



Sorensen

XBT32-3FTP

Benchtop DC Power Supply

Operation Manual

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Important Safety Instructions

Before applying power to the system, verify that your product is configured properly for your particular application.

 WARNING	Hazardous voltages may be present when covers are removed. Qualified personnel must use extreme caution when servicing this equipment. Circuit boards, test points, and output voltages also may be floating above (below) chassis ground.
 WARNING	The equipment used contains ESD sensitive ports. When installing equipment, follow ESD Safety Procedures. Electrostatic discharges might cause damage to the equipment.

Only *qualified personnel* who deal with attendant hazards in power supplies, are allowed to perform installation and servicing.

Ensure that the AC power line ground is connected properly to the Power Rack input connector or chassis. Similarly, other power ground lines including those to application and maintenance equipment *must* be grounded properly for both personnel and equipment safety.


Always ensure that facility AC input power is de-energized prior to connecting or disconnecting any cable.

In normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, **HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY** may be normally generated on the output terminals. The customer/user must ensure that the output power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is eliminated.


Guard against risks of electrical shock during open cover checks by not touching any portion of the electrical circuits. Even when power is off, capacitors may retain an electrical charge. Use safety glasses during open cover checks to avoid personal injury by any sudden component failure.

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SAFETY SYMBOLS

 **WARNING**
Risk of Electrical Shock


 **CAUTION**
Refer to Accompanying Documents


 Off (Supply)

 Direct Current (DC)

 Standby (Supply)

 Alternating Current (AC)

 On (Supply)

 Three-Phase Alternating Current

 Protective Conductor Terminal

 Earth (Ground) Terminal

 Fuse

 Chassis Ground

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Product Family: XBT32-3FTP

Warranty Period: Three (3) Years

WARRANTY TERMS

AMETEK Programmable Power, Inc. ("AMETEK"), provides this written warranty covering the Product stated above, and if the Buyer discovers and notifies AMETEK in writing of any defect in material or workmanship within the applicable warranty period stated above, then AMETEK may, at its option: repair or replace the Product; or issue a credit note for the defective Product; or provide the Buyer with replacement parts for the Product.

The Buyer will, at its expense, return the defective Product or parts thereof to AMETEK in accordance with the return procedure specified below. AMETEK will, at its expense, deliver the repaired or replaced Product or parts to the Buyer. Any warranty of AMETEK will not apply if the Buyer is in default under the Purchase Order Agreement or where the Product or any part thereof:

- is damaged by misuse, accident, negligence or failure to maintain the same as specified or required by AMETEK;
- is damaged by modifications, alterations or attachments thereto which are not authorized by AMETEK;
- is installed or operated contrary to the instructions of AMETEK;
- is opened, modified or disassembled in any way without AMETEK's consent; or
- is used in combination with items, articles or materials not authorized by METEK.

The Buyer may not assert any claim that the Products are not in conformity with any warranty until the Buyer has made all payments to AMETEK provided for in the Purchase Order Agreement.

PRODUCT RETURN PROCEDURE

1. Request a Return Material Authorization (RMA) number from the repair facility (**must be done in the country in which it was purchased**):
 - **In the USA**, contact the AMETEK Repair Department prior to the return of the product to AMETEK for repair:
Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America)
858-450-0085, ext. 2295 or ext. 2463 (direct)
 - **Outside the United States**, contact the nearest Authorized Service Center (ASC). A full listing can be found either through your local distributor or our website, www.programmablepower.com, by clicking Support and going to the Service Centers tab.
2. When requesting an RMA, have the following information ready:
 - Model number
 - Serial number
 - Description of the problem

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.

NOTE: A returned product found upon inspection by AMETEK, to be in specification is subject to an evaluation fee and applicable freight charges.

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1. INTRODUCTION

The XBT32-3FTP is a programmable benchtop power supply that provides variable DC low voltage power to devices and assemblies in a laboratory setting. This section provides an overview of the XBT32-3FTP DC Power Supply and lists its features, functions and specifications.

1.1 Overview

The XBT32-3FTP is a programmable DC power supply with three (3) outputs: Channel 1 and Channel 2 are linear power supplies and Channel 3 is a switching mode power supply. XBT32-3FTP comes with 16 bits resolution. The maximum total output power is 222 watts with both Channel 1 and Channel 2 providing 96 watts each (0 ~ 32V/3A) and Channel 3 providing a maximum of 30 watts (0 ~ 15V/5A). This means that when the Channel 3 output voltage is set to 6 volts or less, the output current can be up to 5A. If the Channel 3 output voltage is set above 6 volts then the maximum output current depends on the voltage setting with the output power of 30 watts. This is a unique feature that differs from traditional power supplies.

1.2 Features and Functions

In addition to the triple independent output, other important features and functions include:

- parallel mode for an output current up to 6A
- series mode for an output voltage up to 64V
- precision voltage and current measurement
- dual tracking
- digital rotary and push button controls
- LCD display

- memory to store 100 configurations for recall
- built-in timer (1sec – 100 hrs) to disable power
- over voltage protection (OVP)
- over current protection (OCP)
- key lock
- load and line regulation within .01%
- remote control mode with less than 50 ms transient time
- USB and RS232 control standard
- GPIB optional interface
- Ethernet/LAN connectivity, 10/100 base-T compatible
- 16-bit programming and 16-bit readback of voltage and current
- SCPI compliant command set

Minimum System Requirements for Ethernet Option

PC Connection

- Pentium-based laptop or desktop computer running Microsoft Windows XP
- Ethernet-based Network Interface Card (NIC) or built-in port capable of 10/100 Mbit operation
- Standard CAT 5 cable Ethernet interconnect cable
- Microsoft Internet Explorer version 6.0 or later

LAN Connection

- Pentium-based laptop or desktop computer running Microsoft Windows XP
- Ethernet-based Network Interface Card (NIC) or built-in port capable of 10/100 Mbit operation
- Switch or hub (Linksys brand strongly recommended) for LAN connection
- Standard CAT 5 cable Ethernet interconnect cable
- Microsoft Internet Explorer version 6.0 or later

1.3 Specifications

Model	XBT32-3FTP	
Channel NO.	CH1 & CH2	CH3
Output Voltage	0 - 32V	0 - 15V
Output Current	0 - 3A	0 - 5A
Output Power (CH3 Auto Ranging)	96W	30W
Line Regulation \pm(% of output +offset)		
Voltage	0.01% + 2mV	
Current	0.01% + 300uA	
Load Regulation \pm(% of output +offset)		
Voltage	3mV	5mV
Current	0.01% + 300uA	
Ripple and Noise (20Hz ~ 20MHz)		
Normal Mode Voltage	500uVrms / 5mVpp	1mVrms / 20mVpp
Normal Mode Current	1mA	5mA
Resolution		
Programming	1mV / 100uA	
Readback	1mV / 100uA	
Programming Accuracy \pm(% output +offset)		
Voltage	0.01% + 5mV	
OVP	0.1%+50mV, trigger time 400ms	
Current	0.01% + 3mA	
OCP	0.1%+50mA, trigger time 400ms	
Readback Accuracy \pm(% output +offset)		
Voltage	0.01% + 5mV	
Current	0.01% + 3mA	0.01% + 3mA
Temperature Coefficient per C° \pm(% output +offset)		
Voltage	0.01% + 3mV	
Current	0.02% + 2mA	

Tracking Accuracy \pm(% of output +offset)	
Voltage	0.02% + 10mV
Transient Response Time For 50% load change (25 to 75% to within 20mV)	50μS
Stability, constant output & temperature \pm(% of output +offset), 8hrs	
Voltage	0.02% + 2mV
Current	0.01% + 1mA
Voltage Programming Speed	
Rising Time at Full Load	3mSec
Rising Time at No Load	3mSec
Falling Time at Full Load	8mSec
Falling Time at No Load	250mSec
Environmental Requirements	
Temperature Ratings	Operating(0°C to 40°C) Storage (- 10°C to 70°C)
Relative Humidity Range	20% to 80%, non-condensing
Pollution Degree	2
Altitude	2000 m / 6600 ft
Transient Overvoltage Protection	2500V at AC Input
General	
AC Line Input Voltage Ranges	115/230 VAC \pm 10%(50/60Hz)
Common-Mode Voltage	\pm 240Vdc
Dimensions (WxHxD)mm	216W \times 135H \times 432D
Communication port	RS232/USB
Option communication port	GPIB, LAN, I/O
Weight	18.7 lbs / 8.5 kg
Regulatory	Compliant to CE mark, Certified to cETL _{US}

2. INSTALLATION AND MAINTENANCE

This section describes installation and maintenance requirements.

2.1 Initial Inspection

Remove device from packaging; inspect for any physical damage incurred during shipment; report any such damage to the carrier.

2.2 Conditions of Use

- Operate indoors only.
- Refer to Section 1.3, Specifications, of this manual.
- Select the correct voltage setting (see Section 2.3, Power-Line Voltage).
- Ensure that the operating environment power supply is free of dust, vibration, direct sunlight and corrosive gas.
- Ensure clearance of at least 10 cm for adequate ventilation.
- Install a power filter if noise from the AC power source is inevitable.
- Calibrate annually.

2.3 Power-Line Voltage

The power supply uses AC power 115V/230V 50Hz/60Hz. Before plugging in the power cord, make sure the POWER switch (see Section 3.1) is in the OFF position and the voltage input selection switch on the bottom of the unit is the same as the required voltage.



Caution

Exceeding the maximum rated AC input voltage could result in damage to the unit.

2.4 Fuse

There is one fuse installed in the rear panel. If and when it becomes necessary to replace the fuse, first turn off the power and disconnect the AC power cord and all other connections to the power supply. Open the fuse cover, located on the rear panel below the AC socket, using a flat-head screwdriver or by holder from under the AC socket.

Mark	Range	Fuse	Max Power
115	104V~126V	T5A /250V	500VA
230	207V~253V	T2.5A /250V	500VA
50/60 Hz			



Caution

For continuous protection against fire hazard, replace fuse only with the same type and rating specified.

2.5 Connections

Of the interface connections available, RS-232 and USB are standard interfaces, and the GPIB and Ethernet interfaces are options.

2.6 Warming Up

This supplypower supply activates at power on. However, in order to meet the

accuracy in the specification, 30 minutes or longer is necessary.

2.7 Maintenance or Repair

When the power supply is not in use or is unattended, make sure to turn off the power switch. When necessary, remove dust with a damp cloth. If the power supply needs repair, follow the Warranty instructions (page v) in this manual.

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3. OPERATION

This section describes the features, controls and functions of the XBT front and rear panels.

3.1 XBT32-3FTP Front Panel

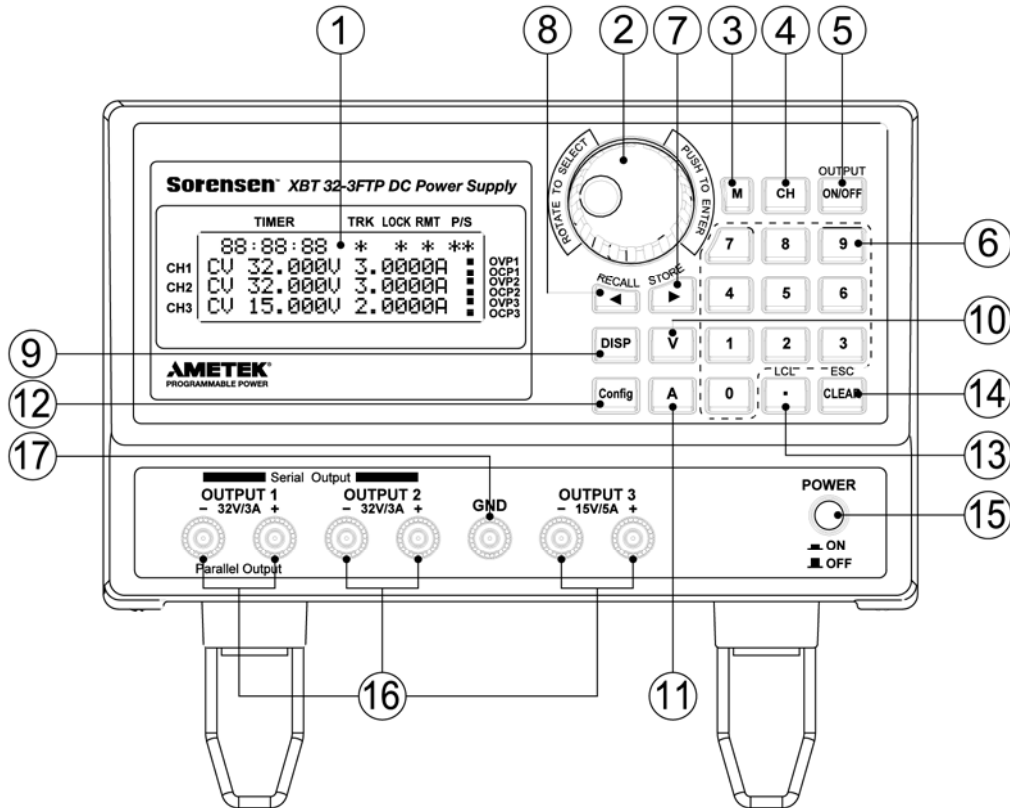
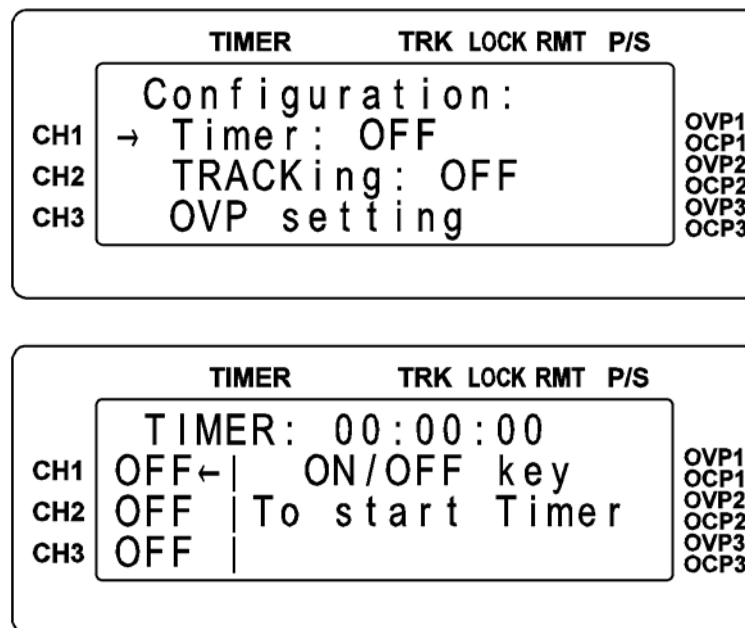


Figure 3-1. XBT32-3FTP Front Panel

- (1) Display:
20x4 blue backlight LCD
- (2) Rotary Adjust/Enter Control:
This control has two functions:
 - Rotate to adjust voltage and current.
 - Press to enter any input.
- (3) M:
Memory key to either store a new configuration or recall a previously stored configuration.
 - To store the current configuration, press the M key then the ►STORE key (7). (There is enough memory to store up to 100 configurations).
 - To recall any of the stored configurations, press the M key then the ◀RECALL key (8). ;
- (4) CH:
Channel selection key; press to scroll to CH1, CH2 or CH3.
- (5) ON/OFF:
Enables/disables the output.
- (6) Number Key:
Keys labeled 0 through 9 to input value for voltage or current.
 - To set voltage, use the number keys to input the desired value, then press the “V” key (10).
 - To set current, input the desired value, then press the “A” key (11).
- (7) ►(STORE):
Dual function key (selecting and storing):
 - When the output is on, this key moves the cursor to select the digit to be adjusted. Once selected, adjust the digit (change the value) by turning the rotary control (2) or press a number key.
 - When in memory function (M key (3)), press this key to store the current configuration..
- (8) ◀(RECALL):
Dual function key:
 - When the output is on, this key moves the cursor to the digit to be adjusted. Once selected, adjust the digit (change the value) by either turning the rotary control (2) or press a number key.
 - When in memory function (M key (3)), press this key to recall a stored configuration from the memory.

- (9) **DISP:**
Display key to select either the voltage/current or power/resistance readout to show in the display screen.
- (10) **V(Voltage):**
Sets voltage after value is input by either the Adjust control (2) or the number keys (6).
- (11) **A(Current):**
Sets current after value is input by either the Adjust control (2) or the number keys (6).
- (12) **Config:**
Configure mode for 16 items to be configured:.

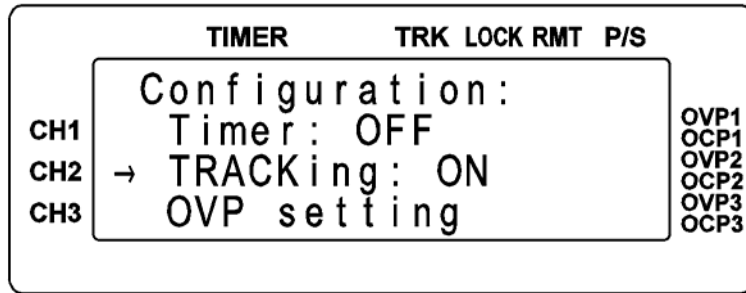
1. **Timer:** The initial value is OFF. Press the Rotary Adjust/Enter Control (rotary) to enter the timer configuration.



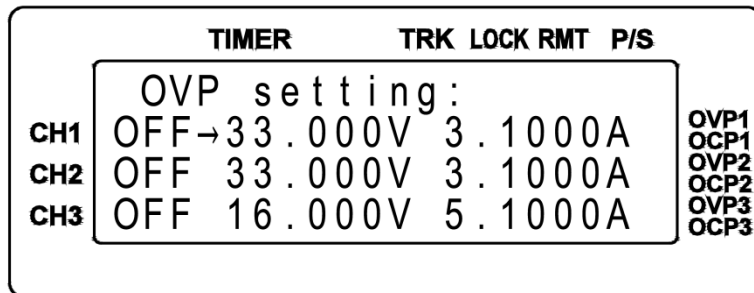
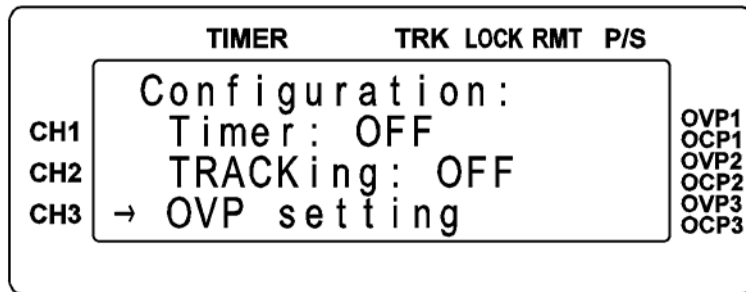
- A. To set up the timer: Use rotary or ◀▶ keys to move the cursor to the digit to be changed; use the number keys to input hours, minutes and/or seconds. (HH:MM:SS).
- B. Select CH1, CH2, or CH3 by pressing the CH key. .
- C. Start Timer by pressing the ON/OFF key
- D. Pause Timer by pressing rotary + CLEAR. Continue Timer by pressing

rotary + CLEAR again.

2. TRACKING: The initial value is OFF, switch to ON by pressing the rotary. The CH2 will have the same voltage and current setting as the CH1.

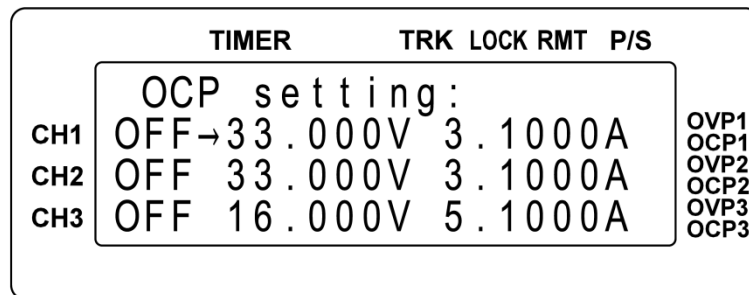
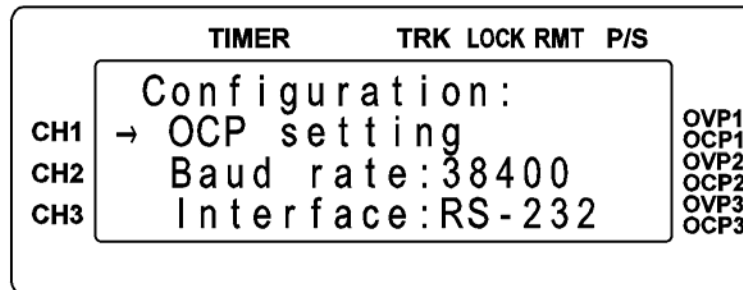


3. OVP setting: Over voltage protection. Press the rotary to enter OVP Configuration. Press “CH” to select CH1/CH2/CH3. Use the number keys to input the OVP value; press rotary (Enter) to “set” (save) the value just input. Press ON/OFF to enable or disable OVP.

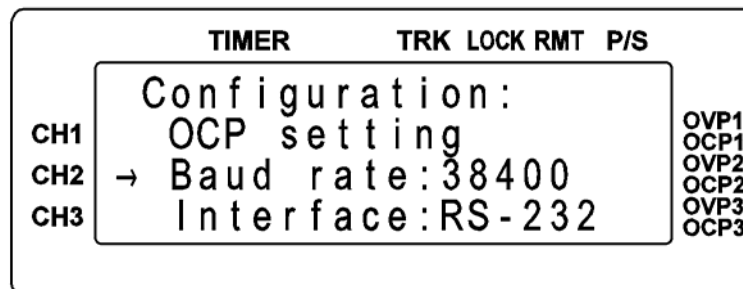


4. OCP setting: Over current protection. Press rotary to enter OCP Configuration. Press “CH” to select CH1/CH2/CH3. Use the

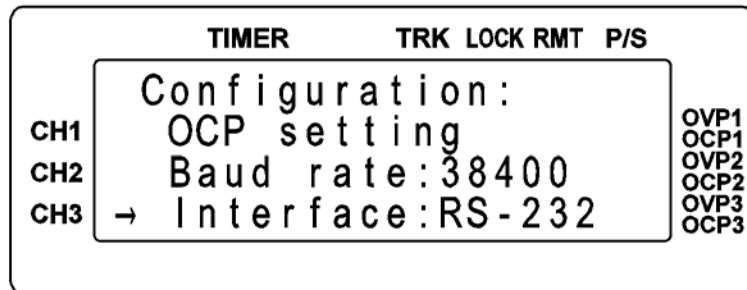
number keys to input the OCP value; press rotary (Enter) to “set” (save) the value just input. Press ON/OFF to enable or disable OCP.



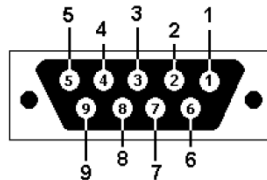
- Baud rate: Transmission speed. Select baud rate for 1200, 2400, 4800, 9600, 19200, 38400 by using rotary.



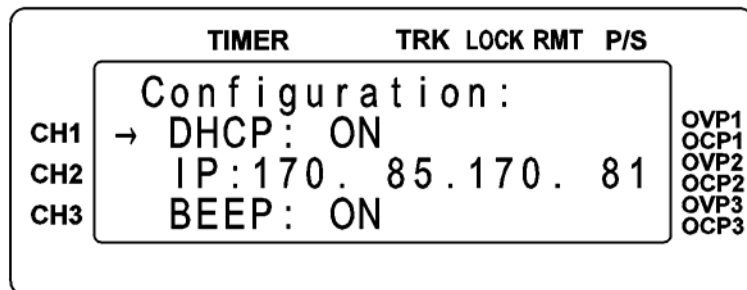
6. Interface: Transmission interface. Select RS232, USB, GPIB (XBT32-3FTP optional), LAN Port (XBT32-3FTP optional) by using rotary.



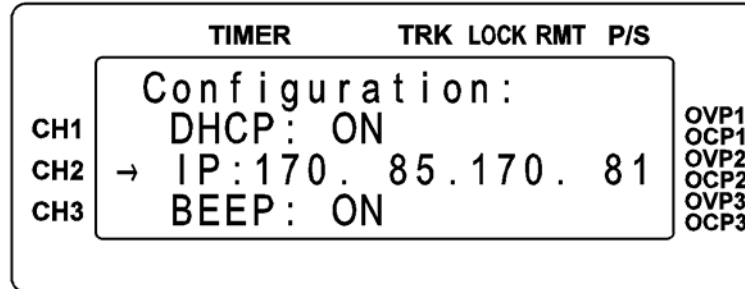
- RS-232 Setup Parameters:
 - Parity none
 - Data Bits 1
 - Stop Bits 1
- DB9 Connector Definition
 - Pin 2 TX
 - Pin 3 RX
 - Pin 5 Ground



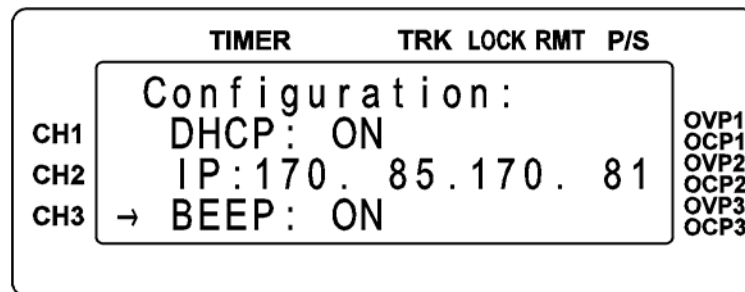
7. DHCP: This parameter is for LAN port setting. The default is Off. Press the rotary to toggle between ON or OFF. In DHCP "On" mode, a dynamic IP address can be obtained from the server. In DHCP "Off" mode, a static IP address can be set in the IP parameter.



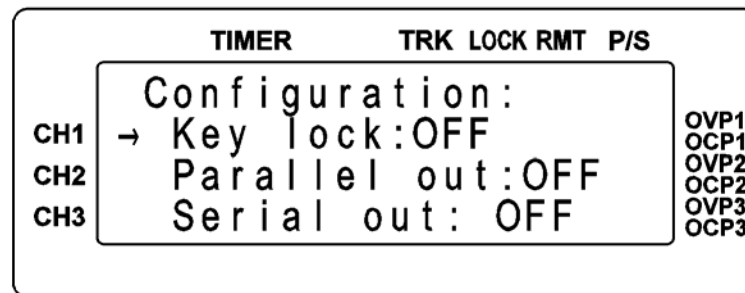
8. IP 170.85.170: This parameter is for LAN port setting. (Default LAN configuration is: static, IP address 0.0.0.0, subnet mask 255.255.255.0). Set a static IP address with DHCP "Off." Use the ◀▶ keypads to position the cursor at each value in the IP address; use the number keypads to input the desired IP address.



9. BEEP: Audible signal. Press rotary to switch the audible signal on or off.

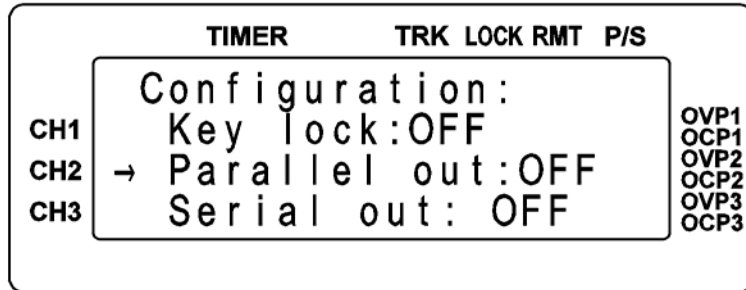


10. Key lock: Key lock function. Disables key pad to avoid accidental inputs or changes. The initial value is OFF. Press rotary to enable key lock function. Rotary + CLEAR to clear key lock and resume normal use of the key pads.

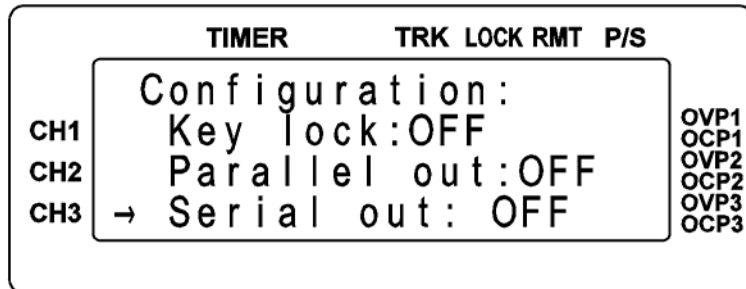


11. Parallel out: Parallel output. The initial value is OFF. Press rotary to

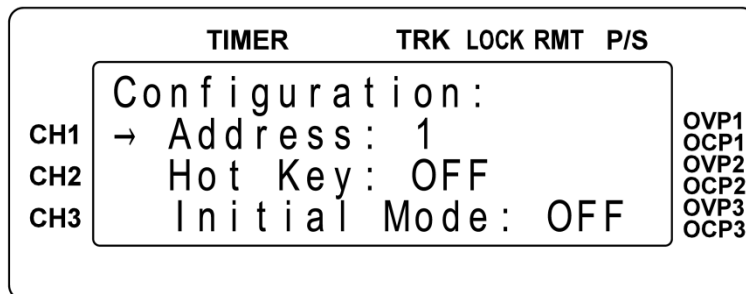
enable parallel output. The total output current is equal to the output of both CH1 and CH2 when they are parallel-connected.



12. Serial out: Serial output. The initial value is OFF. Press rotary to enable serial output. The total output voltage is 4equal to the total voltage of CH1 and CH2 when they are serial-connected.

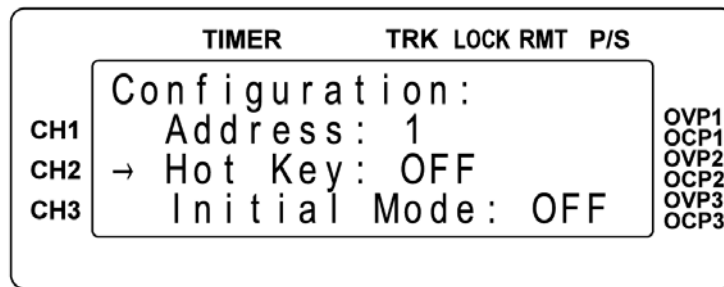


13. Address: GPIB address setting. Acceptable range is 1~31. Use the numbers keypad to input the value for the GPIB address and press rotary to save the settings.

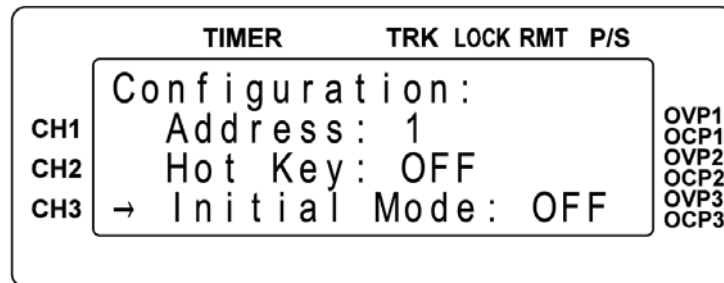


14. Hot Key: Express function key to go directly to stored memory setups. The initial value is OFF. Press rotary to turn on hot key. Press any number key 0-9 to recall the settings stored in the

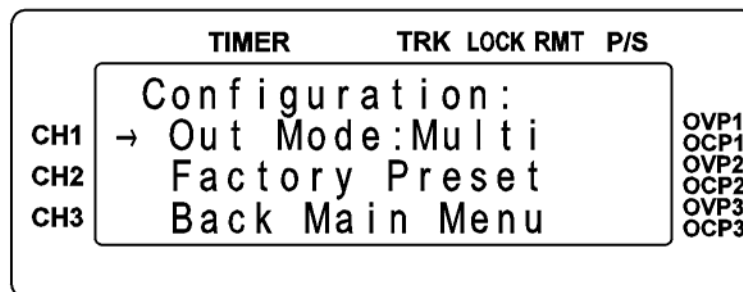
corresponding memory locations.



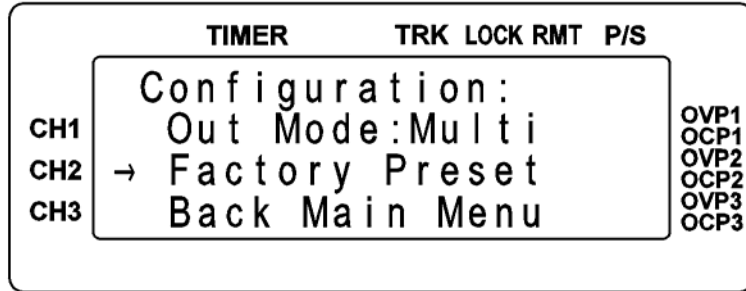
15. Initial Mode: Save most recent settings to memory before powering off, to be recalled at next power on. The initial value is OFF. Press rotary to enable the function (ON) prior to powering off.



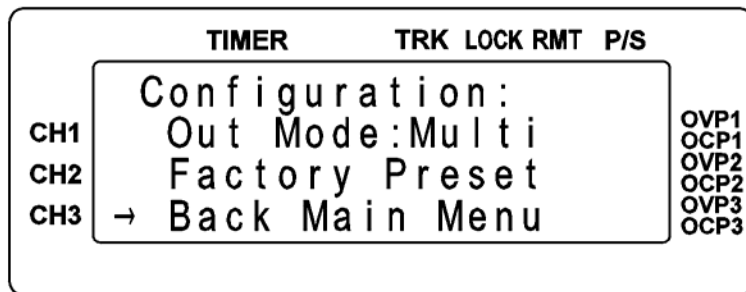
16. Out Mode: Output mode. The initial value is single. Press rotary to switch to multi mode. In the multi mode, CH1/CH2/CH3 output on or off will synchronize by press the ON/OFF key.



17. Factory Preset: Reset to default settings





18. Back Main Menu: End configuration mode and save the settings.



(13) (LCL): Either decimal point or, when in REMOTE mode, resets to LOCAL mode.

(14) CLEAR (ESC):
Clear the number input. Or, return to the previous display.

(15) Power Switch (POWER ON/OFF): raised position  is OFF; depressed position  is ON.



Caution

Before powering on, ensure that the POWER switch is in the OFF position and that the voltage selection on the bottom of the unit is set to the required voltage for the AC power being used.

(16) CH1/CH2/CH3 Output terminals
Important: note the positive and negative pole markings on front panel.

(17) GND:
Connected to the ground. Power source connection must be a three-prong plug for ground connection.

3.2 XBT32-3FTP Rear Panel

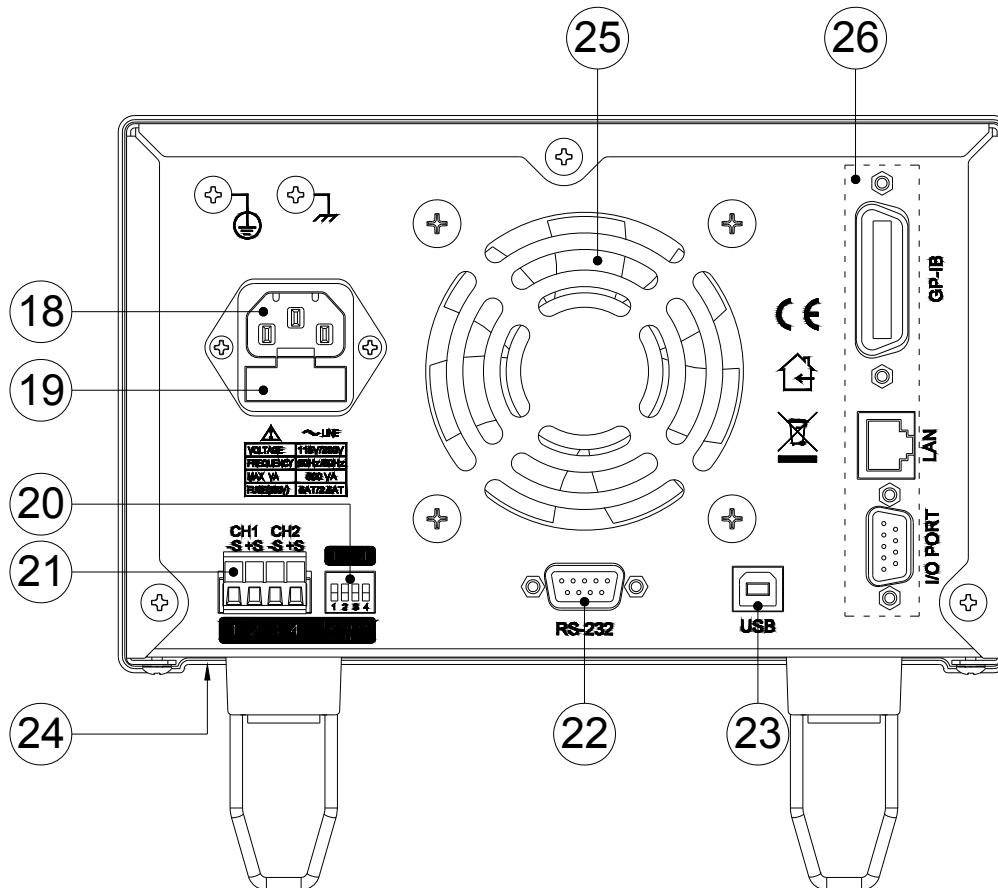


Figure 3-2. XBT32-3FTP Rear Panel

- (18) AC Power Input:
Connector for AC source (115V/230V).
- (19) Fuse compartment:
The fuse used for power source. When the switch set to 115V, using 5A slow fuse; set to 230V, using 2.5A slow fuse.
- (20) Remote Sense/Local Sense DIP switches:
When the switches are set to Local, the voltage is measured internally at the output terminals. When the switches are set to Remote sense, voltage is measured through the \pm Sense connector. Maximum line drop compensation is 1V.

(21) CH1 \pm S / CH2 \pm S:

Connect the +Sense to the positive pole of the device under test (DUT) and the –Sense to the negative pole of the DUT. When the DIP switches are set to Remote sense, the power supply has voltage compensation, and measures and controls voltage at the DUT.

(22) RS232 Interface

(23) USB Interface

(24) 115V/230V AC input power select switch (on the bottom of the power supply toward the front panel).

(25) Cooling Fan:

Variable speed adjusts with the load current.

(26) Optional Interface:

There are GPIB, LAN, I/O port.

4. OPERATION SETTING

4.1 Voltage Setting

Press "CH" to select channel (CH1, CH2 or CH3), indicated by the location of the asterisk (*) in the LCD. Use the number keys to input the voltage; press "V" to accept the voltage value.

	TIMER	TRK	LOCK	RMT	P/S
	SET: 32V				
CH1	OFF*	32.000V	3.0000A		OVP1 OCP1
CH2	OFF	10.010V	3.0000A		OVP2 OCP2
CH3	OFF	5.000V	3.0000A		OVP3 OCP3

4.2 Current Setting

Press "CH" to select channel (CH1, CH2 or CH3), indicated by the location of the asterisk (*) in the LCD. Use the number keys to input the current; press "A" to accept the current value.

	TIMER	TRK	LOCK	RMT	P/S
	SET: 3A				
CH1	OFF*	32.000V	3.0000A		OVP1 OCP1
CH2	OFF	10.010V	3.0000A		OVP2 OCP2
CH3	OFF	5.000V	3.0000A		OVP3 OCP3

4.3 Set OVP

Press “Config” to enter Configuration mode; turn rotary or press the ◀▶ keys to move the cursor to OVP setting. Press rotary to enter OVP setting display. Press “CH” to select channel to be set (CH1, CH2 or CH3), indicated by the location of the asterisk (*). Press the ON/OFF key to turn on or off OVP. Use the number keys to input the voltage. Press rotary to accept the OVP settings.

4.4 Set OCP

Press “Config” to enter Configuration mode; turn rotary or press the ◀▶ keys to move the cursor to OCP setting. Press rotary to enter OCP setting display. Press “CH” to select channel to be set (CH1, CH2 or CH3), indicated by the location of the asterisk (*). Press the ON/OFF key to turn on or off OCP. Use the number keys to input the current. Press rotary to accept the OCP settings.

4.5 Adjust Voltage

When output is on, adjust the voltage with the rotary control. First, press ◀ or ▶ keys to position the cursor at the value to be adjusted. Adjust the voltage by turning the rotary. To change channels, press the “CH” key. This provides a convenient testing tool when observing the variation of the voltage.

	TIMER	TRK	LOCK	RMT	P/S	
CH1	CV *	1.999V	0.0000A			OVP1
CH2	OFF	10.010V	3.0000A			OVP2
CH3	OFF	5.000V	3.0000A			OCP2 OVP3 OCP3

5. REMOTE INTERFACE PROTOCOL AND PACKAGE MODE

This section presents communication protocol, which includes SCPI instructions and low-error protocol.

5.1 Introduction

SCPI compliant commands allow remote operation, control and monitoring of the power supply by connecting to a personal computer (PC) via USB, IEEE-488.2 or RS-232 interface.

5.2 Definition of Parameters

Type	Valid arguments
<boolean>	ON or 1 / OFF or 0
<NR1>	The data format <NR1> is defined in IEEE-488.2 for integers. Zero, positive and negative integer numeric values are valid data.
<NRf>	The data format <NRf> is defined in IEEE-488.2 for flexible numeric representation. Zero, positive and negative floating point numeric values are valid data.
<string>	Characters are enclosed by single or double quotes.
<NL>	New line, hex code is 0x0Ah
<Rtn>	Return, hex code is 0x0Dh
<END>	end or identify

Note: All commands must end with the <NL> and <Rtn>. And there must be a space between the command and the parameter.

For example, to set the GPIB address of 10 to a XBT32-3FTP . The command line is as follows:

ADDR 10<NL><Rtn>

Note: The <NL> and <Rtn> are not presented in the following examples and command descriptions. However, they must be added to the end of each command when coding.

5.3 Error Message List

The SCPI maintains an Error/Event Queue as defined by SCPI. The queue holds up to 10 errors and events. It is queried by using the **status:error?** command which reads in a First In/First Out (FIFO) manner. The read operation removes the entry from the queue. The ***CLS** command will clear all entries from the queue.

Following is a list of error messages and their descriptions:

Error	Description
=====	
-000	No error
-002	GET not allowed
-003	Parameter not allowed
-005	Command Header Error
-010	Numeric data error
-011	Invalid character in number
-013	Too many digits
-014	Numeric data not allowed
-016	Invalid suffix
-020	Invalid character data
-030	Invalid expression
-035	Macro parameter error
-056	Timer currently running
-058	Timer syntax error

-059	Cannot create timer
-060	Password error
-088	Media protected
-089	Expression Error
-100	Program error
-101	Cannot create program
-104	Program currently running
-105	Program syntax error
-106	Program runtime error
-108	Syntax error
-109	Data type error
-110	Input voltage overwrite error
-111	Input current overwrite error

5.4 SCPI Compatible Information

The SCPI commands conform to all specifications for devices as defined in IEEE-488.2 and comply with SCPI command syntax version 1995.0. Confirmed Commands are those commands that are approved commands in the SCPI 1995 Specification, Volume 2: Command Reference.

SCPI Common Command

Command Description

=====

*CLS	Clear status (include error code)
*CAL?	As same as CALi? command,return calibration parameter
*IDN?	Response:<Manufacturer>, <model>, <serial number>, <firmware type, & version>
*RCL	Recalls settings from memory. Memory numbers from 0 to 99 are valid.
*RST	Resets the power supply to its power on state.
*SAV	1. Saves defined parameters 2. Saves current settings to memory. Memory numbers from 0 to 99 are valid.
*WAI	Sets the device to wait until all previous commands and queries are

complete before executing commands following the *WAI command.

Examples:

How to save V/I to memory:

*SAV 15 ==> Saves current settings to memory number 15
SAV 0 ==> Saves current settings to memory number 0

How to recall memory V/I variable to output:

*RCL 3 ==> recall setting from memory location 3
RCL 120 ==> the data value is invalid

How to save configuration parameters:

SAV
*SAV

How to do the software reset procedure:

*RST
RST

How to return the device identification:

*IDN?
IDN?

SCPI Command for Subsystem

OUT[n]	on/off subsystem for channel n: 1 - 3
[state/bool]	ON/1 (enable) or OFF/0 (disable) output action
:ALL[state/bool]	ON/1 (enable) or OFF/0 (disable) output action for all channels
:TRACK	enable track mode
:PARAllel	enable parallel mode
:SERial	enable serial mode
:NORMal	resume normal mode

STATus

[?]

status subsystem

read back machine status

:ERRor[?]	read back machine error code
:CCP[?]	read back Iset DAC value
:CVP[?]	read back Vset DAC value
:MONV[?]	read back Vout DAC value
:MONI[?]	read back Iout DAC value
PROG ram	program subsystem
[state/bool]	ON/1 (enable) or OFF/0 (disable) program action
[n]	select [n] as the program number, n range from 0 ~ 99
:VSET[n] [level]	volt setting for channel n: 1 - 3 voltage level: 0 – 32V for ch1 and ch2, 0 – 15V for ch3
:ISET[n] [level]	current setting for channel n: 1 - 3 current level: 0 – 3A for ch1 and ch2, 0 – 5A for ch3
:TIMER [?/ hh:mm:ss]	return or set up timer
:FASTimer [level]	set up timer for fast action unit is millisecond, range from 4~65535ms
:NEXT [?]	next step return the next program number
:END	end current program
:NEXT	next program number = current program number + 1
:JUMP[n]	jump to program number n: 0 ~ 99
:SAVE	save programmable 0 ~ programmable 99 value
TIMER	timer subsystem
[?]	return timer setting
[ON/OFF]	enable/disable timer
[hh:mm:ss]	set up timer
:TIMER?	response is current timer parameter
:PAUSE	stop running the timer

MEMory

[n]

:VSET[n]
 [level]

:ISET[n]
 [level]

:SERial?
:PWD
:PASSword
 [string]
:PWD?
:PASSword?
:SAVE

memory subsystem

select [n] page memory number, n range from 0 ~ 99
voltage level: 0 – 32V for ch1 and ch2, 0 – 15V for ch3
current setting for channel n
current level: 0 – 3A for ch1 and ch2, 0 – 5A for ch3
read back serial number
set up password
the string must be less than 15 charsters
return password
store memory subsystem parameters

CONTRol

:LCD
 [state/bool]
:FASTREQ

 [state/bool]
:HOTKey
 [state/bool]
:LOCK
 [state/bool]
:MONItor

 [state/bool]
:DHCP
 [state/bool]
:IP
 [?/ xxx.xxx.xxx.xxx]
:CHannel

control subsystem

turn ON (1) or OFF (0) the LCD backlight
ON/1 (enable) or OFF/0 (disable) fast output mode
enable/disable hotkey mode
enable/disable keypad and rotary lock
enable/disable monitor to send "status" & V/I message (GPIB & Ethernet not supported)
select DHCP command
enables/disables DHCP mode
select IP command
return IP address or set IP address
select channel

[n] channel number n: 1 - 3
:ADDRESS set up GPIB address for XBT32-3FTP
[?/ n] return or set GPIB address n: 1 - 31
:DEFAULT resume factory preset (password protected)
:PWD enter password to verify
:PASSWORD
[string] the string must be less than 15 characters
:LOCAL ON disable remote mode and back to local mode
:GPIO this command is valid when optional card exists
[?/ level] read or set up level of GPIO pins, level: 0 - 255
:DIRrection n set GPIO pins as input or output (0-input, 1-output), n: 0 – 255

GPIO	Pin 9	Pin 8	Pin 7	Pin 6	Pin 5	Pin 4	Pin 3	Pin 2	Pin 1
Bit	Bit 7	Bit 6	Bit 5	Bit 4	GND	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	X	8	4	2	1

MEASure

measure subsystem for channel n: 1 - 3
:CURRent[n]? Return the floating point value of the DC output current in amps for channel n: 1 - 3.
:VOLTage[n]? Return the floating point value of the DC output voltage in volts for channel n: 1 - 3.
:POWer[n]? Return DC output power in watts.
:RESistance[n]? Return DC output impedance in ohms.

SOURce

source subsystem
:CURRent[n] Set the floating point value of the DC output current in amps for channel n: 1 - 3.
[level] current level: 0 – 3A for ch1 and ch2, 0 – 5A for ch3
:PROTection over current protection (OCP)
[?/ level] return or set the over current in amps
:TRIGger trigger current protection

[state/bool]	ON/1 (enable) or OFF/0 (disable) OCP
:VOLTage[n]	Sets the floating point value of the DC output voltage in volts for channel n: 1 - 3.
[level]	voltage level: 0 – 32V for ch1 and ch2, 0 – 15V for ch3
:PROTection	over voltage protection (OVP)
[?/ level]	return or set the over voltage in volts
:TRIGger	trigger voltage protection
[state/bool]	ON/1 (enable) or OFF/0 (disable) OVP

EXAMPLES:

How to set tracking mode:

OUT:TRACK

How to set serial output mode:

OUT:SER

OUT:SERIAL

How to set parallel output mode:

OUT:PARA

OUT:PARALLEL

How to resume normal output mode:

OUT:NORM

OUT:NORMAL

How to read back machine status:

STATUS?

How to read back machine error code:

STAT:ERR?

STATUS:ERR?

STATUS:ERROR?

STAT:ERROR?

How to read voltage setting DAC value:

STATUS:CVP? ==> read CVP DAC value

How to read current setting DAC value:

STATUS:CCP? ==> read CCP DAC value

How to read voltage DAC value:

STATUS:MONV? ==> read MONV DAC value

How to read current DAC value:

STATUS:MONI? ==> read MONI DAC value

How to set all channels to synchronously output:

OUT:ALL 1 ==> tri-channel output is ON

OUT:ALL OFF ==> tri-channel output is OFF

How to set up timer:

TIMER 00:10:00 ==> set up the timer to run for 10 minute

TIM 99:59:59 ==> set up timer to run 99 hours 59 minutes 59 seconds and then stop

How to start timer:

TIMER ON

TIM ON

How to close timer:

TIMER OFF

TIM OFF

How to read timer parameter:

TIMER?

TIM?

How to set up a program (example):

step 1: PROG 10	==> select program number 10, program number shall be in 0 ~ 99.
step 2: PROG:VSET1 16V	==> set output voltage to 16v for ch1
step 3: PROG:VSET2 25V	==> set output voltage to 25v for ch2
step 4: PROG:VSET3 3.3V	==> set output voltage to 3.3v for ch3
step 5: PROG:ISSET1 1A	==> set output current up to 1A for ch1
step 6: PROG:ISSET2 2A	==> set output current up to 2A for ch2
step 7: PROG:ISSET3 3.3A	==> set output current up to 3.3A for ch3
step 8: PROG:TIMER:00:05:00	==> set up the run-time to 5 minutes
step 9: PROG:NEXT:NEXT	==> next step is the next program, program number 11 in this example
:	

How to save program:

PROGRAM:SAV
PROG:SAVE

How to start program:

PROG n	==> select the program number n: 0 - 99
PROGRAM ON	==> start running the program selected in the above command

How to close program:

PROG OFF

How to read program parameter:

PROGRAM?	==> Return program parameter
PROGRAM:TIMER?	==> Return timer parameter

How to set memory:

step 1: MEM:1	==> select memory number is 1
step 2: MEM:VSET 1.5	==> set channel 1 output voltage to 1.5 V.
step 3: MEM:ISSET3 5	==> set channel 3 output current up to 5 A.

How to read memory parameter:

step 1: MEM 2 ==> select memory number is 2
 step 2: MEM? ==> read back memory NO.2 parameter

How to set up GPIO direction:

GPIO	Pin 9	Pin 8	Pin 7	Pin 6	Pin 5	Pin 4	Pin 3	Pin 2	Pin 1
Bit	Bit 7	Bit 6	Bit 5	Bit 4	GND	Bit 3	Bit 2	Bit 1	Bit 0
Hex	0x80	0x40	0x20	0x10	X	0x08	0x04	0x02	0x01
Value	128	64	32	16	X	8	4	2	1

Bit 0 = $2^0 = 1$, Bit 1 = $2^1 = 2$, Bit 2 = $2^2 = 4$, Bit 3 = $2^3 = 8$
 Bit 4 = $2^4 = 16$, Bit 5 = $2^5 = 32$, Bit 6 = $2^6 = 64$, Bit 7 = $2^7 = 128$

Direction: if set Pin N high (1) means set it as an output pin;
 otherwise set Pin N Low (0) means set it as an input pin

CONT:GPIO:DIRECTION 15 ==> set GPIO pin 1 ~ pin 4 as output pins and the
 pin 6 ~ pin 9 as input pins
 15 (DEC) = 0x0F (HEX) = 0x00001111 (BIN)
 CONT:GPIO:DIR 16 ==> set GPIO pin 6 as output pin and other pins as
 input pins
 16 (DEC) = 0x10 (HEX) = 0x00010000 (BIN)

How to read back and set up GPIO levels:

*Read back or set up GPIO value base on the GPIO direction that had been set

CONT:GPIO:DIR 15 ==> set GPIO pin 1 to pin 4 as output pins,
 and pin 6 to pin 9 as input pins
 CONT:GPIO 3 ==> set pin 1 and pin 2 to a high level
 3 (DEC) = 0x03 (HEX) = 0x00000011 (BIN)
 CONT:GPIO:DIR 15 ==> set GPIO pin 1 to pin 4 as output pins,
 and pin 6 to pin 9 as input pins.
 CONT:GPIO? ==> if return a value of 96, it means the input pin 7
 and pin 8 are high and other input pins are low
 (output pins return 0)
 96 (DEC) = 0x60 (HEX) = 0x01100000 (BIN)

How to read back serial number:

MEM:SERIAL?
MEMORY:SER?

How to modify machine ID (address):

CONTROL:ADDR 23 ==> modify id to 23
CONT:ADDRESS 09 ==> modify id to 9

How to check password:

CONT:PASSWORD 123456 ==> enter password to verify

How to enter or leave the monitor mode (not supported over GPIB or Ethernet LAN):

CONT:MONITOR ON ==> enter the monitor mode
CONTROL:MONI OFF ==> exit the monitor mode

How to change channel:

CONT:CHANNEL 1 ==> change to channel 1
CONT:CH 1 ==> change to channel 1
CONTROL:CH 2 ==> change to channel 2

How to enter or leave lock status:

CONT:LOCK ON ==> enter lock mode
CONTROL:LOCK OFF ==> exit lock mode

How to enter or leave hotkey status:

CONT:HOTK ON ==> enter hotkey mode
CONTROL:HOTKEY OFF ==> exit hotkey mode

How to measure current:

MEASURE:CURRE1? ==> read back current 1 result
MEAS:CURRENT3? ==> read back current 3 result
MEAS:CURRE3? ==> read back current 3 result
CURRE1? ==> read back current 1 result
CURRENT2? ==> read back current 2 result

IOUT1? ==> read back current 1 result
 IOUT2? ==> read back current 2 result

How to measure voltage:

MEASURE:VOLT1? ==> read back voltage 1 result
 MEAS:VOLTAGE3? ==> read back voltage 3 result
 MEAS:VOLT3? ==> read back voltage 3 result
 VOUT1? ==> read back voltage 1 result
 VOUT2? ==> read back voltage 2 result

How to measure power:

MEASURE:POW1? ==> read back power for ch1
 MEAS:POWER3? ==> read back power for ch3
 MEAS:POW3? ==> read back power for ch3

How to measure resistance:

MEASURE:RES1? ==> read back resistance for ch1
 MEAS:RESISTANCE3? ==> read back resistance for ch3
 MEAS:RES3? ==> read back resistance for ch3

How to set output voltage:

SOUR:VOLTAGE2 12 ==> set output voltage to 12V for channel 2.
 SOURCE:VOLT1 30 ==> set voltage to 30V for channel 1.
 VOLT3 10 ==> set voltage to 10V for channel 3.
 VOLTAGE3 5 ==> set voltage to 5V for channel 3.
 VSET2 15 ==> set voltage to 15V for channel 2.

How to set output current:

SOUR:CURRENT2 1 ==> set current to 1A for channel 2.
 SOURCE:CURR1 3 ==> set current to 3A for channel 1.
 CURR3 1.2 ==> set current to 1.2A for channel 3.
 CURRENT3 5 ==> set current to 5A for channel 3.
 ISET2 1.5 ==> set current to 1.5A for channel 2.

How to define over voltage protection:

SOUR:VOLTAGE3:PROT 12	==>	set over voltage to 12V for channel 3.
SOURCE:VOLT1:PROT 30	==>	set over voltage to 30V for channel 1.
SOUR:VOLT2:PROTECTION 10	==>	set over voltage to 10V for channel 2.
VOLTAGE3:PROT 7	==>	set over voltage to 7V for channel 3.
VOLT2:PROT 18	==>	set over voltage to 18V for channel 2.
VOLT1:PROTECTION 27	==>	set over voltage to 27V for channel 1.
VOLT:PROTECTION 25	==>	set over voltage to 25V for channel 1.
OVSET2 19	==>	set over voltage to 19V for channel 2.

How to define over current protection:

SOUR:CURRENT3:PROT 1.2	==>	set over current to 1.2A for channel 3
SOURCE:CURR1:PROT 3	==>	set over current to 3A for channel 1
SOUR:CURR2:PROTECTION 2	==>	set over current to 2A for channel 2
CURRENT3:PROT 2.7	==>	set over current to 2.7A for channel 3
CURR2:PROT 1.8 <NL>	==>	set over current to 1.8A for channel 2
CURR1:PROTECTION 2.7	==>	ses over current to 2.7A for channel 1
CURR:PROTECTION 2.5	==>	set over current to 2.5A for channel 1
OISET2 1.9	==>	set over current to 1.9A for channel 2.

How to read back over voltage parameter:

SOUR:VOLTAGE3:PROT?	==>	return over voltage for channel 3
SOURCE:VOLT1:PROT?	==>	return over voltage for channel 1
SOUR:VOLT2:PROTECTION?	==>	return over voltage for channel 2
VOLTAGE3:PROT?	==>	return over voltage for channel 3
VOLT2:PROT?	==>	return over voltage for channel 2
VOLT1:PROTECTION?	==>	return over voltage for channel 1
VOLT:PROTECTION?	==>	return over voltage for channel 1
OVSET2?	==>	return over voltage for channel 2

How to read back over current parameter:

SOUR:CURRENT3:PROT?	==>	return over current for channel 3
SOURCE:CURR1:PROT?	==>	return over current for channel 1
SOUR:CURR2:PROTECTION?	==>	return over current for channel 2
CURRENT3:PROT?	==>	return over current for channel 3
CURR2:PROT?	==>	return over current for channel 2

CURR1:PROTECTION? ==> return over current for channel 1
 CURR:PROTECTION? ==> return over current for channel 1
 OISET2? ==> return over current for channel 2

How to enable or disable over voltage protection (OVP):

SOUR:VOLTAGE3:PROT:TRIG ON ==> enable OVP for channel 3.
 SOURCE:VOLT1:PROT:TRIG OFF ==> disable OVP for channel 1.
 SOUR:VOLT2:PROTECTION:TRIG OFF ==> disable OVP for channel 2.
 VOLTAGE3:PROT:TRIG ON ==> enable OVP for channel 3.
 VOLT2:PROT:TRIGGER ON ==> enable OVP for channel 2.
 VOLT1:PROTECTION:TRIG OFF ==> disable OVP for channel 1.
 VOLT:PROTECTION:TRIG OFF ==> disable OVP for channel 1.
 OVP2 ON ==> enable OVP for channel 2.
 OVP3 OFF ==> disable OVP for channel 3.

How to enable or disable over current protection (OCP):

SOUR:CURRENT3:PROT:TRIG ON ==> enable OCP for channel 3.
 SOURCE:CURR1:PROT:TRIG OFF ==> disable OCP for channel 1.
 SOUR:CURR2:PROTECTION:TRIG OFF ==> disable OCP for channel 2.
 CURRENT3:PROT:TRIG ON ==> enable OCP for channel 3.
 CURR2:PROT:TRIGGER ON ==> enable OCP for channel 2.
 CURR1:PROTECTION:TRIG OFF ==> disable OCP for channel 1.
 CURR:PROTECTION:TRIG OFF ==> disable OCP for channel 1.
 OCP2 ON ==> enable OCP for channel 2.
 OCP3 OFF ==> disable OCP for channel 3.

How to set up a program (example):

PROG 10 ==> define program 10
 PROG:ISET1 1 ==> set max. output current of 1A for ch1
 PROG:ISET2 1 ==> set max. output current of 1A for ch2
 PROG:ISET3 1 ==> set max. output current of 1A for ch3
 PROG:VSET1 1 ==> set output voltage of 1V for ch1
 PROG:VSET2 1 ==> set output voltage of 1V for ch2
 PROG:VSET3 1 ==> set output voltage of 1V for ch3
 PROG:FAST 4 ==> output above setting for 4 ms

PROG:NEXT:NEXT	==> go on to program 11
PROG?	==> read back the setting of program 10 for verification
PROG 11	==> define program 11
PROG:ISET1 1	==> ch1 output up to 1 A
PROG:ISET2 1	==> ch2 output up to 1 A
PROG:ISET3 1	==> ch3 output up to 1 A
PROG:VSET1 3	==> ch1 output 3V
PROG:VSET2 3	==> ch2 output 3V
PROG:VSET3 3	==> ch3 output 3V
PROG:FAST 100	==> output above setting for 100 ms
PROG:NEXT:JUMP 13	==> jump to program 13
PROG 12	==> define program 12
PROG:ISET1 1	==> ch1 output up to 1 A
PROG:ISET2 1	==> ch2 output up to 1 A
PROG:ISET3 1	==> ch3 output up to 1 A
PROG:VSET1 5	==> ch1 output 5V
PROG:VSET2 5	==> ch2 output 5V
PROG:VSET3 5	==> ch3 output 5V
PROG:FAST 500	==> output above setting for 500 ms
PROG:NEXT:END	==> end the program
PROG 13	==> define program 13
PROG:ISET1 1	==> ch1 output up to 1 A
PROG:ISET2 1	==> ch2 output up to 1 A
PROG:ISET3 1	==> ch3 output up to 1 A
PROG:VSET1 7	==> ch1 output 7V
PROG:VSET2 7	==> ch2 output 7V
PROG:VSET3 7	==> ch3 output 7V
PROG:FAST 1000	==> output the setting of program 13 for 1 second
PROG:NEXT:JUMP 12	==> jump to program 12

How to enable or disable DHCP status:

CONT:DHCP ON	==> enable DHCP
CONTROL:DHCP 1	==> enable DHCP
CONT:DHCP 0	==> disable DHCP
CONTROL:DHCP OFF	==> disable DHCP

How to get the IP address:

CONT:IP?	==> return the IP address
CONTROL:IP?	==> return the IP address

How to set the IP address:

CONT:IP 192.168.10.1	==> set up the IP address for XBT32-3FTP
CONTROL:IP 192.168.10.1	==> set up the IP address

5.5 Rules of Status Definition

byte 0:	bit 7	channel 3 on/off status
	bit 6	channel 2 on/off status
	bit 5	channel 1 on/off status
	bit 4	channel 3 OVP setting flag
	bit 3	channel 2 OVP setting flag
	bit 2	channel 1 OVP setting flag
	bit 1	channel 3 OCP setting flag
	bit 0	channel 2 OCP setting flag
byte 1:	bit 7	channel 1 OCP setting flag
	bit 6	output mode status; 0: single output 1: multi-output
	bit 5	power on status,0:output off,1: rember pre-setting status
	bit 4	hot-key flag
	bit 3	serial output mode
	bit 2	parallel output mode
	bit 1	track output mode
	bit 0	beep trigger flag

byte 2:	bit 7	disable remote mode, inhib communication
	bit 6	programmable flag
	bit 5	remote flag
	bit 4	keypad between push and pop status
	bit 3	machine running at time mode
	bit 2	machine running at sub-menu mode
	bit 1	machine running at configuration sub-menu mode
	bit 0	machine running at memory item mode
byte 3:	bit 7	machine running at power on status
	bit 6	keypad & Rotary lock flag
	bit 5	machine running at EPROM write or read mode
	bit 4	machine running at synchize mode
	bit 3	display I/V or W/ohm flag
	bit 2	machine running at LCD process mode
	bit 1	detect double- key flag
	bit 0	machine running at key-pad process mode
byte 4:	bit 7	RESERVED
	bit 6	RESERVED
	bit 5	RESERVED
	bit 4	channel 3 OVP is occur flag
	bit 3	channel 2 OVP is occur flag
	bit 2	channel 1 OVP is occur flag
	bit 1	channel 3 OCP is occur flag
	bit 0	channel 2 OCP is occur flag
byte 5:	bit 7	channel 1 OCP is occur flag
	bit 6	relay switch flag
	bit 5	in line system program flag
	bit 4	password is correct flag
	bit 3	machine running at DAC read-back mode
	bit 2	timer pause flag
	bit 1	machine running in calibration mode
	bit 0	reserved
byte 6:	bit 7	display lock message flag
	bit 6	continue to send "V/I,status" message flag

	bit 5	reserved
	bit 4	reserved
	bit 3	DHCP on or off flag
	bit 2	when the bit is on,LCD to display minus ('-') signal
	bit 1	fast-output flag
	bit 0	RESERVED
byte 7:		fan PWM value.

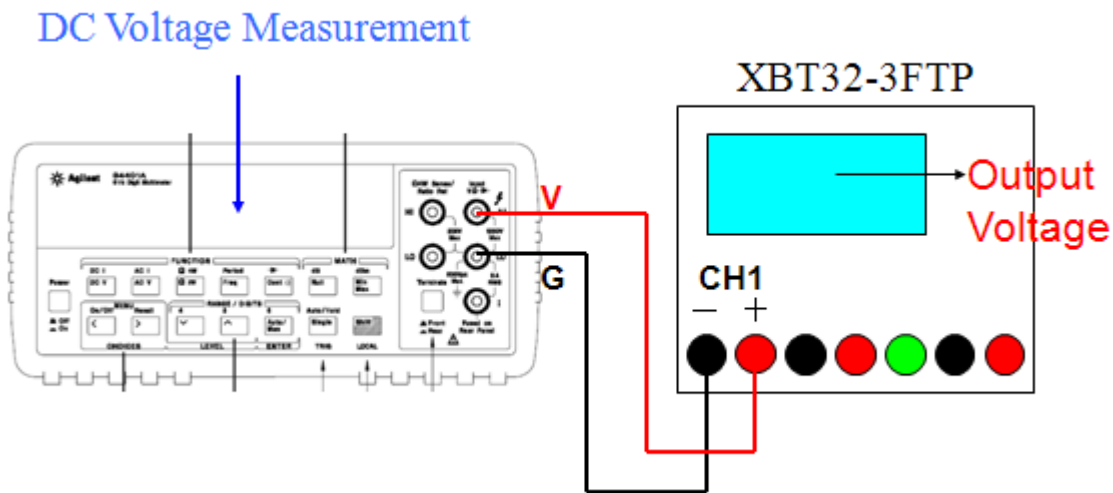
6. CALIBRATION PROCEDURE

6.1 Requirement of calibration instrument

- * Electric meter (6 ½- digital).
- * Please note if the current shunt of electric meter is too large, the current measurement will be not correct.
- * The current of the third channel can reach 5A. Therefore, please make you use the current mode at 5A (or larger). Or it will damage your meter.

6.1.1 How to enter calibration mode of CH1 : Press the rotary & numerical key “1” simultaneously.

Wiring to calibrate CH1 (voltage mode)



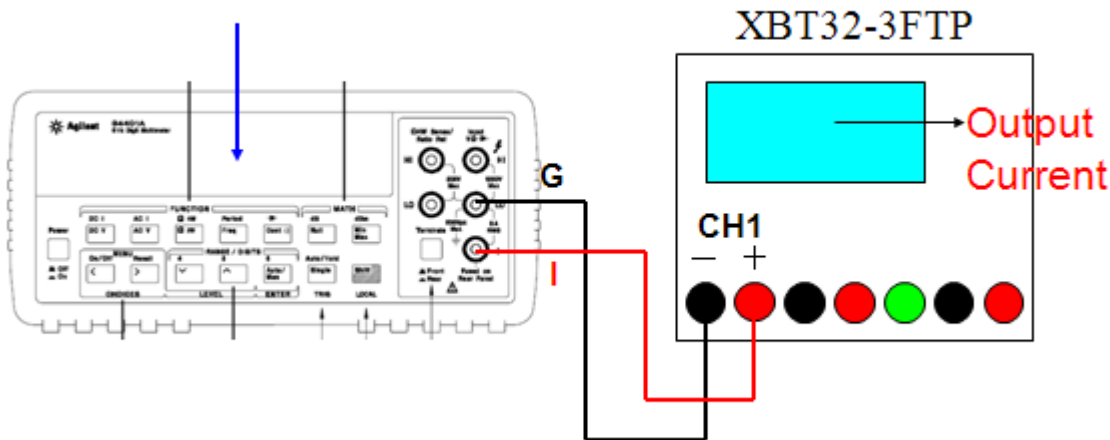
- First, you can read the screen of the voltage calibration mode of CH1, XBT32-3FTP shall output one low voltage. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high voltage. Please check the reading of electric meter and input the actual value. Once the

data input is confirmed, the voltage calibration procedure is finished. Then go to the next step to calibrate current mode of CH1.

Wiring to calibrate CH1 (current mode)

Please remember to switch your electric meter to Current Measurement mode.

DC Current Measurement

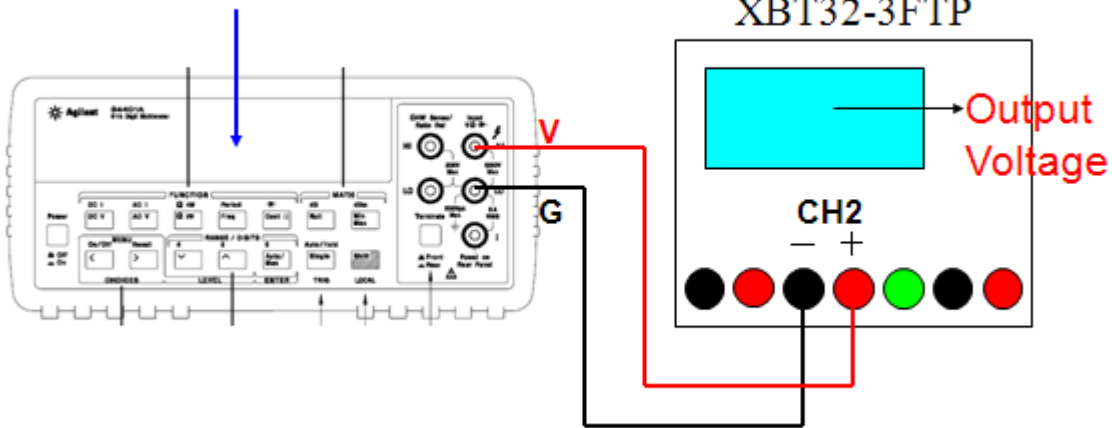


- First, you can read the screen of the current calibration mode of CH1, XBT32-3FTP shall output one low current. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high current. Please check the reading of electric meter and input the actual value. Once the data input is confirmed, the current calibration procedure is finished.

6.1.2 How to enter calibration mode of CH2 : Press the rotary & numerical key “2” simultaneously.

Wiring to calibrate CH2 (voltage mode)

DC Voltage Measurement

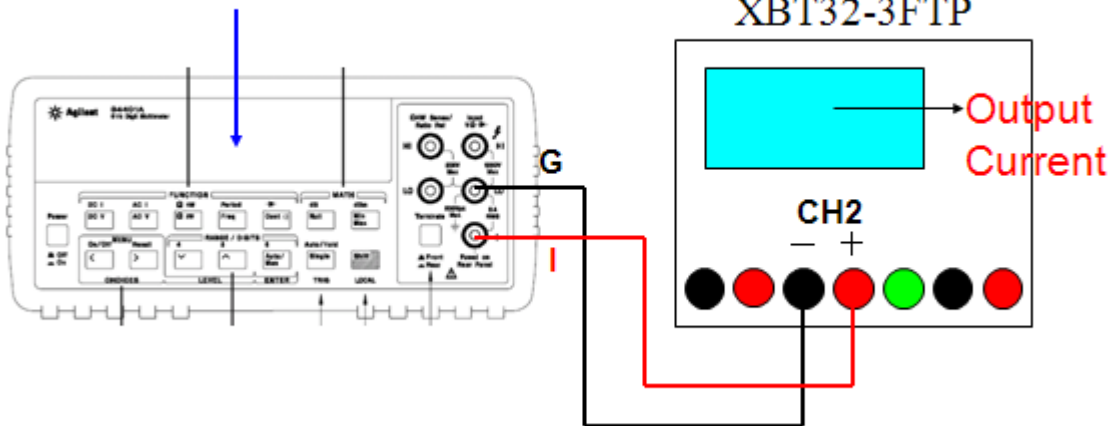


- First, you can read the screen of the voltage calibration mode of CH2, XBT32-3FTP shall output one low voltage. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high voltage. Please check the reading of electric meter and input the actual value. Once the data input is confirmed, the voltage calibration procedure is finished. Then go to the next step to calibrate current mode of CH2.

Wiring to calibrate CH2 (current mode)

Please remember to switch your electric meter to Current Measurement mode.

DC Current Measurement

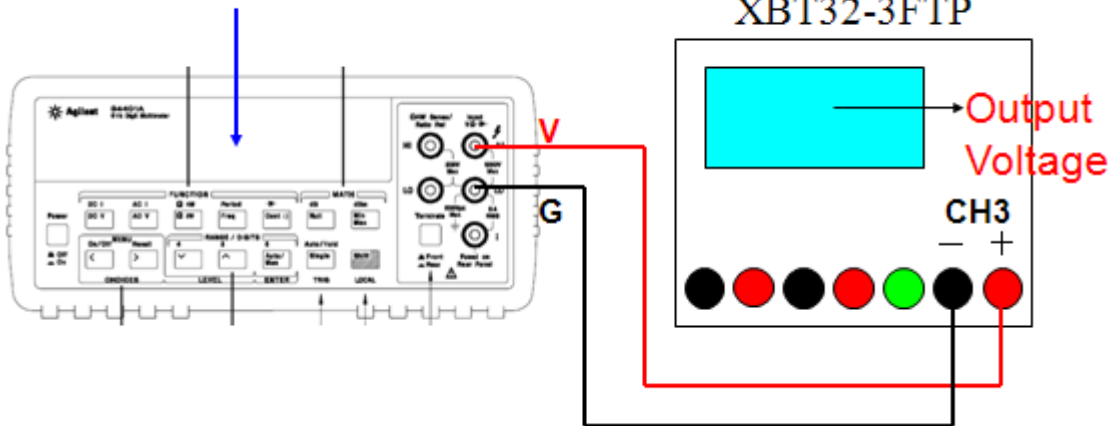


- First, you can read the screen of the current calibration mode of CH2, XBT32-3FTP shall output one low current. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high current. Please check the reading of electric meter and input the actual value. Once the data input is confirmed, the current calibration procedure is finished.

6.1.3 How to enter calibration mode of CH3 : Press the rotary & numerical key “3” simultaneously.

Wiring to calibrate CH3 (voltage mode)

DC Voltage Measurement

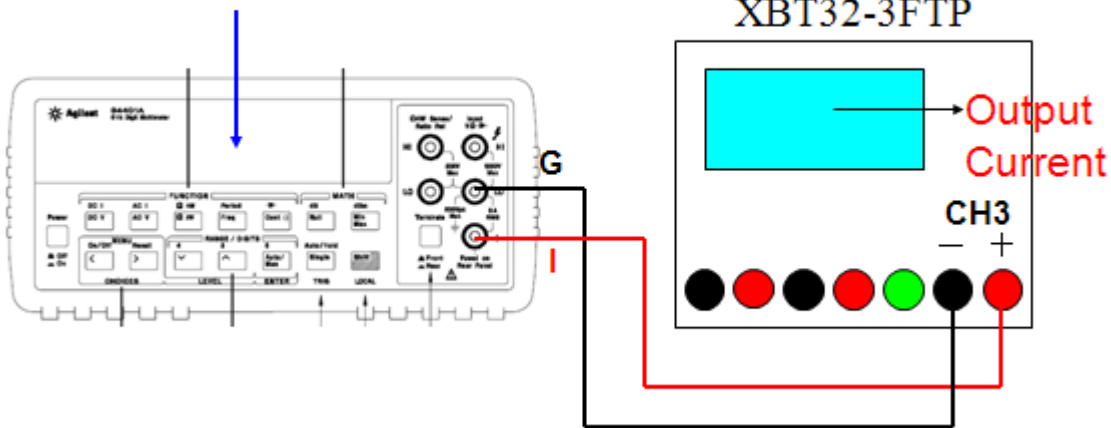


- First, you can read the screen of the voltage calibration mode of CH3, XBT32-3FTP shall output one low voltage. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high voltage. Please check the reading of electric meter and input the actual value. Once the data input is confirmed, the voltage calibration procedure is finished. Then go to the next step to calibrate current mode of CH3.

Wiring to calibrate CH3 (current mode)

Please remember to switch your electric meter to Current Measurement mode.

DC Current Measurement



- First, you can read the screen of the current calibration mode of CH3, XBT32-3FTP shall output one low current. Please read the actual reading from your electric meter and input the value to XBT32-3FTP. Then press the rotary to confirm the data input. Second, XBT32-3FTP shall output one high current. Please check the reading of electric meter and input the actual value. Once the data input is confirmed, the current calibration procedure is finished.