SYSTEM8700

User's Manual

Manual for setup and
use of SYSTEM8700
Control system

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1. Introduction

1.1. Important safety information

This document may contain warnings:

GENERAL HAZARD

Indicates a potentially hazardous general situation. The keyword (DANGER, WARNING, and CAUTION) indicates the hazard level.

ELECTRICITY

Indicates a potentially hazardous electrical situation. The keyword (DANGER, WARNING, and CAUTION) indicates the hazard level.

MAGNETIC FIELD

Indicates a potentially hazardous magnetic field situation. The keyword (DANGER, WARNING, and CAUTION) indicates the hazard level.

1.1.1. General warnings

Please review the following safety precautions and all warning and caution information throughout the manual.

WARNING!

This Magnet Power Supply (MPS) is intended for professional incorporation into complete accelerator systems as a part of a fixed installation. If installed incorrectly it may present a safety hazard. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction.

WARNING!

Do not perform any flash test or voltage withstand test on the Magnet Power Supply. Any electrical measurements required must be carried out with power supply disconnected.

CAUTION!

Only qualified electricians are allowed to install and maintain this equipment.

DANGER! ELECTRIC SHOCK HAZARD!

Disconnect power at switch board before attempting to work on the Magnet Power Supply. High voltages are present at the terminals and within the power supply for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable measuring device that no voltage is present prior to commencing work.

CAUTION!

Ensure correct grounding connection. The grounding cable must be selected to be able to carry the maximum supply fault current. This is normally limited by fuses at the switch board. Fuses at the switch board must be selected according to local legislation or code.

1.2. About this document

This document is intended for design and service engineers responsible for the installation, maintenance and repair of the Power Supplies using SYSTEM8700 control system supplied by Danfysik A/S. The power supply itself and its regulation system is not within the scope of this document.

1.2.1. Intended use

The Magnet Power Supply (MPS) is intended for professional incorporation into complete accelerator systems as a part of a fixed installation. It must be installed in an enclosed operating area. The power supplies are built according to industrial standards.

The intended use is to control a magnet by supplying the current for the magnet. The MPS includes an interlock system, which shuts down the power supply in case a number of predefined errors occur.

Only qualified personnel are allowed to install the MPS, and only instructed personnel are allowed to operate it.

In case of failure, the accelerator system must have the means to shut down in a safe manner.

1.3. Warranty and warranty repair

Unless other specific warranty terms has been agreed upon following terms apply:

DANFYSIK A/S warrants that the products manufactured by us will be free from defects in material and workmanship that adversely would affect the normal functioning of the unit, for a period of 24 months from the date of shipment. The exceptions to this are:

a) Parts not manufactured by DANFYSIK A/S which are covered by the original equipment manufacturer's warranty.
b) Repair work which is warranted for six (6) months from the date of shipment from DANFYSIK.

DANFYSIK A/S will repair or replace either on site or at the factory, at option and without charge, any equipment which proves to be defective within its warranty period.

In the case of warranty, DANFYSIK A/S will pay or reimburse lowest freight rate (two-way) of any item returned to DANFYSIK or our designated agent/representative, provided that prior written authorization for such return has been given by DANFYSIK A/S.

This warranty shall not apply to any equipment which has become defective or unworkable due to mishandling, improper maintenance, incorrect use, radiation damage or any other circumstance not generally acceptable for equipment of a similar type.

On standard products, DANFYSIK A/S reserves the right to make changes in design without incurring any obligation to modify previously manufactured units.

The foregoing is the full extent of this warranty, and no other warranty is expressed or implied. In no event shall DANFYSIK be liable for special damages arising from the delivery, late delivery or use of the equipment.

If any fault develops, the following steps should be taken:

- All RMA-cases are handled via Danfysik's web based RMA-system. It can be accessed from the official Danfysik web page www.danfysik.com (via the Service & Test tab), where a RMA Quick Guide also can be downloaded. Alternatively, the RMA-system can be accessed directly via www.dfservice.dk/rma/
- Notify DANFYSIK A/S, giving full details of the problems, and include Model-Type and Serial number.
  On receipt of this information, DANFYSIK A/S will give you either service information or instructions for shipping.
- All shipments of DANFYSIK equipment should be made according to our instructions and shipped in the original or a similar container.
- Only suitable materials are to be used for shipment.

2. Unpacking and installation

2.1. Receiving the goods

The Shipping container and the Magnet Power Supply should be thoroughly inspected for signs of obvious physical damage immediately upon receipt.

All materials in the container should be checked against the enclosed packing list. DANFYSIK A/S will not be responsible for shortages against the packing list unless notified immediately. The following must be included in the delivery:

- To be defined

2.2. Instructions for unpacking

The Magnet Power Supply is shipped on a wooden pallet enclosed in either reinforced cardboard or wood crate.

Remove the packing straps and nails. If packed in a wood crate, the top lid should be removed first. If the equipment is damaged in any way, a claim should be filed with the shipping agent, and a full report of the damage should be forwarded to DANFYSIK A/S or our local agent/representative immediately.

Upon receipt of this report, you will be issued instructions for the repair, replacement or return shipment.

Please include the Model no, Type no, Serial no and Order no for the Magnet Power Supply on any communication with DANFYSIK A/S or our representatives.

2.3. Installation requirements

During installation of the Magnet Power Supply (MPS), local rules and regulations for electric power and water supplies should be respected and the following conditions and installations should be available.

- A normal, dust free room with humidity not above 80 % and a room temperature within 15 to 35 centigrade.
- The Control System is supplied from a 24Vdc. This is typically handled as an internal voltage within the power supply. Please see Power Supply manual and drawing for details.
- Ground connection according to the local authority regulation and the requirements for the equipment.

2.4. **Electrical Installation**

2.4.1. Connection of Power

The PLC is powered by 24 V DC, please see Figure 1.

2.4.2. Connection of Remote Control Cable

The power supply can be remote controlled via an Ethernet connection. The connection is made directly on the rear of the IPC. Seen from behind, open the right-hand door and make the connection to the rightmost of the two RJ45 connectors.

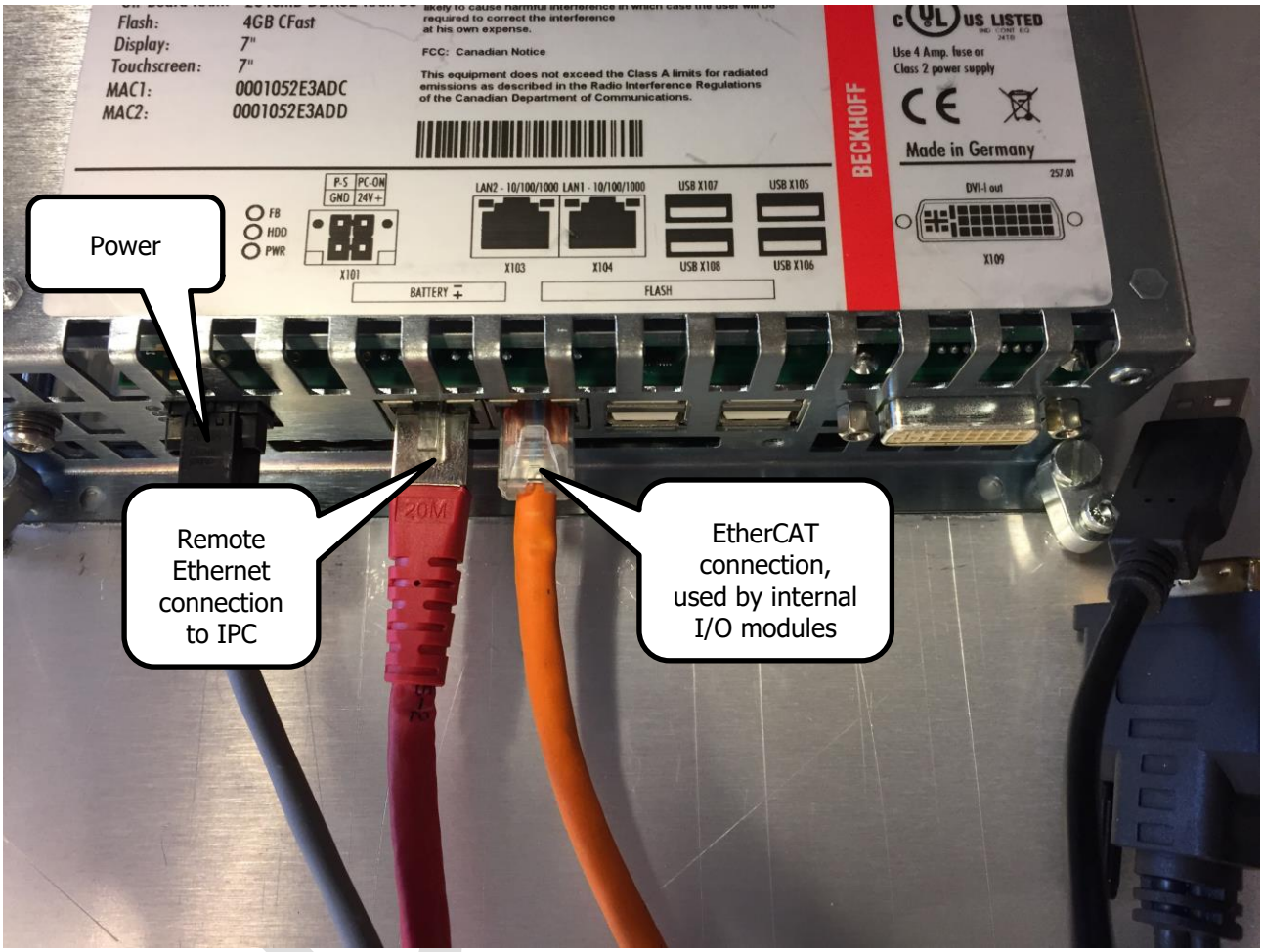


Figure 1: Connections to the PLC

Instructions for remote line setup and use are given in chapter 4.

2.4.3. Connection of External Interlocks

Interlocks, externals as well as internals, are connected to the control system PLC through 24V relays. Both PLC and the relays can shut down the power supply in case of an interlock. This offers two undependable ways of shutting down.

Interlock inputs are designed for external potential free contacts. The open circuit voltage is <30V and the closed-circuit current is <20mA. See power supply manual and drawings for details.

3. Local control interface

The local interface is a Beckhoff CP6706 Industrial PC with a touch sensitive monitor on which the HMI of the control system is displayed.

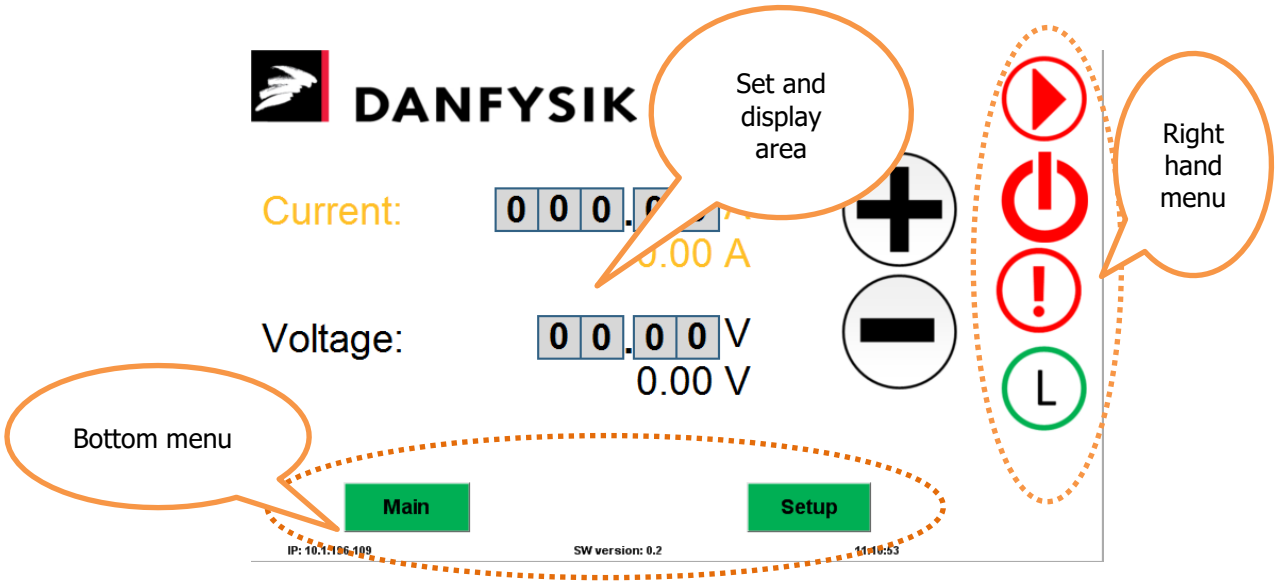


Figure 2: The main screen

When the power supply is turned on, the operating system will boot up and show the main screen, please see Figure 2. The main screen consists of three main areas, the right-hand menu, bottom menu and the set and display area. In the bottom of the screen the IP address for remote connection can be seen as well as the version of the current software running on the PLC and the time of date.

3.1. The right-hand menu

The right-hand menu consists of four buttons and they are from the bottom the mode button, controlling the local/remote mode of the MPS, the interlock button, showing the interlock state, the standby button and the on button.

3.1.1. Changing the mode

The control system can be in four command modes: Local, Local Locked, Remote and Remote Locked. When the system is in Local mode, the MPS can be controlled only from the local interface. It is possible to ask about status on the remote line but it is not possible to set values on the remote line. It is possible to switch to Remote mode from the local interface and also set it in Remote mode from the remote line. When the system is in Local Locked mode, the system can only be set in a different mode from the local interface. When the system is in Remote Locked mode, the system can only be set in a different mode from remote.

When the system is in Remote mode it is possible to set values over the remote line and the values will be displayed on the local interface but it is not possible set values from the local interface.

3.1.2. Interlocks and warnings

All interlocks and warnings are displayed in the interlock list, which can be accessed by pressing the interlock button in the right-hand menu. When there is an interlock, the interlock button is red, when there are only warnings the button is yellow. All interlocks are latched, meaning they will only be reset and disappear from the list after a Reset command has been issued or the reset button, depending on what mode the MPS is in. Warnings are not latched and are

therefore only displayed while they are active. Interlocks are displayed in red text, and warnings are displayed in red text with a star (*) in front.

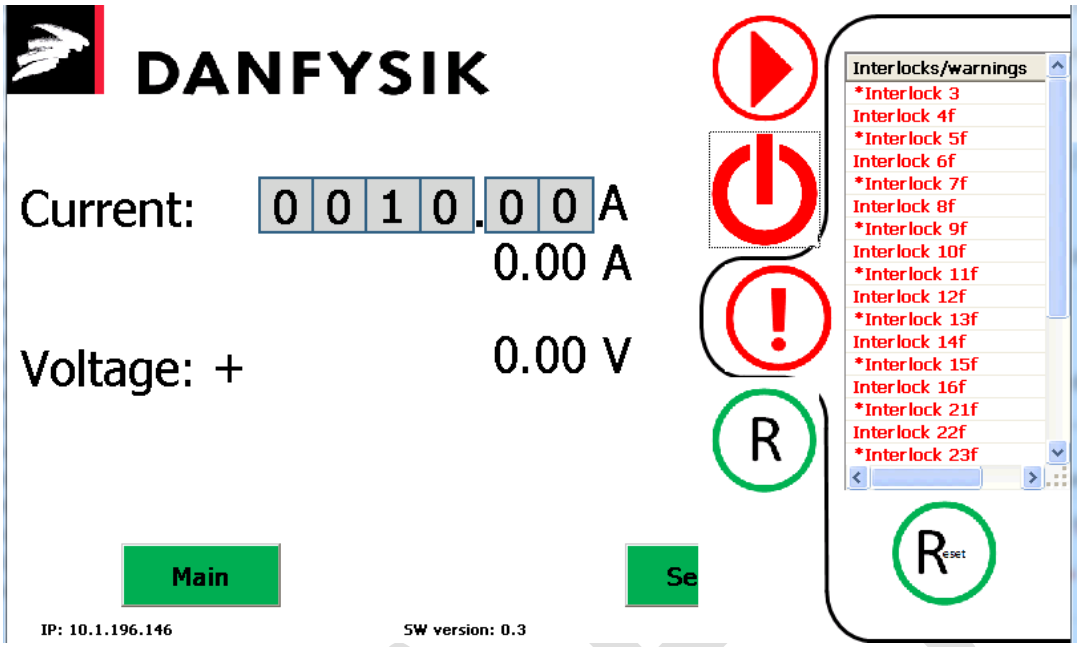


Figure 3: The interlock list

The interlock list is collapsed again when the interlock button is pressed.

3.1.3. Turning the power supply on

The power supply has three states: Off, Standby and On. The power supply must first be in Standby state before it can be turned On.

In order to turn the power supply On from the local panel, the following sequence must be executed:

1. Set the system in Local mode by pressing the mode button in the right-hand panel and pressing "L".
2. Make sure that there are no faults. Faults are indicated with a red "FAULT" button in the right panel. Press the red Faults button to view the faults in the Faults screen. Press the Reset button to reset them.
3. Press the STANDBY button, the button will turn green when it is in standby mode
4. Press the ON button, the button will turn green when it is in On mode.

3.1.4. Turn the Power Supply Off

To turn the power supply Off, press the OFF button (it is not necessary to go through the Standby state).

An overview if the Standby, On and Off state is shown in Figure 5. A diagram of how the states relate to each other is indicated in Figure 4.

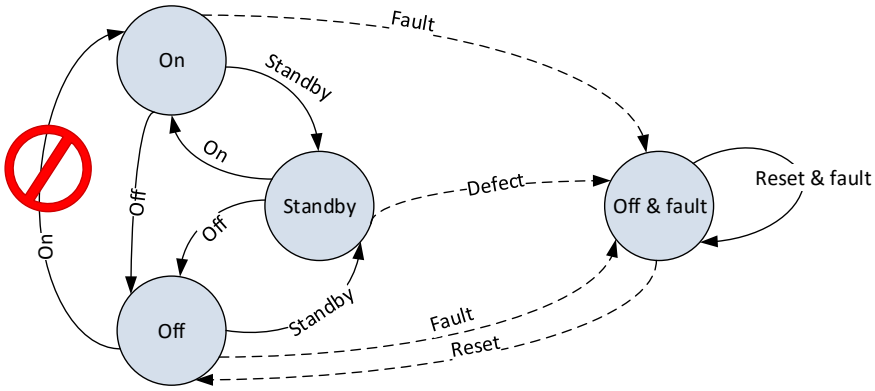


Figure 4 The state diagram.

3.2. **Setting a current or voltage**

From the main screen the current can be set by selecting a digit and change its value using the + and - buttons. If the MPS is in the On state, the set current (or set voltage, see later) is changed as soon as the digit is changed. The current is set and read in amps by default but the software can be configured to use PPM for the set current, in the setup screen. When the digit is changed upward and it reaches "9", moving it up one more will change that digit to "0" but the digit to the left will also increase by 1.

The set values are limited to the minimum and maximum values indicated in the setup screen.

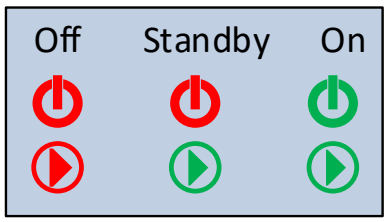


Figure 5 How the Off, Standby and On states are indicated

3.3. **Settings**

In order to get access to the setup screen the Setup button in the bottom menu can be pressed.

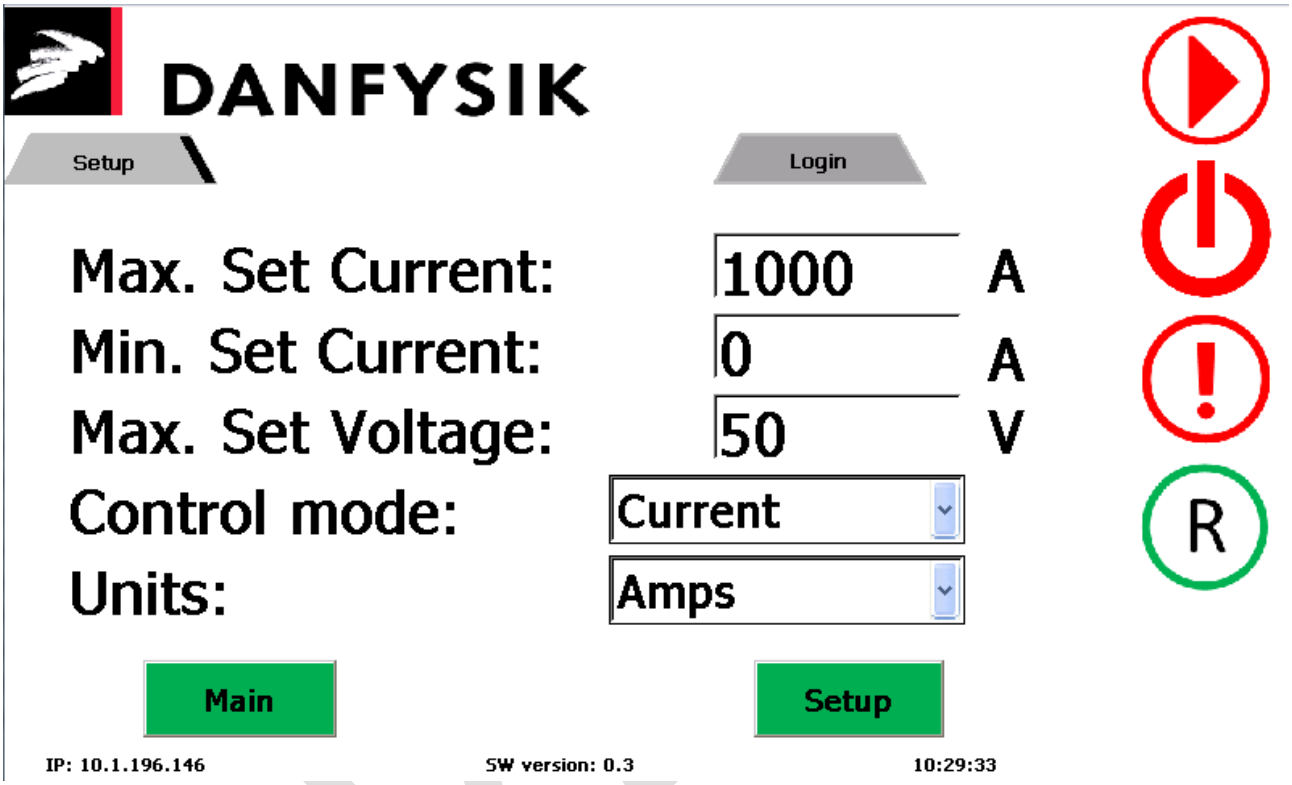


Figure 6: The Setup window

On the setup screen the Maximum and minimum current can be set as well as the maximum voltage. The user will not be allowed to set values on the main page outside the ranges indicated here.

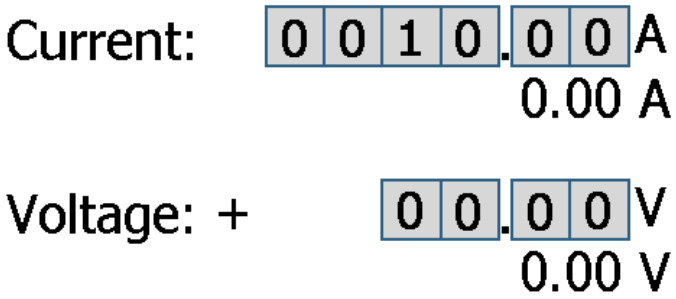


Figure 7 Control mode set to Voltage

Also, the control mode can be set, current or voltage controlled. If the control mode is set to Voltage, an extra input field appears on the front page allowing to also set a voltage. Note that this is only possible for power supplies with implemented voltage control loop in the regulation system. For power supplies without this feature; use of voltage control will have no effect

The units for the set current can be set to either Amps or PPM (parts per million). If PPM is selected the current set digits changes to a 6 digit display where 999999 ppm is 100% output current. The read back value of the current is always in Amps. Both set voltage and read back voltage is always in volts, please see Figure 8.

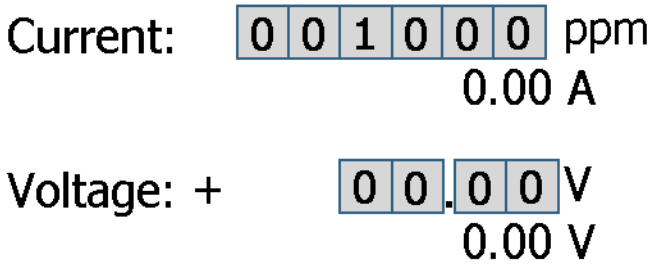


Figure 8 Unit set to PPM

3.4. **The login screen**

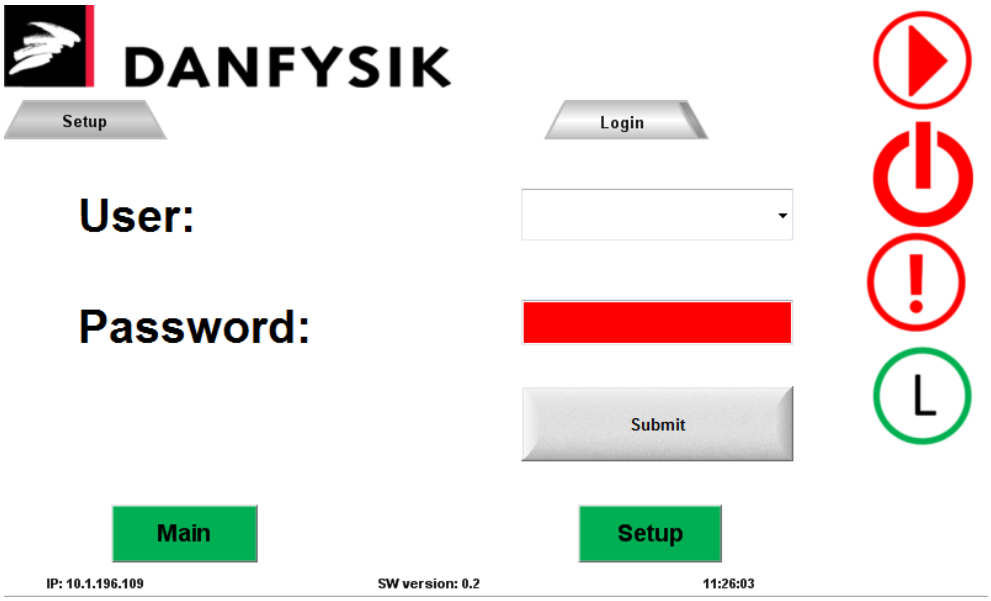


Figure 9 The setup screens login window

The login screen is used by Danfysik staff for calibration and maintenance tasks.

3.5. **Advanced Settings**

Following settings are for advanced use only. Use of strict syntax is important for the stability of the control system.

3.5.1. The interlock file

The interlock file controls the setup of interlocks: what text should be shown and if it is a warning or a real interlock.

The format is as follows:

```
PersistentData.aInterlocks[3].sDisplayText:='Water flow too low'
PersistentData.aInterlocks[3].bIsLock:=TRUE
PersistentData.aInterlocks[3].bIsWarn:=FALSE
```

and there is a section like above for each interlock. The number in the square brackets is the index of the interlock, please use Table 4, Table 5 and Table 6 to find out what digital input is connected to what interlock data variables.

The variables are used as follows:

- `sDisplayText`: This variable sets the display text that will be shown in the interlock list in the HMI.
- `bIsLock: True` indicates that this is a true interlock.
- `bIsWarn: True` indicates that this a warning.

`bIsLock` and `bIsWarn` cannot be true at the same time.

It is very important that the format and the order of the file is maintained. The software that reads the file on the PLC requires a specific syntax to read the file. It is not allowed to make comments in the file. It is not allowed to add extra white spaces in the file.

3.5.2. Editing the files

Basically there are two ways to edit the file:

- FTP. Use a normal FTP client to connect to the PLCs IP address and use the user name "Danfysik" and password "Danfysik". Navigate to the directory /root-www/Recipes and download the required file. Edit the file and upload the file again.
- Local editor. On the local monitor go to the Windows Start menu as described in section 4.4.1 and Click Run and type in "notepadce". In the NotepadCE program click File/Open and navigate to \Hard Disk\WWW\Recipes\ and load the required file.

4. Remote control interface

The MPS can be controlled remotely either via ethernet or via RS232.

4.1. Ethernet interface

The remote communication interface is TCP/IP, via the RJ45 connector marked LAN2 in the bottom of the Beckhoff CP6706 IPC (Industrial PC), please see Figure 10. Please note that there are two RJ45 connectors on the IPC, the one marked "LAN1" in Figure 1 is for the communication to the I/O modules.

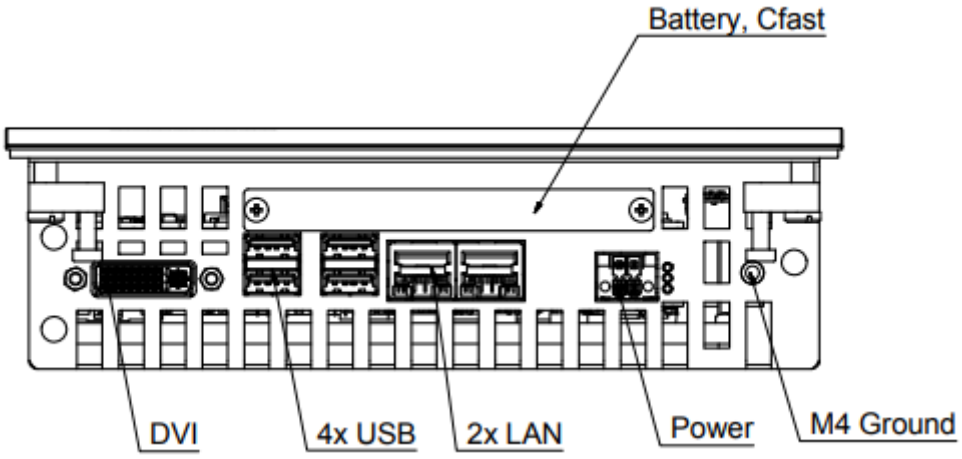


Figure 10: The connections on the Beckhoff CP6706 IPC

4.2. Serial RS232 interface

To be described

4.3. Remote control commands

There are two sets of commands for controlling the MPS, SCPI commands and a subset of the commands used for the older models of the Danfysik MPS.

4.3.1. SCPI commands

The SCPI communication protocol is based on the IEEE standard "Standard Commands for Programmable Instruments" (SCPI) but only a subset of commands is implemented. The definition of the standard can be found here:

http://www.ivifoundation.org/docs/scpi-99.pdf

However, this is rather lengthy and an easier to read example of how it can be implemented can be found here:

http://www.us.tdk-lambda.com/hp/pdfs/product_manuals/83034100.pdf, please see page 35-45.

In short, SCPI is a standard set of commands implemented by many of the major instrument companies, making it much easier to implement different instruments in software.

Most SCPI commands, but not all, have "set" version and an "ask" version. Example:

- The command "OUTP:CURR 22.56" sets the current to 22.56 amps.
- The command "OUTP:CURR?" asks for the current set value and will return "22.56".

The computer uses port 13000 for the SCPI communication.

The implemented commands are listed in Table 1.

Table 1: Implemented SCPI commands

Command	Description
***CLS**	Clear status command, same as the reset command *RST
***IDN?**	Identification query. The response includes the PLC version as well as the parser version.
***RST**	Reset command, resets all interlocks.
***STB?**	Returns the Status register. The command is equivalent to STATus?
SYSTem:ERRor[:NEXT]?	Returns the top entry of the status queue for the parsing of the commands in the format "error#, error text". Error# 0 means no error. When the command is issued the entry is removed from the queue and next entry is brought to the top of the queue.
SYSTem:VERSion?	Returns the software release number

Command	Description
STATus?	Returns the Status register bits as a decimal number. What the bits represents is listed in Table 2.
STATus:OPERation?	Returns the Status:Operations register bits as a decimal number. What the bits represents is listed in Table 3.
STATus:OPERation:REG1?	Returns the Status:operations:REG1 register bits as a decimal number. These are the warning/interlock bit, but the exact mapping is Listed in Table 4.
STATus:OPERation:REG2?	Returns the Status:operations:REG2 register bits as a decimal number. These are the warning/interlock bit, the exact mapping is listed in Table 5.
STATus:OPERation:REG3?	Returns the Status:operations:REG3 register bits as a decimal number. These are the warning/interlock bit, the exact mapping is listed in Table 6.
STATus:OPERation:REG4?	Returns the Status:operations:REG4 register bits as a decimal number. These are the warning/interlock bit from the digiloop card, the exact mapping is listed in Table 7.
[:SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude] {<level (A)>	Sets the current
[:SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude] ?	Returns the set current
[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] {<level (V)>	Sets the voltage
[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] ?	Returns the set voltage
OUTPut:RELay[:STATe] {0|1|2|STB|ON|OFF}	Sets the state of the system, on/off/standby. 0 = STB, 1 = ON, 2 = OFF. The system must be in STB before it can be set in ON state.
OUTPut:RELay[:STATe]?	Returns the state of the system 0 = STB, 1 = ON, 2 = OFF, 3 = ERROR.
MEASure[:SCALar]:VOLTage[:DC]?	Returns the read voltage
MEASure[:SCALar]:CURRent[:DC]?	Returns the read current
SYSTem:DATE yyyy, mm, dd	Sets the date. Both e.g. "9" and "09" will work for setting moth and day.

Command	Description
SYSTem:DATE? <yyyy>-<mm>-<dd>-<hh>:<mm>:<ss>	Returns the date and time in the format DT#yyyy-mm-dd-hh:mm:ss
SYSTem:LOCK:OWNer?	This query returns what mode the system is currently in. 0 = Local, 1 = Remote, 2 = Local locked, 3 = Remote locked
SYSTem:LOCK:RELease	This event releases the system from the Remote Locked Mode. If the system is not in the remote locked mode, this command has no effect. This command has no query form.
SYSTem:LOCK:REQuest?	The command attempts to set the system in remote mode. This event is only implemented as a query.
SYSTem:LOCK:LREQuest?	The command attempts to set the system in remote locked mode. The system must be in remote mode to allow this operation. This event is only implemented as a query.
SYSTem:TIME hh, mm, ss	Sets the system time. All three parameters must be given. Both 9 and 09 will work for e.g. setting the hours. Hours are set as on a 24 hour clock.
SYSTem:TIME? <yyyy>-<mm>-<dd>-<hh>:<mm>:<ss>	Returns the date and time in the format DT#yyyy-mm-dd-hh:mm:ss
[SOURce:]FREQuency[:LEVel] {<level (Hz)>|	Sets the switching frequency. This command is not implemented on all versions of the MPS.
[SOURce:]FREQuency[:LEVel]?	Returns the switching frequency. This command is not implemented on all versions of the MPS.

4.3.1.1. Status reporting

The status reporting is done via the OPERation status register with the command STATus:OPERation. The different status, warnings and errors are split up in separate arrays, see below. The array is summed up on the level above with an "or" so that if one or more bits are set in an array, the bit on the level above will also be set. New sub commands have been constructed to get the individual sub arrays e.g. to read the status bits in register 1, the command STATus:QUEStionable:REG1 is used.

In the tables below the Bit indicates what bit the signal corresponds to after the decimal number returned by the command has been converted to a binary digit, see also the example after Table 6 for further explanation. The Input column indicates what digital input the signal is connected to. If no input is indicated the signal is generated internally.

4.3.1.2. Status, bit 9

Command: STATus

Bit	Signal	Interpretation
0	Output On	1: Output is on
1	Ready	1: regulation reports output within defined limits
2	-	Not used
3	-	Not used
4	Sum interlock	1: one or more interlocks present
5	-	Not used
6	-	Not used
7	Operation Status	1: Further info in Operation Status registers available

Table 2 The status register

4.3.1.3. Operation status , bit 7

Command: STATus:OPERation

Bit	Signal	Interpretation
0	-	Not used
1	-	Not used
2	-	Not used
3	-	Not used
4	-	Not used
5	-	Not used
6	-	Not used
7	-	Not used
8	-	Sum interlock
9	-	Not used
10	REG1	Sum bit for register 1, see below.
11	REG2	Sum bit for register 2, see below.
12	REG3	Sum bit for register 3, see below.
13	REG4	Sum bit for register 4, see below.
14	-	Not used

Table 3 Operation register

4.3.1.4. Register 1, bit 10

Command: STATus:OPERation:REG1.

Bit	Input	Signal (Index)	Interpretation/default configuration
0	-	eIL_CommFail	Regulation board communication failure
1	-	eIL_RegModFail	Regulation failure, regulation board has an interlock
2	-	eIL_PlcModule	PLC module failure
3	-	eIL_PolSwitch	Polarity switch failure
4	-	eIL_SoftStart	Soft start failure
5	-	eIL_PullUpPwr	Pull up power failure
6	-	eIL_Overload	Overload
7	-	eIL_Sum	Sum interlock
8	-	eIL_WaterTempIntl	Water temperature interlock (*)
9	-	eIL_WaterTempWarn	Water temperature warning (*)
10	-	eIL_WaterFlowIntl	Water flow interlock (*)
11	-	eIL_WaterFlowWarn	Water flow warning (*)

Table 4 Register 1

* = Rutherford project

4.3.1.5. Register 2, bit 11

Command: STATus:OPERation:REG2.

Bit	Input	Signal (Index)	Interpretation/default configuration
0	bInterlock1_3	eIL_Interlock2_03	E-Off
1	bInterlock1_4	eIL_Interlock2_04	Door Interlock
2	bInterlock1_5	eIL_Interlock2_05	AC IN OCP
3	bInterlock1_6	eIL_Interlock2_06	Phase error
4	bInterlock1_7	eIL_Interlock2_07	Transformator over temp
5	bInterlock1_8	eIL_Interlock2_08	Rectifier over temp

6	bInterlock1_9	eIL_Interlock2_09	Choke over temp
7	bInterlock1_10	eIL_Interlock2_10	Transistor over temp
8	bInterlock1_11	eIL_Interlock2_11	MPS water flow
9	bInterlock1_12	eIL_Interlock2_12	Earth leak
10	bInterlock1_13	eIL_Interlock2_13	Preregulation error
11	bInterlock1_14	eIL_Interlock2_14	Regulation error
12	bInterlock1_15	eIL_Interlock2_15	MPS spare 1
13	bInterlock1_16	eIL_Interlock2_16	MPS spare 2

Table 5 Register 2

4.3.1.1. Register 3, bit 12

Command: STATus:OPERation:REG3.

Bit	**Input**	**Signal (Index)**	**Interpretation/default configuration**
0	bInterlock2_1	eIL_Interlock3_01	Magnet over temp
1	bInterlock2_2	eIL_Interlock3_02	Magnet flow interlock
2	bInterlock2_3	eIL_Interlock3_03	External 1
3	bInterlock2_4	eIL_Interlock3_04	External 2
4	bInterlock2_5	eIL_Interlock3_05	External 3
5	bInterlock2_6	eIL_Interlock3_06	External 4
6	bInterlock2_7	eIL_Interlock3_07	MPS spare 3
7	bInterlock2_8	eIL_Interlock3_08	MPS spare 4
8	bInterlock2_9	eIL_Interlock3_09	MPS spare 5
9	bInterlock2_10	eIL_Interlock3_10	MPS spare 6
10	bInterlock2_11	eIL_Interlock3_11	Status spare 1
11	bInterlock2_12	eIL_Interlock3_12	Status spare 2
12	bInterlock2_13	eIL_Interlock3_13	Status spare 3
13	bInterlock2_14	eIL_Interlock3_14	5% transistor fail

Table 6 Register 3

4.3.1.1. Register 4, bit 13

Command: STATus:OPERation:REG4.

Bit	Input	Signal (Index)	Interpretation
0	-	eIL_RegBoard0	Drive AD
1	-	eIL_RegBoard1	Drive BC
2	-	eIL_RegBoard2	Temp AD
3	-	eIL_RegBoard3	Temp BC
4	-	eIL_RegBoard4	Temp AD+BC
5	-	eIL_RegBoard5	PS Fail
6	-	eIL_RegBoard6	Overload
7	-	eIL_RegBoard7	Earth leak
8	-	eIL_RegBoard8	Over temp
9	-	eIL_RegBoard9	Current DCCT
10	-	eIL_RegBoard10	Trip in
11	-	eIL_RegBoard11	Trip out
12		eIL_RegBoard12	Pre trig fault (warning)
13		eIL_RegBoard13	Polarity signal missing (warning)

Table 7 Register 4

Example:

If e.g. we have an interlock connected to the first input module, module 1, and the wire is connected to the modules input 5, this is what we in the table above call input bInterlock1_5, please see Table 5, this would be the 3rd interlock in register 2. The command;

```
STAT:OPER:REG2?
```

Would then return 4, corresponding to the bit pattern 100, where the third bit is high.

Because there is a high signal in register 2 bit 11 is set high in the Operation register, please see Table 3, and the command

```
STAT:OPER?
```

will return 2048, corresponding to the bit pattern 100000000000 where bit 11 is high as there is at least one error signal active in register 2.

The command;

```
STAT?
```

will return 128, corresponding to 10000000 where bit 7 is high as there is at least one high signal in the operations array, please see Table 2.

4.3.2. Legacy commands

Command	Description
S1H	Queries the status on MPS. **Format**: S1H **Response**: XXXXXXXX (X = hexadecimal character) See section 4.3.2.1 for individual bits.
AD	Queries one of the measurements made by the PLC. **Format**: AD 'ch' where 'ch' is the decimal channel number. Available channels: 0: current in PPM of nominal. Range: -999999 to 999999 2: voltage in PPM of nominal. Range: -999999 to 999999 8: same as channel 0 16: same as channel 0
DA (read)	Queries the setvalue (DAC value) from the PLC. **Format**: DA 'ch' where 'ch' is the decimal channel number. Available channels: 0: current in PPM of nominal. Range: -999999 to 999999 2: voltage in PPM of nominal. Range: -999999 to 999999 **Response**: DDDDDD (D=decimal digit)
DA (write)	Sets current or voltage output. **Format**: DA 'ch' 'Val' where 'ch' is the decimal channel number and 'val' is a decimal value in PPM of nominal. Available channels: 0: current in PPM of nominal. Range: -999999 to 999999 2: voltage in PPM of nominal. Range: -999999 to 999999 **Response**: If the mode is different from Local or LocalLocked, the set request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command).

Command	Description
RS	Resets interlocks. **Format**: RS **Response**: If the mode is different from Local or LocalLocked, the reset request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command).
N	Requests the output turned on. The MPS must be set in standby mode first. **Format**: N **Response**: If the mode is different from Local or LocalLocked, the ON request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command). The S1H will reflect the resulting status of the MPS.
F	Requests the output turned off. The MPS will be set in standby mode. **Format**: F **Response**: If the mode is different from Local or LocalLocked, the OFF request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command). The S1H will reflect the resulting status of the MPS.
VER	Returns the version of the MPS firmware. **Format**: VER **Response**: Copyright DANFYSIK A/S 2017 System 8700 PLC: 'version' Parser: 'date'
CMD	Queries the control mode of the MPS. **Format**: CMD **Response**: LOC if the mode is Local or LocalLocked, otherwise REM
CMDSTATE	Queries the control mode of the MPS. **Format**: CMDSTATE **Response**: LOC if the mode is Local LOCK if mode is LocalLocked REM if mode is Remote RLOCK if mode is RemoteLocked
REM	Requests the PLC into Remote control mode. **Format**: REM **Response**: If the mode is different from LocalLocked, the request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command).
LOC	Requests the PLC into Local control mode. **Format**: LOC **Response**: If the mode is different from LocalLocked or RemoteLocked, the request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command).

Command	Description
ERRC	Changes the error response to ? 'errorcode" **Format**: ERRC **Response**: OK
EERT	Changes the error response to ? 'errortext" **Format**: ERRT **Response**: OK
RLOCK	Requests the PLC into RemoteLocked control mode. **Format**: RLOCK **Response**: If the mode is different from Local or LocalLocked, the request is sent to PLC and OK is returned. Otherwise error 5 is returned (Cannot execute command).
S3H	**Format**: S3H Queries the status on MPS. **Response**: XXXX (X = hexadecimal character) See section 4.3.2.2 for individual bits.

Table 8 Implemented Legacy commands

4.3.2.1. S1H response

Bit	Interpretation
0	Sum of interlocks eIL_Interlock3_06 to eIL_Interlock03_14
1	eIL_Interlock3_05
2	eIL_Interlock3_04
3	eIL_Interlock3_03
4	eIL_Interlock3_02
5	eIL_Interlock3_01
6	eIL_Interlock2_16
7	eIL_Interlock2_15
8	eIL_Interlock2_14
9	eIL_Interlock2_13
10	eIL_Interlock2_12

11	eIL_Interlock2_11	
12	eIL_Interlock2_10	
13	eIL_Interlock2_09	
14	eIL_Interlock2_08	
15	eIL_Interlock2_07	
16	eIL_Interlock2_06	
17	eIL_Interlock2_05	
18	eIL_Interlock2_04	
19	eIL_Interlock2_03	
20	Overload,	1: overload detected
21	Pull up power failure,	1: failure present
22	Soft start failure,	1: failure present
23	Polarity switch failure,	1: failure present
24	PLC module failure,	1: failure present
25	Regulation board interlocks, 1: one or more interlocks present from regulation board. Use command S3H to read regulation board interlocks	
26	Regulation board comm. failure, 1: failure present	
27	Tracking,	1: not tracking
28	Sum interlock,	1: one or more interlocks present
29	Polarity reverse,	1: polarity is reversed
30	Polarity normal,	1: polarity is positive
31	Output On,	1: Output is on

4.3.2.2. S3H response

Bit	**Interpretation**
0	Interlock from regulation board, eIL_RegBoard0
1	Interlock from regulation board, eIL_RegBoard1
2	Interlock from regulation board, eIL_RegBoard2

3	Interlock from regulation board, eIL_RegBoard3
4	Interlock from regulation board, eIL_RegBoard4
5	Interlock from regulation board, eIL_RegBoard5
6	Interlock from regulation board, eIL_RegBoard6
7	Interlock from regulation board, eIL_RegBoard7
8	Interlock from regulation board, eIL_RegBoard8
9	Interlock from regulation board, eIL_RegBoard9
10	Interlock from regulation board, eIL_RegBoard10
11	Interlock from regulation board, eIL_RegBoard11
12	Not used. Always 0.
13	Not used. Always 0.
14	Not used. Always 0.
15	Not used. Always 0.

4.4. **Additional remote access**

4.4.1. Remote Desktop

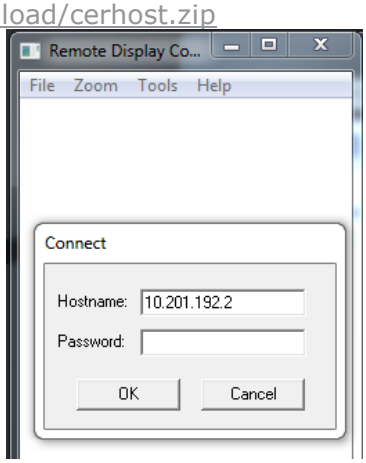
The normal Remote Desktop is not supported on Windows CE. Instead a special remote desktop program must be used, called Microsoft Remote Display or Cerhost. Please go to:

https://infosys.beckhoff.com/content/1031/cx8010/download/cerhost.zip

and download Cerhost.

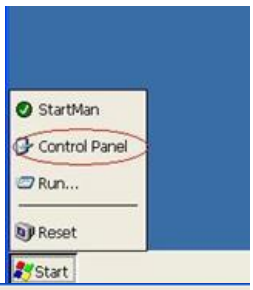
When connecting, enter the IP address of the power supply, as can be seen on the local interface and leave the password field empty.

If the GUI is running, the operating system can be accessed by connecting a USB keyboard to the computer (see Figure 10), and pressing the "Windows key".



4.4.2. Setting IP

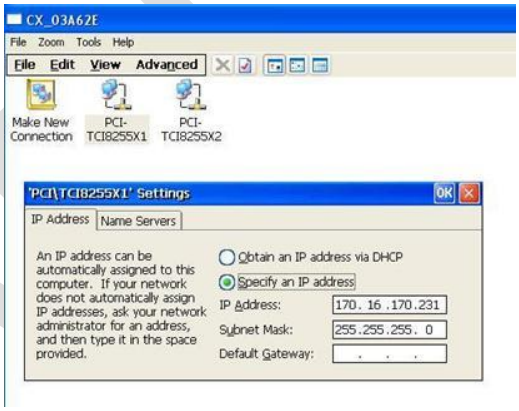
The setup of the power supply's IP address can be done on the local control or via Cerhost.



Click on Start button and select Control Panel.

Select the Network and Dial-up Connections.

Open the network properties for the network card and enter the IP address or select DHCP. End the setup by clicking the OK button.



4.4.3. Testing remote communication

An easy way to test the remote communication is via a TCP client where the commands from Table 1 can be entered. A client found to work well, is the Hercules tool from HW Group, please see Figure 11.

In Hercules, the carriage return and line feed characters "$0D$0A" must be used as stop character, please see Figure 11.

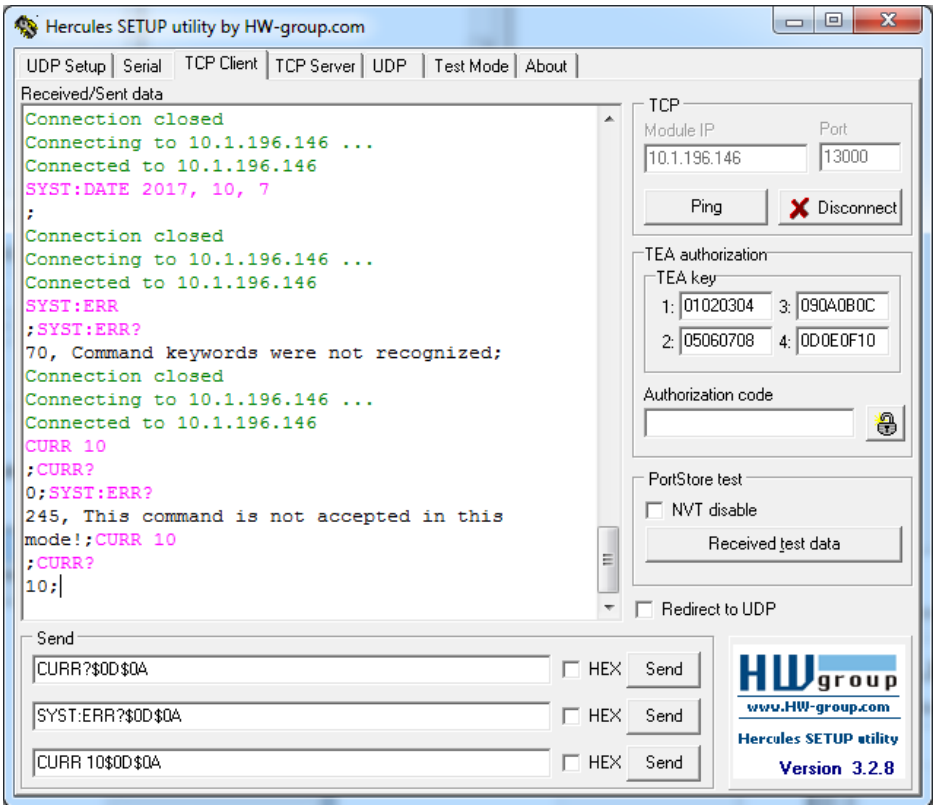


Figure 11: The Hercules utility from HW Group.

Further information on Hercules and a download link can be found here: http://www.hw-group.com/products/hercules/index_en.html

5. Maintenance

5.1. Warning before servicing/working on the power supply

- Turn off the power supply on the local control panel.
- Press the Emergency Stop switch located at the front door.

Power supply is now safe for maintenance.

Until main power is disconnected externally, dangerous voltages may is still be present on the input terminals, EMI filter, Q1 input side and F4 input side!

5.2. **Introduction**

Servicing DANFYSIK Magnet Power Supplies is only allowed by trained and qualified personal.

DANGER!

Dangerous voltages capable of causing loss of life are present inside this Magnet Power Supply. Use extreme caution when accessing, handling, testing and adjusting.

CAUTION!

Only qualified personnel are allowed to maintain this equipment.

DANGER! ELECTRIC SHOCK HAZARD!

Disconnect power at switch board before attempting to work on the Magnet Power Supply. High voltages are present at the terminals and within the Magnet Power Supply for up to 10 minutes after disconnection of the electrical supply. Always ensure by using a suitable measuring device that no voltage is present prior to commencing work.

5.3. **Preventive maintenance**

In a normal operating environment, perform the following tasks at one year intervals:

- Clean all fan protection grills.
- Vacuum clean the openings in the cabinet and all heat sinks mounted on printed circuit boards to ensure a normal flow of cooling air.
- Check that all screw connections to the primary and from the secondary of the transformer are tightened.
- Check that connections from the secondary of the transformer to the output terminals are tightened. (I.e. cable and bus bars carrying heavy current).
- Check that the water-flow switch works correct.
- Check that external interlocks are functioning.
- Check function of door interlocks.

In dusty or dirty environments the above-mentioned points should be performed more often.

- Visually inspect the power supply for overheated components or other suspicious signs.

5.4. **Adjustment and calibration**

To be described

6. Spare Parts, Ordering of

The available spare parts may vary from supply to supply. As a rule of thumb, circuit boards and major components can be ordered individually from Danfysik A/S.

All RMA-cases are handled via Danfysik's web based RMA-system. It can be accessed from the official Danfysik web page www.danfysik.com (via the Service & Test tab), where a RMA Quick Guide also can be downloaded. Alternatively the RMA-system can be accessed directly via www.dfservice.dk/rma/

Please include the following information in your request:

- Magnet Power Supply type (e.g. MPS 854).
- The serial number of the unit. See the data label on the front door.
- The module or component part no, you wish to order (e.g. 8100084741).

6.1. Handling ESD-sensitive Components

CAUTION!

Observe precautions, when handling ESD-sensitive components. Electrostatic discharge can damage ESD-sensitive components such as the PCB's installed in this Magnet Power Supply.

Use a grounding armband or similar whenever working with these components.

Keep ESD-sensitive components in antistatic material during storage, transport or packing for shipment.