

Protocol SBI for Cubis MCA balances

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1 Introduction

1.1 Purpose and scope

This document describes how values can be read from the MCA balance via the SBI interface protocol and how the balance can be operated with commands.

2 Protocol SBI

The Sartorius Balance Interface, or SBI for short, is a standard protocol for connecting Sartorius balances to a PC or PLC. This simple ASCII-based protocol allows you to control the basic functions of the balance using ESC commands. The protocol does not support bidirectional commands and does not acknowledge executed commands. For more complex applications, we recommend using a bi-directional protocol such as the ReST API.

2.1 Overview of supported SBI commands

The SBI commands implemented in the MCA balance are described in this manual.

2.1.1 Standard commands of each balance

Command	Description
P	Output display value (weight value / calculated value)
T	Execute zero or tare function

Command	Description
K	Set ambient condition 1, very stable
L	Set ambient condition 2, stable
M	Set ambient condition 3, unstable
N	Set ambient condition 4, very unstable
S	Restart the balance
x1_	Output model name of the balance
x2_	Output the balance serial number
x3_	Output firmware version of the weighing unit (BAC), short form
x4_	Output firmware version of the display unit (APC), short form
X5_	Output device ID
x20_	Output the firmware version of the weighing unit (BAC)
x21_	Output firmware version of the display unit (APC)
x25_	Outputting the firmware version of the draft shield unit (WPC)
x27_	Output firmware version of the system unit (MCU)
x29_	Firmware version, output complete package of the balance

2.1.2 Zero and tare commands

Command	Description
U	Execute tare function
V	Execute zeroing function
f3_	Execute zeroing function
f4_	Execute tare function
t0_	Clear tare function

2.1.3 Calibration/Adjustment Commands

Command	Description
W	Perform external calibration/adjustment
Z	Perform internal adjustment
x0_	Perform internal calibration
@	Move internal weight down
?	Move internal weight up

2.1.4 Draft shield and ionizer commands (optional)

Command	Description
f5_	Release left draft shield key, open as learned or close
f6_	Release right draft shield key, open as learned or close
w0_	LiDS: Output draft shield status, doors open/closed RoDS: Output draft shield status, draft shield position LiRoDS: No output
w1_	LiDS: Open left door completely RoDS: Open draft shield 100° anti-clockwise, to the left
w2_	LiDS: Close all doors RoDS: Close draft shield
w3_	LiDS: Open upper door completely RoDS: Open draft shield to the learned position
w4_	LiDS: Open right door completely RoDS: Open draft shield 260° clockwise, open to the right
w5_	LiDS: Open left and upper door completely
w6_	LiDS: Open left and right door completely
w7_	LiDS: Open right and upper door completely
w8_	LiDS: Open all doors fully
w9_	LiDS: Output draft shield status, doors open/closed RoDS: Output draft shield status, draft shield position LiRoDS: Output draftshield status, door position of LiDS and draft shield position of RoDS
m0_	Output ionizer status
m1_	Switch on ionizer function, with preset time
m2_	Switch off ionizer function

2.1.5 Climate control commands

Command	Description
c{...}_	Print climate data of addressed climate module
ca1	Air temperature, internal module
ca2	Air humidity, internal module
ca3	Air pressure, internal module

2.1.6 Remote control commands

Command	Description
kP_	Trigger the "Save" button and the output execute according to the print profiles of the current task
s3_	Trigger cancel or delete function
O, R	Block / release touch display

2.1.7 Special functions

Command	Description
ea{x...x}_	Stores the weight value at stability in the data memory, optionally with a label (x ... x) (2.4.43)
p{ }_	Output display weight value with conversion to target unit (2.4.44)

2.2 Syntax and Grammar

The SBI commands and their responses are strings with a fixed format. This section contains general aspects, while the details are described in the respective section on the commands.

2.2.1 Command notation

Overview of the command variants:

Variant	Command character	Example
1	Only one capital letter	<ESC>P
2	A lowercase letter and a number	<ESC>x1_
3	One lowercase letter, one uppercase letter and one number	<ESC>kF1_
4	A lowercase letter and a free string	<ESC>tArticle1_
5	Two lowercase letters and a free character string in a curly bracket	<ESC>ea{x...x}_

Except for variant 1, all other variants require a terminating character.

Description of the command variants in detail.

Variant 1:

- Requires the start character <ESC> or the end character <CR>, <LF>.
- Can also be sent with start character <ESC> and completion <CR>, <LF>.
- Valid options are: "<ESC>P", "<ESC>P<CR><LF>" or "P<CR><LF>"

The preferred syntax is:

- Start character <ESC>, then the command in capital letters, <CR> and <LF> is optional.

Variant 2 to 5:

- Requires the start character <ESC> or the end character underscore "_".
or the terminating characters <CR>, <LF>.
- Can also be used with start character <ESC> and the final character underscore "_".
and <CR>, <LF> are sent.
- Valid options are: "<ESC>x1_", "x1_", "x1<CR><LF>", "<ESC>x1_<CR><LF>"

The preferred syntax is:

- Start character <ESC>, then the command in lower case with the options and as
final character the character underscore "_", <CR> and <LF> is optional.

2.3 Command execution

The SBI interface has a serial protocol, with a connected PC or PLC as master and the balance as slave. By default, communication is initiated by the connected device and not by the user interface of the balance.

An exception is the ESC kP_ command with which the "Save" button of the currently started task can be triggered and thus output to the interfaces according to the loaded print profiles of this task.

2.3.1 Rules for the execution of SBI commands

The SBI command interpreter can process several commands that are sent together (up to 20 commands). The SBI commands are executed (or started) in the order they are received, even if several commands are sent simultaneously.

However, the following commands that are waiting to stop (a configuration option) delay the execution (or start) of other commands until they are complete.

It is these commands that wait for the balance to stabilize:

- Zero/tare: ESC T
- Zeroing: ESC V or ESC f3_
- Tare: ESC U or ESC f4_
- Output display value: ESC P

If the weight value does not reach stability, these commands can also be aborted with the command <ESC>s3_.

2.3.2 Overload protection

The SBI command interpreter protects the balance from overload if SBI commands are sent too fast or too many commands are sent simultaneously. The commands are then ignored and rejected. The display shows an error message e.g. "Error XXX: SBI command buffer overflow".

2.3.3 Command execution when starting the balance

SBI commands are not executed during startup, shutdown or standby. The command interpreter for SBI will not execute commands again until the login screen is displayed.

2.3.4 Instruction execution independent of the task

All SBI commands are executed independently of the running task and the rights of the currently logged in user. To avoid interactions the SBI interface can be disabled.

2.4 The ESC commands in detail

In the following description of the commands in the output examples, the blanks " " and the terminating characters <CR>, <LF> are not shown separately.

2.4.1 ESC P - Output display value (weight value / calculated value)

Command: <ESC>P
Function: Output the display value depending on the selected output mode.
Execution: Synchronous to the output rate of the weight values in the display
Output example: N + 100.000 g

Automatic output - Off (executed with ESC P)

Function: With each ESC P, the output with / without stability of the display value, i.e. weight value or calculated value, according to the "Settings for the SBI protocol" in the format with / without header.
Response: The output is only on the interface on which the ESC P command was received.

Automatic output - Any value

Function: Synchronous to the output rate of the weight values in the display an automatic output with / without stability of the display value, i.e. weight value or calculated value, according to the "Settings for the SBI protocol" in the format with / without header. The output can be stopped or restarted with ESC P.
Response: The cyclic output is performed on all interfaces on which the SBI protocol is set.

Automatic output - 1 to 60 seconds

Function: In the selected time grid of 1, 2, 5, 10, 30 or 60 seconds, an automatic output with / without stability of the display value, i.e. weight value or calculated value, is generated according to the "Settings for the SBI

Protocol" in the format with / without header. The output can be stopped or restarted with ESC P.

Response: The cyclic output is performed on all interfaces on which the SBI protocol is set.

The output formats for weight values or calculated values, as well as for status and error messages, are described in detail in the chapter 2.5.1.

2.4.2 ESC T - Execute zero or tare function

Command: <ESC>T

Function: The zero or tare function is executed, with or without stability, depending on the setting by the loaded weighing profile.

The version with stability waits for a stable weight value and only then executes the function.

Without stability, the function is executed immediately, regardless of whether the balance is stable or not. (This function is blocked on verified models).

If the balance is in the zeroing range, the function zeroing is executed.

If the applied load is greater than the zero setting range, the balance is tare.

Execution: Synchronous to the output rate of the weight values

Response: None

2.4.3 ESC K, L, M, N - Set ambient condition 1-4

Command:	<ESC>K, <ESC>L, <ESC>M or <ESC>N
Function:	These commands can be used to temporarily change the environmental condition. K - Very quiet: ideal condition, Weighing mode 1: weak filter, fast output L - Quiet: Normal laboratory conditions, Weighing mode 2: normal filter M - Unsteady: production, little protected conditions Weighing mode3: stronger filter, slow output N - Very unsteady: noticeable and slow underground vibrations Weighing mode 4: very strong filter, very slow output This overwrites the environmental condition by the current weighing profile of the task. When a task is restarted, however, the environmental condition set in the weighing profile is activated again.
Execution:	Synchronous to the output rate of the weight values
Response:	None

2.4.4 ESC S - Restart the balance

Command:	<ESC>S
Function:	This command triggers a restart of the balance. All components receive a warm start reset, running functions are aborted, motorized functions move to their home position. The interface will not execute SBI commands again until the login screen is displayed.
Execution:	Direct
Response:	None

2.4.5 ESC O, R – Block touch display

Command:	<ESC>O, <ESC> R
Function:	This command is used to block / unblock the display of the balance touch function in weighing mode. This command works only in the weighing screen and not in menu screens. The weighing screen will show a small locking symbol. O - Block touch R - Unblock touch
Execution:	Direct
Response:	None

2.4.6 ESC x1_ - Output model name of the balance

Command: <ESC>x1_

Function: The x1_ command returns the model name of the balance.
Depending on the length of the model name and the formatting settings, the name is output in the format with 20 characters, spread over several lines or in real length.

Execution: Direct

Output example: Model MCA8201S-2S00-0

The output format for the model name is described in detail in the chapter "Responding to Commands".

2.4.7 ESC x2_ - Output balance serial number

Command: <ESC>x2_

Function: The x2_ command outputs the serial number of the balance.
Depending on the setting in the format with 20 characters or in real length.

Execution: Direct

Output example: SerNo. 0038403855

The output format for the serial number is described in detail in the chapter "Responding to commands".

2.4.8 ESC x3_ - Output firmware version BAC, short form

Command: <ESC>x3_

Function: This command returns the firmware version of the weighing unit BAC in short form.
Depending on the setting in the format with 20 characters or in real length.

Execution: Direct

Output example: BAC: 00-61-03

2.4.9 ESC x4_ - Output firmware version APC, short form

Command: <ESC>x4_

Function: This command returns the firmware version of the APC display unit in short form.
Depending on the setting, in 20-character format or in real length.

Execution: Direct

Output example: APC: 11-02-04

2.4.10 ESC x5_ - Output device ids

Command: <ESC>x5_
Function: This command returns both device ids even they are set or empty.
 Depending on the setting, in 20-character format or in real length.
Execution: Direct
Output example: ID 1 ABC123
 ID 2 ABC123

2.4.11 ESC x20_ - Output firmware version of the weighing unit

Command: <ESC>x20_
Function: This command outputs the firmware version of the weighing unit (BAC).
 Depending on the setting in 20-character format or in real length.
Execution: Direct
Output example: BAC: 00-61-03.01.09

2.4.12 ESC x21_ - Output firmware version of the display unit

Command: <ESC>x21_
Function: This command outputs the firmware version of the display unit (APC).
 Depending on the setting, in 20-character format or in real length.
Execution: Direct
Output example: APC: 11-02-04.08.01

2.4.13 ESC x25_ - Output the firmware version of the draft shield unit

Command: <ESC>x25_
Function: This command outputs the firmware version of the draft shield unit
 (WPC). Depending on the setting, format with 20 characters or in real
 length.
 This function is optional if the balance is equipped with a draft shield
 unit.
Execution: Direct
Output example: WPC: 05-08-01.01.01

2.4.14 ESC x27_ - Output firmware version of system unit

Command: <ESC>x27_
Function: This command prints the firmware version of the system unit (MCU). Depending on the setting, in 20-character format or in real length. This function is optional if the balance is equipped with a separate weighing unit and e-box.
Execution: Direct
Output example: MCU: 05-08-01.01.01

2.4.15 ESC x29_ - Firmware version, output complete package of the balance

Command: <ESC>x29_
Function: This command outputs the firmware version of the complete software package of the balance. Depending on the setting in the format with 20 characters or in real length.
Execution: Direct
Output example: CDF: 09-03-04.08.01

2.4.16 ESC V or f3_ - Execute zeroing function

Command: <ESC>V or <ESC>f3_
Function: The zero function is executed, with or without stability, depending on the setting by the loaded weighing profile.

The version with stability waits for a stable weight value and only then executes the function.

Without stability, the function is executed immediately, regardless of whether the balance is stable or not. This function is blocked on verified models.

If the balance is in the zeroing range, the function Zeroing is executed, otherwise the error message "Err 08" is displayed.
Execution: Synchronous to the output rate of the weight values
Response: None

2.4.17 ESC U or f4_ - execute tare function

Command: <ESC>U or <ESC>f4_
Function: The tare function is executed, with or without stability, depending on the setting by the loaded weighing profile.

The version with stability waits for a stable weight value and only then executes the function.

Without stability, the function is executed immediately, regardless of whether the balance is stable or not. This function is blocked on verified models.

The tare function is only executed if the current gross value of the balance is greater than zero, otherwise the error message "Err 09" is issued.

Execution: Synchronous to the output rate of the weight values

Response: None

2.4.18 ESC t0_ - clear tare function

Command: <ESC>t0_

Function: The current tare value will be cleared if tare is set.

Execution: Synchronous to the output rate of the weight values

Response: None

2.4.19 ESC W - Perform external calibration/adjustment

Command: <ESC>W

Function: Command ESC W initiates an external calibration/adjustment with the standard weight for this balance.

The external calibration/adjustment function is only executed if it is not blocked, e.g. on verified balances, otherwise the error message "Err 07" is output.

In addition, the balance must be in the zero setting range and zeroed when the function is triggered, otherwise the error message "Err 02" will be displayed.

If the calibration/adjustment is not performed within a certain time, e.g. the balance does not get stability, the function is aborted with the error message "Err 03".

Execution: Synchronous to the output rate of the weight values

Response: None

2.4.20 ESC Z - Perform internal adjustment

Command: <ESC>Z

Function: The command ESC Z initiates an internal calibration/adjustment of the balance.

When the internal calibration/adjustment function is triggered, the balance must be in the zeroing range, otherwise the error message "Err 02" is displayed.

If the calibration/adjustment is not performed within a certain time, e.g. the balance does not get stability, the function is aborted with the error message "Err 03".

Execution: Synchronous to the output rate of the weight values
Response: None

2.4.21 ESC x0_ - Perform internal calibration

Command: <ESC>x0_

Function: The command ESC x0_ only triggers an internal calibration of the balance.

When the internal calibration function is triggered, the balance must be in the zero setting range, otherwise the error message "Err 02" is displayed.

If the calibration does not take place within a certain time, e.g. the balance does not get stability, then the function is aborted with the error message "Err 03".

At the end of the calibration, the deviation from the last adjustment is displayed. The balance will not be recalibrated.

Execution: Synchronous to the output rate of the weight values
Response: None

2.4.22 ESC s3_ - Cancel function

Command: <ESC>s3_

Function: This command can be used to cancel the execution of an active command or function.

Execution: Direct
Response: None

2.4.23 ESC f5_ - Trigger left draft shield key (optional)

Command: <ESC>f5_

Function: The function of the left draft shield key (handball switch) is triggered.
If the draft shield is closed, the draft shield opens with the specified opening or as learned for this key.

When the draft shield is open, the draft shield is completely closed.

Specification depending on the draft shield design:

- LiDS: Open / close left door completely
- RoDS: Open draft shield to 260°, clockwise to the right side / close

Execution: Direct

Response: None

2.4.24 ESC f6_ - Trigger right draft shield key (optional)

Command: <ESC>f6_

Function: The function of the right-hand draft shield key (handball switch) is triggered.

If the draft shield is closed, the draft shield opens with the specified opening or as learned for this key.

When the draft shield is open, the draft shield is completely closed.

Specification depending on the draft shield design:

- LiDS: Open / close right door completely
- RoDS: Open the draft shield to 100°, counterclockwise to the left side / close

Execution: Direct

Response: None

2.4.25 ESC w0_ - Output draft shield status for one draftshield (optional)

Command: <ESC>w0_

Function: This command outputs the current draft shield status.

LiDS: Draft shield status, as well as status of the doors open/closed

RoDS: Draft shield status and the draft shield position (angle)

Execution: Direct

Example of an Response: closed for draft shield

LiDS: Stat W 016CCC
RoDS : Stat W 016000

LiRoDS: No Response

The output format for the draft shield status is described in detail in the chapter entitled "Responding to Commands" under Draft Shield.

2.4.26 ESC w1_ - Open draft shield left (optional)

Command: <ESC>w1_
Function: This command opens the windscreen to the left.
LiDS: Open left door completely
RoDS: Open draft shield 100° anti-clockwise, to the left
Execution: Direct
Response: None

2.4.27 ESC w2_ - Close draft shield (optional)

Command: <ESC>w2_
Function: This command closes the draft shield completely.
LiDS: Close all doors
RoDS: Close draft shield
Execution: Direct
Response: None

2.4.28 ESC w3_ - Open draft shield depending on version (optional)

Command: <ESC>w3_
Function: This command opens the draft shield depending on the version.
LiDS: Open upper door completely
RoDS: Open draft shield to the learned position
Execution: Direct
Response: None

2.4.29 ESC w4_ - Open draft shield right (optional)

Command: <ESC>w4_
Function: This command opens the windscreen to the right.
LiDS: Open right door completely
RoDS: Open draft shield 260° clockwise, open to the right
Execution: Direct
Response: None

2.4.30 ESC w5_ - Draft shield opens left and upper door (optional)

Command: <ESC>w5_

Function: With the draft shield (LiDS), the left and upper doors are fully opened.

Execution: Direct

Response: None

2.4.31 ESC w6_ - Draft shield opens left and right door (optional)

Command: <ESC>w6_
Function: With the draft shield (LiDS), the left and upper doors are opened completely.
Execution: Direct
Response: None

2.4.32 ESC w7_ - Draft shield opens right and upper door (optional)

Command: <ESC>w7_
Function: With the draft shield (LiDS), the right and upper doors are fully opened.
Execution: Direct
Response: None

2.4.33 ESC w8_ - draft shield opens all doors (optional)

Command: <ESC>w8_
Function: With the draft shield (LiDS), all doors are fully opened.
Execution: Direct
Response: None

2.4.34 ESC w9_ - Output draft shield status for two draftshields (optional)

Command: <ESC>w9_
Function: This command outputs the current draft shield status for two draftshields.

LiDS: Draft shield status, as well as status of the doors open/closed
RoDS: Draft shield status and the draft shield position (angle)
LiRoDS: Draft shield status of LiDS and RoDS

Execution: Direct
Example of an
Response: closed for draft shield
LiDS: Stat W 016CCC---
RoDS : Stat W 016---000
LiRoDS: Stat W 016CCC000

2.4.35 ESC m0_ - Output ionizer status (optional)

Command: <ESC>m0_
Function: This command outputs the current ionizer status.
Execution: Direct
Example of an for ionizer switched on
Response: Stat I 001

The output format for the ionizer status is described in the chapter "Responding to commands" under Ionizer.

2.4.36 ESC m1_ - Switch on ionizer (optional)

Command: <ESC>m1_
Function: The ionizer is switched on at the preset time.
Execution: Direct
Response: None

2.4.37 ESC m2_ - Switch off ionizer (optional)

Command: <ESC>m2_
Function: The ionizer is switched off.
Execution: Direct
Response: None

2.4.38 ESC ca1_ - Print air temperature of internal climate module

Command: <ESC>ca1_
Function: Get air temperature of internal climate module.
Execution: Direct
Response: TempC1 24.15 °C

2.4.39 ESC ca2_ - Print air humidity of internal climate module

Command: <ESC>ca2_
Function: Get air humidity of internal climate module.
Execution: Direct
Response: RHumC1 27.3 %

2.4.40 ESC ca3_ - Print air pressure of internal climate module

Command: <ESC>ca3_
 Function: Get air temperature of internal climate module.
 Execution: Direct
 Response: PresC1 995.27 hPa

2.4.41 ESC c{..}_ - Print parameter of climate module

Command: <ESC>c{ ModuleID.ParameterID:ClimateModuleNo}_
 Function: Get the value of a specific parameter and climate module. The available parameters and the meaning are listed below. The parameter is separated from the climate module number by a double-point.
 x = 0 - Internal climate module, (printout of header with "C1")
 x = 1 - External climate module, (printout of header with "C2")

Parameter	Function
DEVICE.CLMOD_MEAS_TEMP:<x>	Air temperature in °C or F (Unit depends on menu setting)
DEVICE.CLMOD_MEAS_HUMID:<x>	Air rel. humidity in %
DEVICE.CLMOD_MEAS_PRESS:<x>	Air pressure in hPa
DEVICE.CLMOD_MEAS_AIR_DENS:<x>	Air density in kg/m ³
DEVICE.CLMOD_UNC_TEMP:<x>	Uncertainty of temperature in °C
DEVICE.CLMOD_UNC_HUMID:<x>	Uncertainty of humidity in %
DEVICE.CLMOD_UNC_PRESS:<x>	Uncertainty of air pressure in hPa
DEVICE.CLMOD_UNC_AIR_DENS:<x>	Uncertainty of air density in kg/m ³
DEVICE.CLMOD_SERIAL_NO:<x>	Climate module serial number
DEVICE.CLMOD_MODEL_NO:<x>	Climate module model number
DEVICE.CLMOD_VERSION:<x>	Version of climate module
DEVICE.CLMOD_CAL_LAB_TEMP:<x>	Calibration information temperature: Laboratory
DEVICE.CLMOD_CAL_CER_TEMP:<x>	Calibration information temperature: Certificate
DEVICE.CLMOD_CAL_DAT_TEMP:<x>	Calibration information temperature: Date

DEVICE.CLMOD_CAL_LAB_HUMID:<x>	Calibration information humidity: Laboratory
DEVICE.CLMOD_CAL_CER_HUMID:<x>	Calibration information humidity: Certificate
DEVICE.CLMOD_CAL_DAT_HUMID:<x>	Calibration information humidity: Date
DEVICE.CLMOD_CAL_LAB_PRESS:<x>	Calibration information air pressure: Laboratory
DEVICE.CLMOD_CAL_CER_PRESS:<x>	Calibration information air pressure: Certificate
DEVICE.CLMOD_CAL_DAT_PRESS:<x>	Calibration information air pressure: Date

Execution: Direct

Response examples: Command: <ESC>c { DEVICE.CLMOD_MEAS_TEMP:1 } _
 Response: TempC2 24.15 'C

2.4.42 ESC kP_ - Trigger "Save" button

Command: <ESC>kP_

Function: The ESC kP_ command triggers the "Save" button of the currently started task. According to the loaded print profiles of this task, the values are output, e.g. to the printer memory or directly from the interfaces with SBI-Direkt or PC-Direkt.

There are help texts in the balance for the printing concept of the MCA balance and the settings in the print profiles, which can also be exported as PDF files.

Execution: Synchronous to the output rate of the weight values, the function waits for stability.

Response: Depending on the settings in the loaded print profiles.

2.4.43 ESC ea{x...x}_ - Stores the weight value in the data memory

Command: <ESC>ea{x...x}_

Function: This command stores a stable weight value in the data memory and outputs this stored value with the serial number of the balance and the memory number from the data memory to the SBI interface.

Only valid values are accepted, no acceptance takes place if the warning symbol is displayed as unit.

Depending on the occupancy of the tare memories, the tare memories and the gross value calculated from them are also output.

Optionally, a text with up to 80 characters (UTF-8) can be passed to the command, which is entered into the data memory to identify the weight values. The marking of weight values with this text is then carried out each time they are stored in the data memory, also by other commands, until a blank text or a new text is transferred with the command `ESC ea{x...x}` .

With the setting SBI output without stability, no entry is made in the data memory.

Execution: Synchronous to the output rate of the weight values, with or without stability

[illegible][illegible][illegible]

Answer example 4:	>>>>>>>>>>>>>>>>>>>>>>>>>>>> N1 + 173.511 g T + 3.511 g PT1 + 125.000 g GC + 302.022 g SerNo. 23201202 MemNo. 507 MemID <<<<<<<<<<<<<<<<<<<<<<<<<<<<	For take-over with standstill: Net value 1, Tare and tare hand 1 receipt No transfer of a label ID
-------------------	---	---

Answer example 5:	>>>>>>>>>>>>>>>>>>>>>	For take-over with standstill:
	N2 + 228.866 g	
	T1 + 0.200 g	Net value 2,
ea{Abcdefghijklm	T2 + 99.505 g	Tare 1 and tare 2 occupied
nopqrstuvwxyz}_	GC + 328.371 g	
	SerNo. 23201202	

	MemNo. 508 MemID Abcdefghijklmn <<<<<<<<<<<<<<<<<<<<<<<	Transfer of a longer marking ID, with formatting cut off to 20 characters
Answer example 6:	>>>>>>>>>>>>>>>>> G + 173.511 g SerNo. 23201202 MemNo. 509 MemID Abcdefghijklmnopqrst uvwxyz <<<<<<<<<<<<<<<<<<<<<<<	For take-over with standstill: Gross value, no tare occupied
ea{Abcdefghijklm nopqrstuvwxyz}_		Transfer of a longer ID, with the formatting on several lines of 20 characters
Answer example 7:	>>>>>>>>>>>>>>>>> G + 173.511 g SerNo. 23201202 MemNo. 509 MemID Abcdefghijklmn <<<<<<<<<<<<<<<<<<<<<<<	For take-over with standstill: Gross value, no tare occupied
ea{Abcdefghijklm nopqrstuvwxyz}_		Transfer of a longer ID, with the formatting on cut off at 14 character line
Answer example 8:	>>>>>>>>>>>>>>>>> <<<<<<<<<<<<<<<<<<<<<<<	For takeover without standstill:
ea{}_		There is no transfer to the data memory

2.4.44 ESC p{}_ - Output display value converted (weight value)

Command: <ESC>p{<target unit>}_

Function: Output the display value depending on the selected output mode.

Execution: Synchronous to the output rate of the weight values, with or without stability

Output examples:

Display:

N + 100.000 g

Output to Carats:

p{ct}_

N + 500.000 ct

Output to Ounces:

p{oz}_

N + 3.5274 uz

Implemented weight units:

Unit	Quantity symbol
Universal	o
Microgram	µg, ug
Milligram	mg
Gram	g
Kilogram	kg
Tonne	t
Millicarat	mct
Carats	ct
Kilocarat	kct
Austrian carats	K
Pounds	lb
Ounces	oz
Pounds:ounces	lb:oz

Unit	Quantity symbol
Troy ounce	ozt
Pennyweights	dwt
Grains	GN
Parts per pound	/lb
Hong Kong tael	tlh
Singapore tael	tls
Taiwanese tael	tlt
Chinese tael	tlc
Momme	mom
Tola	tol
Baht	bat
Mesghal	MS
Newtons	N

The output formats for weight values are described in detail in the chapter 2.5.1.

2.4.45 ESC s11_ - Get number of commands in queue

Command: <ESC>s11_

Function: The ESC s11_ command retrieves the number of commands in the current SBI command queue.

The command s11_ is not increasing the queue size and executed immediately even other commands are queued.

Header ID of response is "Queue". Number is written to the last position of line format.

Execution: Direct

Response: Queue <number>

e.g., Queue 0

2.4.46 ESC @ - Move internal weight down

Command: <ESC>@

Function: The ESC@ moves the internal weight down.

The command can only be executed on non-approved balances

Execution: Synchronous

Response: none

2.4.47 ESC ? - Move internal weight up

Command: <ESC>?

Function: The ESC? moves the internal weight up.

The command can only be executed on non-approved balances

Execution: Synchronous

Response: none

2.4.48 ESC pt1{}_ - Set preset tare

Command: <ESC>pt1{<number>}_
 Function: The ESCpt1{}_ sets the preset tare value.
 Execution: Synchronous
 Response: none

2.4.49 ESC pt1_ - Get preset tare

Command: <ESC>pt1_
 Function: The ESCpt1_ gets the preset tare value.
 If a preset tare is set, the command will respond with the current preset tare. The response header will be PT1.
 If no preset tare is set, the response header is T1.
 Execution: Synchronous
 Response: [P]T1 <sign> <value> <unit>
 e.g.,
 PT1 + 2.00000 g
 T1 0.00000 g

2.5 Response to the commands

This section describes the output format for the different commands that output a response.

2.5.1 Response format for weight values

Some commands have responses that output a weight value. These values are always formatted in the same way. Depending on the selected format, the output is with 22 characters "with header" or with 16 characters "without header".

Weight value output with up to 8 digits:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	V	V.	V.	V.	V.	V.	V.	V.	V.	␣	U	U	U	CR	LF
G	␣	␣	␣	␣	␣	␣	0	.	0	0	0	0	0	0	0	␣	g	␣	␣	CR	LF
N	␣	␣	␣	␣	␣	-	␣	␣	␣	0	.	0	0	0	1	␣	m	g	␣	CR	LF
G	␣	␣	␣	␣	␣	-	␣	␣	0	.	0	0	0	0	1	␣	!	␣	␣	CR	LF
N	␣	␣	␣	␣	␣	+	2	0	0	.	0	0	0	0	1	␣	g	␣	␣	CR	LF
Q	n	t	␣	␣	␣	+	␣	␣	␣	␣	␣	␣	␣	1	0	␣	p	c	s	CR	LF

Weight value output with up to 9 digits:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	V	V.	V.	V.	V.	V.	V.	V.	V.	V.	U	U	U	CR	LF
G	▯	▯	▯	▯	▯	▯	0	.	0	0	0	0	0	0	0	0	g	▯	▯	CR	LF
N	▯	▯	▯	▯	▯	-	▯	▯	▯	0	.	0	0	0	0	1	m	g	▯	CR	LF
G	▯	▯	▯	▯	▯	-	▯	▯	0	.	0	0	0	0	0	1	!	▯	▯	CR	LF
N	▯	▯	▯	▯	▯	+	2	0	0	.	0	0	0	0	0	1	g	▯	▯	CR	LF

H = Header with max. 6 characters

S = Sign, +, - or ▯ (space)

V, V. = Numerical value with max. 8 or 9 characters with decimal point

▯ = Space

U = Unit with max. 3 characters

CR, LF= Final character (carriage return and line feed characters)

Note:

The weight value on calibrated balances is output in the same way as on standard balances, i.e. the non-verified digits are not given special characters or marks with square brackets.

2.5.2 Response format for status and error messages

Output at status "Low", "High" or invalid value:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	▯	▯	▯	▯	▯	▯	▯	▯	▯	L	o	w	▯	▯	▯	▯	CR	LF
S	t	a	t	▯	▯	▯	▯	▯	▯	▯	▯	H	i	g	h	▯	▯	▯	▯	CR	LF
S	t	a	t	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	▯	CR	LF

Output on error:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	▯	▯	▯	▯	▯	E	r	r	▯	▯	0	2	▯	▯	▯	▯	CR	LF
S	t	a	t	▯	▯	▯	▯	▯	E	r	r	▯	2	9	4	▯	▯	▯	▯	CR	LF

H = Header, max. 6 characters

V = String with max. 14 characters

▯ = Space

CR, LF = Final character (carriage return and linefeed characters)

Output during calibration/adjustment:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	V	V.	V.	V.	V.	V.	V.	V.	V.	␣	U	U	U	CR	LF
S	t	A	t	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	CR	LF
C	a	L	-	T	␣	␣	2	0	0	.	0	0	0	0	0	␣	!	␣	␣	CR	LF
C	a	L	-	T	␣	␣	␣	␣	0	.	0	0	0	0	0	␣	!	␣	␣	CR	LF

H = Header with max. 6 characters

S = Sign, +, - or ␣ (space)

V, V. = Numerical value with max. 8 characters with decimal point

␣ = Space

U = Unit with max. 3 characters

CR, LF = Final character (carriage return and line feed characters)

2.5.3 Response format for model, serial number, version

Depending on the settings for formatting, the output here is in 20 character format, distributed over several lines or in real length.

Example of output in format with 20 characters:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
M	o	D	e	I	␣	M	C	A	2	2	4	S	-	2	C	E	U	-	I	CR	LF
S	e	R	N	o	.	␣	␣	␣	␣	0	0	3	9	3	0	7	0	2	8	CR	LF
A	P	C	:	␣	␣	␣	␣	␣	␣	␣	␣	1	1	-	0	2	-	0	4	CR	LF
C	D	F	:	␣	␣	0	9	-	0	3	-	0	4	.	0	8	.	0	2	CR	LF

H = Header, max. 6 characters

V = String with max. 14 characters

␣ = Space

CR, LF = Final character (carriage return and linefeed characters)

2.5.4 Response format for draft shield status (optional)

The output of the draft shield status "W xxxyyy" consists of 2 parts. The first part "xxx" consists of an addition of status information and the second part "yyy" differs depending on the draft shield model. For LiDS the status open/closed of the three doors is transferred and for RoDS the opening angle in degrees.

Decimal value of status information (bits)

- 1 Draft shield error
- 2 Draft shield in motion
- 8 Learning function active

- 16 Draft shield completely closed
- 64 Draft shield was operated manually

For example, the status "000" means draft shield open, "002" draft shield in motion and "016" draft shield closed.

Linear draft shield (LiDS):

For the state of the right, top and left door, the "C" sign indicates closed and the "O" sign indicates open. This means that in the "CCC" state all doors are closed, "OOO" all doors are open, "OCC" only the right door is open, "COC" only the upper door is open and in the "CCO" state only the left door is open.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	_	_	_	_	_	_	_	_	W	_	0	1	6	C	C	C	CR	LF
S	t	a	t	_	_	_	_	_	_	_	_	W	_	0	0	0	O	O	O	CR	LF

Rotational draft shield (RoDS):

The opening angle of the rotation draft shield is output in degrees from 0° to 360°. The specified opening angle to the left is 100° and to the right 260°. Centrally open is 180° and closed is the windscreen at 0° and 360° respectively.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	_	_	_	_	_	_	_	_	W	_	0	1	6	0	0	0	CR	LF
S	t	a	t	_	_	_	_	_	_	_	_	W	_	0	0	0	1	0	0	CR	LF

Linear draft shield and rotational draft shield (LiRoDS):

Balance with LiRoDS will not respond to w0_. Can only be queried with the w9_ command. Consists of the LiDS and RoDS status and door information. If one of them is missing, its door information is replaced by ---.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	_	_	_	_	_	W	_	0	1	6	C	C	C	0	0	0	CR	LF
S	t	a	t	_	_	_	_	_	W	_	0	1	6	-	-		0	0	0	CR	LF
S	t	a	t	_	_	_	_	_	W	_	0	1	6	C	C	C	-	-	-	CR	LF

H = Header, max. 6 characters

V = String with max. 14 characters

_ = Space

CR, LF = Final character (carriage return and linefeed characters)

MCA-3 requires a license for the Draftshield. If this is not available, the commands have no effect.

2.5.5 Response format for ionizer status (optional)

The status of the ionizer is output in the format "I xxx", with "I 000" for off and "I 001" for on.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
H	H	H	H	H	H	S	S	S	S	S	S	S	S	S	S	S	S	S	S	CR	LF
S	t	a	t	␣	␣	␣	␣	␣	␣	␣	␣	I	␣	0	0	0	␣	␣	␣	CR	LF
S	t	a	t	␣	␣	␣	␣	␣	␣	␣	␣	I	␣	0	0	1	␣	␣	␣	CR	LF

H = Header, max. 6 characters

V = String with max. 14 characters

␣ = Space

CR, LF = Final character (carriage return and linefeed characters)

2.6 Settings for the SBI protocol

For the output of weight values or calculated values, the format of the output, the output with/without stability and the execution manual/automated can be selected.

These settings apply to all interfaces that are set to the SBI protocol. The delivery settings are marked with "*".

2.6.1 Format of the output

The format of the output can be selected:

- Value without header The output is done without the marking with a header. Only the display value with unit is output.
With this format, 16 characters including the final characters CR, LF are output per line.
- Value (with header) * The output is with marking, i.e. a header (abbreviation) with 6 characters is output before the display value with unit.
Thus, this format has 22 characters per line including the final characters.
- Date & Time, Value (two lines) With this format, a line with date and time is additionally output before the value with header and unit. The output in this format thus has two lines with 22 characters each.

2.6.2 Output / Version with or without stability

The output of display values for single request with the ESC P command or for automatic output can be done with or without stability for SBI.

- Without stability * The output of the current display value is independent of the stability of the balance, with or without stability.
- With stability The output of the current display value is only carried out if the balance is stable. In the case of the individual request with the command ESC P, the execution at non-stability waits until stability is reached. With the automatic output, the output is also only made if the balance is stable.

2.6.3 Manual or automatic output

The output to the SBI interface can be done by individual request with the command ESC P, automatically in the grid of the weighing sequence or automatically in a certain time grid.

- Off (executed with ESC P) * The automatic output is switched off. The request for the output must be made individually with the ESC P command.
- Any value The automatic output takes place in the grid of the weighing sequence, which is specified by the weighing profile or set by the commands ESC K, L, M or N.

If the setting with stability is selected, an output is only made when the balance shows stability, otherwise not. With the setting without stability, an output is always made.
- 1 second The automatic output takes place every second.

If the setting with stability is selected, an output is only made when the balance shows stability, otherwise not. With the setting without stability, an output is always made.
- 2 seconds As before, but output every 2 seconds.
- 5 seconds As before, but output every 5 seconds.
- 10 seconds As before, but output every 10 seconds.
- 30 seconds As before, but output every 30 seconds.
- 60 seconds As before, but output every 60 seconds.

2.6.4 Display SBI error messages

For easier identification of errors when entering SBI commands, the display of error messages can be switched on.

- Off * No error messages are displayed if errors are detected when entering SBI commands.
- A Error messages are displayed when errors occur during the reception and execution of SBI commands.

2.6.5 Formatting Output Values

This setting allows you to select how formatting should be done on output, especially if the length of labels, such as Device ID, Batch L-ID or Samples S-ID, exceeds the standard output format of 20 characters.

The output of weight values is not changed by these settings.

- Output in one line with full length Here the output is done in one line, the elements like header and value are output in full (real) length, separated by a space, left-aligned, without padding with spaces.
- Output in several lines with 20 characters each Output that does not fit into the standard output format of 20 characters due to its length is distributed over several lines with 20 characters each. Each line is left-aligned and filled up to 20 characters with spaces if necessary.
- Cutting to a line with 20 characters * The output here is fixed in the standard output format of 20 characters, longer outputs are cut off at the back.

2.7 Interfaces for the SBI protocol

The SBI protocol can be used via the COM-RS232, USB-B interfaces on the rear panel of the balance and via the Ethernet interface on the display head.

The SBI protocol can be set for the respective interface, which can then be operated independently of the task and its application.

2.7.1 Interface COM-RS232

The COM-RS232 interface is intended for serial connection to a PC or PLC control unit. Baud rate, data bits, parity, stop bits and handshake must be set for this interface according to the connected device.

2.7.2 Interface USB-B

The USB-B interface is used to connect a PC via a standard USB cable, with USB-A to USB-B plug. On the PC, this connection is set up and displayed as a virtual

COM port (VCP). The driver for this interface is automatically installed on the PC by the operating system, provided the user has the appropriate rights.

2.7.3 Network connection

It is also possible to use the serial communication protocol SBI via the Ethernet network connection. This client/server connection requires the setting of a common TCP port. The default is port 55555.

2.8 Abbreviations

Abbreviation	Description
APC	Application Processor Controller, processor from display head
ASCII	American Standard Code for Information Interchange The american standard code for information exchange is a 7-bit character encoding.
BAC	Balance Controller, processor of the weighing unit
CR	Carriage return character, Control character ^M, Hexadecimal 0x0D, Decimal 13
ESC	Escape character, marker, Control character ^[, Hexadecimal 0x1B, Decimal 27
LF	Line feed character, line feed character, Control character ^J, Hexadecimal 0x0A, Decimal 10
LiDS	Optional: Linear draft shield with three doors (right, top, left)
MCU	Micro Controller Unit, Processor in the weighing system for balances with E-Box
Pos.	Character position in the protocol
LiRoDS	Optional: Linear and rotation drafts shield.
RoDS	Optional: Rotation draft shield
RS232	Recommended Standard 232, Standard for serial interfaces
SBI	Sartorius Balance Interface, Interface protocol with which the balance can be controlled.
SP	Space character, space, " ", Hexadecimal 0x20, Decimal 32
PLC	Programmable Logic Controller
TCP	Transmission Control Protocol, network protocol for transmission control
VCP	Virtual COM Port

Abbreviation	Description
WPC	Windshield Processor Controller, Processor for the optional draft shield