



Elektro-Automatik



APPLICATION NOTE: IU TABLE FUNCTION (XY TABLE)

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INTRODUCTION

All models of the PSB, PSI, and ELR 10000 series feature an IU table function as part of the function generator. The IU table function (XY table) offers the user the ability to set a DC output current based on the DC voltage measured at the DC terminals. This feature works in either source or sink mode. In the IU function, an internal measuring circuit measures the voltage on the DC output. For every possible voltage on the scale of 0-125% rated voltage, the loaded IU table holds a current value, which can be any value between 0 and the rated current.

IU Function: $I = f(U)$

The function is driven by a table with exactly 4096 values which are distributed over the range of 0-125% of the rated voltage.

For example, using a device rated for 500V.

$$500 * 125\% = 625$$

$$625 / 4096 = 0.153 \text{ per value or cell}$$

In this example, the voltage would change by about 15 V for every 100 cells in the table.

However, only approximately 3277 set points are effective, as the user can only program the device up to 102% of the rating. It is recommended that the remaining cells have the same value as what was used for 100-102% rating.

The XY table is not stored inside the device and must be loaded into it every time before using it in the function generator. The data and settings are separate from what can be manually set up using the HMI. The table can be uploaded from a USB stick through the USB port on the front of the device, or through the EA Power Control software, or via remote control (Modbus protocol, or SCPI).

APPLICATIONS

Simulate a Charging or Discharging Battery

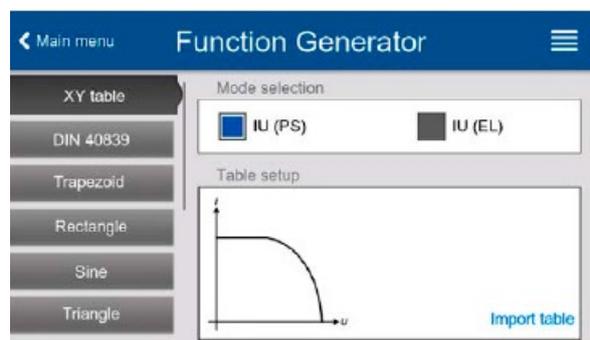
As a battery charges, current is maintained at a maximum value until the battery approaches the maximum voltage, at which point the current begins to decrease. As a battery discharges, the current slowly reduces from a maximum value to almost 0A. Both scenarios could be simulated using the XY table.

Simulate a Solar Panel in PV-Related Tests

When a solar cell has an open circuit, or is not connected to a load, the voltage will be at maximum, but there will be no current. On the other hand, when there is a short circuit, the current will be at maximum, but there will be no voltage. The solar cell has an I-V characteristics curve between these two points that could be simulated using the XY table.

LOADING IU TABLES FROM A USB STICK

1. The USB stick must be formatted in FAT32.
2. The file(s) must be saved inside a folder named **HMI_FILES** in the root path of the stick, and the file name must begin with **IU** (not case sensitive)
3. The file must be saved as an Excel CSV file (*.csv) and contain only one column with exactly 4096 values without gaps.
4. Values with decimal places must use a decimal separator that matches the selection in the setting **Log file separator format**, which defines the decimal separator between a dot and a comma. (US default should be a dot)
5. No value may exceed the rated current of the device. For example, if you have a 420 A model, none of the 4096 values can be higher than 420 A.
6. If these specifications are not met, the device won't accept the file and will display an error message.
7. While the DC terminal is switched off, open the function selection menu by tapping on , then select **XY table**. If using the PSB, select to run the function in either sink mode with **IU (EL)** or select **IU (PS)** to run the function in source mode. The PSI will only have the option for **IU (PS)** and the ELR will only have the option for **IU (EL)**

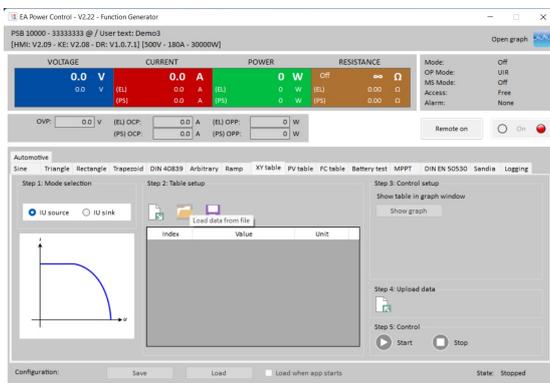


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8. Insert the USB stick (if not already done), then tap on **Import table** and select the table you want to load (the USB may contain multiple IU files with different names and list them to be selected) and confirm with 
9. In case the file is not accepted for any of the above-listed reasons, correct the file format and content, then try again
10. Tap **Next** to proceed to the next screen where you can adjust the global set values
11. Tap **Next** to proceed to the main function screen to start and control the function
 - a. The function can be **started** by either tapping  or if the DC terminal is currently switched off, by pushing the **"On/Off"** button on the front
 - b. The function can be **stopped** by tapping  or by pressing the **"On/Off"** button

CONTROLLING IU TABLES THROUGH EA POWER CONTROL SOFTWARE

1. Open EA Power Control software and click on **Search for Device** if device is not already displayed
2. Click on the device and drag to **Function Generator**.
3. Select **XY table**
4. If using a PSB, you may select either **IU source** or **IU sink**
5. Click on the Folder to Load data from file



6. Select the file you want to load and click Open
7. The file should be displayed in the **Table setup**
8. Click on **Upload data**



9. Click on **Start** to run the function and **Stop** to stop the function



UPLOADING AND CONTROLLING IU TABLES VIA MODBUS

1. Switch the device to remote control: **00 05 01 92 FF 00 2D FA**
2. Select the XY function mode with following registers:

Mode	PSB 10000 Series	PSI / ELR 10000 Series
IU	856	855

For example, to select IU source mode on the PSB:

00 06 03 58 00 01 C8 4C

3. Load the XY table data in 256 blocks of 16 values (registers 2600-6695). This corresponds to the maximum 4096 values for a measurement range of 0-125% rated voltage or current. Less data can also be loaded, for instance, 3277 values for 0-100%. All values which are not set will result in 0A.

a) Calculate the percent values with: Hex value in % =
Real current value * 0.8 / Inom * 32768

b) Example for block 0:

**00 10 0A 28 00 10 20 24 01 24 02 24 03 23 04 23 05 22
06 21 07 21 08 21 09 21 0A 11 0B 11 0C 11 0D 11 0E 11
0F 11 10 89 AE**

4. Set static values which are not affected by the table.

IU function: voltage (register 500 or VOLT command) and power (register 502 or POW command)

a) Example for voltage:

00 06 01 F4 68 72 67 F0

b) Example for power:

00 06 01 F6 68 72 C6 30

5. Run the function generator by switching the DC terminal on (register 405).

00 05 01 95 FF 00 9C 3B

6. Exit the function generator by deselecting your former mode setting from step 1 via the same registers.

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UPLOADING AND CONTROLLING IU TABLES VIA SCPI

1. Select the function mode.

SOURce:FUNction:GENerator:SElect IU (IU =IU curve)

For **PSB** models, the user must select either source (PS) or sink (EL) mode.

- a. **SOURce:FUNction:GENerator:SElect IUPS** (IUPS =IU curve in source mode)
 - b. **SOURce:FUNction:GENerator:SElect IUEL** (IUEL =IU curve in sink mode)
 - c. **SOURce:FUNction:GENerator:SElect IU** (IU =IU curve in combined source-sink mode. The current set value from the curve is either set for source or sink mode, depending on the relation between voltage set value and actual value on the DC terminal)
2. Load the table data. For PSB models, there are two data tables. Table 1 is assigned to source mode, and table 2 is assigned to sink mode.

The commands for Table 1 (source mode):

- a. **SOURce:FUNction GENerator:XY:LEVel <NR1>**
(Choose a table position from 0...4095)
- b. **SOURce:FUNction GENerator:XY:DATa <NR2>** (Writes a current value in A to the previously selected position.)
- c. **SOURce:FUNction GENerator:XY:SUBMit** (Submits the data that has been written so far. This could be any number out of the maximum 4096 entries. The rest of the table data would then be 0.)

The commands for Table 2 (sink mode):

- a. **SOURce:FUNction GENerator:XY:SECond:LEVel <NR1>**
(Choose a table position from 0...4095)
 - b. **SOURce:FUNction GENerator:XY:SECond:DATa <NR2>**
(Writes a current value in A to the previously selected position.)
 - c. **SOURce:FUNction GENerator:XY:SUBMit SECond** (Submits the data that has been written so far for the 2nd table. This could be any number out of the maximum 4096 entries. The rest of the table data would then be 0.)
3. Run the simulation by switching the DC terminal on.

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