SIPART DR22 process controller

Overview

The SIPART DR22 process controller is a digital controller with extended functionality. It offers a large number of prepared functions in its program memory for controlling engineering processes that the user can simply call without programming experience or other aids.

In addition and if necessary, you can easily insert function blocks for computing and logic functions in the input range of the controller. This helps you accomplish an optimal adaptation even to complex tasks.

Application

The SIPART DR22 process controller has a sophisticated adaptation method that significantly simplifies commissioning even of critical controlled systems. The controller hereby determines the optimal control parameters independently on request without requiring the user to have prior knowledge about the process behavior. The applied method is suitable for systems with compensation and acyclic settling behavior. Even larger dead times are taken into account.

The SIPART DR22 controller can be used as:

- Fixed-setpoint controller for control of one, two or three components, optionally also with two setpoints
- DDC fixed-setpoint controller for control of one, two or three components
- SPC controller
- Slave controller (synchronous controller), optionally with internal/external switchover
- Fixed or guided ratio controller with internal/external switchover
- Cascade controller (dual controller)
- Ratio cascade controller (dual controller)
- Override controller (dual controller)
- Dual controller with two independent control channels.

Universal use is supported by the comprehensive hardware features of the device; if necessary, the hardware can be easily expanded by a variety of signal converters (e.g. communication over a serial interface with a higher-level system).

The SIPART DR22 process controller is very generously equipped with indicators. There is one analog and one digital indicator each for the controlled variable as well as the setpoint. The manipulated variable is displayed digitally.

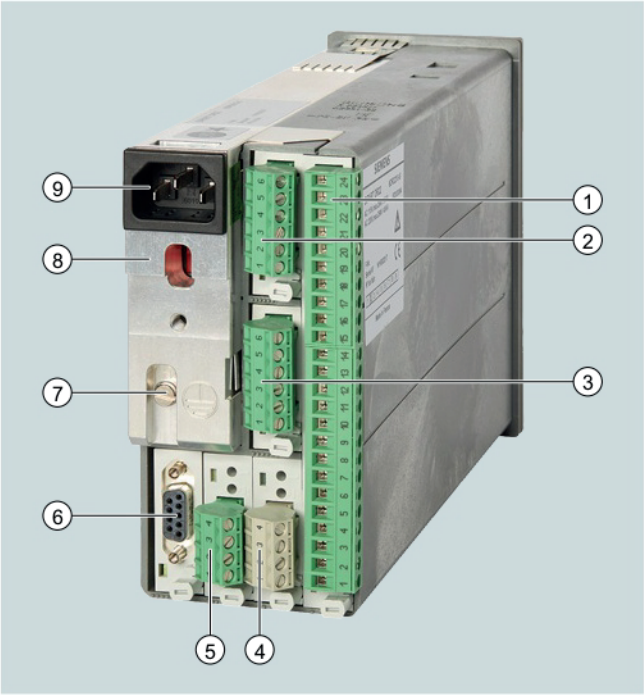
The SIPART DR22 controller can be used either as continuous controller with a current output signal or as three-point step controller for connection of electromotive drives. Split range mode of the C-controller can also be configured.

Design

The SIPART DR22 process controller has a modular structure. The basic unit consists of:

- Front module with the control and display elements
- Main circuit board with CPU and terminal strips
- Polycarbonate enclosure with connector circuit board and power supply unit

The main circuit board has one 10-pin and one 14-pin plug-in terminal strip via which all inputs and outputs of the basic unit are connected. An additional 5 slots are available for function expansion by means of signal converters (see figure). Connection of field signals to the signal converters takes place per module by means of a dedicated plug-in terminal strip or a plug (SES).



SIPART DR22 process controller, rear view

1 Slot 1, main circuit board
2 Slot 6, fitted with module
3 Slot 5, fitted with module
4 Slot 2, fitted with module
5 Slot 3, fitted with module
6 Slot 4, fitted with module
7 Grounding screw
8 Mounting rail (included in the scope of delivery of the relay module)
9 Power plug

The basic unit has:

- 3 analog inputs for voltage signals (0/0.2 to 1 V or 0/2 to 10 V) or current signals (0/4 to 20 mA). The inputs offer galvanic isolation with high common mode rejection.
- 4 binary inputs 0/24 V and 8 binary outputs 0/24 V which can be assigned various functions and can act in a normal or inverted manner.
- 3 analog outputs, current signal 0 to 20 mA or 4 to 20 mA. The analog outputs can be freely assigned to a wide variety of internal controller variables.
- Short-circuit proof *L*+ output (24 V DC, 100 mA) for supplying transmitters.

The power supply unit is in a completely closed metal enclosure.

Available versions:

- 6DR2210-4 for auxiliary power 24 V UC
- 6DR2210-5 for auxiliary power 230 V AC, can be switched to 115 V AC

The measuring point label and the scale can be exchanged.

The number of inputs and outputs can be expanded by additional modules.

Modules are available for:

- Current or voltage input (U/I)
- UNI module for TC/RTD/R/mV

With adapter plug also mA and V; with galvanic isolation

- Resistance input (potentiometer) (R)
- Analog outputs and binary inputs
- Binary inputs and outputs (BE/BA)
- Relay outputs (Rel)
- Serial interface (SES)
- PROFIBUS DP module

Equipment for functional expansion:
See table "Signal converters for SIPART DR22", page 3/16.

Mode of operation

A large number of interconnected functions for controlling process plants is stored in the memory of the digital SIPART DR22. Users themselves structure the controller according to their task by selecting the desired function by setting so-called configuring switches. To solve complex control tasks, the user can release the fixed interconnection of the analog input area and insert a number of prepared computing or logic functions (see figure, page 3/5).

Configuring the device requires neither special programming knowledge nor a specific programming device. The specifically created program is saved in the device.

The user memory can be replaced.

The SIPART DR22 controller can be structured as P, PD, PI or PID controller.

Function

Analog input area

Input area permanently interconnected

During structuring of the device, the analog inputs AE1 to AE11 are assigned freely to the function inputs FE1 to FE12. These function inputs then form the analog input channels of the different controller types.

The meaning of the function inputs FI1 to FI12 is determined by the structured controller type or the output structure of the controller.

Each analog input has a connectable first-order filter to suppress external interferences. In addition, a connectable root-extracting element is contained in each analog input channel.

A function generator (linearizer) with 13 intermediate values for linearizing input signals can be switched into each of the function inputs FI1 and FI3. (The two linearizers can be assigned in any way in the "Freely interconnectable input area").

Freely interconnected input area

In this operating mode, additional computing and logic functions can be inserted between the data sources (analog inputs, parameters, constants) and the data sinks (FI1 to FI 12) (see figure, page 3/5). Like the other structuring of the device, insertion takes place by means of the front module according to a menu-led question/answer procedure or via an interface.

The following data sources/data sinks are contained in the "Freely interconnected input area":

Data sources	
Label	**Explanation**
AE1.A ... AEb.A	Analog signal input (filter/square root extraction)
P01 ... P15	Parameters (setting in onPA)
-1.0 ... +1.0	Constants
BE01 ... BE09	Binary inputs BE1 to BE9
AE1 ... AE5	Single signal sensor break (alarm message)
AE	Group signal sensor break (alarm message)
A1 ... A4	Alarm A1 to A4
Int1 and Int2	Status message operating mode internal controller 1 / controller 2
SPI 1 and SPI 2	Internal setpoint controller 1 and controller 2
SP1 and SP2	Effective setpoint controller 1 and controller 2
YI and YII	Manipulated variable Y controller 1 and controller 2 (C-controller)
SAA1 ... SAA4	Serial analog input (can only be written via interface)
MQ .4 ... no .4	Outputs of the function blocks defined in FdEF (blocks that are not defined are hidden)

Data sinks	
Label	**Explanation**
FI01 ... FI08	Function inputs "analog values" for the structured controller or the hardware outputs of the device.
FI09 ... FI12	Function inputs "analog values" for the structured controller or the analog or binary signals for the hardware outputs of the device.
MI .1 ... no .3	Inputs of the function blocks defined in FdEF (blocks that are not defined are hidden)

The following functions can be inserted (see figure, page 3/5):

- 6 arithmetic blocks (Ar1 to Ar6)
  Each of these 6 arithmetic blocks can be occupied by any of the 4 basic computing types or a combination of them.
- 2 function generators (Fu1 and Fu2)
  Each of these two function generators (linearizers) assigns an output variable in the range -199.9 to +199.9 % to each value of its input variable in the range -10 to +110 % via the function entered by the user; Q = f (*I*).
  The function is entered in increments of 10 % using the 13 intermediate values for -10 to +110 % input signal. Parabolas are placed between the intermediate values by the stored computing program which merge with the intermediate values tangentially so that a constant function results.
- 3 function blocks "Max. selection" (MA1/MA2/MA3)
  A maximum selection of 2 or 3 input variables can be made in each of these 3 function blocks. These function blocks can also be used as minimum limits.
- 3 function blocks "Min. selection" (Mi1/Mi2/Mi3)
  A minimum selection of 2 or 3 input variables can be made in each of these 3 function blocks. These function blocks can also be used as maximum limits.
- 1 correction calculator (rE1)
  The correction calculator is used to calculate the flow of gases from the active pressure p depending on the pressure and temperature. Mass flows and volume flows in relation to the operating state as well as volume flows in relation to the standard state can be corrected. The medium must be in a pure phase, i.e. no separation can take place, for example.
  The following relationship applies to output variable A:

$$A = \sqrt{\Delta p} \cdot \sqrt{f\,(E_2, E_3)}$$

$$f\,(E_2, E_3) = \frac{(P_E\text{-}P_A)\;E_2 + P_A}{(t_E\text{-}t_A)\;E_3 + t_A}$$

With the correction parameters t_A, t_E, P_A and P_E, the measuring ranges are standardized to the calculation state. t_A and P_A can be set in the range from 0.01 to 1.000, t_E and P_E in the range from 1.000 to 99.99.

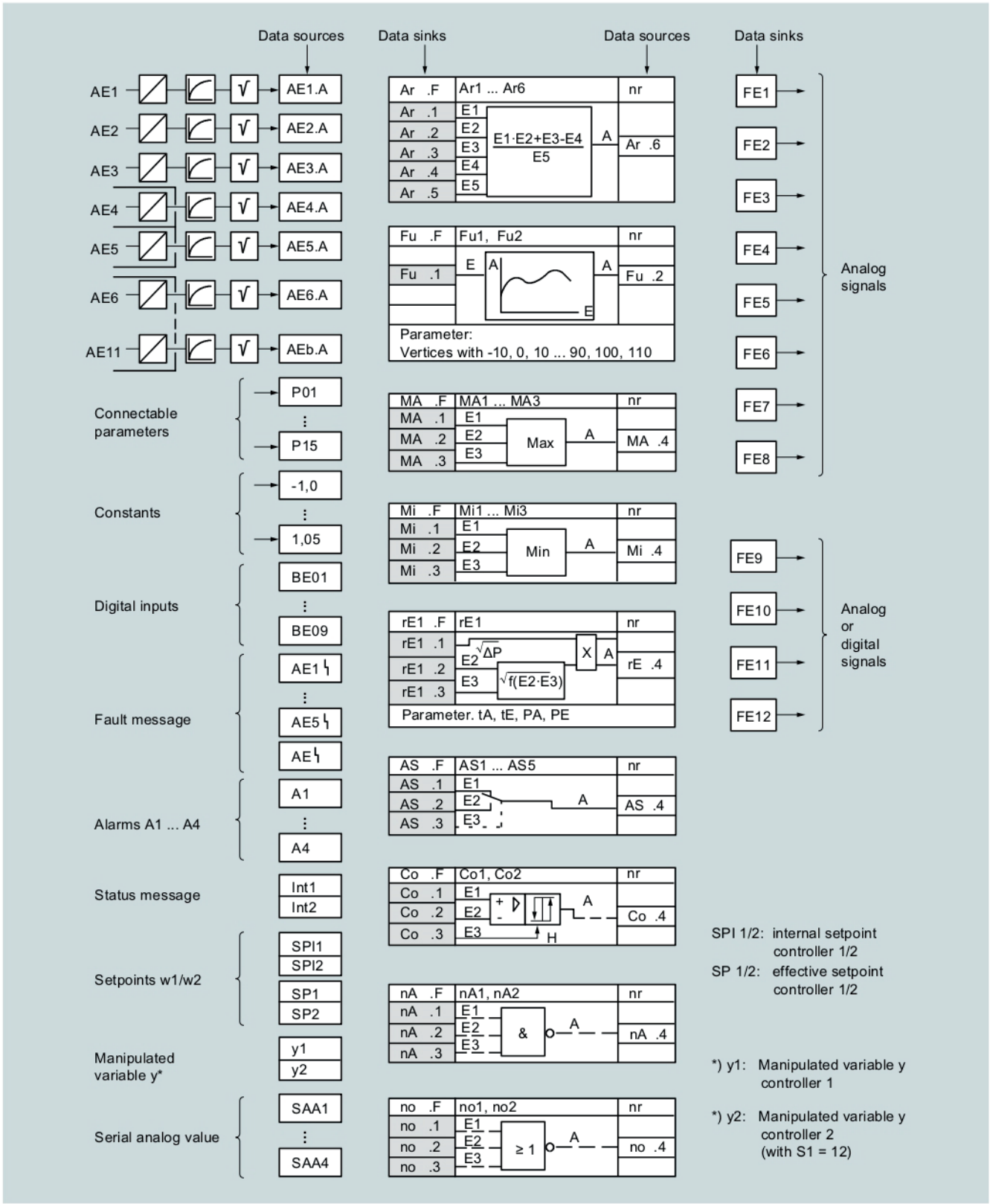
- 5 changeover switches for analog values (AS1 to AS5)
- 2 comparators with adjustable hysteresis (Co1, Co2)
- 2 "NAND" logic functions (nA1, nA2)
- 2 "NOR" logic functions (no1, no2)

Analog output area

The 9 analog outputs of the SIPART DR22 controller (3 × basic unit, 6 × option module) output a current signal of 0 to 20 mA or 4 to 20 mA.

The outputs are not assigned to any fixed variables. During structuring of the device, they are assigned to any internal controller variable. This means that split range mode is also possible without any problems.

Function (continued)



Inserting additional functions in the freely interconnectable input area

Function (continued)

Binary input and output area

The basic unit has 4 binary inputs BE1 to BE4 and 8 binary outputs BA1 to BA8. During structuring of the controller, these are assigned to the binary functions needed for the respective application. If the number of binary inputs or outputs offered by the basic unit is not sufficient, it can be increased by inserting additional option modules in the controller. Slots 5 and 6 on the back of the controller are provided for this purpose. Depending on the options used, a total of 14 binary inputs or up to 16 binary outputs is possible in this way.

The binary inputs and outputs of the device are non-isolated.

The binary outputs are active. They provide a 24 V DC voltage signal with a current carrying capacity of up to 50 mA per output.

Floating outputs are available when the relay module with 2 binary outputs is used (option).

Furthermore, a coupling relay module can be clipped to a mounting rail on the back of the controller. This additional module can contain either two or four relays with one changeover contact each for 250 V AC, 8 A, which are controlled directly from the binary outputs.

Binary inputs

The following functions are available for assignment to the binary inputs:

CB I/II	Computer readiness (controller 1/controller 2) Depending on the controller type, this binary signal in connection with the internal/external button either initiates a changeover in the setpoint range, also SPC operation, or it starts DDC operation. With SPC and DDC mode, this is the central COMPUTER FAIL cable.
He I/II	Manual mode, external (controller 1/controller 2) This signal blocks the output of the controller and allows direct manual adjustment of the manipulated variable via the front input level.
N I/II	Tracking (controller 1/controller 2) With this signal, the output of the C-controller and the three-point step controller is tracked with external position feedback to the tracking signal y_N.
Si I/II	Safety mode (controller 1/controller 2) With C-controllers and with three-point step controllers with external position feedback, the manipulated variable takes on the configured safety value. In three-point step controllers with internal position simulation, the manipulated variable runs against 0 % or 100 % as defined.
tS I/II	Disabling the setpoint ramp (controller 1/controller 2)
WSL I/II	Switchover of external setpoint analog or via SES (controller 1/controller 2)
BLB	Blocking of operation
BLS	Blocking of structuring
BLPS	Blocking of parameter assignment and structuring
P I	P-operation of the controller I
P II	P-operation of the controller II
PAU	Parameter switchover / Parameter set I of the individual controller can be switched to parameter set II through this binary signal.
±Δ*w*	Incremental setpoint adjustment
±Δ*y*	Incremental manipulated variable adjustment
±Δ*y*BL I/II	Direction-dependent blocking of the manipulated variable (controller 1/controller 2)

Binary outputs

The following functions are available for assignment to the binary outputs:

RB I/II	No computer readiness (controller 1/controller 2)
RC I/II	No computer operation (controller 1/controller 2)
H I/II	Manual mode (controller 1/controller 2)
N I/II	Follow-up mode (controller 1/controller 2)
A1/A2	Alarm 1 and 2
A3/A4	Alarm 3 and 4
MUF	Transmitter fault
Int I/II	Internal mode (slave controller) (controller 1/controller 2)
FI9 ... FI12	Function inputs (data sinks) in freely interconnectable input area

If a three-point step controller has been structured, its manipulated variable outputs ±Δ*y* are specified to the binary outputs BA7 and BA8. In a dual controller, if controller 2 has been structured as step controller, its manipulated variable outputs ±Δ are specified to the binary outputs BA5 and BA6. These binary outputs are then no longer available to be assigned freely.

Display technology

Equipping the SIPART DR22 controller with indicators is very convenient. The device has an analog indicator and a digital indicator for both the actual value range and the setpoint range.

The two analog indicators consist of vertical LED bar graphs. 1 or 2 LEDs light up alternately. The center of the indicator field shows the measured value. Because the actual value and setpoint indicators are arranged next to one another, a setpoint/actual value comparison can easily be performed. The analog indicators are intended for a dynamic trend display.

The two digital indicators for the actual value and the setpoint can be structured as a physical unit or a percentage. Actual value displays are always red, setpoint displays always green. This applies to both the analog and the digital indicators as well as the associated operator controls.

The indicators are switched to the relevant measured variables using the switchover button controller I/controller II. This means that a clear and informative display is ensured also with the dual controller functions that can be structured (cascade and override controls, 2 independent control loops).

In addition, there is also a three-digit yellow digital indicator on the front of the device for the manipulated variable, which is always displayed in percent. The associated operator controls are also yellow.

There are also 11 LEDs on the front of the device for displaying operating states and alarms. These LEDs are permanently assigned to the functions.

The described display functions relate to the process control level of the controller. On the selection level and the configuring level, some of these displays have a different meaning (see section "Operator control and display functions", page 3/10).

Function (continued)

Configurable functions

The EPROM of the SIPART DR22 controller contains application circuits for process controllers which are already interconnected and easy to retrieve. In connection with the freely interconnectable input area, this device is suitable for universal use for all control tasks in process engineering.

Below, the device types that can be structured are displayed in function charts and described briefly. For the sake of clarity, only the most important functions are mentioned. Additional structuring possibilities that are valid for all controller types are described in the following section "Functions that can be structured".

The factors and constants c_1 ... c_9 given in the following figures as well as the setpoint ramp *tS* can be set as parameters.

Using function input FI4 or FI7, an additional disturbance variable can be connected to the manipulated variable either dynamically via the D element or statically.

The function inputs are only displayed in the figures if they have a fundamental function in the operating mode relevant controller type.

Functions that can be structured which increase the convenience and reliability of the SIPART DR22 operation

Display in physical units and linearization of process variables

The process variables that can be displayed by the two 4½-digit digital indicators (controlled variable *x* and tracking variable *w*) can be output as percentage or in physical units. The start value, end value and decimal point of the indicators are set as parameters.

For digital display of a non-linear input variable to be possible, it needs to be linearized first. Two function generators (linearizers) are available for this purpose.

Transmitter monitoring

Selectable by means of configuring switches, the analog inputs can be monitored for signals falling below or exceeding the range (< -3 % or > +103 %). In the event of a fault, a message is output via the four-digit digital indicator - selectively for the inputs AE1 ... AE5. A group alarm message can be output via the binary output MUF.

In addition, automatic switchover to manual mode, starting with the last manipulated variable or the safety setpoint, can be structured.

The fault display can be acknowledged with the switchover button (point 12, figure "Control and display elements" in the section "Operator control and display functions", page 3/10).

Setpoint ramp, setpoint limitation and x tracking

In addition to the ramp function, the range within which the setpoint or target ratio can be set can be limited by the parameters SA and SE. The setpoint ramp and setpoint limitation both take effect with internally set and externally provided setpoints.

It is possible to structure tracking. The setpoint of the controlled variable is hereby tracked in manual, tracking and DDC mode as well as with the safety setpoint so that no control deviation can build up during this mode. After switching back to automatic mode, the manipulated variable is applied not only bumplessly, but also without drift. The setpoint ramp has no effect during tracking, but setpoint limitation does.

Function (continued)

Filter and response threshold of the control deviation

All analog inputs have a first-order filter that can be activated. The filter time constants TF1 to TF11 can be set in the range from 0.1 to 1000 s. In addition, the control deviations are routed via adaptive filters TFI and TFII to be able to filter out low-frequency interferences too:

Within a band in which switches frequently occur, changes are detected as faults by the filter and attenuated with the given time constant. Changes outside of the band are immediately forwarded to the control algorithm to achieve fast compensations. If the fault level changes over time, these adaptive filters adapt autonomously to the new level.

If the output of the controller (or both controllers) is settled further, dead zone elements in the control deviation can be activated. This allows a symmetrical range to be hidden as response threshold AHI and AHII.

Adjustment of the direction of action

The basic setting of the controller(s) applies to normally acting systems. With reversing systems, the sign of the proportional gain K_{PI} or K_{PII} must be inverted through structuring. This applies to both the proportional action and the integral action. Independent of this, the D element can work with or against the controller variable.

Special features of the control algorithm

The P(D) and PI(D) control algorithm is implemented as an interaction-free parallel structure for both controllers and has the same type regardless of output structure S or C of the device.

Two different parameter sets can be stored in the device that are assigned to controllers I and II with dual controllers. With structuring as single controllers, switching between parameter set I and parameter set II can take place with the binary signal PAU. Switch from PI to P control takes place through the binary inputs PI and PII.

Switchover from automatic to manual mode and vice versa as well as switchover from all other operating modes to automatic mode is bumpless.

With P-operation, this results in an automatic setting of the operating point y_0. If this is not desired, the operating point can be set between 0.1 and 100 % with the parameters y_{0I} and y_{0II}, optionally also manually, but switchover to automatic mode is then not bumpless. With three-point step controllers, P-operation is permissible only with external position feedback.

Limitation of manipulated variable

With a C output structure and with an S output with external feedback, the manipulated variable can be limited with the parameters y_Q and y_I. This manipulated variable limitation can have an effect either only in automatic mode or in all operating modes. If - depending on the default setting - the manipulated variable reaches one of the limits y_Q or y_I, further integration is prevent in addition to the limitation so that no integral saturation can occur. In this way, a change to the manipulated variable can take place immediately on polarity reversal of the control deviation.

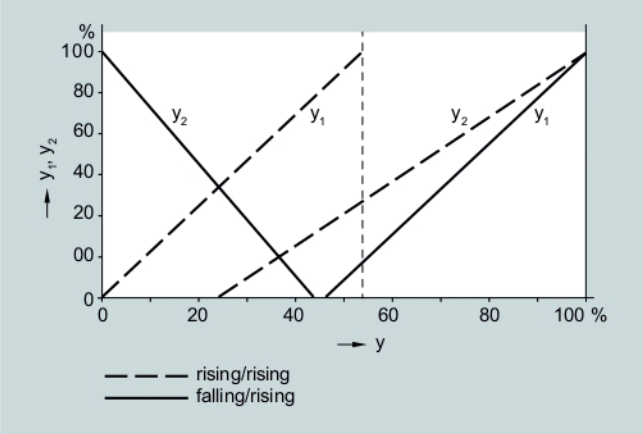
If travel out of the y_A ... y_E range takes place in manual, tracking, safety or DDC mode, the last manipulated variable is applied bumplessly on switch back to automatic mode, but changes are only executed in the direction of the limited range.

In addition to the fixed manipulated variable limitation described, a further direction-dependent manipulated variable limitation is available in the SIPART DR22 controller. In this case, limitation is activated via the binary inputs ±yBL through external signals. This limitation is always active in every operating mode.

Additional analog outputs, split range operation

The total of 9 analog outputs can be assigned to all relevant internal controller variables, e.g. $x(x_v)$, $w(w_v)$, y, (50 % $+x_d$), (50 % $-x_d$), the inputs AE1A to AE11A or the function inputs FE1 to FE12.

If the device is used as C-controller, it is possible to structure split range operation. The output y_1 always works with a rising characteristic curve. A rising or falling characteristic curve can be selected for output y_2. The manipulated variable ranges of y_1 and y_2 are parameterizable. The three-digit manipulated variable indicator shows y_1 or y_2 depending on which output is currently active.



Possibilities of split range operation

Limit monitor

The alarm functions A1/A2 and A3/A4 can be assigned to the internal controller process variables x_d, $x(x_v)$, $w(w_v)$, y, $(y_{1/2})$, the inputs AE1A ... AE11A or the function inputs FE1 and FE12 for monitoring. They can be structured to maximum or minimum monitoring.

High or low limit violations are displayed by the LEDs A1/A2 and A3/A4 (points 5 and 7, figure "Control and display elements", page 3/10) and can be structured to binary outputs for external messages.

The thresholds are normally set in the parameter assignment level. As an option, however, you can also display and set the alarms in the process control level. The hysteresis of the limit monitor can be configured between 0.1 and 10 %.

Parameter control

With the SIPART DR22 controller, the control parameters of the device which are determined at different operating points can be controlled in a targeted manner using the parameter control. In this way, the same control quality can be achieved in the entire load range in non-linear controlled systems or control valves.

The parameters proportional gain K_P, integral time T_n, derivative-action time T_v and response threshold AH, as well as the operating point y_0 for the P-controller, are calculated over a straight line made up of 5 grid points, depending on the value of a controlling variable. The grid points are at 10, 30, 50, 70 and 90 % of the controlling variable. Controlling variables can be either one of the internal controller process variables $x(x_v)$, $w(w_v)$, y or $10 \cdot |x_d|$ or one of the input signals AE1A ... AE11A or the function inputs FE1 ... FE12. The parameters in effect in the grid points should be determined and entered beforehand.

Because both parameter set I and parameter set II can be selected for the control, this method can be applied with the dual controllers in controller I or in controller II. With the single controllers, it is possible to switch back and forth between a fixed and a controlled parameter set using the binary signal PAU.

Function (continued)

Adaptation method

An adaptation method for determining the optimal control parameters based on the tried-and-tested SIEPID method is stored in the SIPART DR22 process controller. The complete controlled system step response is taken up here. Process parameters, system gain, system time constant and system order are calculated using a method for optimum model adaptation. Prior knowledge about the system is not required for this purpose.

The determined control parameters are offered for a PI or PID controller. They can be applied directly or influenced by the user.

Blocking of input level as well as the parameter assignment and structure level

The device offers 3 binary signals with which the following input levels can be blocked:

- The binary function BLB blocks operation of the device
- The binary function BLS blocks switchover to the structuring level. However, in addition to normal process control, online control parameters and adaptation can be set.
- In contrast, the binary function BLPS completely blocks switchover of the device from the process control level. Only the interventions usual in normal process operation, e.g. manual switchovers, are possible.

Restart conditions

Brief interruptions of the operating voltage are bridged depending on the current load of the device by the storage effect of the power supply unit. In the event of a longer power failure, the configured parameters and structures are retained in a non-volatile, plug-in user program memory. The last operating mode, the last setpoint and the last manipulated variable are also loaded into a non-volatile memory.

On voltage return after power supply interruptions or after reclosing, processing starts autonomously with the structured operating modes.

Optical signaling after power failure can be structured.

Self-diagnostics

Comprehensive monitoring routines check the internal data traffic of the microcontrollers between one another and with the memories cyclically or after a POWER ON or watchdog reset.

If a fault is detected, an error message is automatically output by the front indicators which indicates the cause of the error and options for resolving it.

Communication with higher-level systems

By means of an interface module (option), the SIPART DR22 controller can send and receive operating states, process variables, parameters and configuring switch settings. The following interface modules are available:

- PROFIBUS DP module
  - Transmission rate up to 1.5 Mbps
  - Addressing range up to 125
    (Number of possible devices on PROFIBUS is determined by the master interface, the data area of the interface and the amount of configured process data)
- SES module RS 232
  - Transmission rate 9.6 Kbps
  - RS 232 as point-to-point connection
  - RS 485 bus, up to 32 devices

Even when used together with higher-level systems, the advantages of the autonomous SIPART DR22 controller come into effect:

- Problem-free adaptation of every controller to the task
- Operational reliability; When the higher-level system or part of it is switched off or fails, the SIPART DR22 controller continues to operate as an autonomous device under the conditions defined previously
- Flexibility; Changes or expansions to individual control loops are possible even during operation of the overall system
- Both SPC and DDC operation is possible
- Transferring the controller functions to the individual device relieves load on the higher-level system in SPC operation
- Clear overview due to distributed configuration of the plant

Function (continued)

Operator control and display functions

Operation of the SIPART DR22 process controller takes place on 3 main levels:

- Process control level
- Selection level
- Configuration level (parameter assignment and structuring mode)

On these three input levels, some of the buttons and indicators on the front of the device have different functions.

Process control

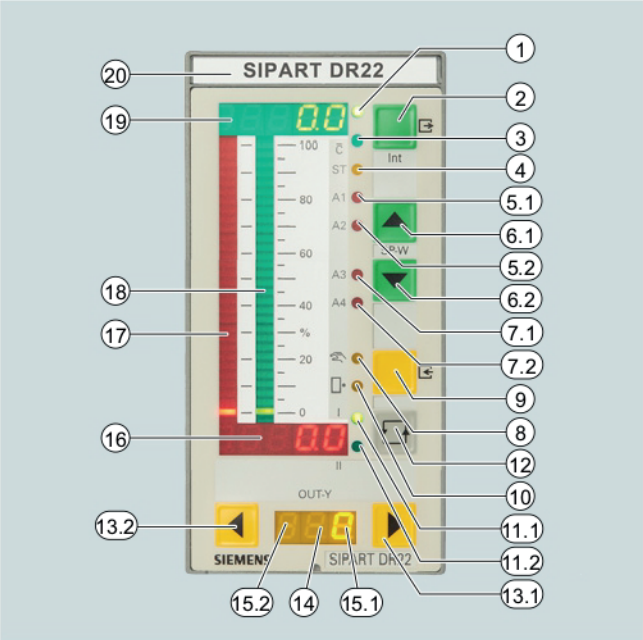
Thanks to the design and color scheme of the front panel, the control elements and the labeling, operation of the SIPART DR22 controller in process mode is clear and simple.

- **Red** is the color of the actual value:
  The red digital indicator (16) and the red vertical LED bar graph (17) show the actual value.
- **Green** is the color of the setpoint:
  The green digital indicator (19) and the green LED bar graph (18) show the setpoint. The green button (2) switches between internal and external operation. The internal setpoint is set with the green control buttons (6). The green LED (1) signals operation with internal setpoint. LED (3) also lights up green if there is no binary signal CB.
- **Yellow** is the color of the manipulated variable:
  The yellow button (9) switches between manual and automatic mode. The yellow LED (8) signals with continuous and flashing light that a switch to manual operation has taken place. The yellow LED (10) lights up to indicate an external intervention in the manipulated variable, e.g. follow-up mode. The manipulated variable can be set in manual mode with the yellow buttons (13). This is displayed by the yellow digital indicator (14). The yellow LEDs (15) show the output of the setting increments in all operating modes of the S controller.

Violations of high or low thresholds are signaled by LEDs (5) and (7) lighting up. LED (4) signals the progress of parameter optimization during the adaptation process with a continuous or flashing light.

Switchover of the indicators and setpoint buttons in the dual controllers takes place with button (12). This button also allows switching the indicators to different signal levels with the single controllers. The associated LEDs (11) signal the switching state.

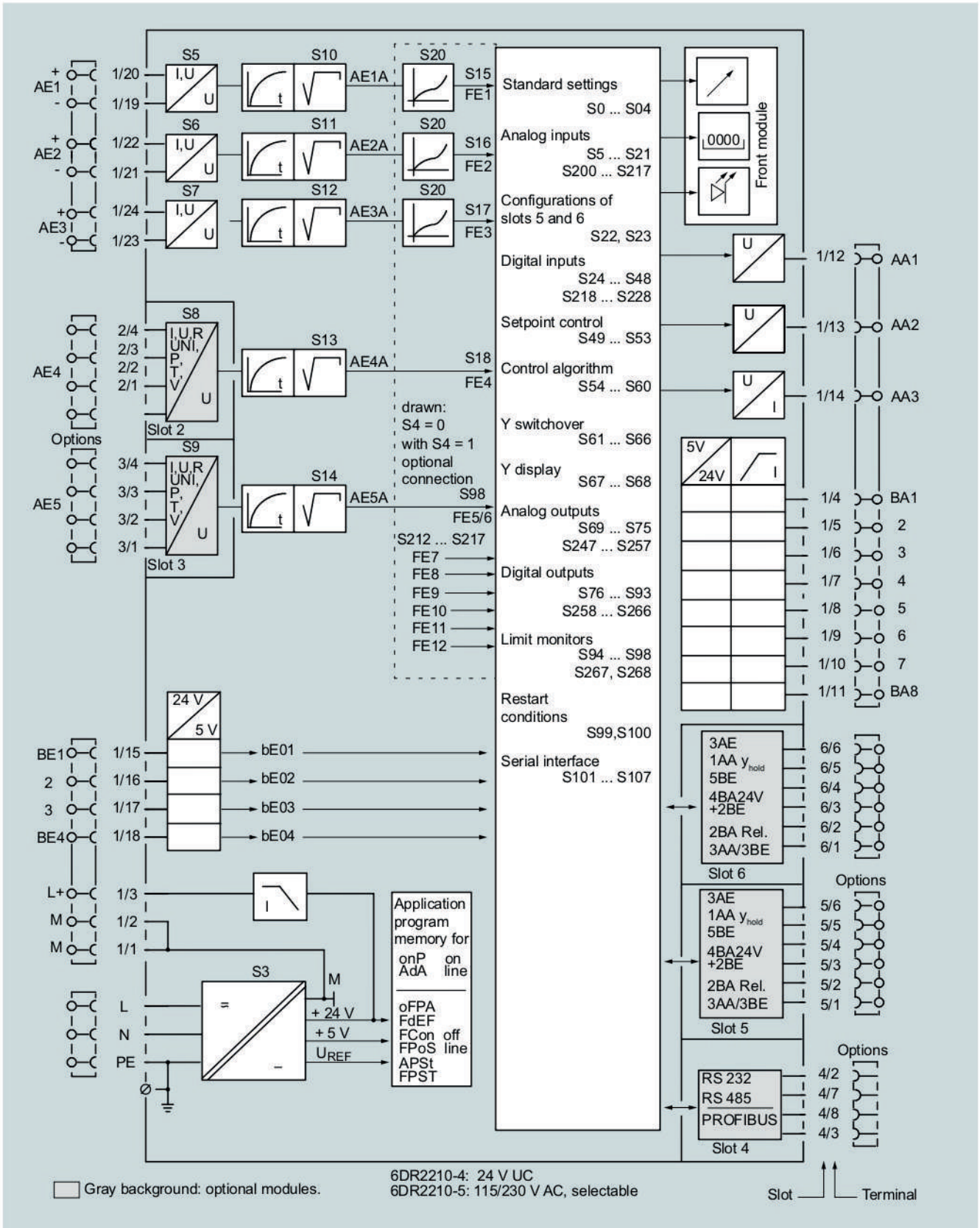
The measuring point label (20) can be exchanged. For this purpose, the cover can be opened in the center with a pointed tool and the label can be removed. A screw becomes visible behind it. When this is loosened, the front module can be separated from the controller. The electrical connections between the front module and basic unit are established via a plug-in flat ribbon cable.



SIPART DR22 process controller, control and display elements

1	LED (green), signals "Internal setpoint"
2	Internal/external button / Exit button
3	LED C (green), signals "No computer operation"
4	LED ADAPT (yellow) - Flashing light: Adaptation in progress - Continuous light: Adaptation finished
5.1	LED A1 (red), signals "Threshold A1 reached"
5.2	LED A2 (red), signals "Threshold A2 reached"
6.1	Button +Δ*w*: Button for setting the internal setpoint
6.2	Button -Δ*w*: Button for setting the internal setpoint
7.1	LED A3 (red), signals "Threshold A3 reached"
7.2	LED A4 (red), signals "Threshold A4 reached"
8	LED (yellow) - Flashing light: Manual mode, external - Continuous light: Manual mode, internal
9	M/A button for selecting between manual/automatic mode / Enter button
10	LED (yellow), lights up in the event of an external y intervention
11.1	LED I (green), operator control/display functions controller - Flashing light: Display and effective functions are not identical - Continuous light: Display and effective functions are identical
11.2	LED (green), operator control/display functions controller II - Flashing light: Display and effective functions are not identical - Continuous light: Display and effective functions are identical
12	Switchover button controller I/controller II
13.1	Button +Δy: Control button for manual manipulated variable
13.2	Button -Δy: Control button for manual manipulated variable
14	Digital indicator (yellow) for manipulated variable y
15.1	LED +Δ*y* (yellow) for display of setting increment output on the S controller
15.2	LED -Δ*y* (yellow) for display of setting increment output on the S controller
16	Digital indicator (red) for controlled variable x
17	Analog indicator (red) for controlled variable x
18	Analog indicator (green) for setpoint w
19	Digital indicator (green) for setpoint w
20	Exchangeable measuring point label, with a screw behind it to loosen the front module

Function (continued)



SIPART DR22 process controller, function block diagram

Technical specifications

General data	
Mounting position	Any
Climate class according to IEC 721	
• Part 3-1 Storage 1K2	-25 ... +75 °C
• Part 3-2 Transport 2K2	-25 ... +75 °C
• Part 3-3 Operation 3K3	0 ... +50 °C
Degree of protection according to EN 60 529	
• Front	IP64
• Enclosure	IP30
• Connections	IP20

Device design

Electrical safety
- According to DIN EN 61010-1
- Protection class I according to IEC 536
- Protective separation of line connection and field signals
- Clearance and creepage distances, unless expressly mentioned otherwise, for overvoltage class III and pollution degree 2

CE mark compliance with respect to
- EMC Directive 2014/30/EU
- LVD Directive 2014/35/EU

Interference emission, noise immunity according to DIN EN 61326-1, NAMUR NE21

General data	
Weight, basic unit without options	Approx. 1.2 kg
Color	
• Frame of the front module	RAL 7037
• Front surface	RAL 7035
Material	
• Enclosure and front frame	Polycarbonate, glass-fiber reinforced
• Front film	Polyester
Auxiliary power terminal	
• 115/230 V AC	Three-pin device plug IEC 320/V
• 24 V AC/DC	Two-pin plug
Connection system for process signals	Multi-pin screw terminal blocks, coded, plug-in for conductor cross-section 1.5 mm^2 (AWG 14)
Protective conductor connection	Grounding screw

A mounting rail can be installed on the PSU rear panel. The mounting rail is included in the scope of delivery of the coupling relay module.

Auxiliary power				
Nominal voltage	230 V AC, switchable	115 V AC, switchable	24 V UC	24 V UC
Operating voltage range	187 ... 276 V AC	93 ... 138 V AC	20 ... 28 V AC	20 ... 35 V DC [1]
Frequency range	48 ... 63 Hz	48 ... 63 Hz	48 ... 63 Hz	–
External current I_{Ext} [2]	450 mA	450 mA	450 mA	450 mA
Power consumption				
Active power/apparent power (capacitive)				
Basic unit				
• Without options, without I_{Ext}	8 W/17 VA	8 W/13 VA	8 W/11 VA	8 W
• With options, without I_{Ext}	13 W/25 VA	13 W/20 VA	13 W/18 VA	13 W
• With options, with I_{Ext}	26 W/45 VA	26 W/36 VA	28 W/35 VA	28 W
Permissible voltage dips [3]				
Basic unit				
• Without options, without I_{Ext}	≤ 90 ms	≤ 70 ms	≤ 55 ms	≤ 30 ms
• With options, without I_{Ext}	≤ 80 ms	≤ 60 ms	≤ 50 ms	≤ 25 ms
• With options, with I_{Ext}	≤ 50 ms	≤ 35 ms	≤ 35 ms	≤ 20 ms

1) Including harmonics.

2) Current emitted from *L+*, BA, AA to external consumers.

3) The load voltage of the analog outputs is hereby reduced to 13 V, *L+* is reduced to +15 V, and the voltage at the binary outputs drops to +14 V.

Technical specifications (continued)

Inputs and outputs, display technology	
Analog inputs AE1, AE2, AE3 and AE6 ... AE11 (signal converter 6DR2800-8A)	
Voltage	
Nominal signal range (0 ... 100 %)	0/199.6 ... 998 mV or 0/2 ... 10 V routable
Total operating range	≤ -4 ... 110 %
Input resistance	
• Difference	> 200 kΩ
• Common mode	> 500 kΩ
Common mode voltage	0 ... +10 V
Filter time constant	50 ms
Zero point error	0.1 % + A/D converter error
Full-scale value error	0.2 % + A/D converter error
Linearity error	See technical specifications "A/D conversion"
Common mode error	0.07 %/V
Temperature influence	
• Zero point	0.05 %/10 K
• Full scale value	0.1 %/10 K
Static destruction limit	± 35 V
Current	
Nominal signal range	0/4 ... 20 mA
Total operating range	-1 ... 22 mA
Input resistance	
• Difference (load)	49.9 Ω ± 0.1 %
• Common mode	> 500 kΩ
Common mode voltage	0 ... +10 V
Filter time constant	50 ms
Zero point error	See technical specifications "A/D conversion"
Full-scale value error	See technical specifications "A/D conversion"
Linearity error	See technical specifications "A/D conversion"
Common mode error	0.07 %/V
Temperature influence	
• Zero point	0.05 %/10 K
• Full scale value	0.1 %/10 K
Analog outputs AA1 ... AA3	
Nominal signal range (0 ... 100 %)	0 ... 20 mA or 4 ... 20 mA
Total operating range	0 ... 20.5 mA or 3.8 ... 20.5 mA
Load voltage	From -1 ... 18 V
No-load voltage	≤ 26 V
Inductive load	≤ 0.1 H
Time constant	1 ms
Residual ripple 900 Hz	≤ 0.05 %
Resolution	12 bits
Load dependence	≤ 0.02 %
Zero point error	≤ 0.05 %
Full-scale value error	≤ 0.2 %
Linearity	≤ 0.05 %
Temperature influence	
• Zero point	≤ 0.1 %/10 K
• Full scale value	≤ 0.1 %/10 K
Static destruction limit	-1 ... 35 V

Inputs and outputs, display technology	
Transmitter supply L+	
Nominal voltage	+20 ... 26 V
Load current	≤ 100 mA, short-circuit proof
Short-circuit current	≤ 20 mA, clocked
Static destruction limit	-1 ... +35 V
Binary inputs BE1 ... BE4	
Signal state 0	≤ 4.5 V or open
Signal state 1	≥ 13 V
Input resistance	≥ 27 kΩ
Static destruction limit	± 35 V
Binary outputs BA1 ... BA8 (with wired OR diodes)	
Signal state 0	≤ 1.5 V
Signal state 1	+19 ... 26 V
Load current	≤ 50 mA
Short-circuit current	≤ 80 mA, clocked
Static destruction limit	-1 ... +35 V
Cycle time	Adaptive 60 ms to 120 ms (typically 80 ms)
A/D conversion	
Process	Successive approximation, per input > 120 conversions and averages within 20 or 16.67 ms
Total operating range	-4 ... 110 %
Resolution	11 bits = 0.06 %
Zero point error	≤ 0.2 %
Full-scale value error	≤ 0.2 %
Linearity error	≤ 0.2 %
Temperature influence	
• Zero point	≤ 0.05 %/10 K
• Full scale value	≤ 0.1 %/10 K
D/A conversion	See technical specifications "Analog outputs AA1 ... AA3"
Setpoint and manipulated variable adjustment	
Setting	With 2 buttons (more - less)
Speed	Progressive
Resolution wi	1 digit
Resolution y	0.1 %
Parameters	
Setting	With 2 buttons (more - less)
Speed	Progressive
Resolution	
• Linear parameters, %	0.1 %
• Linear parameters, physical	1 digit
• Logarithmic parameter	128 values/octave
Accuracy	
• Time parameters	± 1 %
• All others	Corresponding to resolution, absolute

Technical specifications (continued)

Inputs and outputs, display technology	
Display technology	
x and w display digital	4½-digit, 7-segment LED
• Color, x indicator	Red
• Color, w indicator	Green
Number height	7 mm
Display range	Beginning and end adjustable
Number range	-1999 ... 19999
Overflow	<–1999: -oFL
	>19999: oFL
Decimal point	Adjustable (fixed point) _.--- to ----
Repeat rate	Adjustable 0.080 … 8.000 s [1]
Resolution	1 digit, but better than A/D converter
Display error	Corresponding to A/D converter and analog inputs
x and w display analog	
• Color, x indicator	Red
• Color, w indicator	Green
Display range	
Overflow	Flashing of first or last LED
Resolution	1.7 %, through alternate lighting of 1 or 2 LEDs, the center of the light field is considered as pointer
Repeat rate	Cyclic
y display (digital)	3-digit, 7-segment LED
Color	Yellow
Number height	7 mm
Display range	0 ... 100 %
Overflow	-10 ... 110 %
Repeat rate	Adjustable 0.080 … 8.000 s [1]
Resolution	1 %

[1] Typical cycle time.

Selection and ordering data

	Article No.
SIPART DR22 process controller	
Basic unit in 72 × 144 mm format, with • 3 analog inputs • 3 analog outputs • 4 binary inputs • 8 binary outputs • User program memory	
Design	
• For auxiliary power 24 V UC	**6DR2210-4**
• For auxiliary power 230 V/115 V AC, switchable	**6DR2210-5**
Accessories (signal converters)	
Module for analog signals	
• For current 0/4 ... 20 mA or voltage 0/0.2 ... 1 V or 0/2 ... 10 V	**6DR2800-8J**
• For resistance-based sensors (R module)	**6DR2800-8R**
• UNI module for TC/RTD/R/mV signals, programmable	**6DR2800-8V**
• Reference junction terminal for TC, internal (use in connection with UNI module)	**6DR2805-8A**
Module for switching signals	
• With 5 binary inputs	**6DR2801-8C**
• With 4 binary outputs and 2 binary inputs	**6DR2801-8E**
• With 2 relay outputs	**6DR2801-8D**
Coupling relay module	
• With 4 relays (250 V AC)	**6DR2804-8A**
• With 2 relays (250 V AC)	**6DR2804-8B**
Interface modules	
• For serial communication (SES) via RS 232 or RS 485	**6DR2803-8C**
• PROFIBUS DP module	**6DR2803-8P**
Documentation	
The entire documentation is available for download free of charge in various languages at: http://www.siemens.com/processinst-rumentation/documentation	
6DR2210 controller, operating manual • German, English	**C79000-G7400-C154**
Serial SIPART 6DR2210 bus interface, operating instructions • German, English	**C73000-B7400-C155**

Scope of delivery

The scope of delivery of the DR22 controller includes:

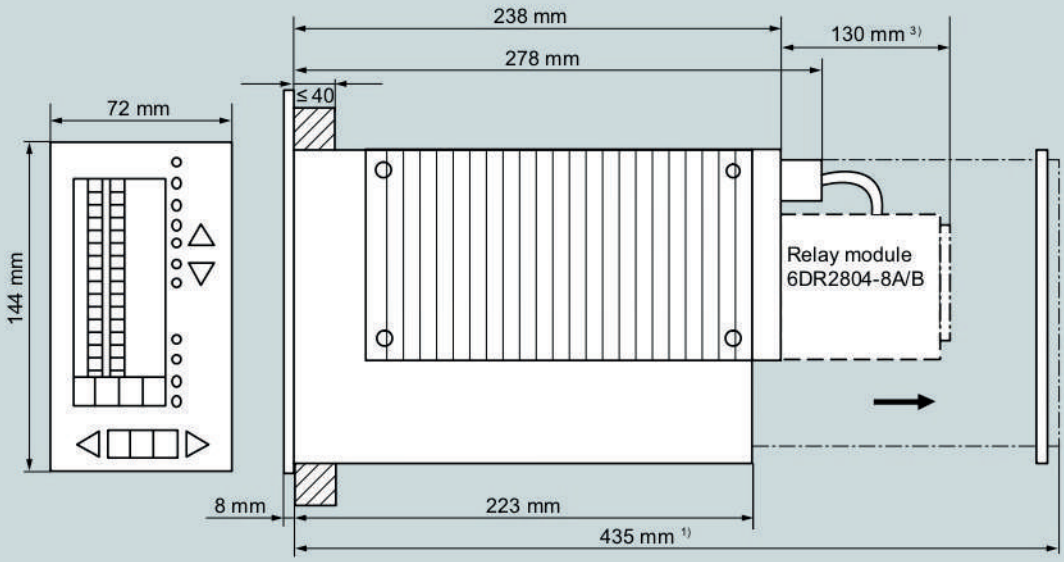
- 1 process controller according to the configuration
- 1 device plug according to IEC 320/V with auxiliary power 115/230 V AC or one plug with auxiliary power 24 V UC
- 2 clamping elements, plug-in

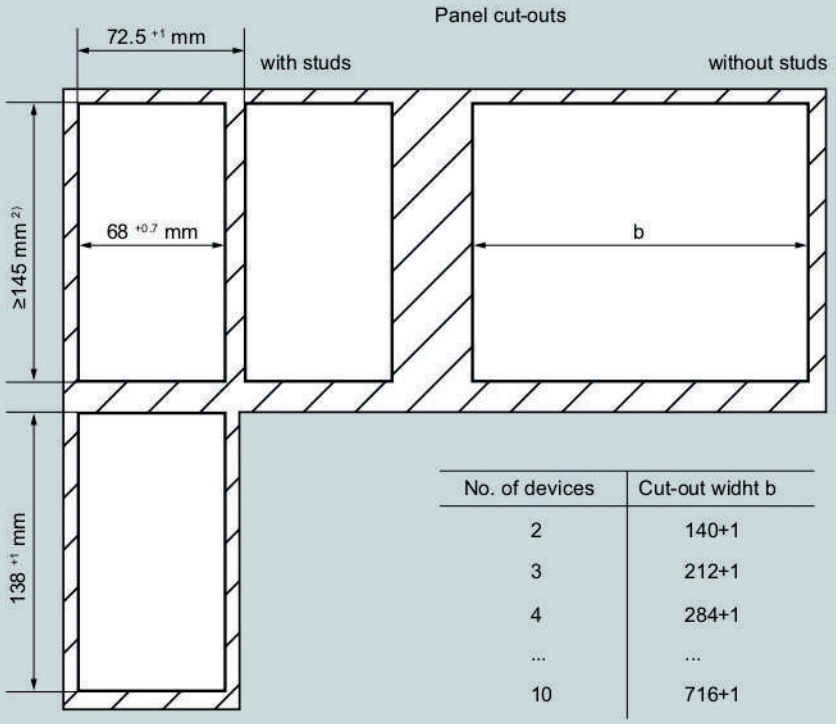
Signal converters and accessories

The signal converters/modules are described in Catalog MP 31, section 5.

The software for assigning parameters via PC, coupling to systems and the accessories for coupling (plugs, cable drivers etc.) can be found in catalog section 6.

Dimensional drawings





No. of devices	Cut-out widht b
2	140+1
3	212+1
4	284+1
...	...
10	716+1

SIPART DR22 process controller and panel cutouts, dimensions in mm

Accessories

Signal converters for SIPART DR22

Modules for analog signals		SIPART DR22					Description on page
		Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	
U/I module	**6DR2800-8J**	AE4	AE5	-	-	-	**5/4**
3 × U/I module	**6DR2800-8A**	-	-	-	AE9/10/11	AE6/7/8	**5/5**
R module	**6DR2800-8R**	AE4	AE5	-	-	-	**5/6**
Pt 100 module	**6DR2800-8P**	(AE4)*)	(AE5)*)	-	-	-	**5/7**
UNI module (TC/RTD/R/U/I)	**6DR2800-8V**	AE4	AE5	-	-	-	**5/8**
3AA/3BE	**6DR2802-8B**	-	-	-	AA7/8/9 BE5/6/7	AA4/5/6 BE10/11/12	**5/11**

*) Preferably use UNI module 6DR2800-8V.

Modules for switching signals		SIPART DR22					Description on page
		Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	
5BE	**6DR2801-8C**	-	-	-	BE5/6/7/8/9	BE10/11/12/13/14	**5/12**
2BA relay module	**6DR2801-8D**	-	-	-	BA9/10	BA13/14	**5/13**
4BA/2BE	**6DR2801-8E**	-	-	-	BA9/10/11/12 BE5/6	BA13/14/15/16 BE10/11	**5/14**

Interface module		SIPART DR22					Description on page
		Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	
SES module	**6DR2803-8C**						**5/15**
• RS 232		-	-	Yes	-	-	**5/15**
• RS 485		-	-	Yes	-	-	**5/15**
PROFIBUS DP module	**6DR2803-8P**	-	-	Yes	-	-	**5/16**

Coupling relay module		SIPART DR22	Description on page
Mounting on the back is possible:			
With 4 relays	**6DR2804-8A**	Yes	**5/17**
With 2 relays	**6DR2804-8B**	Yes	**5/17**

In connection with the UNI module 6DR2800-8V, the following can be used depending on the application:		Description on page
Reference junction terminal	**6DR2805-8A**	**5/8**