Measurement · Weighing · Control

Analog Signal Transmitter AST 5P

Program version 1.2.x



Technical Manual

BLH NOBEL
A VPG Brand

PRECAUTIONS

Read this manual before installing, operating or servicing this instrument. The manual helps you use the instrument safely and efficiently. Follow the instructions provided here and in the following chapters. Save this manual for future reference.

> ***WARNING***
>
> *Only permit qualified personnel to install and service this instrument.*
>
> *DO NOT allow untrained personnel to operate, clean, perform service, or in any other way handle this instrument.*

Meaning of symbols in this manual



Ground symbol

WARNING *Warning text*

Warning text that points out a risk that you need to be aware of

INTENDED USE

General

The AST 5P is a measuring unit intended for industrial use. Its basic function is to convert the signals from transducers into useful information. Transducer excitation is included as well as parameter-controlled signal processing, indication of output signal levels and error monitoring.
The product has an interface for communication, a connection for strain gauges, two digital inputs, two relay outputs and an analog output.

CE considerations

The product is classified as class B group 1 equipment. This means that:
* the product is not designed to intentionally generate and/or use radio frequency energy; and
* even though intended for industrial use, this product can also be used in domestic environment or environment sharing low voltage power supply network with residential environment without any special measures.

FCC considerations

The product is classified as class B digital device, according to the US Federal Regulations.

WARNIING

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential environment. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio and television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- reorient or relocate the receiving antenna;
- increase the separation between the equipment and receiver;
- connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- consult the dealer or an experienced radio/TV technician for help.

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1. Introduction

General

AST 5P is a high-performance signal transmitter, designed for industrial measuring by means of strain gauge transducers. The compact module is easily installed on a DIN-rail.
By serial communication a number of AST 5P modules can be combined to form a network with a common control unit.

Transducer excitation is included in the transmitter module and the analog transducer signal is converted to a digital signal with very high resolution.
By parameter-controlled calculations an internal measurement value is produced, which can be converted to a current or voltage signal at the analog output.
The measurement value can also be transmitted to the control unit, or to an external display unit.
Level supervision at two levels can be performed and the status is transmitted over the serial communication.

AST 5P inputs and outputs are galvanically isolated from each other and from the power supply for the unit (digital inputs share 0V with power supply).

Functions

Measuring with strain gauge transducers. The output signal and the sense (representing the excitation voltage) are measured at the transducer by four wires so that the voltage drop in the supply line does not affect the measurement result. The cable between AST 5P and a distant transducer must therefore contain six conductors.

A/D conversion. The analog signal-to-sense ratio from the transducer is converted to a digital value and filtered to give an internal transducer signal representation with high resolution of the load on the transducer.

Calculation. Influenced by calibration data, the internal transducer signal is converted to a digital measurement value, the weight value, that can be presented at the local display window and at the control unit.

Analog output. The calculated weight value is also converted into an analog output signal, e.g. for presentation on an external display. Current or voltage output can be selected. The analog output can also be set to provide a fixed output signal, current or voltage.

Error supervision. The error supervision is checking for electrical errors, invalid parameter values, and signals out of valid limits. As long as no error is detected, the signal 'In process' is present. If an error is detected an error message will be displayed and the signal 'In process' will be off, the relays will be deactivated, and the analog output signal will be set to 0V / 0mA.

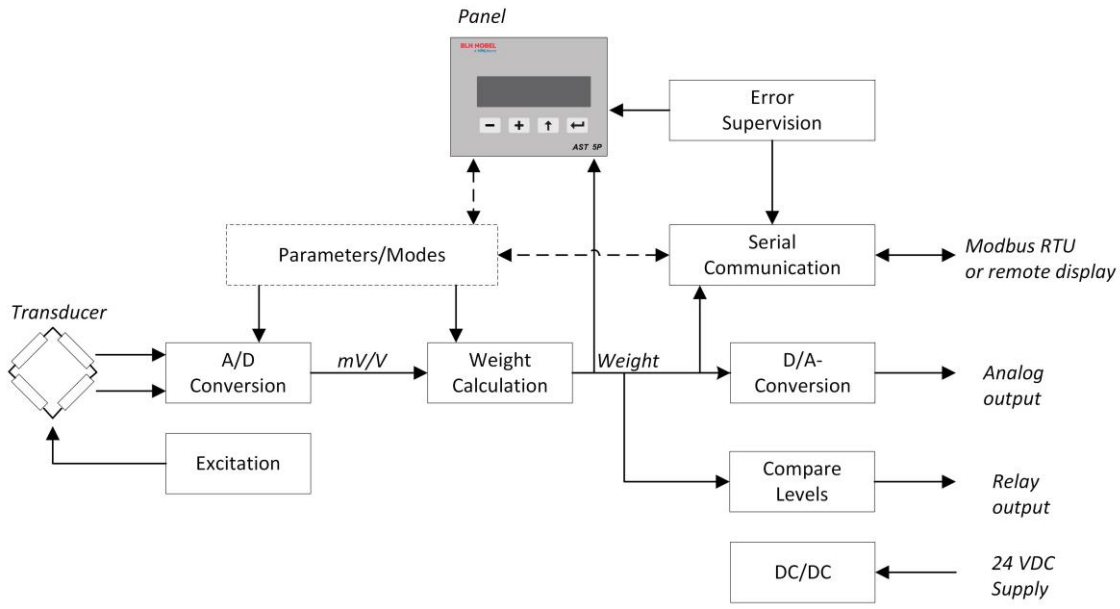


Figure 1. AST 5P converts analog transducer signals into precise measurement values for use in industrial processes

Levels. Two level comparators in AST 5P can be set to switch at defined levels for selected signals and reports the status of the signals to the control unit.
Two switching relays can be set to indicate the status of the level comparators or the status of the signal 'In process'.

Serial communication. In AST 5P the serial interface RS485, on 2-wires or 4-wires, is used for communication with the control unit. Set-up and calibration parameters, weight value, level status, error status etc. is transmitted via the Modbus protocol.
If the serial interface is not used for control unit communication, it can be used to transmit the weight value to external digital equipment.

Instrument modes. At power-on the unit enters the Start-up mode, displaying its identity while internal tests are performed.
Depending on setup, the instrument may enter the Wait for start mode (selected by a parameter), waiting for a start command from the operator.
After completed start-up, the AST 5P unit is normally working in Operating mode, continuously presenting the weight value (or other selected information).
If editing of set-up parameters should be performed, AST 5P must be switched over to Set-up mode.
If an error is detected, AST 5P will automatically switch over to Error mode, displaying an error message.
As AST 5P is in Set-up mode or Error mode, normal instrument operation is disabled, the relays are deactivated, and the analog output is set to zero.

Parameter setting. In AST 5P set-up parameters are used to control all operating functions. The parameter values can be entered as numerical values or selected from a list of alternatives via the front panel keys and display window. It can also be set from a connected control unit.

Presentation. AST 5P can present parameter values and measured or calculated signal values at a control unit and at the panel display.
The measurement value is also presented by the analog output signal.



Figure 2. AST 5P can utilise serial communication to carry out different operational tasks

Technical data

Transducer input

Transducers	1-8 trancducers, 350 Ohm each (350 Ohm – 43.75 Ohm)
Excitation	8 – 10 VDC
Signal input	± 3.3 mV/V
Sense input	1,8 – 10 VDC
A/D conversion	24 bits

Analog output

Bipolar voltage or current

Voltage	0 – 10 VDC or +/-10 VDC over >1 kOhm
Current	0 – 20 mA, +/-20 mA, 4 – 20 mA, -12 – 20 mA in <500 Ohm
Filter	0.05 to 100 Hz, selectable bandwidth
Resolution	16 bits (65 000 counts)
Non-linearity	<0.01 % of full range
Zero drift	<0.005 % of full range/°C
Gain drift	<0.003 % of actual value/°C
EMI	<0.25% of full range

Serial output

Interface	RS485, 2-wires or 4-wires
Baud rate	Up to 115.2 kbaud
Data format	Modbus RTU protocol for control unit communication
Filter	0.05 to 100 Hz, selectable bandwidth
Non-linearity	<0.005 % of full range
Zero drift	<0.0002 % of 3.3 mV/V /°C
Gain drift	<0.0025 % of actual value/°C
EMI	<0.01% of 3.3 mV/V

Relay output

Number of relays	2 (each with 1 switching group)
Relay load	Max 1 A, 30 VAC or DC

Spark suppression required at inductive load.

Digital inputs

Number of inputs	2
Range, high level	19 – 29 VDC
Range, low level	0 – 6 VDC
Current	10 mA at 24 VDC

Calibration

Methods	Data sheet, Dead weight or Table

Power supply

Supply voltage	24 VDC ±20 %
Consumption	6 W

Front panel

Display	2 x 16 character, LCD
Keys	4 keys for menu control and data entry

Mechanical data

Dimensions	75 x 100 x 110 mm At least 10 mm air gap between units
Rail mount	Top hat rail TH 35 (35 mm) (acc. to EN 60715)

Environment

Temperature range	-10 to +50 °C
Degree of protection	IP20 (acc. to EN 60529)
EMC	Class B group 1 equipment, industrial electromagnetic environment (acc. to EN 61326-1, EN IEC 61326-1 and IEC 61326-1) Class B digital device (acc. to 47 CFR part 15)

Regulatory fulfilment

Compliance	CE, FCC

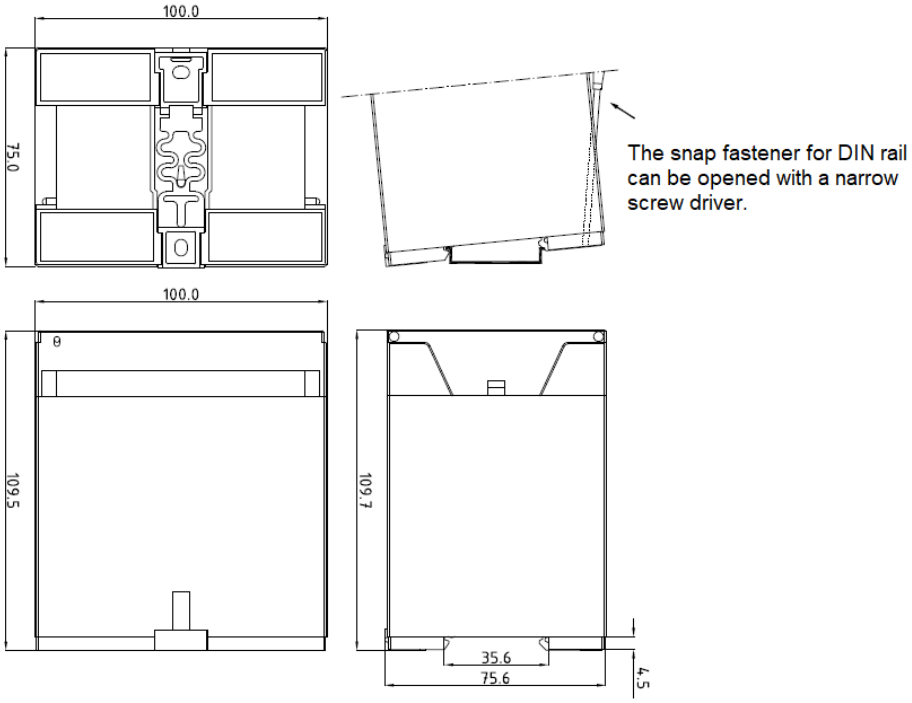


Figure 3. Mechanical dimensions for AST 5P

2. Installation

Mechanical installation

Each signal transmitter module contains several circuit boards, built into a protective plastic housing. The module can be snap-mounted on a 35 mm wide DIN rail.
The module has detachable terminal blocks for connecting the cables. The sensor cable is connected on one side of the module, and all other cables on the opposite side.

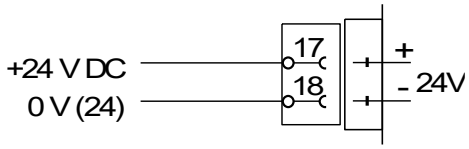
Electrical installation

All electrical connections to the AST 5P module, including possible connection to ground, are made via plug-in terminal blocks. For all interfaces, except for the power input, shielded cables must be used. All other cabling should be routed away from power cables in order to avoid risk for electromagnetic interference.

Input and output signals for AST 5P are galvanically isolated from each other to facilitate connection to various external equipment.

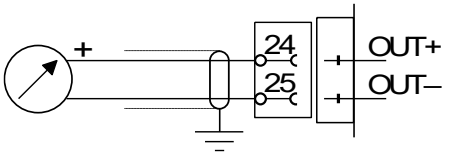
There are no limitations on the length of the cables connected to AST 5P as long as it is possible to ensure proper function of the corresponding interface.
Cable connection is shown in the diagrams below.

Power supply



Connections are made to terminals 17, 18.
The AST 5P product is powered by 24 VDC, see requirements in section “Technical data”.

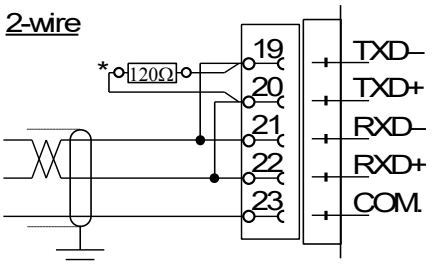
Analog output



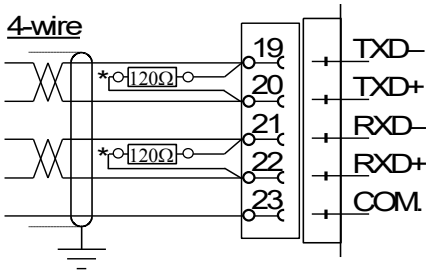
Connections are made to terminals 24, 25.
Current output or voltage output for presentation of the measured value at the process control or at an external analog instrument.
Shielded cable must be used and the cable shield must be connected to ground, preferably
to a ground terminal on the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.

Serial communication

Connections are made to terminals 19 – 23.
A serial port for RS485, on 2-wire or 4-wire with common signal ground (COM), is used to connect AST 5P to a control unit, or to transmit values to an external display unit.
At both ends, the transmission line must have terminating resistors of 120 Ohm. For AST 5P they should be mounted on separate terminals and be connected according to the diagrams on the right.
For a control unit or external display, refer to manufacturer instructions concerning line termination.
Depending on the installation and the master, external fail-safe resistors might be needed.
Shielded cable with twisted pairs must be used and the cable shield must be connected to ground, preferably to a ground terminal on the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.
When connecting several units to a transmission line, wires from two cables must be connected to the terminals at AST 5P. To facilitate that connection, use cable ferrules crimped on the two wires.



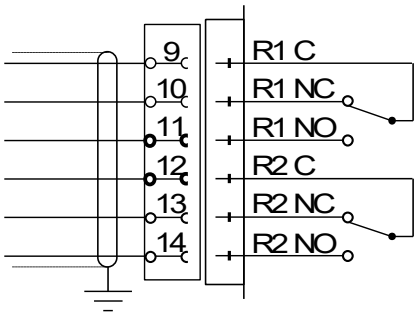
* Terminating resistor on separate terminals at the last unit on the line.



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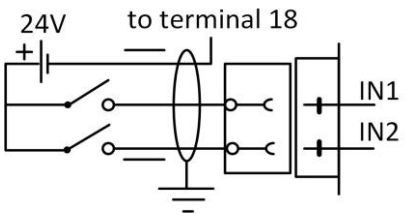
Relay outputs

Connections are made to terminals 9 – 11 and 12 – 14.
Observe the contact ratings given in section “Technical data”.
Shielded cable must be used and the cable shield must be connected to ground, preferably to a ground terminal on the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.
When the relays are used, the installation contractor has to observe the requirements of interference emission for electrical and electronic devices (acc. to EN 50081) on the contact side and take appropriate measures, if necessary.



Digital inputs

Connections are made to terminals 15, 16.
By connecting 24 VDC to the digital inputs, the signals can be read using the instrument or a control unit.
Shielded cable must be used and the cable shield must be connected to ground, preferably to a ground terminal on the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.



Transducer input

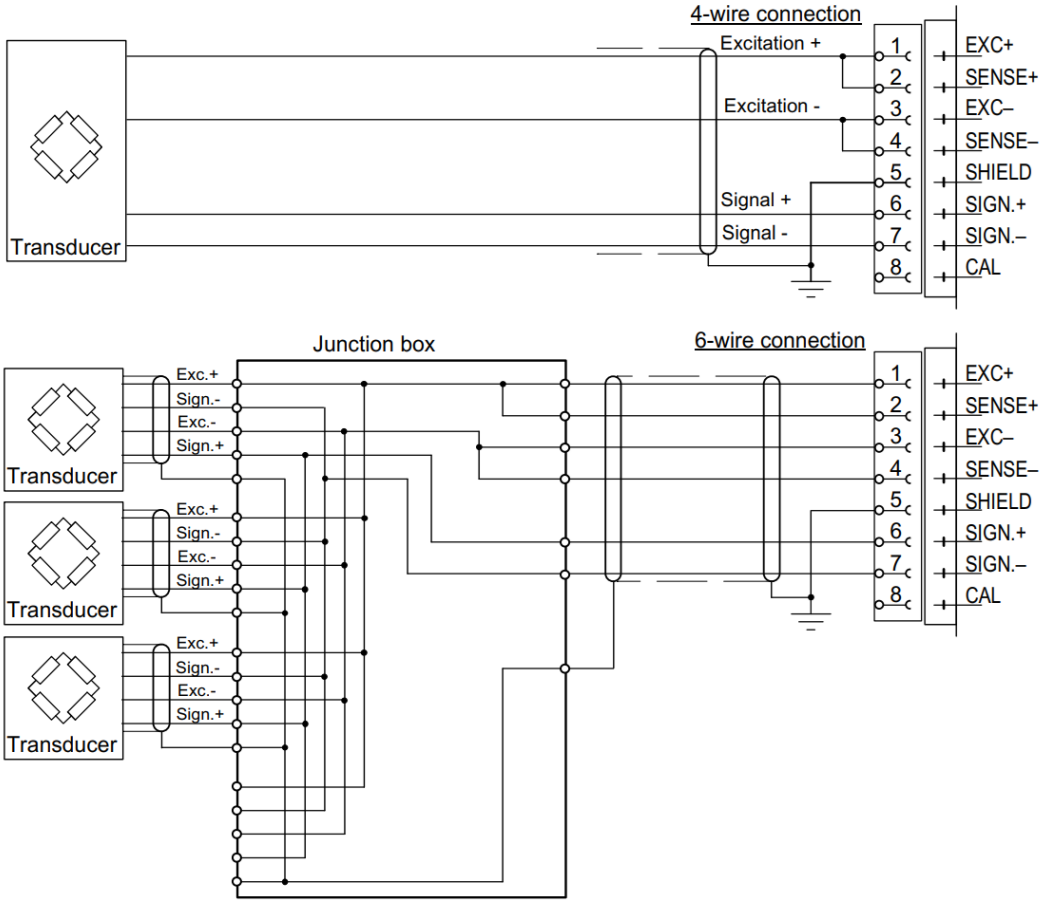
Connections are made to terminals 1 – 7. Terminal 8 shall be left unconnected. Connection of transducers should be handled with great care to achieve good measuring data. Shielded cable must be used.
For transducers delivered with integrated connection cable, this cable must not be shortened.

> ***WARNING***
> *Transducer cables must be routed at least 200 mm away from 110-240 V, 50/60 Hz power cables. For power cables carrying other frequencies or high power, an even wider distance is preferable.*

AST 5P is designed for 4-wire connection or 6-wire connection of transducers.

4-wire connection should be used if the cable, delivered with the transducer, is long enough to be connected directly to the AST 5P terminals. By 4-wire connection, excitation and sense must be interconnected, as shown in the diagram below. The cable shield and terminal 5 must be connected to ground via the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.

6-wire connection should be used if the cable, delivered with the transducer, must be lengthened or if several transducers should be connected to the AST 5P unit. Connect the transducer cable(s) to a junction box, and use 6-wire connection between the junction box and AST 5P. The cable shield and terminal 5 must be connected to ground via the mounting rail close to AST 5P. Make sure that the shield length between the cable and the grounding point is as short as possible.



Single wire break detection

The transducer input has high impedance to ensure the highest possible accuracy even if there is external resistance due to long cables or intrinsic safety barriers included in the installation.

On the other hand, the high impedance can affect the time to detect a single wire break. If this is of importance in a particular installation, the detection of SIGN.+ and SIGN.- wire break can be improved by adding an external resistor between EXC+ and SIGN.+ and EXC- and SIGN.-, respectively, in the connector at the AST 5P instrument end. Thus, in the event of single wire break, the external resistors will force the signals to the outside of the measurement range providing a quick error indication. A value of 50 MOhm for each of the resistors is recommended.

It is important to note that adding external resistors, as described above, will influence the zero setting of the scale. If the scale is already calibrated, a new zero setting is required.

Presentation panel

The presentation panel has a 2x16 character LCD display and four keys.
In Operating mode the weight value is presented in one view, but other views may also be selected.
Set-up can be performed in two ways: the 'Quick set-up' with only a few vital parameters or the 'Normal set-up' with all the parameters available.
Error messages or parameter explanations can also be displayed.
The keys are used to select a parameter, to edit the parameter value, and to save the new value in the memory or to exit without saving the new value.

The key functions in the different modes are explained in the table below.

Key explanation

	Name	**Function** In Operating mode:	 In Set-up mode:
↵	ENTER	In view Zero setting: Set the value to zero. In all other views: No function.	In a 'Main menu': Go to the first parameter. Parameter viewing, *without* cursor: Make editing possible. Parameter editing, *with* cursor: Accept the digit at the cursor and go to next digit. *** **Note!** If ENTER is pressed for 2 seconds: The displayed parameter value is activated. The cursor disappears.***
+	plus	Go to next view. See Figure 10. Together with ↑ for 2 sec.: Go to 'Normal set-up'. (Password may be required.) Together with – for 2 sec: Go to 'Display settings'.	In a 'Main menu': Go to next main menu. Parameter viewing, *without* cursor: Go to next parameter. Parameter editing, *with* cursor: Increment the digit at the cursor or Go to next alternative.
–	minus	Go to previous view. See Figure 10. Together with + for 2 sec: Go to 'Display settings'.	In a 'Main menu': Go to previous main menu. Parameter viewing, *without* cursor: Go to previous parameter. Parameter editing, *with* cursor: Decrement the digit at the cursor or Go to previous alternative.
⇧	ESCAPE	If pressed for 2 seconds: Go to 'Quick set-up'. (Password may be required.) If held while + is pressed for 2 seconds: Go to 'Normal set-up'. (Password may be required.)	In a 'Main menu': No function. Parameter viewing, *without* cursor: Go to the main menu. Parameter editing, *with* cursor: Interrupt the editing.

Example for how to use the keys:
As an AST 5P is started for the first time it enters the Operating mode, displaying the Weight value. This example describes how to change ‘Measurement unit’ to pounds (lb) and Capacity to 1000 (lb), using the ‘Quick set-up’. See figure 5.

* To leave Operating mode and enter ‘Quick set-up’, press ⇧ for 2 seconds.
* ‘Main menu Quick set-up’ is displayed. Press ↵ to get to the first parameter in the ‘Quick set-up’.
* The first parameter, ‘Language’, is displayed. Press + to get to ‘Measurement unit’.
* For parameter ‘Measurement unit’, the default value ‘kg’ is displayed.
  Press ↵ to start editing. A cursor makes the first letter on the lower line blinking.
* With a cursor on the lower line + or − are used to step forwards or backwards through the list of alternatives. Press + or − until ‘lb’ is displayed.
* To accept the displayed alternative, press ↵ for 2 seconds.
  The cursor disappears.
* Now, without cursor on the lower line, use + to get to parameter ‘Capacity’.
  The default value on the lower line, 500.0 lb, should be changed to 1000.0 lb.
* Press ↵ to start editing.
  The lower line will display ‘00500.0 lb’ with a cursor at the first digit.
* The parameter value should be changed to ‘01000.0 lb’.
  Press ↵ once to accept the first digit and move to the second digit.
  Press + or − to change the digit to ‘1’.
  Press ↵ to accept the value ‘1’ and move to next digit.
  Press + or − to change the digit from ‘5’ to ‘0’. Now the value is correct.
  Press ↵ for 2 seconds, the cursor disappears and ‘1000.0 lb’ is displayed.
* As the editing is ready, press ⇧ to get to ‘Main menu Exit set-up’.
* Press ↵. The sub menu ‘Save changes? No Esc. Yes’ will be displayed.
  (Press ⇧ if you do not wish to exit from the set-up mode.)
* Answer by ↵ (Yes) to save the new edited values.
  Answer by − (No) to cancel the new values and return to previously saved values.

In both cases the set-up is finished and the module switches to Operating mode, displaying the Weight value.

3. Set-up

General

All operating functions in AST 5P are controlled by permanently stored parameters, so the information will not be lost if the module is switched off. At delivery the parameters are factory-set to default values, giving the module an initial standard function.
For AST 5P modules connected to a control system, the parameter values can be edited by Modbus communication from a control unit in the system. If a computer with Windows is used, the setup procedure is simplified by using the deltaCOM program from BLH Nobel.
All parameter values for the module can be edited by the front panel function keys.

When set-up from the control unit is in progress, local set-up is prevented, and a message is displayed:

```
Remote set-up
Please wait!
```

When an AST 5P is first taken into service, only a few parameters need to be edited to adapt the signal transmitter to the transducer and to obtain basic measuring function and correct values. These parameters are gathered in the ‘Quick set-up’ sequence, easily accessible from the AST 5P front panel by activation of a single key, see figure 5 on next page.

When parameter values, not accessible in the ‘Quick set-up’ need to be edited, it is necessary to enter the ‘Normal set-up’ sequences. These sequences contain all set-up parameters, divided in groups under a number of main menus.
The ‘Normal set-up’ is started by activation of two keys simultaneously, see figure 6.

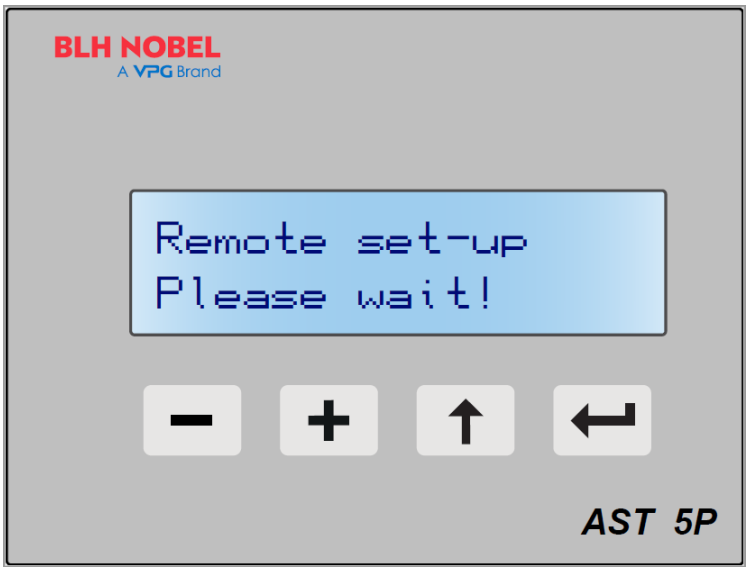


Figure 4. During set-up from a control computer, a message is given and the panel keys cannot be used

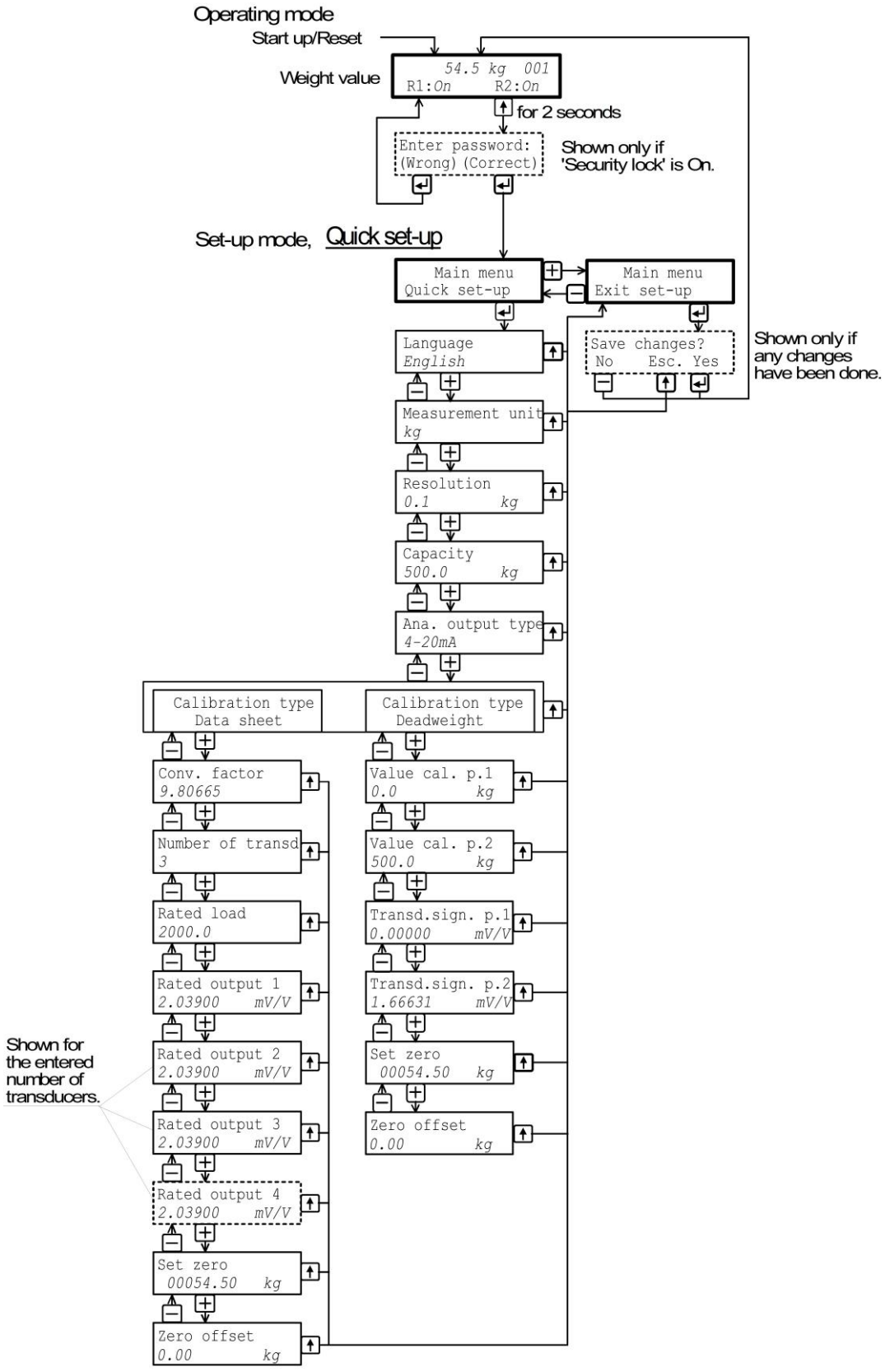


Figure 5. In the 'Ouick set-up' only some basic parameters can be edited

Quick set-up

In 'Quick set-up' a few basic parameters can be edited.
A separate publication," AST 5P Operating instructions, Quick installation",
gives a step-by step instruction for the set-up operation.
A brief instruction is given below. Parameter explanations are found on
pages 3-4, 3-5 and in the complete parameter list on pages 3-10 to 3-21.

Enter 'Quick set-up'

> ***WARNING***
> *When AST 5P is in Set-up mode, all normal measuring operations are stopped!*

Press ⇧ for 2 seconds. 'Main menu Quick set-up' will be displayed,
possibly after entry of a correct password.

Show the parameters

When 'Main menu Quick set-up' is displayed, press ↵ to attain the sequence
of parameters. Parameter name and the actual parameter value are displayed
together. Press the − key or the + key to step backwards or forwards in
the parameter sequence, see figure 5.

Select a parameter to edit

Press ↵ as the parameter is displayed. A blinking cursor appears to the left
on the second line, and numerical parameter values get leading zeros.
The cursor indicates that editing can be performed.

Edit a parameter value

For parameters with choices the value is selected from a list of alternatives. As a cursor
is blinking on the lower line, press the + (or −) key to find the correct alternative,
then press ↵ for 2 seconds to accept it, and the cursor disappears.
For numerical parameters each digit is edited separately. The digit at the cursor
can be edited by the + or − key. The value of that digit is accepted by ↵ , and
the cursor moves to next digit.
Repeat this procedure until a correct value with leading zeros is displayed, then press
↵ for 2 seconds to accept it, and the cursor disappears.
If the accepted value is out of range an error message will start flashing.
Any key can be pressed to remove the message, cancel the incorrect value,
and make continued editing possible.
Press ⇧ to cancel the editing in progress and remove the cursor.

Calibration

Two calibration types are supported by 'Quick set-up': data sheet calibration and dead
weight calibration. See section Calibration for more information about calibration types
and parameters.

Exit 'Quick set-up'

See figure 5. First press ⇧ to get to 'Main menu Exit set-up', and then press ↵ .
If nothing was edited, 'Quick set-up' is finished and view 'Weight value' is displayed.
If any parameter has been edited, 'Save changes? No Esc. Yes' is displayed.
(Press ⇧ if you do not wish to exit from the 'Quick set-up'.)
If ↵ (Yes) is pressed, all edited parameter values will be saved.
The new values should also be recorded in a set-up list. See Appendix 1.
If − (No) is pressed, all edited parameter values will be cancelled.
All parameters resume the values they had before 'Quick set-up' was started.
This finishes the 'Quick set-up' and the view 'Weight value' will be displayed.

Parameters in ‘Quick set-up’

‘Quick set-up’ for includes parameters for setting of basic instrument properties and for calibration of the measuring equipment. For each parameter a short explanation and the range for the parameter value is given.
The parameters are also explained on pages 3-10 to 3-21.

‘Language’
Defines the language, used for parameters and messages.
List of alternatives: Svenska, English, Deutsch, Français.
Default value: English.

‘Measurement unit’
Selection of engineering unit for the measurement value.
List of alternatives:
NONE, g, kg, t, lb, N, kN, oz, psi, kPa, MPa, bar, l, lbf, kgf, PLI, N/m, kN/m, Nm, daN.
Default value: kg.

‘Resolution’
Selection of decimal point position and resolution format for the measurement value.
All set-up parameters using the selected measurement unit will be written with the resolution selected here.
List of alternatives: 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50.
Default value: 0.1.

‘Capacity’
Nominal range of the analog output, expressed in ‘Measurement unit’.
An asterisk (*) on the upper line indicates that the range for the analog output has been changed by parameters in ‘Normal set-up’.
Possible values: from 0.5 to 999999.
Default value: 500.

‘Ana. output type’
For the analog output, several signal types can be selected: bipolar or monopolar current, bipolar or monopolar voltage.
List of alternatives: +/-20mA, -12–20mA, 0–20mA, 4–20mA, +/-10V, 0–10V.
Default value: 4–20mA.

‘Calibration type’
Data sheet calibration is recommended as a preliminary calibration. With simple means it gives fairly good accuracy, so the equipment can be tested. Settings from an earlier dead weight calibration are lost if data sheet calibration is selected.
Dead weight calibration is the most accurate calibration type. Known weights are used as load on the equipment.
See section Calibration for further information on calibration types.
List of alternatives: Data sheet and Deadweight.
Default value: Data sheet.

'Conv. factor'
This parameter defines the conversion factor by which a value expressed in 'measurement unit', must be multiplied to be expressed in the transducer data sheet unit. Consequently the factor is 1 if measurement unit and data sheet unit are equal. Default value can be used if 'measurement unit' is 'kg' and data sheet unit is 'Newton'.
Possible values: from 0.01 to 99.
Default value: 9.80665.

'Number of transd'
This parameter defines the total number of transducers and fixed support points for the load. If the number of support points is over 4, set the parameter value to 1.
Possible values: 1 to 4.
Default value: 3.

'Rated load'
This parameter defines the rated load for the transducer, expressed in the unit of the transducer data sheet.
*** **Note!** If for example the rated load is 5 kN, this parameter should be set to 5 000 (N).***

If the number of support points is over 4, the value of this parameter should be: rated load multiplied by that number.
Possible values: from 1 to 999999.
Default value: 2000.00.

'Rated output 1' (2, 3, 4)
These parameters define the rated output for transducers and fixed support points. For transducers the rated output, in mV/V, is given in the data sheet. For fixed support points the rated output should be set to 0.00000 (mV/V).
If the number of support points is over 4, the parameter value should be: the sum of all rated output values, divided by the number of transducers.
Possible values: from 0 to +9.99999.
Default value: 2.03900.

'Value cal. p.1' (p.2)
These parameters define the known load on the scale for the two calibration points.
Calibration point 1 is the lower point, normally unloaded scale.
Calibration point 2 is the higher point, at least 2/3 of the nominal capacity.
Possible values: from -999999 to +999999.
Default values: Value cal. p.1: 0 Value cal. p.2: 500

'Transd.sign. p.1' (p.2)
These parameters give the transducer signals for the two calibration points. The values can not be edited. Make a note of them in the 'Set-up list' (Appendix 2) for possible use in a table set-up of a replacement instrument.
Possible values: from -9.99999 to +9.99999.
Default values: Transd.sign. p.1: 0.00000 mV/V Transd.sign. p.2: 1.66631 mV/V

'Set zero'
Used in both calibration types for zeroing of the instrument.
The actual weight is displayed. Press ↵ , the weight value is set to zero.
Press ↵ for 2 sec., the zeroing is accepted.

'Zero offset'
Displayed after zeroing for both calibration types.
Make a note of the parameter value in the 'Set-up list' (Appendix 2) for possible use in set-up of a replacement instrument.

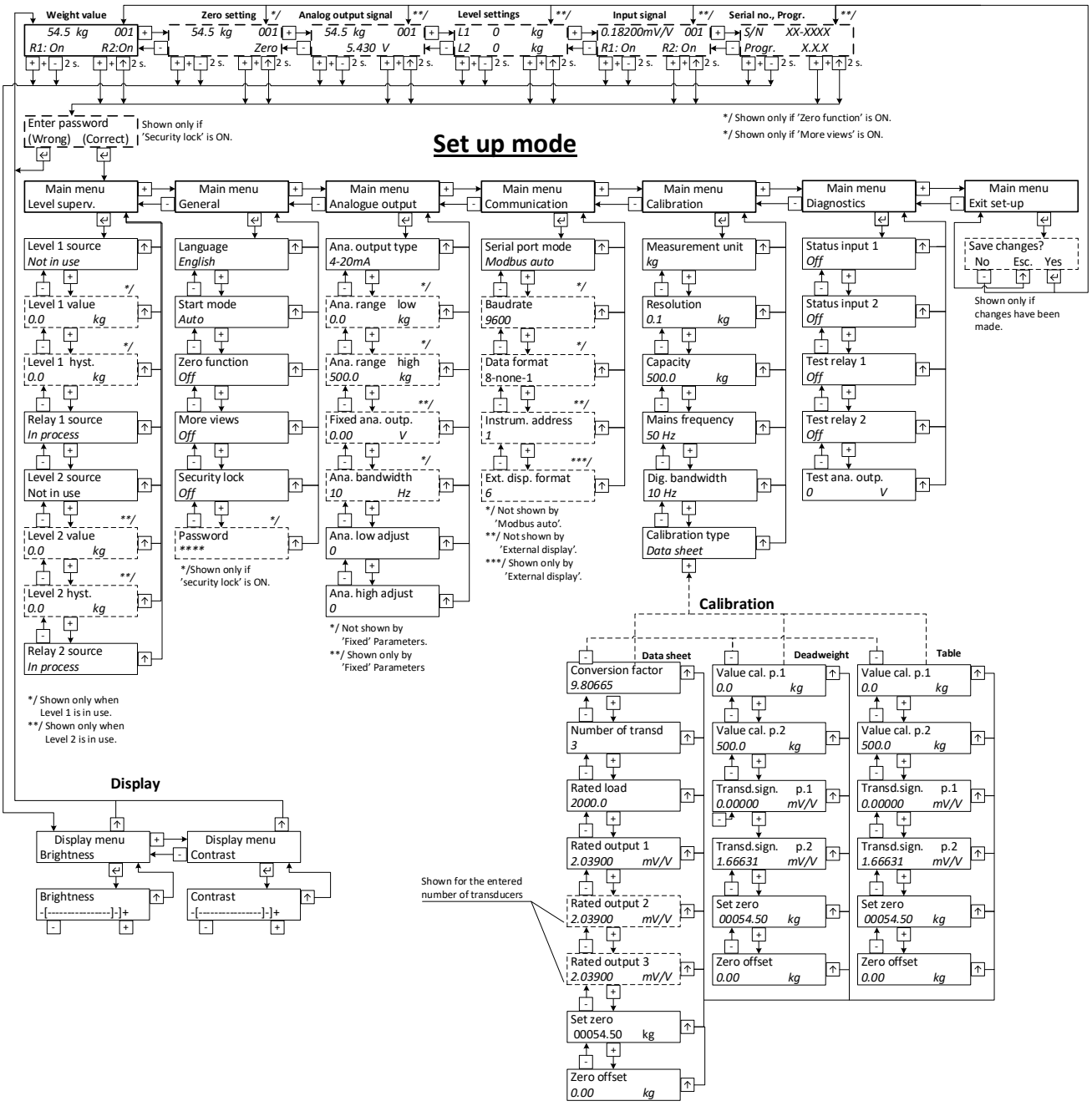


Figure 6. In 'Normal set-up' all adequate parameters are available for editing. Display of some parameters, indicated by intersected frames, depends on the setting for other parameters. The number of views available in Operating mode also depends on parameter settings. In this figure the parameter values are only examples.

Normal set-up

At delivery, the parameters have default values. During the set-up operation the parameters are set to appropriate values for the actual installation. These values are saved in the AST 5P memory, and should also be recorded manually, for example in a set-up list like the one in Appendix 1.
Set-up can be performed locally by the keys and the display on the front panel of AST 5P. Set-up can also be performed from a connected control unit, preferably using the deltaCOM program from BLH Nobel.

Enter 'Normal set-up'

> ***WARNING***
> *When AST 5P is in Set-up mode, all normal measuring is stopped.*

From any of the views in Operating mode, switch-over to 'Normal set-up' takes place when the keys ⇧ and + are activated simultaneously for 2 seconds.
(Possibly after entry of a correct password).

Menu survey

All parameters in AST 5P are accessible for editing by 'Normal set-up'.
The parameters are divided in groups under the main menus, see figure 6 and 7.
Each main menu with its parameters is also presented later in this section.

As shown in the figures, the keys − and + are used to step backwards and forwards in the sequence of main menus.

As a main menu is displayed, press ↵ to get access to the parameters.

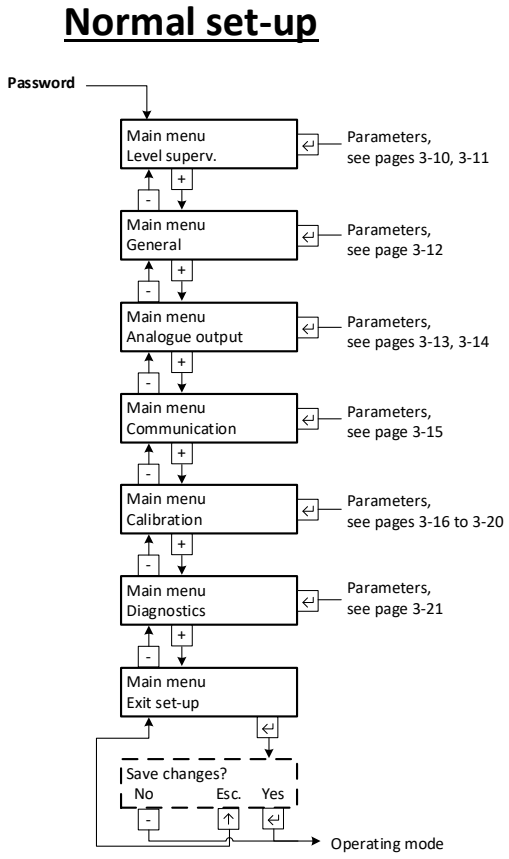


Figure 7. The set-up parameters are grouped under a number of main menus

Main menus

‘Level superv.’
AST 5P has two identical channels for level supervision, called Level 1 and Level 2. Parameters under ‘Level superv.’ are used to activate these channels and to select supervision of the transducer input signal or of the internal weight value.
Switching levels for the two channels are set individually to negative or positive values in a wide range. At the switching levels, a negative or positive hysteresis range can be added, giving a difference in switch level for increasing and decreasing signal.
Status indication for Level 1 and Level 2 are sent on the serial communication.
There are two internal relays that can be set to indicate the status of Level 1 and Level 2, or to indicate when AST 5P is in operation.

‘General’
This main menu contains parameters for general use, like setting of a security lock for entry in the set-up mode, and a password for the lock, setting the type of instrument start up after power-on or reset, automatically or on operator command.
Selection of the language and the number of available views is also set by parameters under ‘General’.

‘Analog output’
The analog output can present the measurement value as current or voltage. Several formats can be selected here. Scaling and adjustment of the output can also be done. Parameters are included to set the analog output to a fixed current or voltage level, independent of the internal weight value.

‘Communication’
The instrument has a serial port for communication purposes. By parameters it can be set for control unit communication with suitable baudrate, data format, and instrument address, or for transmission of the measurement value to an external display unit.

‘Calibration’
‘Calibration’ contains parameters for selection of engineering unit and resolution for the measurement value, setting of capacity for the instrument, and setting of filters to reduce mains frequency interference and to give a suitable bandwidth for the internal signal conversion.
Three calibration types are available:
Data sheet, where information about the used transducers and values from the transducer data sheets are entered.
Dead weight, where the scale is loaded with known weights and the instrument is set to display corresponding weight values.
Table, where recorded values from a previous dead weight calibration of the installation is entered in a replacement instrument.
The calibration types also include parameters for zero setting and indication of the zero offset value.

‘Diagnostics’
Parameters are available to test the digital inputs, the internal relays, and the analog output.

‘Exit set-up’
A sub menu gives the opportunity to save, or to cancel, all edited values before leaving the ‘Normal set-up’.

Editing procedure

To perform editing of a parameter in 'Normal set-up', first go to the main menu that contains the parameter and press ENTER (the ↵ key).
Then use key + or − to step forwards or backwards in the sequence to find the wanted parameter.

As the wanted set-up parameter is displayed, start the editing operation by ↵ .
This will place a flashing cursor to the left on the lower line, and a numerical parameter value will get leading zeros. The cursor indicates that editing can be performed and that the panel key functions will be different.
See also the table on page 2-4.

Key	Function by parameter editing (with cursor)
+	Increment the cursor digit or go to next alternative.
−	Decrement the cursor digit or go to previous alternative.
↵ (short)	Accept the value of the cursor digit and go to next digit.
↵ (2 sec.)	Accept the actual parameter value and finish editing. If a value outside the range for a numeric parameter is entered, an error message is displayed. Then press any key to remove the message, cancel the value, and make continued editing possible.
⇧	Cancel the edited value and interrupt the editing.

As the parameter editing is finished, the set-up mode must be closed to make normal operation possible.

To close the set-up mode,

press ⇧ to get to the main menu,
press + several times until 'Main menu Exit set-up' is displayed,
press ↵ , sub menu 'Save changes? No Esc. Yes' will be displayed.
(Press ⇧ if you do not wish to exit from the set-up mode.)

Answer No (−)	All edited values are cancelled and the parameters will resume their previous values. AST 5P switches over to Operating mode, displaying the weight value.
Answer Yes (↵)	All edited values are saved in the module memory. AST 5P switches over to Operating mode, displaying the weight value.

Parameters

On the following pages all set-up parameters, in groups by the main menus they belong to, are presented in the order they appear in the set-up sequences.
The first line indicates the parameter name and the Modbus addresses, used for set-up by serial communication. The parameters are saved in two different float formats and can therefore be read and written in two different registers.
For choice parameters an index in [ ] is given for each alternative. (These indices are used by set-up via Modbus.)

For numerical parameters a value range is given.

At the end of the table, the default value is given in < >.

To the right there is a short parameter explanation and, *in italic,* the results for the different alternatives.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu Level superv.’

Level 1 source **Modbus: 41000 (46000)**

[0] Not in use
[1] Input sign. mV/V
[2] Weight
<Not in use>

Turns Level 1 off or defines supervision of transducer input signal or internal weight value.
Not in use: *Supervision by Level 1 is turned off.*
Input sign. mV/V: *The transducer input is supervised.*
Weight: *The internal weight value is supervised.*

Level 1 value **Modbus: 41002 (46002)**

Range:
+/-999999 or
+/-4.0000
Unit:
Measurem. unit
or mV/V
<0>

Defines the switch level for Level 1.
This parameter is set to zero if the alternative for Level 1 source is changed.
A suitable engineering unit, depending on the supervised signal, is automatically added.

Level 1 hyst. **Modbus: 41004 (46004)**

Range:
+/-999999 or
+/-4.0000
Unit:
Measurem. unit
or mV/V
<0>

Defines the hysteresis range for Level 1. Positive value gives a hysteresis range above the switch level, negative value gives a range below the switch level.
This parameter is set to zero if the alternative for Level 1 source is changed.
A suitable engineering unit, depending on the supervised signal, is automatically added.

Relay 1 source **Modbus: 41006 (46006)**

[0] Not in use
[1] In process
[2] Above level
[3] Below level
<In process>

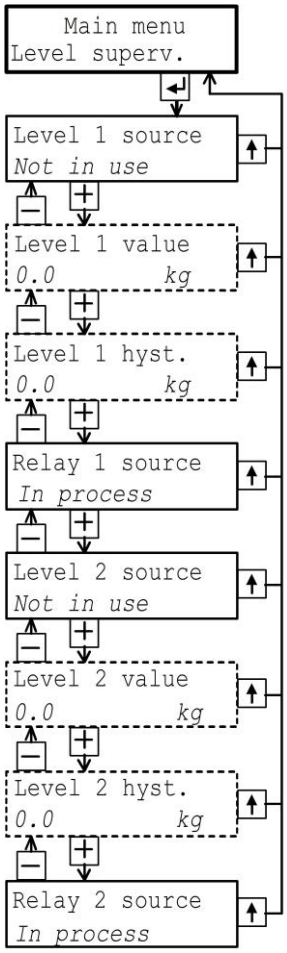
Defines the conditions for activation of Relay 1.
Not in use: *Relay 1 is not in use, deactivated.*
In process: *Relay 1 is active as AST 5P is in operation.*
Above level: *Relay 1 is active as the supervised signal level is above ‘Level 1 value’.*
Below level: *Relay 1 is active as the supervised signal level is below ‘Level 1 value’.*

[index]	Range/Alternative <default value>	Explanation and result of alternatives

Level 2 source **Modbus: 41008 (46008)**

[0] Not in use
[1] Input sign. mV/V
[2] Weight
<Not in use>

Turns Level 2 off or defines supervision of transducer input signal or internal weight value.
Not in use: *Supervision by Level 2 is turned off.*
Input sign. mV/V: *The transducer input is supervised.*
Weight: *The internal weight value is supervised.*



Level 2 value **Modbus: 41010 (46010)**

Range:
+/-999999 or
+/-4.0000
Unit:
Measurem. unit
or mV/V
<0>

Defines the switch level for Level 2. This parameter is set to zero if the alternative for Level 2 source is changed.
A suitable engineering unit, depending on the supervised signal, is automatically added.

Level 2 hyst. **Modbus: 41012 (46012)**

Range:
+/-999999 or
+/-4.0000
Unit:
Measurem. unit
or mV/V
<0>

Defines the hysteresis range for Level 2. Positive value gives a hysteresis range above the switch level, negative value a range below the switch level. This parameter is set to zero if the alternative for Level 2 source is changed.
A suitable engineering unit, depending on the supervised signal, is automatically added.

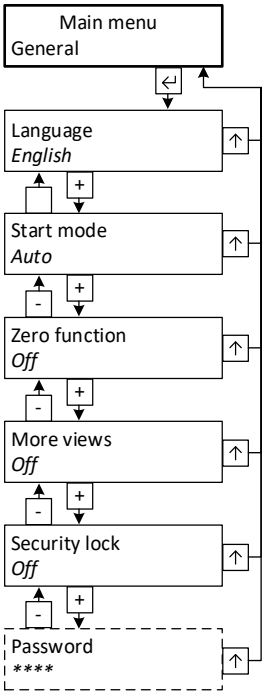
Relay 2 source **Modbus: 41014 (46014)**

[0] Not in use
[1] In process
[2] Above level
[3] Below level
<In process>

Defines the conditions for activation of Relay 2.
Not in use: *Relay 2 is not in use, deactivated.*
In process: *Relay 2 is active as AST 5P is in operation.*
Above level: *Relay 2 is active as the supervised signal level is above 'Level 2 value'.*
Below level: *Relay 2 is active as the supervised signal level is below 'Level 2 value'.*

[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu General’



Language **Modbus: 41016 (46016)**

[0] Svenska
[1] English
[2] Deutsch
[3] Français
<English>

Defines the language to be used in parameters and messages.

Start mode **Modbus: 41018 (46018)**

[0] Command
[1] Auto
<Auto>

Defines the start mode after power-on or reset.
Command: *A ‘start operation’ command from control computer or panel key is required for start up.*
Auto: *Automatic start up.*

Zero function **Modbus: 41022 (46022)**

[0] Off
[1] On
<Off>

Off: *The ‘Zero setting’ view in Operating mode is not available.*
On: *‘Zero setting’ is available.*

More views **Modbus: 41024 (46024)**

[0] Off
[1] On
<Off>

Off: *The views ‘Analog output signal’, ‘Level settings’, ‘Input signal’, and ‘Serial no., Progr.’ are not available in Operating mode.*
On: *These views are available.*

Security lock **Modbus: 41026 (46026)**

[0] Off
[1] On
<Off>

Off: *No security lock is activated.*
On: *A security lock is activated, preventing unauthorised entry in Set-up mode.*

Password **Modbus: 41028 (46028)**

Range:
0001 – 9999
<1937>

Defines the valid password for the security lock.
The code is represented by four asterisks, until editing is started.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu Analogue output’

Ana. output type **Modbus: 41030 (46030)**

[0]	+/-20mA	Defines the type of signal, used to represent
[1]	-12–20mA	the weight value at the analog output.
[2]	0–20mA	***+/-20mA, -12–20mA:*** *bipolar current output,*
[3]	4–20mA	***0–20mA, 4–20mA:*** *monopolar current output,*
[4]	+/-10V	***+/-10V:*** *bipolar voltage output,*
[5]	0–10V	***0–10V:*** *monopolar voltage output.*
[6]	Fixed+/-20mA	An output signal, independent of the weight value
[7]	Fixed+/-10V	can also be selected.
	<4–20mA>	***Fixed+/-20mA:*** *fixed current output,*
		Fixed+/-10V: *fixed voltage output.*

Ana. range low **Modbus: 41032 (46032)**

Range:	Defines the weight value that should give the lowest
+/-999999	value (0 mA, 4 mA or 0 V) at the analog output.
Unit:	The value automatically changes to 0 if parameter
Measurem. unit	‘Capacity’ in ‘Quick set-up’ is changed.
<0>	This parameter is not shown if a Fixed output type
	is selected in ‘Ana. output type’.

Ana. range high **Modbus: 41034 (46034)**

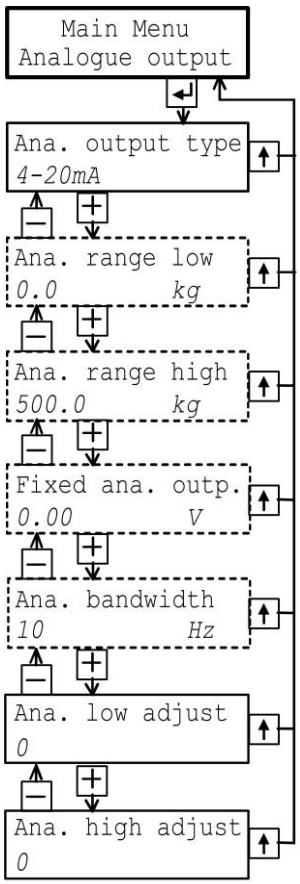
Range:	Defines the weight value that should give the highest
+/-999999	analog output (20 mA or 10 V).
Unit:	The value changes to the capacity value if parameter
Measurem. unit	‘Capacity’ in ‘Quick set-up’ is edited.
<500>	This parameter is not shown if a Fixed output type
	is selected in ‘Ana. output type’.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

Fixed ana. outp. **Modbus: 41036 (46036)**

Range:
+/-22.00 or
+/-11.00
Unit: mA or V
<0>

Defines the fixed signal value at the analog output.
The range and unit depends on the alternative for 'Ana. output type', and the value automatically changes to zero each time 'Ana. output type' is changed.
This parameter is shown only if a Fixed output type is selected in 'Ana. output type'.



Ana. bandwidth **Modbus: 41038 (46038)**

[0]	0.05	Hz
[1]	0.1	Hz
[2]	0.2	Hz
[3]	0.5	Hz
[4]	1	Hz
[5]	2	Hz
[6]	5	Hz
[7]	10	Hz
[8]	20	Hz
[9]	50	Hz
[10]	100	Hz
	<10	Hz>

Defines the bandwidth for the analog output.
Low bandwidth value *improves suppression of unstable transducer signal, but also delays the response to fast transducer signal changes.*
High bandwidth value *gives fast response to transducer signal changes, but reduces the accuracy of the analog output.*
This parameter is not shown if a Fixed output type is selected in 'Ana. output type'.

Ana. low adjust **Modbus: 41040 (46040)**

Range:
+/-999
<0>

As this parameter is edited, the analog output is activated with the lowest output signal (0 mA, 4 mA or 0 V).
The signal level can be adjusted to give wanted reading at the analog instrument.
The adjustment range corresponds to about ±2 % of maximum analog output.
The parameter value will be set to zero each time 'Ana. output type' is changed.

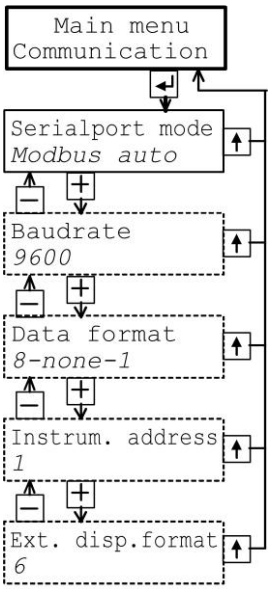
Ana. high adjust **Modbus: 41042 (46042)**

Range:
+/-999
<0>

As this parameter is edited, the analog output is activated with the highest output signal (20 mA or 10 V). The signal level can be adjusted to give wanted reading at the analog instrument.
The adjustment range corresponds to about ±2 % of maximum analog output.
The parameter value will be set to zero each time 'Ana. output type' is changed.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu Communication’



Serialport mode **Modbus: 41044 (46044)**

[0] Not in use
[1] Modbus
[2] Modbus auto
[3] External display
<Modbus>

Defines the serial port use.
Not in use: *The serial port is not used.*
Modbus: *Communication with a control unit.*
Modbus auto: *The control unit baudrate (from 9600) and bit configuration (8-none-1, 8-even-1 or 8-odd-1) is autodetected and used by AST 5.*
External display: *The serial port is used for transmission of the measurement value to an external display unit.*

Baudrate **Modbus: 41046 (46046)**

[0] 300
[1] 600
[2] 1200
[3] 2400
[4] 4800
[5] 9600
[6] 19200
[7] 38400
[8] 57600
[9] 115200
<9600>

Defines the baudrate for the serial communication.
The parameter must be set to the baudrate of the control computer, or to a baudrate suitable for the external display unit.
This menu is not shown if ‘Modbus auto’ is selected in ‘Serialport mode’.

Data format **Modbus: 41048 (46048)**

[0] 7-none-2
[1] 7-even-1
[2] 7-even-2
[3] 7-odd-1
[4] 7-odd-2
[5] 8-none-1
[6] 8-none-2
[7] 8-even-1
[8] 8-odd-1
<8-none-1>

Defines the bit configuration for the serial communication.
This parameter must be set to the same configuration as for the control computer, or to a configuration suitable for the external display unit.
This menu is not shown if ‘Modbus auto’ is selected in ‘Serialport mode’.

Instrum. address **Modbus: 41050 (46050)**

Range:
1 to 247
<1>

Defines the address for the AST 5P-unit.
Shown only if ‘Modbus’ or ‘Modbus auto’ is selected in ‘Serialport mode’.

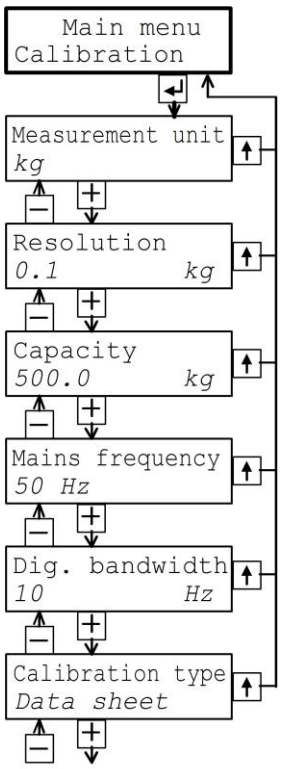
Ext. disp.format **Modbus: 41052 (46052)**

[0] 4
[1] 5
[2] 6
[3] 7
<6 >

Defines the number of digits on the external display unit.
See section 6, Communication, for further information.
Shown only if ‘External display’ is selected in ‘Serialport mode’.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu Calibration’



Measurement unit **Modbus: 41054 (46054)**

Defines the engineering unit that should be used for the measurement value and for related set-up parameters.

[0] NONE
[1] g
[2] kg
[3] t
[4] lb
[5] N
[6] kN
[7] oz
[8] psi
[9] kPa
[10] MPa
[11] bar
[12] l
[13] lbf
[14] kgf
[15] PLI
[16] N/m
[17] kN/m
[18] Nm
[19] daN
<kg>

Resolution **Modbus: 41056 (46056)**

Defines the decimal point position and resolution format for the displayed value. All set-up parameters using the measurement unit will be written with the decimal point position selected here. If the last digits of the weight value are not stable, a more coarse resolution can be selected to get a stable reading.

[0] 0.001
[1] 0.002
[2] 0.005
[3] 0.01
[4] 0.02
[5] 0.05
[6] 0.1
[7] 0.2
[8] 0.5
[9] 1
[10] 2
[11] 5
[12] 10
[13] 20
[14] 50
<0.1>

Capacity **Modbus: 41058 (46058)**

Range:
0.5 to 999999
<500>

Defines the nominal range for the analog output.

[index]	Range/Alternative <default value>	Explanation and result of alternatives

Mains frequency **Modbus: 41060 (46060)**

[0] 50 Hz
[1] 60 Hz
<50 Hz>

Defines a filter for suppression of mains frequency noise.
50 Hz: *50 Hz filter activated.*
60 Hz: *60 Hz filter activated.*

Dig. bandwidth **Modbus: 41062 (46062)**

[0] 0.05 Hz
[1] 0.1 Hz
[2] 0.2 Hz
[3] 0.5 Hz
[4] 1 Hz
[5] 2 Hz
[6] 5 Hz
[7] 10 Hz
[8] 20 Hz
[9] 50 Hz
[10] 100 Hz
<10 Hz>

Defines the bandwidth of a filter for the internal weight value that is displayed at the front panel and can be sent to a connected control unit.
Low value: *Improves suppression of unstable transducer signal, but delays the response to fast changes in the transducer signal.*
High value: *Gives fast response to changes in the transducer signal, but a less stable value.*

Calibration type **Modbus: 41064 (46064)**

[0] Data sheet
[1] Deadweight
[2] Table
<Data sheet>

Defines the type of calibration to be performed.
Data sheet: *Data sheet calibration is easy to use and doesn't demand any reference equipment, except data from the transducer data sheet.*
Deadweight: *Dead weight calibration is normally the most accurate calibration type. It requires known weights to at least 2/3 of the wanted measuring range.*
Table: *Table calibration is used to enter recorded values from a previous calibration of the measuring equipment to a replacement instrument.*

[index]	Range/Alternative <default value>	Explanation and result of alternatives

'Data sheet'

Conv. factor **Modbus: 41066 (46066)**

Range: 0.01 to 99 <9.80665>

Defines the relationship between a measurement value expressed in data sheet unit and expressed in the selected measurement unit.

Number of transd **Modbus: 41068 (46068)**

Range: 1 to 4 <3>

Defines the total number of transducers and fixed support points in the scale installation. All transducers must have equal rated load. If the total number is over 4: enter 1 here.

Rated load **Modbus: 41070 (46070)**

Range: 1 to 999999 Unit: Data sheet unit <2000.0>

Defines the rated load for one transducer, expressed in the unit of the transducer data sheet.
*** **Note!** If, for example, the data sheet value is 5 kN, the parameter should be set to 5 000 (N).***
If the total number of transducers and fixed supports is over 4: multiply that number with the rated load for one transducer and enter the result here.

Rated output 1 **Modbus: 41072 (46072)**

Range: 0 – +9.99999 Unit: mV/V <2.03900>

Defines rated output for transducer 1, specified in the data sheet.
If the total number of transducers and fixed supports is over 4: add up all rated output values, divide by the number of transducers, and enter the result here.

Rated output 2 **Modbus: 41074 (46074)**

Range: 0 – +9.99999 Unit: mV/V <2.03900>

Defines the rated output signal for transducer 2.
The value is specified in the transducer data sheet.

Rated output 3 **Modbus: 41076 (46076)**

Range: 0 – +9.99999 Unit: mV/V <2.03900>

Defines the rated output signal for transducer 3.
The value is specified in the transducer data sheet.

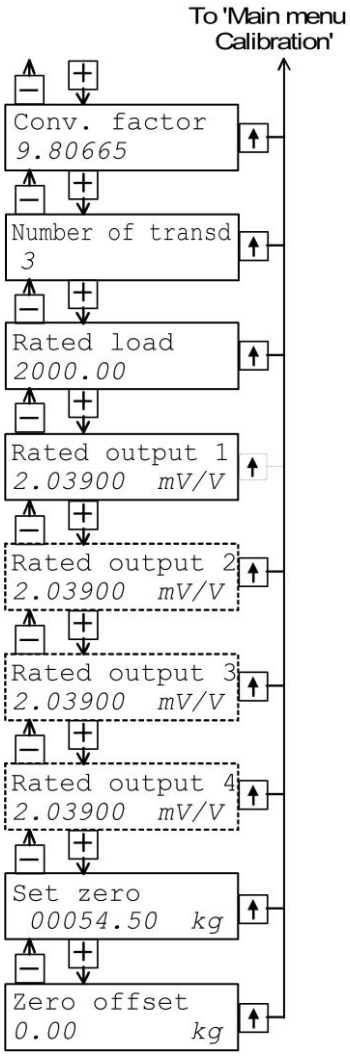
Rated output 4 **Modbus: 41078 (46078)**

Range: 0 – +9.99999 Unit: mV/V <2.03900>

Defines the rated output signal for transducer 4.
The value is specified in the transducer data sheet.

Set zero **Modbus: 41088 (46088)** and
Zero offset **Modbus: 41090 (46090)**

See under 'Deadweight' on page 3-20.



[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Deadweight’

Value cal. p.1 **Modbus: 41080 (46080)**

Range: +/-999999
Unit: Measurem. unit
<0>

The scale is calibrated at two points, normally unloaded and loaded to at least 2/3 of the wanted range.
This parameter defines the load on the scale at the lower calibration point, normally 0.

Value cal. p.2 **Modbus: 41082 (46082)**

Range: +/-999999
Unit: Measurem. unit
<500>

This parameter defines the load on the scale at the higher calibration point, at least 2/3 of the wanted range.

Transd.sign. p.1 **Modbus: 41084 (46084)**

Range: +/-9.99999
Unit: mV/V
<0.00000>

This parameter indicates the transducer signal at the lower calibration point.
The value can not be edited.

Transd.sign. p.2 **Modbus: 41086 (46086)**

Range: +/-9.99999
Unit: mV/V
<1.66631>

This parameter indicates the transducer signal at the higher calibration point.
The value can not be edited.

Set zero **Modbus: 41088 (46088)**

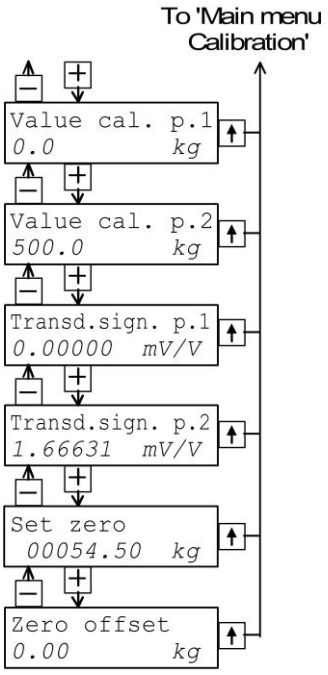
Range: +/-999999
Unit: Measurem. unit
<‘Live’>

The actual weight value is displayed. Enter the wanted value for the actual load, usually '0', i.e. unloaded scale.
*** **Note!** This parameter should be used for zeroing of the instrument.***

Zero offset **Modbus: 41090 (46090)**

Range: +/-999999
Unit: Measurem. unit
<0>

This parameter indicates the offset value acquired by zeroing in ‘Set zero’.
If this parameter is edited, the zeroing will be influenced.



[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Table’

Value cal. p.1 **Modbus: 41080 (46080)**

Range: +/-999999
Unit: Measurem. unit
<0>

Calibration with recorded values from a previous dead weight calibration. This parameter should be set to the recorded value for the load on the scale at the lower calibration point.

Value cal. p.2 **Modbus: 41082 (46082)**

Range: +/-999999
Unit: Measurem. unit
<500>

This parameter should be set to the recorded value for the load on the scale at the higher calibration point.

Transd.sign. p.1 **Modbus: 41084 (46084)**

Range: +/-9.99999
Unit: mV/V
<0.00000>

This parameter should be set to the recorded value of the transducer signal at the lower calibration point.

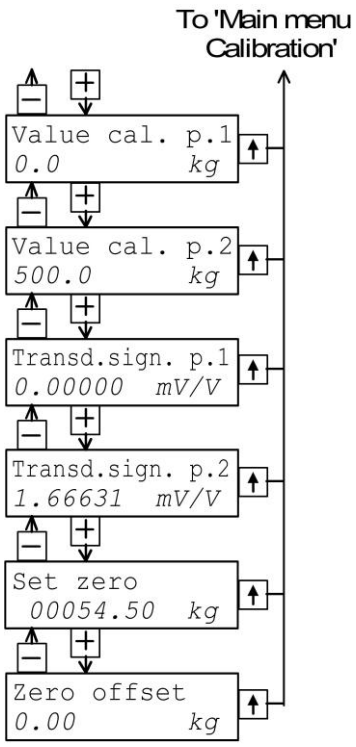
Transd.sign. p.2 **Modbus: 41086 (46086)**

Range: +/-9.99999
Unit: mV/V
<1.66631>

This parameter should be set to the recorded value of the transducer signal at the higher calibration point.

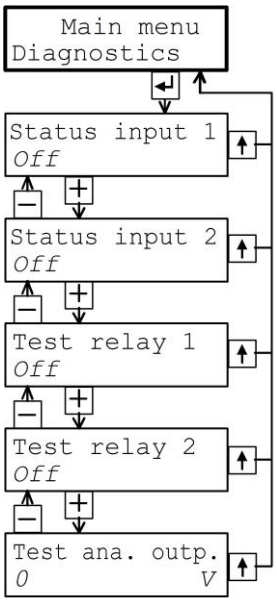
Set zero **Modbus: 41088 (46088)** and
Zero offset **Modbus: 41090 (46090)**

See under ‘Deadweight’ on page 3-20.



[index]	Range/Alternative <default value>	Explanation and result of alternatives

‘Main menu Diagnostics’



Status input 1 **Modbus: 41360 (46360)**

[0] Off
[1] On

Displays the status of digital input 1.
No changes can be made.

Status input 2 **Modbus: 41362 (46362)**

[0] Off
[1] On

Displays the status of digital input 2.
No changes can be made.

Test relay 1 **Modbus: 41364 (46364)**

[0] Off
[1] On
<Off>

This parameter controls the status for relay 1.
Off: *Relay 1 is deactivated.*
On: *Relay 1 is activated.*

Test relay 2 **Modbus: 41366 (46366)**

[0] Off
[1] On
<Off>

This parameter controls the status for relay 2.
Off: *Relay 2 is deactivated.*
On: *Relay 2 is activated.*

Test ana. outp. **Modbus: 41368 (46368)**

Range:
See explanation
Unit: mA or V
<0>

Setting of a fixed value at the analog output.
A suitable unit is added automatically.

Range: Depends on selected ‘Ana. output type’.

‘Main menu Exit set-up’

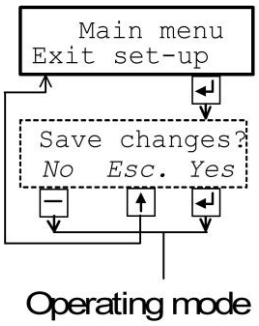
Save changes?

Range:
No,
Esc.,
Yes

To exit from Set-up mode,
press ↵ in ‘Main menu Exit set-up’.
If any parameter values have been changed ‘Save changes? No Esc. Yes’ is displayed.
(Press ⇧ if you do not wish to exit from the set-up mode.)

Press ↵ (Yes) to exit from Set-up mode and save the new parameter values.
Press − (No) to exit from Set-up mode and cancel the new parameter values.

This finishes the set-up operation,
AST 5P will switch over to Operating mode, displaying the ‘Weight value’.



4. Calibration

General

When measuring with AST 5P, the transducer output signal, corresponding to the transducer load, is converted to a weight value and presented at the analog output, at the panel or at a connected control unit. The conversion is controlled by several parameter values, defined in the calibration.

Three calibration types are supported in AST 5P:

- **Data sheet calibration -** entry of values from the transducer data sheet.
- **Dead weight calibration -** entry of values for certain known loads.
- **Table calibration -** entry of recorded values from a previous calibration.

It is recommended to start with a data sheet calibration, which is easy to accomplish and will give a fairly good accuracy.
To get the best accuracy a dead weight calibration, with known loads to at least 2/3 of the measuring capacity, must be performed.
After calibration the parameter values should be recorded. See Appendix 1.
If the transmitter module must be replaced, the recorded values can be used to make a table calibration for the new module.

All calibration parameters are collected under ‘Main menu Calibration’.
See section 3 “Set-up” section “Parameters” and Figure 6.

In weighing applications, it is essential for correct results that fixed mechanical connections to the scale are avoided. Necessary connections must be flexible and perpendicular to the measuring direction. If the scale has several transducers connected in parallel, they must have the same rated load and impedance.
If fixed supports and transducers are combined, the load must be evenly distributed on all the support points.

Load Cell

Type:	KIS-1R	Rated Load:	50 kN
Serial No:	378210	Over Load Safe:	100% R.L.
Part No:	1157652	Over Load Ultimate:	200% R.L.
		Side Load Safe:	100% R.L.
		Side Load Ultimate:	200% R.L.

Electrical

Electrical Connection SHIELDED 4-CONDUCTOR CABLE

Signal Positive:	WHITE WITH GREEN STRIPE	Excitation Positive:	GREEN WITH RED STRIPE
Signal Negative:	RED WITH WHITE STRIPE	Excitation Negative:	BLACK

Excitation Voltage (Recommended):	10 V AC OR DC
Excitation Voltage (Maximum):	18 V AC OR DC
Input Resistance:	349.55 Ω
Output Resistance:	349.65 Ω

Temperature

Range:	-40 TO +80°C
Compensated Range:	-10 TO +50°C
Effect On Output:	0.0015 % of Output/°C
Effect On Zero Balance:	0.003 % of R.O./°C

Performance

Rated Output (R.O.):	2.0439 mV/V
Non Linearity:	0.0211 % R.O.
Zero Balance:	0.1889 % R.O.
Creep 5 Minutes:	0.0039 % R.O.

Calibration Values (Tolerance 0.1%)

Shunt Resistor Connected Between Excitation Negative And Signal Negative

40 kΩ Corresponds To:	49.942 kN
80 kΩ Corresponds To:	25.039 kN

Figure 8. Each transducer from Nobel Weighing Systems is delivered with a detailed data and calibration sheet

Common calibration parameters

For all the calibration types, measurement unit and resolution for the weight value and some other characteristics must be specified. The sequence of these parameters, common for all calibration types is given on pages 3-16 and 3-17.

The parameter ‘Measurement unit’ defines the engineering unit used for the weight value. This engineering unit will also be used for the Resolution and Capacity, for the Level values and for set-up of the analog output.

The ‘Resolution’ parameter defines the number of decimals and the resolution for the weight value, displayed or transmitted to external equipment.
If the weight value is unstable, reduced resolution will give a more stable reading with reduced accuracy.

‘Capacity’ is a parameter, defining which weight value that will give full range signal at the analog output.
(The weight values corresponding to the highest and the lowest analog output signals may also set by parameters under ‘Main menu Analog output’.)

The parameter ‘Mains frequency’ controls filters for suppression of induced low frequency noise. It should be set to the surrounding mains frequency.

The parameter ‘Dig. bandwidth’ controls the filtering of the internal measurement signal. Low digital bandwidth gives a suppression of oscillations in the signal, making the reading more stable. High digital bandwidth makes it possible to detect fast changes in the measurement value.

In the following parameters under ‘Calibration’, calibration type and parameter values for the latest performed calibration are displayed.

If ‘Calibration type’ is not edited, the parameter values from previous calibration, including the zero offset value, will be displayed.
If ‘Calibration type’ is edited, even if it is not changed, the zero offset value will be set to zero, so at least a new zeroing is required.

Editing of parameter values, including the type of calibration, should be performed according to instructions on page 3-9.

Example:
Select a different type of calibration in ‘Calibration type’

1. As menu ‘Calibration type’ is displayed, press  and a cursor will be flashing at the first character on the lower line.
2. Find the wanted calibration type, using the key  or  until the correct alternative is displayed.
3. Accept the displayed calibration type by pressing  for 2 seconds. The cursor disappears and the selected calibration type will be displayed.

Data sheet calibration

Data sheet calibration is the default value for ‘Calibration type’ because it is recommended as first-time calibration for AST 5P. An accuracy of 0.1 % can be obtained without use of known loads etc. By data sheet calibration in weighing applications it is essential that no external forces influence the scale installation. By data sheet calibration, values from the transducer data sheets should be entered as parameter values.

Conv. factor
The transducer is often calibrated in an engineering unit which differs from the wanted unit of the displayed measurement value. This parameter defines a constant by which a weight value, expressed in the instrument measurement unit, should be multiplied to be expressed in the data sheet unit.
When using a transducer, calibrated in Newton, in a scale displaying weight values in kg, the ‘Conv. factor’ should be the local gravitation constant in m/s^2.
The default value, 9.80665, is an international mean value for the gravitation constant (world-wide range 9.78 – 9.83).
If the data sheet unit is the same as the measurement unit, the conversion factor parameter value should be set to 1.0000.

Number of transd.
In weighing applications the load on the scale may be supported by several transducers and fixed supports. This parameter value defines the total number, up to four, of transducers and fixed support points.
If the scale has more than four support points this parameter should be set to ‘1’ and the parameter value for ‘Rated load’ and ‘Rated output 1’ should be calculated.

Rated load
Rated load for the used transducer type, expressed in the data sheet unit used to calculate the ‘Conversion factor’, should be entered as parameter value.
*** **Note!** If the data sheet value is 5 kN, this parameter should be set to 5 000 (N).***
If several transducers are used in a scale, they must all have the same rated load.
If the scale has more than four support points, ‘Number of transd’ should be set to ‘1’ and the value of this parameter should be calculated as:
rated load for one transducer, multiplied by the total number of support points.

Rated output 1
Rated output is given in the data sheet for every transducer and should be entered here. Parameters will be available for the number of support points specified in ‘Number of transd’. For fixed supports, the rated output value is 0.00000 (mV/V).

If the scale has more than four support points, ‘Number of transd’ should be set to ‘1’ and the parameter value for ‘Rated output 1’ should be calculated as:
the mean value of rated output for all active transducers.

Set zero
After the data sheet values have been entered as parameter values, the instrument will perform necessary calculations, and a weight value corresponding to the actual load on the transducer will be displayed here.

The parameter value is set to zero as  (enter) is pressed.

This zero value can be accepted, if  is pressed for 2 seconds, or

edited (numerical value) and then accepted, if  is pressed for 2 seconds.

Zero offset
This parameter indicates the zero offset value that is used to get the ‘zero’ value selected for the parameter ‘Set zero’.

Dead weight calibration

This is normally the most accurate calibration type. The transducer signal is measured and stored together with the entered value of the known load (expressed in the selected measurement unit) for two calibration points.
It is essential for good accuracy to utilise calibration points at both ends of the measuring range, for example at zero load and at least 2/3 of rated load.
Make a manual record of all values, see Appendix 1.

Value cal. p.1
This parameter defines the load for the low calibration point. Normally the scale should be unloaded and the parameter value set to 0 (zero). This weight value and the corresponding transducer signal value are saved in the instrument.

Value cal. p.2
This parameter defines the load for the high calibration point. The scale should be loaded with known weights, at least 2/3 of the rated load. This value shall then be entered as parameter value. The entered load value and corresponding transducer signal value are saved in the instrument.

Transd.sign. p.1
This parameter indicates the stored transducer signal value for the low calibration point. The parameter value can not be edited.

Transd.sign. p.2
This parameter indicates the stored transducer signal value for the high calibration point. The parameter value can not be edited.

Set zero
See Data sheet calibration on page 4-3.

Zero offset
See Data sheet calibration on page 4-3.

Table calibration

The table calibration can be used to copy values from a dead weight calibration for AST 5P to a replacement instrument. It is necessary to have access to recorded values from a dead weight calibration in two points.
As Table calibration is selected, the ‘zero offset’ value is <u>not</u> set to zero.

Value cal. p.1, Value cal. p.2
These parameter values should be set to the recorded weight values from a previous calibration for the low calibration point (p.1) and the high calibration point (p.2).

Transd.sign. p.1, Transd.sign. p.2
These parameter values should be set to the recorded transducer signal values from a previous calibration for the corresponding calibration points.

Set zero
See Data sheet calibration on page 4-3.

Zero offset
See Data sheet calibration on page 4-3.

5. Operation

General

Function control and parameter set-up is performed via serial communication from a control unit or locally via the keys and display at the front panel.

Power supply

The signal transmitter is powered by 24 VDC and should not be turned off during week-ends and over-night. Continuous power supply to electronics and transducer prevents moisture condensation in the units.

Power-up sequence

When AST 5P is powered up it displays ‘AST 5P’, the program version, and the serial number of the module for about five seconds while a number of internal tests are performed.
If errors are detected the power-up sequence stops and an error code is displayed. See section Troubleshooting for further information.
If no errors are detected the module enters Operating mode (automatic start-up), displaying the weight value and status for the used relays, or the module enters the ‘Wait for start’ state (by operator start-up), displaying the text ‘Press ENTER to start operation!’. Automatic or operator start-up is selected with the set-up parameter ‘Start mode’ under ’Main menu General’.

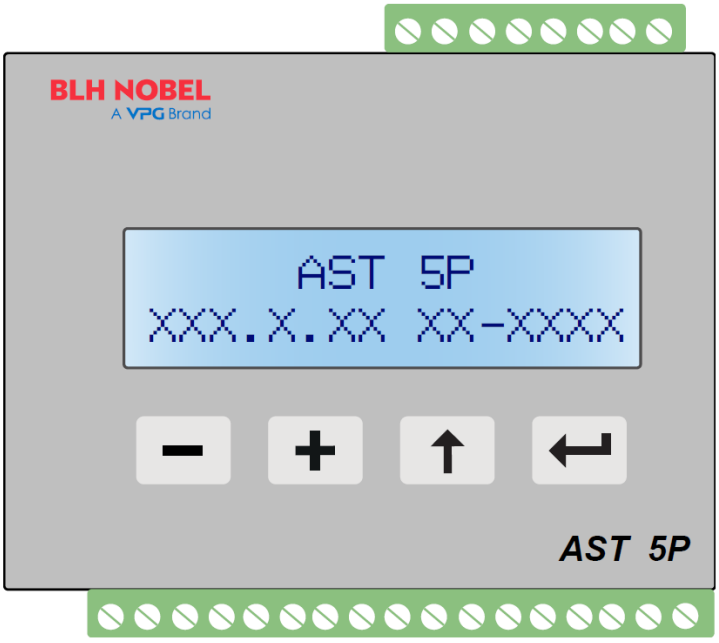


Figure 9. The display of AST 5P during the power-up sequence

Display views in Operating mode

For AST 5P in Operating mode, one of the display views, Weight value, is always available. More views can be set On or Off in parameters under 'Main menu General'.

The panel keys [−] and [+] are used to select among the available views.

In 'Weight value', and in some other views, information about serial communication is given at the end of the upper line:
The module address means communication with a control unit and blink when a correct message has been received.
'EXT' means communication to an external display unit.
No indication in this area means that the serial communication is not in use.

Weight value
This is the first view displayed after power-up, reset or set-up operations.
The upper line displays the actual measurement value, here called weight value, followed by the area with information about the serial communication.
The lower line displays the status for the used relays, R1:/R2: On or Off.

Zero setting
This view can be set On or Off by parameter 'Zero function'. Actual weight value, and information about the serial communication, is displayed. 'Zero' on the lower line indicates that the weight value can be set to zero by ENTER (the key [↵]).

*** **Note!** If AST 5P is unpowered or switched over to Set-up mode, the zero setting by this view will be lost and replaced by the zero setting from the latest calibration.***

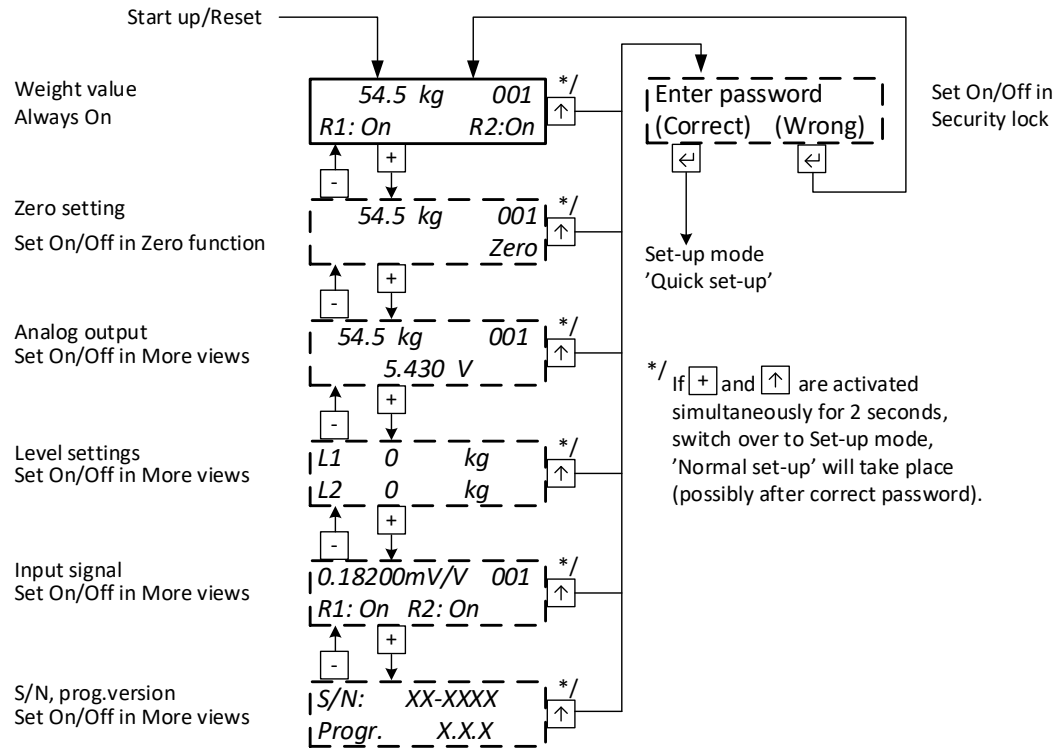


Figure 10. The number of views available in Operating mode depends on several parameter settings

Analog output signal
This view can be set On or Off by parameter ‘More views’.
The upper line displays the actual weight value, followed by the area with information about the serial communication.
The lower line displays the signal at the analog output, a value in V or mA depending on the choice for parameter ‘Ana. output type’.

Level settings
This display can be set On or Off by parameter ‘More views’.
At the upper line the switching level for ‘Level 1’ is displayed.
At the lower line the switching level for ‘Level 2’ is displayed.

Input signal
This display can be set On or Off by parameter ‘More views’.
The upper line displays the transducer input signal for the actual load, a value in mV/V, followed by the area with information about the serial communication.
The lower line displays the states of the used relays, R1:/R2: On or Off.

S/N: Progr.
This display can be set On or Off by parameter ‘More views’.
The upper line displays the serial number for the AST 5P module and the lower line displays the installed program version.

From any of the above views, the AST 5P can be switched to Set-up mode.
‘Quick set-up’ is started if the key ⇧ is pressed for 2 seconds. See Figure 5.
‘Normal set-up’ is started if ⇧ and + are pressed for 2 seconds. See Figure 6.

Zero setting

Zero setting of the weight value is normally performed as the AST 5P unit is calibrated. By calibration the value of the zero offset parameter is permanently saved in the AST 5P memory and can only be changed in Set-up mode. Temporary zero setting can be performed from the zero setting view in Operating mode, enabled by parameter ‘Zero function’ under ‘Main menu General’.
*** **Note!** The zero offset value captured by this method is lost if the AST 5P is unpowered or if Set-up mode is entered.***
A third way of zero setting is via a serial communication command.
*** **Note!** The zero offset value captured by this method is lost if the AST 5P is unpowered or if Set-up mode is entered.***

Analog output

AST 5P has an analog output with several voltage and current output ranges.
The range limits are very precise, but minor adjustment can be done to adapt the output to the external equipment.
A separate analog output filter with a wide span of variable bandwidth can be set to reduce oscillation in the output signal, or to enable registration of fast changes by the analog output.
If an error occurs, the analog output signal will be set to 0 V / 0 mA.
One way to select the range of measurement value, presented at the analog output, is by parameter ‘Capacity’ in ‘Quick set-up’.
Another way is to select any measurement value for the lowest and for the highest output signal respectively under ‘Main menu Analog output’.

The analog output can also be set to precise, fixed voltage or current output, independent of the internal weight value.

Level supervision, relays

Level supervision is used to indicate whether a selected signal is above or below a certain level. In AST 5P two level supervision channels are included. For each channel, supervised signal, switch level, and hysteresis region are set individually by parameters under ‘Main menu Level superv.’.
To get fast response, the analog or digital bandwidth, whichever is highest, is used for the supervision channels. The status of the level supervision channels (above or below Level) are available on the serial communication.

In AST 5P two output relays with switching contacts can be set to indicate either the status of the supervision channels, or if AST 5P is ‘In process’.
If an instrument error occurs, both relays will be deactivated.

See page 3-10 and 3-11 for set-up sequence and parameters for the level supervision.

Level 1 source, Level 2 source
Two signals can be selected for supervision in the two channels:

Input sign. mV/V:	Supervision of the input signal from the transducer.
Weight :	Supervision of the measurement value, named weight value, can be used to keep the load on a scale within given limits, to maintain a working pressure etc.

Level 1 value, Level 2 value
The switching levels are set individually for the two level supervision channels within a wide range of positive and negative values. A suitable engineering unit is automatically added, depending on the selected level source.

Level 1 hyst., Level 2 hyst.
Hysteresis is the difference between the switching level by increasing signal and by decreasing signal. The hysteresis can be set separately for the channels within a wide range of positive and negative values. A suitable engineering unit is automatically added, depending on the selected level source.
The positive hysteresis region is from the Level value and upwards.
The negative hysteresis region is from the Level value and downwards.

Relay 1 source, Relay 2 source
Two relays in AST 5P can be controlled either by the level supervision channels or by the ‘In process’ signal.

In process	The relay is active as AST 5P is in Operating mode.
Above level	The relay is active as the value of the selected signal source is above the set switch level, hysteresis included.
Below level	The relay is active as the value of the selected signal source is below the set switch level, hysteresis included.

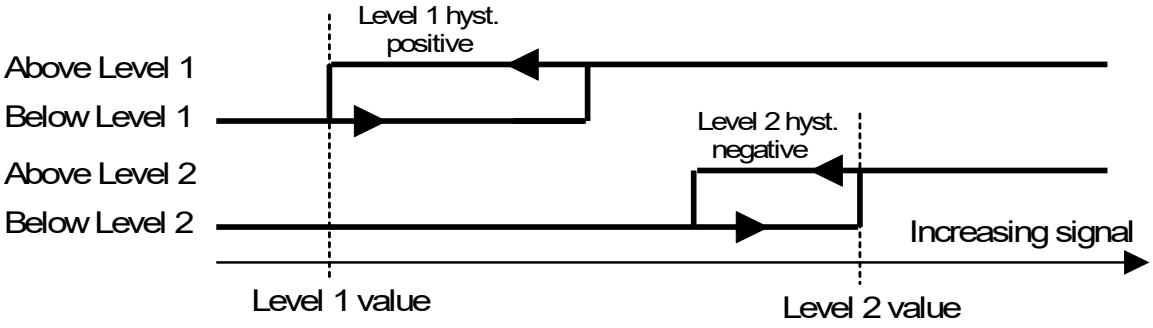


Figure 11. Influence of hysteresis on the indication from level supervision: Level 1 having positive hysteresis and Level 2 having negative hysteresis

Display settings

From any of the views in Operating Mode, the display property menus can be entered by simultaneously pressing the keys [−] and [+] for 2 seconds. Under this menu, you can set the desired brightness and contrast. This can be done without affecting the measurement functions and does not require a password.

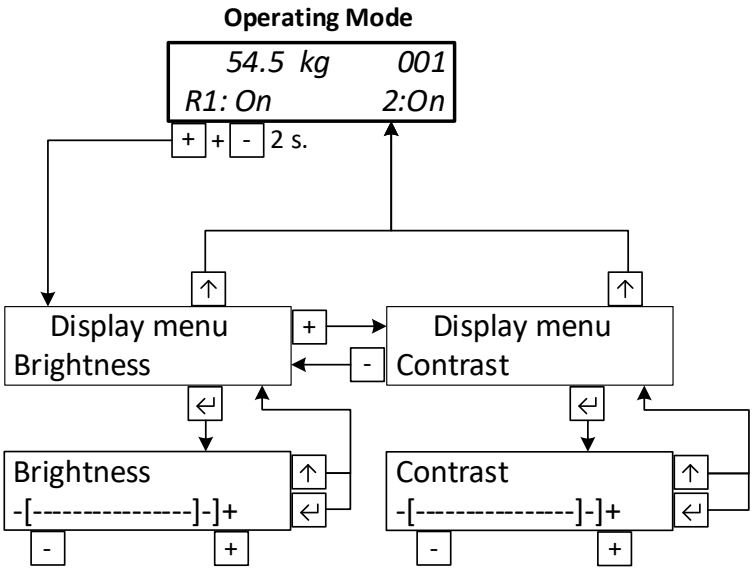
Menu overview

Press [−] or [+] followed by [↵] to select brightness or contrast. Then the current set level is displayed graphically.

Press [−] or [+] to decrease or increase the level, the result is shown immediately.

Press [↵] to accept the changes or press [⇧] to cancel. Accepted change is saved immediately.

Press [⇧] to return to Operating Mode.



6. Communication

The analog signal transmitter AST 5P has one serial communications port, primarily used for communication with a control unit. Alternatively it can be used for data transmission to an external display.

Communication interface

The serial communication utilises RS485 for 2-wire or 4-wire. RS485 is an interface working with differential voltages, giving a noise resistant transmission in a network with several units and long distances. The host computer (master) must have an asynchronous communication port for RS485 or use a converter.
If 2-wire transmission is used, the control unit must be capable of data flow direction control or utilise a converter for automatic data flow direction.
When 4-wire transmission is used, no data flow direction control is needed.

Line termination

To ensure good communication, the RS485 transmission line requires correct termination at both ends. In the AST 5P unit, fail-safe resistors are included, but depending on the installation and the master, external resistors might be needed. At the last unit on the transmission line, terminating resistor(s) must be connected, see section Installation.

If the control unit is connected at one end of the transmission line, refer to the computer manual for line termination.

Transmission principles

All the AST 5P units connected to the network can listen to what is transmitted in the network, but only one unit at a time can transmit. A time-sharing principle is needed to allow communication in both directions (half duplex).

All communication in the network must be initiated by the control unit (master). When AST 5P units are working together with a master, the AST 5P units are all slaves, only allowed to reply to master commands. As the master has sent a command message, addressed to a specific slave unit, it listens for the reply during a specified time, before sending next command message.
If the reply from a slave unit fails it may be due to:

- Mismatch in communication parameters. (baud rate, address, . .)
- More than one slave unit has been transmitting at the same time. This can distort the reply message and make it impossible to decode.

Modbus

General

For communication between AST 5P and a master computer (PLC) the Modbus protocol is used. The Modbus protocol is a standard protocol, used for master/slave communication in the industry. With AST 5P the Modbus RTU protocol is used.

Information is transmitted in blocks of data to minimise polling and response time delays. For example both the error register, status register and weight register could be read with one command to the AST 5P.

When a command that can not be performed is sent, the AST 5P responds with an exception code. For a better explanation of some errors, a special error register could be read.

All register and coils described in this manual uses the standard Modbus (Modicon) register and I/O numbering.
See the Modbus driver documentation for the master if it deviates from the standard Modbus (Modicon) register and I/O numbering.

Setup of Modbus communication

- Set the requested communication parameters ‘Main menu Communication’.
- By default the AST 5P will be given the address 1. If more than one AST 5P is used in a network, each AST 5P must be given a unique address in parameter ‘Instrum. address’. (The address is shown to the right in the AST 5P display and when a correct message is received, it flashes.)

Supported Modbus functions

Function	Description
01 **Read Coil Status**	Reads the ON/OFF state of discrete outputs (0X references, coils). This function is only implemented because some 'masters' use this function to initialise communication (check that communication is working OK). Coil range: 1 – 16 Max number of points to read: 16 Action: AST 5P will respond with zero (OFF) for all requested points.
02 **Read Input Status**	Reads the ON/OFF state of discrete inputs (1X references). This function is implemented only because some 'masters' use this function to initialise communication (check that communication is working OK). Input range: 1 – 16 Max number of points to read: 16 Action: AST 5P will respond with zero (OFF) for all requested points.
03 **Read Holding Reg.**	Reads the binary contents of holding registers (4X references). This function will read selected number of consecutive registers from the AST 5P. Available registers in the AST 5P are described below. Max number of registers to read: 100 Action: AST 5P will respond with the contents of the requested registers.
05 **Force Single Coil**	Forces a single coil (0X references) to either ON or OFF. This function is used to activate actions in the AST 5P (see description of I/O bits later in this chapter). Each of a number of coils or I/O bits, is linked to an action in the AST 5P. The action is activated if the master sets the I/O bit to 'ON'. If the master sets the I/O bit to 'OFF', this is accepted, but the corresponding action is not activated. Coil range: 1 – 110
06 **Preset Single Reg.**	Presets a value into a single holding register (4X references).
08 **Diagnostics**	This function can provide a series of different communication tests, depending on a sub function code. AST 5P supports only sub function code 00, which is a 'loop-back' test. The same data as received will be sent back to the master. Max number of data bytes: 64

Function	Description
15 **Force Multiple Coils**	Forces each coil (0X references) in a sequence of coils to either ON or OFF. This function is used to activate an action in the AST 5P (see description of I/O bits below). Each coil or I/O bit is linked to an action in the AST 5P. The action is activated if the master sets the I/O bit to 'ON'. If the master sets the I/O bit to 'OFF' , this is accepted, but the corresponding action is not activated. *** **Note!** Even though it is possible to set multiple I/O bits (coils) with this function, AST 5P will act on the lowest addressed I/O bit (coil) only. Example: To set coil 8, the first coil to set must be number 8.*** I/O bit (coil) number range: 0 – 110 Max. number of points: 16 (only the first is used)
16 **Preset Multiple Reg.**	Presets values into a sequence of holding registers (4X references). This function will preset values into the selected number of consecutive registers in the AST 5P. Max number of registers to preset: 100

*** **Note!** No broadcast messages are allowed.***

*** **Note!** It is possible to send or fetch any number of registers (max 100) or I/O bits (max. 16). If the master tries to read more registers than there are available, the AST 5P module will send dummy values for those registers not available.***

Data representation

Data values sent to and from the AST 5P uses 16 bit holding registers (40XXX).

All operative parameters: weight, status, etc. are stored in three different register areas in the AST 5P. Which area that should be used depends on the master (PLC).

- Integer area: Two different types
  - 16 bit unsigned integer
  - 32 bit scaled integer
- Float area
- Modicon float area

Operative parameters Integer area

Unsigned integer (1 modbus register)

Error codes, status etc. are saved in one modbus register as an unsigned integer (16 bit number without decimals).

Scaled integer (2 modbus registers + 1 modbus register = 3 modbus registers)

Values bigger than 32767 and values containing decimals (Weight, levels) are always saved in a special 3 register format. The first two registers are used as a 32 bit long integer value (with sign) and the third register is holding the number of decimals in the value.

Example: 12345678 (32 bit number) in the two first registers and 3 in the third register give the value: 12345.678.

Regis-ter	Binary	Hexa-decimal	Decimal	Description
1	0000 0000 1011 1100	00BC	188	The 16 most significant bits in the value.
2	0110 0001 0100 1110	614E	24910	The 16 least significant bits in the value.
3	0000 0000 0000 0011	0003	3	The number of decimals.

Depending on number of decimals, divide the value with a number from these tables.

Decimals	Number to divide with
0	1
1	10
2	100

Decimals	Number to divide with
3	1000
4	10000
5	100000

Calculations in decimal numbers:

First multiply the most significant register with 2^{16} (65536) and add the least significant register to the value.

188 * 2^{16} + 24910 = 12345678

Now divide the number to get the right number of decimals.
The decimal register was set to 3 in this example, which gives the value 10^3 = 1000 to divide with.

12345678 / 1000 = 12345.678

*** **Note!** If your PLC system can't handle 32 bit values, the second register can be used as a 16 bit register with the number of decimals that is indicated in the third register. This will limit the value range to -32768 to +32767. This must be regarded in the calibration of the instrument. A flag in Status register 1 indicates when the weight is bigger than a 16 bit integer. This flag can be checked to be sure that the weight fits in just one register.***

Operative parameters float area & Set-up parameters

The set-up parameters, and the operative parameters are stored as standard IEEE 32 bit float values. Each value has two registers assigned to it.
To read/write a float value an even number of Modbus registers, starting at an even address, must be read/written each time.

The parameters are stored in two different float formats. Some devices may transfer the values with the high order bits in the first register and the low order bits in the second register. Other devices may invert the register order.

Modicon float: For true Modicon PLC's, use these register areas.

Float: Many third party controllers that support Modicon protocol use the float format where all bytes are written out in order to one 32 bit register, as opposed to Modicon float which uses 2 consecutive 16 bit registers. Use these register areas for these types of controllers.

Register description - Process parameters

AST 5P simulates a number of Modicon 'Holding Registers' (registers 4XXXX ...). These are 16 bits binary registers and holds the data that can be transferred between the master and the AST 5P. Some of these registers can only be read from the master, while others can both be read from and written to.
The Modbus function 03 'Read Holding Registers' should be used to read these registers and the Modbus function 05 'Preset Single Register' or 16 'Preset Multiple Registers' should be used to write to the registers.
This table is a summary of all process parameters in the AST 5P.
The leftmost column holds the registers that should be used when float numbers can't be read, and the next two columns hold the register numbers for parameters in float format.

A good way to find out which of the float formats that should be used is to read the 'Instrument type' register (40200/45200) which should equal 5003 for AST 5P.

Register area Integer	**Register area Float (2 reg./value)**	**Register area Modicon float (2 reg./value)**	**Explanation**	**R/W**
40001 (1 reg)	40200	45200	Instrument type	R
40002 (1 reg)	40202	45202	Program number	R
40003 (1 reg)	40204	45204	Program version	R
40004 (3 reg)	40208	45208	Serial number	R
40007 (1 reg)	40210	45210	Command error	R
40008 (1 reg)	40212	45212	Instrument state	R
40009 (1 reg)	40214	45214	Instrument error	R
40010 (1 reg)	40216	45216	Status 1	R
40011 (1 reg)	40218	45218	Status 2	R
40012 (3 reg)	40220	45220	Weight	R
40024 (3 reg)	40228	45228	Analog output value	R
40027 (3 reg)	40230	45230	Input signal (mV/V)	R
40030 (1 reg)	40232	45232	Command register	R/W *
40031 (3 reg)	40234	45234	Level 1 value	R/W
40034 (3 reg)	40236	45236	Level 2 value	R/W
40037 (3 reg)	40238	45238	Analog fixed value	R/W

Important: The weight register should never be read alone because the status of the value is indicated in some other registers. A good choice is to read at least the registers 40009 – 40014 (integer) or the registers 40214 – 40221 (45214 – 45221) (float).

*/ The read value is always 'zero'.

Instrument type register

This is a READ ONLY register.
This register holds the type of the instrument. For AST 5P this value is 5003.

Program number

This is a READ ONLY register.
This register holds the program number of the AST 5P. Normal programs have a value below 100 and special programs a value above 100.

Program version

This is a READ ONLY register.
This register holds the program version of the AST 5P. The value 100 means 1.00.

Serial number

This is a READ ONLY register.
This register holds the serial number of the instrument.
The value 241000 means 24-1000.
This can be used by the master to be sure that an instrument with a specific serial number is used for a special process.

Command error

This is a READ ONLY register.
This register holds the error code when a command has been sent to the AST 5P.
A command that gives 03 as exception will have an error code with a better description of the problem in this register. For an explanation of the error codes see chapter 7 Troubleshooting. Normally this register should contain ‘00’ which means no error. Error codes 100 to 65535 are valid in this register.

Instrument state register

This is a READ ONLY register.
This register contains the state of the AST 5P unit.

Code	Description
00	**'Starting up' state.** The instrument is starting up after a reset or power on.
01	**'Wait for start' state.** The AST 5P is waiting for a start command to go in process.
02	**'Normal' state.** There are no parameter errors in the system. *** **Note!** Weight errors still indicates normal state.***
03	**'Local Set-up' state.** Someone is modifying the set-up parameters from the front of the AST 5P. It's not possible to enter Remote Set-up or Remote Restore state from here.
04	**'Remote Set-up' state.** A master computer is modifying the set-up parameters in the AST 5P. It's not possible to enter Local Set-up state from here.
05	**'Remote Restore' state.** A master computer is restoring a full set-up to the AST 5P. It's not possible to enter Local Set-up state from here.
06	**'Error' state.** An error has been detected during start up of the instrument.
07	**'Fatal error' state.** An error has been detected during start up of the instrument. It's not possible to enter any other state from here.
08	**'Test' state.** AST 5P is running in a special mode used for service and production test.
99	**'Boot' state.** The AST 5P is ready to receive a new program.

Instrument error

This is a READ ONLY register.
This register holds the error code in the AST 5P, for example weight, RAM, Flash, EEPROM errors. For an explanation of the error codes see chapter 7 Troubleshooting. Normally this register should contain '00' which means no error. Error codes 000 to 099 are valid in this register.

Status register 1

This is a READ ONLY register.
The register status bits have the following meaning (bit = 1 means true while bit = 0 means false). (Bit 0 is the least significant bit in the register).
The bits not mentioned in the table are always zero.

Bit no	Function	Comment
1	Weight > INT size	The weight value occupies more than one register. Useful information if the weight in 'scaled integer' format is handled as a 16-bit value.
13	Weight > 6 digits	The weight value is out of precision and should normally not be used.

*** **Note!** When this register is read in the float area a float value representing the bits set, is returned. For example if bit 13 is set the value 8192.0 is returned as a float value, and if both bit 1 and bit 13 is set the value 8194.0 is returned as a float value. To use the value it's a good choice to convert it to an unsigned integer where the bits can be compared.***

Status register 2

This is a READ ONLY register.
The register status bits have the following meaning (bit = 1 means true while bit = 0 means false). (Bit 0 is the least significant bit in the register)
The bits not mentioned in the table are always zero.

Bit no	Function	Comment
0	Relay 1 activated	
1	Relay 2 activated	
4	Power failure	The 'power failure' bit is cleared when a 'Read Holding Reg.' (function 03) command reads this register Status 2 (however, the reply contains the set bit, if it was set).
6	Fixed analog output	The analog output is working in fixed mode, and new fixed values can be loaded in the 'Analog fixed value' register.
7	Digital input 1 activated	There is a 24V signal active on the input.
8	Digital input 2 activated	There is a 24V signal active on the input.
9	Above Level 1	The weight (or mV/V value) is above level 1.
10	Above Level 2	The weight (or mV/V value) is above level 2.
11	Analog output voltage/current	Bit set indicates voltage.

*** **Note!** When this register is read in the float area a float value representing the bits set, is returned. For example if bit 4 is set the value 16.0 is returned as a float value, and if both bit 0 and bit 4 is set the value 17.0 is returned as a float value. To use the value it's a good choice to convert it to an unsigned integer where the bits can be compared.***

Weight

This is a READ ONLY register.
This register holds the weight. The weight should **not** be read alone because the status and error codes are stored in other registers. The weight is only valid when the register 'Instrument error' equals 00.
A good choice is to read at least the registers 40009 – 40014 (integer) or the registers 40214 – 40221 (45214 – 45221) (float).

Analog output value

This is a READ ONLY register.
This register holds the current output signal on the analog output. This register could be used for fault finding in the system.
*** **Note!** The value is rounded off to two decimals.***

Input signal (mV/V)

This is a READ ONLY register.
This register holds the current input signal in mV/V. This register could be used for fault finding in the system.

Command register

As this register is read, the answer will always contain only zeros.
There are a number of actions that can be activated in the AST 5P. The value of this register (when different from zero) will activate one of these actions, as described below. When an action can not be performed for some reason (wrong state etc.) an exception is given as reply. When an exception with code 03 is received, the command error register could be read to get a better error explanation.

Register value	**Action activated in AST 5P**
8	Set to zero This command is used to set the instrument to zero.
16	Start operation When the AST 5P is in 'Wait for start state', this command can be used to start up the instrument.

Level 1 value, Level 2 value

These are READ/WRITE registers.
The registers are used to set temporary levels for the relays. At start up these level values are fetched from corresponding set-up parameters (saved in the memory), which means that the values written to these registers are only valid up to reset or power fail.

Analog fixed value

This is a READ/WRITE register.
The register could be used to set new temporary values on the analog output, when the analog output is configured as ‘Fixed+/-20mA’ or ‘Fixed+/-10V’ in the set-up.
At start up the value is fetched from corresponding set-up parameter (saved in the memory), which means that a value written to this register is only valid up to reset or power fail.

I/O bit (coil) description

AST 5P simulates a number of I/O bits that the master can write to using Modbus function 05 or 15.

Each of these I/O bits, is linked to an action in the AST 5P. The action is activated if the master sets the I/O bit to 'ON'. If the master sets the I/O bit to 'OFF', this is accepted, but the corresponding action is not activated.

All I/O bits are WRITE ONLY. This means the master cannot read the I/O bits but only write to them. An action is performed in the AST 5P when the master writes to an I/O bit. Modbus function 05 'Force Single Coil' or Modbus function 15 'Force Multiple Coils' should be used to write to I/O bits.

*** **Note!** If the master tries to write to more than one I/O bit (Modbus function 15) the AST 5P will act on the lowest I/O bit number only.***

Coil	Action activated in AST 5P	Description
8	Set to zero	This command is used to set the instrument to zero.
16	Start operation	When the AST 5P is in ‘Wait for start state’, this command can be used to start up the instrument.
100	Enter Remote Set-up	This command is used to be able to change the set-up of the AST 5P from remote.
101	Enter Remote Restore	This command is used to be able to restore a saved set-up to the AST 5P from remote.
102	Exit Remote Set-up/Restore and save changes	This is used when the parameters are changed from remote and should be saved in the AST 5P.
103	Exit Set-up without saving changes	This can be used to discard edits made to the set-up parameters, before the set-up is left.
104	Do Reset	This command is used to reset the instrument from remote location.
105	Check set-up data	This command checks that the set-up is correct.

Exception responses

When the master sends a query to a slave it expects a normal response (as described earlier). One of the following three events occur after a query from the master.

1. Normal response.
The slave has received the query without communication error and can handle the query normally. The slave returns a normal response.

2. Communication error.
If the slave does not receive the query due to a communication error, or detects some communication error (parity error or checksum error), **no** response is returned. The master should process a time-out for the query.

3. Command error.
If the slave receives the query without any communication error, but cannot handle the query, e.g. if the command was not valid, the requested register number not valid or AST 5P in a mode where the command was not allowed, then the slave will return an exception response informing the master of the nature of the error.

The following exception codes are possible:

Code	Name	Description
01	Illegal function	Not a valid function code. Valid function codes are 01, 02, 03, 05, 06, 08, 15, 16.
02	Illegal data address	Not a valid data address. See ‘Register description - Process parameters’ for a list of allowed registers.
03	Illegal data value	Value in data query field not valid. To get a better explanation of the error, the ‘command error’ register could be read.

Set-up registers

Set-up registers data area

All set-up parameters are saved in float format and can be read and manipulated by a remote master. Two different types of float formats are supported, which one you should use depends on your Modbus master. To be able to edit the parameters a Coil must first be set to enter set-up remote state.
*** **Note!** Normally the Windows programme deltaCOM, supplied by BLH Nobel, is used to edit parameters from a remote computer, and therefore this information is only useful if you are writing your own set-up program on your master computer. Consult chapter 3 for explanation and location of each set-up parameter.***

Register area Float	Register area Modicon float	Description	R/W
40380	45380	First normal set-up register (normally 41000). If 'Modicon float' is used, add 5000 to this value.	R
40382	45382	Number of normal set-up registers.	R
40384	45384	First application programme specific set-up register. If 'Modicon float' is used, add 5000 to this value.	R
40386	45386	Number of application specific set-up registers (normally 0).	R
40388	45388	Start of special set-up registers (used for diagnostic purposes).	R
40390	45390	Number of special set-up registers (used for diagnostic purposes).	R
40394	45394	Set-up version.	R
40396	45396	Set-up data version.	R
41000 – 41700	46000 – 46700	Set-up registers. Register area containing the set-up registers. See chapter 3 for an explanation of the different parameters.	R/W

How to edit set-up registers

Example: Change resolution to 0.2.

- Start by setting coil 100 'Enter Remote Set-up'.
- Locate the resolution parameter in chapter 3. This gives modbus register 41056.
- Set resolution '0.2' by sending '7' to modbus register '41056'.
- Proceed with changes of all the parameters that are to be changed.
- Finish by setting coil 102 'Exit Remote Set-up/Restore and save changes'.
- The AST 5P makes a reset and the changes go into action.

External display

If the choice ‘External display’ is selected for parameter ‘Serialport mode’, the serial port on the AST 5P can be used for presentation of the weight on an external display unit.
The transmitted weight is adapted for Newport/London large digit indicators with 4, 5, 6 or 7 digits.
To get a working remote display the parameters ‘Baudrate’, ‘Data format’ and 'Ext. disp.format’ must be set to those defined by the remote display.

In the set-up parameter 'Ext disp.format’ the following formats for the transmitted weight value can be selected:

Type	Description
4 (digits)	Four digit indicator. Display: -999 – 9999 (plus possible decimal point).
5 (digits)	Five digit indicator. Display: -9999 – 99999 (plus possible decimal point).
6 (digits)	Six digit indicator. Display: -99999 – 999999 (plus possible decimal point). Possible gross/net indicators will be activated. (GROSS ONLY ON AST).
7 (digits)	Seven digit indicator. Display: -999999 – 9999999 (plus possible decimal point).

Remote display with 4 to 7 digits

The remote display normally shows the current weight, but under the following conditions only ‘dashes’ (-----) are displayed:

- the number of digits in the transmitted weight value is outside the indicators range.
- the instrument is not in normal state or there is a weight error.

Definition of weight value to large digit indicator with 4, 5 or 7 digits:

Character No.	Value alphanumeric.	Value Hex	Function
1		02	Start character (STX).
2 to 5 – 9	0 – 9, . , -	30 – 39, 2E, 2D	*/ Weight value: 4, 5 or 7 digits and a possible decimal point. (The first digit may be a minus sign).
Last		0D	End character (CR).

Definition of weight value to large digit indicator with 6 digits:

Character No.	**Value alphanumeric.**	**Value Hex**	**Function**
1		02	Start character (STX).
2	H, blank	48, 20	This character is present only if 6 digits is selected in 'Ext. disp,format'. H = Left led ON, blank = led's OFF.
3 to 8 or 9	0 – 9, . , -	30 – 39, 2E, 2D	*/ Weight value: 6 digits and a possible decimal point. (The first digit may be a minus sign).
Last		0D	End character (CR).

*** **Note!** */ The number of digits in the weight value (including a minus sign, if present) will equal the number of digits selected in 'Ext. disp.format'. Leading zeros will be added to fill up to the selected number of digits. The decimal point does not occupy any digit position.***

7. Troubleshooting

General

AST 5P has an automatic error checking facility. This serves to facilitate troubleshooting and to ensure that the instrument will function in the best possible manner. The error checking provides guidance on how to deal with the fault or error.

When an error occurs the signal ‘In process’ will be off, the relays will be deactivated, the analog output will be set to 0V / 0mA and an error code will be displayed. This error code can be fetched by Modbus communication to a connected control unit. Some error codes may present an error description corresponding to the error code and hints on how to correct the error.

Error codes

The error codes are divided in four groups, depending on their origin:

- **Weight errors**, occur when transducer signals or output values go out of given ranges.
- **Start-up errors**, occur only during start-up.
- **General errors**, usually occur due to faulty entries from the front panel, alternatively invalid data or unallowed commands from the control unit.
- **Set-up errors**, can only occur during instrument set-up (from the front panel or by serial communication).

On the following pages a summary of all error codes is given (note that code 000 always means 'no error').

Weight errors

The indication is either temporary or stays on until the cause is cured.

Error code	Explanation
000	**No error.** The instrument is in Operating mode and no error is detected.
001	**Instrument in Remote set-up state.** Weight is not valid.
003	**Instrument not in normal state.** Weight is not valid.
005	**Overrange error.** Overrange means that the input signal from the transducer exceeds the operating range.
007	**Under range error.** Under range means that the input signal from the transducer is below the operation range.
010	**Excitation short-circuit.** Excitation signals are outside limits. Either a short-circuit in the excitation circuit or too many transducers connected. (A fault in a transducer or inside the signal transmitter is also possible.) Check transducer connections. See section, 2 Installation.
011, 022	**Sense voltage error.** Sense signals are outside limits. The sense voltage might be too low, unbalanced or has a reversed polarity. (A fault in a transducer or inside the signal transmitter also possible.) Check transducer connections. See section, 2 Installation.
013	**Transducer signal out of range.** The input signal is too large. The measurement signal is too large relative sense signals, or the sense signals is attenuated at the instrument input. Check transducer connections. See section, 2 Installation.
015	**Transducer signal out of range.** The input signal is too low. The measurement signal is too low relative sense signals, or the sense signals is attenuated at the instrument input. Check transducer connections. See section, 2 Installation.
014, 020-021	**Internal signal error.** Signal or sense is too high or low internally in the instrument. Check transducer connections and restart the instrument. See section, 2 Installation. Contact distributor if issue is not resolved.
023-024	**Internal signal conversion error.** Conversion of transducer signal failed internally in the instrument. Check transducer connections and restart the instrument. See section, 2 Installation. Contact distributor if issue is not resolved.

Start-up errors

These error codes can only appear during start-up.

Error code	Explanation
080	**Invalid set-up version.** This error usually occurs at first start-up after a program upgrade. The actual settings have been replaced by default values. Enter set-up mode, perform the necessary editing and save the new parameter settings.
081	**Invalid set-up data.** Indicates faulty parameter checksum. The actual settings have been replaced by default values. Enter set-up mode, perform the necessary editing and save the new parameter settings.
083-084	**Invalid factory calibration.** Invalid factory calibration is a fatal error. It indicates that the range constant stored in the non-volatile memory during manufacture has been corrupted. Specially trained service personnel is required. The distributor must be contacted.
096	**FLASH error in Application program.** Indicates that the loaded application program is incorrect and needs to be upgraded. The message appears only briefly after rebooting, then the device automatically enters upgrade mode. Upgrade the application with the deltaCOM program or contact the distributor if needed.
098	**FLASH error in Bootloader.** Flash memory error is a fatal error. It indicates equipment failure which requires trained service personnel. The distributor must be contacted.
099	**Watchdog error.** If a watchdog error appears the system will be reinitialised. The operator must then send a reset command from the control computer, or power the instrument off and on, to achieve normal operation. The program regularly sends impulses to a special watchdog circuit to ensure that the circuits and the program operate correctly. However, if these impulses for any reason are omitted the watchdog error indication will result.

General errors

These errors generally occur due to faulty entries from the front panel, alternatively invalid data or unallowed commands from the control unit.

Error code	Explanation
100	**Instrument in wrong state.** The transmitted command is not applicable to the present AST 5P mode.
101	**Value too high.** Value over allowed range. Compare with restrictions for the parameter.
102	**Value too low.** Value under allowed range. Compare with restrictions for the parameter.
103	**Illegal start address.** When writing float values or set-up values the start address of the written data must be even.
104	**Illegal number of registers.** When writing float values the number of registers of the written data must be even. This error can also occur when writing scaled integer values.
105	**Illegal value error.** When using scaled integer format the number of decimals must be less than 8.
130	**Enter set-up/restore not allowed.** The transmitted command is not applicable to the present AST 5P mode.
131	**Exit set-up/restore not allowed.** The exit set-up command is only allowed when the instrument state is ”Remote set-up state” or ”Remote restore state”.

Set-up errors

These errors occur only during instrument set-up, from the front panel or by serial communication.

Certain errors depends on more than one set-up parameter and it is the operator's responsibility to locate and correct all faulty set-up parameters.

Error codes 179 – 192 occur when it is not allowed to exit remote set-up or remote restore because of faulty parameter values.

Error code	Explanation
162	**Calibration timeout error.** Transducer signal is not stable within 5 seconds during calibration.
163	**Saving of set-up value not allowed.** Certain set-up parameters are dependent on other parameters and saved automatically when you save a new value for the related set-up. Thereafter, certain automatically saved parameters can only be browsed. If you try to save a new value in one of these set-ups this indication will result.
165	**Too many digits.** The Capacity value has more than the permitted 6 digits. Select a combination of Resolution and Capacity that will result in max. 6 digits plus decimal point.
179	**Bandwidth mismatch.** The ratio between analog and digital bandwidth must not exceed 100. Example: 0.1 Hz ↔ 10 Hz.
188	**Too many digits.** The Capacity value has more than the permitted 6 digits. Select a combination of Resolution and Capacity that will result in max. 6 digits plus decimal point.
189	**Too high transducer signal in cal. point 2.** The mV/V signal in calibration point 2 is too high (often due to a previous, strange data sheet calibration).
190	**Too high transducer signal in cal. point 2.** The mV/V signal in calibration point 2 is too high, due to strange data sheet calibration. The conversion factor, rated load etc. does not correspond to each other.
191	**Illegal calibration direction.** Increasing transducer signal must correspond to increasing weight value.
41000 - 41900	Exit Remote Set-up/Restore not allowed. There is an error in the parameter pointed out by this error code. The parameter value is out of range.

Set-up list for AST 5P

Location/Notes: .....

Progr. version: ..... Ser. no.: ..... Date: .....

Modbus number	Parameter name	Default value	Set-up value	
41000	Level 1 source	Not in use [0]	.....	.....
41002	Level 1 value	0.0	.....	.....
41004	Level 1 hyst.	0.0	.....	.....
41006	Relay 1 source	In process [1]	.....	.....
41008	Level 2 source	Not in use [0]	.....	.....
41010	Level 2 value	0.0	.....	.....
41012	Level 2 hyst.	0.0	.....	.....
41014	Relay 2 source	In process [1]	.....	.....
41016	Language	English [1]	.....	.....
41018	Start mode	Auto [1]	.....	.....
41022	Zero function	Off [0]	.....	.....
41024	More views	Off [0]	.....	.....
41026	Security lock	Off [0]	.....	.....
41028	Password	1937	.....	.....
41030	Ana. output type	4–20mA [3]	.....	.....
41032	Ana. range low	0.0	.....	.....
41034	Ana. range high	500.0	.....	.....
41036	Fixed ana. outp.	0.00	.....	.....
41038	Ana. bandwidth	10 Hz [7]	.....	.....
41040	Ana. low adjust	0	.....	.....
41042	Ana. high adjust	0	.....	.....
41044	Serialport mode	Modbus [1]	.....	.....
41046	Baudrate	9600 [5]	.....	.....
41048	Data format	8-none-1 [5]	.....	.....
41050	Instrum. address	1	.....	.....
41052	Ext. disp.format	6 [2]	.....	.....
41054	Measurement unit	kg [2]	.....	.....
41056	Resolution	0.1 [6]	.....	.....
41058	Capacity	500.0	.....	.....
41060	Mains frequency	50 Hz [0]	.....	.....
41062	Dig. bandwidth	10 Hz [7]	.....	.....
41064	Calibration type	Data sheet [0]	.....	.....

Set-up list for AST 5P

Location/Notes: .....

Progr. version: ..... Ser. no.: ..... Date: .....

Modbus number	Parameter name	Default value	Set-up value	
41066	Conv. factor	9.80665	……...	……...
41068	Number of transd	3	……...	……...
41070	Rated load	2000.0	……...	……...
41072	Rated output 1	2.03900	……...	……...
41074	Rated output 2	2.03900	……...	……...
41076	Rated output 3	2.03900	……...	……...
41078	Rated output 4	2.03900	……...	……...
41080	Value cal. p.1	0.0	……...	……...
41082	Value cal. p.2	500.0	……...	……...
41084	Transd.sign. p.1	0.00000	……...	……...
41086	Transd.sign. p.2	1.66631	……...	……...
41090	Zero offset	0.00	……...	……...

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