AN011: Realising slopes

This document is intended to inform the user about how to realise or create voltage or current ramps with a certain slope, using a power supply or electronic load. There are several possibilities to select from, which are partly illustrated below. The ideal way of realising perfect ramps is to use a purely analogue device with a function generator or an analogue card in a PC with proper software

1. The device creates the ramp itself (sheet 2)
At the moment, only power supplies of the series PSI 8000 and PSI 9000 can generate such ramps for voltage or current with the integrated function manager (FM, SEQ). This feature will automatically generate a ramp, if the time for a sequence point is bigger than the minimum step of 2ms. The ramp is created with a varying number of intermediate steps, calculated by the device-internal microcontroller. See documentation of the device about what‘s are functions, sequences and points.

- Advantages:
  - No external control required
  - Fast rise time selectable (min. 2ms)

- Disadvantages:
  - Only 50 different sequence points can be stored inside the device
  - Only 1 function can be stored inside the device

Note: technically, a power supply is not always able to follow the time values that can be given in the function/sequence setup. It depends primarily on the dU between two points. For example, a standard PSI 8360-15 2U (360V, 15A) can not let the output voltage rise from 0% to 100% within 4ms or 8ms, but from 60% to 80% it can.

2. The ramp is controlled from a PC (sheet 1)
This can be realised for any device with a digital interface. Here, the maximum transmission speed of the interface plays a role. It defines the minimum interval time of a command and thus next point of the ramp. The ramp is generated by sending set value after set value in a certain interval. This can be done using the freely available softwares EasyLoad Lite (for loads) resp. EasyPower Lite (for power supplies). The use can of course create custom software for this purpose.

- Advantages:
  - Ramps are stored in form of files on the PC and can easily be swapped
  - Much more points for a ramp or sequence available (very important for slowly rising ramps)

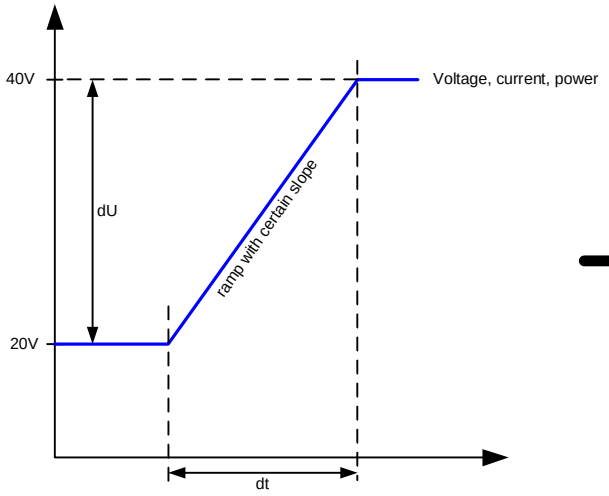
- Disadvantages:
  - Ramps need to be generated by user as sequence points
  - The device won‘t calculate intermediate steps
  - Ramps (sequence files) are processed row by row, sending set values to the device
  - Minimum time per row (i.e. point) is much bigger than with PSI 8000 /PSI 9000 function manager, the ramp can look like stairs

3. The ramp is generated by an external function generator (sheet 3)
This method requires an anlogue interface on the device, which is available with most power supplies and with any load model. The function generator creates an analogue signal (trapezoid, saw tooth) with an adjustable rise/fall time and adjustable ΔU and puts it out to the analogue interface. The device will follow the signal with a certain delay (except for loads, they don‘t have a delay), because the analogue interface has to sampled first by the microcontroller of the device. If the rise time of the signal is long enough, for example 20s for 20V, then the device will reproduce the signal almost 1:1.

- Advantages:
  - With loads, this method is highly dynamic because of the purely analogue interface
  - On power supply with or without FM also power can be „ramped“, if the device features adjustable power

- Disadvantages:
  - Additional device required
  - The external function generator might be unable to adjust very long rise time, such as desired
  - With power supplies only suitable for longer rise times

1: EasyPower Lite (EPL)



	A	B	C	D	E	F	G
1	U set	I set	P set	Hour	Minute	Second	Millisecond
2	20	50	3000	0	0	0	500
3	21	50	3000	0	0	1	0
4	22	50	3000	0	0	1	0
5	23	50	3000	0	0	1	0
6	24	50	3000	0	0	1	0
7	25	50	3000	0	0	1	0
8	26	50	3000	0	0	1	0
9	27	50	3000	0	0	1	0
10	28	50	3000	0	0	1	0
11	29	50	3000	0	0	1	0
12	30	50	3000	0	0	1	0
13	31	50	3000	0	0	1	0
14	32	50	3000	0	0	1	0
15	33	50	3000	0	0	1	0
16	34	50	3000	0	0	1	0
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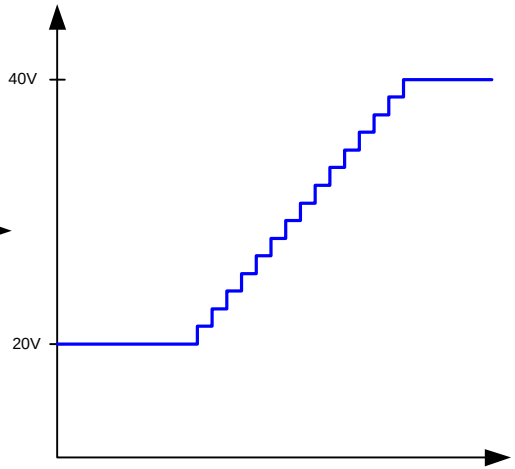
22	40	50	3000	0	0	1	0



Das ist der gewünschte Anstieg, z. B. 20V/20s.

Für EPL (EasyPower Lite) muß eine Sequenzdatei erstellt und geladen werden.

Hinweis: die Zeit pro Zeile könnte auf die minimal 0.5s verringert werden, würde aber auch die doppelte Anzahl Zeilen erfordern.

So wird in etwa die resultierende Rampe aussehen.

Hinweis: jeder Schritt in der Sequenzdatei wird als Sollwert an das Gerät geschickt und dort mit einer gewissen, aber kurzen Verzögerung gesetzt. Zusammen mit dem Zeitwert des Sequenzschrittes ergibt sich eine treppenförmige Rampe. Die Stufen könnten in dem Beispiel noch verringert werden, indem die Zeit auf die minimalen 0,5s gesetzt wird.
Vorteil einer Sequenzdatei: viele Schritte machbar, leicht zu editieren und zu laden
Nachteil einer Sequenzdatei: die Rampen sind nicht so glatt wie mit dem FM und die minimal Zeit pro Schritt ist viel höher

This is what's wanted.
For example 20V/20s.

For EPL (EasyPower Lite), you have to set a sequence file and run it.

Note: the minimum time per row can be decreased to 0.5s, but would require double the rows.

This is the result of the voltage on the output, as long as the PSU is not in CC or CP

Note: every step in the sequence file is sent as set value to the device and is instantly set to the output, resulting in a stair-like ramp. The minimum time could be decreased to 0.5s, so the steps are smaller.
Advantage of sequence files: large number of steps possible with Excel file, different files are easily loaded
Disadvantage of sequence files: ramps are not so „smooth" as with FM, minimum step time much higher

以20V/20s为例，这是用户所希望的。

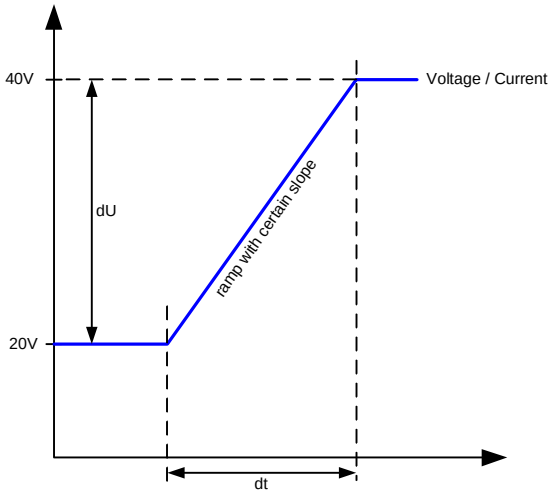
利用EPL (EasyPower Lite)£¬按照必须设置一个序列文档并运行它。

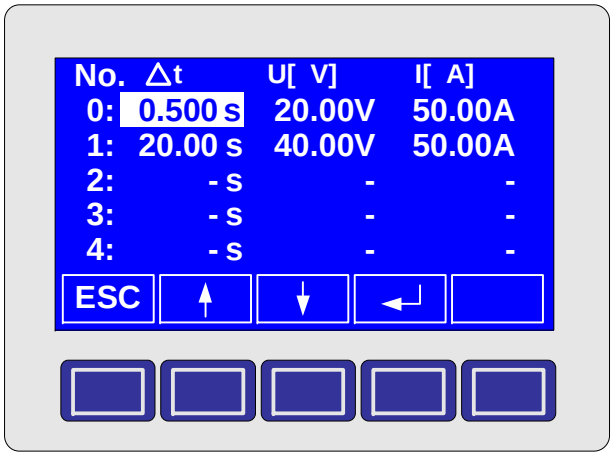
提示：每一行的最小时间可缩短至0.5s，但这样会需要双倍数量的行数

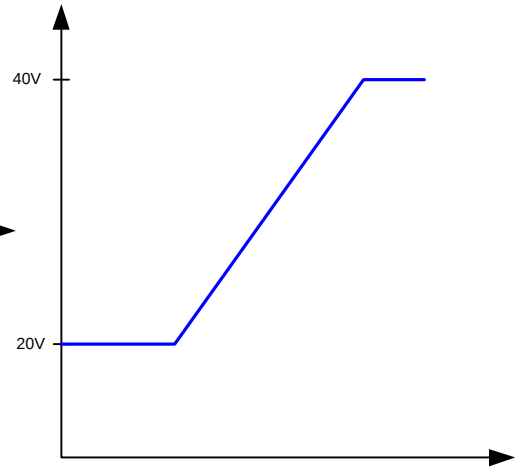
这个是在输出端形成的电压，只要产品未处于CC或CP模式

注意：序列文档的每步数据以设定值发送到产品上，并立即传输给输出端，从而形成梯形曲线。每步跳跃时间可以缩短至0.5s，这样步距会更小一些。
序列文档的优点：可以创建EXCEL文档格式的大量步距跳跃次数，而且不同的文档都能上传。
序列文档的缺点:曲线不能像FM(函数管理器）那样“平滑”，因为每个步距的最短时间要长得多。

2: Function manager (FM, SEQ)
函数管理器







Das ist der gewünschte Anstieg,
z. B. 20V/20s.

Das müßte im Funktionsmanager mindestens gesetzt werden

Hinweis: die minimale Zeit für einen Schritt (point) ist hier 2ms, somit ist der FM viel schneller

So würde die resultierende Rampe der Ausgangsspannung aussehen, sofern das Gerät nicht in CC oder CP wechselt.

Hinweis: das Gerät erzeugt selbständig Zwischenschritte, so kleine wie möglich, um die Rampe zu generieren. Die Anzahl der Zwischenschritte ist nicht unendlich und bei langen Zeiten werden die Schritte sichtbar in Form von Treppenstufen.

This is what's wanted.
For example 20V/20s.

This is what has to be set in the function manager for this one ramp

Note: minimum time for a step/point is 2ms, so the FM is much faster

This is the result of the voltage ramp on the output, as long as the PSU is not in CC or CP

Note: the device generates steps, as small as possible, to set them within the time, so a ramp results. The number of steps to calculate is not infinite, so with very long times set, the steps become visible and the ramp looks like stairs.

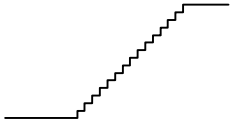
以20V/20s为例，这是用户所希望的。

按照范例参数，需在函数管理器上设置这些参数，以获得这个阶跃曲线。

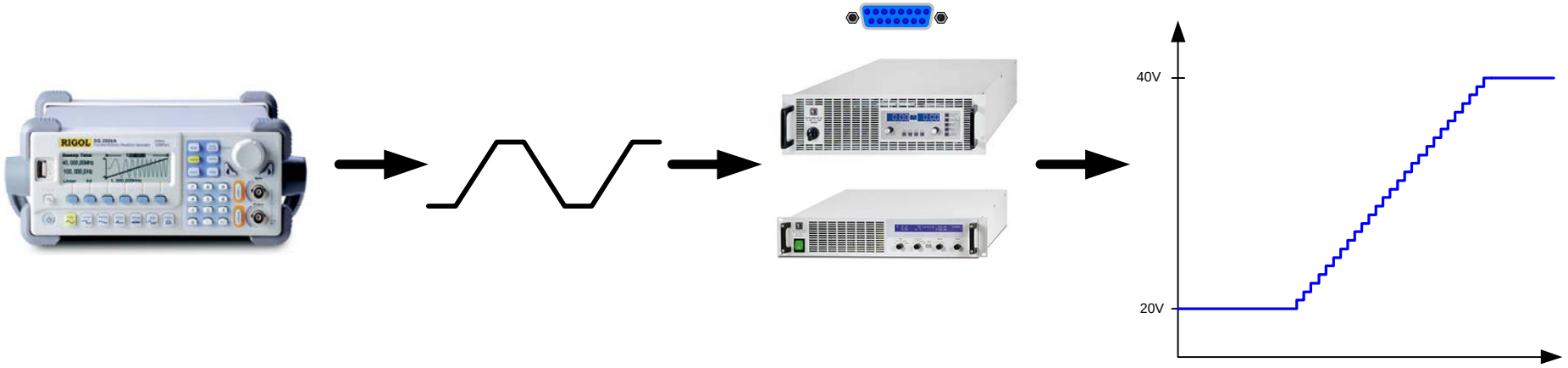
提示：每步/每点的最短跳跃时间可为2ms，故FM（函数管理器）要快很多

这个是在输出端形成的电压阶跃曲线，只要产品未处于CC或CP模式

注意：电源产品会在最短时间内产生尽可能小的步距，从而形成阶跃曲线。跳跃的次数不是无穷的，如果按较长的设定时间，就可以看到这些台阶，而阶跃曲线会像楼梯形状。



3: Analogue interface (of a digitally controlled device)
（数控设备）的模拟接口



Funktionsgenerator 0...5V oder 0...10V, Zeit für Rampe einstellbar wie benötigt

Rampe, wie eingestellt, als Signal vom Generator in die analoge Schnittstelle

Resultierende Rampe am Ausgang eines Netzgerätes (nicht bei CC/CP), mit mehr oder weniger sichtbaren Stufen

Hinweis: das Resultat hängt stark von der Anstiegszeit und -höhe ab. Etwas besser als mit EPL, aber auch etwas schlechter als beim FM.

Function generator with 0...5V or 0...10V and rise/fall times adjustable as desired

Ramp with slope dU/dt, as adjusted on the generator, fed into the analogue interface of the power supply or load

Resulting rampe on the output of, for example, a power supply (if not in CC/CP), with more or less visible steps

Note: the result is primarily depending on the time (dt) and the amplitude (dU). It will be better than with EPL, but worse than with the FM.

函数发生器以0...5V或0...10V运行，可按需调节上升/下降时间

按照dU/dt斜率，如函数发生器上调节的一样，形成阶跃，反馈到电源或负载的模拟接口

在电源输出端（若不是在CC/CP模式）形成或多或少带有一定步距的阶跃曲线

提示：主要根据时间（dt)和幅度(dU)形成，这个会比EPL(EasyPower Lite)软件要好一些，但是查过FM(函数发生器）形成的曲线。