

# **Instruction Manual**

## **SINGLE OUTPUT PROGRAMMABLE DC POWER SUPPLY**

**Model 9120  
0 – 30V, 0 – 3A**

**Model 9121  
0 – 20V, 0 – 5A**

**Model 9122  
0 – 60V, 0 – 2.5A**

**BK PRECISION®**

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# General Information

Single output programmable DC power supplies.

Output voltage is:           0 to 30.0 V for Model 9120  
                                  0 to 20.0 V for Model 9121  
                                  0 to 60.0 V for Model 9122

Output current is:           0 to 3.00 A for Model 9120  
                                  0 to 5.00 A for Model 9121  
                                  0 to 2.50 A for Model 9122

The power supply can be locally or remote controlled.

Interfaces:                   RS232 (Standard)

The commands available in remote interface mode are

- SCPI (*Standard Commands for Programmable Instruments*) commands (SCPI 99 standard)

## Features

- **Constant Voltage / Constant Current modes of operation**

This power supply can operate in either constant voltage or constant current modes. The passing from one mode of operation to another is automatic.

The active mode of operation is indicated using two indicators:

- CV – constant voltage mode of operation
- CC – constant current mode of operation

- **Overvoltage protection**

Overvoltage protection circuit can be locally or remote activated.

When it is active, **ovp** indicator is displayed.

- **Output on / off**

When output off, output voltage is 0 V and the current is 0.002 A.

This permits a zero output voltage without switching off the power supply.

- **100 operating states storage**

States are identified by location number and name.

Stored parameters are: voltage limit, step voltage, overvoltage protection level, current limit, step current, stored state name, state of overvoltage protection circuit, state of display, output state.

- **error messages**

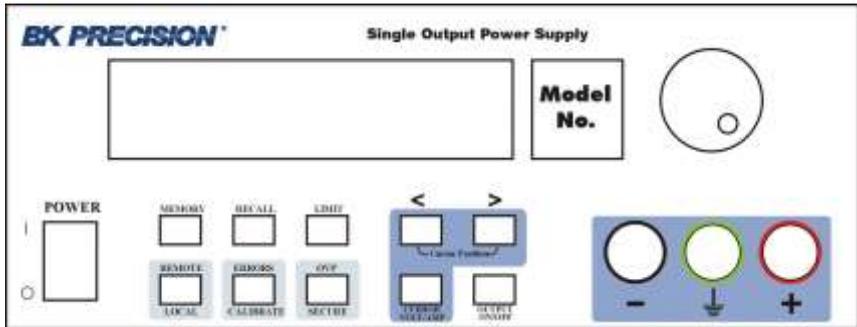
Errors are stored in a 20 locations FIFO (first in first out) queue.

They can be read in local mode (error number returned) or in remote operation mode (error number and definition returned).

Every error is announced by a beep and the **err** indicator.

# Local mode operation

## Front panel keys description



## Memory key

Note: Memory location 000 is the “Power-up” state. When the unit is powered up the power supply will set itself to the settings stored in location 000. Note: If you press the Recall button while turning the power on the power supply will power up using memory location 001 parameters.

This button is used to store power supply’s operating state in non-volatile memory. Using this function all operating parameters are saved so they can be recalled even if the power supply has been switched off or unplugged. You can store 100 different operating states in the non-volatile memory.

Stored parameters are: voltage limit, step voltage, overvoltage protection trip level, current limit, step current, stored state name, state of overvoltage protection circuit, state of display, output state.

By pressing **Memory** key, you enter in Memory menu.  
By turning the knob following options will be displayed:

Store State
Name State
Exit

Options are selected by pressing **Memory** key when the desired option is displayed.

### Memory menu overview

Store State

**Store State** option will store the current operating state without setting a name for this state. The state will be identified using location number in non-volatile memory and the default name.

By pressing **Memory** key, state number and state name are displayed in ascending order by turning the knob.

In this menu **Exit** option is available, too. In this case, you leave the store operation mode, without changing anything. **No Change** message will be displayed and the power supply returns to the previous state (the state before entering **Memory** menu).

The states are scrolled using the knob.

A location is selected by pressing **Memory** key. If the location you choose is already written, it is overwritten (without any warning) with the current state parameters, but the name (the set one or the default one remains unchanged). **Done** message will be displayed.

Name State

**Name State** option allows you to set a name for the current state (you can also change a name set before).

By pressing **Memory** key, state number of non-volatile memory locations is displayed in ascending order by turning the knob.

In this menu **Exit** option is available, too. In this case, you leave the store operation mode, without changing anything. **No Change** message will be displayed and the power supply returns to the previous state (the state before entering **Memory** menu).

The states are scrolled using the knob.

By pressing **Memory** key again, state name can be set. A state name must be set here, or the state will not be saved. When setting the name, selected digit has the cursor underneath it. Characters of the name are selected by

rotating the knob. When desired ASCII character is displayed, you can pass to another digit selection using > < cursor position keys. When the name is set, you press **Memory** again and the current state is stored in the selected location of the non-volatile memory. **Done** message will be displayed.

Exit
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**Exit** option allows you to leave the store operation mode, without changing anything. **No Change** message will be displayed and the power supply returns to the previous state (the state before entering **Memory** menu).

**Important note!**

If you enter in the **Memory** menu and no action takes place for approx. 20 seconds, the power supply leaves the **Memory** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **Memory** menu).

## Storing states in front panel mode

To store an operating state in front panel mode you must follow the steps described below:

### 1. Set the power supply in the desired operating state

Stored parameters are: voltage limit, step voltage, overvoltage protection trip level, current limit, step current, stored state name, state of overvoltage protection circuit, state of display, output state.

### 2. Enter the Memory menu

By pressing **Memory** key, you enter **Memory** menu.

By turning the knob, following options are displayed:

Store State
Name State
Exit

Options are selected by pressing **Memory** key again.

### 3. Select the storage location in the non-volatile memory

When **Store State** or **Name State** options are selected, state number and state name (if available) of non-volatile memory locations are displayed in ascending order, by turning the knob.

If **Store State** option is selected, the stored operating state has the default name (State 1 or State 2 etc.), if none set before. This means that **Store State** option does not set a name for the storage location, so this location will not have a name or it will have the set name if you overwrite a storage location which already had a name.

The difference between **Store State** and **Name State** options is that with the first option you cannot set a name when you store the state, while the latter option allows you to set a name for the stored state before the moment of saving.

After setting a name for the operating state, the power supply will display state number and state name:

002: Test_mode
----------------

#### 4. Save the operating state in the chosen storage location

For both options the saving action (with or without setting a name for the storage location) is realized by pressing **Memory** key. After that, **Done** message will be displayed.

Done

## Recall key

This key is used to recall an operating state from the storage locations in non-volatile memory. You can recall any operating state from 100 different operating states stored in the non-volatile memory. The recalled state becomes the current operating state.

By pressing **Recall** key, you enter in Recall menu.  
By turning the knob following options will be displayed:

001:

002: Test\_mode

etc. (all 100 operating states are displayed)

Exit

Reset

Options are selected by pressing **Recall** key when the desired option is displayed.

## Recall menu overview

001: State 1

When a state option is selected, the stored state recalled becomes the current operating state of the power supply.

Recalled parameters are: voltage limit, step voltage, overvoltage protection trip level, current limit, step current, state of overvoltage protection circuit, state of display, output state.

Recalling action is terminated by pressing **Recall** key. After that, **Done** message will be displayed.

Exit

**Exit** option allows you to leave the **Recall** menu, without changing anything. **No Change** message will be displayed and the power supply returns to the previous state (the state before entering **Recall** menu).

Reset
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**Reset** option allows you to reset the power supply without switching off.

In *normal* mode, the power supply displays the measured values to the output of the power supply.

In *limit* mode displayed values are 0 V and 3 A.

After reset, overvoltage protection circuit is enabled and OVP trip level is programmed to 33,00 V.

### **Important note!**

If you enter **Recall** menu and no action takes place for approx. 20 seconds, the power supply leaves the **Recall** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **Recall** menu).

## Recalling states in front panel mode

To recall an operating state in front panel mode you must follow the steps described below:

### 4. Enter the Recall menu

By pressing **Recall** key, you enter the **Recall** menu.  
By turning the knob, following options are displayed:

001: State 1

002: Test\_mode

etc. (all 100 operating states are displayed)

Exit

Reset

### 2. Select the operating state

By using < > keys and turning the knob all operating states stored in non-volatile memory are displayed. An operating state is selected by pressing **Recall** key when desired state is displayed.

### 3. Recall the operating state

When **Recall** key is pressed, the selected operating state becomes the current operating state of the power supply, after **Done** message is displayed.

## Limit key

The power supply works in 2 modes:

- *Limit* mode
- *Normal* mode

In *limit* mode limit values of voltage and current are displayed. In this mode they can also be adjusted (see constant voltage operation and constant current operation).

In *normal* mode, voltage and current values measured at the output terminals of the power supply are displayed. In this mode they can also be adjusted.

**Limit** key is used to get the power supply to *limit* mode. In this mode, **lmt** indicator and limit values for voltage and current will be displayed.

In *limit* mode, limit values can be adjusted by turning the knob. To adjust values in *limit* mode, > < keys must be used to select the digit you want to adjust. The selected digit has the cursor underneath it. To increase / decrease value of digit, knob must be turned.

When you turn on the power supply, the cursor is placed underneath the voltage value (units digit). To pass from voltage value to current value **Volt/Amp** key must be used. This key toggles between voltage value and current value.

### Important!

> < **Volt/Amp** keys work the same way in *normal* mode, when you want to adjust displayed values.

After setting the limit values, by pressing **Limit** key, the power supply returns to *normal* mode. It also returns to *normal* mode after several seconds (display time-out) with no action.

## Constant current operation

In constant current operation, current values in *limit* mode and *normal* mode are the same, but voltage values are not. In this situation you can adjust voltage limit value by turning the knob.

### Important note!

In *normal* mode you cannot see voltage limit value adjusted by turning the knob. You can see that only in *limit* mode.

To set the power supply in constant current operation, you must follow the steps described below:

#### 1. Connect a load to the output terminals

Turn off the power supply and connect a load between (-) and (+) terminals.

#### 2. Turn on the power supply

When you turn on the power supply, default values are available:

Measured values to the output terminals – in *normal* mode

0 V / 3 A (5A) – in *limit* mode

**Output off** message will be displayed.

#### 3. Set *limit* mode operation

Press **Limit** key to set *limit* mode.

Now the power supply displays limit values for voltage and current. **lmt** indicator is displayed, too. (it will be displayed until you go to *normal* mode).

#### 4. Set the voltage limit value

Now you can set the voltage limit value by using:

**Volt / Amp** key to select current value,

> < keys to select the digit to adjust (selected digit has cursor underneath it)

knob to set the digit to desired value

#### 5. Set output current

Still in *limit* mode (**lmt** indicator is still displayed), you can set output current by using:

**Volt / Amp** key to select voltage value,

> < keys to select the digit to adjust (selected digit has cursor underneath it)

knob to set the digit to desired value

## 6. Set *normal* mode operation

You can set *normal* mode operation by pressing **Limit** key or let the display time-out (after several seconds with no action, power supply returns to *normal* mode operation).

**Output off** message will be displayed and **lmt** indicator will not be displayed anymore.

## 7. Enable the output of the power supply

By pressing **On / Off** key, you enable the output.

Power supply goes to *normal* mode operation and **CC** indicator will be displayed. In this case constant current operation is active.

If **CV** indicator will be displayed, you must set a higher value for voltage limit.

### **Important note!**

If voltage limit value is exceeded in *normal* mode operation, power supply goes to constant voltage operation.

In this case, voltage value in *normal* mode remains unchanged, even if you turn the knob to raise it. You can see the raising of the voltage value according to knob turning only in *limit* mode.

## Constant voltage operation

In constant voltage operation, voltage values in *limit* mode and *normal* mode are the same, but current values are not. In this situation you can adjust current limit value by turning the knob.

### Important note:

In *normal* mode you cannot see current limit value adjusted by turning the knob. You can see that only in *limit* mode.

To set the power supply in constant voltage operation, you must follow the steps described bellow:

### 1. Connect a load to the output terminals

Turn off the power supply and connect a load between (-) and (+) terminals.

### 2. Turn on the power supply

When you turn on the power supply, default values are available:

Measured values at the output terminals – in *normal* mode

0 V / 3 A (5A) – in *limit* mode

**Output off** message will be displayed.

### 3. Set *limit* mode operation

Press **Limit** key to set *limit* mode.

Now the power supply displays limit values for voltage and current. **lmt** indicator is displayed, too. (it will be displayed until you go to *normal* mode).

### 4. Set the current limit value

Now you can set the current limit value by using:

**Volt / Amp** key to select current value,

> < keys to select the digit to adjust (selected digit has cursor underneath it)  
knob to set the digit to desired value

### 5. Set output voltage

Still in *limit* mode (**lmt** indicator is still displayed), you can set output voltage by using

**Volt / Amp** key to select voltage value,

> < keys to select the digit to adjust (selected digit has cursor underneath it)  
knob to set the digit to desired value

### 6. Set *normal* mode operation

You can set *normal* mode operation by pressing **Limit** key or let the display time-out (after several seconds with no action, power supply returns to *normal* mode operation).

**Output off** message will be displayed and **lmt** indicator will not be displayed anymore.

### **7. Enable the output of the power supply**

By pressing **On / Off** key, you enable the output.

Power supply goes to *normal* mode operation and **CV** indicator will be displayed. In this case constant voltage operation is active.

If **CC** indicator will be displayed, you must set a higher value for current limit.

### **Important note!**

If current limit value is exceeded in *normal* mode operation, power supply goes to constant current operation.

In this case, voltage value in *normal* mode remains unchanged, even if you turn the knob to raise it. You can see the raising of the voltage value according to knob turning only in *limit* mode.

## On / Off key

**On / Off** key is used to enable / disable the output of the power supply from the front panel.

When the output is off, power supply displays:

Output off

The indicators according to power supply's state will also be displayed (e.g.: ovp, err indicators).

When output off, output voltage is 0 V and the current is 0.002 A. So this command permits a zero output voltage without switching off the power supply.

When you turn on the power supply, the output is disabled and the OVP circuit is enabled (OVP trip level is 33 V). So the power supply will display:

Output Off  
ovp

When output off, knob is disabled, to prevent the unwanted changes in voltage and current values. The keys from the front panel are not disabled. You can also go to *limit* mode and set limit values for voltage and current. In this case both **lmt** and **off** indicators will be displayed.

When output off, if you press **On / Off** key you enable the output. The power supply will go to *normal* mode of operation (voltage and current measured values are displayed).

By pressing **On / Off** key, you alternate these two states: output on / output off.

The output state of the power supply is stored in non-volatile memory.

## Remote / Local key

This key has a double function: remote settings and return to *local* mode of operation (for the latter see **Calibration** section).

When in *local* mode of operation, by pressing **Remote / Local** key, you may choose the remote interface you want. By turning the knob, following options are displayed:

RS - 232

Options are selected by pressing **Remote / Local** key when the desired option is displayed.

## RS – 232 interface

RS - 232

This option allows you to select RS 232 interface.

Available settings for RS232 interface:

- ◆ Baud rate: 1200, 2400, 4800, 9600 (**factory setting: 9600**)
- ◆ Parity and data bits: None – 8 data bits (**factory setting**)  
Odd – 7 data bits  
Even – 7 data bits
- ◆ Number of start bits: 1 bit (cannot be changed)
- ◆ Number of stop bits: 2 bits (cannot be changed)

## Set RS – 232 remote interface

### 1. Select RS – 232 interface

Press **Remote / Local** key.

By turning the knob, select RS - 232 interface.

Press **Remote / Local** key again, to set RS – 232 interface. Baud rate settings will be displayed.

## 2. Select baud rate

By turning the knob, you will view available baud rate.

When desired baud rate is displayed, press **Remote / Local** key. Parity settings will be displayed

## 3. Select parity

By turning the knob, you will view available parities.

When desired parity is displayed, press **Remote / Local** key.

These settings are saved in non-volatile memory, so they don't change when you turn of the power supply.

If you didn't change anything of the previous set parameters, the power supply will display **No Change** message.

If you did change a single parameter from the previous set parameters, **Saved** message will be displayed.

After one of these messages is displayed for several seconds, you return to the previous state.

### Important note!

If you enter in the **Remote / Local** submenu and no action takes place for approx. 20 seconds, the power supply will leave this submenu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering this submenu).

When in *remote interface* mode of operation, **rmt** indicator will be displayed. **Local** function is active. This allows you to put the power supply in *local* mode of operation, so front panel keys become active.

**Local** function is also active in *calibrating* mode (see **Calibration** section).

## Errors / Calibrate key

This key has a double function: errors related in *normal* mode (see this section) and calibration related in *calibration* mode (see calibration section).

There are 2 types of errors: user defined errors and errors defined by SCPI 1999 standard.

Every time an error is generated, you hear a beep and **err** indicator will be displayed.

Generated errors are saved in an error queue, in FIFO (first in – first out) order. If more than 20 errors are generated, the last error is overwritten with *-350* error (queue overflow error) and no more errors are saved.

While in remote mode (**rmt** indicator is displayed), errors are erased from the queue as you read them.

By pressing **Errors / Calibrate** key, you enter **Errors / Calibrate** menu. By turning the knob, following options are displayed:

Errors

Cal String

Exit

Options are selected by pressing **Errors / Calibrate** key when the desired option is displayed.

Errors

**Errors** option allows you to view the generated errors.

If you press **Errors / Calibrate** key again, by turning the knob you can see all generated errors. Error's code will be displayed. When all errors were viewed, if continue to turn the knob, they will be displayed again.

After you viewed all errors, you press **Errors / Calibrate** key again. The power supply will erase all the errors from the error queue and **Errors Erased** message will be displayed.

and after several seconds the power supply will go back to *normal* mode. **err** indicator will not be displayed anymore.

If there are no errors in the queue and you select **Errors** option in order to view the errors, the power supply will display:

No Errors

And then it will return to *normal* mode.

There are 2 ways of erasing the error queue:

- ◆ By turning off and then turning on the power supply
- ◆ By pressing **Errors** / **Calibrate** key after errors are displayed, in *local* mode
- ◆ By reading errors, in remote operation.

### **Important note!**

If you let the display time out, the power supply will go back to *normal* mode, without erasing the error queue.

Cal String

The power supply allows you to store a calibration message. It may contain last calibration date, the date when the next calibration must be done or the name and the phone number of the person to contact for a new calibration

This message can have up to 40 characters. It can be set only remote interface and it is saved in non-volatile memory.

**Cal String** option allows you to view the calibration string.

If you press **Errors** / **Calibrate** key when **Cal String** option is displayed, the calibration message will be displayed. To scroll through the calibration message, you must press < key. To increase the scrolling speed, you must press > key. To decrease scrolling speed, you must press < key.

Exit
------

**Exit** option allows you to leave this menu, without changing anything. **Exiting** message will be displayed and the power supply returns to the previous state (the state before entering this menu).

**Important note!**

If you enter in the **Errors / Calibrate** menu and no action takes place for approx. 20 seconds, the power supply leaves this menu. **Exiting** message is displayed and the power supply returns to the previous state (the state before entering **Errors / Calibrate** menu).

## Calibration overview

Calibration is a procedure that ensures that the power supply will work properly, with parameters specified within *Technical Specification* section.

Before initiating the calibration procedure, you must disconnect any loads connected to the power supply and turn it on. You let the power supply turned on for 1 hour, with no loads connected and after that you can start calibration procedure.

Recommended calibration interval is 1 year.

## Calibration security code

To prevent accidental or unauthorized calibration procedures, the power supply has a calibration security code. This security code is optional, so you may have it or not. The power supply will work properly in both cases.

Security code may contain numbers (0..9), small letters (a..z) and spaces (“ “). Any of these characters may be used as the first character in security code.

Security code may contain up to 11 characters. But it is not necessary for you to use all 11 characters for the security code.

The security code is saved in non-volatile memory and it doesn't change when you turn on or turn off the power supply.

When delivered, power supply has no security code.

In order to initiate the calibration procedure, first you must unsecure the power supply (if a security code is set).

## Unsecure procedure for calibration

To unsecure the power supply, you must follow the next steps:

### 1. Turn on the power supply in *calibrating* mode

To enter *calibration* mode, you must turn on the power supply while pressing **Errors / Calibrate** key. You release the key after the long beep. After that, the power supply will display:

Calibrating Mode Secured
-----------------------------

if the power supply is secured (if the power supply has a security code set). If this message is displayed, go to step 2.

or :

Calibrating Mode  
Unsecured

if the power supply is not secured (if the power supply has been turned off after the unsecure procedure, or if you unsecured the power supply using hardware unsecure procedure).

From now on, the power supply remains unsecured until you set a new secure code.

If the power supply is already unsecured, you can proceed with calibration (see **Calibration procedure** section)

## 2. Enter security code

Press **OVP / Secure** key. The power supply will display:

Security code:  
-----

Here you must enter the security code, using > < keys and knob. The selected digit has the cursor underneath it. If you set the digit to the desired value, you must press **OVP / Secure** key and go to the next digit, if you want.

After you entered the security code, press **OVP / Secure** key again and if the security code is correct, the power supply will display:

Calibrating Mode  
Unsecured

From this moment you can proceed with calibration (see **Calibration procedure** section) or you can go back to *normal* mode operation.

If the security code you entered is not correct, power supply will display:

Security code:  
invalid

for 1 second. 703 error (*Invalid secure code*) and a short beep will be generated. You can see the error in *normal* mode operation (by pressing **Local** key).

After that power supply will display again:

Security code: -----
-------------------------

and you must enter security code again. If you don't remember the correct security code, you may follow the hardware unsecure procedure (see **Hardware unsecure procedure**).

### **Important Note!**

While in *calibrating* mode, before you unsecure the power supply, only **Local** and **Secure** keys are active (all the rest are locked).

**Local** key is used to leave *calibrating* mode and go back to *normal* mode operation.

**Secure** key is used in unsecure procedure of the power supply (allows you to enter and validate the secure code).

While in *calibrating* mode, after you unsecure the power supply, only **Local**, **Secure** and **Calibrate** keys are active.

**Local** key is used to leave *calibrating* mode and go back to *normal* mode operation.

**Secure** key is used to set a new security code (you may introduce a new security code and secure again the power supply).

**Calibrate** key is used to proceed with calibration.

### **Attention!**

**Local** key is active all the time while in *calibrating* mode.

After you changed the security code or unsecured the power supply, you can go back to *normal* mode by pressing **Local** key. (You can come back to *calibrating* mode only by turning off the power supply and starting it in *calibrating* mode).

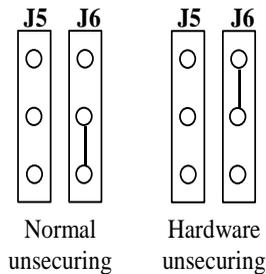
But once you started the calibration procedure, it is recommended to finish it and to go back to *normal* mode by turning off and on the power supply.

## Hardware unsecure procedure for calibration

This procedure may be used to unsecure the power supply if you forgot the security code.

To unsecure the power supply without using the security code, follow the next steps:

1. Turn off the power supply. Disconnect the power cord and all loads connected to the power supply.
2. Remove power supply's cover. Set **J6** jumper for hardware unsecuring mode.



3. Connect the power cord to the power supply. Turn on the power supply in *calibrating* mode.
4. Unsecure the power supply.

To unsecure the power supply you must press **Secure** key. Power supply will display:

Calibrating Mode  
Secured

Press again **Secure** key and you will unsecure the power supply. It will display:

Calibrating Mode  
Unsecured

The power supply remains unsecured until you enter a new security code.

### Important note!

Even if you are in *calibrating* mode, you cannot set a security code as long as the **J6** jumper is in hardware unsecuring position.

5. Set **J6** jumper for normal unsecuring mode.

**Important note!**

If you turn on the power supply in either *normal* mode or *calibrating* mode and **J6** jumper is in hardware unsecuring position, 701 error (*Calibration security disabled by jumper*) will be generated.

6. Turn off the power supply and reassemble it.

## Calibration procedure

Before initiating the calibration procedure, you must disconnect any loads connected to the power supply and turn it on. You let the power supply turned on for 1 hour, with no loads connected and after that you can start calibration procedure.

On calibration procedure there are three parameters that must be calibrated: voltage, OVP and current.

You can leave the calibration procedure at any time by turning off the power supply or by pressing **Local** key.

But once you started the calibration procedure, it is recommended to finish it and to go back to *normal* mode by turning off and then turning on the power supply.

In order to be sure that the power supply will work properly in *normal* mode after you leave the calibration procedure, you must turn off the power supply.

Recommended calibration interval is 1 year.

Before calibrating the power supply you must unsecure it, if secured (see **Calibration Overview** section).

After you unsecured the power supply and you pressed **Calibrate** key, you go to **Calibrate** menu. By turning the knob next options are available:

- Volt Zero Scale
- Volt Full Gain
- OVP
- Curr Zero Scale
- Curr Full Gain

Options are selected by pressing **Calibrate** key.

### **Important note!**

The restrictions in calibration order are:

- ◆ You must perform voltage calibration procedure before OVP calibration procedure.
- ◆ In voltage / current calibration procedure, you must perform *zero scale* procedure before *full gain* procedure.

## Voltage Calibration Procedure

After you unsecured the power supply and you pressed **Calibrate** key, you entered *calibrate* mode.

### Volt Zero Scale Calibration

#### 1. Select *Volt Zero Scale* calibration procedure

In order to start voltage calibration procedure, you must select **Volt Zero Scale** option.

The power supply will display:

Calibrating Mode  
Volt Zero Scale

You select this option by pressing **Calibrate** key.

The power supply will display:

Volt Zero Scale  
DAC:1999

#### 2. Initiate DAC calibration procedure

Connect a digital voltmeter to the output terminals of the power supply. After that, you must adjust DAC value displayed by the power supply until the voltmeter indicates 0.000 Volt.

For this, you use > < keys and the knob.

It is not necessary to disconnect the digital voltmeter, since you will need it later on calibration procedure!

#### 3. Initiate ADC calibration procedure

Press **Calibrate** key. This will initiate ADC calibration procedure. The power supply will display:

Volt Zero Scale  
ADC Calibrating

After ADC calibration, power supply will return to **Calibrate** menu.

## **Volt Full Gain Calibration**

### **1. Select Volt Full Gain calibration procedure**

In order to finish voltage calibration procedure, you must select **Volt Full Gain** option.

The power supply will display:

Calibrating Mode  
Volt Full Gain

You select this option by pressing **Calibrate** key.

The power supply will display:

Volt Full Gain  
DAC:31470

### **2. Initiate DAC calibration procedure**

Connect a digital voltmeter to the output terminals of the power supply. After that, you must adjust DAC value displayed by the power supply until the voltmeter indicates 16.384 Volt.

For this, you use >< keys and the knob

### **3. Initiate ADC calibration procedure**

Press **Calibrate** key. This will initiate ADC calibration procedure. The power supply will display:

Volt Full Gain  
ADC Calibrating

After ADC calibration, power supply will return to **Calibrate** menu.

## **OVP Calibration**

### **Important note!**

You must perform voltage calibration procedure before OVP calibration procedure.

### **1. Select OVP calibration procedure**

In order to initiate OVP calibration procedure, you must select **OVP** option.

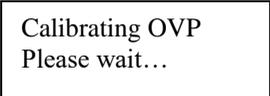
The power supply will display:



Calibrating Mode  
OVP

You select this option by pressing **Calibrate** key.

The power supply will display:



Calibrating OVP  
Please wait...

### **Important note!**

**This calibration procedure will take several minutes.**

After OVP calibration, power supply will return to **Calibrate** menu.

## Current Calibration Procedure

Current calibration may be executed at any moment of time of calibration procedure!

### Current Zero Scale Calibration

#### 1. Select *Curr Zero Scale* calibration procedure

In order to start current calibration procedure, you must select **Curr Zero Scale** option.

The power supply will display:

Calibrating Mode Curr Zero Scale
-------------------------------------

#### 2. Initiate DAC calibration procedure

You select this option by pressing **Calibrate** key. So **Current Zero Scale** calibration procedure will be initiated.

The power supply will display:

Curr Zero Scale ADC:Calibrating
------------------------------------

After a while, the power supply will display:

Curr Zero Scale DAC:Calibrating
------------------------------------

#### **Important note!**

This calibration procedure will take several minutes.

After **Current Zero Scale** calibration procedure, power supply will return to **Calibrate** menu.

## **Curr Full Gain Calibration**

### **1. Select *Curr Full Gain* calibration procedure**

In order to finish current calibration procedure, you must select **Curr Full Gain** option.

The power supply will display:

Calibrating Mode  
Curr Full Gain

You select this option by pressing **Calibrate** key.

The power supply will display:

Curr Full Gain  
Connect Ammeter

### **2. Initiate DAC calibration procedure**

In order to initiate Curr Full Gain calibration procedure, you must connect a digital ammeter to the output terminals of the power supply.

If don't connect a digital ammeter within 30 seconds, the power supply will display:

Calibrating Mode  
CC Not Set

and it will return to Calibrate menu.

After you connected the digital ammeter, you must adjust DAC value displayed by the power supply until the ammeter indicates 2.62144 Ampere.

For this, you use > < keys and the knob.

### **3. Initiate ADC calibration procedure**

Press **Calibrate** key. This will initiate ADC calibration procedure. The power supply will display:

Curr Full Gain  
ADC Calibrating

After ADC calibration, power supply will return to **Calibrate** menu.

## **OVP / Secure key**

This key has a double function: OVP settings in *normal* mode operation and secure key in *calibration* mode operation (for the latter see **Calibration** section).

In this section OVP functions will be described.

OVP circuit prevents the output voltage from rising above a programmed voltage value. So the load connected to the output terminals is protected to overvoltage situations.

Overvoltage protection circuit is activated when output voltage value becomes equal or greater than the programmed trip level for overvoltage protection circuit.

## **OVP menu overview**

By pressing **OVP / Secure** key, you enter OVP menu.

By turning the knob programmed OVP trip level will be displayed:

Level 33.00V

When you turn on the power supply, OVP trip level is set to 33 Volt value.

Here you can set desired OVP trip level, by using > < keys to select the digit you want to adjust (selected digit has the cursor underneath) and knob to set the digit to desired value.

The OVP trip level you set is programmed by pressing **OVP / Secure** key.

After that, you enter the OVP menu again.

By turning the knob, following options are displayed:

OVP On

OVP Clear

OVP Off

Options are selected by pressing **OVP / Secure** key when the desired option is displayed.

### OVP On

**OVP On** option enables overvoltage protection circuit. OVP trip level is the level value you programmed on **Level** option (after you first pressed **OVP / Secure** key).

If you want to keep the previously programmed trip level (or the power on trip level, 33 V), you simply press **OVP / Secure** key, without changing anything.

If you enable the overvoltage protection circuit, when you return to *normal* mode, **ovp** indicator will be displayed.

### OVP Off

**OVP Off** option disables overvoltage protection circuit. In this case, even if the output voltage value gets equal or greater than programmed OVP trip level, the overvoltage protection circuit will not become active. So the power supply does not protect the connected load from overvoltage situations.

If you disable the overvoltage protection circuit, when you return to *normal* mode, **ovp** indicator will not be displayed anymore.

### OVP Clear

**OVP Clear** option is used to clear to OVP condition (for more details about how you get back to *normal* mode after OVP level was tripped, see next section).

After you select the desired option, a message will be displayed.

If you didn't change anything of the previous set parameters, the power supply will display **No Change** message.

If you did change a single parameter from the previous set parameters **Done** message will be displayed.

After one of these messages is displayed for several seconds, you return to *normal* mode.

**Important note!**

If you enter in the **OVP** menu and no action takes place for approx. 23 seconds, the power supply will leave the **OVP** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **OVP** menu).

If the output voltage value becomes equal or greater than OVP programmed level and the overvoltage protection circuit is enabled, the power supply will display:

Over Voltage Output Off
----------------------------

And the output voltage value will be 0 V (output is disabled).

There are three ways of clearing the OVP condition:

- By increasing OVP trip level and clearing the OVP condition
- By decreasing the output voltage and clearing the OVP condition
- By disabling OVP circuit and by clearing the OVP condition

**Important note!**

When you turn on the power supply, the overvoltage protection circuit is enabled and the OVP trip level is set to 33 V.

## Programming overvoltage protection circuit in front panel mode

If you want to program an OVP trip level and to enable the overvoltage protection circuit, follow the next steps:

### 1. Turn on the power supply

When you turn on the power supply, the overvoltage protection circuit is enabled and OVP trip level is set to 33 V.

### 2. Enter the OVP menu and set OVP trip level

By pressing **OVP / Secure** key, you enter the OVP menu. The power supply will display the programmed OVP trip level:

Level 33.00V

For changing this value, you can use > < to select the digit you want to adjust (selected digit has the cursor underneath) and then turn the knob to set the desired value.

After you set the desired value for OVP trip level, you press **OVP / Secure** key.

### Important note!

You cannot set an OVP trip level lower than 1 Volt.

### 3. Enable the OVP circuit

After you set the desired OVP trip level and you pressed **OVP / Secure** key, **OVP On, OVP Off and OVP Clear** options are available.

To enable the OVP circuit, you select **OVP On** option by turning the knob

OVP On

### 4. Exit the OVP submenu

To exit the OVP submenu and to validate all the settings you have done, then you press **OVP / Secure** key.

After that, **Changed** message will be displayed and the power supply return to previous state (the state before you entered the OVP submenu), in *normal* mode operation.

Changed

**ovp** indicator will be displayed.

If you didn't change anything, the power supply will display **No Change** message.

### **Clearing the overvoltage condition**

There are three ways of clearing the OVP condition:

- By increasing OVP trip level and clearing the OVP condition
- By decreasing the output voltage and clearing the OVP condition
- By disabling OVP circuit and by clearing the OVP condition

### **Attention!**

The latter solution disables the OVP circuit, but the first and the second don't!

In this section we will describe the steps you must follow to clear the OVP condition in all three cases.

If the output voltage value becomes equal or greater than OVP programmed level and the overvoltage protection circuit is enabled, the power supply will display:

Over Voltage Output Off
----------------------------

And the output voltage value will be 0 V (output is disabled).

## Clearing OVP condition

### Clearing the OVP condition by increasing OVP trip level

#### 1. Enter the OVP menu

By pressing **OVP / Secure** key, you enter the OVP menu.

#### 2. Adjust OVP trip level

When you enter OVP menu, OVP trip level is displayed.

Here, you set OVP trip level to a level higher than the tripped level.

#### 3. Clear OVP condition

After you set the OVP trip level, you press **OVP / Secure** key.

Here, **OVP On**, **OVP Off**, **OVP Clear** options are available. Select **OVP Clear** option by turning the knob.

OVP Clear

After that, press **OVP / Secure** key. The power supply will display:

Clear OVP:Done

and after several seconds it will return to *normal* mode. **ovp** indicator will be displayed (the OVP circuit is still enabled).

#### Important note!

If you enter in the **OVP** menu and no action takes place for approx. 23 seconds, the power supply will leave the **OVP** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **OVP** menu).

## Clearing the OVP condition by decreasing the output voltage

### 1. Decrease the output voltage level bellow OVP trip level

Press **Limit** key and enter *limit* mode. Limit values of voltage and current will be displayed. **ovp** and **lmt** indicators will also be displayed.

Adjust for output voltage limit to a lower value than the OVP trip level.

Press **Limit** key to exit *limit* mode.

### 2. Enter OVP menu and clear OVP condition

Here you check that the OVP trip level is greater than the output voltage limit you set. If it isn't, go to step 1.  
Don't adjust OVP trip level!

Clear OVP condition by turning the knob and selecting **OVP Clear** option:

OVP Clear

After that, press **OVP / Secure** key. The power supply will display:

Clear OVP:Done

and after several seconds it will return to *normal* mode. **ovp** indicator will be displayed (the OVP circuit is still enabled).

### Important note!

If you enter in the **OVP** menu and no action takes place for approx. 23 seconds, the power supply will leave the **OVP** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **OVP** menu).

## Clearing the OVP condition by disabling OVP circuit

### 1. Disable OVP circuit

By pressing **OVP / Secure** key, you enter OVP menu.

Here you disable OVP circuit by turning the knob and selecting **OVP Off** option.

OVP Off

It doesn't matter if you change or not OVP trip level as long as you disable the OVP circuit. But you must be careful to set it to the right value before you enable OVP circuit next time.

After you selected **OVP Off** option and you pressed **OVP / Secure** key, the power supply will display

Over Voltage  
Output Off

because you didn't clear the OVP condition yet

### 2. Enter OVP menu and clear OVP condition

You enter OVP menu again by pressing **OVP / Secure** key. Now you clear OVP condition by turning the knob and selecting **OVP Clear** option:

OVP Clear

After that, press **OVP / Secure** key. The power supply will display:

Clear OVP:Done

and after several seconds it will return to *normal* mode. **ovp** indicator will be displayed (the OVP circuit is still enabled).

### Important note!

If you enter in the **OVP** menu and no action takes place for approx. 23 seconds, the power supply will leave the **OVP** menu. **No Change** message is displayed and the power supply returns to the previous state (the state before entering **OVP** menu).

## Remote interface

RS – 232 interface is used for remote communication.

For this, you must connect your power supply to a computer terminal (see Technical Specification section, Interface Cable paragraph).

For remote control of the power supply, SCPI (*Standard Commands for Programmable Instruments*) commands are used.

In this section SCPI commands will be described to you.

Here are some conventions used in SCPI standard:

- ◆ A command consists of a command keyword (command name) and a parameter (it may be optional or not)
- ◆ Lower case and upper case letters are considered equivalent
- ◆ Letter case is used to differentiate between the accepted short form (the uppercase characters) and the long form (the whole keyword)
  
- ◆ Square brackets ([]) are used to enclose:
  - ◆ a keyword that is optional when programming the command
  - ◆ one or more parameters that are optional when controlling the instruments.
- ◆ Braces or curly brackets ({} ) are used to enclose one or more parameters that may be included zero or more times.
- ◆ The angle brackets (<>) are used to enclose the type name.
- ◆ The vertical bar ( | ) can be read as “or” and it is used to separate alternative parameter options.
  
- ◆ The query form of a command is generated by appending a question mark to the last keyword. Not all commands have a query form and some commands exist only in query form.

## SCPI commands

### DISPLAY Subsystem

DISPlay

[ : WINDow ] [ : STATe ] { OFF|ON }

[ : WINDow ] [ : STATe ] ?

[ : WINDow ] :TEXT [ :Data ] <quoted string>

[ : WINDow ] :TEXT [ :DATA ] ?

[ : WINDow ] :TEXT :CLear

### MEASure Subsystem

MEASure

:CURRent[:DC]?

[ :VOLTage][:DC]?

### OUTPut Subsystem

OUTPut

[ :STATe ] { OFF|ON }

[ :STATe ] ?

### SOURCE Subsystem

[SOURce]

:CURRent[:LEVel][:IMMediate][:AMPLitude] { <current>|MIN|MAX|UP|DOWN }

:CURRent[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX]

:CURRent[:LEVel][:IMMediate]:STEP[:INCrement] { <numeric value>|DEFAULT }

:CURRent[:LEVel][:IMMediate]:STEP[:INCrement]? [DEFAULT]

:VOLTage[:LEVel][:IMMediate][:AMPLitude] { <current>|MIN|MAX|UP|DOWN }

:VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX]

:VOLTage[:LEVel][:IMMediate]:STEP[:INCrement] { <numeric value>|DEFAULT }

:VOLTage[:LEVel][:IMMediate]:STEP[:INCrement]? [DEFAULT]

:VOLTage :PROTection [ :LEVel ] { <voltage>|MIN|MAX }

:VOLTage :PROTection : STATe { 0|1|OFF|ON }

:VOLTage :PROTection :STATe?

:VOLTage :PROTection :TRIPped?

:VOLTage :PROTection :CLear

### SYSTEM Subsystem

SYStem

:BEEPer [ :IMMediate ]

:ERRor?

:REMote

:VERsion?

# SCPI commands overview

## System – Related Commands

### DISPlay Subsystem

This subsystem controls the presentation of textual information and measurement data.

#### **DISPlay [:WINDow] [:STATe] {0|1|OFF|ON}**

This command turns power supply's display off and on. When the display is off, only annunciators are displayed.

You can replace **off|on** parameters with **0|1** numeric values.

#### **DISPlay [: WINDow ] [: STATe ]?**

This command queries front panel display status. It returns only numeric values: **0 (off)** or **1 (on)**.

#### **DISPlay [: WINDow ] :TEXT [:Data] <quoted string>**

This command displays a message on the front panel. The power supply will display up to 16 characters and all the rest will be truncated. The string will be sent between simple or double quotes.

#### **DISPlay [:WINDow] :TEXT [:DATA]?**

This command queries the last sent message. It returns a quoted string.

#### **DISPlay [: WINDow ] :TEXT:CLEar**

This command clears the message displayed on the front pannel. Power supply will return to the previous state.

### OUTPut Subsystem

This subsystem controls the output of the power supply.

#### **OUTPut: [:STATe] {0|1|OFF|ON}**

This command enables and disables the output of the power supply. You can replace **off | on** parameters with **0 | 1** numeric values.

When output is enabled, the power supply will display voltage and current value measured on the output terminals of the power supply.

When output is disabled, the power supply will display **Output Off** message and the annunciators according to power supply's state.

When output is disabled, output voltage is 0 V and the current is 0.002 A.

After power on reset, output will be disabled.

### **OUTPut[:STATe]?**

This command queries the output state of the power supply. It returns only numeric values: **0** (for **off** state) or **1** (for **on** state)

## **SYSTem Subsystem**

This subsystem contains functions that are not directly related to power supply performance.

### **SYSTem:BEEPer [:IMMEDIATE]**

This command determines the power supply to generate a beeper right after she received this command.

### **SYSTem:ERRor?**

This command queries the power supply's error queue. Errors are retrieved in a first-in-first-out order, so the first generated error is the first read error. When all the errors were read, **err** annunciator will not be displayed anymore and error queue is empty.

The error queue can store up to 20 errors. If more errors will be generated, on the last position will be written – 350 error (queue overflow) and no more errors will be stored until the queue is cleared.

### **SYSTem :VERsion?**

This command queries the SCPI version number for which the instrument complies. The response is a string in the form *YYYY.V*, where *YYYY* represents the year version and *V* represents the approved revision number for that year (for example, 1990.0).

## **Output Setting Commands**

### **SOURce Subsystem**

According to SCPI standard, **SOURce** node is optional, so the devices which are primarily sources accept shorter commands.

This subsystem contains commands that program power supply parameters or commands that query programmed power supply parameters (for example: programmed values for current and voltage, programmed values for step current and step voltage, lowest or highest value possible to program for current and voltage )

**CURRENT[:LEVel][:IMMediate][:AMPLitude] {<current>|MIN|MAX|UP|DOWN}**

This command allows you to set the current value to the output of the power supply.

Instead of a numeric value, you can use “MINimum” or “MAXimum”, “Up” or “DOWN” parameters.

MIN allows you to set the lowest current value, which is 0 A.

MAX allows you to set the highest possible current value for model you have.

With UP or DOWN parameters, this command allows you to increase / decrease the output value of the current with a preset value (the step you set with **:CURRENT:STEP {<numeric value>|DEFAULT}** command, or the default step of the power supply). When you exceed the minimum or the maximum possible value by increasing / decreasing the output value, error – 222 (Data out of range) error will be generated.

**:CURRENT[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX]**

This command queries the programmed current level. When using MIN or MAX parameters, the power supply returns the lowest and the highest value that are possible to program for current.

**:CURRENT[:LEVel][:IMMediate]:STEP[:INCrement]{<numeric value>|DEFAULT}**

This command allows you to set the current step for CURR UP or CURR DOWN command. The minimum value for step is 1 mA.

**:CURRENT[:LEVel][:IMMediate]:STEP[:INCrement]? [DEFAULT]**

This command queries the programmed step value (if no parameter specified), or the default step value (if DEFAULT parameter is specified within the command). The returned value is specified in Amps.

**Example:** Here is an example of how you program current step value and how you increase / decrease current output value using step.

```
CURR:STEP 0.2      ;program current step value
CURR UP           ;increase output current
```

```
CURR:STEP 0.5      ;program current step value
CURR DOWN         ;decrease output current
```

*Note: If no step value was programmed before CURR UP or CURR DOWN commands, default step value (0.001 A) will be used.*

**VOLTage[:LEVel][:IMMediate][:AMPLitude] {<voltage>|MIN|MAX|UP|DOWN}**

This command allows you to set the voltage value to the output of the power supply.

Instead of a numeric value, you can use “MINimum” or “MAXimum”, “Up” or “DOWN” parameters.

MIN allows you to set the lowest current value, which is 0 V.

MAX allows you to set the highest possible current value for model you have.

With UP or DOWN parameters, this command allows you to increase / decrease the output value of the voltage with a preset value (the step you set with **:VOLTage:STEP {<numeric value>|DEFault}** command, or the default step of the power supply). When you exceed the minimum or the maximum possible value by increasing / decreasing the output value, error – 222 (Data out of range) error will be generated.

**:VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX]**

This command queries the programmed voltage level. When using MIN or MAX parameters, the power supply returns the lowest and the highest value that are possible to program for voltage.

**:VOLTage[:LEVel][:IMMediate]:STEP[:INCRe ment]{<numeric value>|DEFault}**

This command allows you to set the voltage step for VOLT UP or VOLT DOWN command. The minimum value for step is 10 mV.

**:VOLTage[:LEVel][:IMMediate]:STEP[:INCRe ment]? [DEFault]**

This command queries the programmed step value (if no parameter specified), or the default step value (if DEFault parameter is specified within the command) for voltage. The returned value is specified in Volt.

**Example:** Here is an example of how you program voltage step value and how you increase / decrease voltage output value using step.

```
VOLT:STEP 0.2      ;program voltage step value
VOLT UP           ;increase output voltage
```

```
VOLT:STEP 0.5     ;program voltage step value
VOLT DOWN         ;decrease output voltage
```

*Note: If no step value was programmed before VOLT UP or VOLT DOWN commands, default step value (0.011 V) will be used.*

**:VOLTage:PROTection[:LEVel] {<voltage>|MIN|MAX}**

This command allows you to set the voltage level at which the the overvoltage protection circuit will be activated. If the output voltage will get equal or greater than the programmed OVP level, then the power supply will have output voltage value 0 V (output is disabled).

**:VOLTage :PROTection :STATe {0|1|OFF|ON}**

This command allows you to disable / enable the overvoltage protection circuit. After power on reset, the overvoltage protection circuit is enabled and the programmed OVP value is 33 Volt.

**:VOLTage :PROTection :STATe?**

This command queries the overvoltage protection circuit state. The returned parameter is always a numeric parameter: **0** (for **OFF** state) or **1** (for **ON** state).

**:VOLTage :PROTection :TRIPped?**

This command queries if the protection circuit is tripped or not. The returned parameter is always a numeric parameter: **0** for OVP circuit not tripped or **1** for OVP circuit tripped.

**:VOLTage :PROTection :CLEar**

This command allows you to clear the overvoltage protection circuit. This command does not affect the programmed voltage trip level.

After this command the power supply returns to the previous state (output voltage will have the same value as before OVP was enabled). In this case, before you clear the protection circuit, you must lower the output voltage below OVP trip level or increase the OVP trip level above the output voltage value.

Here are some examples of how you work with overvoltage protection circuit using remote interface commands:

**Example 1: Here is an example of how you program the overvoltage protection circuit using remote interface commands:**

VOLT:PROT 5 ;set OVP trip level at 5V

VOLT:PROT? ;responds with programmed OVP trip level (5V)

VOLT:PROT:STAT ON ;enable OVP circuit

VOLT:PROT:STAT? ;responds with OVP circuit state (1 –0n)

VOLT:PROT:TRIP? ;responds if OVP circuit is enabled

;(0 if output voltage lower than OVP trip level and 1 otherwise)

**Attention:** OVP circuit is enabled if output voltage becomes equal or greater than the programmed trip level for OVP circuit.

*It is not necessary to check every setting with the interrogative command! Here is an example of how you use this commands.*

**Example 2: Here is an example of how you clear the overvoltage condition by increasing OVP trip level, using remote interface commands:**

*Let's say that the output voltage is lower than 5V. No load connected.*

```
VOLT:PROT 5          ;program OVP trip level
VOLT:PROT:STAT ON    ;enable OVP circuit
```

*If OVP circuit is already enabled, you don't have to enable it again!*

```
VOLT 6              ;OVP circuit enabled
```

*When output voltage becomes equal or greater than OVP trip level (here is 5V), OVP circuit is enabled. Output is disabled and **Over Voltage** message will be displayed.*

```
VOLT:PROT 5.5      ;increase OVP trip level
```

*Still output is disabled and **Over Voltage** message is displayed (because you didn't clear OVP condition yet)*

```
VOLT:PROT:CLEAR    ;clear OVP condition
```

*Power supply returns to previous state before enabling OVP circuit. It will display 6V and 0A. Since you didn't disable OVP circuit, **ovp** annunciator will be displayed.*

**Example 3: Here is an example of how you clear the overvoltage condition by decreasing output voltage level, using remote interface commands:**

*Let's say that the output voltage is lower than 10V. No load connected.*

```
VOLT:PROT 10        ;program OVP trip level
VOLT:PROT:STAT ON   ;enable OVP circuit
```

*If OVP circuit is already enabled, you don't have to enable it again!*

```
VOLT 10            ;OVP circuit enabled
```

*When output voltage becomes equal or greater than OVP trip level (here is 10V), OVP circuit is enabled. Output is disabled and **Over Voltage** message will be displayed.*

```
VOLT 5.5           ;decrease output voltage level  
VOLT?              ;returns programmed output voltage (5.5V)
```

*Still output is disabled and **Over Voltage** message is displayed (because you didn't clear OVP condition yet)*

```
VOLT:PROT:CLEAR    ;clear OVP condition
```

*Power supply returns to previous state before enabling OVP circuit. It will display 5.5V and 0A. Since you didn't disable OVP circuit, **ovp** annunciator will be displayed.*

**Example 3: Here is an example of how you clear the overvoltage condition by disabling OVP circuit, using remote interface commands:**

*Let's say that the output voltage is lower than 7V. No load connected.*

```
VOLT:PROT 8         ;program OVP trip level  
VOLT:PROT:STAT ON   ;enable OVP circuit
```

*If OVP circuit is already enabled, you don't have to enable it again!*

```
VOLT 15             ;OVP circuit enabled
```

*When output voltage becomes equal or greater than OVP trip level (here is 8V), OVP circuit is enabled. Output is disabled and **Over Voltage** message will be displayed.*

```
VOLT:PROT:STAT OFF ;Disable OVP circuit
```

**Attention:** *if you have anything connected to the output terminals of the power supply, it is strongly recommended that you disconnect it before disabling OVP circuit (because you don't change output level and this it may harm your connected circuitry)*

```
VOLT:PROT:STAT?    ;returns OVP circuit state (0 – off state)
```

*Still output is disabled and **Over Voltage** message is displayed (because you didn't clear OVP condition yet)*

VOLT:PROT:CLEAR ;clear OVP condition

*Power supply returns to previous state before enabling OVP circuit. It will display 15V and 0A. Since you disabled OVP circuit, **ovp** annunciator will not be displayed anymore, until you enable OVP circuit again.*

## **MEASure Subsystem**

This subsystem contains commands that allow you to measure the current and voltage to the output terminals of the power supply.

### **MEASure:CURRent[:DC]?**

This command queries the current measured to the output terminals of the power supply.

### **MEASure[:VOLTag[:DC]?**

This command queries the voltage measured to the output terminals of the power supply.

### **Important note!**

**VOLT?** Command returns previously programmed voltage level

**MEAS?** Command returns voltage measured to the output terminals of the power supply.

**CURR?** Command returns previously programmed current value

**MEAS:CURR?** Command returns the measured current to the output terminals of the power supply

## Error Messages

There are 2 kinds of errors that will be generated by the power supply:

- ◆ **standard errors** (errors defined by SCPI standard, in [-399,-100] interval)
- ◆ **device specific errors** (user defined errors, in [1,32767] interval)

Following types of errors may occur:

- ◆ Command errors (standard errors)
- ◆ Self test errors (device specific errors)
- ◆ Calibration errors (device specific errors)

## Execution errors

Execution errors are defined by SCPI standard. Here are execution errors generated by the power supply:

### **Error - 101: Invalid character**

An invalid character was received in the command string, within the parameter

### **Error - 102: Syntax error**

The command string is not in syntactically correct (\*, : in the wrong place)

### **Error - 103: Invalid separator**

Wrong separator between commands in the same command string.

### **Error - 108: parameter not allowed**

More parameters than expected were received for the header

### **Error - 109: Missing parameter**

Fewer parameters than required were received for the header

### **Error - 113: Undefined header**

The received header was not defined for this device

### **Error - 114: Header suffix out of range**

The value for the numeric suffix attached to the program mnemonic is not correct. The device recognizes only the default header suffix (which is 1).

### **Error - 121: Invalid character in number**

An invalid character was received within the numeric parameter (or within the suffix).

**Error -123: Exponent too large**

The numeric parameter received has an exponent larger than 32,000.

**Error -124: Too many digits**

The decimal numeric parameter has a mantissa which contains more than 255 digits, excluding leading zeros

**Error - 128: Numeric data not allowed**

A legal numeric data element was received, but is not the right data element for the header

**Error -131: Invalid suffix**

The received suffix for the numeric parameter is not specified for this device.

**Error - 138: Suffix not allowed**

This numeric parameter does not accept a suffix.

**Error - 141: Invalid character data**

The character data element contains an invalid character.

**Error - 151: Invalid string data**

A string data element was expected, but it was invalid for some reason (it didn't start/stop with simple/double quotes).

**Error - 158: String data not allowed**

A legal string data element was received, but it is not the right data element for the header.

**Error - 222: Data out of range**

The numeric parameter value is out of range.

**Error - 223: Too much data**

A legal string program data element contains more data than the device could handle due to memory or due to device specific requirements.

**Error - 224: Illegal parameter data value**

A legal type of parameter was received, but it is not the expected parameter for the header.

**Error - 350: Queue overflow**

Queue error is full, more than 20 errors occurred. No more errors will be saved until error queue will be erased.

## **Self test errors**

Self test errors are user defined. Here are self test errors generated by the power supply:

**Error 601: Front panel does not respond**

**Error 602: CV not high**

**Error 603: CV not low**

**Error 604: CC not high**

**Error 605: CC not low**

**Error 606: OVP not high**

**Error 607: OVP not low**

**Error 608: Fan test failed**

**Error 609: Unable to sense line frequency**

**Error 611: EEPROM absent**

**Error 612: ADC offset register V checksum failed**

**Error 613: ADC offset register I checksum failed**

**Error 614: DAC offset register V checksum failed**

**Error 615: DAC offset register I checksum failed**

**Error 616: ADC full gain register V checksum failed**

**Error 617: ADC full gain register I checksum failed**

**Error 618: DAC offset register OVP checksum failed**

**Error 619: DAC V step register checksum failed**

**Error 620: DAC I step register checksum failed**

**Error 621: DAC OVP step register checksum failed**

**Error 630: Data in location 1 checksum failed**

**Error 631: Data in location 2 checksum failed**

**Error 632: Data in location 3 checksum failed**

**Error 633: Data in location 4 checksum failed**

**Error 634: Data in location 5 checksum failed**

**Error 635: GPIB address checksum failed**

**Error 641: Filter register error**

**Error 642: ADC not locked**

**Error 643: ADC not ready**

**Error 644: ADC out of range**

**Error 651: DAC out of range**

**Error 661: I/O processor does not respond**

**Error 662: I/O processor failed self test**

**Error 663: I/O processor communication error**

### **Calibration errors**

Here are calibration error messages generated by the SDSA power supply:

**Error 637: Secure code checksum failed**

**Error 701: Calibration security disabled by jumper**

The power supply was turned on in *calibration* mode and J6 jumper is set for *calibrating* mode operation.

**Error 703: Invalid secure code**

**Error 706: Secure code memory bad**

**Error 711: DAC offset register V start value out of range**

**Error 712: DAC offset register V out of range**

**Error 713: DAC V calibration failed**

**Error 714: DAC offset register V memory bad**

**Error 715: ADC offset register V out of range**

**Error 716: ADC offset register V memory bad**

**Error 721: DAC V step register start value out of range**

**Error 722: DAC V step register out of range**

**Error 723: DAC V step calibration failed**

**Error 724: DAC V step register memory bad**

**Error 725: ADC full gain register V out of range**

**Error 726: ADC full gain register V memory bad**

**Error 731: DAC offset register OVP start value out of range**

**Error 732: DAC offset register OVP out of range**

**Error 733: DAC offset register OVP memory bad**

**Error 734: DAC OVP step register start value out of range**

**Error 735: DAC OVP step register out of range**

**Error 736: DAC OVP step register memory bad**

**Error 741:  $I_{\text{mon}}$  register out of range**

**Error 742: ADC offset register I out of range**

**Error 743: ADC offset register I memory bad**

**Error 744: DAC offset register I start value out of range**

**Error 745: DAC offset register I out of range**

**Error 746: DAC offset register I memory bad**

**Error 751: DAC I step register start value out of range**

**Error 752: DAC I step register out of range**

**Error 753: DAC I step calibration failed**

**Error 754: DAC I step register memory bad**

**Error 755: ADC full gain register I out of range**

**Error 756: ADC full gain register I memory bad**

**Important note!**

Although they don't have a number, following errors may be displayed:

**OVP fault**

**CC fault**

**CV fault**

In this case, you must perform again entire OVP, CC, and CV calibration procedure (according to the message displayed). No error will be generated.

## Technical specifications

Table 1: Technical specifications for Model 9120

Parameter		Model 9120
<b>Output Ratings</b> (at 0° - 40° C)		0 to +30V / 0 to 3A
<b>Programming Accuracy</b> [1] 12 months ( at 25° C±5° C) ± (% of output + offset)	Voltage	≤ 0.05%+10mV
	Current	≤ 0.2%+10mA
<b>Readback/Meter Accuracy</b> [1] 12 months(over GIPB and RS 232 or front panel with respect to actual output at 25° C ± 5° C) ± (%of output + offset)	Voltage	≤ 0.05%+5mV
	Current	≤ 0.15%+5mA
<b>Ripple and Noise</b> (with output leads shielded, or with either output terminal grounded, 20Hz to 20MHz)	<i>Normal mode voltage</i>	≤ 0.5V <sub>rms</sub> and 5mV <sub>p-p</sub>
	<i>Normal mode current</i>	≤ 4mA <sub>rms</sub>
	<i>Common mode current</i>	≤ 1.5 μA <sub>rms</sub>
<b>Load Regulation(utiilizing Remote Senseing),</b> ± (% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Line Regulation,</b> ±(% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Programming Resolution</b>	Voltage	0.5mV
	Current	0.08mA
<b>Readback Resolution</b>	Voltage	0.25mV
	Current	0.04mA
<b>Front Panel Resolution</b>	Voltage	10mV
	Current	1mA

**Table 2: Technical specifications for Model 9121**

Parameter		Model 9121
<b>Output Ratings</b> (at 0° - 40° C)		0 to + 20V / 0 to 5A
<b>Programming Accuracy</b> [1] 12 months ( at 25° C±5° C) ± (% of output + offset)	Voltage	≤ 0.05%+10mV
	Current	≤ 0.2%+10mA
<b>Readback/Meter Accuracy</b> [1] 12 months(over GIPB and RS 232 or front panel with respect to actual output at 25° C ± 5° C) ± (%of output + offset)	Voltage	≤ 0.05%+5mV
	Current	≤ 0.15%+5mA
<b>Ripple and Noise</b> (with output leads shielded, or with either output terminal grounded, 20Hz to 20MHz)	<i>Normal mode</i> voltage	≤ 0.5V <sub>rms</sub> and 5mV <sub>p-p</sub>
	<i>Normal mode</i> current	≤ 4mA <sub>rms</sub>
	<i>Common mode</i> current	≤ 1.5 μA <sub>rms</sub>
<b>Load Regulation(utilizing Remote Senseing),</b> ± (% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Line Regulation,</b> ±(% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Programming Resolution</b>	Voltage	0.5mV
	Current	0.08mA
<b>Readback Resolution</b>	Voltage	0.25mV
	Current	0.04mA
<b>Front Panel Resolution</b>	Voltage	10mV
	Current	1mA

**Table 3: Technical specifications for Model 9122**

Parameter		Model 9122
<b>Output Ratings</b> (at 0° - 40° C)		0 to + 60V / 0 to 2.5A
<b>Programming Accuracy</b> [1] 12 months ( at 25° C±5° C) ± (% of output + offset)	Voltage	≤ 0.05%+10mV
	Current	≤ 0.2%+10mA
<b>Readback/Meter Accuracy</b> [1] 12 months(over GIPB and RS 232 or front panel with respect to actual output at 25° C ± 5° C) ± (%of output + offset)	Voltage	≤ 0.05%+5mV
	Current	≤ 0.15%+5mA
<b>Ripple and Noise</b> (with output leads shielded, or with either output terminal grounded, 20Hz to 20MHz)	<i>Normal</i> mode voltage	≤ 0.5V <sub>rms</sub> and 5mV <sub>p-p</sub>
	<i>Normal</i> mode current	≤ 4mA <sub>rms</sub>
	<i>Common</i> mode current	≤ 1.5 μA <sub>rms</sub>
<b>Load Regulation(utilizing Remote Senseing),</b> ± (% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Line Regulation,</b> ±(% of output + offset)	Voltage	≤ 0.01 % + 3 mV
	Current	≤ 0.01 % + 250 μA
<b>Programming Resolution</b>	Voltage	0.5mV
	Current	0.08mA
<b>Readback Resolution</b>	Voltage	0.25mV
	Current	0.04mA
<b>Front Panel Resolution</b>	Voltage	10mV
	Current	1mA

[1] Accuracy specifications are after an 1-hour warm-up with no load and calibration at 25 °C

### **Transient Response Time**

Less than 50µsec for output to recover to within 15mV following a change in output from full load to half load or vice versa.

### **Setting time**

Less than 90msec for the output voltage to change from 1% to 99% or vice versa following the receipt of VOLTAGE or APPLY command via direct GPIB or RS-232 interface

### **OVP Accuracy, ± (% of output + offset)**

< 50mV

**Activation time:** Average time for output to start to drop after OVP condition occurs.

≤ 1.2 msec when the trip voltage is equal or greater than 3V

≤ 1.2 msec when the trip voltage is less than 3V

### **Remote sensing capability**

Voltage drop      Up to 1V per each lead

Load regulation    Add 5mV to spec for each 1-volt change in the + outputs lead due to load current change.

Load voltage      Subtract voltage drop in load leads from specified output voltage rating.

### **Temperature coefficient, ±(% of output+offset)**

Maximum change in output/readback per °C after a 30-minute warm-up:  
Voltage            ≤ 0.02%+2mV

Current            ≤ 0.1%+1mA

## **Output voltage overshoot**

During turn-on or turn-off of AC power, output plus overshoot will not exceed 1V if the output control is set to less than 1V. If the output control is set to 1V higher, there is no overshoot.

## **Programming language**

SCPI (Standard Commands for Programmable Instruments)

## **State storage memory:**

100 user configurable states

## **Recommended calibration interval:**

1 year

## **Output terminal isolation (maximum, from chassis ground):**

$\pm 60$  Vdc when connecting shorting conductors without insulation between the (+) output and the (+) sense terminals and between the (-) output and the (-) sense terminals.

$\pm 240$  Vdc when connecting insulated shorting conductors between the (+) output and the (+) sense terminals and between the (-) output and the (-) sense terminals.

## **AC Input Ratings (selectable via the line voltage receptacle switch):**

115 Vac  $\pm 10\%$  for 47 to 63 Hz

230 Vac  $\pm 10\%$  for 47 to 63 Hz

## **Line voltage selection:**

The line fuse is located in the space just below the input receptacle. To change line voltage values first remove fuse holder and then remove tan colored fuse bracket. The line voltage value is determined by value shown through the window of the fuse holder. Please ensure correct insertion and fuse rating.

## **Fuse ratings:**

Model 9120: 3.15A/250V for 115Vac, 2A/250V for 230V

Model 9121: 3.15A/250V for 115Vac, 2A/250V for 230V

Model 9122: 5A/250V for 115Vac, 3.15A/250V for 230V

All fuses are type T (temporized) for high power up currents

## **Cooling:**

Fan cooled

## **Operating temperature:**

32<sup>°</sup> to +104<sup>°</sup> F (0<sup>°</sup> to 40<sup>°</sup> C),  $\leq 75\%$  R.H. for full rated output

**Storage temperature:**

-4 ° to +158 ° F (- 20 ° to + 70 ° C), ≤85%R.H. for storage environment

**Environmental conditions:**

Designed for indoor use.

**Net weight:**

12.5 (5.6 kg)

**Dimensions (H x W x D):**

3.15 x 8.27 x 15” (8 x 21 x 38 cm)

**Important note!**

The technical specification are warranted for 32 ° to 104 ° F (0 ° to 40 ° C) with a resistive load. Supplemental characteristics are not warranted. They are determined either by testing or design.

**Programming Ranges**

The power supply parameters are programmed using command of SOURce subsystem. Here are programming ranges, programming values for MINimum, MAXimum, DEFault parameters and reset state:

**Table 3: Programming ranges for voltage parameters**

<b>Voltage parameters</b>	<b>Model 9120</b>	<b>Model 9121</b>
Programming range	0 to 30.5 V	0 to 18.5 V
MINimum	0 V	0 V
MAXimum	30.5 V	18.5 V
DEFault	0 V	0 V
Reset	0 V	0 V

**Table 4: Programming ranges for current parameters**

<b>Current parameters</b>	<b>Model 9120</b>	<b>Model 9121</b>
Programming range	0 to 3.05 A	0 to 5.05 A
MINimum	0 A	0 A
MAXimum	3.05 A	5.05 A
DEFault	0 A	0 A
Reset	3.00 A	5.00 V

## Reset values

Here are the power supply parameter values after a power on reset.

**Table 5: Reset values for power supply parameters**

Power supply parameters	Model 9120	Model 9121
Voltage	0 V	0V
Voltage step	0.01 V	0.01 V
OVP circuit state	ON	ON
OVP trip level	33 V	20 V
Current	3.00 A	5.00 A
Current step	0.001 A	0.001 A
Display state	ON	ON
Output state	OFF	OFF

## Interface Cable

In order to command the power supply over the remote interface, you must connect it to a computer terminal.

Usually, the computer terminals are DTE (Data Terminal Equipment). The power supply is also DTE, so you need a DTE to DTE interface cable. These cables are called null-modem or crossover cables.

There are 2 types of serial connectors: DB-9 and DB-25. The power supply has a male DB-9 connector.

Here is cable pin diagram for DB-9 connector:

