Supercool
Serial Command Interface
SSCI_v1.6c

1 Overview

The Supercool Serial Command Interface is a serial communications protocol, which efficiently handles the control of the regulator. The regulator unit is acting like a slave or stand-alone unit. Each command from the master unit results in a response from the regulator.
At startup of the regulator, the values in the internal EEPROM memory will be copied into the runtime registers. The master can then change the EEPROM memory by first writing to the runtime registers and then issue the RW command to write runtime registers to EEPROM. There is no need to issue a RW command after each register change Change all registers first, and then write to EEPROM if needed.
All communication is by ASCII chars, which will be possible to stream to file or terminal for debugging, if needed.

Features

- RS232 (or TTL) serial interface, 115200 baud, 1 start, 8 bit, 1 stop bit, no parity, no handshake
- Slave and/or stand-alone unit
- All communication with ASCII char
- EEPROM register holding startup regulator values
- Advanced PID regulator system, where all parameters can be adjusted
- Possibility to get the actual temperature values
- Possibility to get runtime register values
- Possibility to upgrade the firmware by using boot loader mode
- IEEE754 transfer mode implemented, to improve data accuracy
- Saving LOGG data every 20min. Can be used to check voltage/current/temp values.

2 Command

The command set is built up by (with an example):

start char	*command*	*data*	*stop char*
$	R41=	23.5	<cr>

When the regulator is ready to receive next command, we get '>' char and <CR>. After each command to the regulator there is a response so that the master unit knows how the regulator decoded the command. If there is an unknown command we get a question mark as response. Note that there is a <CR> after each command and response.

Command	Description	Regulator Response
$Q	Clear RUN flag	
$W	Set Run flag	
$V	Show current software version	<version string>
$v	Show current software version and interface version	<version string><interface version>
$S	Get status flag	<flag1><alarm1><alarm2>
$SC	Clear status flag	<flag1><alarm1><alarm2>
$RW	Write regulator register values to EEPROM	
$RC	Clear EEPROM to default, and reboot the regulator	Normal boot info
$RR	Display regulator register	<parameter list>
$Rxx=data	Write data (float or int) to register xx	<display new data stored>
$Rxx?	Read data (float or int) from register xx	ex. +2.000e+01
$RNxx=data	Write float data in IEEE754 type to register xx	<display new data stored>
$RNxx?	Read float data in IEEE754 type from register xx	ex. A1A8FCBA

$Ax	Continuous log of values, where X is 1..7	continues data
$B	Enter BOOT LOADER mode (described in a boot loader document)	Se bootloader document
$BC	Reboot the board	boot text
$LI	Get board info and ID name	ID string of data
$LD	Display logg data (max/min/avr)	<num> VIN, CURR, T1, T4
$LL	Load logg data from eeprom to ram	<num> VIN, CURR, T1, T4
$LC	Clear logg data in eeprom, use with care	<num> VIN, CURR, T1, T4
<CR>	Perform last command	
	Unknown command	?

IEEE754 is handled as a 32 bit hex value, displayed as 8 char with the MSB char first. This helps us to move values more accurate data to/from controller unit to/from a PC.

3 Register

The following registers are defined for the moment, but will change prior to the software release.

Register	Default value	R/W	Type	Description
0	20.0	RW	float/IEEE	Set Point - (fgTref) Main temperature reference
1	20.0	RW	float/IEEE	PID – (Kp) P constant
2	2.0	RW	float/IEEE	PID – (Ki) I constant
3	5.0	RW	float/IEEE	PID – (Kd) D constant
4	2.0	RW	float/IEEE	PID – (KLP_A) Low pass filter A (+value)
5	3.0	RW	float/IEEE	PID – (KLP_B) Low pass filter B (+value)
6	100.0	RW	float/IEEE	MAIN – (TcLimit) Limit the Tc signal (0..100)
7	3.0	RW	float/IEEE	MAIN – (TcDeadBand) Dead band of Tc signal (0..100)
8	100.0	RW	float/IEEE	PID – (iLim) Limit I value (0..100)
9	0.05	R	float/IEEE	MAIN – (Ts) Sample rate 1/Hz
10	1.0	RW	float/IEEE	MAIN – (Cool Gain) Gain of cool part of Tc signal (+value)
11	1.0	RW	float/IEEE	MAIN – (Heat Gain) Gain of heat part of Tc signal (+value)
12	0.1	RW	float/IEEE	PID – (Decay) Decay of I and low pass filter part (+value)
13	20480	RW	int	REGULATOR MODE – Control register
14	5.0	RW	float/IEEE	ON/OFF Dead band (+value)
15	5.0	RW	float/IEEE	ON/OFF Hysteresis (+value)
16	1	RW	int	FAN 1 Mode select
17	20.0	RW	float/IEEE	FAN 1 Set temperature
18	8.0	RW	float/IEEE	FAN 1 Dead band (+value)
19	4.0	RW	float/IEEE	FAN 1 Low speed hysteresis (+value)
20	2.0	RW	float/IEEE	FAN 1 High speed hysteresis (+value)
21	60.0	RW	float/IEEE	FAN 1 Low Speed voltage (0..60)
22	100.0	RW	float/IEEE	FAN 1 High Speed voltage (0..60)
23	1	RW	int	FAN 2 Mode select
24	20.0	RW	float/IEEE	FAN 2 Set temperature
25	8.0	RW	float/IEEE	FAN 2 Dead band (+value)
26	4.0	RW	float/IEEE	FAN 2 Low speed hysteresis (+value)
27	2.0	RW	float/IEEE	FAN 2 High speed hysteresis (+value)
28	60.0	RW	float/IEEE	FAN 2 Low Speed voltage (0..60)
29	100.0	RW	float/IEEE	FAN 2 High Speed voltage (0..60)
30	0	RW	float/IEEE	POT input - AD offset
31	0	RW	float/IEEE	POT input - offset

32	1	RW	float/IEEE	POT input - gain
33	0	RW	float/IEEE	Expansion port AD out – offset
34	1	RW	float/IEEE	Expansion port AD out - gain
35	1.0	RW	float/IEEE	Temp 1 gain
36	0.0	RW	float/IEEE	Temp 1 offset
37	1.0	RW	float/IEEE	Temp 2 gain
38	0.0	RW	float/IEEE	Temp 2 offset
39	1.0	RW	float/IEEE	Temp 3 gain
40	0.0	RW	float/IEEE	Temp 3 offset
41	1.0	RW	float/IEEE	Temp FET gain
42	0.0	RW	float/IEEE	Temp FET offset
43	128	RW	int	Temp 1 digital pot offset (0..255)
44	10	RW	int	Temp 1 digital pot gain (0..255)
45	20.0	RW	float/IEEE	ALARM level voltage high
46	10.0	RW	float/IEEE	ALARM level voltage low
47	10.0	RW	float/IEEE	ALARM level main current high
48	0.01	RW	float/IEEE	ALARM level main current low
49	2.0	RW	float/IEEE	ALARM level FAN 1 current high
50	0.01	RW	float/IEEE	ALARM level FAN 1 current low
51	2.0	RW	float/IEEE	ALARM level FAN 2 current high
52	0.01	RW	float/IEEE	ALARM level FAN 2 current low
53	13.0	RW	float/IEEE	ALARM level internal 12v high
54	8.0	RW	float/IEEE	ALARM level internal 12v low
55	12	RW	int	Temp1 mode
56	4	RW	int	Temp2 mode
57	4	RW	int	Temp3 mode
58	4	RW	int	Temp4 mode
59	1.0372838e-03	RW	float/IEEE	Temp1 Stainheart cof A
60	2.33172381e-04	RW	float/IEEE	Temp1 Stainheart cof B
61	8.38954293e-08	RW	float/IEEE	Temp1 Stainheart cof C
62	2.1867114e-03	RW	float/IEEE	Temp2 Stainheart cof A
63	8.87341375e-05	RW	float/IEEE	Temp2 Stainheart cof B
64	7.75986052e-07	RW	float/IEEE	Temp2 Stainheart cof C
65	2.1867114e-03	RW	float/IEEE	Temp3 Stainheart cof A
66	8.87341375e-05	RW	float/IEEE	Temp3 Stainheart cof B
67	7.75986052e-07	RW	float/IEEE	Temp3 Stainheart cof C
68	2.1867114e-03	RW	float/IEEE	Temp4 Stainheart cof A
69	8.87341375e-05	RW	float/IEEE	Temp4 Stainheart cof B
70	7.75986052e-07	RW	float/IEEE	Temp4 Stainheart cof C
71	50.0	RW	float/IEEE	ALARM Temp 1 high
72	-10.0	RW	float/IEEE	ALARM Temp 1 low
73	50.0	RW	float/IEEE	ALARM Temp 2 high
74	-10.0	RW	float/IEEE	ALARM Temp 2 low
75	50.0	RW	float/IEEE	ALARM Temp 3 high
76	-10.0	RW	float/IEEE	ALARM Temp 3 low
77	70.0	RW	float/IEEE	ALARM Temp 4 high
78	-10.0	RW	float/IEEE	ALARM Temp 4 low
79	343.15	RW	float/IEEE	Temp1 Stainheart resistans value H
80	298.15	RW	float/IEEE	Temp1 Stainheart resistans value M

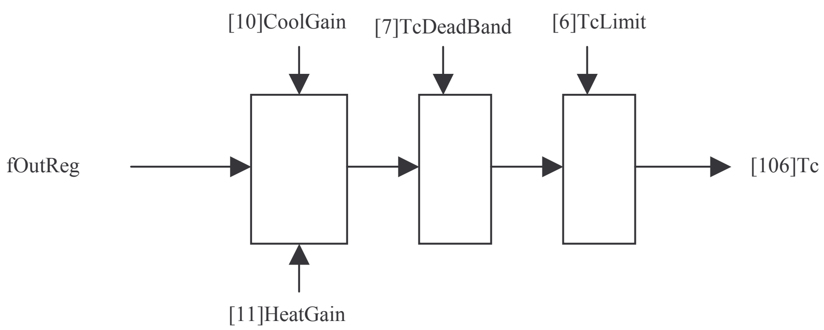
81	273.15	RW	float/IEEE	Temp1 Stainheart resistans value L
82	333.15	RW	float/IEEE	Temp2 Stainheart resistans value H
83	298.15	RW	float/IEEE	Temp2 Stainheart resistans value M
84	253.15	RW	float/IEEE	Temp2 Stainheart resistans value L
85	333.15	RW	float/IEEE	Temp3 Stainheart resistans value H
86	298.15	RW	float/IEEE	Temp3 Stainheart resistans value M
87	253.15	RW	float/IEEE	Temp3 Stainheart resistans value L
88	333.15	RW	float/IEEE	Temp4 Stainheart resistans value H
89	298.15	RW	float/IEEE	Temp4 Stainheart resistans value M
90	253.15	RW	float/IEEE	Temp4 Stainheart resistans value L
91	351	RW	uint	Alarm enable bits low
92	255	RW	uint	Alarm enable bits high
93	8.0	RW	float/IEEE	Setpoint 2, when in test loop mode
94	300	RW	unit	TimeHigh, when in loop mode (cycles)
95	200	RW	unit	TimeLow, when in loop mode (cycles)
96	65532	RW	uint	Sensor Alarm Mask, select warning or alarm of sensors
99	-	R	uint	Regulator event count. Increments one time each regulator event.
100	-	R	float/IEEE	Temp 1 value (AN5)
101	-	R	float/IEEE	Temp 2 value (AN6)
102	-	R	float/IEEE	Temp 3 value (AN7)
103	-	R	float/IEEE	Temp FET value (AN8)
104	-	R	float/IEEE	Temp POT reference (AN0)
105	-	R	float/IEEE	TRef
106	-	R	float/IEEE	MAIN (Tc) output value (-100..+100)
107	-	R	float/IEEE	FAN 1 output value (0..100)
108	-	R	float/IEEE	FAN 2 output value (0..100)
110	-	R	float/IEEE	PID – Ta
111	-	R	float/IEEE	PID – Te
112	-	R	float/IEEE	PID – Tp
113	-	R	float/IEEE	PID – Ti
114	-	R	float/IEEE	PID – Td
117	-	R	float/IEEE	PID – TLP_A
118	-	R	float/IEEE	PID – TLP_B
122	-	R	int	ON/OFF – runtime state
123	-	R	float/IEEE	ON/OFF – runtime max
124	-	R	float/IEEE	ON/OFF – runtime min
125	-	R	int	FAN1 – runtime state
126	-	R	float/IEEE	FAN1 – runtime max
127	-	R	float/IEEE	FAN1 – runtime min
128	-	R	int	FAN2 – runtime state
129	-	R	float/IEEE	FAN2 - runtime max
130	-	R	float/IEEE	FAN2 – runtime min
150	-	R	float/IEEE	(AN1) Input voltage
151	-	R	float/IEEE	(AN10) Internal 12v
152	-	R	float/IEEE	(AN9) Main current
153	-	R	float/IEEE	(AN11) FAN1 current
154	-	R	float/IEEE	(AN4) FAN2 current

NOTE:

- The master is responsible for checking that the value is within the range of the parameter. If a value is outside recommended value, unpredictable behavior may occur. If the value is not decodable, zero is inserted.
- ALARM check is value can be zero, and use enable bits to use check alarm.
- Float values will only display six decimals. Example 4.123456, -3.878667, +4.887667, or width E value, +1.23456e-04 etc.
- IEEE mode. Float value sent by 8 char of hex byte.
- Only Steinhart cof A, B, C is used in the regulator, but the Steinhart resistans parameter is used by the PC program to be able to calculate right set points.
- All parameters are possible to change on the fly (when regulator is active) and will take effect directly. It is also possible to change all parameters and then save to internal EEPROM memory. This gives the control unit the possibility to work online with a master unit or as a stand-alone unit.

4 Main regulator

The main regulator is controlling the main output, which is a H-bridge output. The output is regulating the power and current direction through the peltier modules connected. You can set the output control in different modes, PID, POWER and ON/OFF control mode.



Issue command "$W" to set RUN flag, and "$Q" to clear the regulator flag. To store the RUN flag into EEPROM , issue command "$RW" after issuing "$W" and the current settings on all registers and flags are stored in the EEPROM. From now on and after each power up, these are the values that are in use.

We have a delay of 3 seconds, which is in effect after each power up, and after an error is cleared.

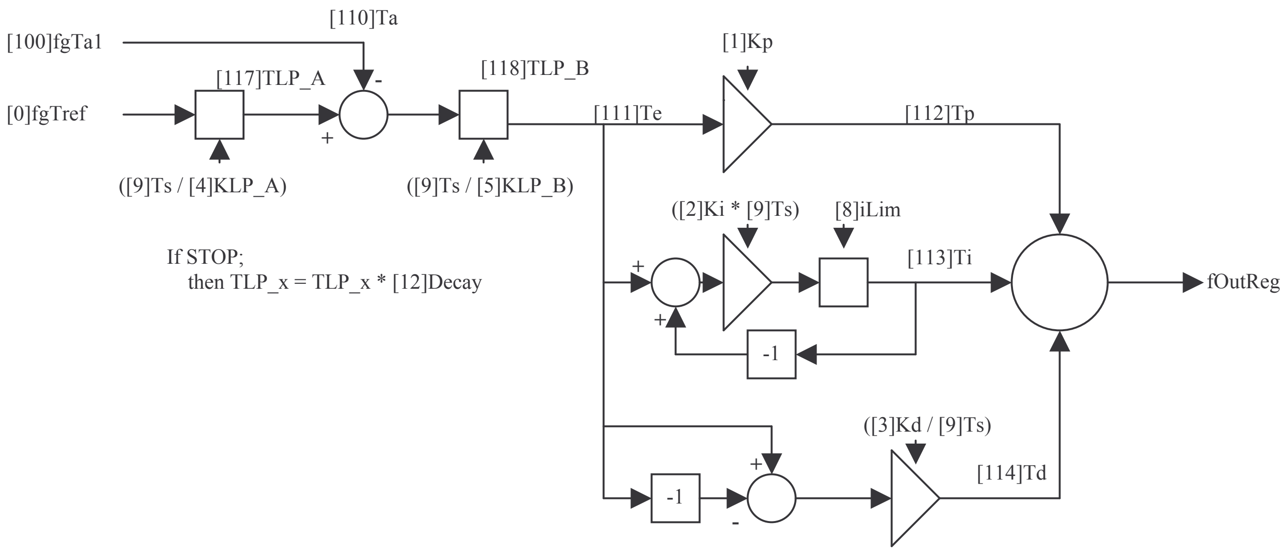
We have a Watchdog activated to catch any fault in the system.

Parameters:
[0] Set point – to set the temperature to regulate towards
[6] Limit Tc – is to limit the output signal to a max value. This is always in effect. Good to use if we only need a max effect on the output.
[7] Dead band of Tc signal – is limiting the signal around zero value. Good to adjust if we do not like fast switching from one voltage/current direction to the other direction. This helps to save the life of the peltier modules.
[9] Sample rate – 1/0.05 = 20Hz. This is a fix sample rate. Contact Supercool if there is a need for a different sample rate.
[10] Cool gain – to adjust the cool gain part. Normally this is 1.0
[11] Heat gain – to adjust the heat gain part. Normally this is 1.0
[13] Regulator Mode – use to switch between the different regulator modes.
0 = no regulator mode
1 = POWER mode
2 = ON/OFF mode
3 = P regulator mode

4 = PI regulator mode
5 = PD regulator mode
6 = PID regulator mode

4.1 PID regulator mode

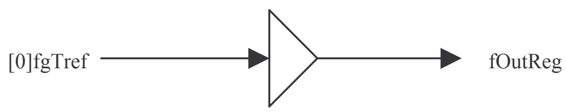
The PID regulator is controlling the main output when selected. This mode is possible to use in P, PI, PD, or PID mode. Of course it is possible to use PID mode and only set P, I or D constants to zero, but the possibility to change mode without changing the constants helps to trim and adjust the values for optimal use.



Parameters:
[1] P constant
[2] I constant
[3] D constant
[4] Low pass filter A
[5] Low pass filter B
[8] Limit I signal
[12] Decay of I signal, and low pass filter parts when the regulator is switched off.

4.2 Power regulator mode

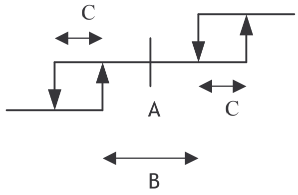
This mode is normally only used when to check that the load is working, and when to adjust the COOL [10] and HEAT [11] gain parameters. The internal set point [0] is used to set the output power needed. This means that we enter a control value from –100 to +100 and the main output will set this on the output. Note that the dead band [7] should be zero, and limit [6] should be 100, if the full range is to be used.



4.3 ON/OFF regulator mode

ON/OFF Regulator is a regulator mode used to simulate an old regulator with a set point, dead band and hysteresis around it.

<u>*Temperature control*</u>
(ON/OFF)
[0] A Set point *-50 ... 100°C*
[14] B Dead band 0 … 50°C
[15] C Hysteresis 0 … 10°C



5 FAN regulator

The FAN is possible to set in different modes. The RUN flag “$W” must be activated for the FAN regulator to run, and that there are no errors or Alarms activated.

[16] FAN Mode selection register
0 = always off
1 = always on
2 = COOL mode
3 = HEAT mode
4 = COOL/HEAT mode
5 = FAN regulator mode

5.1 Always off

The FAN is always off.

5.2 Always on

The FAN is always on if the RUN flag “$W” is activated and there is no error.

5.3 COOL mode

In this mode the FAN is on when runtime register [102] main output is negative. The FAN is operating at the speed set in the register [22] FAN High Speed Value.

5.4 HEAT mode

In this mode the FAN is on when runtime register [102] main output is positive. The FAN is operating at the speed set in the register [22] FAN High Speed Value.

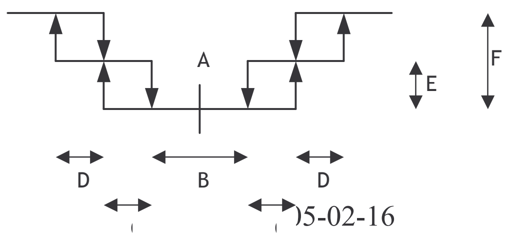
5.5 COOL / HEAT mode

In this mode the FAN is on when runtime register [102] main output not is zero. The FAN is operating at the speed set in the register [22] FAN High Speed Value.

5.6 FAN regulator mode

In this mode we get the FAN to switch on and off with the input temperature, adjusted to the FAN set point register. The FAN has two speeds, which are adjustable.

<u>*Fan control*</u>
[17] A Set point -50 … 100°C
[18] B Dead band 0 … 50°C
[19] C Low speed hysteresis 0 … 10°C



[20] D High speed hysteresis 0 … 10°C
[21] E Low speed voltage 0 … 60V
[22] F High speed voltage 0 … 60V

C C

6 Temp sensor

The Temperature settings are possible to adjust for good quality of the signal.
The basic use of gain and offset is in the following equation:

temp = (1024- ad_value + offset) * gain;

The 1024 value is adjusting AD value to go from 1..1024 for rising temperature, if NTC resistance is in use.

NOTE: standard mode is to use Steinhart coefficients to calculate right temperature.

6.1 Temp 1

Temp 1 is the main temp sensor for the system. And this is the only sensor with the possibility to adjust the electrical parts on board by changing digital potentiometers. The connector's pin 1 is feeding voltage to the sensor with at serial resistor of 20k. Pin 3 is the ground. Pin 2 is the input signal with a pull-up resistor of 510kohm. The purpose of this resistor is to put the input signal high if no sensor is connected. The digital pot offset control is adjusting the reference voltage from 0 to 5 Volt, where pot value of 0 is 0 volt, and pot value of 255 is 5Volt. The pot gain value of 0 is max gain, and the value of 255 is the gain of 1.
The purpose of the digital pot values is mainly to adjust to the sensor connected, but it is also possible to zoom in on the signal and track it. Then the temperature resolution can be very high.

In the future we will integrate a possibility to put in the K factors of the sensor, and automatically get high-resolution sensor signal. But for now, we need to adjust this by hand. Contact Supercool to get help with the best values for your sensor.

Sensor mode bit:
0 – not implemented
1 – not implemented
2 – to activate Steinhart calculation
3 – to activate Zoom mode (internal control of digital pot)
4..7 – not implemented

NOTE: standard mode is to use Steinhart coefficients to calculate right temperature.

[35] Temp 1 gain
[36] Temp 1 offset
[43] Temp 1 digital pot offset
[44] Temp 1 digital pot gain
[55] Temperature 1 sensor mode
[59] Temp1 Steinhart coff A
[60] Temp1 Steinhart coff B
[61] Temp1 Steinhart coff C
[79] Temp1 Steinhart resistans value high
[80] Temp1 Steinhart resistans value mid
[81] Temp1 Steinhart resistans value low

6.2 Temp 2 and Temp 3

Temp 2 and 3 are temp sensor inputs of the same kind. The electrical gain is 1.05, but can be changed by changing the resistor values. There is a pull-up resistor of 5k1 ohm. If no sensor is connected to the input, the AD value will be 1023 (the highest value of a 10bits AD). With this in mind it is possible to calculate the right values for the gain and offset values. The values can be pos or negative.

Sensor mode bit:
0 – not implemented
1 – not implemented
2 – to activate Steinhart calculation
3..7 – not implemented

NOTE: standard mode is to use Steinhart coefficients to calculate right temperature.

[37] Temp 2 gain
[38] Temp 2 offset
[56] Temperature 2 sensor mode
[62] Temp2 Steinhart coff A
[63] Temp2 Steinhart coff B
[64] Temp2 Steinhart coff C
[82] Temp2 Steinhart resistans value high
[83] Temp2 Steinhart resistans value mid
[84] Temp2 Steinhart resistans value low
[39] Temp 3 gain
[40] Temp 3 offset
[57] Temperature 3 sensor mode
[65] Temp3 Steinhart coff A
[66] Temp3 Steinhart coff B
[67] Temp3 Steinhart coff C
[85] Temp3 Steinhart resistans value high
[86] Temp3 Steinhart resistans value mid
[87] Temp3 Steinhart resistans value low

6.3 Temp FET

Temp FET is a temp sensor on the board, close to the power transistors (FET), which gives us the possibility to check for overheating before it becomes a problem. The electrical gain is 1.05, but can be changed by changing the resistor values. There is a pull-up resistor of 5k1 ohm. If no sensor is connected to the input, the AD value will be 1023 (the highest value of a 10bits AD). With this in mind it is possible to calculate the right values for the gain and offset values. The values can be positive or negative.
The NTC resistance used is 1kohm at +25 degree C. B25/50 value is 3200 K.

NOTE: standard mode is to use Steinhart coefficients to calculate right temperature.

[41] Temp 4 gain
[42] Temp 4 offset
[58] Temperature 4 sensor mode
[68] Temp4 Steinhart coff A
[69] Temp4 Steinhart coff B
[70] Temp4 Steinhart coff C
[88] Temp4 Steinhart resistans value high
[89] Temp4 Steinhart resistans value mid
[90] Temp4 Steinhart resistans value low

7 "$Ax" - Continues log

We have a possibility to get log values at the regulator speed (20Hz), as a continuous log. Let the application software receive the log values for real time presentation of values in different modes, or use for debug purpose, log to a text file, and analyze the data in an Excel spreadsheet. When read into Excel use filter with <SPACE> as tab separator.
After issuing the command, the first text line is the header data. After that we get a text line for every regulator sample, at the speed of 20Hz. All values are <space> separated. The first char in the row is the log mode value. So A1, will have number 1 as the first char.

"$A" – stop the log
"$A1" – log all A/D values
"$A2" – log some of the global values
"$A3" – log PID regulator values
"$A4" – log all temperature related values
"$A5" – log temperature regulator input values
"$A6" – runtime data
"$A7" – runtime data in IEEE754 mode
"$A8" – runtime data of LOGG data

7.1 "$A1"

Data value:
1 - Mode value 1
2 – AD0, not in use, value can be anything
3 – AD1, input voltage to the regulator
4 – AD2, FAN2 current
5 – AD3, temperature input 1
6 – AD4, temperature input 2
7 – AD5, temperature input 3
8 – AD6, temperature input FET
9 – AD7, main out current
10 – AD8, internal voltage value
11 – AD9, FAN 1 current
12 – AD10, not in use, value can be anything
13 – AD11, not in use, value can be anything

7.2 "$A2"

Data value:
1 – Mode value 2
2 – error flags, value in hex
3 – regulator mode flag, value in hex
4 – AD value of temperature 1
5 – Main (Tc) output value
6 – FAN 1 output value
7 – FAN 2 output value

7.3 "$A3"

Data value:
1 – Mode value 3
2 – error flags, value in hex
3 – regulator mode flag, value in hex

4 – Tc value (+/- 100)
5 – Ta1 temperature 1 value in degree C
6 – Ta2 temperature 2 value in degree C
7 – Tr set point value in degree C
8 – Ta value in degree C
9 – Tp value
10 – Ti value
11 – Td value
12 – TLP_A value
13 – TLP_B value

7.4 "$A4"

Data value:
1 – Mode value 4
2 – error flags, value in hex
3 – regulator mode flag, value in hex
4 – Tc value (+/- 100)
5 – Tr set point value in degree C
6 – AD value of current load

7.5 "$A5"

Data value:
1 – Mode value 5
2 – error flags, value in hex
3 – regulator mode flag, value in hex
4 – TrExt, temperature value, external ref
5 – Tref, temperature value
6 – Tr, temperature value

7.6 "$A6"

Data value:
1 – Mode value 6
<runtime data> contact Supercool to get more information

7.7 "$A7"

Data value:
1 – Mode value 7
<runtime data IEEE754 mode> contact Supercool to get more information

7.8 "$A8"

Data value:
1 – Mode value 8
2 – logg count value, will save when the value is 24000, and will cleared to zero. (20Hz * 60s * 20min = 24000)

8 ALARM settings

We can check parts of the system by monitoring the value and alarm if we get to the trig value selected. Clear enable bit to zero if no alarm checking should be performed. The value zero in ALARM register is now a valid number, and will not stop the alarm check, as it used to.

[45] ALARM level voltage high
[46] ALARM level voltage low
[47] ALARM level main load current high
[48] ALARM level main load current low
[49] ALARM level FAN 1 current high
[50] ALARM level FAN 1 current low
[51] ALARM level FAN 2 current high
[52] ALARM level FAN 2 current low
[53] ALARM level internal 12 voltage high
[54] ALARM level internal 12 voltage low
[91] ALARM low enable bits
[92] ALARM high enable bits

The alarm values entered are the actual A/D reading value, (0..1023). This will be changed in the future to real values.

Use “$A1” to get the A/D values.

9 Status and error flags

We have Status and Error flags.

“$S” – to read the status and error flags.
“$SC” – to clear error flags.

Result string from unit:
XXXX YYYY ZZZZ

Where
XXXX = Temperature alarm flags in HEX
YYYY = current error flags in HEX
ZZZZ = old error flags in HEX, show the errors that occurred since power up or last error clear.

Status bits:
0 = Temperature sensor 1 - to high
1 = Temperature sensor 1 - to low
2 = Temperature sensor 1 – shortcut
3 = Temperature sensor 1 - missing
4 = Temperature sensor 2 - to high
5 = Temperature sensor 2 - to low
6 = Temperature sensor 2 – shortcut
7 = Temperature sensor 2 - missing
8 = Temperature sensor 3 - to high
9 = Temperature sensor 3 - to low
10 = Temperature sensor 3 – shortcut
11 = Temperature sensor 3 - missing
12 = Temperature sensor 4 - to high
13 = Temperature sensor 4 - to low
14 = Temperature sensor 4 – shortcut
15 = Temperature sensor 4 - missing

ERROR flag bits:
0 = STARTUP_DELAY, internal telling that we are in the startup delay mode

1 = DOWNLOAD_ERROR, we got error while downloading registers
2 = C_ERROR, critical error flag
3 = R_ERROR, regulator overload error
4 = HIGH_VOLT, we detected high voltage, alarm value set in register [45]
5 = LOW_VOLT, we detected low voltage, alarm value set in register [46]
6 = HIGH_12V, internal 12V is too high, alarm value set in register [53]
7 = LOW_12V, internal 12V is to low, alarm value set in register [54]
8 = CURRENT_HIGH, we detected high load current, alarm value set in register [47]
9 = CURRENT_LOW, we detected low load current, alarm value set in register [48]
10 = FAN1_HIGH, we detected high FAN current, alarm value set in register [49]
11 = FAN1_LOW, we detected low FAN current, alarm value set in register [50]
12 = FAN2_HIGH, we detected high FAN current, alarm value set in register [51]
13 = FAN2_LOW, we detected low FAN current, alarm value set in register [52]
14 = Temp sensor alarm has stoped the regulator
15= Temp sensor alarm is indication only

10 Runtime registers

The master unit can read the runtime register values and watch over the regulator function and performance, if needed. Read the same way as normal registers.

11 The parameter.h file

Use this file in the PC application to always access the right register.

```
// -----------------------------
// PARAMETER.H
// -----------------------------
//
// Supercool Parameter file
//
// 2004-12-20, ver 1.6b
// * add filter type selections
//
// 2004-11-08, ver 1.6
// * adding alarm mask variabel
//

#ifndef _PARAMETER_H
#define _PARAMETER_H

#define VER_INTERFACE "SSCI_v1.6b"

// -----------------------------------------------------------
typedef union {
   uns16 ALL;
   struct {
       unsigned STARTUP_DELAY:1;    // mark startup delay
       unsigned DOWNLOAD_ERROR:1;   // we got a timeout while downloading parameters
       unsigned C_ERROR:1;          // critical error
       unsigned REG_OVERLOAD_ERROR:1;   // regulator overload error

       unsigned HIGH_VOLT:1;        // we have high voltage error
       unsigned LOW_VOLT:1;     // we have low voltage error
       unsigned HIGH_12V:1;     // we have high 12 voltage in the system
       unsigned LOW_12V:1;          // we have low 12 voltage in the system

       unsigned CURRENT_HIGH:1;     // over or under current check
       unsigned CURRENT_LOW:1;      // over or under current check
       unsigned FAN1_HIGH:1;
       unsigned FAN1_LOW:1;

       unsigned FAN2_HIGH:1;
       unsigned FAN2_LOW:1;
       unsigned TEMP_SENSOR_ALARM_STOP:1;   // sensor alarm to stop regulator
       unsigned TEMP_SENSOR_ALARM_IND:1;// sensor alarm indication
```

```
        // ### OBS! max 16 bits
    }BIT;
} ERROR_BITS;

typedef union {
    uns16 ALL;
    struct {
        unsigned TEMP1_HIGH:1;
        unsigned TEMP1_LOW:1;
        unsigned TEMP1_SHORT:1;
        unsigned TEMP1_MISSING:1;

        unsigned TEMP2_HIGH:1;
        unsigned TEMP2_LOW:1;
        unsigned TEMP2_SHORT:1;
        unsigned TEMP2_MISSING:1;

        unsigned TEMP3_HIGH:1;
        unsigned TEMP3_LOW:1;
        unsigned TEMP3_SHORT:1;
        unsigned TEMP3_MISSING:1;

        unsigned TEMP4_HIGH:1;
        unsigned TEMP4_LOW:1;
        unsigned TEMP4_SHORT:1;
        unsigned TEMP4_MISSING:1;
        // ### OBS! max 16 bits
    }BIT;
} TEMP_ALARM_BITS;

// ----------------------------------------------------------
// Alarm enable bits
// ----------------------------------------------------------
typedef union {
    uns16 ALL;
    struct {
        unsigned OVER_VIN:1;
        unsigned UNDER_VIN:1;
        unsigned OVER_12V:1;
        unsigned UNDER_12V:1;
        unsigned OVER_CURR:1;
        unsigned UNDER_CURR:1;
        unsigned OVER_FAN1:1;
        unsigned UNDER_FAN1:1;
        unsigned OVER_FAN2:1;
        unsigned UNDER_FAN2:1;
        // ### obs! max 16 bits
    } BIT;
} E_ALARM_L;

typedef union {
    uns16 ALL;
    struct {
        unsigned HIGH_T1:1;
        unsigned LOW_T1:1;
        unsigned HIGH_T2:1;
        unsigned LOW_T2:1;
        unsigned HIGH_T3:1;
        unsigned LOW_T3:1;
        unsigned HIGH_T4:1;
        unsigned LOW_T4:1;
        // ### obs! max 16 bits
    } BIT;
} E_ALARM_H;


// ----------------------------------------------------------
// G_ui_R_Mode
// ----------------------------------------------------------
#defineR_MODE_OFF       0   // no regulator
#defineR_MODE_POWER 1   // POWER mode
#defineR_MODE_ALGO      2   // ON/OFF mode
#defineR_MODE_P     3   // P regulator
#defineR_MODE_PI        4   // PI regulator
#defineR_MODE_PD        5   // PD regulator
#defineR_MODE_PID       6   // PID regulator
#define R_MODE_MASK             0x000f  // bit 0..3
```

```
#define R_MODE_TrExtSelect      0x0010  // bit 4
#define R_MODE_TcPowerInt       0x0020  // bit 5
#define R_MODE_DownloadParameters 0x0040// bit 6
#define R_MODE_AutoStart        0x0080  // bit 7
#define R_MODE_LoopMode         0x0100  // bit 8
#define R_MODE_InvertOutput     0x0200  // bit 9
//...
#define R_MODE_FilterAMask      0x3000
#define R_MODE_FilterA_OFF      0       // off
#define R_MODE_FilterA_MUL      0x1000  // multiplication type
#define R_MODE_FilterA_LIN      0x2000  // linjear type
#define R_MODE_FilterA_LEAD_LAG 0x3000  // lead / lag type
#define R_MODE_FilterBMask      0xc000
#define R_MODE_FilterB_OFF      0       // off
#define R_MODE_FilterB_MUL      0x4000  // multiplication type
#define R_MODE_FilterB_LIN      0x8000  // linjear type
#define R_MODE_FilterB_LEAD_LAG 0xc000  // lead / lag type
//## max 16 bits

// ---------------------------------------------------------
// G_ui_F1_Mode
// ---------------------------------------------------------
#define RFx_MODE_MASK       0x0f// bit 0..3
#defineRFx_MODE_OFF     0   // FAN off
#defineRFx_MODE_ALWAYS_ON   1
#defineRFx_MODE_COOL        2
#defineRFx_MODE_HEAT        3
#defineRFx_MODE_COOL_HEAT   4
#defineRFx_MODE_ALGO        5

//## max 8 bits

// ---------------------------------------------------------
// G_ui_temp1_mode
// ---------------------------------------------------------
#define TEMPx_MODE_bVrefPlus    0x0001
#define TEMPx_MODE_bVrefMinus   0x0002
#define TEMPx_MODE_bSteinhart   0x0004
#define TEMPx_MODE_bZoom        0x0008


// ---------------------------------------------------------
// g_param[] index list
// ---------------------------------------------------------

#define REG_VERSION 0x02        // ## change this if you edit in the list

enum {
   G_TrInt = 0,
   G_Kp,
   G_Ki,
   G_Kd,
   G_KLP_A,
   G_KLP_B,
   G_RegLim,
   G_Deadband,
   G_ILim,
   G_Ts,
   G_CoolGain,
   G_HeatGain,
   G_Decay,
   G_ui_R_Mode,     // (13) *16*
   G_ON_TDb,
   G_ON_THyst,

   G_ui_F1_Mode,    // (16) *8* FAN 1
   G_F1_Tr,
   G_F1_Db,
   G_F1_Hyst,
   G_F1_Fh,
   G_F1_LSV,
   G_F1_HSV,

   G_ui_F2_Mode,    // (23) *8* FAN 2
   G_F2_Tr,
   G_F2_Db,
   G_F2_Hyst,
```

```
    G_F2_Fh,
    G_F2_LSV,
    G_F2_HSV,

    G_ScaleAin_AD_offset,    // (30)
    G_ScaleAin_offset,
    G_ScaleAin_gain,
    G_ScaleAout_offset,
    G_ScaleAout_gain,

    G_Temp1_gain,    // (35)
    G_Temp1_offset,
    G_Temp2_gain,
    G_Temp2_offset,
    G_Temp3_gain,
    G_Temp3_offset,
    G_Temp4_gain,
    G_Temp4_offset,

    G_ui_pot_offset, // *8*
    G_ui_pot_gain,       // *8*

    G_v_high,    // error level check
    G_v_low,
    G_curr_high,
    G_curr_low,
    G_fan1_high,
    G_fan1_low,
    G_fan2_high,
    G_fan2_low,
    G_v12_high,
    G_v12_low,

    G_ui_temp1_mode,     // *8*
    G_ui_temp2_mode,     // *8*
    G_ui_temp3_mode,     // *8*
    G_ui_temp4_mode,     // *8*

    G_t1_stain_A,        // stain coff A, B, C
    G_t1_stain_B,
    G_t1_stain_C,
    G_t2_stain_A,
    G_t2_stain_B,
    G_t2_stain_C,
    G_t3_stain_A,
    G_t3_stain_B,
    G_t3_stain_C,
    G_t4_stain_A,
    G_t4_stain_B,
    G_t4_stain_C,

    G_alarm_temp1_high,
    G_alarm_temp1_low,
    G_alarm_temp2_high,
    G_alarm_temp2_low,
    G_alarm_temp3_high,
    G_alarm_temp3_low,
    G_alarm_temp4_high,
    G_alarm_temp4_low,

    G_t1_res_H,      // stain resistans (high/mid/low) point for coff A, B, C
    G_t1_res_M,
    G_t1_res_L,
    G_t2_res_H,
    G_t2_res_M,
    G_t2_res_L,
    G_t3_res_H,
    G_t3_res_M,
    G_t3_res_L,
    G_t4_res_H,
    G_t4_res_M,
    G_t4_res_L,

    G_ui_alarm_enable_L, // *16* enable bit for alarm setting
    G_ui_alarm_enable_H, // *16*

    G_TrInt2,            // Setpoint 2, when in loop mode low value
```

```
   G_uiTimeHigh,        // *16* time, 0xffff=65535 loops / 20 = 3276 sekunder
   G_uiTimeLow,     // *16* time, 0xffff=65535 loops / 20 = 3276 sekunder

   G_ui_sensor_alarm_mask,  // *16* enable which alarm that should stop regulator

   G_SIZE      /* must be last in list, max value 255 */
} PARAM_NUM;


#endif // _PARAMETER_H
```

Revision list:

Rev 1.1
- Created this document
- Description of new serial interface

Rev 1.2 040831 / Thomas
- Implemented full description of the commands.

Rev 1.3 040908 / Thomas
- Implementing PR59 register use

Rev 1.4 041021 / Thomas
- Removed register 119, 120, 121
- Added registers 78 to 92
- New command RNxx using IEEE754 type
- Include “parameter.h” file
- We now uses Steinhart coefficients to calculate temperature value
- Corrected some typo error
- Sensor information update

Rev 1.6b 050113 / Thomas
- Many changes in the document
- New command handling ID information
- New command handling auto logging of some data
- More registers defined and in use

Rev 1.6c 050211 / Thomas
- Correct some typo error