PROCESS SENSORS CORPORATION

PSC-SSS-RATIO communication interface

1. Serial interface parameters

Baud rate:	9600…115200, set by user (factory default: 9600)
Data bits:	8
Parity:	none
Stop bits:	1
Flow control:	off

Protocol

The protocol of the PSC-SSS-RATIO is a binary protocol. Beginning with firmware rev. 26 a checksum is needed for set commands but not for read commands. The protocol has no additional overhead with CR, LR or ACK bytes. This makes the communication fast.
To get the current object temperature the user must send a simple 01_{hex} byte and the SSS will respond with the two byte temperature. Deducted by 1000_{dec} the result is the temperature in tenth degrees.

Command list

The following table lists all commands accessible for the user.

Cmd. (Hex)	Command	Data bytes	Answer bytes	Command description	Unit
01	READ Temp - Target	-	2	*T)	°C
02	READ Temp - Head	-	2	*T)	°C
03	READ Temp - Box	-	2	*T)	°C
04	READ Epsilon	-	2	=(byte1*256 + byte2) / 1000	
05	READ Transmission	-	2	=(byte1*256 + byte2) / 1000	
06	READ AVG Time	-	2	=(byte1*256 + byte2) / 10	s
07	READ Valley Hold Time	-	2	=(byte1*256 + byte2) / 10	s
08	READ Peak Hold Time	-	2	=(byte1*256 + byte2) / 10	s
09	READ Temp. Unit	-	1	1 = °C, 0 = °F	
0A	READ AL1 Value	-	2	*T)	°C
0B	READ AL2 Value	-	2	*T)	°C
0C	READ AL3 Value	-	2	*T)	°C
0D	READ AL4 Value	-	2	*T)	°C
0E	READ Serial Number	-	3	=byte1*65536 + byte2*256 + byte3	
0F	READ FW Rev.	-	2	=byte1*256 + byte2	
10	READ Multidrop Address	-	1	=byte1 (1..79)	
11	READ Scal_Out_Min	-	2	mV or µA	
12	READ Scal_Out_Max	-	2	mV or µA	
13	READ Amb. Temp. Source	-	1	1 = ext. Analog, 2 = ext. FIX, 3 = Head Temp	
14	READ Amb. Temp. Fix Value	-	2	*T)	°C
15	READ Eps. Source	-	1	1 = ext. Analog, 2 = ext. FIX, 3 = Table	
16	READ IR Failsafe Mode	-	1	0 = always HIGH 1 = under -> HIGH over -> LOW 2 = always LOW 3 = under -> LOW over -> HIGH	
17	READ Amb. Failsafe Mode	-	1		
18	READ Low End for output	-	2	*T)	°C
19	READ High End for output	-	2	*T)	°C
1A	READ Output value for IR-DAC	1		% value of defined range	%
1B	READ Output value for Ambient-DAC	1			%
1C	READ AVG Mode (adaptive)	-	1	1 = adaptive Mode , 0 = normal	
1D	READ Advanced Hold Mode	-	1	0 = off, 1 = peak, 2 = valley	
1E	READ Advanced Hold Treshold	-	2	*T)	°C
1F	READ Eps. Calculation Required Temp	-	2	*T)	°C
20	READ Eps. Calculation Current Temp	-	2	*T)	°C
21	READ Eps. Calculation State	-	1	1 = ON; 0 = OFF	
22	READ Adv. Hold Hysteresis	-	2	*T)	°C
23	READ Material Table	1	2	See example	
24	READ Head Code	1	3	byte1 = block number byte2..4 = head code	

Cmd. (Hex)	Command	Data bytes	Answer bytes	Command description	Unit
26	READ Tweak Offset	-	2	*T)	°C
27	READ Tweak Gain	-	2	= (1/2^15) * (byte1*256 + byte2)	
28	READ ALARMx Mode	1	2	byte1 = Alarm x (x = 0..3) byte2 = Bit sequence: (see Example)	
2B	READ F3 Low temperature (0Volt)	-	2	*T)	°C
2C	READ F3 High temperature (5Volt)	-	2	*T)	°C
2D	READ Checksum	1	1	1 = ON; 0 = OFF	
2E	Line Mode request	1	2 n	byte1 = number of devices on the RS485 bus (up to 79) answer : 2 byte Target Temp for any device	
2F	Line Mode Timer SET (continuously line mode)	2	2 n	byte1 = cycle time in milliseconds byte2 = number of devices on the RS485 bus (up to 79) continuously answer : 2 byte Target temperature for any device	
50	READ Burst string	-	4	command for read out of the burst string	
51	SET Burst string	4	4	set burst string	
52	SET Burst mode	1	1	1 = start; 0 = stop	
81	READ Act. Temp.	-	2	*T)	°C
82	SET Baud rate	1		0 = 9600, 1 = 19200, 2 = 38400 3 = 57600, 4 = 115200	
84	SET Epsilon	2	2	See command 04	
85	SET Transmission	2	2	See command 05	
86	SET AVG Time	2	2	See command 06	s
87	SET Valley Hold Time	2	2	See command 07	s
88	SET Peak Hold Time	2	2	See command 08	s
89	SET Temp. Einheit READ	1	1	See command 09	
8A	SET AL1 Value	2	2	*T)	°C
8B	SET AL2 Value	2	2	*T)	°C
8C	SET AL3 Value	2	2	*T)	°C
8D	SET AL4 Value	2	2	*T)	°C
8E	SET Serial number	3	3	See command 0E	
8F	RESET of DAC percent output	-		See command 0F	
90	SET Multidrop Address	1	1	See command 10	
91	SET Scal_Out_Min	2	2	See command 11	
92	SET Scal_Out_Max	2	2	See command 12	
93	SET Ambient Temp. Source	1	1	See command 13	
94	SET Ambient Temp. Fix Value	2	2	*T)	°C
95	SET Eps. Source	1	1	See command 15	
96	SET IR Failsafe Mode	1	1	See command 16	
97	SET Ambient Failsafe Mode	1	1	See command 17	
98	SET Low End for output	2	2	*T)	°C
99	SET High End for output	2	2	*T)	°C
9A	SET Output value for IR-DAC	1	1	See command 1A	%
9B	SET Output value for Amb-DAC	1	1	See command 1B	%
9C	SET AVG Mode	1	1	See command 1C	
9D	SET Advanced Hold Mode	1	1	See command 1D	
9E	SET Advanced Hold Treshold	2	2	*T)	°C
9F	SET Eps. Calculation Required Temp	2	2	*T)	°C
A0	SET Eps. Calculation Current Temp	2	2	*T)	°C
A1	SET Eps. Calculation State	1	1	See command 21	
A2	SET Adv. Hold Hysteresis	2	2	*T)	°C
A3	SET Material Table	3	3	See command 23	
A4	SET Head Code	4	4	See command 24	
A6	SET Tweak Offset	2	2	*T)	°C
A7	SET Tweak Gain	2	2	See command 27	
A8	SET ALARMx Mode	2	2	See command 28	
AB	SET F3 Low temperature (0Volt)	2	2	*T)	°C
AC	SET F3 High temperature (5Volt)	2	2	*T)	°C
AD	SET Checksum	1	1	1 = ON; 0 = OFF	

*T) = Encoding of temperature: = (byte1*256 + byte2 - 1000) / 10

Addressing

This is relevant for communication with the RS485 bus only. PSC SSS's with RS232 or USB communication will respond to any address. If you use the RS485 interface board you must use the multidrop addresses.

A multidrop address is a simple prefix byte to the command. The byte is build by adding the hexadecimal value B0 to the device address. B5 01 will read the temperature from the device with the address 5.

The address of any device can be set by the device user interface (“M__01”) or by the communication interface with the command 90.

A special case is address prefix B0 for set commands. Because there is no multidrop address 0 this addresses no certain device. But a SET command with prefix broadcast the command to all devices at the RS485 bus.
Note: The command is executed immediately on any of the devices even if they do not respond to the command. That is because all are slaves and can’t talk at the same time.

Checksum’s

This is relevant for PSC-SSS with firmware revision 26 or higher.
If the device is setup to use checksums any SET command must have a checksum suffix. The checksum can be switched off with command AD. After every “Power on” the device will expect the checksum again.
The checksum byte is build by the arithmetical XOR of all command bytes except of the address prefix.

To switch off the checksums with the SET command 90 you must send the checksum.
To switch on the checksums with the SET command 90 you must not send the checksum.

Examples

Read Commands	Send	Receive	
Reading a target temperature	01	04 D3	$(04D3_{hex}$ -1000)/10 = (1235-1000)/10 = 23.5°C
Reading a target temp. with device address 5	B5 01	04 D3	23.5°C
Reading emissivity	04	03 B6	$03B6_{hex}$/1000 = 950/1000 = 0.950
Reading serial number	0E	3D CC 5D	$3DCC5D_{hex}$ = 4050013
Query whether the device uses checksums	2D	01	01 = Device uses checksums

Set Commands	Send *)	Receive	
Setting the alarm 1 value	8A 04 D3 [5D]	04 D3	$(04D3_{hex}$ -1000)/10 = (1235-1000)/10 = 23.5°C
Setting the alarm 1 value with device address 5	B5 8A 04 D3 [5D]	04 D3	23.5°C
Setting the emissivity to 0.95	84 03 B6 [31]	03 B6	$03B6_{hex}$/1000 = 950/1000 = 0.950
Giving the device with address 5 the new address 6	B5 90 06 [96]	06	After this command you have to use B6 as address prefix
Switch the checksums off, if the device uses checksums	AD 00 [AD]	00	
Switch the checksums on, if the device does not use checksums	AD 01	01	
Setting the baud rate of all devices at the same time to 115200 baud	B0 82 04 [86]		After this the communication baud rate is set to 115200 and the master device must change its own baud rate too.

*) Checksum in square brackets

Line mode commands	Send	Receive	
Reading the target temperatures from the devices with addresses 1..5 one time:	2E 05	04 D3 04 4C 04 B0 05 14 05 78	Addr 1 = $04D3_{hex}$ = 23.5°C Addr 2 = $044C_{hex}$ = 10.0°C Addr 3 = $04B0_{hex}$ = 20.0°C Addr 4 = 0514_{hex} = 30.0°C Addr 5 = 0578_{hex} = 40.0°C
Reading the target temperatures from the devices with addresses 1..5 continouosly with a cycle time of 50ms, timer is device 3	B3 2F 32 05	2E 05 04 D3 04 4C 04 B0 05 14 05 78	2E 05 is the continuously repeated command of time device 3 temperatures: (23.5°, 10°, 20°, 30°, 40°)
Stopping the continuously line mode of timer device 3	B3 2F 00 00	-	This stops line mode of timer device 3. Note: If you setup a big number of devices with a short cycle time it is possible that the line mode cant be stopped.

Head Code

The head code commands (read 24, set A4) must be sent for any of the three blocks of the head code. The first byte of the command is the head code block number.
The three following data bytes of any of the three commands encode the four digits of any block in a 5-bit-format

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte2					d3.4	d3.3	d3.2	d3.1
Byte3	d3.0	d2.4	d2.3	d2.2	d2.1	d2.0	d1.4	d1.3
Byte4	d1.2	d1.1	d1.0	d0.4	d0.3	d0.2	d0.1	d0.0

dx.4 .. dx.0 encodes the bytes of the block in a 5-bit-format (the ASCII-numbers followed by the ASCII-letters):

00000	00001	00010	00011	00100	00101	00110	00111	01000	01001	01010	01011	01100	01101	01110	01111
0	1	2	3	4	5	6	7	8	9	A	B	C	C	E	F

10000	10001	10010	10011	10100	10101	10110	10111	11000	11001	11010	11011	11100	11101	11110	11111
G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

Example: (headcode is B6JG M2IM 0IKC):
Send the two bytes 24 01 to retrieve the second block of the Head code:
The command responds: 01 0B 0A 56
This is binary: `00000001 00001011 00001010 01010110`
With other words: `10110 00010 10010 10110` => M2IM

Read/Set Head Code	Send *)	Receive	
Read head code block 1	24 00	00 05 9A 70	B6JG
Read head code block 2	24 01	01 0B 0A 56	M2IM
Read head code block 3	24 02	02 00 4A 8C	0IKC
Set head code block 1 to B6JG	A4 00 05 9A 70 [4B]	00 05 9A 70	B6JG
Set head code block 2 to M2IM	A4 01 0B 0A 56 [F2]	01 0B 0A 56	M2IM
Set head code block 3 to 0IKC	A4 02 00 4A 8C [60]	02 00 4A 8C	0IKC

*) Checksum in square brackets

Alarm mode

The PSC-SSS has 4 alarms. These alarm modes can be controlled by the Alarm mode command (read 28, set A8).
To read or set a alarm mode a byte must follow the command byte that specifies the alarm:

Byte1	Alarm
0	Alarm 1
1	Alarm 2
2	Output channel 2 (ambient / head temperature)
3	Output channel 1 (IR / Object temperature)

The data byte (byte2) contains the following information

Bit	Description		Relevant for alarm			
			0	1	2	3
Bit7	Source for the alarm is the box temperature		x	x	x	-
Bit6	Source for the alarm is the head temperature		x	x	x	-
Bit5	Source for the alarm is the object temperature		x	x	x	x
Bit4	0 = contact is normally closed, 1 = contact is normally open		x	x	x	x
Bit3	1 = Output is digital, 0 = output is analog (if not used for alarm)		-	-	x	x
Bit0…2	0 = Output as 0…10mV	1 = Output as 0…5V	-	-	x	x
	2 = Output as 0…20mA 4 = Output as TCK	3 = Output as 4…20mA 5 = Output as TCJ	-	-	-	x

Note: not every setting is relevant for all alarms. For example the IR-Output cant watch the box temperature, but it is the only one that can configured as Thermocouple J.

Read/Set alarm examples	Send *)	Receive	
Read alarm mode, alarm 1	28 00	00 80	Source=TBox, normally closed
Read alarm 1 value	0A	04 1A	5°C
Read alarm mode, alarm 2	28 01	01 90	Source=TBox, normally open
Read alarm 2 value	0B	05 DC	50°C
Read alarm mode, ambient output	28 02	02 51	Source=THead, normally open, digital
Read ambient output alarm value	0C	06 A5	70.1°C
Read alarm mode, IR output	28 03	03 23	Source=TObj, normally closed, digital, 4..20mA
Read IR output alarm value	0D	0B B8	200°C
Set alarm mode, IR output	A8 03 03 [88]	03 23	Source=TObj, normally closed, digital, 4..20mA
Set IR output alarm value	8D 07 D0 [5A]	07 D0	100°C

*) Checksum in square brackets

Material table

The material table is organized in 8 rows and 4 columns. The rows correspond with the 8 entries in the table and the columns are defined as follow:

Column	Content	
0	Epsilon	=(byte2*256 + byte3) / 1000
1	Alarm value A	= (byte2*256 + byte3 - 1000) / 10
2	Alarm value B	= (byte2*256 + byte3 - 1000) / 10
3	Device (is the same for all 8 entries)	Higher 4 bit of byte3: source of alarm A Lower 4 bit of byte3: source of alarm B Alarm sources: 0 = alarm 1 (blue backlight) 1 = alarm 2 (red backlight) 2 = output channel 2 (ambient output) 3 = output channel 1 (IR output) 4 = alarm is not used by material table

Also see the PSC-SSS manual for material table editing.

To read or set a value in the material table a byte must follow the command byte that specifies row and column in the table.
The higher 4 bit of this byte determines the table entry number (0..7).
The lower 4 bit determines the column (0 = Eps., 1 = Alarm A, 2 = Alarm B, 3 = Device).

Read/Set material table	Send *)	Receive	
Read material table entry 0, epsilon	23 00	00 03 C0	$03C0_{hex}$/1000 = 960/1000 = 0.96
Read material table entry 0, alarm A	23 01	01 04 B0	($04B0_{hex}$ -1000)/10 = (1200-1000)/10 = 20°C
Read material table entry 0, alarm B	23 02	02 07 D0	($07D0_{hex}$ -1000)/10 = (2000-1000)/10 = 100°C
Read material table entry 0, device	23 03	03 00 31	Source for alarm A: 3 = IR ouput Source for alarm B: 1 = alarm 2
Set material table entry 7, epsilon	A3 70 03 D4 [04]	70 03 D4	ε = 0.98
Set material table entry 7, alarm A	A3 71 17 70 [B5]	71 17 70	500°C
Set material table entry 7, alarm B	A3 72 1F 40 [8D]	72 1F 40	700°C
Set material table entry 7, device	A3 73 00 31 [E1]	73 00 31	Source for alarm A: 3 = IR ouput Source for alarm B: 1 = alarm 2

*) Checksum in square brackets

Burst mode

The burst string consists of 8 “half bytes”.

Half byte	Value
1	Target temperature
2	Head temperature
3	Box temperature
4	Current target temperature
5	Emissivity
6	Transmissivity
7-15	not used
0	End of burst string

Read/Set Burst examples	Send *)	Receive	
Command for read out of burst string	50	12 34 56 78	reads the burst string
Set burst string	51 12 00 00 00	12 00 00 00	sets burst string to target and head temperature
Start burst mode	52 01	AA AA xx xx xx xx xx …	starts the burst mode; AA AA is for synchronisation, will be send in front of each new burst
Stop burst mode	52 00		stops the burst mode

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