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Novelty Edition

JUMO
Programming
FOR
DUMMIES

Learn to:

- **Program the JUMO manually**
- **Use JUMO provided software**
- **Use ElCommandante JUMO Interface**

Brian M Kapustka

JUMO Programming For Dummies

There are several ways to program and operate the ETH, JUMO controlled, cold boxes. This guide will go over how to make simple programs from the JUMO controller window, the JUMO software (Windows 7), and lastly the ElCommandante program.

1 Installation and Running a Program

This section deals with the basics of installing the JUMO software to get the controller to an operational state. Furthermore, it will show how to run a simple program. However, before actually running a program, it is advised that the CoolingBox Commissioning document is reviewed, and followed, to determine that everything works properly.

1.1 Installing basic Programs

Install the JUMO software provided with the JUMO controller. If no cd is available, software is provided at https://twiki.cern.ch/twiki/bin/view/CMS/ETHZurich-PixelUpgrade.

Once the installation is complete, using the instructions provided, it will be possible to establish a connection to the JUMO controller using the following steps:

> 1-go to "start"
> 2-select "devices and printers," look for the JUMO
> 3-right-click and look to details, look for which COM port the JUMO is using
> 4-go to the JUMO software window, and click on "Datatransfer"
> 5-select "establish connection..."
> 6-in the "info" box you may enter a name for the JUMO, hit next twice
> 7-on this page it will ask for a COM port in the "connected to" drop down box, hit next twice, and finish

Now that the JUMO is connected to the computer, the default programs may be loaded, using the following instructions:

> 1-go to the JUMO software window, and click on "Datatransfer"
> 2-select "Data transfer to device..."
> 3-select "startup"

(NOTE: First, the user will have to open a file containing the default programs, this may be accessed on the ETH groupshare. For group share instructions please look to the link provided at the beginning of this section)

Following this, the JUMO will load all necessary data, and it will have 5 programs ready for use.

1.2 Operation

Before attempting to operate the cold box, one should determine that everything works properly. Please visit https://twiki.cern.ch/twiki/bin/view/CMS/ETHZurich-PixelUpgrade, and follow the instructions provided in the CoolingBox Commissioning document.

In order to select a new program to run:

> 1-call up program selection by hitting Prog -> Start program

2-select the program using the cursor keys
3-confirm by hitting enter

In order to start the currently selected program, simply hit the Start button installed on the the cold box, or the JUMO controller.

2 Programming using the JUMO

This method for making and editing programs is most likely the least efficient, but the most direct. There are two possibilities for making changes to a program. One possibility is to edit a program while it is running. This is useful for minor one time adjustments. After the program is finished running, any changes will be removed, and the program will go back to its original settings. The other possibility is to change a program permanently, or to make another program.

2.1 JUMO Controller Basics

Below, in figure 1, is an example of a JUMO program, as well as an explanation of what each field shows.

Programm		1 Programm 01						
Channel	**1**	**Segment**	**1**	**Mode**	**Edit**			
Nr	Setp.	Zeit	CtrlCon	Cy	Nr	TolMin	TolMax	Par
1	20	00:20:00	00000001	0	1	0	0	1
2	60	00:40:00	00000000	0	1	0	0	1
3	60	00:15:00	00000001	0	1	0	0	1
4	90	00:30:00	00000001	0	1	0	0	1
5	40	00:55:00	00000000	0	1	0	0	1

Fig 1. An example of a single channel of a JUMO program.

Explanation:
-Programm: Shows program number, followed by program name.
-Channel: Shows which channel is displayed, for any JUMO program there are two channels, channel 1 is in control of cooling and channel 2 is in control of heating.
-Segment: Shows which segment of the program is highlighted.
-Mode: Shows which mode is being used to change the program, "Edit" means that the changes will be permanent, "Temporary Alteration" means that the change will only last as long as the program is running.
-Nr: Shows segment number.
-Setp.: Setpoint, this shows the temperature that the current channel will try to achieve for each segment.
-Zeit: Shows the duration of each segment (Max 99 hr, 59 min, 59 sec, or displayed as 99:59:59).
-CtrlCon: Control Contacts, this is what the JUMO controls. For the purposes of the cold box, the JUMO only controls 4 variables. Each bit corresponds to if a variable is on or off (1 = on, 0 = off).

-Bit 0: This controls the polarity of the cooling elements. If the bit is set to 0, then the JUMO is set
    to cooling mode.
-Bit 1: This controls the dry air / N_2 flush.
-Bit 2: This controls the water and the dry air / N_2 flow.
-Bit 3: This controls the safety indicator (for cold box this is always on).
-Bits 4-7: Control nothing. The ETH Cold box does not make use of all contacts (16 total possible)
-Cy: Number of cycles (better explanation in Nr)
-Nr: Sets from which segment to cycle. In current example, each segment is used once. Example: In the
    above program, if segment 4 was edited, to have Cy = 1, and Nr =2, then segments 2 through 4,
    would be repeated once more, after they were completed the first time.
-TolMin: Minimum tolerance band (for cold box this is left alone)
-TolMax: Maximum tolerance band (for cold box this is left alone)
-Par: Parameter set number, should be set to 1 for an active channel (A more detailed explanation will
    be given later).

2.2 One Time changes

Once a program is running, it is possible to adjust the variables. For example, if the JUMO was using
the program used as an example from section 2.1, and it was desired that in the 4th step the cold box
reaches a setpoint of 100 instead of 90:

      1-call up the program temporary alteration menu by selecting "Talt"
      2-use the cursor keys to select the setpoint field for segment 4
      3-hit enter, change the setpoint to 100, and hit enter to confirm

At this point the JUMO will run this program once, and revert the changes made.

2.3 Fixed Changes

In order to make permanent changes there are two possibilities. It is possible to edit an existing
program, or to make a completely new one.

In order to edit an existing program (when there is no program running):
      1-call up the program edit menu by selecting Prog -> Edit Program
      2-select the program using the cursor keys, and hitting enter
      3-edit program channels 1 and 2 using sections 2.1+3.1 as a guides

If there is a program that is similar to one that you wish to make:
      1-call up the program edit menu by selecting Prog -> Edit Program
      2-select the program using the cursor keys, and hit copy
      3-select an empty program slot (or program to be overwritten), and hit paste

3 Programming with JUMO software

It is possible to edit, and make programs using the same software that was used to load the startup
software. There is an example of a program written for the cold box shown in figures 2 and 3 in the
following section, where they will be explained.

3.1 Programming Explanation

	Program: 4			Programmkanal: 1			Name: BestProgEver		
Segment	Setpoint 1	Setpoint 2	Time	Control contacts	Cycles	Target segment	Min. tolerance	Max. tolerance	Parameter set
1	40.000	0.000	00:02:00	2, 4 ▾	0	1	0.000	0.000	1 ▾
2	20.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
3	15.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
4	10.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
5	5.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
6	0.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
7	-5.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
8	-10.000	0.000	00:10:00	3, 4 ▾	0	1	0.000	0.000	1 ▾
9	40.000	0.000	00:02:00	1, 3, 4 ▾	0	1	0.000	0.000	1 ▾
10									
11									

Fig 2. An example program of program channel 1

	Program: 4			Programmkanal: 2			Name: BestProgEver		
Segment	Setpoint 1	Setpoint 2	Time	Control contacts	Cycles	Target segment	Min. tolerance	Max. tolerance	Parameter set
1	-40.000	0.000	00:02:00	0 ▾	0	1	0.000	0.000	1 ▾
2	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
3	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
4	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
5	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
6	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
7	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
8	-40.000	0.000	00:10:00	0 ▾	0	1	0.000	0.000	1 ▾
9	20.000	0.000	00:02:00	0 ▾	0	1	0.000	0.000	1 ▾
10									
11									

Fig 3. An example program of program channel 2

When the JUMO software is first opened, one set of items that it will display is the programs that can be edited and loaded onto the JUMO. In figures 2 and 3, we have a look at the BestProg(ram)Ever. This program flushes with dry air / N_2 for 2 minutes. Then it goes from 20 C to -10 C in 5 C increments every 10 min, while the dry air / N_2 and water is flowing. Lastly, it warms back up to 20 C with dry air / N_2 and water flowing.

There are a couple items to note:
> 1-for program channel 2, all of the control contacts are turned to 0, this is because if a control contact is turned on for one channel, it is turned on for the other
> 2-for program channel 1 step one, the setpoint is set to 40, this is because we want the cold box to "cool" down to 40, since it is below 40, it will not cool
> 3-for program channel 2, all but the last step have a setpoint of -40, likewise, we want the cold box to "heat" to -40, since it cannot, it will not heat
> 4-for our purposes, the parameter set can always be left at the default, #1
> 5-there is a second set of setpoint temperatures, for our purposes, this can also be left alone

Once the desired programs are completed, they can be loaded onto the JUMO with the same process that was used in section 1.1 (except that this time, the user will have to add a check to the boxes next to the new programs to be loaded). The programs can be given names, as well as icons, by selecting the "ABC" button at the top of the JUMO software window.

4 Why Two Channels?

To this point, it has been explained how to program the JUMO controllers 2 channels, but not why

there are two channels to begin with. This section will give a detailed look into the reason. Below, in figure 4, there is a simplified circuit diagram of what the control bit for polarity does. One can also see what would happen should the cold box be in "cooling" or "heating" mode.
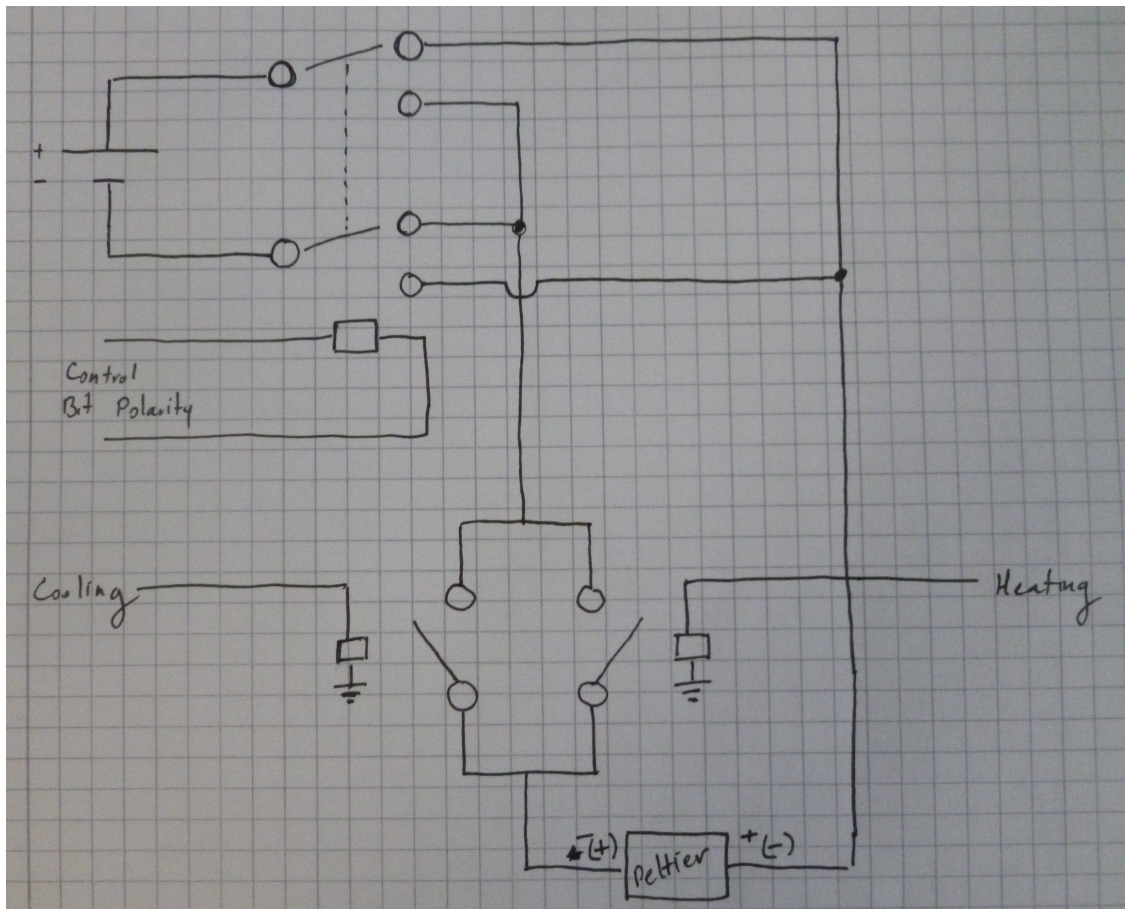

Fig 4. A depiction explaining how the two channels work, in conjunction with the polarity control bit.

There are two things to take away from figure 4. If the JUMO controller sees that the cold box is below the heating channel setpoint, or above the cooling channel setpoint, then the Peltier will just be turned on. What actually controls the direction of heat flow is the polarity control bit, not the "cooling" or "heating" conditions. This means that it is possible that while the JUMO controller wants to cool the box down, but the polarity is set incorrectly, the cold box will instead heat the cold box. In turn, the cold box will heat up uncontrollably, until it reaches an equilibrium of heat being generated by the Peltiers, and heat dissipation with the surrounding environment (which will be well over 100 C, if it's environment is at room temperature).

5 Programming with ElCommandante

(to be added)