DANFYSIK

# MANUAL FOR

# CONTROL MODULE
# SMT Version

## Part No.: 81083852

| | Prepared By | Approved by |
|---|---|---|
| Name | P.A.Elkiær | |
| Date | 09 FebruarY 2009 | |
| Signature | | |

**M A N U A L**
**SMT CONTROL MODULE**
**SYSTEM 8500**

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Revision History log.

| REV. | By | Approved | Date | Description | Page's |
|---|---|---|---|---|---|
| 1.0 | P.A.E. | | 27 Apr. 2000 | Initial version | 92 |
| 1.1 | PAE | | 14 Jun 2000 | SW Commands updated | 78 |
| 1.2 | PAE | | 22 Jun 2000 | SW version SCS104 | 81 |
| 1.3<br>1.4 | PAE | | 21Jun 2001 | SW version SCS107<br>Updated print layout | 44<br>Without SW |
| 1.5 | PAE | | 08 Feb 2002 | SW version SCS108<br>Updated print layout | 45<br>Without SW |
| 1.6 | PAE | | 07 Oct 2002 | SW version SCS109 | 47<br>Without SW |
| 1.7 | PAE | | 08 Dec 2003 | SW version SCS110<br>(RS485 & Always answer) | 48<br>Without SW |
| 1.8 | PAE | | 14 Aug 2008 | SW version SCS113<br>(ON/OFF control & Auto Slew Rate option) | 50 |
| 2.0 | PAE | | 09 Feb 2009 | SW version SCS114<br>(Auto slew rate, Two level set, limit) | 52 |
| 2.1 | PAE | | 17 May 2011 | Some spelling mistake corrected | 52 |
| 2.2 | PAE | | 28 Apr 2011 | Plug signal description removed<br>New Logo and address | 52 |

# Table of contents.

**Please note:** Manuals for all the system 8000 power supplies are automatically generated. This means that chapters may be omitted if not applicable.

# 1 Warranty and warranty repair.

DANFYSIK A/S warrants that the products manufactured by us will be free from defects in material and workmanship, that adversely would effect the normal functioning of the unit, for a period of 18 months from the date of shipment or 12 months from the date of installation whichever occurs first.

The exeptions 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 the DANFYSIK works.

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 it's 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 have 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.

Notify DANFYSIK A/S, giving full details of the problems, and include Model-Type and Serial number.

On receipt of these 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.

For smaller parts a carton will be sufficient, if the parts are wrapped in plastic or paper and surrounded with at least 10 centimetres of shock-absorbing material.

# 2. Unpacking and installation.

## 2.1. Receiving the goods.

The Shipping package 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.

## 2.2. Instructions for unpacking.

The electronic modules contains sensitive components that may be damage by electrostatic discharge or wrong handling. Please handle with care and leave the modules inside the anti static bags as long as possible.

If the modules are 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 Power Supply on any communication with DANFYSIK A/S or our representative.

# 3.3. Operating by RS 232-C, RS422 or RS 485 I/O.

The Control-Module uses standard serial interfaces compatible with many computers, PC and terminals.

Two data communication lines are available:

- A REMOTE LINE, with either RS 232C, RS422 or RS 485 communication.

- A LOCAL LINE, with either RS 232C, RS422 or RS 485 communication.

The two channels are galvanically isolated from all other internal voltages through opto couplers but are supplied from the same voltage source.

## 3.3.1. Setting up the MPS.

The set up of the MPS is done by two dip switches SW1 and SW2 together with the push button S2 (SETUP), or through SW commands. Please refer to the “ESC” commands in the SW appendix chapter for further information.

The two dip switches are configured as a multi function port, that will be validated by the CPU upon pressing the button S2.

The four levers on SW2 instruct which parameter to set up, and the eight levers on SW1 deliver the value for the selected parameter.

A parameter is saved and acknowledged when pressing the SETUP switch S2.

The SW2 switch position can also be seen as a binary number. The following table to the right shows the SW2 number position and which parameters it controls.

Leaving all levers in the OFF position (parking position) will disable the SETUP switch, and thereby prevent any accidental setup modification. All switches should therefor be left in the OFF position.

If one of the setup modes are selected, the yellow LED to the left of the switch “LD18" will light up indicating, that setup port is activated. The eight green LEDs to the left of SW1 will show the present setup of the selected parameter. Changing SW1 has no immediate effect. Pressing S2 will save the settings, and the green LEDs will then take the same indication as SW1.

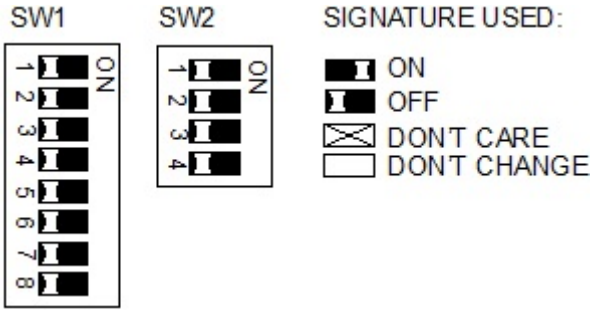
| SW2 position Number | Parameter |
|---|---|
| 0 {0000} | Parking position |
| 1 {0001} | REM_UART_SETUP |
| 2 {0010} | REM_LINE_SETUP |
| 3 {0011} | REM_ADR_SETUP |
| 4 {0100} | LOC_UART_SETUP |
| 5 {0101} | LOC_LINE_SETUP |
| 6 {0110} | LOC_ADR_SETUP |
| 7 {0111} | COLD_BOOT_SETUP |
| 8 {1000} | AUX_SETUP_1 |
| 9 {1001} | POWER_ON_PULSE |
| 10 {1010} | AUXILIARY_1_ON_PULSE |
| 11 {1011} | AUXILIARY_2_ON_PULSE |
| 12 {1100} | POLARITY_DELAY_PULSE |
| 13 {1101} | AUX_SETUP 2 |
| 14 {1110} | AD_AUTO_SCALE |
| 15 {1111} | DA_AUTO_SCALE |

Be aware when changing the Baud rates. Wrong setting may cause communication loss. Modifying a baud rate with the HW switches will alter the baud rate right away, whereas modifying the baud rate through the appropriate SW command, will first take place after a reset.

Reverting all set ups to the factory default can be accomplished as follows.

> Short circuit ST60 (just below SW2). Press at the same time S2 continuously. All green parameter LEDs will start flashing. After the fifth flash, the default parameters will be restored. Please note that all parameters will be restored, also any selected addresses and the ON pulse width. The last one may cause the power supply to be unable to be turned ON.

For switch settings, the following terminology will be used:



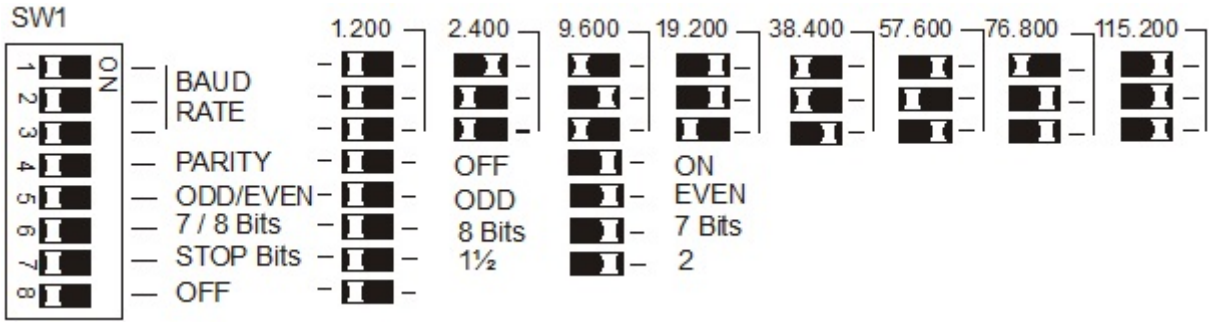
UART HW SET UP.

In the “UART HW SETUP” mode the baud rate and associated parameters for the serial lines can be set.

SW2 selects which line to set up.

Hint: Selecting SW2 will immediately display the present setting on the green LEDs left to SW1.


Parameters




Default setting after “COLD BOOT”

Local Line: 9600Baud, No party, 8 Bits, 2 Stop bits

Remote Line: 9600Baud, No party, 8 Bits, 1 Stop bits

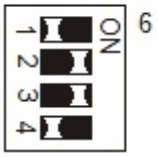
ADDRESS LINE SET UP.

When using the RS422 or RS485 standard for the serial communication Remote or Local, it is possible to attach a specific address to the line for multi drop connection.

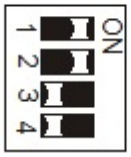
The LOCAL line addressing can be used for controlling more power supplies through one M-Panel. (SW nr. 4 in the M-PANEL must be ON). Earthing problems has to be taken into consideration to avoid communication problems due to noise and high differential voltages that may jam the input signals.

The REMOTE line addressing can be used for controlling more power supplies through one serial line (one PC). Earthing problems has to be taken into consideration to avoid communication problems due to noise and high differential voltages that may jam the input signals.

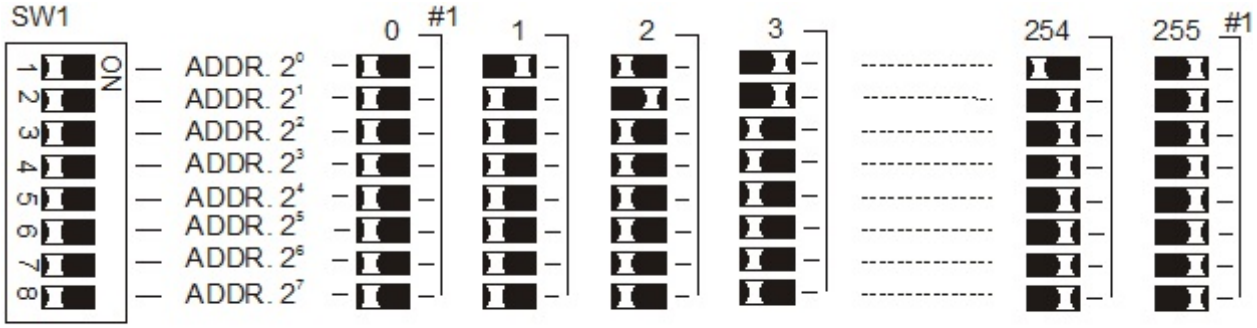
SW2 FOR LOCAL LINE




SW2 FOR REMOTE LINE




Parameters.




#1: Selecting address 0 or 255 equals allways addressed channel.

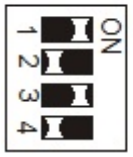
Default setting after “COLD BOOT”

| | |
|---|---|
| Local Line: | Address 0 |
| Remote Line: | Address 0 |

LINE FUNCTION PROTOCOL SETUP.

The “LINE FUNCTION PROTOCOL SETUP” is for setting up serial line protocols.
Following settings are only available from SW version SCS110

SW2 FOR LOCAL LINE

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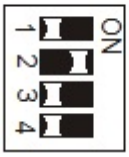
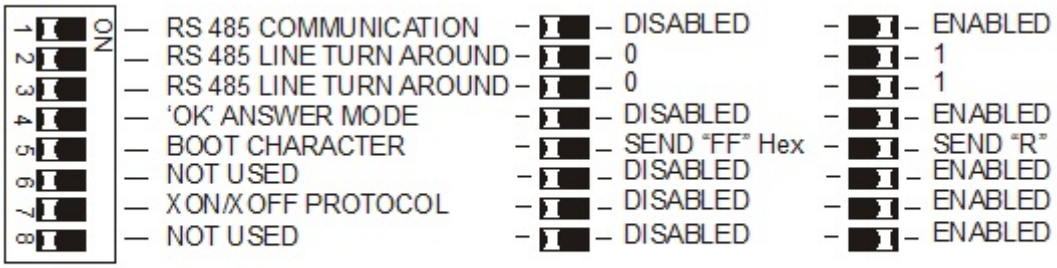
SW2 FOR REMOTE LINE




2

Parameters:

SW1



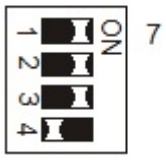

| | | Dedefault setting after “COLD BOOT” v | |
|---|---|---|---|
| Remote Line: | RS485 Communication: | Disabled | |
| (=0) | RS485 Line turn around time: | 0 | Line turn around set bit 0 |
| | RS485 Line turn around time: | 1 | Line turn around set bit 1 |
| | OK Answer mode: | Disabled | |
| | BOOT character: | "FF" / "R" | |
| | NU | Disabled | |
| | XON/XOFF Protocol: | Disabled | |
| | NU | Disabled | |
| Local Line: | RS485 Communication: | Disabled | |
| (=1) | RS485 Line turn around time: | 0 | Line turn around set bit 0 |
| | RS485 Line turn around time: | 1 | Line turn around set bit 1 |
| | OK Answer mode: | Disabled | |
| | BOOT character: | "FF" / "R" | |
| | NU | Disabled | |
| | XON/XOFF Protocol: | Disabled | |
| | NU | Disabled | |

| | | |
|---|---|---|
| Line turn around set bit: | 2, 3: 0, 0 | Delay = 0 |
| | 2, 3: 0, 1 | Delay = time to transmit 2 dummy characters |
| | 2, 3: 1, 0 | Delay = time to transmit 4 dummy characters |
| | 2, 3: 1, 1 | Delay = time to transmit 8 dummy characters |

COLD BOOT SETUP.

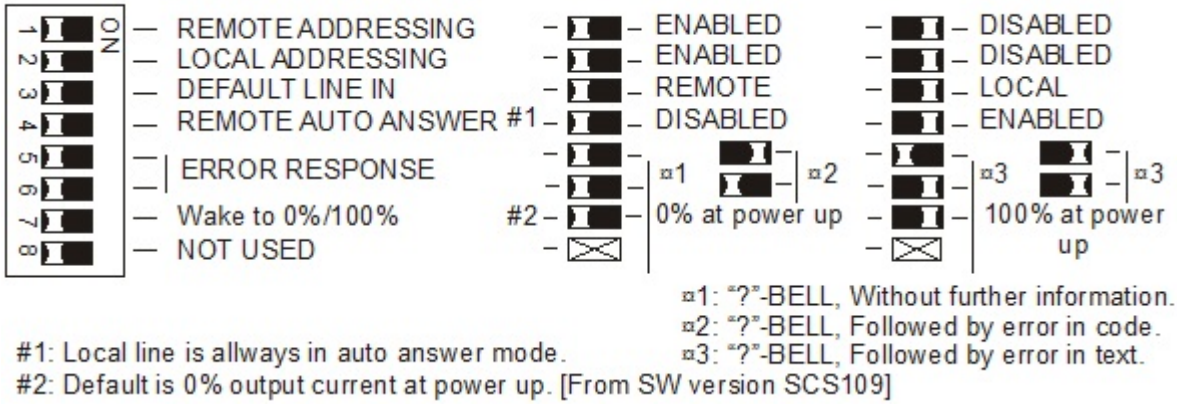
After power up or reset, the power supply can wake up in different control conditions. The below shown switch settings describe the possible Wake up conditions.

SW2 FOR COLD BOOT INITIAL SETUP




Parameters:

SW1




Default setting after "COLD BOOT"

| | |
|---|---|
| Remote addressing: | Disabled |
| Local addressing: | Disabled |
| Default line in: | Local |
| Remote Auto answer: | Disabled |
| Error response: | "?"-BELL only |
| Wake up output current: | 0% [From SW version SCS109] |

AUXILIARY SETUP 1.

Special options can be initiated with the auxiliary switch set up 1.

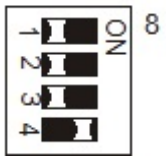
Setting of bit 16 and 17 is intended for Offset DAC use. That is a 16 bit setting between 88 and 96% (Bit16=0 & BIT 17=1) or between 92% and 100% output current (Bit16=1 & BIT 17=1).

For linear DAC settings, please set bit 16 & 17 to transparent mode.

Using the “WA” command a leading zeroes or trailing zeroes input format can be chosen.

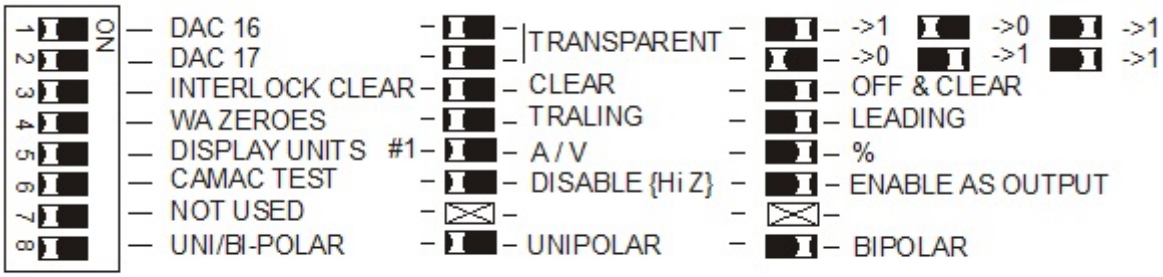
- For leading zeroes: “WA 123" equals “WA 000123"
- For trailing zeroes: “WA 123" equals “WA 123000"

SW2 FOR AUXILIARY SETUP 1




Parameters:

SW1




#1 AD Scaling factor must be set accordingly.

Default setting after “COLD BOOT”

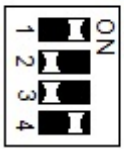
| | |
|---|---|
| DAC 16 & 17: | Transparent |
| Interlock clear: | OFF & CLEAR resets interlocks |
| “WA” Zeroes: | WA command uses trailing zeroes. |
| UNI/BI-Polar DAC: | UNIPOLAR (From SW version SCS108) |

If a CAMAC Control Module is not inserted at slot P3 (Pin P3.A32 pulled low), the DAC port may be configured as an output by setting lever 6 to ON. This enables either the DAC bits to be analysed or to be connected to another power supply in a parallel tracking mode (the second supply must be configured for CAMAC control). Default setting is disabled, that is High impedance.

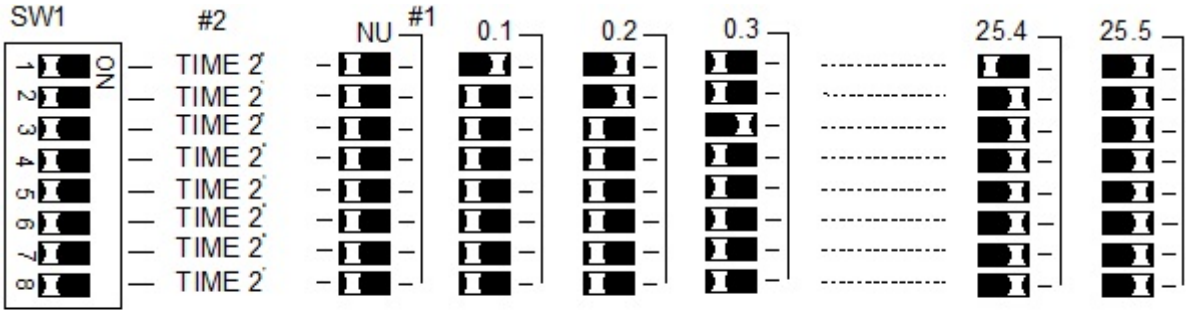
ON PULSE TIME SETUP.

Some power supplies requires a longer ON pulse for latching ON. This due to the extended charging time when containing large capacitor banks. (Typical for switch mode supplies)

SW2 FOR PPULS




Parameters




#1: Zero defaults to 0.1 sec.
#1: Time is in 0.1 sec steps.

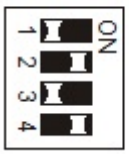
Default setting after “COLD BOOT”

ON time: 0.5 seconds

AUXILIARY OUTPUT-1 ON PULSE TIME SETUP.

The Auxiliary output line 1 can be programmed to produce a pulse or a static level output, software command N1, F1. Below are the settings for this Auxiliary line

SW2 FOR PPULS1

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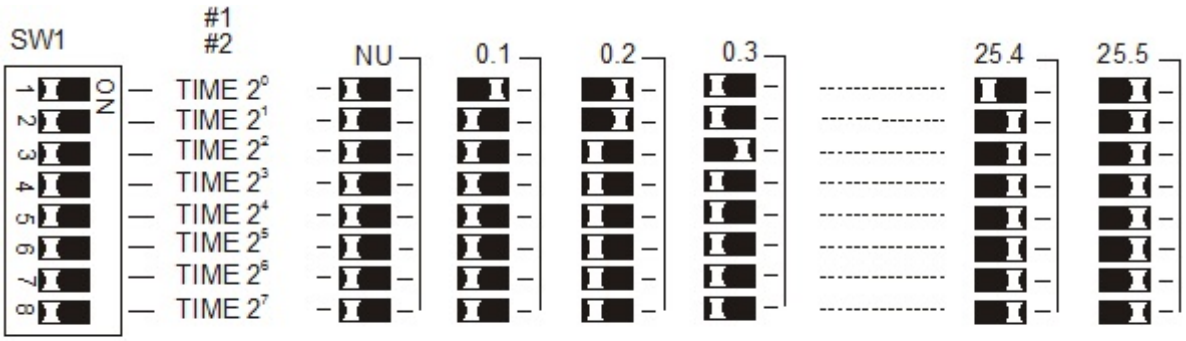
Parameters




#1: Time is in 0.1 sec steps.
#2: Zero defaults to static operation

Default setting after “COLD BOOT”

Static level operation

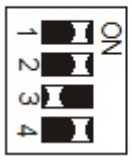
AUXILIARY OUTPUT-2 ON PULSE TIME SETUP.

From SW version SCS108

As an option, can the polarity switch control line can be used as an auxiliary output line 2 exact in the same way as for the auxiliary -1 line(see previous page).
To disable the polarity sequence and to use the output port as an auxiliary output line, a new software configuration must be given. This can only be done by authorised Danfysik service personnel.

If enabled the Auxiliary-2 output line can be programmed to produce a pulse or a static level output, software commend N2, F2. Below are the settings for this Auxiliary line

SW2 FOR PPULS2

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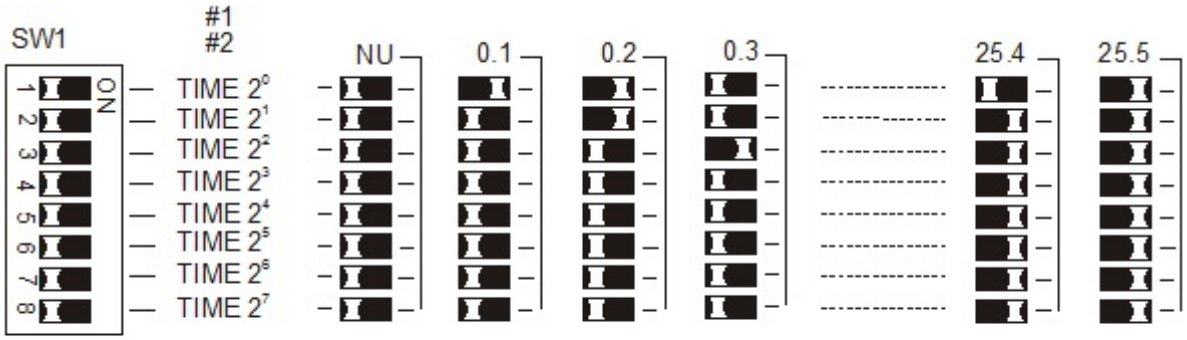
Parameters




#1: Time is in 0.1 sec steps.
#2: Zero defaults to static operation

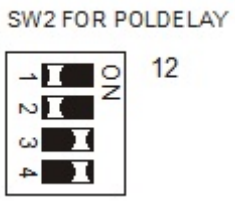
Default setting after “COLD BOOT”

Disabled auxiliary-2 option (enabled polarity change over sequence).

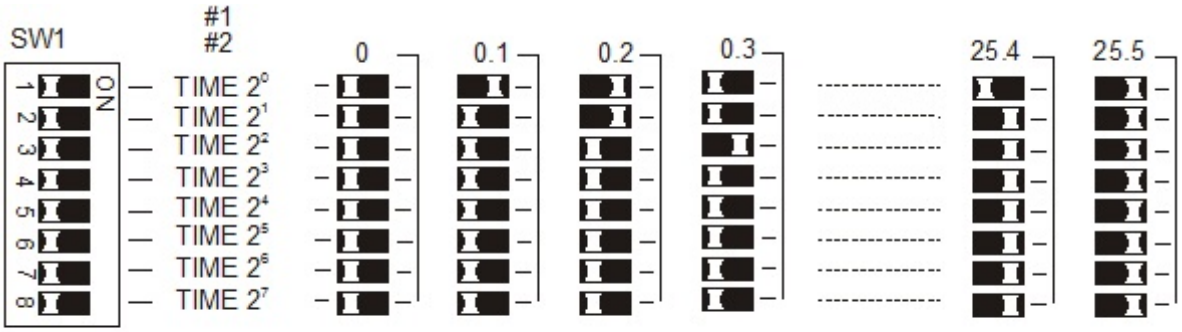
POLARITY DELAY TIME SETUP.

From SW version SCS108

A time delay can be inserted between the OFF state and the activation of the polarity change over switch. The range of the time delay can be set from 0 to 25.5 seconds, this for letting the rest energy in the magnet to decay.
The time delay is only inserted, if the power supply was ON before invoking the POL +/- command. That is, when just changing the polarity in the power OFF mode, no time delay will be inserted.




Parameters




#1: Time is in 0.1 sec steps.
#2: Zero defaults to no delay

Default setting after “COLD BOOT”

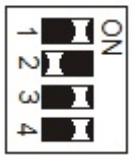
No polarity delay.

AUXILIARY SETUP 2.

From SW version SCS109

Special options can be initiated with the auxiliary switch set up 2.
(Enhancement of AUXILIARY SETUP 1)

SW2 FOR AUXILIARY SETUP 2

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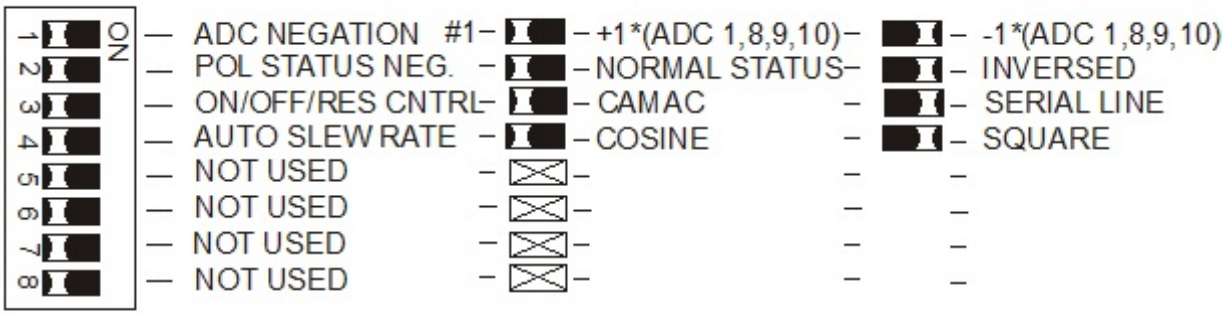
SW1




#1 AD Reading fo channel 0, 8, 9 & 10
will be multiplied by "1" or "-1".

Parameters:
Default setting after "COLD BOOT"

| | | |
|---|---|---|
| ADC multiplication: | +1 | |
| Polarity status signals | Normal. | |
| CAMAC ON/OFF Control | CAMAC. | - From SW version SCC112 |
| Auto slew rate shape | Cosine. | - From SW version SCC113 |

Lever 1 will negate all current read back readings. This is useful when connected to a regulation loop that requires a positive signal feed back (negative signal feed back is normal for System 8500).

Lever 2 will inverse the status bits coming from the output polarity switch. If you encounter that the polarity sign is shown inversed on older systems, then this switch corrects the problem.

Lever 3 determines who controls the ON/OFF/RESET line when the CAMAC bit is active (custom interface plugged into P3 and pulling pin C32 low).

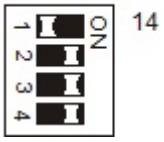
Lever 4 determines the shape of Auto Slew Rate function.

AD AUTO ADJUSTMENT (Gain & Offset).

From SW version SCS104

The scaling factors for the AD channels can automatically be adjusted with this setting.

SW2 FOR ADSET

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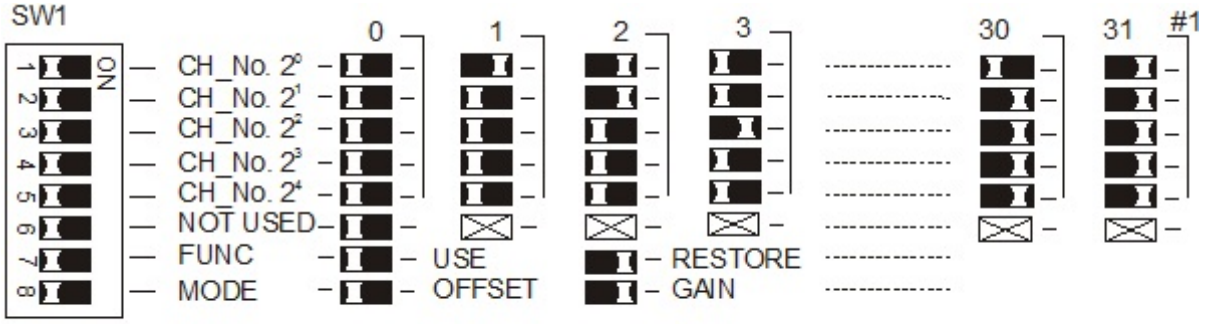
Parameters




#1: Not all channels are implemented.

OFFSET adjustment.

The OFFSET adjustment can automatically be executed if the value lies between 0 and 255 of the AD channel resolution.
To activate the automatic OFFSET adjustment following steps must be performed:

- Select SW2 as above. “setting number14"
- Select the desired channel number “lever 1 to 5" on SW1
- Set lever 8 on SW1 to OFF (The SW1 LEDs will display the present Offset value)
- Ensure that the AD input signal is set to zero. Grounded or turned OFF in any way.
- Press the Setup Button
- To restore the Offset value to default factory setting (Zero), please set lever 7 to one before pressing the Setup Button.

GAIN adjustment.

From SW version SCS104

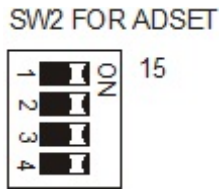
The GAIN adjustment can automatically adjust the scaling factor of the selected channel to only nines. That is eg. 99999 for the 16 bit output current reading. This adjustment is only useful for the output current and voltage read back (CH0, CH2, CH8, CH11 and CH12) Please do not use this feature if the output reading is in Volts and Amps and for not applicable channels.
To auto adjust to a specific value, please use the “Esc”ADSET command.

To activate the automatic GAIN adjustment following steps must be performed:

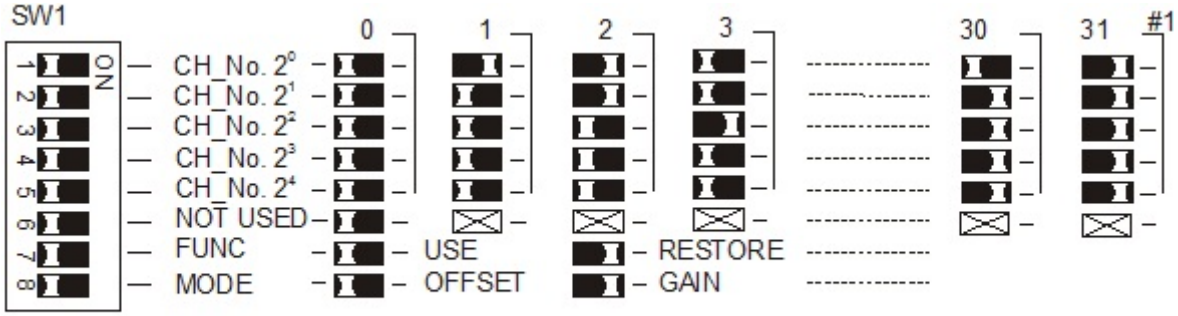
- Select SW2 as above. “setting number14"
- Select the desired channel number “lever 1 to 5" on SW1
- Set lever 8 on SW1 to ON
- Ensure that the AD input signal is set to 100%
- Press the Setup Button
- To restore the Gain value to default factory setting , please set lever 7 to one before pressing the Setup Button.

DA AUTO ADJUSTMENT (Gain & Offset).

The scaling factors for the DA channels can automatically be adjusted with this setting. This feature is specially designed for “non calibrated” DACs as for the 855 DAC.




Parameters




#1: Not all channels are implemented.

OFFSET adjustment.
The OFFSET adjustment can automatically be executed if the value lies between 0 and 255.
To activate the automatic OFFSET adjustment following steps must be performed:

- Select SW2 as above. “setting number15"
- Select the desired channel number “lever 1 to 5" on SW1
- Set lever 8 on SW1 to OFF and lever 7 to OFF (The SW1 LEDs will display the present Offset value)
- Set the AD channel value (WA for “DA 0") to a value that gives a zero output.
- Press the Setup Button. A given “DA 0 0" or “WA 0” will now produce a zero output at the DA channel. Due to the unipolar operation of the DACs only positive offset values can be added.
- To restore the Offset value to default factory setting (Zero), please set lever 7 to one before pressing the Setup Button.

GAIN adjustment.

The GAIN adjustment can automatically adjust the scaling factor of the selected channel to only nines. That is eg. 999999 for the WA command.
To auto adjust to a specific value, please use the “Esc”DASET command. (DAC setting in Amps)

To activate the automatic GAIN adjustment following steps must be performed:

- Select SW2 as above. “setting number15"
- Select the desired channel number “lever 1 to 5" on SW1
- Set on SW1 lever 8 to ON and lever 7 to OFF.
- Set the output signal to 100% with the DA or the WA command
- Press the Setup Button.
- To restore the Gain value to default factory setting , please set lever 7 to one before pressing the Setup Button.

Ps. For Bipolar DAC operations, the Gain adjustment can only be performed at +100%

## 3.3.2. Data communication.

Connection for the host is located on the Control Board behind the front door of the Power Supply. The host connection cable can get access to the board through the front-hole in the bottom of the power supply.
The pin numbers on the D-SUB Female 25 - pin connector tell which type of communication is used. RS 232C, RS 422 or RS 485.

The direction used in the tables below are:

Rx : Signals received by the Control Module from its host.
Tx : Signals transmitted by the Control Module to its host.

| RS 232C | DB 25 S. | RS 422 | DB 25 S. | RS 485 | DB 25 S. |
|---|---|---|---|---|---|
| Pin No. | Signal. | Pin No. | Signal | Pin No. | Signal |
| 2 | Tx. | 7 | GND. | 7 | GND. |
| 3 | Rx. | 9 | Tx high. | 9 | Tx/Rx high. |
| 7 | RETURN. | 10 | Tx low. | 10 | Tx/Rx low. |
| | | 11 | Rx high. | | |
| | | 12 | Rx low. | | |

NOTE! The selection between RS 232, RS 422 and RS 485 is done with jumpers on the Control Board.

Local line: Jumper

| | | |
|---|---|---|
| RS232: | Jumper on ST16 | ST14 and ST15 must be left open |
| RS422 | Jumper on ST15 | ST14 and ST16 must be left open |
| RS485 | Jumper on ST14 | ST15 and ST16 must be left open |
| RS485 | Jumper on ST13 | ST19 must be left open |

Remote line:

| | | |
|---|---|---|
| RS232: | Jumper on ST9 | ST10 and ST11 must be left open |
| RS422 | Jumper on ST10 | ST9 and ST11 must be left open |
| RS485 | Jumper on ST11 | ST9 and ST10 must be left open |
| RS485 | Jumper on ST18 | ST17 must be left open |

## 3.3.2.1. Termination using RS 422 or RS 485.

There is no termination resistor mounted inside the control module. An external termination resistor of 100 Ohm must therefore be added at the end of the communication cable. This for both the local and the remote line.

Hint. This resistor can be placed inside the last DB 25 plug for the remote line and the DB9 plug for the Local line.

When using the RS 485 or the RS 422 line in the multi drop configuration, it is very important during an address transfer to leave the lines at the "SPACE" state when tri stated. That is when the line is not driven by any transmitters at all. The "SPACE" state can be utilized by adding 1K Ohm resistors to +5V(non inverting) and GND (inverting) on both the transmit and the receive lines. The control module can provide this by short circuiting ST2, ST4, ST6 and ST8 for the remote line and ST1, ST3, ST5 and ST7 for the local line (use a thin soldering iron). The 1K resistors increases the noise

immunity eliminating noise to be treated as commands thereby flawing the first character after being addressed.

NOTE! None of the two serial lines have control signals (hand checking). Use the XON/XOFF protocol if necessary.

## 3.3.3. Programming.

The power supply communication protocol is built upon plain ASCII characters where each command or reply is delimited by a "Carriage Return" <CR> character. However, replies have a “Line Feed” <LF> character added before the <CR> for a friendlier display when using a terminal. <LF> characters on commands will be ignored.

Hint. Actually the protocol allows full control of the power supply from a "dumb" terminal. In case of a service- debug- situation a terminal can be used to tap the communication transfer by a simple parallel connection.

Hint: When debugging, the "ERRT" command enables error messages to be given as a read able text.

More commands may be transmitted in a chain but each single command must be trailed individually with the delimiter character <CR>. The power supply is able to execute up to 200 commands a second depending of the complexity of each command.

Ps. Issuing short commands faster than the time to transmit the answer eg. “S1" will overload the internal transmit buffer regardless of the selected baud rate.

All commands can be divided into three sections.

a) Directive commands. Eg. the "N" command that turns the power supply ON
b) Status commands . Eg. the "S1" that returns the power supply status
c) Set up commands. Eg. the “ESC”<PPULS 5 that sets the ON pulse to 0.5 seconds.

Status commands always deliver a reply, whereas directive- and setup- commands only respond with an error message if the command couldn’t be understood or if the given parameters are incorrect. From SW version SCS110 it is possible to set the power supply to always generate an answer (see ‘esc’LINE setup for SW version SCS110). This feature is very useful when using RS485 protocol.

Hint. When using the "Always Answer" mode (‘OK’ respond from SW version SCS110) a re-transmission of the last given command can be performed if no answer or an error message is received. The System 8500 respond time is around 5ms after receiving the last bit of the termination character.

Answer scheme if set to “Always Answer” mode.

| | | | |
|---|---|---|---|
| d) | Directive commands. | Answer: | - No answer<br>- ERROR message<br>- OK if set to always answer mode (from SW ver. SCS110) |
| e) | Status commands . | Answer: | - Data<br>- ERROR message |
| f) | Set up commands. | Answer: | - No answer<br>- ERROR message<br>- OK if set to always answer mode (from SW ver. SCS110) |

Below is an example written in BASIC on how to turn ON the power supply and read the status without and with acceptance answer:

Turning the power supply ON and reading/evaluating the status with always answer disabled.

```
LPRINT "N"+CHR$(13)              :REM Turns the power supply on
LPRINT "S1"                      :REM Issues the status command
LINPUT S1$                       :REM Read the MPS reply
IF LEFT$(S1$,1) = CHR$(?)        :REM Is it an error message reply?
 GOTO ERROR_HANDLING             :REM Yes then go to error module
ENDIF
J=1
DO                               :REM evaluate status reply
 IF MID$(S1$,J,1)="!"
  GOSUB STATUS(J)_ACTIVE         :REM set this status bit active
 ELSE
  GOSUB STATUS(J)_ACTIVE         :REM set this status bit inactive
 ENDIF
 J=J+1
UNTIL J=24
```

Turning the power supply ON with always answer enabled

```
J=0 :ERROR$=”“
DO
 J=J+1                           :REM Counter for maximum attempts
 LPRINT "N"+CHR$(13)             :REM Turns the power supply on
 LINPUT RE$                      :REM Read the MPS reply with 0.1 Sec. time out
 IF LEFT$(RE$,1) = CHR$(?)       :REM Is it an error reply?
  ERROR$=RE$                     :REM Mark the error code
 ELSEIF RE$=”OK”                 :REM Is it a good reply
  BRAKE                          :REM then exit DO loop
 ELSEIF J=6                      :REM Try only six times
  IF LEFT$(ERROR$,1) = CHR$(?)   :REM Was it error reply?
   GOTO ERROR_HANDLING           :REM Yes then go to error module
  ELSEIF
   GOTO NO_COMMUNICATION         :REM Yes then go to “No answer” error module
  ENDIF
 ENDIF
UNTIL -1                         :REM loop endless
```

Ps. An ERROR message includes a "?BELL". (Bell = ASCII 7.)

## 3.3.4. Software Profile Programming.

The RAMP PROFILE software is an option that can be ordered with the power supply or be added to a present system. No additional hardware is needed.

With the ramp profile SW, it is possible to download and run a pre defined ramp sequence that the output current must follow. The ramp sequence can be programmed in three quite different methods. A) Arbitrary point method; B) Equal timeslot method; C) Auto Slew Rate Ramp Profile method.

If the power supply is delivered with the software ramp profile option, then all three methods will be available, but only one method can be used at a time.
The examples below are shown for a uni polar power supply. For bipolar supplies, the output current may also be set negative. (From software version SCC108)
Method A) From software version SCC100
Method B) From software version SCC108
Method C) From software version SCC113

## 3.3.4.1. Arbitrary point ramp profile method.

With the"Arbitrary point method", it is possible to download up to fifteen independent points each generating a ramp line (through interpolation). This profile must be stored in one of the 15 available stacks.
Each ramp point consist of a stack number, a starting point (current set value, normally the previous end point), an end point (current set value) and a time value for reaching the given end point.

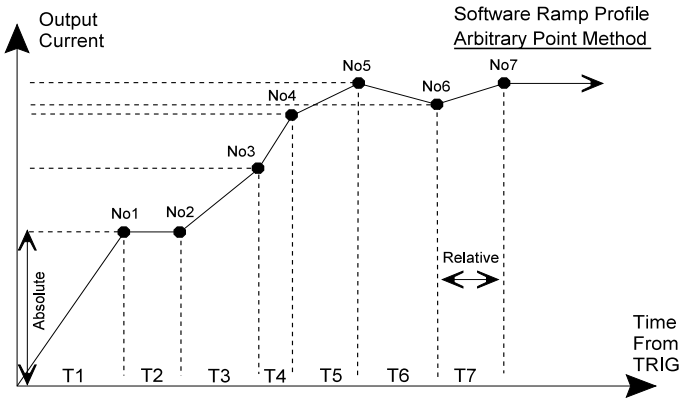
Eg. **Command:** WSA' sp' stack, start, stop, time 'cr'

To use the Arbitrary point method at least the following steps must be performed:

- Clear the stack "CSS [parameter]",- Program the stack "WSA [parameter]",- Set the speed "SPEED [parameter]", -Set the attenuator "MULT [parameter]", -Start the stack "TS [parameter]", -Read the status of the running stack "S2".

Please refer to the Appendix 2 "SW2 Ramp Profile Commands" for full instructions.

The figure shows an example of one ramp profile stack. ( Ps. not all 15 points need to be programmed - empty entries will be ignored.)



The SW will after the start (Trig) command update the output current every 1.25m. sec in the FAST and in the SLOW mode (Step Time). This enables it to calculate the stair case size (interpolating step size) according to the formulae below:

$$\frac{(START-END)*(StepTime)}{\Delta t}=Step.Size$$

Where "START" and "END" are the set values in ppm., The "Step Time" is 1.25m. Seconds, Δt in seconds and the "Step. Size" will come out as ppm. value.

In-between the 1.25ms step time a second HW interpolation counter will update the set value for every 78µs (fast ramp times) to about 78µs (slow ramp times).

Starting the ramp is done with the trig command "TS (stack no.)".

If synchronisation to an eternal event is required, it is possible to arm the ramp sequence first with the synchronisation command "SYNC (stack no.), [trigger delay]". A hardware signal on the trigger input P33 pin 1&2 (10 to 24V) or a TS command will start the sequence. If a trig delay is entered, the sequence will first start after the delay time has elapsed.

If more power supplies have to be synchronized, one of the supplies has to be appointed as master. Connecting the master trig output P33 pin 3&4 to the other supplies trig input will start the other supplies when the master is triggered. A maximum skew of 5µs between the supplies may be expected. (an external 15V auxiliary supply is needed, as the trig output is an open collector and the trig input is an opto coupler input.)

## 3.3.4.2. Equal time slot ramp profile method.

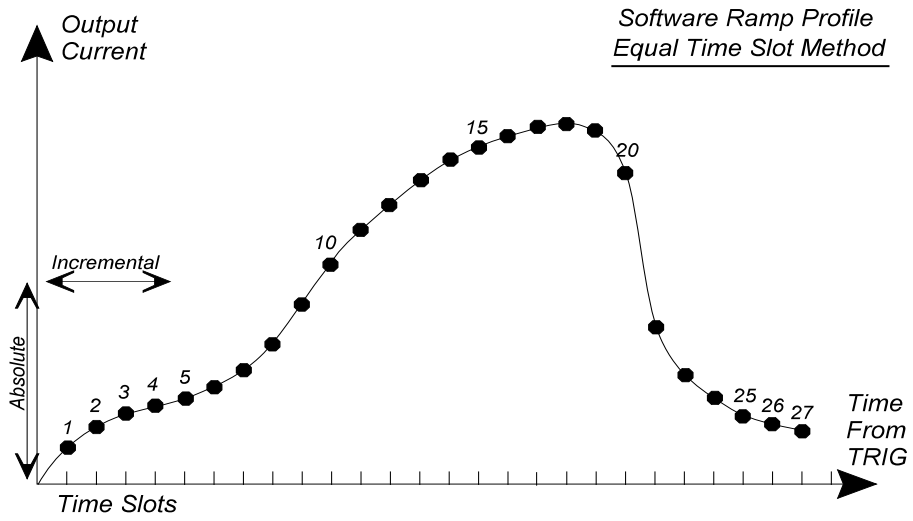
With the"Equal time slot method" it is possible to download up to 1000 current set values and a single time slot value, that will be used for all set values. Only one stack is available.
This profile method is specially useful for faster and more accurate curves fitting profiles e.g. as an function generator.

To use the Equal time slot method at least the following steps must be performed:
- Clear and set the stack "RAMPSET [parameter]",- Program the stack "R [parameter]", -Start the stack "RAMP [parameter]", -Read the status of the running stack "RAMP".

PS. A difference in the value parameter setting compared to the "Arbitrary point method" is, that all values must be given as a floating point number scaled to "1.000000". That is; 1.25ms must be entered as 0.00125 and 19.54% output current as 0.1954.

Please refer to the Appendix 2 "SW2 Ramp Profile Commands" for full instructions.

The figure below shows an example of one ramp profile stack. ( Ps. not all 1000 points need to be programmed empty entries will be ignored.)




The time slot must be given as a multiple of 1.25ms. Between 1.25ms to 1 second. Any value in-between will automatically be rounded according to formulae:

{time slot}=frac({time}/0.00125)*0.00125

The SW will after the start command update the output current every 1.25m. sec. By means of interpolation regardless of the programmed time slot value:

In-between the 1.25ms step time a second HW interpolation counter will update the set value for every 70µs.

The ramp can be starter to run as a single shot “RAMP R”, auto iteratively (auto loop) “RAMP RL” or HW triggered auto armed “RAMP TW”. For a full documentation on controlling the “Equal time slot method” please refer to the appendix 2 Ramp Profile Commands.

If synchronisation to an eternal event is required, it is possible to arm the ramp sequence first with the synchronisation command “RAMP T”. A hardware signal on the trigger input P33 pin 1&2 (10 to 24V) or a “RAMP R” command will start the sequence.

If more power supplies have to be synchronized, one of the supplies has to be appointed as master. Connecting the master trig output P33 pin 3&4 to the other supplies trig input will start the other supplies when the master is triggered. A maximum skew of 5µs between the supplies may be expected. (an external 15V auxiliary supply is needed, as the trig output is an open collector and the trig input is an opto coupler input.)

## 3.3.4.3. Auto Slew Rate Ramp Profile method.

With the"Auto Slew Rate Ramp Profile Method" an automatic ramp profile will be generated and executed when issuing a new current set point. In other words, this feature acts like a software driven slew rate controller.

Two shapes can be preselected. A cosines and a square shape. Which shape is selected, is given by the Aux2 setting bit 4. 0=Cosines & 1=Square

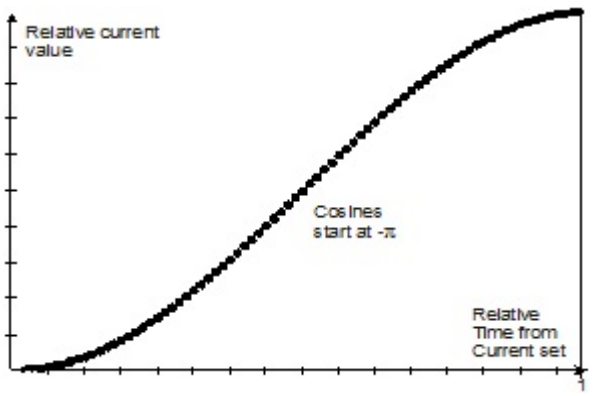
Example: If the power supply is at 10% output current, the slew rate is set to 1 second ('esc'<slopetime 1,1) and a set command "da 0,600000" is given the power supply will start at 10% and run to 60% within ½ a second with the selected shape.

The positive and negative slew rate value can be set individually. Please refer to the SW manual describing the "'esc'<slopetime 'val1','val2"' for further information.

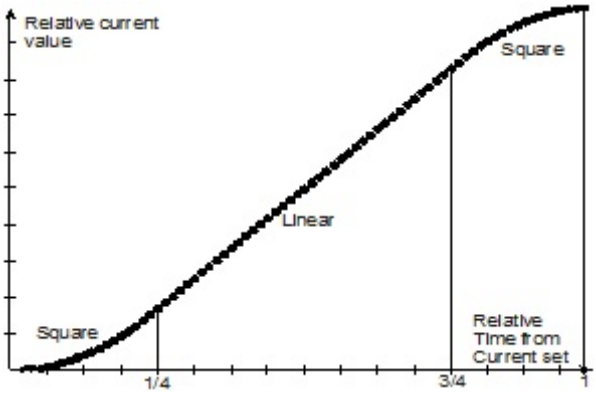
The two ramp profile shapes has both its benefit and draw backs. The cosines shape is smooth all the way but has a higher dI/dt in the middle and results in a sinus output voltage shape on an inductive load whereas the square shape in a trapezoidal output voltage

The ramp profile consist of 80 points with HW interpolated points in-between. Each of the 80 points has a distance of 1.25ms. In-between. Profiles with shorter distances than 100ms (80*1.25ms) are achieved by omitting points. Eg. a ramp time of 10ms will only consist of 8 points thereby resulting in a more course profile.

The figures below shows the shape of the two ramp profiles.




Cosines ramp shape




Quadratic ramp shape

The time slot must be given as a multiple of 1.25ms. Between 1.25ms to 1 second. Any value in-between will automatically be rounded according to formulae:

{time slot}=frac({time}/0.00125)*0.00125

The ramp profile can be stopped eithe with a "STOP" command or when the power supply is turned OFF. The state of the ramp profile can be read through the "RR" command.

# 3.3.4.4. SW limits.

**The limits of the "Arbitrary point method" ramp profile SW are:**

- The set value must be given in ppm. Units
- The time between two points can be between 0.2 to 65535 seconds.
- Maximum numbers of stacks: = 15
- Maximum number of lines in a stack: = 15

**The limits of the "Equal time slot method" ramp profile SW are:**

- The set value must be given in a floating point representation normalized to 1.000000.
- The time slot may be between 0.0125 to 1 second given in a floating point representation normalized to 1.0000.
- Maximum numbers of stacks = 1
- Maximum number of time slots in a stack = 1000

**The limits of the "Auto Slew Rate method" ramp profile SW are:**

- Maximum positive slew rate time = 10 sec,
- Maximum negative slew rate time = 10 sec,
- Minimum positive slew rate time = 5m sec,
- Minimum negative slew rate time = 5m sec,
- Number of points = 80 with a minimum interval of 1.25ms

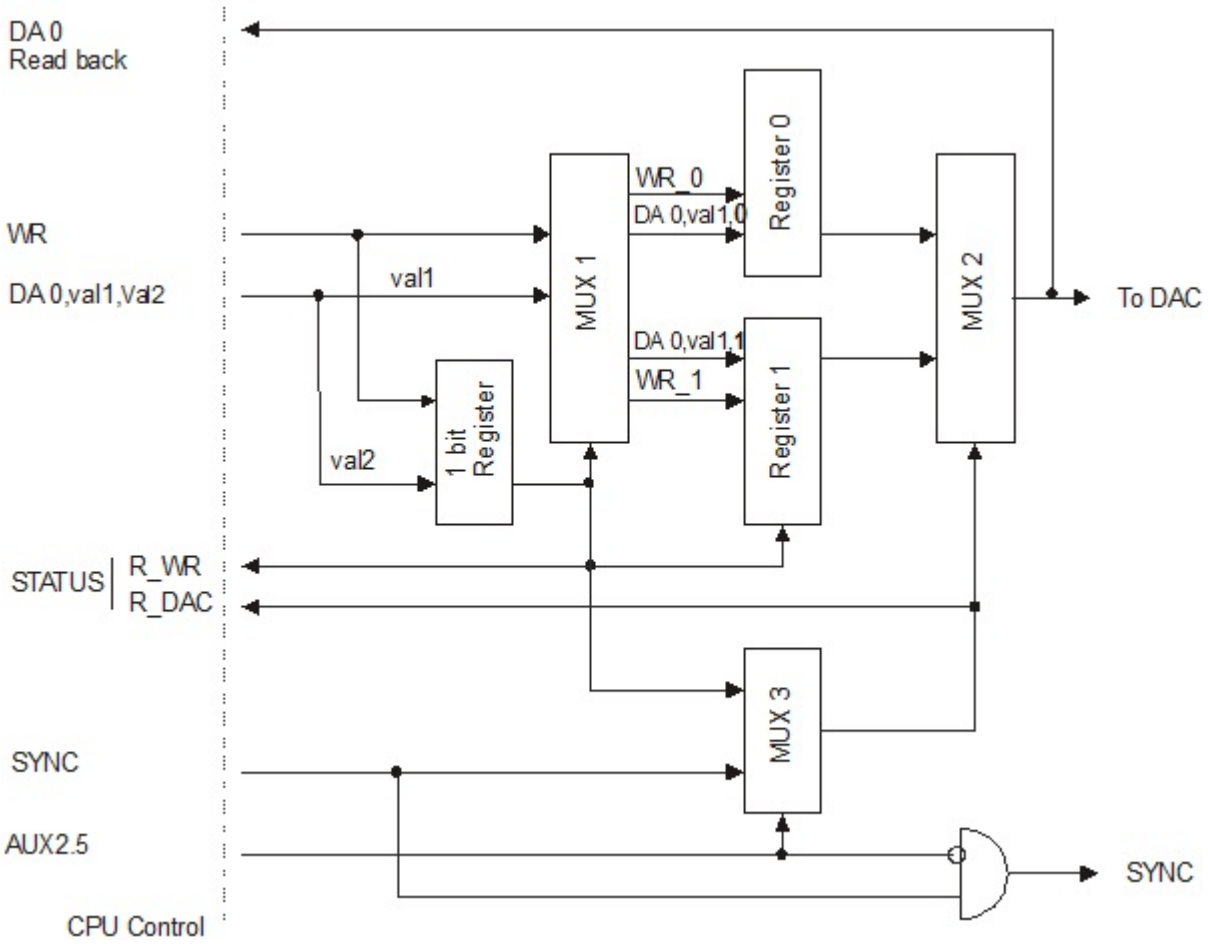
## 3.3.5. Two level value set.

The two level value set function enables the power supply to quickly switch between two arbitrary given set points (this ab SW version SCS 114). For bipolar power supplies e.g. it could be between any positive and negative value or for unipolar power supplies. it could be between any positive value and zero.

The two level value function, which is always enabled, is partially implemented in HW (inside the FPGA) and SW. If this function is not used, set register 0 will be default selected making the system both HW and SW compatible with previous versions.

The two levels can either be selected through SW from an added parameter in the ‘da 0’ command or through HW using the ‘SYNC’ line. If the ‘SYNC’ line is used for the two level select, it must first be enabled by setting ‘AUX2 bit 5' to “1" thereby deselecting its use for ramp synchronization purposes.

The two level function is shown from the simplified block schematic below:



# 3.3.5.1 Using the two level function.

Selecting which register to set:

Writing to register 0 with the ‘da 0,val1,val2' command requires ‘val2' to be “0", and writing to register 1 must ‘val2' be “1". ‘MUX 1' routes in other words ‘val1' to either register 0 or 1 according to its information. Not specifying ‘val2' will update the last selected register. Chancing the register without altering the set value can be done by omitting the ‘val1' information. E.g. changing to register 1 is done with the command ‘da 0,,1'.

Ps. Changing the output current with the M-Panel will be performed through the last selected register.

Selecting which register to be used for the DAC:

‘MUX 2' routes one of the two set registers to the DAC, which inturn sets the output current of the MPS. ‘MUX 2' is controlled from the AUX2 bit 5 setup setting (see SW command manual in appendix 1 on how to set the AUX2 bits. If AUX2 bit 5 is zero (SW control) will the used register to the DAC follow the ‘val2' information issued by the ‘da 0,val1,val2' command. That is, selecting register 0 for writing, will also select register 0 be connected to the DAC. If AUX2 bit 5 is one (HW control) will the used register to the DAC follow the HW SYNC signal.

Ps. Using the SYNC line for the two level function will automatically disable its use for the ramp profile synchronisation.

Reading which register is selected for writing and which to be used for the DAC:

The two level HW circuit delivers the MUX1 & MUX2 control lines back to be used as status indication on how the registers are routed. This status can be red with the command ‘da 0,r’, which delivers following answer: 0,xxxxxx,yy where:

| | |
|---|---|
| xxxxxx | is the given DAC value |
| yy | First y, selected register for writing (MUX 1 position) |
| | Second y, selected register to DAC (MUX 2 position) |

# 3.3.6. SW Commands.

Following are the commands for the standard software listed in alphabetic order.
Please see the SW appendix for detail explanation of every command.

STANDARD COMMANDS. summary

AD X . . . Read value from an ADC channel.
ADR . . . Read the address of the MPS.
ADR XXX . . Write an address to a MPS.
ASW . . . Enters answer mode.

CLOCK. . . Reads the current time
CLOCK . . HH,MM,SS,DD,MM,YYYY
Sets the clock.

CMD . . . Read current control mode.
CMDSTATE . Read current control state.

DA x,xxxxxx . Writes a value xxxxxx to a Digital to Analog converter x. (Alternative W(x) or WA command.)
DA 0,xxxxxx,y Writes a value xxxxxx to the Digital to Analog converter 0, which is used for the current setting, through HW register 0 or 1 given by the value y.
ERRC . . . Coded error message.
ERRT . . . Text string error message.

F . . . . Main Power OFF.
F1 . . . . Auxiliary-1 output line OFF.
“F2" . . . Auxiliary-2 output line OFF.

GOFF . . . Global OFF
Same as N1 command

IEEE . . . Used to set IEEE interface communication if present

LALL . . . Listen ALL.
LOC . . . Change to Local Control.
LOCK . . . Lock the MPS in Local Control.
N . . . . Main Power ON.
N1 . . . . Auxiliary-1 output line ON.
“N2" . . . Auxiliary-2 output line ON.
NASW . . . No answer mode.
NERR . . . No error message.

PO . . . Polarity status.
PO +/- . . . Change to Normal polarity.

PRINT . . . Reads internal user information about the MPS

R(x). . . . Read slew DAC 1 or 2
R3 . . . . Read slew DAC 1 absolute
RA . . . . Read the set value.
(Preferred new command: “DA 0")
REM . . . Change to remote control.
RLOCK . . Remote line only
RS . . . Reset interlocks.

S1 . . . Read the internal status.
S1H . . . Read internal status in HEX format
S3 . . . Read the internal extended status.
S3H . . . Read internal extended status in HEX format
S1FIRST. . . Read the interlock first catch status.
SFIRSTH. . . Read the interlock first catch status in HEX format
S1TIME. . . Read the time when the first interlock occurred..

SOFF . . . Slow OFF
Off command followed by an WA 000000

TD . . . Test DAC function
TYPE . . . AD type in use

UNLOCK . . Unlock the MPS

VER. . . . Reads the software version

W(x) . . . Write slew DAC 1 or 2
W3 . . . Write slew DAC 1 absolute
WA XXXXXX . Write a set value (Set output current). (Preferred new command: “DA 0,xxxxxx”)

X is a number from 0 to 9 and Commands in quotation marks are optional.

Following are the set up commands in alphabetic order.
Please see the SW appendix 1 for parameter formats and further detail explanation.

Esc SET UP COMMANDS. summary

Esc<AD . . . Configures the AD converter scaling and routing (Output reading adjustment or output reading in % or Amps).
Esc<ADR . . Configures the communication address setting (in RS422 mode).
Esc<ADSET . Auto Configures the scaling "gain" and Offset for an AD converter channel.
Esc<AUX . . Configures the special options.
Esc<AUX2 . . Configures the special options.
Esc<BAUD. . Configures the Baud rate for the serial lines.
Esc<COLDBOOT Configures the power up state. (Wake up position)
Esc<DA . . Configures The Digital to Analog converters. (Slew rate setting in A/sec or set value in Amps)
Esc<DASET. . Auto Configures the scaling (gain) and Offset for a DA converter channel.
Esc<INTERLOCK Configures which input that has to be latched. Other inputs will act as status inputs.
Esc<LINE . . Configures the protocol for the serial lines.
Esc<POLDELAY Plarity change over delay time (in OFF).
Esc<PPULS . Configures the ON pulse width.
Esc<PPULS1 . Auxiliary line ON pulse width.

Following are the commands for the software driven "RAMP PROFILE" listed in alphabetic order.
These commands are optionally available.
Please see the SW appendix 2 for parameter formats and further detail description.

SW RAMP PROFILE COMMANDS for "Arbitrary point method". summary

CONT . . . Continue sequence operation
CSS . . . Clear sequence stack and pointers.
FAST . . . Fast sequence timing
HALT . . . Halt sequence operation
MULT . . . Reads the multiplying factor for DAC scaling
MULT . . . Writes a multiplying factor for DAC scaling
RRSP . . . Reset read sequence pointer
RR Read ramp status
RSA . . . Read sequence and auto increment
RSP . . . Read sequence position
RWSP XX . . Reset write pointer.
S2 . . . Read sequence status
SLOW . . . Slow sequence timing
SPEED . . . Read sequence timing
STOP . . . Stop sequence executing
SYNC . . . Synchronization of sequence.
TS . . . Trig sequence
WSA . . . Write sequence and auto increment
WSP . . . Write Sequence position

X is a number from 0 to 9

SW RAMP PROFILE COMMANDS for “Equal time slot method”. summary

| | | | |
|---|---|---|---|
| R value | Writes data to the stack. | RR | Read ramp status |
| RAMP [RSHT],[LWB] | Controls the stack operation. | RAMPSET Time,Multiplicant,TrDly [LWN],C | Configures the ramp operation. |

SW RAMP PROFILE COMMANDS for “Auto,slew rate method”. summary

| | | | |
|---|---|---|---|
| Esc<SLOPETIME | Set slew rate time for auto slew rate ramp profile execution. | RR | Read ramp status |
| | | STOP | Stops the running Auto slew rate execution. |

# 4. Theory of operation.

Following chapter describes the features of the Control module more in detail.

## 4.2. Control Board

Schematic: 83853 1/7 to 7/7
Assy: P-83852

The task of the Control Board module is to control and supervise the different functions within the power supply. Turning the power supply ON and OFF, communication with the “Front panel” module, external serial link or a parallel CAMAC module for user interface, monitoring different analog signals and setting of the output current value (DAC control). A micro processor takes care of the above mentioned functions.
To do so it also acts as a motherboard link for other modules.

The Control Board can be divided in following functions:

- µ-Processor.
- Real time Clock
- Serial Communication. RS232/RS422
- Parallel Communication. CAMAC
- Interlock control.
- DAC control. Current setting and ramp profile interpolation
- ADC control. Analog measurements.
- Setting up the board parameters.
- Ramp profile HW interpolation and synchronization.
- Water Flow measurement
- Motherboard .

### 4.2.1. µ-Processor:

The µ-processor is the intelligent part of the control module. It consists of the µ-processor IC16 and the memory circuit’s, IC8, IC14 and IC15 in the page 5. IC10, IC11, IC12 and IC17 are buffers and select chips for the other circuits. To expand the I/O capabilities of the µ-processor an FPGA IC20 is added.

The µ-Processor is of the type Hitachi H8 with built in A/D channels, serial interface and some I/O bits.
The CPU runs at 14 MHz, controlled from the crystal Y2.

IC12 is a “Reset”, "Watchdog" circuit that will reset the CPU, if it for some reason stops to refresh the watchdog every second. At the same time will the LED D3 flash once.

IC10 and IC15 are coupled as address decoders for attached I/O Chips.

The CPU can be reset with switch S1.

## 4.2.2. Real time clock:

IC13 with the crystal Y1 is the real time clock circuit. This clock circuit is used to catch the exact time spot for the first arriving interlock after the last issued interlock reset.

This circuit is optional.

The clock can be set through SW commands. To maintain synchronized with the local time, it is recommended to set the time at least every week. The clock is not designed for high accurate time keeping.

A Lithium Cell of 3V type CR2450 ensures that the clock will continue running without the control power. A red LED located beside the cell indicates if the battery needs to be replaced. (normally after 5 years)

## 4.2.3. Serial Communication:

The communication between the control board and the outside world can be performed through serial links or a parallel CAMAC interface (See next paragraph). There are two serial communication ports implemented for the communication.

A) Con. P14 RS422 to the M-PANEL (Chip IC4,IC5)
B) Con. P13 RS422/RS232 to the Remote control.
(Chip IC2, IC6 and IC7)

All serial communication lines are galvanically isolated from the μP by means of opto couplers ISO1 to ISO6 and a separate isolated voltage supply. The lines are administered by the serial controllers inside the CPU, controlling the baud rate, parity check and the data format (see page 5). The data setting can be assigned either through the dip switches or through software. Please refer to chapter 3 for further information.

For isolation purposes the opto couplers PC400 with TTL logic output are used, and as for the TTL to RS422 converter the SN75176 chip with three state output capability. The “three state” output option is used when the system is connected in a multidrop mode. This permits up to 255 control modules to be connected in parallel.

The RS232 line is driven by a MAX 232 or a LT1181 (IC2).

Switching between RS422, RS232 and RS485 (option) line operation is done by soldering one of the 0 Ohms resistor (or a strap) ST14 to ST16 for the remote line and ST9 to ST11 for the local lines See schematic for more detail information which resistor selects which mode. This more complicated way to select the working mode is chosen, to prevent accidentally change in working condition and to minimize that more than one mode is chosen at one time. Ones it set, normally no change will be needed later.

The data communication protocol is explained else where in the manual.

## 4.2.4. Parallel Communication:

The power supply can also be remotely controlled through a parallel interface also called CAMAC interface. This requires mostly an additionally customer module attached to plug P3. E.g. CAMAC/IGOR interface or equivalent.

Controlled by the CAMAC interface, serial status readings are still possible; but many of the advanced features, as the first catch interlock register, Analog measurements or the real time clock, are not aviable from the CAMAC port.

The parallel control consists of following TTL compatible lines.

- Control lines: ON, OFF, RESET, INV polarity (Active high pulses)
- Current setting digital: 20 bit digital current set.
- Current setting Analog: Must be connected directly to the regulation module.
- Status lines Digital: Interlocks and status
- Status lines Analog: Actual current, Output voltage and Pass bank voltage if applicable.
- Water Flow measurement:

Please se P3 plug interface specifications for further signal information.

To activate the CAMAC interface must pin A32 be pulled low. This will turn the DAC setting buffer's IC24, IC26 and IC28 to inputs, and if set to remote operation will the FPGA IC20 reroute the DAC setting bits to the regulation module. !! **Be aware** !! if A32 is left open, will the DAC setting buffer's be directed as outputs. This enables parallel operation of more tracking supplies, where one acts as master and the other as inputs with CAMAC interface with P3.A32 pulled low. The interlock status bits are always enabled as outputs IC25 and IC27.

IC28 is also used to pass the control signals ON, OFF, RESET, INVERT
.

## 4.2.5. Interlock, status and OF/OFF control:

The interlock, status and ON/OFF signals are processed by this block. See page 2 of the diagram 83853.

External interlock and status signals are opto isolated from the electronics. The opto couplers are driven from an isolated 24 Volt supply, with a current of 24 mA which ensures a good contact cleaning.

Internal interlock and status signals are connected directly without galvanically isolation.

Inputs that are configured as interlock are hard wired (OR'ed) to the OFF circuit through diodes. Soldered straps in series with the diodes decide if the signal has to be treated as interlock or status. If the signal also has to latched and incorporated within the first catch register, can be programmed with the "Esc"INTERLOCK command. Please see the SW appendix for further information on this.

Please refer to the plug description for a detail information on all possible inputs and outputs.

A delay-line ensures that an interlock signal only is accepted, if it stays high for longer than app. 100 mSec. R87, C42, R86 and C41. This in order to eliminate false noise generated interlocks. The output of the delay-line will trigger Q10, Q11 that acts like a thyristor and thereby turns off the opto coupler ISO21 that controls the main contactor. The sum interlock signal is also connected to the LED D6 for a latched interlock.

Turning the power supply ON is initiated by turning Q7 on for a certain pulse with (programable but ½ a second as default). ISO21 will if allowable (no interlock) conduct turning the main contactor on. This will in turn activate the PW_IS_ON line that will direct Q6 on, and thereby let the power supply in the on state. If though for some reason the main contactor doesn't goes on within the ON pulse time of Q7 will the ON sequence be terminated.

If the µP. wants to turn OFF the power supply (as a response to a command from the local control panel or the remote line) it activates Q4 that forces Q7 and Q6 OFF.

For safety reasons the main interlock chain is as previously explained hard wired.The display of an interlock event however is controlled by the FPGA and the CPU. The latched interlock information can be seen from the LED's (LD22-LD45), on the local control panel and it can be requested via the remote line via an S1 command.

Each interlock is individually connected to FPGA. Every time an edge transition is detected it will be latched in an internal register. The first one must though come with sum interlock.

On arriving of the first interlock, the FPGA will store this interlock together with status information in a first catch register. The time of arrival will also be stored. These values can be red from the remote serial line with the commands "S1FIRST" and "S1TIME".

## 4.2.6. DAC control:

The DAC control block produces the bits to the Digital to Analog Converter located in the regulation module for setting the output current level. (see diagram sheet 4)

This function is realized inside the FPGA, but in the CAMAC operating mode the FPGA only watches the bits for display purposes only.

The system can manage the DAC setting with up to 24 bit resolution (only 20 bit resolution is actualized at the present stage). In serial control operation are the bits passed to the FPGA from the µ-Processor.
If a CAMAC- or a custom made- board (parallel) is plugged into P3 (P3 pin A32 pulled low) and the system is in remote control, are the DAC bits passed from the IC24, IC26 and IC28 (see sheet 4) to the DAC buffers IC18, IC19 and IC2.

The DAC control has also an influence on the SW ramp profile feature (Aviable as option). It automatically smoothen out the "current set" step values given by the software by a hardware interpolating counter between the two points.

For further information on the Soft Ware controlled ramp profile features, please see the chapter "3.3 Operating by RS232or RS422 I/O"

## 4.2.7. Analog measurements:

Different voltages are monitored by means of Analog to Digital converters, as internal supply voltages and DAC-BOX delta temperatures and as well external values as output load currents and voltages.
The following analog signals are monitored:

| LOGICAL CHANNEL | PHYSICAL CHANNEL | VALUE | BIT RESOLUTION |
|---|---|---|---|
| 0 | IC34/CH0 | Output current | 11 + sign |
| 1 | IC34/CH3 | Tesla (+1V) | 11 + sign |
| 2 | IC34/CH2 | Output Voltage | 11 + sign |
| 3 | IC16/CH1 | Internal +15V sup. | 10 |
| 4 | IC16/CH2 | IInternal -15V sup. | 10 |
| 5 | IC16/CH3 | Internal +5V sup. | 10 |
| 6 | IC34/CH1 | Delta temperature | 11 + sign |
| 7 | IC34/CH5 | Trans. Bank Vce | 11 + sign |
| 8 | Piggy Board/CH0 | Optional Iout (16 Bit) | 16 + sign |
| 9 | | Mirror of logical channel 0 | |
| 10 | | Mirror of logical channel 8 | |
| 11 | IC34/CH6 | Iout Optional | 11 + sign |
| 12 | IC34/CH4 | Vout Optional | 11 + sign |
| 13 | FPGA | Water flow | 16 |
| 14 | IC34/CH7 | Free on plug P29 (±1V) | 11 + sign |
| 15 | IC16/CH0 | Free on plug P19 (10V) | 10 |

The ADC block can be seen no sheet 3 of the schematic 83853. The 10 bit converters are located inside the CPU IC16.

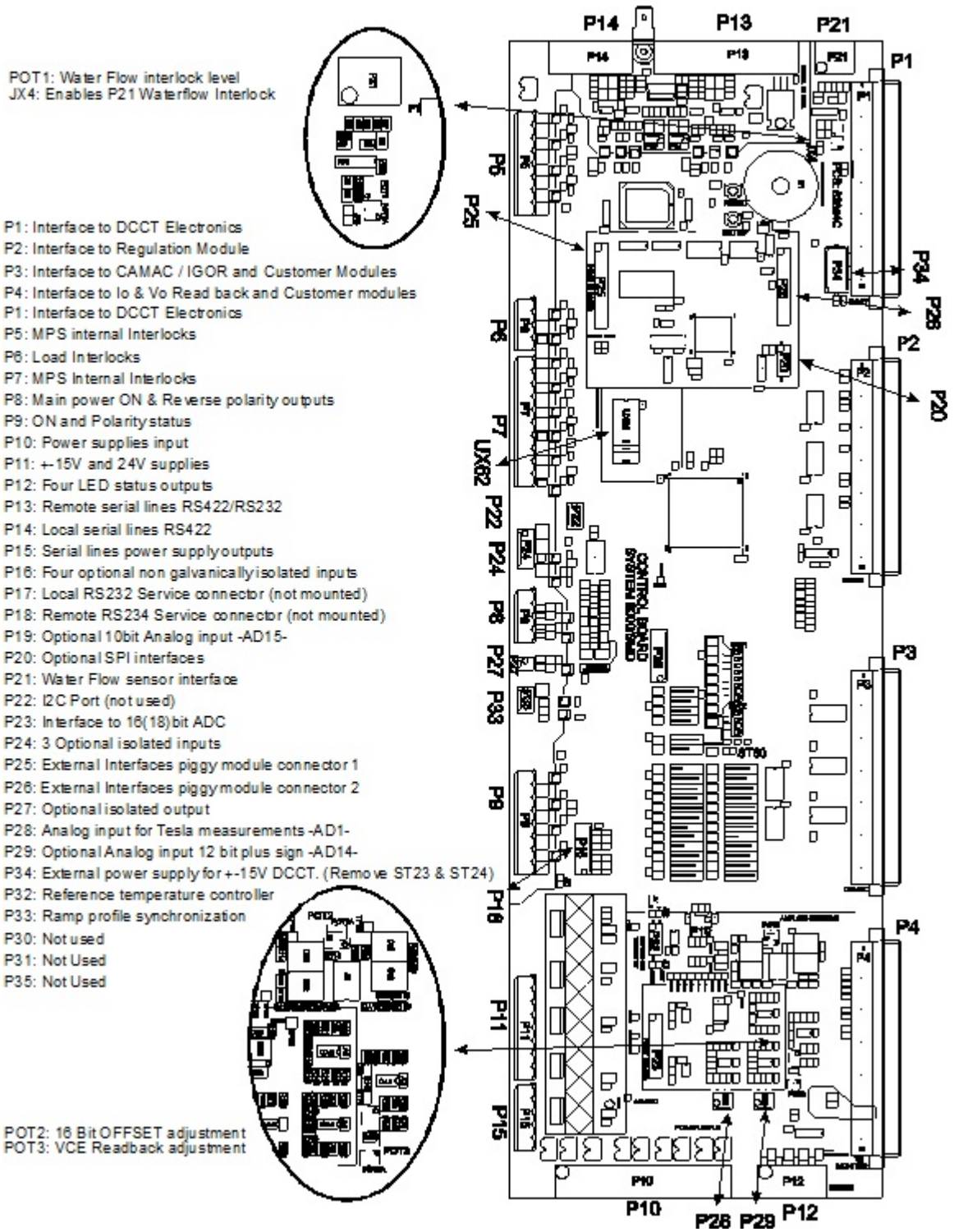
The measurements are available both on the local control panel and the serial remote lines.

The reference voltage for the ADC converters comes from IC30 that delivers a voltage of 4.096V which can be measured on TP23.

The burden resistor on the regulation board receives one Ampere for 100% output current. The voltage of the burden resistor is measured by a high input impedance low drift differential amplifier A1 to give an excellent measurement, especially when the optional 16 bit ADC is used.

Adjustment and calibration of the AD channels are mainly performed by changing the ADC scale factor through SW for each channel. Only the VCE reading and the Iout Off-set value can be trimmed through potentiometers. Please se the picture on the next page for a more detailed visualization of the potentiometer locations and the different plugs including the user analog inputs. The plug description later in this chapter input resolution for the different AD channels.

# ADJUSTMENTS and PLUGS



## 4.2.8. Motherboard:

The control board contains the control and monitoring circuits for the MPS. In addition it is used as motherboard for the following modules:

DCCT module, Regulation module, CAMAC module (Option) and the Isolation module for external monitoring of the output current and voltages (0 → 10V) (Option)

Sheet 1 of the circuit diagram shows'the interconnection wiring between the different module, as well as the supply voltages to the different boards. Some of the supply voltages are galvanically isolated from each other in order to prevent ground loops.

The voltage regulators are IC31, IC33, IC35, IC37, IC29 and IC1 shown in sheet 7.

If the DCCT electronics requires a different voltage as the given ±8V unregulated supply for the compensation current, an external supply can be provided to plug P34. If so, please remember to disconnect this new supply from the rest of the module by removing ST23 and ST24.

## 4.2.9. Water Flow measurement:

A Water flow sensor giving pulses proportional to the flow rate can be attached to P21.

The water flow sensor must have a TTL compatible output signal, Totem Pole or open collector. Pin 1 and 3 of P21 can be used as 5V supply voltage for the sensor.

IC3 on sheet 3 acts as a level detector adjustable with Pot1. JX4 enables the circuit to pass the water flow interlock to the interlock chain. This interlock is then Or'ed with the external interlock from P5 pin 5&6.

The flow pulses are also connected to the FPGA, that converts the frequency to a pseudo analog signal aviable on logical AD channel 13.

The flow circuit is calibrated for a flow sensor giving 752 pulses pr. liter pr. minutes.

As all the AD channels can be rerouted and re scaled, is it possible to replace the water flow information on the M-Panel instead of the TESLA reading.

## 4.2.10. LED indications on the board:

Most of the status signals indicated on the remote lines can also be read from light-emitting diodes. Most of these LED's are software controlled and they are therefore only valid if the µP works.

On the over next page is a list of these LED's with their description:

## 4.2.11. Polarity reversal.

An output line driven from ISO22 and Q9 for a polarity reversal switch is provided on P8 pin 3&4. This output line (open collector) will deliver a pulse of a ½ second duration controlled by the SW. The polarity operation can be HW-suppressed by pulling ST19 low.

A polarity sequence controlled by the SW is as follows:
- The DAC is first set to zero, - When the current is zero, will the Main Power be switched OFF, - The switch motor is activated to reverse the polarity, - When the switch is in the new correct position, will the DAC be set back to its original value and the Main Power will be switched ON, - The output current will increase until it reaches the previous numerical value. (If the Main Power is OFF the above sequence is initiated but the Main Power will not be switched ON.)
It is also possible to use this line as an auxiliary output port controlled through the N2 and the F2 commands. To do so, must the PO command be replaced with the N2 and the F2 commands. This can only be done by Danfysik service personnel {SW setups}.

## 4.2.12. Setting up the board parameters:

Setting up the board is done by two dip switches SW1 and SW2 together with the push button S2 (SETUP), or through SW commands. Please refer to the “ESC” commands in the SW appendix chapter for further information.

The two dip switches are configured as a multi function port, that will be validated by the CPU upon pressing the button S2.

The four leavers on SW2 instruct what parameters to set up, and the eight leavers on SW1 delivers the actual parameters for this set up. The parameters are first acknowledged after pressing the SETUP switch S2.

Leaving all leavers in the OFF position will disable the SETUP switch, and thereby any unforeseen set up modification (parking position).

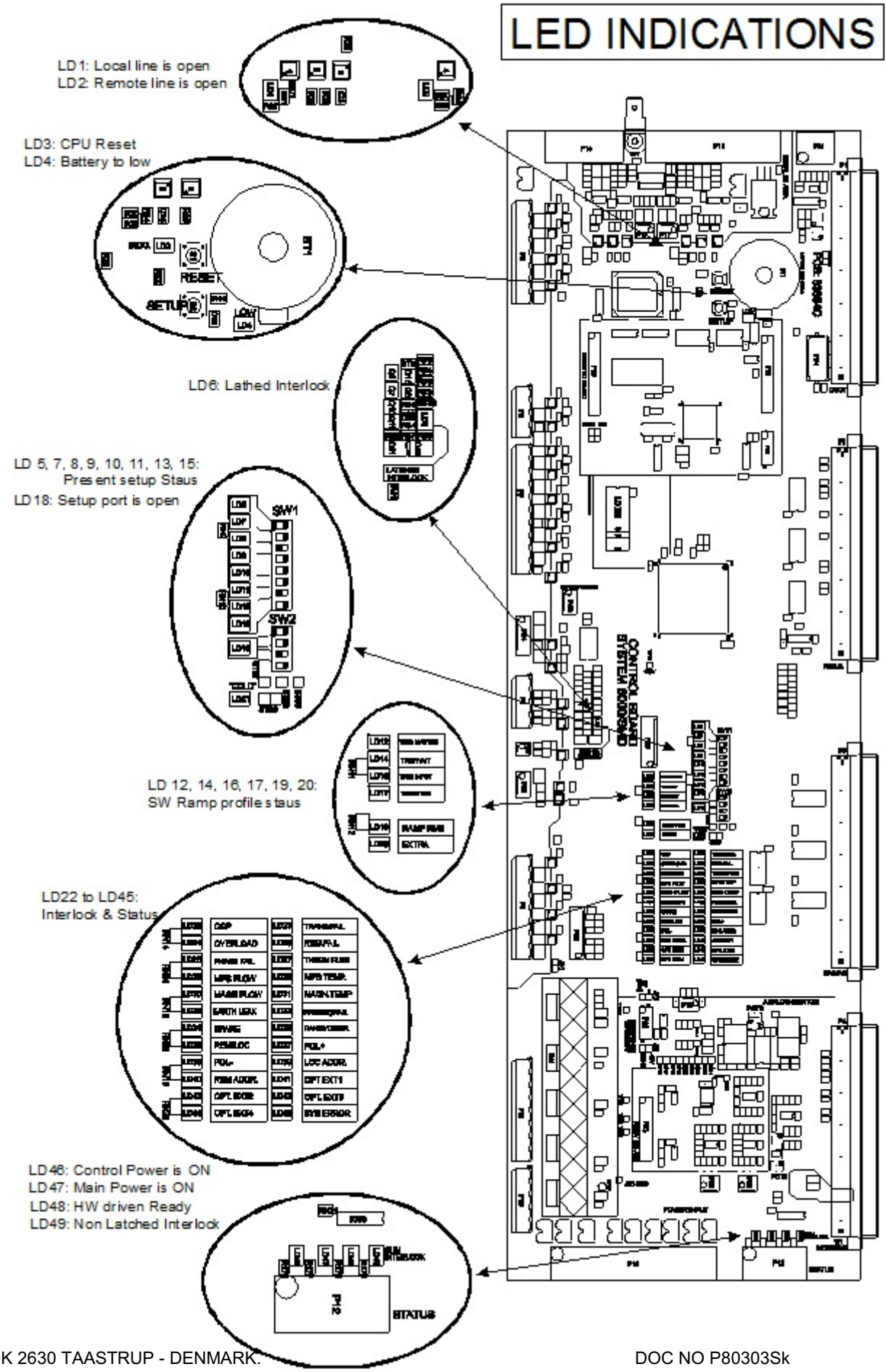
If the one of the set up modes are selected, will the yellow LED to the left of the switch “LD18" lit up indicating, that set up port is activated. The eight green LED’s to the left of SW1 will show the present parameter of selected mode. Changing SW1 has no effect, first after pressing S2 will the green LED’s take the same indication as SW1.

Please see chapter 3.3 for further information on all setup parameters.

Reverting all set ups to the factory default can be accomplished as follows.

Short circuit ST60 (just below SW2). Press at the same time S2 continuously. All green parameter LED’s will start flashing. After the fifth flash will the default parameter be restored. Please note that all parameters will be restored also any selected addresses, AD scaling factors and also the ON pulse with. The last one may cause the power supply not being able to be turned ON.

# LED INDICATIONS



## 4.2.13. Interface specification:

The Driver Interface board has following connection:

- P1: Interface to DCCT Electronics
- P2: Interface to Regulation Module
- P3: Interface to CAMAC / IGOR and Customer Modules
- P4: Interface to Io & Vo Read back and Customer modules
- P5: MPS internal Interlocks
- P6: Load Interlocks
- P7: MPS Internal Interlocks
- P8: Main power ON & Reverse polarity outputs
- P9: ON and Polarity status
- P10: Power supplies input
- P11: ±15V and 24V supplies
- P12: Four LED status outputs
- P13: Remote serial lines RS422/RS232
- P14: Local serial lines RS422
- P15: Serial lines power supply outputs
- P16: Four optional non galvanically isolated inputs
- P17: Local RS232 Service connector (not mounted)
- P18: Remote RS234 Service connector (not mounted)
- P19: Optional 10bit Analog input -AD15-
- P20: Optional SPI interfaces
- P21: Water Flow sensor interface
- P22: I2C Port (not used)
- P23: Interface to 16(18)bit ADC
- P24: 3 Optional isolated inputs
- P25: External Interfaces piggy module connector 1
- P26: External Interfaces piggy module connector 2
- P27: Optional isolated output
- P28: Analog input for Tesla measurements -AD1-
- P29: Optional Analog input 12 bit plus sign -AD14-
- P30: Not used
- P31: Not Used
- P32: Reference temperature controller
- P33: Ramp profile synchronization
- P34: External power supply for ±15V DCCT. (Remove ST23 & ST24)
- P35: Not Used

# 8 Drawings.

| MODULE | SCHEMATIC Dwg. No. | ASSEMBLY Dwg.No. |
|---|---|---|
| Control Module SMT | 83853B | 83852A |
| 16 Bit ADC, SMT | 83914 | 83913 |

# 10. Parts Lists.

| MODULE | PART NUMBER |
|---|---|
| Control Board SMT | 8100083852 (13) |
| 16 Bit ADC, SMT | 8100083913 (only if applicable) |