Operation Manual

APF Series – Rev 1.1 P/N 160956-10

APF Series Programmable AC Power Sources





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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 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



Danger 🥂

- Dangerous high voltages exist inside this machine. Do not open any covers of this machine unless authorized and done by trained technicians. Otherwise, electrical shock to persons may happen.
- In case the machine needs to be moved or re-wired, all electricity to the machine must be disconnected and removed. After electricity is removed, please wait for at least 20 minutes before touching any live parts of this machine or electrical shock may occur: the electrical charges on the bulky capacitors inside the machine need some time to be fully discharged.
- For optimal safety protection to the users, this machine must have solid connections to the earth. Do not use this machine if it is not grounded.
- In case of fire, use an extinguisher with powder chemicals instead of liquid agents. Electrical shock may occur if liquid extinguishing products are used.
- Any foreign objects and/or liquid are strictly prohibited from entering to the inside of this machine.



- Storage and operating environment have a certain degree of influence on the life and reliability of this product. Therefore, avoid placing and/or operating this machine in environments with the following:
 - (a) Having extreme ambient temperature or humidity that exceeds the allowable limit stated in the specification, temperature: 0° C-45 $^{\circ}$ C, humidity: 0-90%.
 - (b) Having direct sunlight exposure, or being near a heat source.
 - (c) Places that tend to be vibrated or hit by other objects.
 - (d) Having heavy dust, heavy salt, corrosive chemicals or inflammable chemicals in the air.
- Please keep air ventilation inlets and outlets clear and clean. Obstruction on the inlet or outlet will have a significant negative impact on the machine's quality and reliability.
- If the machine is not used for a long time, please store it in a dry and clean environment with a temperature in the range of -40°C to +70°C.
- This machine is composed of many delicate and precision devices. Please do not open any covers of this machine unless authorized and done by trained technicians. Warranty is voided if the quality seal is broken.

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.

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1) **BEFORE APPLYING POWER**

Verify that the equipment is set to match with the power line input.

2) **PROTECTIVE GROUNDING**

Make sure to connect the equipment to the protective ground to prevent an electric shock before turning on the power.

3) NECESSITY OF PROTECTIVE GROUNDING

Never cut off the internal or external protective grounding wire, or disconnect the wiring of protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.

4) DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

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

5) DO NOT REMOVE THE COVER OF THE EQUIPMENT

Hazardous voltages may be present when the covers are removed. Component replacement and internal adjustment can be done only by qualified service personnel.



LETHAL VOLTAGES. Depending on configuration, this equipment can supply 310Vac L-N or 400Vac L-N or 600V L-N at its output. DEATH on contact may result if either the output terminals or the circuits connected to the output are touched when the power is applied.



3 Product Overview

This chapter provides an overview of the APS APF Series programmable, AC power sources. It introduces the reader to general operating characteristics of these power sources. Operational information and menu navigation details are provided in Section 6, "Front Panel Operation".

3.1 General Description

The APF series is a high power programmable AC power source utilizing advanced PWM technology to deliver power with THD ≤0.5% and up to 100kVA. Available output frequency range configurations options are 45~500Hz (type A), 45-120Hz (type B) with accuracy of ± 0.02%, or 300-840Hz (type C) expanded frequency. The APF series is ideal to simulate different region's power grid voltage and frequency conditions, and can cover a wide range of applications such as renewable energy, EV charger, motor, medical equipment, and EMC laboratory.

The APF series features STEP and RAMP programmable functions to easily simulate single or continuous output changes. Three phase independent adjustment, optional remote sensing and optional phase angle adjustment all provide convenient control to simulate different types of line disturbance. These features are ideal for test applications in R&D design verification, quality assurance and production test. For remote control, the APF series has a standard RS-232/RS-422/RS-485/Ethernet interface combination card and optional USB, GPIB and Analog interfaces for easy setup and programming.

The standard dual AC Voltage ranges (High and Low) support maximum RMS current for loads with power factors of 0.775 or less. For loads with power factors greater than 0.775 through 1.0, maximum available RMS current derated from 120Vac/240Vac to max. voltage on each voltage range as shown in the figure below.







3.2 Key Product Features

1 User Control

- a) Local front panel operation using large color touch screen on front panel
- b) Remote control using RS485, RS422, RS232 serial, Ethernet LAN or optional USB, GPIB or analog I/O controls.
- c) Protection against Over Voltage (OVP), Over Current (OCP), Over Power (OPP), Over Temperature (OTP) and AC input voltage low line (Vin LVP).

2. Input / Output Voltage and Frequency

- a) Selective output voltage range with HIGH range 0-310V or LOW range 0-155V.
- b) Input voltage is 380V±15% and customized input voltage is available.
- c) Output voltage 0-310VAC (L-N)
- d) Output Frequency Models:

A version: 45-500Hz, B version: 45-120Hz, C version: 300-840Hz.

- e) Precise Meter Measurement
- f) Single phase output: V/F/I/VA/W/PF
- g) Three phase output: V(L-N) /I(L-N)/P(L-N)/VA/W/PF/Σ of three phases (for threephase balanced only)
- h) Output frequency B version 45-120Hz characteristic chart



Figure 3-2: Output Voltage Current Charts -B Version 45-120 Hz





i) Output frequency A version 45-120Hz characteristic chart

Figure 3-3: Output Load Rating vs Frequency Curve -A Version 45-500 Hz

Note: The short term operation time versus frequency setting under 100% rated load is shown in the Figure below. When choosing version A series output frequency 45-500 Hz, the output power will be influenced per the information here (Figures Figure 3-3 and Figure 3-4). It is suggested the user selects the optimal model to meet their needs or a higher output power model to circumvent this limitation.



Figure 3-4: Short Term Operation Output Time vs Frequency Setting





j) Output frequency A version 45-120Hz characteristic chart

Figure 3-5: Output Load vs Frequency Curve C Version

3.3 Available Models

The table below lists the available APF Series Models, Output Phase Modes, Power Levels and 3 Phase AC input power options.

Model	Rated Power (KVA)	Frequency Range options	Output	Input Voltage Specified at time of order
APF1010	10		Single Phase Output	-208 / -480 Va 3ø
APF1020	20		Single Phase Output	-208 / -480 Va 3ø
APF1045	45		Single Phase Output	-480 Va 3ø
APF3015	15		Three Phase Output	-208 / -480 Va 3ø
APF3030	30	A:45-500 Hz	Three Phase Output	-480 Va 3ø
APF3045	45	C: 300-840 Hz	Three Phase Output	-480 Va 3ø
APF3060	60		Three Phase Output	-480 Va 3ø
APF3075	75		Three Phase Output	-480 Va 3ø
APF3100	100		Three Phase Output	-480 Va 3ø
APF3150	150		Three Phase Output	-480 Va 3ø



3.4 Available Options

There are several optional features that can be fitted on the APF Series models. These options are **not retrofittable** however so **must** be specified at the time or order

Options:					
Α	Type A: Output Frequency 45-500Hz*3. Changes "B" postfix to A				
В	Type B: Output Frequency 45-120Hz*3. No Charge.				
С	Type C : Output Frequency 300-840Hz*1*3 Changes "B" postfix to C				
-200	Input Voltage 200V*3				
-208	Input Voltage 208V*3				
-240	Input Voltage 240V*3				
-400	Input Voltage 400V				
-480	Input Voltage 480V				
PS	Programmable Start Angle 0-359°*3				
OL	Overload Capability 200% 2 sec, 150% 5 sec, 125% 15 sec*3				
FV	Fast Voltage Response Option (with Time Setting Resolution 0.01S)*2				
10	Analog Control Interface				
G	GPIB Interface				
Р3	Three Phase Angle Adjustment (3 Phase Models only)				
V400	Output Voltage 0-400V (L-N)				
V600	Output Voltage 0-600V (L-N)				
U	Interface Card (Ethernet/RS-232&RS-485/USB) Replaces standard Ethernet / RS232 / RS485				

The list of available options is shown below.



4 **Technical Specifications**

Technical specifications shown here apply at an ambient temperature of 25° C ± 5°.

4.1 Single Phase Output Models – 10kVA to 45kVA

Model	:	APF1010	APF1020	APF1045	
AC Output					
Power (kVA / kW)		10	20	45	
Phase Mode		Single Phase, 2 Wire + Ground			
Voltage Range	Low		0 ~ 155 V L-N		
	High		0 ~ 310 V L-N		
Resolution			0.1 V		
Accuracy		0.5% F.S. + 4 Counts			
Frequency Range ¹		A version: 45~500H	Hz, B version: 45~120Hz, (C version: 300~840Hz	
Resolution			0.1 Hz		
Accuracy			± 0.02% F.S.		
Current RMS max.	Low Vrange	83.3 A	166.7 A	375.0 A	
	High Vrange	41.7 A	83.3 A	187.5 A	
Line Regulation			< 0.5 %		
Load Regulation			≤ 0.5% (Resistive Load)		
Voltage Distortion	THD ²		≤ 0.5% (Resistive Load)		
Response Time	V change		≤ 1 msec		
Crest Factor	Current	≥ 3:1			
Measurements	·				
		Range	Resolution:	Accuracy:	
Voltage	Vrms	0~310V	0.1 V	0.5% F.S. + 4 counts	
Frequency	Hz	45.0 ~ 840 Hz	0.01 Hz	±0.02% F.S.	
Current	Arms	See Current Spec.	0.1 A	0.5% F.S. + 4 counts	
Power	KWatt	See kVA Spec.	0.1 kW	1.0% F.S + 6 counts	
AC Input Mains					
Frequency Line		47 Hz ~ 63 Hz			
Phase Mode		3 Phase / 3 Wire + Ground			
Input Voltage ³	-208		208Vac ± 10%		
Line Current	Max ⁴	40	80	181	
Input Voltage ³	-480		480Vac ± 10%		
Line Current	Max ⁴	17	35	78	
Input Power Factor			≥ 0.9 @ Max. Power		
General Specification	ons				
Efficiency		> 90% at Max. Power			
User Interface		7" Color Touch Screen			
Program Modes		STEP : 24 sets / 255 cycles. (Volt./Freq./Time)			
		RAMP : 12 sets / 255 cycles. (Volt./Freq./Time)			
Soft Start	Setting : Rated	d Volt. / Rated Freq. / Start Volt. / Start Freq. / Delay Time / Ramp Time			



Model	:	APF1010	APF1020	APF1045
Protections	Input : Input No Fuse Breaker (N.F.B), Over Voltage, Under Voltage,			
	Output : Over Voltage, Over Current, Over Temperature			
	Unit will display the error code and give a warning sound.			
Remote Control	Standard: RS-232/RS-422/RS-485/Ethernet			
	Available Options: GPIB, Analog, USB			
Temperature	0° ~ 45° operating			
Humidity	0 ~ 90%, non-condensing			
Mechanical				
Dimensions ⁵	H x W x D	1045x628x840 mm	1440x628x840 mm	1645x828x840 mm
(Including wheels)		41.2"x24.7"x33"	56.7"x24.7"x33"	64.8"x32.6"x33"
Weight⁵	Kg / lbs	230 / 507	320 / 705.5	580 / 1278.7

Notes: All specifications are subject to change without notice.

- 1. For type A(45-500Hz) and models with output power of 20kVA and higher, the available output power will be as shown in the frequency characteristic curve in section 3.2.
- THD shown is for the output frequency from 45 to 65Hz and output voltage setting from 90 140Vac on Low voltage range or 180 - 280Vac on High voltage range and with a resistive load. THD for type C 300-840Hz frequency range models is ≤ 2%,
- 3. Please contact Adaptive Power Systems for other available input voltage specifications options.
- 4. The max. input current is calculated at stated AC input voltage nominal 15% (low line)
- 5. Dimensions and weight are for input voltage 208V or 480V AC standard unit. Please contact us for dimensions and weight for other input voltage.

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Model	:	APF3015	APF3030	APF3045				
AC Output								
Power (kVA / kW		15	30	45				
Phase Mode		Three Phase, 4 Wire + Ground						
Voltage Range	Low		0 ~ 155 V L-N					
	High		0 ~ 310 V L-N					
Resolution			0.1 V					
Accuracy			0.5% F.S. + 4 Counts					
Frequency Range ¹		A version: 45~500H	Hz, B version: 45~120Hz, 0	C version: 300~840Hz				
Resolution			0.1 Hz					
Accuracy			± 0.02% F.S.					
Current RMS max.	Low Vrange	41.7 A	83.3 A	125.0 A				
	High Vrange	20.8 A	41.7 A	62.5 A				
Line Regulation			< 0.5 %					
Load Regulation			≤ 0.5% (Resistive Load)					
Voltage Distortion	THD ²		≤ 0.5% (Resistive Load)					
Response Time	V change		≤ 1 msec					
Crest Factor	Current		≥ 3:1					
Measurements								
		Range	Resolution:	Accuracy:				
Voltage	Vrms	0~310V	0.1 V	0.5% F.S. + 4 counts				
Frequency	Hz	45.0 ~ 840 Hz	0.01 Hz	±0.02% F.S.				
Current	Arms	See Current Spec.	0.1 A	0.5% F.S. + 4 counts				
Power	KWatt	See kVA Spec.	0.1 kW	1.0% F.S + 6 counts				
AC Input Mains								
Frequency Line			47 Hz ~ 63 Hz					
Phase Mode			3 Phase / 3 Wire + Grour	nd				
Input Voltage ³	-208		208Vac ± 10%					
Line Current	Max ⁴	60	121	181				
Input Voltage ³	-480		480Vac ± 10%					
Line Current	Max ⁴	26	52	78				
Input Power Factor			≥0.9 @ Max. Power					
General Specification	ons							
Efficiency		> 90%	6 at Max. Power					
User Interface		7" Co	lor Touch Screen					
Program Modes		STEP : 24 sets / 2	55 cycles. (Volt./Freq./Tin	ne)				
	RAMP : 12 sets / 255 cycles. (Volt./Freq./Time)							
Soft Start	Setting : Rated	Setting : Rated Volt. / Rated Freq. / Start Volt. / Start Freq. / Delay Time / Ramp Time						
Protections	Input	: Input No Fuse Breake	er (N.F.B), Over Voltage, U	Inder Voltage,				
		Output : Over Voltage,	Over Current, Over Temp	perature				
	ι	Jnit will display the err	or code and give a warnir	ng sound.				
Remote Control		Standard: RS-23	2/RS-422/RS-485/Etherne	et				
		Available Options: GPIB. Analog. USB						

4.2 Three Phase Output Models – 15kVA to 45kVA



Model	:	APF3015	APF3030	APF3045			
Temperature		0° ~ 45° operating					
Humidity		0 ~ 90%	6, non-condensing				
Mechanical							
Dimensions ⁵	H x W x D	1440x628x840 mm	1440 x 628 x 840 mm	1645 x 828 x 840 mm			
(Including wheels)		56.7" x 24.7" x 33" 56.7" x 24.7" x 33" 64.8" x 32.6" x 33"					
Weight ⁵	Kg / lbs	305 / 672.4	400 / 882	560 / 1234.6			

Notes: All specifications are subject to change without notice.

- 1. For type A(45-500Hz) and models with output power of 20kVA and higher, the available output power will be as shown in the frequency characteristic curve in section 3.2.
- THD shown is for the output frequency from 45 to 65Hz and output voltage setting from 90 140Vac on Low voltage range or 180 - 280Vac on High voltage range and with a resistive load. THD for type C 300-840Hz frequency range models is ≤ 2%,
- 3. Please contact Adaptive Power Systems for other available input voltage specifications options.
- 4. The max. input current is calculated at stated AC input voltage nominal 15% (low line)
- 5. Dimensions and weight are for input voltage 208V or 480V AC standard unit. Please contact us for dimensions and weight for other input voltage.



4.3 Three Phase Output Models – 60kVA to 150kVA

Model:	APF3060 APF3075 APF3100 APF315							
AC Output								
Power (kVA / kW		60	60 75 100 150					
Phase Mode			Three Phase, 4	Wire + Ground				
Voltage Range	Low		0~15	5 V L-N				
	High		0~310	DVL-N				
Resolution			0.1	LV				
Accuracy			0.5% F.S	+ 4 Counts				
Frequency Range ¹		A version: 45	~500Hz, B version:	45~120Hz, C versior	n: 300~840Hz			
Resolution			0.1	Hz				
Accuracy			± 0.02	% F.S.				
Current RMS max.	Low	166.7 A	208.3 A	277.8 A	416.7 A			
	High	83.3 A	104.2 A	138.9 A	208.3 A			
Line Regulation			< 0.	5 %				
Load Regulation			≤ 0.5% (Res	istive Load)				
Voltage Distortion	THD ²		≤ 0.5% (Res	istive Load)				
Response Time	V change		≤ 1 r	nsec				
Crest Factor	Current		≥ 3	3:1				
Measurements								
		Range	Resolution:	Accuracy:				
Voltage	Vrms	0~310V	0.1 V	0.5% F.S. + 4 cou	ints			
Frequency	Hz	45.0 ~ 840 Hz	0.01 Hz	±0.02% F.S.				
Current	Arms	See Current	0.1 A	0.5% F.S. + 4 cou	ints			
Power	KWatt	See kVA Spec.	0.1 kW	1.0% F.S + 6 cou	nts			
AC Input Mains								
Frequency Line			47 Hz ⁻	~ 63 Hz				
Phase Mode			3 Phase / 3 W	/ire + Ground				
Input Voltage ³	-480		480Va	c ± 10%				
Line Current	Max ⁴	105	131	184	350			
Input Power Factor			≥ 0.9 @ M	lax. Power				
General Specification	ons							
Efficiency			> 90% at Max. Pc	ower				
User Interface			7" Color Touch Sc	reen				
Program Modes		STEP : 24 s	sets / 255 cycles. (V	olt./Freq./Time)				
		RAMP : 12	sets / 255 cycles. (Volt./Freq./Time)				
Soft Start	Setting : R	ated Volt. / Rated F	req. / Start Volt. / S	tart Freq. / Delay Ti	ime / Ramp Time			
Protections	In	put : Input No Fuse	Breaker (N.F.B), O	ver Voltage, Under '	Voltage,			
	Output : Over Voltage, Over Current, Over Temperature							
	Unit will display the error code and give a warning sound.							
Remote Control		Standard	I: RS-232/RS-422/R	S-485/Ethernet				
		Availa	ble Options: GPIR	Analog, USB				
Temperature		,	$0^{\circ} \sim 45^{\circ}$ onerat	ting				
Humidity			0 ~ 90%, non-cond	ensing				
		0 30%, non-condensing						



Model:		APF3060	APF3075 APF3100		APF3150		
Mechanical							
Dimensions ⁵	H x W x D	1645 x 828 x 840 mm	1900 x 1178 x 1200 mm				
(Including wheels)		64.8" x 32.6" x 33.1"	74.8" x 46.4" x 47.2"				
Weight ⁵	Kg / lbs	670 / 1477.1	960 / 2116.4	1170 / 2579.4	1835 / 4045.4		

Notes: All specifications are subject to change without notice.

- 1. For type A(45-500Hz) and models with output power of 20kVA and higher, the available output power will be as shown in the frequency characteristic curve in section 3.2.
- THD shown is for the output frequency from 45 to 65Hz and output voltage setting from 90 140Vac on Low voltage range or 180 - 280Vac on High voltage range and with a resistive load. THD for type C 300-840Hz frequency range models is ≤ 2%,
- 3. Please contact Adaptive Power Systems for other available input voltage specifications options.
- 4. The max. input current is calculated at stated AC input voltage nominal 15% (low line)
- 5. Dimensions and weight are for input voltage 208V or 480V AC standard unit. Please contact us for dimensions and weight for other input voltage.

4.4 Safety & Regulatory

Refer to Declaration of Conformity sheet in Section 11, "CE MARK Declaration of Conformity" at the end of this manual.



4.5 Cabinet Dimensions

Models	Height	Width	Depth	Chassis No.
APF1010	945 mm 1045 incl casters	628 mm	840 mm	1
AFP1015, APF3015, APF3020, APF3030	1340 mm 1440 incl casters	628 mm	840 mm	2
APF1045, APF3045, APF3060	1545 mm 1645 incl casters	828 mm	840 mm	3
APF3075, APF3100. APF3150	1900 mm	1178 mm	1200 mm	4

Cabinet dimensions and weights by model are shown in the table below.

Table 4-1: Cabinet dimensions by Model



Figure 4-1: Cabinet Types 1, 2 & 3 Dimensions





Figure 4-2: Cabinet Type 4 Dimensions

4.6 Location of Controls and Terminal Blocks

Controls and terminal blocks for connection of AC input and AC output wires can be found inside the cabinet by opening the front door. This should always be done while the unit is disconnected from mains input power and is fully de-energized.

The locations for cabinet sizes 1 through 3 is shown on the next page. The table calls out the location numbers from the illustration and describes the purpose of each.

No.	Name	Description
1	Touch Screen	Input programming data or options by the touch screen.
2	Emergency Stop	When the user presses the emergency stop button, the output will shut down immediately
3	Interfaces	RS-232/RS-485/ Ethernet communication ports
4	Input Switch	Switch to turn on/ turn off the product.
5	AC Input Terminal	R,S,T,G (from left to right)
6	AC Output Terminal	U,V,W,N,G (from left to right)





Figure 4-3: Cabinet Types 1, 2 & 3 Controls & Terminals



The locations for cabinet size 4 is shown on the next page. The table calls out the location numbers from the illustration and describes the purpose of each.

No.	Name	Description
1	Touch Screen	Input programming data or options by the touch screen.
2	Emergency Stop	When the user presses the emergency stop button, the output will shut down immediately
3	Interfaces	RS-232/RS-485/ Ethernet communication ports
4	Input Switch	Switch to turn on/ turn off the product.
5	AC Input Terminal	R,S,T,G (from left to right)
6	AC Output Terminal	U,V,W,N,G (from left to right)



Figure 4-4: Cabinet Type 4 Controls and Terminals



4.7 Remote Control Interfaces

APF units come standard with serial and LAN remote control interfaces. Optional interfaces available are USB and GPIB.

4.7.1 Series Control Interfaces

To remotely control the power source output via one of the serial interfaces - RS-232 / RS-485 / RS-422 - connect a computer via the 9-pin D-type connector according to the following instructions.

The definition for the pins of the RS-232 / RS-485 / RS-422 9-pin D-type female connector is given as follows:



Figure 4-5: RS232/RS485/RS422 DB9 Female Connector

Pin No.	Signal	RS232	RS485	RS422A
1	RX-(B)		RS485B	Receive Data
2	RXD	Receive Data		
3	TXD	Send Data		
4	TX-			Send Data
5	SG	Signal Ground		
6	RX⁺A			Receive Data
7	NC	Delete Send		
8	NC	Request Send		
9	TX ⁺			Send Data

Table 4-2: Serial Interface Signal pin assignments

4.7.2 LAN Control Interface

The LAN interface RJ45 socket is located to the right of the LCD touch screen (See area #3 in Section 4.6) and can be connected when the front panel door is open. Make sure power to the unit is OFF when connecting the unit to a local Ethernet.

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5 Unpacking and Installation

5.1 Unpacking & Inspection

The APF Series power sources are shipped in a crate box with protective foam inserts. Use proper equipment to open the shipping crate and remove the unit from its packaging before use.

Removal Steps:

- 1. Remove crate panels.
- 2. Use a forklift to carefully remove the unit from its crate.

The APF Series of power sources are carefully inspected before shipment. Every reasonable precaution is taken to ensure that the product is not damaged before shipping, however some damage may occur on the product during shipping. Please inspect the product carefully after unpacking and save all packing materials until an inspection is complete. If damage has occurred during transport, please inform the shipping company and Adaptive Power Systems' nearest sales and service office or representative. Do not return the product to the factory without obtaining a Return Merchandise Authorization from Adaptive Power Source.

5.2 User Preparation

Be sure the power source is connected to the correct power line input voltage that meets the models AC input specifications. The device must be installed in an area with good aircirculation, so that the fans built-in are able to ventilate the heat generated by internal components properly. The ambient temperature in the area where the unit is placed should be controlled within 40° C max.

5.2.1 Installation Information

- 1. The device must be installed on a horizontal surface rated to support the unit's weight and should be located as close to the load as possible so that the power connections are as short as possible.
- 2. Leave sufficient space around the device for ventilation and maintenance access (refer to Figure 5-1). Do not block the cooling fan opening in case of internal temperature gets too high and has a negative impact on product life.
- 3. The device should be located in an area with proper ventilation. Ambient temperature and humidity should not be high. Keep the unit away from any liquids, flammable gases, corrosive substance, heat sources or direct sunlight. Keep the vent openings free from dust.
- 4. The operating environment should be free from dust, volatile organic compounds, high salinity or any corrosive substances.
- 5. Do not operate the unit outdoors.



6. Use correct cable type and gauge and a proper power clearance and positioning to ensure the safety of the device and the operator.



Figure 5-1: Required Clearance Placement

5.2.2 Ship Kits

All units are shipped with a ship kit that may contain several items. Ship kits can vary by model so check the contents of the ship kit you received against the relevant table below. If any items appear to be missing, contact Adaptive Power Systems customer service. (support@adaptivepower.com).

Item	Description	APD Series
1	User Manual Download PDF	https://tr.adaptivepower.com/
2	Calibration Certificate	

The following accessories are included with each APF power source.

Table 5-1: APF Series Included Accessories Ship Kit



5.3 Grounding Requirements



Before connecting power to this instrument, the protective ground (earth) terminals of this instrument must be connected to the protective conductor of the line (mains)

The chassis must be grounded. A proper Earth Ground connection must be used at all times. Correct grounding of your electrical system infrastructure according to applicable national standards must be observed.



Always check the AC Voltage Rating of the Power Source to make sure it matches the local grid voltage.

Input Voltage: APF models are available with 208Vac or 480Vac 3 Phase Delta Grid Inputs. Optional alternative input voltage models may be ordered if needed. Check the Model/Serial tag of the unit before connecting to AC mains to make sure the AC input voltage rating matches the local utility voltage.

It is strongly recommended to check the actual line voltage using a suitable multimeter to verify it is within range of the AC input voltage specification of the unit as shown on the Model/Serial tag. The unit could be damaged if it exceed the indicated input voltage range.

Input Frequency: AC input frequency range is 47 Hz through 63 Hz.

Line Current: Refer to Sections 4.1, 4.2 or 4.3 – Technical Specifications, depending on the model at hand.





5.4 **Input & Output Wiring Diagrams**

Please do not turn on the unit before connecting the input and output cables per the information below.

5.4.1 Three Phase Input / Single Phase Output Models APS10xx



MODEL	480Vac Input Terminal		Output ⁻	Output Terminal		208Vac Input Terminal		Output Terminal	
	Rating	Screw	Rating	Screw	Rating	Screw	Rating	Screw	
		Size		Size		Size		Size	
1015	30A	M4	200A	M10	100A	M8	200A	M10	
1020	60A	M6	200A	M10	100A	M10	200A	M10	
1045	100A	M8	Bus bar	M10	200A	M10	Bus bar	M10	

Table 5-2: Currents Single Phase Output Models 480V & 208V

5.4.1 Three Phase Input / Three Phase Output Models APS30xx - 15kVA~60kVA



INPUT

10kVA ~ 60kVA

OUTPUT

MODEL	480Vac Input		Output Terminal		208Vac Input		Output Terminal	
	Terminal				Terminal			
	Rating	Screw	Rating	Screw	Rating	Screw	Rating	Screw
		Size		Size		Size		Size
3015	30A	M4	60A	M6	100A	M8	60A	M6
3030	60A	M6	100A	M8	200A	M10	100A	M8
3045	100A	M8	200A	M10	200A	M10	200A	M10
3060	100A	M8	200A	M10	300A	M10	200A	M10

Table 5-3: Currents Three Phase Output Models 480V & 208V, 15kVA~60KVA

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5.4.2 Three Phase Input / Three Phase Output Models APS30xx – 75kVA~100kVA



MODEL	480Vac Input Terminal		Output 1	Ferminal	208Vac Input Terminal		Output Terminal	
	Туре	Screw Size	Rating	Screw Size	Rating	Screw Size	Rating	Screw Size
3075	Bus Bar	M10	Bus Bar	M10	Bus Bar	M10	Bus Bar	M10
3100	Bus Bar	M10	Bus Bar	M10	Bus Bar	M10	Bus Bar	M10

Table 5-4: Currents Three Phase Output Models 480V & 208V, 75kVA~100KVA

5.5 Recommended Wire Sizes – Input / Output

Care must be taken to properly select wire size for the input and output of APF series according to model number. Refer to Table 5-2, Table 5-3 and Table 5-4.

For input/output connections, please remove the front of the cabinet enclosure which is fixed via screws. Please refer to section Table 5-5and Table 5-6 to connect the terminals of AC input and AC output which are inside behind the front panel with the cables. For safety requirement, ensure that the product and the DUT are switched off before connection, and reinstall and screw the front panel back after all connections are completed.



The front cabinet front MUST remain installed at all times when using this equipment

For 480V input models:

	Input Current	inals	Ground		
AFFINIOUEI	input current	R	S	т	Ground
1010	16.5A	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
1020	33A	4 mm ²	4 mm ²	4 mm ²	4 mm ²
1045	75A	25 mm ²	25 mm ²	25 mm ²	25 mm ²
3015	24.8A	2.5 mm ²	2.5 mm ²	2.5 mm ²	2.5 mm ²
3030	49.5A	25 mm ²	25 mm ²	25 mm ²	25 mm ²





		AC Ir	Crownd		
APF WODEI	input current	R	S	т	Ground
3045	74.3A	25 mm ²	25 mm ²	25 mm ²	25 mm ²
3060	99A	35 mm ²	35 mm ²	35 mm ²	35 mm ²
3075	123.8A	50 mm ²	50 mm ²	50 mm ²	50 mm ²
3100	174.8A	70 mm ²	70 mm ²	70 mm ²	70 mm ²

Table 5-5: AC Input Wire Sizes 480V input

For 208V input models:

	Input Current	Ground			
APP WOULD	input current	R	S	т	Ground
1010	40A	25 mm ²	25 mm ²	25 mm ²	25 mm ²
1020	75A	25 mm²	25 mm ²	25 mm ²	25 mm ²
1045	200A	70 mm ²	70 mm ²	70 mm ²	70 mm ²
3015	60A	25 mm ²	25 mm ²	25 mm ²	25 mm ²
3030	121A	50 mm ²	50 mm ²	50 mm ²	50 mm ²
3045	135A	70 mm ²	70 mm ²	70 mm ²	70 mm ²

Table 5-6: AC Input Wire Sizes 208V input

Output Cable Sizes

	Max	Output Terminals			Neutral	Cround
APP WOULD	Current	U	V	W	Neutrai	Ground
1010	83.3A	25 mm ²			25 mm ²	25 mm ²
1020	125A	70 mm ²			70 mm ²	70 mm ²
1045	375A	150 mm ²			150 mm ²	150 mm ²
3015	41.7A	10 mm ²	10 mm²	10 mm ²	10 mm ²	10 mm ²
3030	83.3A	25 mm ²				
3045	125A	50 mm ²				
3060	166.7A	70 mm ²				
3075	166.7A	120 mm ²				
3100	277.8A	150 mm ²				

Table 5-7: AC Output Wire Sizes

American Wire Gauge vs Current Rating:

AWG	Current Rating	AWG	Current Rating
18	10A	4	100A
16	15A	2	130A
14	25A	1	145A
12	30A	0 (1/0)	170A
10	40A	00 (2/0)	195A
8	55A	000 (3/0)	225A
6	80A	0000 (4/0)	260A

Table 5-8: American Wire Guage vs Current Ratings

Note: The recommended wire sizes are based on an ambient temperature below 35°C, and for a temperature rating of conductor wire insulation of at least 60°C.



Note: The tables above provide minimum recommended cable sizes. These recommendations are for multi core flexible copper cables and are for reference only. The user can select different cables according to the actual input and output conditions. When the length of cabling is more than 20 meters 65 feet, the cable gauge should be doubled.

5.6 AC Input Connections

To connect the AC grid power input wiring, open the front chassis door and remove the button front panel of the product enclosure which is fixed using screws. There you will find the input terminal block as shown in Figure 5-2 below. The input power cord must be rated at least for a temperature of 85°C. The input power cord must also have a current rating current which is greater than or equal to the maximum rated input current of the product. See Section 4 for ratings by model.



Figure 5-2: Three Phase AC Grid Power Input Terminal

Referring to Figure 5-2, follow the steps outlined here:

- 1. Open the front chassis door.
- 2. Remove the bottom front panel.
- 3. Remove the safety cover on the input terminal and screw the power cord tightly to the input terminals of the product as follows,
- 4. Connect the Ground wire to the terminal "G" of the input terminals;
- 5. Connect the A cable wire to the terminal "R" of the input terminals;
- 6. Connect the B cable wire to the terminal "S" of the input terminals;
- 7. Connect the C cable wire to the terminal "T" of the input terminals.
- 8. Slip the safety cover over the input terminals.

Notes:

Three Phase may also be referred to as A / B / C, U / V / W, R / S / T or L1 / L2 / L3.


In different countries, different colors may be used to represent three phase wires and cables. The information below for provided for reference:

Region	Wire Colors
USA	A (Black) / B (Red) / C (Blue) / N (White or Gray) / G (Green or Green with Yellow Stripe)
EU	A (Brown) / B (Black) / C (Gray) / N (Blue) / G (Green)
China	A (Yellow) / B (Green) / C (Red) / N(Blue) / G (Green with Yellow Stripe)
Taiwan	A (Red) / B (White) / C (Black or Blue) / (White) / G (Green with Yellow Stripe)

Other regions may use different designations and / or colors.



Protective Grounding. To protect users, the wire connected to terminal "G" (that is GND) must be connected to the earth ground. Under no circumstances shall this product be operated without an adequate protective grounding connection.

5.7 AC Output (Load) Connections

For Output connections, open the front chassis door and remove the button front panel which is secured using screws, then you will find the output terminal as shown in Figure 5-3 below. Please connect the output wires to the input of the DUT and ensure the wires to the DUT must be sufficiently large gauges, so they will not over-heat while carrying the output current.



Figure 5-3: Single & Three Phase Output Terminals



5.8 Remote Voltage Sense Connections

The APF Series AC Power Sources supports Remote Voltage Sensing functions, monitoring the voltage at the point of load instead of at the output terminals of the power source. This ensures the load programmed output voltage is present at the load terminals by automatically compensating for any output voltage drop due to output connection cable impedance.

5.8.1 Disabling the Remote Voltage Sense Function if appropriate.

If the power supply and the load are in proximity of each other, the Remote Sensing function can be disabled by locally shorting the Vsense connections to the output of the power source. . Refer to 12 for bypassing the Remote Sensing function.



DISABLING REMOTE SENSING

Figure 5-4: Disabling Remote Sensing

5.8.2 Enabling the Remote Voltage Sense Function

When the power supply and the load are a certain distance apart and need long connecting cable, Remote Sensing can be enabled to compensate for the output voltage drop caused by the load cable impedance. Refer to Figure 5-5 for Remote Sensing Connection use. Remove any shorting jumpers that may be installed on the Remote Sensing connector (see prior section) and connect the remote sensing connector SU\SV\SW\SN using sense wires to the corresponding load terminals U\V\W\N at point of load, as shown in Figure 5-5.

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REMOTE SENSE IN USE

Figure 5-5: Enabling Remote Voltage Sense

5.9 Power On Procedure

After the installation of the APF Series high power AC source and closing the front of the unit, apply mains power and switch on the input circuit breaker to turn on the power source. The fan in the unit will start to operate, and the touch screen on the front panel will light up and enter the POWER-ON page (refer to Figure 5-6) for initialization self-check.



Figure 5-6: Power ON Page Screen



6 Front Panel Operation

This Chapter provides an overview of front panel operation for the APF Series power sources. The APF Series supports local operation via touch screen on the front panel, and remote operation via communication interface: standard RS-485/RS-232/RS-422/ Ethernet, optional GPIB, Analog and USB. For remote control operation, refer to Section 8, Remote Control Programming on page 79 of this manual for an overview of available programming commands.

6.1 Powering On



After the installation of the APF Series high power AC source, apply power and switch on the input circuit breaker to turn on the device. The fan in the device will start to operate, and the touch screen on the front panel will light up and enter the POWER-ON page (refer to Figure 6-1) for initializing check. An initial screen animation will appear as shown below.



Figure 6-1: POWER ON screen

After the POWER-ON page, the touch screen will enter the MAIN page (refer to Figure 6-2). Users can input programming data or set up configurations by pressing the touch screen.



APF Series U PHASE V PHASE	300.0 300.0	v v	MENU METER	APF Series VOLTAGE	150.0	V	MENU METER
W PHASE	300.0	v	PGM.	FREQUENCY	50.0	Hz	PGM.
FREQUENCY	50.0	Hz	SOFT START	CURRENT	0.0	A	SOFT START
	READY	A	OUTPUT	НІGН	READY		OUTPUT

Figure 6-2: Main Screen - Three Phase (left) or Single Phase (right)

6.2 Touch Screen Operation

The APF Series provides an intuitive touch screen Human Machine Interface (HMI) for easy operation and data display. Manipulate the touch screen to enter output programming data or control options by pressing the items or icons shown on the screen directly.

Use a virtual numeric keyboard to set parameter values: select the parameter for numeric value entry and the keyboard will pop up.

For example, press the output measurement in the red square on the MAIN page (refer to Figure 6-3) and the numeric keyboard will display. The maximum and minimum value of the parameter is marked on it. Use the numeric keyboard to set parameter values and press

to confirm the entry. Press DEL to delete the last digit. Press to return to the previous page.

APF Series	200.0	_	MENU	APF Series	450.0		MENU
U PHASE	300.0	V	METER	VOLTAGE	150.0	V	METER
V PHASE	300.0	V	METER				METER
W PHASE	300.0	v	PGM.	FREQUENCY	50.0	Hz	PGM.
FREQUENCY	50.0	Hz	SOFT		0.0		SOFT
CURRENT	0.0	Α		CURRENT	0.0	Α	
🔓 🙏 нідн	READY		OUTPUT	нідн	READY	_	OUTPUT

Figure 6-3: Numeric Value Entry on Three Phase or Single Phase models



APF Series				LOW	AP	F Series				HIGH
U VOLTAGE	MAX:300.0 MIN: 0.0		200.0	+ 5	RA	TED VOLT.	MAX:300.0 MIN: 0.0		220.0	÷
	1	2	3	_			1	2	3	_
	4	5	6	CLR			4	5	6	CLR
	7	8	9				7	8	9	
	C)		DEL			C)		DEL
E 👗 LOW	READY			ENTER		READ	Y			ENTER

Figure 6-4: Virtual numeric keyboard - Three-Phase (left) or Single Phase (right)

6.3 MAIN Screen

When users turn on the power switch, the touch screen displays the MAIN page (refer to Section 3.3.1) after the power-on procedures. MAIN page shows the output settings and the measurement readings of the device output. Users can set output value by using the touch screen, and then press the Output & Reset Button on the touch screen to enable the device output. The touch screen will switch to Meter page (refer to Section 3.8) automatically once the device output is enabled.

APF Series			MENU	APF Series			MENU
U PHASE	300.0	V		VOLTAGE	150.0	V	
V PHASE	300.0	V	METER				METER
W PHASE	300.0	v	PGM.	FREQUENCY	50.0	Hz	PGM.
FREQUENCY	50.0	Hz	SOFT		• •		SOFT
CURRENT	0.0	Α	START	CURRENT	0.0	Α	START
🔓 🙏 нідн	READY		OUTPUT	нідн	READY		OUTPUT

Figure 6-5: MAIN page display with Output OFF - Three-Phase (left) or Single Phase (right)

VOLTAGE 150.0 V	Press to set output voltage (L-N).
FREQUENCY 50.0 Hz	Press to set output frequency.
CURRENT 0.0 A	Press to set output current high limit (Note: this item will only be shown when the CURRENT LIMIT function in SETTING page is turned ON)
OUTFUT RESET	Output/Reset button: press over 1 second, and the button will change from grey to blue which indicates that the status of output is ON.







6.3.1 Output Voltage Setting

On the MAIN page, press the item **VOLTAGE** to select the output voltage setting page (refer to Figure 6-6). Users can see the set voltage and change it by using the keypad for different testing conditions. The output voltage setting page also shows the maximum and minimum

set values for the output voltage. Press **ENTER** to confirm and finish setting. Press **CLR** to clear all the input value or press **DEL** to modify setting.

APF Series				LOW	APF Series				HIGH
U VOLTAGE	MAX:150.0 MIN: 0.0		80.0	+∋	RATED VOLT.	MAX:300.0 MIN: 0.0		220.0	+
	1	2	3			1	2	3	_
	4	5	6	CLR		4	5	6	CLR
	7	8	9			7	8	9	
	()		DEL		()		DEL
E 👗 LOW	READY				READ	Y	_		ENTER

Figure 6-6: Output Voltage Settings Screen - Three-Phase (left) or Single Phase (right)

The APF Series provides two output voltage ranges, High Range and Low Range. High Range allows the maximum output voltage setting to be 0~310V. The Low Range supports setting from 0 to 155V rms. Please note that when setting the output voltage to 120V while on the high voltage range, the maximum available output current is only the half that of the maximum output current on the Low Range.

Phase Voltage Setting Coupling

For three-phase models, when this icon is shown on the bottom left of the MAIN page, each phase's output voltage setting is synchronized with each other. As any of the U, V, or W phase's voltage changes, the other two phase voltages changes accordingly as well

(Coupled mode). When this icon is shown, each phase's output voltage can be set independently, thus U, V, or W phase voltage setting can be different from each other (Uncoupled mode). To switch between coupled and uncoupled phase voltage modes, press

the 📥 icon or 📩 icon to switch in between two different settings.



6.3.2 Output Frequency Setting

On the MAIN page, press the item **FREQUENCY** to enter the output frequency setting page (refer to Figure 6-7). The user can see the set frequency and change it by using the keypad for different testing requirements. The output frequency setting page also shows the maximum (MAX) and minimum (MIN) available setting values for the output frequency.

Press ENTER to confirm and finish setting. Press CLR to clear all the input value or press

DEL to modify setting.

APF Series				HIGH
FREQUENCY	MAX:65.0 MIN: 45.0		50.0	Ð
	1	2	3	
	4	5	6	CLR
	7	8	9	
	()		DEL
НІGН	READY			ENTER

Figure 6-7: Output Frequency Setting Screen

6.3.3 Output Current Limit Setting

On the MAIN page, press the item **CURRENT** to enter the output current limit setting page (refer to Figure 6-8). Users can see the current limit set point and change it by using the keypad for different testing requirements. This setting page also shows the maximum and

minimum available set value for the output current limit. Press **ENTER** to confirm and finish setting. Press **CLR** to clear all the input value or press **DEL** to modify setting.

APF Series				LOW
CURRENT	MAX:0.0 MIN: 0.0		0.0	•
	1	2	3	_
	4	5	6	CLR
	7	8	9	
	()		DEL
				ENTER
	READY			LINIER

Figure 6-8: Output Current Setting Screen

Note: The output current limit setting is not available on the default MAIN page. To enable this setting, please refer to Section 6.3.5.1.1, Current High Limit Setting.



6.3.4 Menu Screen Functions

From the MAIN page screen, the user can press Figure 6-9

to enter into MENU page. Refer to



Figure 6-9: MENU Screen

The descriptions for the various icons in the MAIN screen above are as follows.

Qo	Press to enter the SETTING screen
-~-	Press to enter the PGM screen
+	Press to enter the COMMUNICATION screen
	Press to enter the EVENT screen
6	Press to enter the METER screen
i	Press to enter the INFORMATION screen
Â	Press to enter the MAIN screen
Ð	Press to return to the previous screen
	Press to move to the previous screen
•	Press to enter move to the next screen



6.3.5 Setting Screen

With the MAIN screen displayed on the screen, press L The SETTING screen includes two subpages:



• SYSTEM sub-screen

6.3.5.1 Test Sub Screen

When entering the SETTING screen, the TEST sub-screen will be displayed on the screen. Refer to Figure 6-10.

AP	F Series		TEST	SYSTEM	
С	URRENT		ON		
so	FT START	SE	TTING		
PHASE SET		SETTING			
	RI	EADY			

Figure 6-10: TEST sub-screen

The descriptions for the items in the above figure are given as follows.

CURRENT LIMIT	OFF	Press to activate/deactivate the CURRENT HIGH LIMIT function.
SOFT START	SETTING	Press to activate the SOFT START function
PHASE SET	SETTING	Press to activate the PHASE ANGLE CONTROL (OPTION).

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to enter the SETTING screen.



CURRENT OFF

6.3.5.1.1 Current High Limit Setting

The CURRENT HIGH LIMIT function allows the product to shut down the output, if the load current exceeds the set value of CURRENT LIMIT. The condition "Over Current" will be displayed on the screen.

To activate the CURRENT HIGH LIMIT function, the user can press the item

to switch the CURRENT LIMIT state from OFF to ON.							
APF Series	TEST		APF Series		TEST	~	
CURRENT LIMIT	OFF		CURRENT LIMIT		ON		
SOFT START	SETTING		SOFT START	SE	TTING		
RI	EADY		RI	EADY			

Figure 6-11: CUURENT LIMIT Screens

Note: When the CURRENT HIGH LIMIT function is activated, the MAIN screen will indicate this as shown in display as ON or OFF. The red square indicates that the CURRENT HIGH LIMIT function is activated and if it set to OFF (No current limit setting) or ON (current limit setting shown).

APF Series			MENU	APF Series			MENU
U PHASE	220.0	v		U PHASE	220.0	v	
V PHASE	220.0	v	METER	V PHASE	220.0	v	METER
W PHASE	220.0	v	PGM.	W PHASE	220.0	v	PGM.
FREQUENCY	50.0	Hz	SOFT	FREQUENCY	50.0	Hz	SOFT
			START	CURRENT	100.0	Α	JAN I
П 👗 нісн	READY	_	OUTPUT	Б 👗 нісн	READY		OUTPUT
	Figure 6 12. Thr	oo Dhaco M	Indola Cu	mant limit OFF	(laft) ar ON (ria	(h+)	

Figure 6-12: Three Phase Models Current Limit – OFF (left) or ON (right)

APF Series		MENU	APF Series			MENU
VOLTAGE	150.0 v	METER	VOLTAGE	150.0	V	METER
FREQUENCY	50.0 Hz	PGM.	FREQUENCY	50.0	Hz	PGM.
		SOFT START	CURRENT	0.0	A	SOFT
HIGH	READY	OUTPUT	нідн	READY	_	OUTPUT

Figure 6-13: Single Phase Models Current Limit – OFF (left) or ON (right)





6.3.5.1.2 SOFT START Setting

The user can set the SOFT START function on the TEST subpage. This feature can be applied to test loads that require large start-up currents, such as motors. The inrush current of this kind of load can be high at startup and will typically drop down after startup. To prevent the load from being unable to start by the power source due to high inrush current demand, the user can set a lower START VOLT and START FREQ, then set a DELAY TIME and a RAMP TIME to allow the load to reach its RATED VOLT and RATED FREQ operation.



Press the to enter the SOFT START setting screen.

Figure 6-14: SOFT START setting screen



Figure 6-15: SOFT START Operation Mode

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The following icons define the operation of the SOFT START mode.

RATED VOLT. 220.0 V

Press the value field to set the rated voltage value.

Refer to Figure 6-16 for the SOFT START RATED VOLT. setting. The setting screen also shows the maximum and minimum set value for the rated voltage. Press **ENTER** to confirm and finish setting. Press **CLR** to clear all the input values or press **DEL** to modify this setting.



Figure 6-16: SOFT START RATED VOLT. Setting

RATED FREQ. 50.0 Hz

Press the value to set rated frequency.

Please refer to Figure 6-17for the SOFT START RATED FREQ. setting. The setting screen also shows the maximum and minimum set value for the rated frequency. Press **ENTER** to confirm and finish setting. Press **CLR** to clear all the input values or press **DEL** to modify this setting.



Figure 6-17: SOFT START RATED FREQ. Setting



START VOLT. 30.0

v

Press the value to set start voltage.

Please refer to Figure 6-18 for SOFT START START VOLT. setting. The setting screen also shows the maximum and minimum of set value for the start voltage. Press to confirm and finish setting. Press CLR to clear all the input values or press DEL to modify this setting.

APF Series				
START VOLT.	MAX:30.0 MIN: 0.0		30.0	* 5
	1	2	3	
	4	5	6	CLR
	7	8	9	DEL
	(D		DEL
READ		ENTER		

Figure 6-18: SOFT START START VOLT. setting



Press the value to set start frequency.

Please refer to Figure 6-19 for SOFT START - START FREQ. setting. The setting screen also shows the maximum and minimum of set value for the start frequency. Press **ENTER** to confirm and finish setting. Press **CLR** to clear all the input values or press **DEL** to modify

this setting.

APF Series				
START FREQ.	MAX:50.0 MIN: 5.0		5.0	4 0
	1	2	3	
	4	5	6	CLR
	7	8	9	
	C)		DEL
READ	Y			ENTER

Figure 6-19: SOFT START - START FREQ. setting



Press the value to set delay time.

Please refer to Figure 6-20 for SOFT START DELAY TIME setting. The setting screen also shows the maximum and minimum of set value for the delay time. Press to confirm



and finish setting. Press CLR to clear all the input values or press DEL to modify this setting. The setting range for delay time is $0.0 \sim 99.0$ seconds, the default is 0.3 seconds.

APF Series				_
DELAY TIME	MAX:99.0 MIN: 0.0		2.0	•
	1	2	3	_
	4	5	6	CLR
	7	8	9	
	()		DEL
READ	READY			ENTER

Figure 6-20: SOFT START DELAY TIME setting



Press the value to set delay time.

Please refer to figure 3.18 for the SOFT START RAMP TIME setting. This setting screen also

shows the maximum and minimum of the set value for the ramp time. Press ENTER to

confirm and finish setting. Press **CLR** to clear all the input values or press **DEL** to modify this setting. The setting range for ramp time is 0.0 ~ 99.0 seconds, the default is 0.3 seconds.

APF Series				
RAMP TIME	MAX:99.0 MIN: 0.0		5.0	•
	1	2	3	
	4	5	6	CLR
	7	8	9	
		0		DEL
READY				ENTER

Figure 6-21: SOFT START RAMP TIME setting



Press to move to the previous screen of current screen.

 $\mathbf{\nabla}$

Press to move to the next screen of current screen.

Note: In the SOFT START settings, the setting range of the START VOLT. and the START FREQ. will vary depending on the settings for RATED VOLT. and RATED FREQ.



6.3.5.1.3 Phase Angle Control Setting (Option -P3)

SETTING

For three-phase models configured with the P3 option, the user can set phase angle between three phases at TEST subpage. The setting range is 0° to 359°. This feature can be applied to simulate phase shifts for different power conditions.

PHASE SET

to enter the phase angle control setting screen.

APF Series		
U START PHASE	0 .	
U-V PHASE	240°	<u>,</u>
U-W PHASE	120°	

Figure 6-22: PHASE ANGLE CONTROL screen

The descriptions for the icons in the above screen image are as follows:

U START PHASE 0 ·	The starting position of the U phase always defaults to 0° and is not editable.
U-V PHASE 240 *	Press the value to the phase angle between U phase and V phase to change the V phase.

Please refer to Figure 6-23 for the phase angle setting between U phase and V phase. The setting page also shows the maximum and minimum of set value for the phase angle. Press

to confirm and finish setting. Press to clear all the input value or press to modify setting.

APF Series				
U-V PHASE	MAX:360 MIN: 0		240	• >
	1	2	3	_
	4	5	6	CLR
	7	8	9	DEL
	()		DEL
				ENTER

Figure 6-23: U to V Phase Angle Setting





E.			
	U-W PHASE 120°	Press the value to the phase angle between U phase and W	
			phase to change the V phase.

Please refer to Figure 6-24 for the phase angle setting between U phase and V phase. The setting page also shows the maximum and minimum of set value for the phase angle. Press

to confirm and finish setting. Press **CLR** to clear all the input value or press **DEL** to modify setting.

APF Series				_
U-W PHASE	MAX:360 MIN: 0		120	4 0
	1	2	3	_
	4	5	6	CLR
	7	8	9	
		0		DEL
				ENTER
	_			

Figure 6-24: U to W Phase Angle Setting

6.3.5.2 SYSTEM Page

Press SYSTEM in the SETTING screen to enter into the SYSTEM sub screen. Refer to

APF Series			TEST		SYSTEM		PF Series		TEST	SYSTEM	~
LANGUAGE		E١	IGLIS	H			HMI IP	192 . 168	3.1	. 182	
TOUCH SOUND			OFF			P/	LOCK ASSWORD	***	******		
DATE	2018	/	11	/	2		UTO KEY OCK TIME		0	Sec.	
TIME	17	:	20	:	14		SYSTEM	RESET 1	O DEF	AULT	
RI	EADY						R	EADY		_	

Figure 6-25: SYSTEM sub screens

The descriptions for the items and the icons in the above screens are defined as follows.

LANGUAGE ENGLISH	Press to set the operational language: English / Traditional Chinese (繁體中文) / Simplified Chinese (簡體中文)
TOUCH SOUND OFF	Press to set the touch sound: ON/OFF.
DATE 2018 / 10 / 20	Press to set the date: yyyy/mm/dd.



TIME 10 : 41 : 28	Press to set the time: hours/ minutes/ seconds
HMI IP 192 . 168 . 1 . 182	Press to set the human machine interface LAN address (HMI IP).
LOCK PASSWORD	Press to set the screen lock PASSWORD function. When a user sets up for the first time, enter the password directly. The maximum password length is 9 characters. When a user needs to edit the password, enter the original password first.
AUTO KEY LOCK TIME 0 Sec.	Press to set the AUTOMATIC SCREEN LOCK time (0-65535S, 0=OFF).
SYSTEM RESET TO DEFAULT	Press to restore the power source to the factory default settings.



Press to move to the previous screen of current screen.

Press to move to the next screen of current screen.

6.3.5.2.1 System Language Setting

The user can set the system language on the SYSTEM screen. Available settings are English / Traditional Chinese (繁體中文) / Simplified Chinese (簡體中文).

To set the language, press the item **ENGLISH** to select the desired language.



Figure 6-26: System Language Setting Screens



6.3.5.2.2 Touch Sound Setting

The user can set the touch sound ON/OFF from the SYSTEM screen. The default is OFF.

To set the touch sound, press the item **TOUCH SOUND OFF** to toggle the sound ON or OFF.

6.3.5.2.3 Date Setting

DATE

The user can set the date from the SYSTEM screen. Press each figure on item

20'	2018 / 10 / 20 to set year/month/day individually.										
API	APF Series TEST SYSTEM										
	ΥE	AR		MAX:2 MIN: 2	037 000		201	18 🖌	>		
	AP	F Se	ries			TE	ST S	YSTEM			
		MC	ONTH		MAX: MIN:	12 1		11	•	D	
		APF Series					TEST	SYSTE	M		
			DA	Y		MAX:31 MIN: 1			2	•	
						1	2	3			
						4	5	6		CLR	
						7	8	9			
							0			DEL	
				R	EAD	Y				ENTER	

Figure 6-27: Date Setting Screens



D

CLR

DEL

ENTER

6.3.5.2.4 Time Setting

The user can set the time from the SYSTEM screen. Press each figure on item

ATE	2018 / 1	10 / 20 to set	hours/m	ninutes/	seconds	individually.		
	APF Se	ries		Т	EST	SYSTEM	-	L
	SEC	OND	MAX:59 MIN: 0			38	÷	1
	APF	Series			TEST	SYSTE	M	Ì
	Ν	MINUTE	MAX MIN:	:59 0			21	ь
	/	APF Series			Ť	EST SY	STEM	
1		HOUF	२	MAX:23 MIN: 0			17	

Figure 6-28: Time Setting Screens

READY

1

4

7

2

5

8

0

3

6

9

6.3.5.2.5 Screen Lock Setting



The user can set the SCREEN LOCK function from the SYSTEM screen. When setting up for the first time, enter the password directly. The maximum password length is 9 characters. To change a previously set password or edit the current password, enter the original password first. To disable the SCREEN LOCK function entirely, enter the password "0000".





Figure 6-29: Screen Lock Setting Screen

Note: If the user forgot the password and wants to unlock the screen, enter password 8888 to unlock. If the user wants to reset the password or disable the lock function, please go to:

Setting \rightarrow System subpage \rightarrow Lock Password \rightarrow enter 8888 \rightarrow enter new password (max. 9 characters) or enter 0000 to disable the function.

6.3.5.2.6 Automatic Screen Lock Setting

AUTO KEY LOCK TIME

The user may set a time delay for AUTOMATIC SCREEN LOCK

function. The time can be set from 0 to 65,535 seconds or enter 0 to disable the function. The screen will be locked automatically according to the time setting. The time to lock is based on the idle time of the touch screen, i.e. no operator activity).

APF Seri	es		TEST	SYSTEM	-
AUTO K TI	EY LOCK ME	MAX:65535 MIN: 0		0	+
		1	2	3	
		4	5	6	CLR
		7	8	9	
			0		DEL
					ENTER
	READ	Y			

Figure 6-30: Automatic Screen Lock Setting

When the screen is automatically locked, press the screen lock icon on the bottom left corner of main screen and enter the screen lock password to unlock it.



Figure 6-31: Unlock password entry screens

Note: If the user forgot the password and wants to unlock the screen, enter password 8888 to unlock.

6.3.5.2.7 System Reset

Users can reset the power source to the factory default settings. Press the item

and the screen will display as figure 3.19 asking user to confirm the system reset. Pressing and the screen will display a notification: "Factory reset will start at power on". System reset will be completed after restarting the product



Figure 6-32: Confirm System Reset Screen

Figure 6-33: System Reset after Power ON



6.3.6 PGM (PROGRAM) Screen



Figure 6-34: Item PGM on MAIN Screen (left) and MENU page (right)



Figure 6-35: PRM (Program) Setting Screen

The descriptions for the items and icons in the above figure are given as follows.

~

RAMP: Sets the start and end output voltage/frequency, dwell time of ramp mode. The number of Ramps is up to 12 sets. The number of times the entire set can be repeated is 1-255.

STEP: Sets output voltage/frequency, dwell time of step mode. The number of Steps is up to 24 sets. The numbers of times the entire set can be repeated is 1-255.

Note: The minimum time unit is 1 second. When set to 0 seconds, the system will automatically change to 1 second.



6.3.6.1 RAMP Settings

When the MAIN page is displayed on the screen, the user can press 🗹 to enter the RAMP page.

APF Series												
	0.	VOLT.(V)	T.(V) FREQ.(Hz)		lz)	H: M:S						
4	S.	220.0		50.0		0		0		10		•
	E.	220.0		50.0		U		U		10		_
•	S.	220.0		50.0		^		^		10		
2	Ε.	220.0		50.0		U	•	U	•	10		_
2	S.	220.0		50.0		0		•		10		
3	Ε.	220.0		50.0		•	•	0	•	10		
5	STAR	T:1 END:12 LOOP:1	1		_							OUTPUT

Figure 6-36: RAMP Setting Screen

The descriptions for the items and icons in the above figure are given as follows.

	S.	220.0	50.0	0 . 0 . 10	
Press the corresponding value on item	E.	220.0	50.0	0:0:10	of each ramp set to

set start and end output voltage/frequency and dwell time. When the setup is completed, press **ENTER** to confirm. To edit an entry, Press **CLR** to clear all digits or press **DEL** to

press to confirm. To edit an entry, Press to clear all digits or press delete the last digit for editing.

APF Series				HIGH	APF Series				HIGH
VOLTAGE	MAX:300.0 MIN: 0.0		150.0	•	FREQUENCY	MAX:65.0 MIN: 45.0		50.0	•
	1	2	3	_		1	2	3	_
	4	5	6	CLR		4	5	6	CLR
	7	8	9			7	8	9	
	()		DEL		()		DEL
START:1 END:12 LOO	P:1			ENTER	START:1 END:12 LOOP	P:1			ENTER

Figure 6-37: Start/End output voltage and frequency setting screens

Note: In PGM mode, the RAMP output voltage range will be fixed to the high voltage range for a wide setting range.



APF Series									
SECOND									
APF Series									
MINUTE	MAX:5 MIN: 0	59)		0	_				
APF Series		1	2	3	Ē.				
HOUR		MAX:99 MIN: 0		0	•				
		1	2	3					
		4	5	6	CLR				
		7	8	9	DEL				
			0		DEL				
START:1 EN	D:12 LOO	P:1			ENTER				

Figure 6-38: Dwell Time Setting Screens

Press item to set start and end number of Ramp set and the number of times the entire sets is repeated. When the setup is completed, press **ENTER** to confirm. To edit and entry, press **CLR** to clear all digits or press **DEL** to delete the last digit for editing.

APF Series	S	
START NO.	1	+
END NO.	12	
LOOPS	1	
START: 1 END:1	2 LOOP:1	

Figure 6-39: Ramp Start Group/End Group/Cycle times screen



APF Series					APF Series				
START NO.	MAX:12 MIN: 1		12	* 5	END NO.	MAX:12 MIN: 1		12	•
	1	2	3			1	2	3	_
	4	5	6	CLR		4	5	6	CLR
	7	8	9			7	8	9	
	(0		DEL		(0		DEL
				ENTER					ENTED
START: 1 END:12 LOO	DP:1		_		START: 1 END:12 LOC	P:1			ENTER



Figure 6-40: Ramp Start Group/End Group/Cycle times setting screens



Figure 41: RAMP Mode 3 Phase Execution Sample





6.3.6.2 STEP Settings

When MAIN page displa	ays on	the screen	i, users can	press	to enter the RAMP screen.
	APF Ser	ies			METER
	NO.	VOLT.(V)	FREQ.(Hz)	H: M:S	
	1	220.0	50.0	0 : 0 : 10	4 5
	2	220.0	50.0	0 : 0 : 10	
	3	220.0	50.0	0 : 0 : 10	
	4	220.0	50.0	0 : 0 : 10	
	5	220.0	50.0	0 : 0 : 10	
	6	220.0	50.0	0 : 0 : 10	
	STAR	T:1 END:24 LOOP:1	1		OUTPUT

Figure 6-42: STEP Setting Screen

The descriptions for the items and icons in the above figure are given as follows.

Press the corresponding value on the item 220.0 50.0 0 : 0 : 10 of each step set to set the start and end output voltage/frequency values and dwell time. When this setup is completed, press ENTER to confirm. To edit an entry, press CLR to clear all digits or press DEL to delete the last digit.

APF Series				HIGH	APF Series				HIGH
VOLTAGE	MAX:300.0 MIN: 0.0		150.0	+	FREQUENCY	MAX:65.0 MIN: 45.0		50.0	+ 5
	1	2	3	_		1	2	3	_
	4	5	6	CLR		4	5	6	CLR
	7	8	9			7	8	9	
)		DEL		C)		DEL
			ENTER					ENTER	
START: 1 END:24 LOOP: 255			LINIER	START: 1 END:24 LOO	P:255		_	ENTER	

Figure 6-43: STEP Voltage and Frequency Setting Screens

Note: In PGM mode, the STEP output voltage range will be fixed to the high voltage range for a wide setting range.



APF Se	ries								
SEC	COND	MAX:59 MIN: 1				1	0	_	
APF	Series								
	MINUTE	MA) MIN	(:59 : 0				0	+	5
	APF Series				2	3	3		
	HOU	R	MA) MIN	(:99 : 0				0	Ð
				1	2		3		_
				4	5		6		CLR
_				7	8		9		
					0				DEL
	START: 1	END:24 LO	OOP:1						ENTER

Figure 6-44:STEP Dwell Time Setting Screens

Press the item **START: 1 END:24 LOOP: 1** to set start and end number of Step set and the number of times the entire sets is repeated. When setup is completed, press **ENTER** to confirm. To edit an entry, Press **CLR** to clear all digits or press **DEL** to delete the last digit.

APF Series		
START NO.	1	4
END NO.	24	
LOOPS	1	
START:1 END:2	4 LOOP:1	

Figure 6-45: Step Start Group/End Group/Cycle Times Screen

APF SERIES OPERATION MANUAL SECTION 6: FRONT PANEL OPERATION



APF Series					APF Series				
START NO.	MAX:24 MIN: 1		24	•	END NO.	MAX:24 MIN: 1		24	•
	1	2	3			1	2	3	
	4	5	6	CLR		4	5	6	CLR
	7	8	9			7	8	9	
	()		DEL		0.			DEL
START:1 END:24 LOOP:255 SAVE				ENTER	START: 1 END:24 LO	OP:255 SAVE			ENTER



Figure 6-46: Start Group/End Group/Cycle Times Setting Screens



Figure 47: STEP Mode 3 Phase Execution Sample



6.3.7 Communications Screen

Press the icon to enter the Communication screen from the MENU screen.



Figure 6-48: The COMM. Icon location on the MENU Screen

6.3.7.1 RS-485 Setting Screen

Press the item	COMM TYPE Need restart SYS	RS485	to swite	h the com	municatio	on inter	face to R	S485.
	AP	F Series				*		
	CO Net	MM TYPE	R	S485		-		
	PF	ROTOCOL	МС	DBUS				
		ADDR.		2				
		RE	ADY					
		Figure	C 10, DC 10	E Cotting Co	***			

Figure 6-49: RS-485 Setting Screen

The descriptions for the items and the icons in the above figure are given as follows.

COMM TYPE Need restart SYS	RS485	Switch the communication interface to RS-485.
PROTOCOL	MODBUS	The protocol is fixed by default to MODBUS.
ADDR.	2	The communication address can be set within the range of 1-32. Refer to the figure below.

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APF Series				
ADDR.	MAX:32 MIN: 1		2	•
	1	2	3	
	4	5	6	CLR
	7	8	9	
	0			DEL
READ	Y			ENTER

Figure 6-50: Communication Address Setting Screen

6.3.7.2 RS-232 / GPIB Setting Screen

Press the item Need restart SYS RS232/GPIB to switch the communication interface to RS-232/GPIB.

APF Series					
COMM TYPE Need restart SYS	RS232/GPIB				
PROTOCOL	SCPI	ر. م			
ADDR.	2				
READY					

Figure 6-51: RS=232 / GPIB Setting Screen

The descriptions for the items and the icons in the above figure are given as follows.

COMM TYPE Need restart SYS	RS232/GPIB	Switch the communication interface to RS-232 / GPIB.
PROTOCOL	SCPI	The protocol is fixed by default to SCPI (Standard Commands for Programmable Instruments).
ADDR.	2	The communication address can be set within the range of 1-32. Refer to the figure below.



APF Series				
ADDR.	MAX:32 MIN: 1		2	•
	1	2	3	
	4	5	6	CLR
	7	8	9	
	()		DEL
READ	Y			ENTER

Figure 6-52: Communication Address Setting Screen

RS422

6.3.7.3 RS-422 Setting Screen

Press the item Need restart SYS

to switch the communication interface to RS422.

APF Series		
COMM TYPE Need restart SYS	RS422	
PROTOCOL	MODBUS	
ADDR.	2	
RI	EADY	

Figure 6-53: RS-422 Setting Screen

The descriptions for the items and the icons in the above figure are given as follows.

COMM TYPE Need restart SYS	RS422	Switch the communication interface to RS-422.
PROTOCOL	MODBUS	The protocol is fixed by default to MODBUS.
ADDR.	2	The communication address can be set within the range of 1-32. Refer to the figure below.



APF Series					
ADDR.	MAX:32 MIN: 1		2	÷	
	1	2	3		
	4	5	6	CLR	
	7	8	9		
	0			DEL	
READ	Y			ENTER	

Figure 6-54: Communication Address Setting Screen

6.3.7.4 Ethernet Setting Screen

Press the item **COMM TYPE LAN** to switch the communication interface to RS422.

APF Series		~		
COMM TYPE Need restart SYS	LAN	•		
PROTOCOL	SCPI			
ADDR.	192 . 168 . 1 . 128			
PORT	8888			
R	READY			

Figure 6-55: Ethernet / LAN Setting Screen

The descriptions for the items and the icons in the above figure are given as follows.

COMM TYPE Need restart SYS	LAN	Switch the communication interface to Ethernet.
PROTOCOL	SCPI	The protocol is fixed by default to SCPI.
ADDR.	192 168 1 128	Communication address setting. For the settings on the PC, refer to the instructions below.
		The communication port is user-defined.
PORT	8888	After editing, users need to restart the device to complete the update. The default setting is 8888.

Here are the Ethernet settings for the controlling PC:

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1. Open the Ethernet setting. Select Internet Protocol Version 4 and click Properties. Refer to the figure below.

Ethernet Properties	<				
Networking Authentication	_				
Connect using:					
Intel(R) 82567LF Gigabit Network Connection					
Configure					
This connection uses the following items:					
 Client for Microsoft Networks File and Printer Sharing for Microsoft Networks QoS Packet Scheduler Internet Protocol Version 4 (TCP/IPv4) Microsoft Network Adapter Multiplexor Protocol Microsoft LLDP Protocol Driver Internet Protocol Version 6 (TCP/IPv6) 					
< >>					
Install Uninstall Properties					
Description					
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.					

Figure 6-56: Ethernet Setting Page on Windows PC

2. Set the IP address to be the same as the device's communication address and the last set of numbers should be set to different value, ranging from 0-255.

Internet Protocol Version 4 (TCP/IPv4) Properties			
General			
You can get IP settings assigned autor this capability. Otherwise, you need to for the appropriate IP settings. Obtain an IP address automatica Use the following IP address:	matically if your network supports o ask your network administrator Ily		
IP address:	192.168.0.210		
Subnet mask:	255.255.255.0		
Default gateway:			
Obtain DNS server address autor	matically		
• Use the following DNS server add	dresses:		
Preferred DNS server:	· · ·		
Alternate DNS server:			
Validate settings upon exit	Advanced		
	OK Cancel		

Figure 6-57: LAN IP Address Setting Screen on Windows PC

6.3.8 METER Screens

Press at	the MAIN pag	ge or pres	s na	t the MENU p	age to ent	er int	O METER	screen
APF Series			MENU	APF Series				MENU
U PHASE	300.0	V			150	0		
V PHASE	300.0	v	METER	VOLTAGE		•••	V	METER
W 011405	300.0		RCM		50	Λ		PCM
W PHASE	500.0	v	PGM.	FREQUENCY	50	.0	Hz	POM.
FREQUENCY	50.0	Hz	SOFT		•	•		SOFT
CURRENT	0.0	A		CURRENT	U	.0	Α	OTAKT
🔓 🙏 нідн	READY	_	OUTPUT	нідн	READY			OUTPUT

Figure 6-58: METER screens at MAIN for Three Phase (left) or Single Phase (right) models


Figure 6-59: METER icon location on MENU Screen

APF Ser	ies			~	APF Series				
	U PHASE	V PHASE	W PHASE	Σ					
VOLTAGE(V)	220.0	220.0	220.0	381.0	VOLTAGE(V)	150.0	POWER(kW)	0.0	
CURRENT(A)	100.0	100.0	100.0	300.0					
FREQ.(Hz)	50.0	50.0	50.0	50.0	CURRENT(A)	0.0	APPARENT POWER(kVA)	0.0	_
POWER(kW)	0.0	0.0	0.0	0.0					
APPARENT POWER(kVA)	0.0	0.0	0.0	0.0	FREQUENCY(Hz)	50.0	POWER FACTOR	0.00	
POWER	0.00	0.00	0.00	0.00					
TIME	000	:00:00			TIME 000	: 00: 00			
6 X	нідн	READY	_	OUTPUT	нідн	READ	Y		OUTPUT

Figure 6-60 METER screens at Output Three Phase (left) or Single Phase (right) models

The **three**-phase METER screen shown in the figure below is explained here.

APF	Serie	es					
		U PH	ASE	V PHASE	W PHASE	Σ	
VOLTA	GE(V)	120	0.0	120.0	120.0	207.8	
CURREN	NT(A)	C	0.0	0.0	0.0	0.0	
FREQ.(Hz)	45.	00	45.00	45.00	45.00	
POWER	(kW)	0	0.0	0.0	0.0	0.0	
APPARE	ENT (KVA)	0	0.0	0.0	0.0	0.0	
POWER FACTO	R	0.	00	0.00	0.00	0.00	
TIME		0	000	:00:15			
6	Y	LOW	F	UNNING			OUTPUT

Figure 6-61: Three Phase APF Series Models METER screen

U PHASE V PHASE W PHASE voltage(v) 120.0 120.0 120.0	Displays measurement of the output voltage for each phase in volts.
Σ 207.8	Displays measurement of synchronized three- phase, for example (120V+120V+120V)/3*1.732.
$\begin{array}{c c} & \text{U PHASE} & \text{V PHASE} & \text{W PHASE} & \\ \hline \\ \text{current(a)} & \textbf{0.0} & \textbf{0.0} & \textbf{0.0} & \textbf{0.0} \end{array}$	Displays measurement of the output current of each phase and the sum of total output current.



FREQ.(Hz)	U PHASE V PHASE W PHASE Σ 45.00 45.00 45.00 45	.00	Displays measurement of the output frequency of each phase and the sum of total output frequency.
POWER(kW)	U PHASE V PHASE W PHASE Σ 0.0 <t< td=""><td>.0</td><td>Displays measurement of the output power (W) of each phase and the sum of total output power.</td></t<>	.0	Displays measurement of the output power (W) of each phase and the sum of total output power.
APPARENT POWER(kVA)	U PHASE V PHASE W PHASE Σ 0.0 0.0 0.0 0.0 0	0.0	Displays measurement of the apparent power(VA) of each phase and the sum of total output VA.
POWER FACTOR	$\begin{array}{c c} \text{U PHASE} & \text{V PHASE} & \text{W PHASE} & \boldsymbol{\Sigma} \\ \hline \textbf{0.00} & \textbf{0.00} & \textbf{0.00} & \textbf{0.} \end{array}$	00	Displays measurement of the output power factor of each phase and the total output power factor.
TIME	000:00:15		Displays run time (hours/minutes/seconds)

The **single**-phase METER screen shown in the figure below is explained here.

APF Series				ñ
VOLTAGE(V)	150.0	POWER(kW)	0.0	
CURRENT(A)	0.0	APPARENT POWER(kVA)	0.0	
FREQUENCY(H	z) 50.00	POWER FACTOR	0.00	
тіме 000: 00: 00				
ні	H RUNNII	NG		OUTPUT

Figure 6-62: Single Phase APF Series Models METER Screen

VOLTAGE(V) 150.0	Displays measurement of the output voltage.
CURRENT(A) 0.0	Displays measurement of the output current.
FREQUENCY(Hz) 50.00	Displays measurement of the output frequency.
POWER(kW) 0.0	Displays measurement of the output power (W).
APPARENT POWER(kVA)	Displays measurement of the apparent power (VA).
POWER FACTOR 0.00	Displays measurement of the output power factor.
тіме 000: 00: 00	Displays run time (hours/minutes/seconds).



6.3.9 **Event Screen**

Press at MENU page to enter into the EVENT screen.



Figure 6-63: EVENT Icon location in MENU Screen

The Event page records error information that occurs during local operation, including the date, time of the error event.

AP	F Series			~
4	10/19	16:27	U Overload!	
3	10/19	16:26	U Overload!	
2	10/19	16:12	Input Volt. Under!	•
1	10/19	15:55	DC Bus Volt. Under!	
0	10/19	15:55	Input Volt. Under!	
				▼
	CI	EAR E	/ENT	

Figure 6-64: Error EVENT Screen

6.3.10 Product Information Screen

Press in on the MENU page to enter the PRODUCT INFORMATION page.



Figure 6-65: INFO. Icon location in MENU Screen



APF Series

PRODUCER

ADAPTIVE POWER SYSTEMS

HMI

1.00.00

Image: Constraint of the system of

The product information screen will be displayed.

Figure 6-66: Product Information Display Screen

The following items are shown in this screen:

PRODUCER	ADAPTIVE POWER SYSTEMS	Displays the Power Source's Brand.
НМІ	1.00.00	Displays the Human Machine Interface (HMI_ version of the power source.

6.3.11 Error Log Screen

The APF Series has extensive protection functions. When any of these protections is triggered, the unit will shut down the output and display the corresponding error event on the screen.

Please note that if any protection is triggered, the user should eliminate the cause of the error event according to table below before resuming using the device. Once the cause of the protection is eliminated, press the OUTPUT & RESET buttons simultaneously to unlock the protection state and restart the output.

The descriptions of each protection's error code, possible cause and corresponding potential resolution are shown in the table below.

Err No.	Message	Potential Cause	Possible Solution	Error Description
1	U-phase IGBT1 Over	U-phase IGBT	Check and replace	
	current fault	broken	IGBT	
2	U-phase IGBT2 Over	U-phase IGBT	Check and replace	
	current fault	broken	IGBT	
3	U-phase IGBT3 Over	U-phase IGBT	Check and replace	
	current fault	broken	IGBT	
4	U-phase IGBT4 Over	U-phase IGBT	Check and replace	
	current fault	broken	IGBT	
5	V-phase IGBT1 Over	V-phase IGBT	Check and replace	
	current fault	broken	IGBT	
6	V-phase IGBT2 Over	V-phase IGBT	Check and replace	
	current fault	broken	IGBT	



Err No.	Message	Potential Cause	Possible Solution	Error Description
7	V-phase IGBT3 Over	V-phase IGBT	Check and replace	
	current fault	broken	IGBT	
8	V-phase IGBT4 Over	V-phase IGBT	Check and replace	
	current fault	broken	IGBT	
9	W-phase IGBT1 Over	W-phase IGBT	Check and replace	
	current fault	broken	IGBT	
10	W-phase IGBT2 Over	W-phase IGBT	Check and replace	
	current fault	broken	IGBT	
11	W-phase IGBT3 Over	W-phase IGBT	Check and replace	
	current fault	broken	IGBT	
12	W-phase IGBT4 Over	W-phase IGBT	Check and replace	
40	current fault	broken Fan aman	IGB1	00°C hast sink sugar
13	Heat SINK OVEr-	Fan error	Спесктап	>90°C, neat sink over-
1.4		Ean orror	Chock fan	temperature
14	temperature	Fallenoi		
15	Emergency Ston	Emergency Stop is	Check Emergency	
15	Emergency stop	pressed	Stop	
16	Fuse 1 open	Fuse burned	Check and replace	
			fuse	
17	Fuse 2 open	Fuse burned	Check and replace	
			fuse	
18	Fuse 3 open	Fuse burned	Check and replace	
			fuse	
19	IGBT 1 over-	Fan error	Check fan	>90°C,heat sink over-
	temperature			temperature
20	IGBT 2 over-	Fan error	Check fan	>90°C,heat sink over-
	temperature			temperature
21	Input under-voltage	Input voltage too	Check input voltage	<0.85*rated voltage,
	Tault	IOW		foult
22	Input over veltage	Input voltage tee	Chack input voltage	Iduit
22	fault	high	Check input voitage	input over-voltage
	laun	mgn		fault
23	DC voltage too low	Input voltage too	Check input voltage	<390V. DC voltage too
		low		low
24	DC voltage too high	Input voltage too	Check input voltage	>650V, DC voltage too
		high		high
25	U-phase overload	U-phase overload	Check load	
26	V-phase overload	V-phase overload	Check load	
27	W-phase overload	W-phase overload	Check load	
28	Output under-voltage	Output voltage too	Check output	<0V, output under-
	fault	low	voltage	voltage fault
29	Output over-voltage	Output voltage too	Check output	>300V, output over-
	fault	high	voltage	voltage fault
30	line drop	Sensing lead	Check output	Single-phase model:
	compensation error	broken/ voltage	voltage	Low level output
		arop too high		voltage difference



Err No.	Message	Potential Cause	Possible Solution	Error Description
				>15V or output voltage >155V; High level output voltage difference >30V or output voltage >310V
31	U-phase line drop compensation error	Sensing lead broken/phase connection incorrect/ voltage drop too high	Check U-phase output voltage	Three-phase model:
32	V-phase line drop compensation error	Sensing lead broken/phase connection incorrect/voltage drop too high	Check V-phase output voltage	voltage difference >15V or output voltage >155V; high level voltage difference >20V or
33	W-phase line drop compensation error	Sensing lead broken/phase connection incorrect/voltage drop too high	Check W-phase output voltage	voltage >310V

Table 6-1: Error Messages



7 SCPI Commands Programming

7.1 Overview

A APF Series units come standard with serial and LAN remote control interfaces. Optional interfaces available are USB and GPIB. The interface allows the power source settings to be configured remotely and measurement data to be retrieved for analysis and test report generation.

7.2 SCPI Command Syntax

SCPI is short for Standard Commands for Programmable Instruments and defines a communication method for test and measurement instruments. It is based on ASCII characters.

All APF Series power sources use SCPI command syntax. Commands are not case sensitive so any combination of upper- and lower-case characters is permissible.

For consistency, this document will use UPPER CASE to indicate the required characters for each command (Short Form). Lower case characters are used to indicate the alternative Long Form of each command.

7.3 IEEE488.2 Common Commands

The following IEEE488.2 common commands (a.k.a. star commands) are supported by the power source. These commands are provided for compatibility with the IEEE488.2 standard. They are aliases to the relevant proprietary command and can be used interchangeably.

7.3.1 Command Commands Summary Table

Command	Name	Description		
*RST	Reset Command	Resets Unit to power on condition		
Table 7-1: IEEE488.2 Common Commands Supported				

7.3.2 *RST

Resets the instrument to original power on configuration.

7.4 SYST Commands

7.4.1 SYST:REMote

Description: Switches the unit to remote control mode.

7.4.2 SYST:LOCal

Description: Switches the unit to local control mode.



7.4.3 SYST:ERRor?

Query Command:	Returns System Error Code
Response:	SYST:ERR 0x 0x0000000\r\n (MEAS:MODE 0\r\n 32bit)
Format:	32 bit represent a system error code. See Section Table 7-2 in section 7.13 System Error Codes.
Note:	MEAS:MODE I\r\n: Answer Command 0x0000 (16bit)

7.4.4 SYST:INFO?

Query Command:	Returns Information about the power source		
Response:	SYST:INFO 1,3,3,1,1\r\n 32bit)		
Format:	 Param1 Model Name 1 = APF Param2 AC Input, 1 = Single phase ,3 = Three phase Param3 AC Output, 1 = Single phase ,3 = Three phase Param4 Not used Param5 Minimum time (0 ~ 0.01 sec. 1 ~ 1 sec) 		

7.4.5 SYST:FUNC?

Query Command: Returns the optional functions list of the power source

Response: SYST:FUNC 1,1,1,0,0,1,0,0,1\r\n

Format:	Param1 Param2 Param3 Param4 Param5 Param6 Param7 Param8	Three phase independent adjustment, 0 = No, 1 = Yes Step Mode function, 0 = No, 1 = Yes Gradual (Sweep) Mode, 0 = No, 1 = Yes Not used Phase Angle Adjustment, 0 = No, 1 = Yes High/Low Level Setting, 0 = No, 1 = Yes Soft Start, 0 = No, 1 = Yes Not used
	Param9	Current Limit Function, 0 = No, 1 = Yes

7.5 Three Phase SOUR Commands

7.5.1 SOUR:VOLT:RANGe

Description:	Selects High or Low Voltage Range.		
Syntax:	SOUR:VOI	T:RANG 0 1\r\n	
Format:	Param1	High / Low Level, 0 = Low, 1 = High	

7.5.2 SOUR:VOLT:RANGe?

Query Command: Returns High or Low Voltage Range setting

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Syntax:	SOUR:VOLT:RANG?\r\n
Format:	Param1 High / Low Level, 0 = Low, 1 = High
Response:	SOUR:VOLT:RANG 0 1\r\n
Format:	Param1 High / Low Level, 0 = Low, 1 = High

7.5.3 SOUR:VOLT

Description: Setup output voltage for single phase coupled voltage settings or three phase independent voltage settings.

Syntax:	SOUR:VOLT	220.0\r\n (FUNC GEN\r\n mode
Format:	Param1	Output Voltage, resolution 0.1V
Syntax:	SOUR:VOLT	220.0,110.0,150.0\r\n(FUNC THR\r\n mode)
Format:	Param1 Param2 Param3	Set U Phase Output Voltage, resolution 0.1V Set V Phase Output Voltage, resolution 0.1V Set W Phase Output Voltage, resolution 0.1V

7.5.4 SOUR:VOLT?

Description: Returns voltage setting for single phase coupled voltage settings or three phase independent voltage settings.

Syntax:	SOUR:VOLT?\r\n
Response:	SOUR:VOLT 220.0\r\n (Three-Phase Synchronized)
	SOUR:VOLT 220.0,110.0,115.0\r\n (Three-Phase Independent)

7.5.5 SOUR:FREQ

Description:	Setup output frequency.	
Syntax:	SOUR:FREG	Q 50.0\r\n
Format:	Param1	Set Frequency

7.5.6 SOUR:FREQ?

Description:	Returns output frequency setting
Syntax:	SOUR:FREQ?\r\n
Response:	SOUR:FREQ 50.0\r\n

7.5.7 SOUR:STEP:VOLT

Description:	Setup output voltage in STEP mode.		
Syntax:	SOUR:STEP:	:VOLT 1,110.0\r\n	
Format:	Param1	Group no. (1 ~ 24)	



Param2 Output voltage for group

7.5.8 SOUR:STEP:FREQ

Description:	Setup output frequency in STEP mode.		
Syntax:	SOUR:STEP:	FREQ 1,50.0\r\n	
Format:	Param1 Param2	Group no. (1 ~ 24) Output frequency for group	

7.5.9 SOUR:STEP:TIME

Description:	Setup time interval in STEP mode.
Syntax:	Mode1: 1 Hour, 1 Minute, 10.0 Seconds
	SOUR:STEP:TIME 1,1:1:100\r\n
	Mode2: 1 Hour, 1 Minute, 10.0 Seconds
	SOUR:STEP:TIME 1,1:1:1000\r\n

7.5.10 SOUR:STEP:PCYC

Description:	Setup running cycles STEP mode.	
Syntax:	SOUR:STEP:PCYC 1,24,10\r\n	
Format:	Param1 Param2 Param2	Start group no. (1 ~ 24) End group no. (1 ~ 24) Running cycles (1 ~ 255)
Note:	End group	No. cannot be less than start group No.

7.5.11 SOUR:STEP:LOAD

Description:	Setup all STEP data to controller.
Syntax:	SOUR:STEP:LOAD\r\n
Note:	This command is optional.

7.5.12 SOUR:GRAD:VOLT

Description:	Setup output voltage for Gradual Mode.	
Syntax:	SOUR:GRAD	D:VOLT 1,110.0,220.0r\n
Format:	Param1 Param2 Param2	Start group no. (1 ~ 12) Gradual start voltage for group Gradual end voltage for group



7.5.13 SOUR:GRAD:FREQ

Description:	Setup output frequency for Gradual Mode.		
Syntax:	SOUR:GRA	D:FREQ 1,50.0,60.0r\n	
Format:	Param1	Start group no. (1 ~ 12)	
	Param2	Gradual start frequency for group	
	Param2	Gradual end frequency for group	

7.5.14 SOUR:GRAD:TIME

Description:	Setup output frequency in Gradual Mode.
Syntax:	Mode1: 1 Hour, 1 Minute, 10.0 Seconds
	SOUR: GRAD:TIME 1,1:1:100\r\n
	Mode2: 1 Hour, 1 Minute, 10.0 Seconds
	SOUR: GRAD:TIME 1,1:1:1000\r\n

7.5.15 SOUR:GRAD:PCYC

Description:	Setup running cycles in Gradual mode.	
Syntax:	SOUR:GRAD:PCYC 1,12,10\r\n	
Format:	Param1 Param2 Param2	Start group no. (1 ~ 12) End group no. (1 ~ 12) Running cycles (1 ~ 255)

7.5.16 SOUR:GRAD:LOAD

Description:	Setup all GRAD data to controller.
Syntax:	SOUR:GRAD:LOAD\r\n
Note:	This command is optional.

7.5.17 SOUR:SOFT:VOLT

Description:	Setup Start Voltage and Rated Voltage of Soft Start function.	
Syntax:	SOUR:SOFT	:VOLT 5.00,220.00\r\n
Format:	Param1 Param2	Start voltage Rated voltage



7.5.18 SOUR:SOFT:FREQ

Description:	Setup Start	Frequency and Rated Frequency of Soft Start function.
Syntax:	SOUR:SOFT	:FREQ 5.00,50.00\r\n
Format:	Param1 Param2	Start frequency Rated frequency

7.5.19 SOUR:SOFT:TIME

Description: Setup Delay Time and Ramp Time of Soft Start function	Description:	Setup Delay Time and Ramp Time of Sof	t Start function.
--	--------------	---------------------------------------	-------------------

Syntax: SOUR:SOFT:TIME 5.00,3.00\r\n Format: Param1 Delay time

Unnal.	Paralit	Delay time
	Param2	Ramp time

7.6 FUNC Command

Description:	Selects the	Selects the operation function mode.		
Syntax:	FUNC GEN	FUNC GEN STEP GARD THR LVRT TRAN\r\n		
Format:	Param1 Param2	Function abbreviation: GEN General mode, Steady State operation STEP Step mode GRAD Gradual mode THR Three phase independent output SOFT Soft Start Ramp time		
Note:	Before sei function n	nding the OUTPut command, select the correct operation node.		

7.7 INST Commands

7.7.1 INST:COUPling

Description:	Setup Three-Phase Synchronized or Three-Phase Independent Voltage Mode	
Syntax:	INST:COUP 0 1\r\n	
Format:	Param1	Setup voltage operation mode 0—Three-Phase Synchronized 1—Three-Phase Independent



7.7.2 INST:PHASe

Description:	Setup Phase angle for three phase mode		
Syntax:	INST:PHASe 0,240,120\r\n		
Format:	Param1	U phase angle (U phase refence angle defaults to zero, do not change.)	
	Param2	U=V phase angle	
	Param3	U-W phase angle	

7.8 OUTPut Commands

7.8.1 **OUTPut**

Description:	Enable or Disable power source output.		
Syntax:	OUTPut 0	1\r\n	
Format:	Param1	Output Status 0—Output OFF 1—Output ON	

7.8.2 **OUTPut?**

Description:	Query pow	er source output status
Syntax:	OUTPut?\r	\n
Response:	Param1	0 (Output OFF) or 1 (Output ON)

7.9 MEASurement Commands

7.9.1 MEAS:MODE

Description:	Setup meas	surement mode.
Syntax:	MEAS:MOD	DE OUT\r\n
Format:	Param1	Measurement Mode OUT – Output side

7.9.2 MEAS:ALL?

Description:	Read all output side m	Read all output side measurement data.		
Syntax:	MEAS:ALL?\r\n	MEAS:ALL?\r\n		
Response	MEAS:ALL 50,0, 120.0,120.0,120.0 120.0,120.0,120.0 120.0,120.0,120.0 120.0,120.0,120.0	Output Frequency (Phase U, V, W output voltages) (Phase U, V, W output currents) (Phase U, V, W output kW) (Phase U, V, W output kVAR)		



120.0,120.0,120,0\r\n (Phase U, V, W PF)

7.9.3 **MEAS:VOLT?**

Description:	Read all out	tput side three phase RMS voltage measurement data.
Syntax:	MEAS:VOLT?\r\n	
Response	MEAS:VOLT	T 120.0,120.0,120.0\r\n
Format:	Param1	U phase output AC voltage
	Param2	V phase output AC voltage
	Param3	W phase output AC voltage

7.9.4 MEAS:CURR?

Description:	Read all out	tput side three phase RMS current measurement data.
Syntax:	MEAS:CURF	??\r\n
Response	MEAS:CURF	R 74.3,73.9,74.6\r\n
Format:	Param1 Param2 Param3	U phase output AC current V phase output AC current W phase output AC current

7.9.5 MEAS:FREQ?

Description:	Read all out	put side frequency measurement data.
Syntax:	MEAS:FREC	!?\r\n
Response	MEAS:FREC	t 50.0\r\n
Format:	Param1	Output Frequency in Hz

7.9.6 MEAS:POWer?

Description:	Read all output side three phase power measurement data		
Syntax:	MEAS:POW?\r\n		
Response	MEAS:POW	48.0,48.1,47.9\r\n	
Format:	Param1 Param2 Param3	U phase output kW V phase output kW W phase output kW	



7.9.7 MEAS:APParent?

Description:	Read all out	put side three phase power measurement data.
Syntax:	MEAS:APP?\r\n	
Response	MEAS:APP	52.4,51.9,52.2 \r\n
Format:	Param1	U phase output kVAR
	Param2	V phase output kVAR
	Param3	W phase output kVAR

7.9.8 MEAS:PFACtor?

Description:	Read all ou	tput side three phase power factor measurement data.
Syntax:	MEAS:PFAC?\r\n	
Response	MEAS:PFAC	C 0.98,0.99,0.97 \r\n
Format:	Param1 Param2 Param3	U phase output PF V phase output PF W phase output PF

7.9.9 MEAS:PCYCle?

Description:	Read Step or Gradual Mode running cycle number.		
Syntax:	MEAS:PCYC?\r\n		
Response	MEAS: PCY	C 1,2,00:00:09	
Format:	Param1 Param2 Param3	Running parameter no. Running cycle no. Running parameter time interval.	

7.10 LIMit Commands

7.10.1 LIMit:FREQ:LOW?

Description:	Read the frequency lower (low) limit value.		
Syntax:	LIM:FREQ:LOW?\r\n		
Response	LIM:FREQ:LOW 45.0\r\n		
Format:	Param1	Lower frequency limit.	

7.10.2 LIMit:FREQ:HIGH?

Description:	Read the frequency upper (high) limit value.
Syntax:	LIM:FREQ:HIGH?\r\n
Response	LIM:FREQ:HIGH 65.0\r\n



Format: Param1 Upper frequency limit.

7.10.3 LIMit:VOLT:LOW?

Description:	Read the voltage lower (low) limit value.		
Syntax:	LIM:VOLT	:LOW?\r\n	
Response	LIM:VOLT	LOW 0.0\r\n	
Format:	Param1	Lower voltage limit.	

7.10.4 LIMit:VOLT:HIGH?

Description:	Read the vo	oltage upper (high) limit value.	
Syntax:	LIM:VOLT:HIGH?\r\n		
Response	LIM:VOLT:HIGH 310.0\r\n		
Format:	Param1	Upper voltage limit.	

7.10.5 LIMit:POWer?

Description:	Read the ra	ted true power capability of the power source in kW.
Syntax:	LIM:POW?\	\r\n
Response	LIM:POW 1	00.0\r\n
Format:	Param1	Rated maximum power in kW.

7.10.6 LIMit:CURR

Description:	Set the upper limit for current.
Syntax:	LIM:CURR 75.0\r\n
Format:	Param1 Current limit value.
Note:	The current limit set value cannot exceed the maximum current rating of the power source.

7.10.7 LIMit:POWer

Description:	Set the upper limit for power in kW.		
Syntax:	LIM:POW 75.0\r\n		
Format:	Param1	Upper limit power value in kW.	
Note:	The power limit set value cannot exceed the maximum power rating o the power source.		



7.11 COMM Commands

7.11.1 COMM:ERR

Description:	Read the communication status of the last command sent.	
Syntax:	COMM:ERR?\r\n	
Response	COMM:ERR? n\r\n	
Format:	Param1	n= 0, No Error n = 1, No End of String n = 2, Invalid Commands

7.12 Communication Examples

7.12.1 Remote Control

Enter Remote Control mode: SYST:REM\r\n

Read power source rating: LIM:POW?

Note: Reading the rated capacity of the power source is a good way to check if the communication works and the program can receive data successfully. (There is no response returned for SYST:REM command).

7.12.2 Read Device Information

The following sequence of commands may be used top query to complete power source configuration:

SYST:INFO?\r\n

LIM:POW?\r\n

LIM:VOLT:HIGH?\r\n

LIM:VOLT:LOW? \r\n

LIM:FREQ:HIGH? \r\n

LIM:FREQ:LOW? \r\n

SYST:FUNC? \r\n

SOUR:VOLT:RANG:LOW? \r\n

OUTP? $r\n$

Note: The user can select the desired information and send the corresponding command above by including or excluding any of these.

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7.12.3 Phase Angle Control

Send the following command to se the phase angles for phase V and W:

INST:PHASe 0,240,120\r\n

Note 1: The output voltage waveform of all output modes, including the steady state output, the step and the gradual modes, are affected by the phase angle control.

Note2: The default phase angle values are (0,240,120).

7.12.4 Steady State Programming (General Mode)

This example sets the unit to normal operation and programs the phase mode, voltage range, output voltage and frequency and then closes the output relay.

FUNC GEN\r\n	Set General mode
INST:COUP 0\r\n	Set Three-Phase Voltage mode
SOUR:VOLT:RANG 1\r\n	Set High/Low Level
Voltage:SOUR:VOLT 220.0\r\n	Set Output Voltage
SOUR:FREQ 50.0\r\n	Set Output Frequency
OUTP 1\r\n	Enable Output

7.12.5 Step Mode

FUNC STEP\r\n	Set for Step Mode
SOUR:STEP:VOLT 1,220.0\r\n	Set Group1 Output Voltage
SOUR:STEP:FREQ 1,50.0\r\n	Set Group1 Output Frequency

SOUR:STEP:TIME 1,0:0:100\r\n SOUR:STEP:TIME 1,0:0:1000\r\n SOUR:STEP:VOLT 24,220.0\r\n SOUR:STEP:FREQ 24,50.0\r\n

SOUR:STEP:TIME 24,0:0:100\r\n SOUR:STEP:TIME 24,0:0:1000\r\n SOUR:STEP:PCYC 1,24,10\r\n

SOUR:STEP:LOAD\r\n(Optional) OUTP 1\r\n Set Group1 Output Voltage Set Group1 Output Frequency Set Group1 Running Time Interval Mode 1: 0 Hour, 0 Minute, 10.0 Seconds Mode 2: 0 Hour, 0 Minute, 10.00 Seconds Set Group24 Output Voltage Set Group24 Output Frequency Set Group24 Running Time Interval Mode 1: 0 Hour, 0 Minute, 10.0 Seconds Mode 2: 0 Hour, 0 Minute, 10.00 Seconds Set Step Mode Start group/End group/Cycles times Set All Step Data Start to Output



7.12.6 Gradual (Sweep) Mode

FUNC GRAD\r\n SOUR:GRAD:VOLT 1,220.0\r\n SOUR:GRAD:FREQ 1,50.0\r\n

SOUR:GRAD:TIME 1,0:0:100\r\n SOUR:GRAD:TIME 1,0:0:1000\r\n SOUR:GRAD:VOLT 24,220.0\r\n SOUR:GRAD:FREQ 24,50.0\r\n

SOUR:GRAD:TIME 24,0:0:100\r\n SOUR:GRAD:TIME 24,0:0:1000\r\n SOUR:GRAD:PCYC 1,24,10\r\n

SOUR:GRAD:LOAD\r\n(Optional) OUTP 1\r\n Set for Gradual (sweep) Mode Set Group1 Output Voltage Set Group1 Output Frequency Set Group1 Running Time Interval Mode 1: 0 Hour, 0 Minute, 10.0 Seconds Mode 2: 0 Hour, 0 Minute, 10.00 Seconds Set Group24 Output Voltage Set Group24 Output Frequency Set Group24 Running Time Interval Mode 1: 0 Hour, 0 Minute, 10.0 Seconds Mode 2: 0 Hour, 0 Minute, 10.00 Seconds Set Gradual (sweep)Mode Start group/End group/Cycles times Set All Gradual (sweep) Data Start to Output

7.12.7 Three Phase Independent Output Mode

Set Function Mode
Set for Three-Phase Mode
Set High/Low Level
Set Output Voltage
Set Output Frequency :
Start to Output

7.12.8 Measurement Data Query

MEAS:MODE OUT\r\n	Set measurement mode
SYST:ERRor? \r\n	Read system error status
MEAS:ALL? \r\n	Read all measurement data
MEAS:PCYC? \r\n	Read running mode parameters for Step/Gradual Mode operation)



7.12.9 Set RMS Current Limit

LIM:CURR 65.0\r\n

Set the RMS current limit to 65A rms.

- **Note 1:** Once the output current exceeds the set value for upper limit current, the power source disables the output and reports the fault.
- Note 2: The set value of the upper current limit cannot be greater than the maximum rated current value of the power source model.

7.13 System Error Codes

The following are the system error information bit positions for errors reported by the power source. Error codes are 32 bit long integers corresponding to the system error status.

Bit Position	Fault Description
0	AC Mains Input R-phase IGBT1 Over current fault
1	AC Mains Input R-phase IGBT2 Over current fault
2	AC Mains Input R-phase IGBT3 Over current fault
3	AC Mains Input R-phase IGBT4 Over current fault
4	AC Mains Input S-phase IGBT1 Over current fault
5	AC Mains Input S-phase IGBT2 Over current fault
6	AC Mains Input S-phase IGBT3 Over current fault
7	AC Mains Input S-phase IGBT4 Over current fault
8	AC Mains Input T-phase IGBT1 Over current fault
9	AC Mains Input T-phase IGBT2 Over current fault
10	AC Mains Input T-phase IGBT3 Over current fault
11	AC Mains Input
12	Heat sink temperature is above limit
13	AC Input Transformer over-temperature
14	Emergency Stop
15	Fuse 1 is broken
16	Fuse 2 is broken
17	Fuse 3 is broken
18	IGBT 1 is over-temperature
19	IGBT 2 is over-temperature
20	Input under-voltage fault
21	Input over-voltage fault
22	DC voltage is too low
23	DC voltage is too high

Bit Position	Fault Description
24	U-phase current overload
25	V-phase current overload
26	W-phase current overload
27	Output under-voltage fault
28	Output over-voltage fault
29	Line drop compensation error- Single-phase model or U-phase line drop compensation error – Three-phase model
30	V-phase line drop compensation error – Three-phase model
31	W-phase line drop compensation error – Three-phase model

Table 7-2: System Error Codes



8 MODBUS RTU Commands

8.1 MODBUS RTU Overview

MODBUS RTU (Remote Terminal Unit) is a serial communication protocol widely used in industrial automation and control systems. It operates on a master-slave architecture, where a master device communicates with multiple slave devices over RS-232, RS-485, or RS-422 serial interfaces. MODBUS RTU is known for its simplicity, reliability, and efficiency in transmitting data between devices such as programmable logic controllers (PLCs), sensors, meters, and other field instruments. It is commonly used in applications like energy management, process control, and building automation, enabling seamless data exchange in industrial environments.

8.1.1 Communication & Data Transmission

MODBUS RTU transmits data in **binary format**, making it more efficient than its ASCII counterpart. It typically operates over RS-232, RS-485, or RS-422 serial interfaces, with RS-485 being the most common due to its multi-drop capability, allowing multiple devices to be connected on a single bus.

Each communication follows a request-response cycle:

- The **master** initiates a request by sending a message to a specific slave device (or a broadcast message).
- The **slave** processes the request and responds with the requested data or an acknowledgment.

8.1.2 Message Structure

Each MODBUS RTU message consists of the following components:

- 1. Slave Address (1 byte): Identifies the target slave device (range: 1-247).
- 2. Function Code (1 byte): Specifies the action to be performed (e.g., read/write data).
- 3. **Data Field (Variable length):** Contains the register addresses and values for the requested operation.
- 4. CRC (Cyclic Redundancy Check 2 bytes): Used for error detection and ensuring data integrity.

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8.2 MODBUS RTU Command Format

The available MODBUS command registers are covered in this section.

In MODBUS RTU, there is no specific separator character used in multiple register write commands. Instead, the data is structured in a continuous binary format.

For a Write Multiple Registers (Function Code 0x10) command, the message structure is as follows:

MODBUS RTU Write Multiple Registers (0x10) Frame Structure:

- 1. Slave Address (1 byte)
- 2. Function Code (0x10) (1 byte)
- 3. Starting Register Address (2 bytes)
- 4. Number of Registers to Write (2 bytes)
- 5. Byte Count (1 byte) (Indicates the total number of data bytes that follow)
- 6. Register Values (N × 2 bytes) (Each register is 2 bytes, sent in a continuous stream)
- 7. CRC Checksum (2 bytes)

Example: Writing to 3 Registers

If writing values 0x1234, 0x5678, and 0x9ABC to register at address 0x0001, the message sent from the master would be:

Byte	Value	Description
01	0x01	Slave Address (e.g., Device 1)
02	0x10	Function Code (Write Multiple Registers)
03-04	0x0001	Starting Register Address
05-06	0x0003	Number of Registers to Write (3)
07	0x06	Byte Count (3 registers × 2 bytes each)
08-09	0x1234	Register 1 Value
10-11	0x5678	Register 2 Value
12-13	0x9ABC	Register 3 Value
14-15	CRC	Error-checking value

Since MODBUS RTU is a binary protocol, no separator character (like commas or spaces) is used between register values. The data is transmitted as a continuous byte stream with defined positions for each element in the message structure.



8.3 Write Register Commands

8.3.1 Write Single Register Command Format

Slave Address	Function Code	Register Address	Data	CRC16
DevAddr	Func	Addr	{dat1}	CRC_H CRC_L
Byte1 (Device Add	ress): 0x02	(Range:1-32)		
Byte2 (Function Co	ode): 0x06	6 (Write single regis	ter address)	
Byte3,4 (Register A	Address): Writ	e Register Address	(Refer to section 8	.5)
Byte5,6 (Data):	Writ	e Data Content		
Byte7,8 (CRC16):	CRC1	6 checksum for Byt	e 1 to Byte 6 (Refe	r to section 8.6)

8.3.2 Write Single Register Correct Answer Format

Slave Address	Function Code	Register Address	Data	CRC16
DevAddr	Func	Addr	{dat1}	CRC_H CRC_L
Byte1 (Device Add	ress): Ox(02 (Editable)		
Byte2 (Function Co	ode): 0x0	06 (Write single regi	ster address)	
Byte3,4 (Register A	Address): Wr	ite Register Addres	s (Refer to section	8.5)
Byte5,6 (Data):	Wr	ite Data Content		
Byte7,8 (CRC16):	CR	C16 checksum for B	yte 1 to Byte 6 (Re	fer to section 8.6)

8.3.3 Write Multiple Registers Command Format

Slave Address	Function Code	Start Address	No. of Addresses	Byte Count	Data (binary)	CRC16
DevAddr	Func	StartAddr	Num	n	{dat1;datN}	CRC_H CRC_L
Byte1 (Device Address):		: 0	0x02 (Range:1-32)			
Byte2 (Funct	ion Code):	0	x10 (Write mul	tiple regist	er addresses)	
Byte3,4 (Start Address):		: S	Start address of writing register (Refer to 8.5)			
Byte5,6 (Number of Addresses):		dresses): T	The number of register addresses plan to write			
Byte7 (Byte Count):		Т	Total byte count (or data length) of writing data			
Byte8 to N (Data):		V	Write Data Content			
Byte N+1, N+2 (CRC16):			RC16 checksun	n of Byte1 t	o ByteN (Refer to	section 8.6)



	Slave Address	Function Code	Start Address	No. of Addresses	CRC16
	DevAddr	Func	StartAddr	Num	CRC_H CRC_L
	Byte1 (Device Ad	dress):	0x02 (Editable)		
Byte2 (Function Code):		0x10 (Write multiple register addresses)			
Byte3,4 (Start Address):		dress):	Start writing register address (Refer to section 8.5)		
Byte5,6 (Number of Addresses):		The number of register addresses plan to write			
Byte7,8 (CRC16):			CRC16 checksum of Byte1 to Byte6 (Refer to section 8.6)		

8.3.4 Write Multiple Registers Correct Answer Format

8.4 Read Register Commands

8.4.1 Read Register Command Format

Slave Address	Function Code	Start Address	No. of Addresses	CRC16	
DevAddr	Func	StartAddr	Num	CRC_H CRC_L	
Byte1 (Device Ad	dress): (0x02 (Editable)			
Byte2 (Function C	Code): C	0x03 (Read multiple	e register addresses)		
Byte3,4 (Start Address):		Start reading register address (Refer to section 8.5)			
Byte5,6 (Number of Addresses):		The number of register addresses plan to read			
Byte7,8 (CRC6):		CRC16 checksum of Byte1 to Byte6 (Refer to section 8.6)			

8.4.2 Read Register Successful Answer Format

Slave Address	Function Code	Byte Count	Data	CRC16	
DevAddr	Func	n	{dat1;datN}	CRC_H CRC_L	
Byte1 (Device Ad	dress):	0x02 (Range:1-32)			
Byte2 (Function Code):		0x03 (Read multiple register addresses)			
Byte3 (Number of Addresses):		The number of register addresses planned to read			
Byte4 to N (Data):		Read Data Content			
Byte N+1, N+2 (CRC16)		CRC16 checksum of Byte1 to ByteN (Refer to section 8.6)			





8.4.3 Communication Fail Answer Format

Slave Address	Function Code	Error Code	CRC16
DevAddr	Func	ErrCode	CRC_H CRC_L

Byte1 (Device Address): 0x02 (Editable)

Byte2 (Function Code):

Function Code	Description
0x83	Read Register Address Error
0x86	Write Single Register Address Error
0x90	Write Multiple Register Addresses Error

Byte3 (Error Code):

Error Code	Description
0x01	CRC Checksum Error
0x02	Data Format Incorrect
0x03	Start Address does not exist
0x04	Data Length Out of Range

Byte4,5:

CRC16 checksum of Byte1 to Byte6 (Refer to section 8.6)

8.5 Register Address Table

8.5.1 Write Register Addresses

Address (Hex)	Parameter Name	Notes
0001H	System Operation	Stop
		Run General Mode
		Run Step Mode
		Run Gradual Mode
		3Phase Independent Setup
		5-10- Reserved
		11-31 : Reserved
		32-Reset
0002H	Remote/Local	Local
		Remote
0003H	High/Low Level	Low Level
		High Level



Address (Hex)	Parameter Name	Notes
0004H-0029H	Reserved Addresses	
	System Settings	:
0030H	U Phase Base Angle	Phase Angle Setup (Optional)
0031H	Phase Angel between U-V	
0032H	Phase Angel between U-W	
0033H	Not available	
0034H	Limit Current Value	Limit Current Value (optional)
0035H-009fH	Reser	ved Addresses
	General Mode	:
0100H	General Mode Output Voltage	General Mode (3phase synchronized)
0101H	General Mode Output	
	Frequency	
0102H	U Phase Output Voltage	General Mode (3phase Independent)
0103H	V Phase Output Voltage	(Optional Feature)
0104H	W Phase Output Voltage	
	Step Mode :	
0105H	Group No.	Note1 : Group No. Range 1-24
0106H	Voltage	
0107H	Frequency	
0108H	Running Time Interval- Hr	
0109H	Running Time Interval- Min	
010aH	Running Time Interval- Sec	
010bH	Start Running Group No.	
010cH	End Running Group No.	
010dH	Running Repeat Cycles	
	Gradual Mode	:
010eH	Group No.	Note1 : Group No. Range 1-12
010fH	Gradual Start Voltage	
0110H	Gradual Start Frequency	
0111H	Gradual End Voltage	
0112H	Gradual End Frequency	
0113H	Running Time Interval- Hr	
0114H	Running Time Interval- Min	
0115H	Running Time Interval- Sec	
0116H	Start Running Group No.	
0117H	End Running Group No.	
0118H	Running Repeat Cycles	
	Soft Start Mode	:
012dH	Rated Voltage	Option
012eH	Rated Frequency	
012fH	Start Voltage	
0130H	Start Frequency	
0131H	Delay Time (0.1s)	
0132H	Ramp Time (0.1s)	
0136H-019fH	Reser	ved Addresses

Table 8-1: MODBUS RTU Write Register Addresses





8.5.2 Read Register Addresses

Address (Hex)	Parameter Name	Notes
0010H	Equipment Type	System Information
	AFV ⁺ (Volt.×10, Freq.×10)	
0011H	Input Phase (Single/Three)	
0012H	Output Phase (Single/Three)	
0013H	Nominal Rating	
0014H	Not Available	
0015H	Min. Time Interval	
0016H	Min. Voltage	
0017H	Max. Voltage	
0018H	Min. Frequency	
0019H	Max. Frequency	
001aH	Function Mode: 3 Phase Independent	
	Function	
001bH	Function Mode : Step Mode	
001cH	Function Mode : Gradual Mode	
001dH	Not Available	
001eH	Function Mode : Phase Angle Setup	
001fH	Function Mode : High/Low Level Selection	
0020H	Function Mode : Soft Start Function	
0021H	Not available	
	Read Output Measurement Register Address	es :
0200H	Output Status : 0-Stop 1-Run	
0201H	High/Low Status : 0-Low 1-High	
0202H	Output System Error High Byte (16bit)	
0203H	Output System Error Low Byte (16bit)	
0204H	Current Running Group	
0205H	Current Running Cycle	
0206H	Current Operation Time-Hr	
0207H	Current Operation Time-Min	
0208H	Current Operation Time-Sec	
0209H	Output Frequency x 100	
020aH	U Phase Output Voltage x 10	
020bH	V Phase Output Voltage x 10	
020cH	W Phase Output Voltage x 10	
020dH	U Phase Output Current x 10	



020eH	V Phase Output Current x 10
020fH	W Phase Output Current x 10
0210H	U Phase Output kW x 10
0211H	V Phase Output kW x 10
0212H	W Phase Output kW x 10
0213H	U Phase Output kVAR x 10
0214H	V Phase Output kVAR x 10
0215H	W Phase Output kVAR x 10
0216H	U Phase Output PF x 100
0217H	V Phase Output PF x 100
0218H	W Phase Output PF x 100
0219H	Step/Gradual End Running Flag
021aH-021fH	Reserved Addresses

Table 8-2: MODBUS RTU Read Register Addresses

8.6 CRC Checksum Calculation

The following example illustrates the process to use for calculating the CRC Checksum.

```
**Task Name: CRCVerify
**Function Description: Calculate CRC Checksum
static unsigned char auchCRCHi[]={
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01,
0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81,
```



0x40 };

```
static unsigned char auchCRCLo[256] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05, 0xC5, 0xC4,
0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0xOF, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09,
0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD,
0x1D, 0x1C, 0xDC, 0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7,
0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A,
0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE,
0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3, 0xA2,
0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F,
0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB,
0x7B, 0x7A, 0xBA, 0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90, 0x91,
0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C,
0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88,
0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x80,
0x40
};
```

```
unsigned short CRCVerify(unsigned char *pMsg,unsigned short usDataLen)
{
```

```
unsigned char ucCRCHi = 0xff;
unsigned char ucCRCLo = 0xff;
unsigned short uIndex = 0;
while(usDataLen--)
{
uIndex = ucCRCHi ^ *pMsg++;
ucCRCHi = ucCRCLo ^ auchCRCHi[uIndex];
ucCRCLo = auchCRCLo[uIndex];
}
return (ucCRCHi << 8 | ucCRCLo);</pre>
```

}



8.7 MODBUS RTU Communication Examples

8.7.1 Switch between Remote and Local Modes

Remote:	02 06 00 02 00 01 E9 F9	(hex)
---------	-------------------------	-------

Local: 02 06 00 02 00 00 28 39 (hex)

8.7.2 Switch between High and Low Voltage Range

High:	02 06 00 03 00 01 B8 39	(hex)
Low:	02 06 00 03 00 00 79 F9	(hex)

8.7.3 Query Power Source Equipment Information

Read Equipment:	02 03 00 10 00 0A C4 3B	(hex)	
Read Operation Mode a	and High/Low Status:	02 03 02 00 00 02 C5 80	(hex)

8.7.4 Three Phase Voltage Synchronized Mode

Parameter Setup:	02 10 01 00 00 02 04 08 98 01 F4 72 E3	(hex)
Run & Output:	02 06 00 01 00 01 19 F9	(hex)

8.7.5 Three Phase Voltage Independent Mode

Note: All voltage va	alues are actual value x 10, e.g	. 230.4 is returned as 2304.	
Run & Output:	02 06 00 01 00 04 D9 FA	(hex)	
Parameter Setup:	02 10 01 01 00 04 08 01 F4 0	8 98 08 98 08 98 DB 4B	(hex)

8.7.6 Step Mode

Setup Group1 Parameters: 02 10 01 05 00 06 0C 00 01 08 98 01 F4 00 00 00 00 00 0A 66 84 (hex)

Setup Running Cycle Parameters: 02 10 01 0b 00 03 06 00 01 00 18 00 01 EA 5D (hex)

 Run Step Mode:
 02 06 00 01 00 02 59 F8
 (hex)

Note 1: All voltage & frequency values are actual value x 10, e.g. 50.2Hz is returned as 502.

Note 2: The hex data shown in blue is the group number.



8.7.7 Gradual Mode

 Setup Group1 Parameters:
 02 10 01 0e 00 08 10 00 01 08 98 01 F4 04 4C 02 58 00 00 00 00 00 0A 34 FA (hex)

 Setup Running Cycle Parameters:
 02 10 01 16 00 03 06 00 01 00 0C 00 01 71 A3 (hex)

 Run Gradual Mode:
 02 06 00 01 00 03 98 38 (hex)

 Note 1: All voltage & frequency values are actual value x 10, e.g. 50.2Hz is returned as 502.

Note 2: The hex data shown in blue is the group number.

8.7.8 Output Status

 System Error & Output Status:
 02 03 02 02 00 17 A5 8F
 (hex)

Note: All voltage & frequency values are actual value x 10.

8.7.9 Stop

02 06 00 01 00 00 D8 39 (hex)

8.7.10 Reset

02 06 00 01 00 20 D9 E1 (hex)

8.7.11 Set Current Limit

02 06 00 34 02 58 C8 AD (hex)

Note: The current limit values are actual value x 10.

8.7.12 Phase Angle Control (Optional)

02 10 00 30 00 03 06 00 00 00 F0 00 78 E3 AD (hex)

Note: After setting the phase angle value, it applies to all voltages phase angles.

8.8 System Error Codes

Bit Position	Fault Description
0	AC Mains Input R-phase IGBT1 Over current fault
1	AC Mains Input R-phase IGBT2 Over current fault
2	AC Mains Input R-phase IGBT3 Over current fault
3	AC Mains Input R-phase IGBT4 Over current fault
4	AC Mains Input S-phase IGBT1 Over current fault
5	AC Mains Input S-phase IGBT2 Over current fault

Bit Position	Fault Description
6	AC Mains Input S-phase IGBT3 Over current fault
7	AC Mains Input S-phase IGBT4 Over current fault
8	AC Mains Input T-phase IGBT1 Over current fault
9	AC Mains Input T-phase IGBT2 Over current fault
10	AC Mains Input T-phase IGBT3 Over current fault
11	AC Mains Input
12	Heat sink temperature is above limit
13	AC Input Transformer over-temperature
14	Emergency Stop
15	Fuse 1 is broken
16	Fuse 2 is broken
17	Fuse 3 is broken
18	IGBT 1 is over-temperature
19	IGBT 2 is over-temperature
20	Input under-voltage fault
21	Input over-voltage fault
22	DC voltage is too low
23	DC voltage is too high
24	U-phase current overload
25	V-phase current overload
26	W-phase current overload
27	Output under-voltage fault
28	Output over-voltage fault
29	Line drop compensation error- Single-phase model or U-phase line drop compensation error – Three-phase model
30	V-phase line drop compensation error – Three-phase model
31	W-phase line drop compensation error – Three-phase model

Table 8-3: System Error Codes



8.9 Inverter Error Codes

Bit Position	Fault Description						
0	Over temperature in heat sink						
1	DC bus soft over voltage						
2	Reverse current unsymmetrical						
3	3 Emergency Stop						
4	Hard over current						
5	5 Drive over current						
6	DC under voltage error						
7	7 Low command voltage error						
8	Grid phase error						
9	Grid missing phase error						
10	10 Grid frequency error						
11	Grid voltage error						
12	Grid connect over current						
13	Grid voltage does not match						
14	Synchronized phase error						
15	Hardware disconnect						

Table 8-4: Inverter Error Codes



9 Calibration

9.1 Overview

This product supports calibration of the output and measurement accuracy. Users can perform the calibration according to the step by step procedures provided in this chapter. A traceable voltage meter, current meter or power analyzer and a suitable AC load are needed for performing these calibration procedures.



Press METER CALIBRATION at the SYSTEM subpage of SETTINGS page. Use the virtual numeric keys to input the password 8888 to enter the CALIBRATION page. Please see the screen image below.

APF Series		TEST	SYSTEM					TEST	SYSTEM	~
PASSWORD	MAX: MIN:	**	•		LOCK PASSWORD	******				
	1	2	3	<u>,</u>		AUTO KEY LOCK TIME		0	Sec.	
	4	5	6	CLR	li	METER	ENTER			
	7	8	9			CALIBRATION				
	()		DEL	SYSTEM		RESET TO DEFAULT		ULT	
				ENTER						
READY				R						

Figure 9-1: Entering the CALIBRATION Screen



9.2 Voltage Calibration

To calibrate the AC output voltage for each phase, proceed as follows:

- 1. Set the power source to the 310 V voltage range (High Vrange)
- 2. The default output settings are V set 220V and F set 50.0Hz.
- 3. Connect the output of APF series unit U-N, V-N and W-N to a three-phase power analyzer without connecting to any load to the power source yet.
- 4. Press the Output/Reset button at the touch screen to start calibration and the screen will display the output voltage value of each phase.
- 5. Input the voltage value displayed for each phase on the power analyzer to the U REAL / V REAL / W REAL.
- 6. Press SETTING to perform calibration calculation and the system will generate new output voltage value at DISPLAY.
- 7. Compare the DISPLAY value and the REAL value; if they are consistent, then the calibration is completed; If there are differences in one or two phases, it is only necessary to perform the above calibration again for phases with different values.



APS M2000X POWER ANALYZER

APF Serie	es	CURRENT	DOWED	OUTPU	T SETTING	ñ
U DISPLAY REAL	(V) 0.0 0.0	(A) 0.0 0.0	(kW) 0.0 0.0	V set F set	220.0 50.0	Ð
V DISPLAY REAL	0.0	0.0	0.0			
W REAL	0.0	0.0	0.0			
	_	_		-		OUTPUT

Figure 9-2: Voltage Calibration Setup and Screen


9.3 Current Calibration

To calibrate the AC output RMS current for each phase, proceed as follows:

- 1. The default output settings are V set 220V and F set 50.0Hz.
- 2. Connect the output of APF series power source U-N, V-N and W-N to a three-phase power analyzer and a resistive load (it is suggested that load is set for an AC source to output of approximately 80% of the rated current.
- 3. Press the Output/Reset button at the touch screen to start calibration and the screen will display the current value of each phase.
- 4. Input the RMS current value displayed on the power analyzer to U REAL / V REAL / W REAL.
- 5. Press SETTING to perform calibration calculation and the system will generate new output current value at DISPLAY.
- 6. Compare the DISPLAY value and the REAL value; if they are consistent, then the calibration is completed; if there are differences in one or two phases, it is will be necessary to perform the above calibration again for phases with different values.



Â CURRENT POWER (A) (kW) 220.0 V set 0.0 0.0 50.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0



9.4 **Power Calibration**

To calibrate the AC output Power for each phase, proceed as follows:

- 1. The default output settings are V set 220V and F set 50.0Hz.
- 2. Connect the output of the APF series power source U-N, V-N and W-N to a threephase power analyzer and a resistive load (it is suggested that the AFV+ output reaches 80% of the rated power).
- 3. Press Output/Reset button at the touch screen to start calibration and the screen will display the output power value of each phase.
- 4. Input the power value displayed on the power analyzer to the U REAL / V REAL / W REAL.
- 5. Press SETTING to perform calibration calculation and the system will generate new output power value at DISPLAY.
- 6. Compare the DISPLAY value and the REAL value; if they are consistent, then the calibration is completed; if there are differences in one or two phases, it is only necessary to perform the above calibration again for phases with different values.





10 Maintenance

10.1 Overview

In order to maintain the best performance of APF Series power source, it is recommended to conduct product maintenance regularly. Before attempting maintenance or repair, the operator should be familiar with the components of the systems and the theory of operation.

10.2 Maintenance Steps



be done by properly trained and qualified personnel. Hazardous voltages exist inside the unit. **Disconnect the supply from the AC mains input** before performing any maintenance. Service, fuse verification, and connecting of wiring to the chassis must be accomplished at least 10 minutes **after** AC input power has been removed with an external disconnect switch. Do not touch any circuits and/or terminals that are energized.

- Pay attention to the safety summary and read the manual carefully.
- Ensue the power line input is cut off and the device has been shut down for 10 minutes before maintenance.
- Clean the device regularly, especially the air inlet, to ensure good ventilation.
- Do not block the air inlet and outlet on the panels.

10.3 Troubleshooting

Should you experience any problems operating this equipment, here are some general guidelines for troubleshooting. **DO NOT** open any panels or access any interior parts of this equipment while grid power is applied to its input or the AC mains is still connected and **on**. Instead, turn off all MAINS power to the unit. There are no user serviceable parts inside.

Following is a list of items to check.

10.3.1 Introduction

This troubleshooting guide provides step-by-step instructions to diagnose and resolve common issues encountered when using a programmable AC power source. Follow these steps systematically to identify and correct faults. If the problem persists, contact technical support.



10.3.2 General Safety Precautions

Before troubleshooting, ensure the following safety precautions are observed:

- Disconnect power before opening the unit.
- Avoid touching internal components while the unit is powered.
- Ensure proper grounding to prevent electric shock.
- Use appropriate personal protective equipment (PPE) when handling electrical components.

10.3.3 Troubleshooting Steps

• Power and Connection Issues

If the unit does not power on:

- Verify the power cord is securely plugged into a functional three phase outlet with the correct mains voltage. Check the model tag for the required AC mains input voltage.
- Check if the main power switch is turned ON.
- Ensure the Mains power meets the voltage and frequency requirements for the unit.
- Verify proper grounding and electrical connections.

• Display and Interface Issues

If the display is blank or unresponsive:

- Restart the unit and observe if the issue persists.
- If using a remote interface (USB, LAN, GPIB), ensure proper communication settings.
- Check cable connections and inspect for damage.
- Ensure that drivers and software are correctly installed for remote control.
- Reset the unit to factory defaults if unresponsive.

• Output Issues

If the power source does not provide the expected output:

- Verify that the output voltage and frequency settings are correct.
- Check load connections and verify proper wiring.
- Measure output with an external meter to confirm expected values.
- Inspect for overload conditions or excessive current draw.
- Reduce the load and retry operation to rule out overcurrent conditions.
- Error Messages and Alarms

If an error message or alarm is displayed:

• Refer to the user manual for specific error code meanings.



- For overvoltage, overcurrent, or overtemperature warnings, take corrective actions (e.g., reducing load, improving ventilation).
- Clear any error messages and attempt a restart.

• Thermal and Cooling Issues

If the unit overheats or shuts down unexpectedly:

- Ensure that ventilation openings are not blocked.
- Verify that the cooling fans are operational.
- Check for excessive ambient temperature; operate within recommended limits.

• Firmware and Software Issues

If software control or remote operation fails:

- Ensure the latest firmware version is installed.
- Check for compatibility issues with external control software.
- Verify baud rate and protocol settings for communication errors.

• Reset and Factory Defaults

If the issue persists:

- Perform a soft reset via the menu or power cycle the unit.
- If necessary, restore factory default settings.
- Contact the manufacturer for service or further diagnostics.

• 4. Contacting Support

If troubleshooting steps do not resolve the issue, please contact technical support using the contact information in Section 1, "Contact Information" on page 10.

Please provide the following information:

- Model and serial number of the power source.
- Detailed description of the issue, including any error messages displayed.
- Steps already taken to troubleshoot the problem.
- Environmental conditions (temperature, humidity, load characteristics).





11 CE MARK Declaration of Conformity

EU Directives:	2014/30/EC 2014/35/EC 2011/65/EC	EMC Directive Low Voltage Directive RoHS2 directive
Manufacturer	Adaptive Powe	r Systems, Inc.
Product Name Serial Number	APF Series AC P	ower Sources

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

RoHS (DIRECTIVE 2011/65/EU) Standard applied EN 50581:2012 (Exempt as WEEE Category 9 until 22 July 2017) ! SAFETY (DIRECTIVE 2014/35/EC): Standard applied EN 61010–1: 2010+A1:2019 ! EMC (DIRECTIVE 2014/30/EU): Standard applied EN 61326-1: 2013

Supplemental Information: When and Where Issued:

e Issued:	April 4, 2025
	Irvine, California, USA
Authorized Signatory	Quality Assurance Inspector
	Adaptive Power Systems
Responsible Person	Production Manager
	Adaptive Power Systems
	2802 Kelvin Avenue, Suite 100
	Irvine, California, 92614-5897, USA

CE

Mark of Compliance, LVD



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