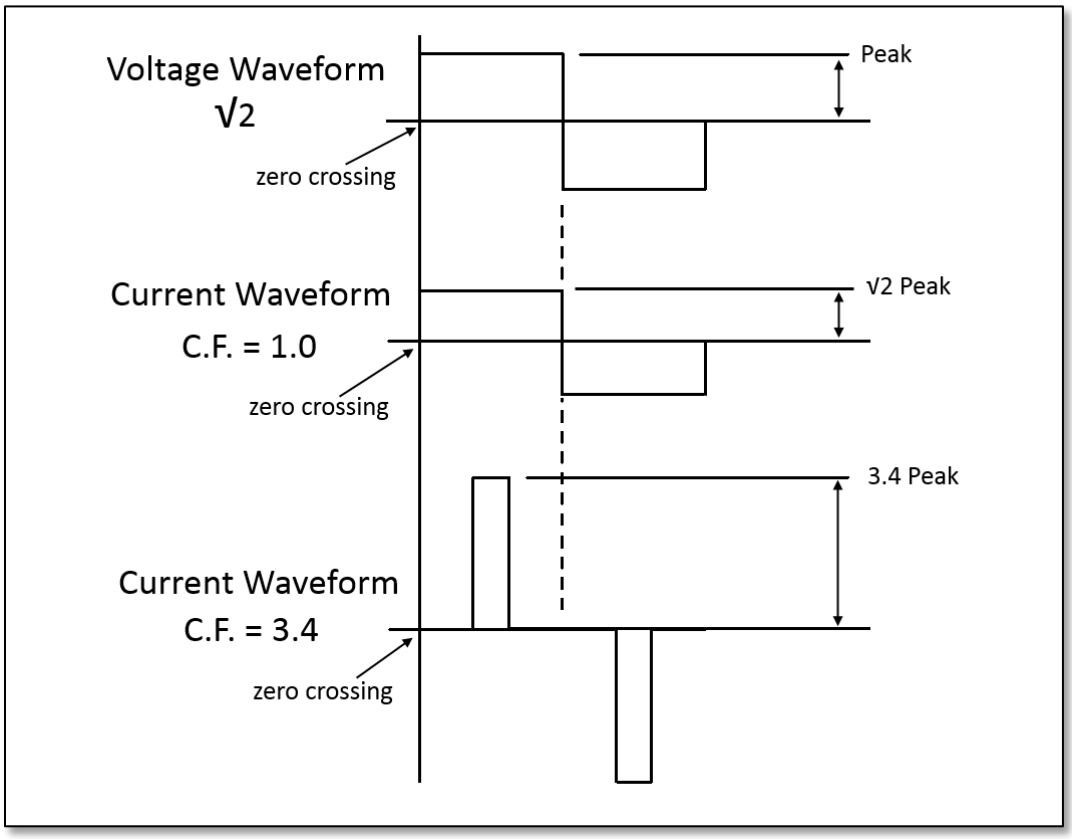


Figure 6-6: Square Waveforms Bank 9

Bank 10 DC Waveforms

Bank 10 contains DC waveforms at various crest factor values in the range of√2 to 3.5.

Total is 5 waveforms. Waveform definition is shown in below.

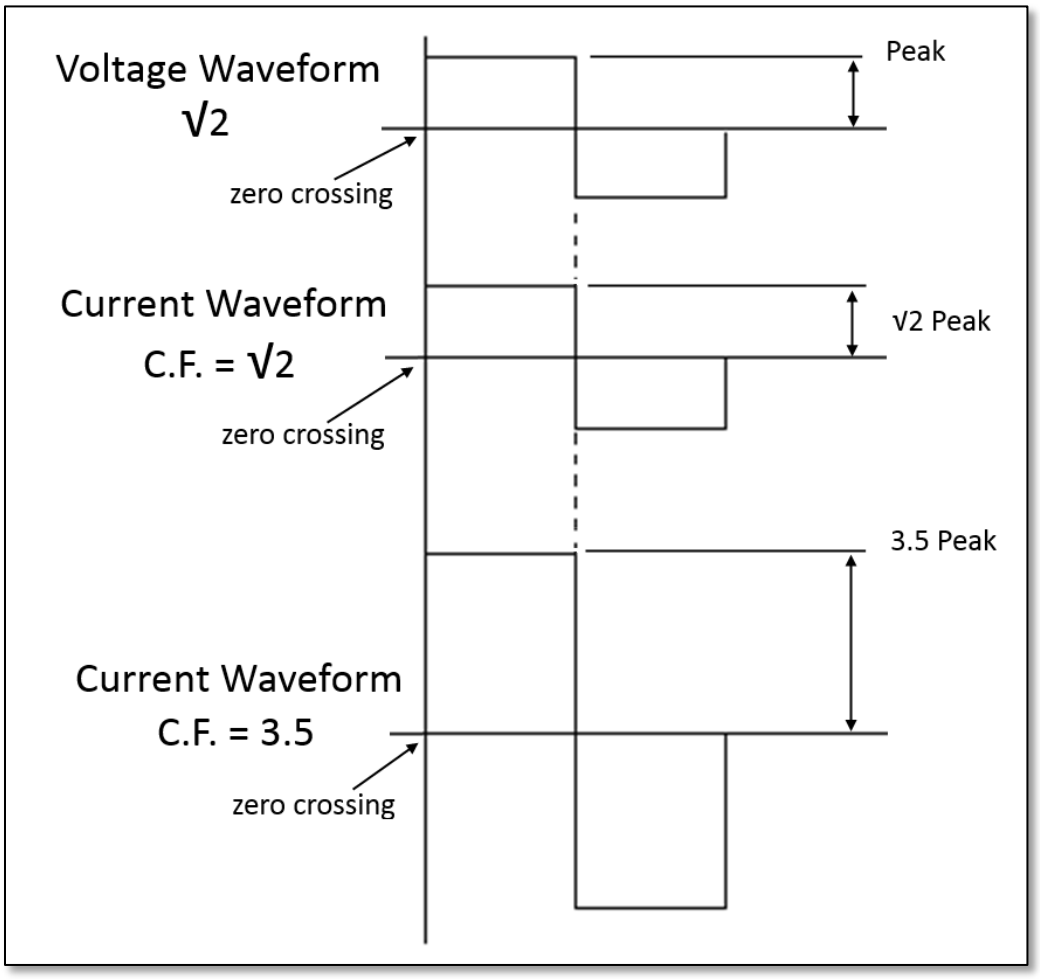


Figure 6-7: DC Waveforms Bank 10

6.2.3 Synchronization Source Setting

Synchronization of load current with AC input voltage is accomplished in one of two available SYNC modes:

- EXTERNAL SYNC
- INTERNAL SYNC

In **EXTERNAL SYNC** mode, the user must provide an input SYNC signal to the Analog Programming Input BNC terminal of the back panel of the 34M01 single slot mainframe or the DB9 connector on the 34M04 four slot mainframe.

The load will synchronize the current waveform to be in phase with the external SYNC signal.

Note: The external SYNC input signal must have a duty cycle of 50%.

In **INTERNAL SYNC** mode, the internal SYNC signal is taken from the sensed input voltage using the loads internal zero crossing detection and isolation circuits.

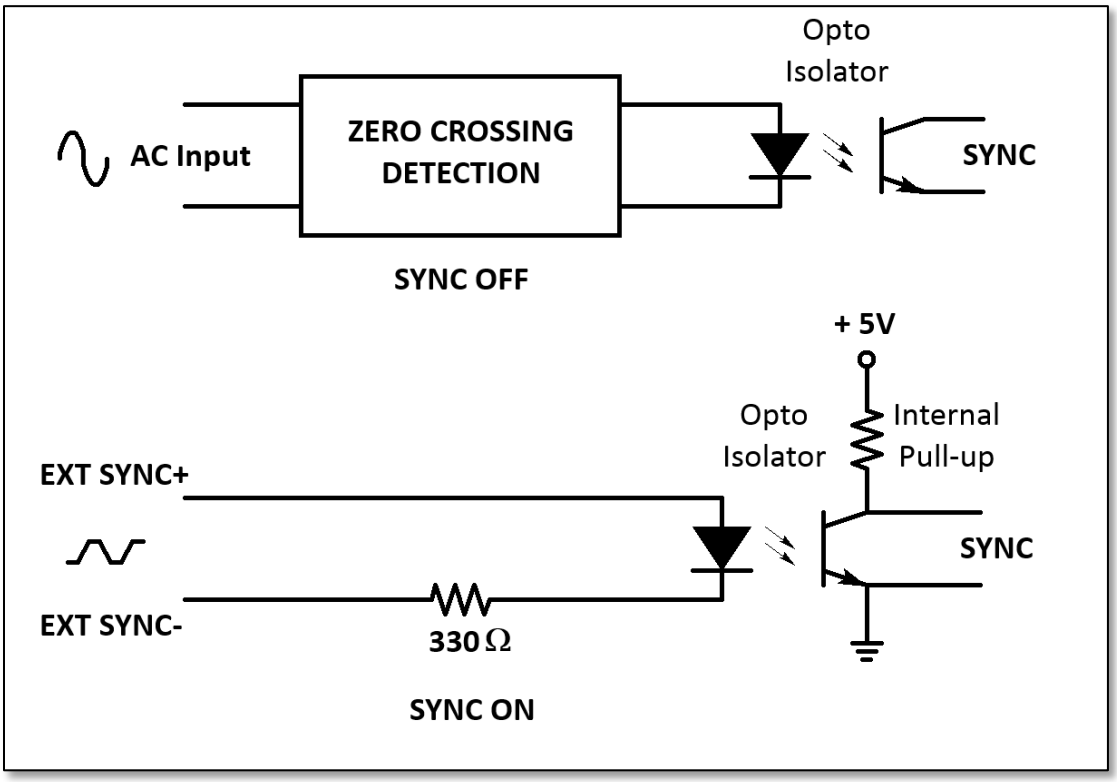


Table 6-6: Internal or External Sync Circuits

6.3 Initial Power-on Settings

When powering up the 3A Series electronic loads, the initial load settings after power ON are as shown in the tables below respectively by model number. These are the factory default settings.

6.3.1 Model 3A060-20 Power-on Settings

Setting	Initial Value	Setting	Initial Value
MODE	CC	C.F.	v2
LOAD	OFF	FREQ	FREQ = 60.0 Hz
LEVEL	A		BANK = 0
SENSE	OFF		SYNC = OFF
PRES	OFF	CC LEVEL A	0.000 A
WATT	OFF	CC LEVEL B	0.000 A
LIMIT	VLIMIT = 80.00V	LIN LEVEL A	0.000 A
	ALIMIT = 25.00A	LIN LEVEL B	0.000 A
	WLIMIT = 400.0W	CR LEVEL A	4800 Ω
	VALIMIT = 400.0W	CR LEVEL B	4800 Ω

Table 6-7: Model 3A060-20 Power-on Settings

6.3.2 Model 3A150-08 Initial Settings

Setting	Initial Value	Setting	Initial Value
MODE	CC	C.F.	v2
LOAD	OFF	FREQ	FREQ = 60.0 Hz
LEVEL	A		BANK = 0
SENSE	OFF		SYNC = OFF
PRES	OFF	CC LEVEL A	0.000 A
WATT	OFF	CC LEVEL B	0.000 A
LIMIT	VLIMIT = 200.00V	LIN LEVEL A	0.000 A
	ALIMIT = 10.00A	LIN LEVEL B	0.000 A
	WLIMIT = 400.0W	CR LEVEL A	30 kΩ
	VALIMIT = 400.0W	CR LEVEL B	30 kΩ

Table 6-8: Model 3A150-08 Power-on Settings

6.3.3 Model 3A300-04 Initial Settings

Setting	Initial Value	Setting	Initial Value
MODE	CC	C.F.	v2
LOAD	OFF	FREQ	FREQ = 60.0 Hz
LEVEL	A		BANK = 0
SENSE	OFF		SYNC = OFF
PRES	OFF	CC LEVEL A	0.000 A
WATT	OFF	CC LEVEL B	0.000 A
LIMIT	VLIMIT = 400.00V	LIN LEVEL A	0.000 A
	ALIMIT = 5.00A	LIN LEVEL B	0.000 A
	WLIMIT = 400.0W	CR LEVEL A	120 kΩ
	VALIMIT = 400.0W	CR LEVEL B	120 kΩ

Table 6-9: Model 3A300-04 Power-on Settings

6.3.4 Last Setting Recall

All 3A Series load modules provide a 'last setup recall' feature. Using this feature, any 3A load module can be set to return to the last setup state in effect at power off. This occurs the next time the load is turned back on and immediately following its power-on self-test. So rather than returning to the factory default setting shown in the tables above, it will return to the last state in which it was used.

6.3.5 Setup Memory Reset

If for any reason the non-volatile setup memory has been corrupted, it can be cleared and returned to factory defaults **(RESET)** using by pressing the "SENSE" and "PRES" keys on the front panel of the load module simultaneously.

During this RESET procedure, the display will show the load model number and firmware revision repeatedly and reset all settings to the factory defaults shown in the tables above until the keys are released.

6.4 Protection Features

The 3A Series electronic loads include the following protection features:

- Over Voltage
- Over Current
- Over Power
- Over Temperature

If any of these conditions occur, the load will turn off to protect it from any damage resulting from abnormal use. The protection status is indicated by a flashing display to notify the operator of a protection fault.

Actual trip limits for the various protection modes by model can be found in Section 4.3, “Protection Modes” of this manual.

6.4.1 Over Voltage Protection

The over voltage protection circuit is set at a predetermined voltage, which **cannot** be changed. If the over voltage circuit has tripped, the load input turns OFF immediately to prevent damaging the load. When an over voltage trip condition has occurred, the upper display will indicate "oVP" and flash on and off. Once the over voltage condition disappears, the upper display monitor will revert to normal operation.

6.4.2 Over Current Protection

The load always monitors the current it is sinking. When the current sink is greater than 105% of the rated maximum current, the load module will turn load to OFF state internally. When an over current condition has occurred, the upper display will indicate "oCP" and flash on and off. Once the over current condition disappears, the upper display monitor will revert to normal operation.

6.4.3 Over Power Protection

The load always monitors the power dissipated by the load. When the power dissipation is greater than 105% of the rated power input, the load module will turn load to OFF state internally. When an over power condition has occurred, the lower display will indicate "oPP" and flash on and off. Once the over power condition disappears, the lower display monitor will revert to normal operation.

6.4.4 Over Temperature Protection

As soon as the temperature of load’s internal heat sinks reaches a level greater than 85° C (180° F), the over temperature protection is triggered. The lower display will indicate "oTP" and flash on and off. Once the over temperature condition disappears, the lower display monitor will revert to normal operation.

Please check environmental conditions such as the ambient temperature and distance between the rear panel of the load chassis and any wall is greater than 15cm / 6 inches.

6.5 Load ON Voltage Adjustment

The factory default "Load ON" voltage is 2.0 volt. This means the 3A Series load modules start to sink current from the connected EUT power supply until the input voltage exceeds the “Load ON” voltage threshold.

The "Load ON " voltage threshold can be adjusted between 2.0V and 20.0V. This threshold is set by a trim potentiometer (VR4) on the PCB of the load module.

The procedure to change the “Load ON” voltage setting should be undertaking only by qualified personnel. If you are not experienced working with electronic assemblies, please seek assistance from someone who is.

To adjust the “Load ON” setting, proceed as follows:

1. Turn the load mainframe chassis off at the front panel Power On/Off switch.
2. Remove the set screw for the relevant load module and carefully remove the module from the chassis.
3. Place the module on an ESD safe surface area and remove the right hand side aluminum cover by loosening its screw on the rear panel of the module.
4. The “Load ON” voltage setting trimmer is located on the first PCB (P/N: 6523261A01) once you remove the Aluminum cover plate of 3A Series load module.
5. Place the load module be adjusted into the most right hand side of 34M04 mainframe, (the load ON voltage setting trimmer VR4 can be adjusted here while power to the 34M04 mainframe is turned ON.) You may have to remove any other module from the mainframe to do so.
6. Turn the 34M04 chassis back on.
7. Use a trim-pot driver to set VR4 to the most counter clockwise position. (Maximum load ON voltage).
8. Connect an AC power source (50Hz or 60Hz) to the AC Load input of the load module.
9. Adjust the AC output voltage from the AC source to the required Load ON voltage. The voltage of AC power source should be less than the maximum rating of the “Load ON” voltage.
10. Set the Load ON/OFF key to ON state. The "load" LED annunciator should be lit on the front panel.
11. Set the load current to 1.0 Amp by using the PRES key. Press the PRES key again to turn the Preset mode OFF after the load current is set.
12. Make sure FREQ is set to50Hz or 60Hz to match the AC source setting.
13. Adjust the load ON voltage setting trimmer VR4 clockwise very slowly and stop immediately once the load starts to sink current from the AC power source. The LOAD ON voltage setting is finished in this procedure.
14. Using the reverse procedure to re-install the 3A series load module.

7 Connectors

This section describes the various connectors available on the 3A Series AC & DC load modules.

7.1 INPUT Terminals

Note: Always refer to Section 2.3 “Safety Information” and Section 2.4 “Safety Notices” before making any load connections.

The positive (high) and negative (low) terminals for load input connections are located on the front panel of each plug-in module. The Input terminal type connectors used on the 3A Series loads offer several convenient alternatives to making load connections. Specifically, the following five methods may be used:

7.1.1 Banana Jack Connectors

This is the most common way for connecting the equipment to be measured with 3A Series load. It is recommended that this connector be used when the load current is less than 20A as the maximum rated current of the plug connector is 20A. Please avoid exceeding maximum rated current to prevent damage caused by overheating. The maximum supported wire gauge for this connection method is AWG #14.

7.1.2 Y-hook / Spade Lug Terminals

Included in the 3A Series load ship kit is a set of two (2) spade lug-type terminals. These can be used to crimp on to stripped wire ends of an EUT. Hook-type terminals provide good contacting characteristics. It is recommended that the hook-type terminal be used for any occasion where practical. The maximum supported wire gauge of the connection wires for this connection method is AWG #10.

7.1.3 Lead Wire Insertion

This is the simplest way to insert stripped ends of connecting wires into the holes on the metal portion of the input connector jacks. The maximum supported gauge of the connecting wire for this connection method is AWG #14.

7.1.4 Banana Jack Connector and Spade Lug Terminals

This combination method provides a higher current rating and lower impedance of the load connection. When input load currents are higher than 20A or the connecting lead wire is long, this method will be optimal.

7.1.5 Plug Connector and Lead Wire Insertion

This method can also be used when the input current is higher than 20A or the connecting lead wire is longer.

7.2 Wire Size

A major consideration in making input connection is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires are sized large enough to limit the voltage drop at the maximum current rating of the AC & DC load to less than 0.5V per connection lead.

If needed, wire size can be increased by doubling the number of wires using two space lugs per side as shown in Figure 7-1.

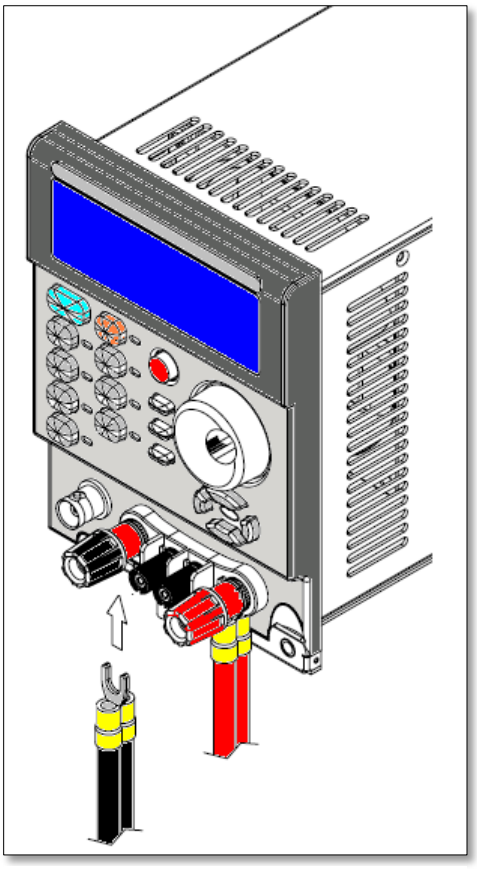


Figure 7-1: Doubling wire size using spade lugs

7.3 Connecting a UUT

WARNING

DO NOT EXCEED LOAD INPUT VOLTAGE RATING

This instrument does NOT have a means to disconnect its Load input from a connected power supply. If the voltage applied to the Load input exceeds its maximum rating – even if the load is turned completely off – damage to the load WILL occur. Damage caused by exceeded maximum load input voltage under any circumstance is NOT covered by the manufacturer's product warranty. Remove any load input connections when the load is not in use, even when it is turned off.

When setting up for a new test and connecting any equipment to the AC & DC load, proceed as follows:

1. Always make sure the AC & DC load is turned OFF at the POWER switch when making any wire connections.
2. Check that the output of the equipment under test is **OFF**.
   Note: Some power equipment's output may still be energized even if the equipment has been turned off or its output is turned off. This is especially true for DC power supplies.

   Note: When working with batteries, it is recommended to provide a suitable disconnect relay or switch so the load connection can be disconnected from the battery for handling purposes.
3. Connect one end of the load wires to the load input terminals on the front panel.
4. Check the polarity of the connections and connect the other end of the load wires to the output terminal of the equipment under test.
5. When connecting multiple loads to the same EUT, makes sure the load wire lengths to each load are the same.

7.4 Voltage Sense Input Terminals

To measure the UUT output voltage at the EUT terminals rather than the load input terminals, the external voltage sense mode must be used. The external voltage sense wire harness is provided for this purpose. It connects to the Voltage sense connector on the front panel of the load module.

For small loads that deliver only low levels of current, INTERNAL sense can be used. For larger loads that draw a considerable amount of current, EXTERNAL sense mode will compensate for voltage drop along the load connection wires. Refer to Figure 7-1 below.

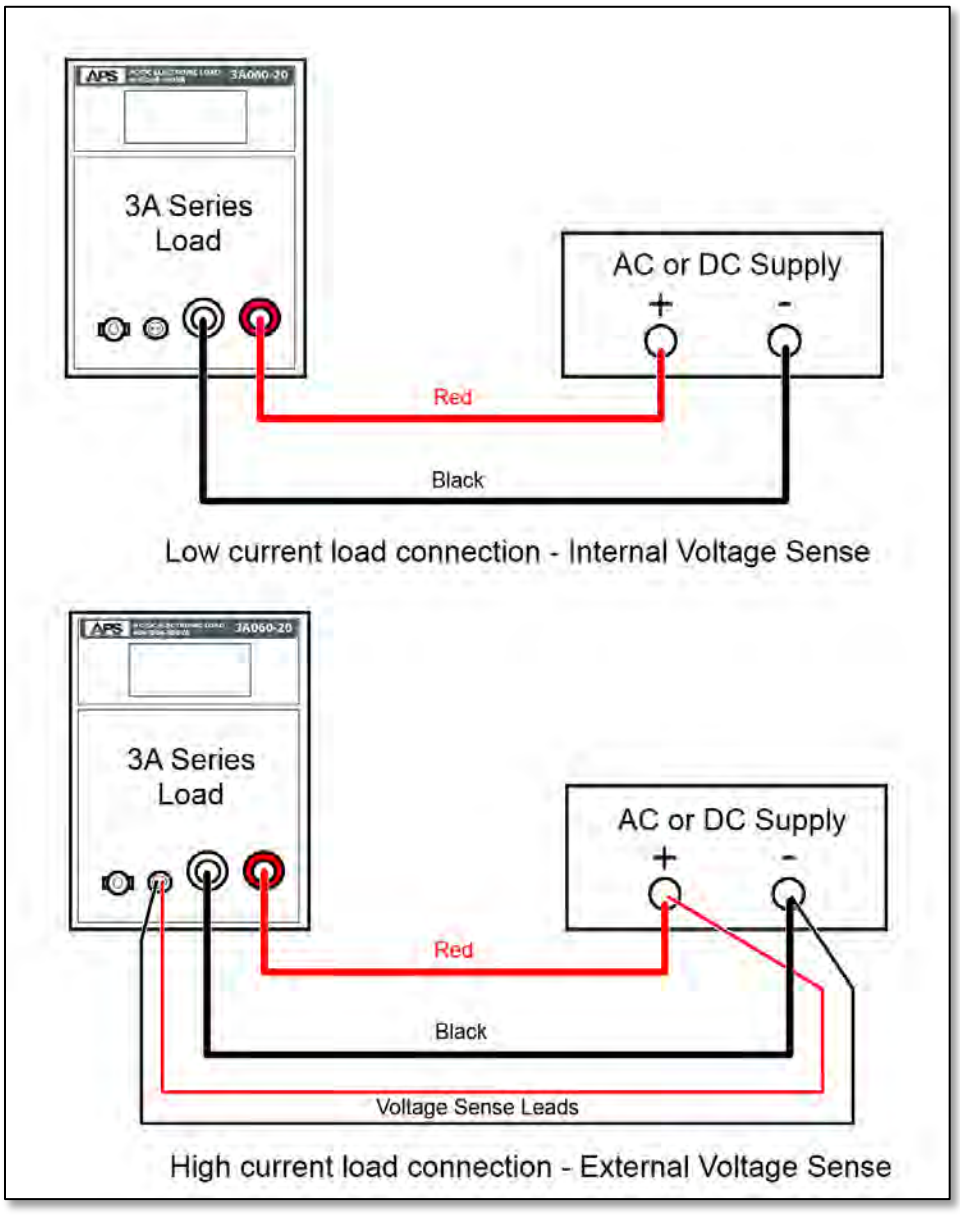


Figure 7-2: Internal and External Voltage Sense Connections

7.5 Current Output Monitor (I-Monitor)

The I-Monitor terminal is designed to monitor the electronic load module's sink current. An isolated amplifier output with 0V to 4V full scale output signal represents the zero to full scale current the electronic load is sinking. Regardless of Preset ON or OFF state, the analog signal output from the I-monitor is in direct proportion to the load current flowing through the load. Please refer to the I-Monitor voltage /current scaling values for each 3A Series load modules in Section 4, “Technical Specifications”.

7.5.1 Isolated Output

The I-monitor BNC output signal on 3A Series loads is through an isolation amplifier, e.g., the earth potential of the output analog signal and the earth potential of the load input are electrically isolated from each other. In this way, when a connection is made to an oscilloscope on which another input channel is connected to both the high and low side of the load to monitor voltage, no metering error results from any current flowing between the negative end of the I-monitor BNC output and the negative end of the oscilloscope due to any voltage differential.

Alternatively, two I-monitor outputs can be connected to two channels of the same oscilloscope to observe two load current waveforms at the same time (Ch1 and Ch2).

8 Remote Control Programming

8.1 Overview

For remote control programming information, refer to the 34M04 4-slot Mainframe Operation Manual (P/N 160924) or the 34M01 single-slot Mainframe Operation Manual (P/N 160921).

9 Multiple Load Operation Modes

9.1 Overview

When the maximum power level of a single 3A Series electronic load module is insufficient to handle an application or a multi-phase AC load is required, the user can combine two or more load modules in either parallel or multi-phase mode of operation.

9.1.1 Parallel Mode

In parallel mode, the total current is shared by the number of load modules used. This type of connection will expand the power and current of the electronic load.

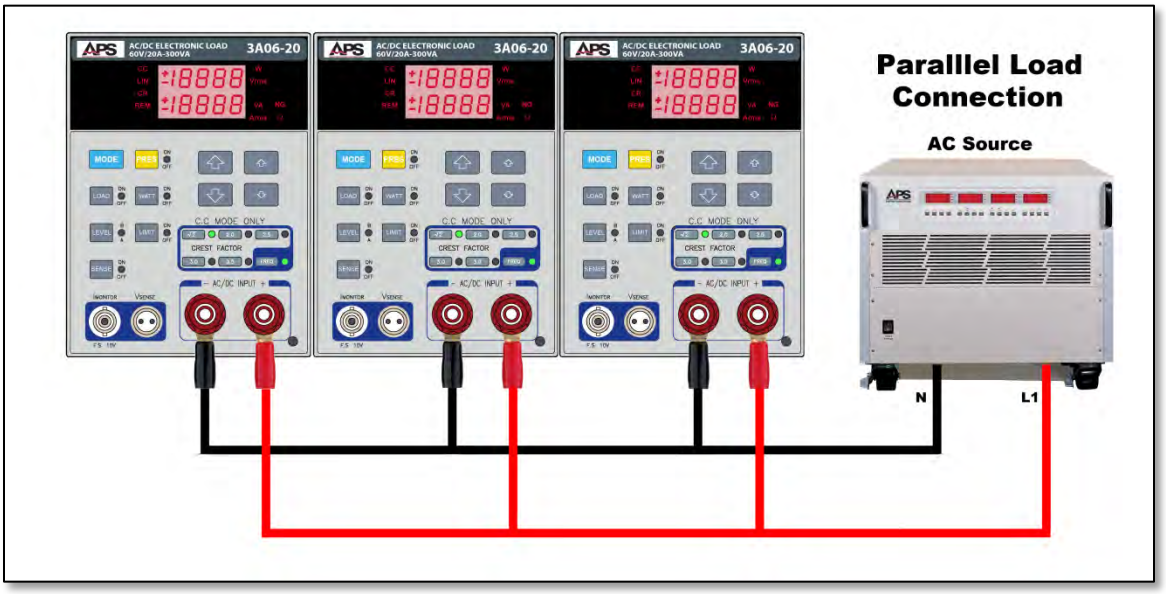


Figure 9-1: Parallel Load Connection

9.1.2 Multi-Phase Mode

Multi-phase AC test applications can be quite common at higher power levels or even at low power levels for avionics and shipboard AC power supplies. This requires one AC load per phase. Since each load synchronizes its current to the phase voltage it detects at its input,

Note: External Sync mode is not recommended for multi-phase applications unless individual sync signals can be provided for each phase voltage. Do not use a single external sync signal to drive all loads in a multi-phase application.

There are two possible configurations for 3 phase loads:

Wye Connection: Also known as star connection or four wire plus ground. This requires a Common or Neutral connection on the AC power source.

Delta Connection: AC loads are connected between line-to-line voltages.

Note: Delta connections typically operate at higher voltages than Wye connections as they put the Line-to-Line voltage across the AC load input. Pay attention to the maximum voltage rating of the AC load when using them in this application.

Note: Each phase must be programmed separately as there is no 'three-phase' control mode that will program all loads to the same setting. Alternatively, the remote interface can be used to do so under program control.

Wiring diagrams for both configurations are shown in the illustrations below.

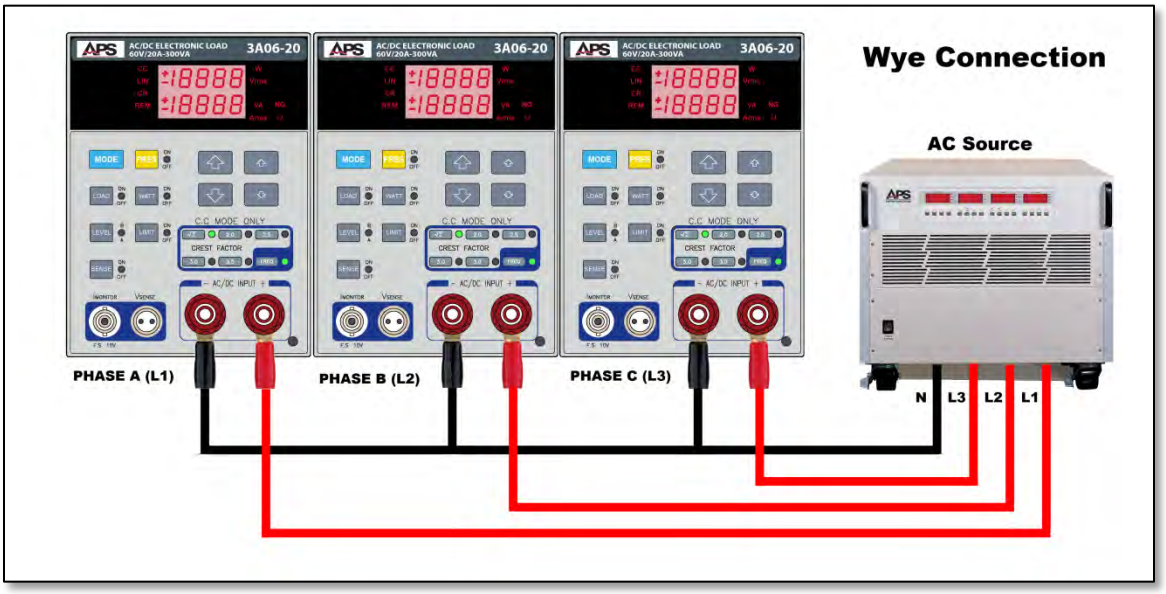


Figure 9-2: Three Phase Wye Connection

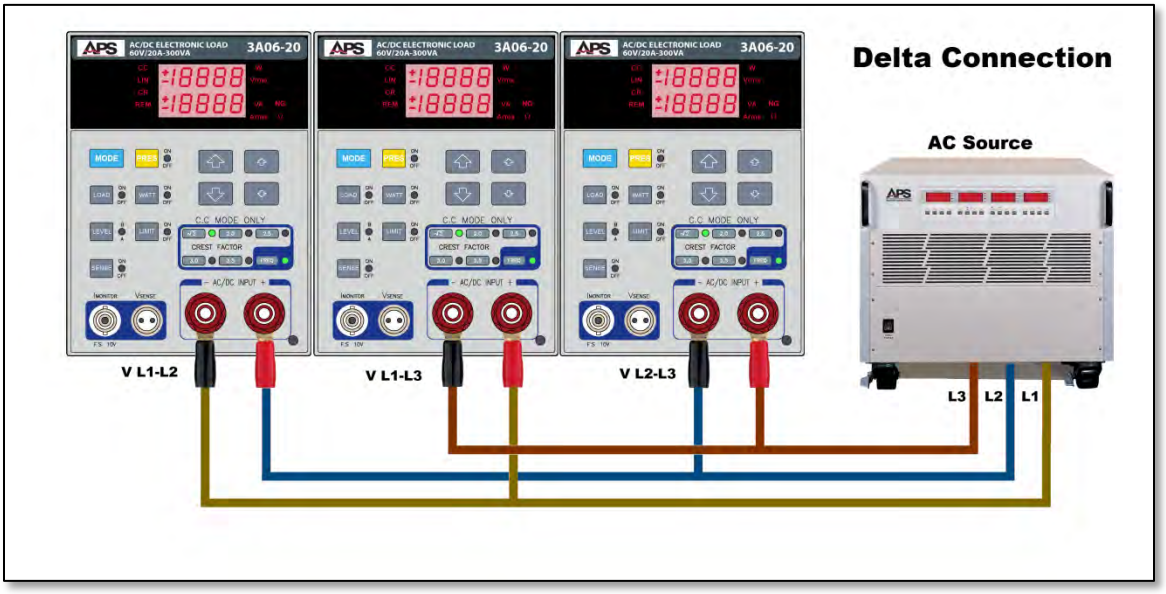


Figure 9-3: Three Phase Delta Connection

10 Calibration

10.1 Overview

All APS products ship with factory calibration. No additional calibration is required when first received.

10.2 Calibration Interval

The recommended calibration interval for these loads is one year (12 months). Routine annual calibration can be performed by most calibration labs that have Low Frequency measurement and power calibration capabilities. Alternative, the load can be returned to the manufacturer to obtain a factory calibration.

10.3 Calibration Coefficients

All calibration is performed through software. No manual internal adjustments have to be made as part of routine calibration.

Calibration coefficients for the following parameters and functions are stored in non-volatile memory:

Parameters	Coefficients Stored
Load Current	All modes, AC & DC, Offset and Gain, High Range & Low Range
Resistance	All modes, AC & DC, Offset and Gain, High Range & Low Range
Voltage Measurement	AC&DC, Offset and Gain
Current Measurement	AC&DC, Offset and Gain
Power Measurement	AC&DC, Offset and Gain

10.4 Calibration Procedures

Certified calibration labs may request a copy of the calibration manual for the relevant load model by contacting the nearest Adaptive Power Systems company location. Refer to Section 1, “Contact Information”.

11 CE MARK Declaration of Conformity

Directive: **2004/108/EC**

Product Name 3A Series AC & DC Electronic Load Modules

Serial Number _____

The manufacturer hereby declares that the products are in conformity with the following standards or other normative documents:

SAFETY:

Standard applied IEC 61010-1:2001

EMC:

Standard applied EN 61326-1:2006

Reference Basic Standards:

EMISSIONS:

CISPR11: 2003+A1: 2004+A2: 2006
EN 61000-3-2: 2006
EN 61000-3-3: 2008

IMMUNITY:

IEC 61000-4-2: 2008
IEC 61000-4-3: 2008
IEC 61000-4-4: 2004 +Corr.1: 2006 +Corr.2: 2007
IEC 61000-4-5: 2005
IEC 61000-4-6: 2003+A1: 2004+A2: 2006
IEC 61000-4-8: 2001
IEC 61000-4-11: 2004

Supplemental Information:

When and Where Issued: March 28, 2014
Irvine, California, USA

Authorized Signatory Loc Tran
Quality Assurance Inspector
Adaptive Power Systems

Responsible Person Joe Abranko
Adaptive Power Systems
17711 Fitch
Irvine, California, 92649, USA

CE **Mark of Compliance**

12 RoHS Material Content Declaration

The table below shows where these substances may be found in the supply chain of APS's products, as of the date of sale of the relevant product. Note that some of the component types listed above may or may not be a part of the enclosed product.

Part Name	Hazardous Substance					
	Pb	*Hg*	*Cd*	*Cr6+*	*PBB*	*PBDE*
PCB Assy's	x	0	x	0	0	0
Electrical Parts not on PCB Assy's	x	0	x	0	0	0
Metal Parts	0	0	0	x	0	0
Plastic Parts	0	0	0	0	x	x
Wiring	x	0	0	0	0	0
Packaging	x	0	0	0	0	0

Legend:

0: Indicates that the concentration of the hazardous substance in all homogeneous materials in the parts is below the relevant RoHS threshold.

x: Indicates that the concentration of the hazardous substance of at least one of all homogeneous materials in the parts is above the relevant RoHS threshold.

Notes:

1. APS has not fully transitioned to lead-free solder assembly at this point in time. However, the vast majority of components used in production are RoHS compliant.
2. These APS products are labeled with an environmental-friendly usage period in years. The marked period is assumed under the operating environment specified in the product specifications.

Example of marking for a 10 year period.

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ADAPTIVE Power Systems

Worldwide Supplier of Power Equipment